Using computer supported multimedia simulation tools within a peer-guided technology enhanced learning experience to explore procedural learning – an exploratory case study with knitters.

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A dissertation submitted to the University of Dublin, in partial fulfilment of the requirements for the degree of Master of Science in Technology & Learning.

2013

Declaration

I declare that the work described in this dissertation 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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Acknowledgements

Again, with thanks to my supervisor

Brendan Tangney

This work draws from the educational

philosophy of John Ruskin.

"There's no way of getting good Art, I repeat, but one – at once the simplest and most difficult – namely, to enjoy it" (Ruskin, 1858, p. 26).

Abstract

Learning procedural knowledge requires the learner to engage in a process of sense making generated from a range of experiences (Piaget, 1950a). However, learning procedures is problematic, given their constant modification in practice (Bruner, 1996a). While trial and error activities (Claparède, 1917), and repetitive tasks (Skinner, 1974) may help learners grasp the basic, procedural mechanics, peers can help explain more tacit aspects (Scribner, 1997a), or guide the learner through problem areas (Rogoff, 1990c). Incorporating computer supported tools into a learning experience, enables peers to simulate specific procedural exercises (Papert, 1993), while use of multimedia simulations provide learners with the opportunity to manipulate procedural information in meaningful way (Mayer, 2005b). As a concrete example of this, learning to knit by hand requires mastery of complex procedures (Jacobson, 2001), which share common elements, but vary significantly depending on the context (Prigoda & McKenzie, 2007). Learning from and with others, plays a core role in shaping the development and application of knitting procedures (Thakkar, 2008). However, developing the skills necessary to perform and develop these procedures continues to remain problematic (Derry, 2011). There is pressing need to explore what role peer guided use of multimedia simulation tools may play in helping learners grasp and apply complex procedures in a meaningful context, which makes sense to the learner and remains relevant to the domain of knitting (Matkovic, Srdjak, & Salopek, 2009). To examine the difficulties surrounding procedural learning within the context of knitting, the researcher constructed a peer guided technology enhanced learning experience incorporating multimedia modules, online game play, knitting exercises and pattern forming simulation tools. A qualitative research strategy, incorporating the analytical processes of coding and theme generation (LeCompte & Schensul, 1999a) was used and data collection techniques included semi structured in-depth ethnographic interviews, participant observation (Spradley, 1979c, 1980), field notes, reflections (Emerson, Fretz, & Shaw, 1995c) and artefact descriptions / photographs (Fetterman, 2010b). Findings suggest that learner participation in the peer guided learning experience helped them understand how processes related to procedures, while the combinational use of multimedia simulation helped learners to visualise and memorise certain aspects of the process. The study concludes by pointing to further research relating to multimedia simulation.

Keywords: Constructivist Theory, Multimedia Simulation, Peer Guidance, Knitting.

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Abbreviations and Definitions

Cast On – Process, which increases loops upon which to attach stitches

Cast Off – Process, which decreases loops for detaching stitches

Stitch – Formation of a loop upon which to attach other loops

Loop – Bi-directional formation used to form knitting stitches

Knit Stitch – Stitch type formation used to generate v shapes in textiles

Purl Stitch – Stitch type formation used to generate wavy line shapes in textiles

Garter Stitch – Alternating combination of knit and purl stitch rows

Row – Completion of knit or purl loop stitch types

Knitting Needles – Cylindrical sticks used to suspend loops or stitches

1. Introduction

This chapter presents the research problem and introduces the research questions.

1.1 Learning Procedural Knowledge

The process of learning procedural knowledge presents us with the challenge of engaging with complex phenomena that are structured according to cognitive and behavioural strategies that are shaped over time to meet particular domain needs (Piaget, 1978). Procedures exist as pre-constructed frames which encase domain specific actions that are ‘bound’ together in structured forms for the purpose of resolving particular problems contained within systems (Bruner, 1974). Procedures are also constructed by culture sharing groups, for the purpose of conveying complex knowledge and expertise in forms which ‘makes sense’ and has wider ‘meaning or import’ to those involved in the process of applying them in practice (Geertz, 1973). Learning procedural knowledge requires learners to engage with procedures as systems, designed to resolve complex problems (Bruner, 1966b), and as systems designed to support sense and meaning making (Vygotsky, 1978a).

1.2 Mechanisms for Conveying Knowledge

Conveying procedural knowledge is problematic, given that procedural demonstrations are often modified through each application (Bruner, 1966b). As procedures are used to impart expertise, or to resolve domain specific problems, their value lies in providing learners with the opportunity to engage with them repeatedly for the purpose of developing many different understandings of the same phenomena over time (Haskell, 2000b). Repeated enactment of the same procedure for example, presents learners with the opportunity to explore aspects in more focus or depth (Gott, 1988). The act of repeated performance helps to lead learners towards developing a more intuitive understanding of procedures (Bruner, 1960a).

1.3 Challenges in Learning Procedural Knowledge

The learner faces many challenges when setting out to learn a procedure. Procedures contain '*preferences*' which contain the meaning behind ideas that are assigned to procedural components by others who use them in practice (Burke, 1966). The presence of 'preference' within procedural learning adds an extra level of complexity to the process (Blumer, 1969a). For example, learners may observe the performance of a particular procedure, attempt to reconstruct it, then 'realise' that the reality of practice deviates away from observed practice (Geertz, 1983a). This disjoint creates great difficulty for the learner, whom, when trying to grasp the basic mechanics of a procedure, may encounter modifications when observing the work of others (Dewey, 1934b). Preferences contain meaning assigned by others to particular aspects of a process (Bruner, 1986). Applying preferences in practice influences the way in which knowledge is conveyed from peer to learner (Mead, 1934a). Peers may assign procedural meaning, but also play important roles in guiding learners through procedures with the aim of showing learners 'how to' complete procedural tasks (Scribner, 1997a). Learning with peers may create opportunity for learners to observe procedural practice but this form of knowledge sharing also provides opportunity to exchange and share ideas (Rogoff, 1990c).

1.4 Using Technology to Learn Complex Procedures

Incorporating computer supported tools into peer guided learning experiences, may help peers' introduce visual examples of complex domain phenomena in ways which may help learners 'concretise' their learning (Papert, 1993). For example, use of multimedia simulation tools enable peers to visually convey complex information in an interactional form (Jong, 2011). System interactions enable learners to change around content in ways that may help them make meaningful connections between concepts (Mayer, 2005b). Interacting with content in this way may also help learners memorise certain configurations or sequences (Low & Sweller, 2005). Embedding multimedia simulation tools into procedural learning experiences may help learners interact with content through the reworking, or modification of tasks (Kirsh, 1996).

1.5 Problem – Learning How to Perform Knitting Procedures

Learning to knit by hand is a complex process. It requires learners to grasp a series of procedures that are used to generate knitted objects (Jacobson, 2001). Learning how to perform these procedures requires learners to engage with context based knowledge which is often developed through the performance of specific tasks within a process (Piaget, 1950b). Hand knitting, is one such process, which requires the learner to 'learn' and perform complex procedures (Brown, 2012). While peers may guide learners through processes, increased availability of technological tools offer peers and learners with the opportunity to approach learning through interaction in many different ways (Bhakar et al., 2004). Multimedia simulatory tools such as online game play, animation, films demonstrating practices (Mayer, 2011) combined with use of pattern simulation tools (Jong, 2011) provide peers and learners with the opportunity to develop understandings of complex knitting procedures. Combined use of these tools together provides peers with the opportunity to present complex phenomena in a form which the learner can manipulate to develop deeper meaning and understanding of the process (Matkovic et al., 2009). This study aims to work with hand knitters with limited experience of the process to help them explore the different types of procedures used to compile knitted objects. The researcher aims to implement a technology enhanced learning experience with knitters to explore the role that use of multimedia simulatory tools may play in helping them develop and deepen their knowledge of procedures that are required to generate knitted objects.

1.6 Research Questions

This study aims to use technology in a variety of ways, to help learners acquire the procedural knowledge and skills necessary to compile textile objects on their own.

1.6.1 Question 1

Question 1 will focus on challenges facing the learner to address:

- What role does engagement in a peer guided technology enhanced learning experience play in helping learners develop procedural understandings?

Question 1 is based on the assumption that peers may play important guiding roles (Rogoff, 2003a) while technology may play important supporting roles in helping learners develop and deepen contextual understandings (Bruner, 1996b).

1.6.2 Question 2

Question 2 will focus on the role that supports play in learning to address:

- What role does the use of multimedia simulation tools play in assisting hand knitters learn the skills necessary to apply hand-knitting procedures in practice?

Question 2 is based on the assumption that technology may help learners contextualise, visualise (Mayer, 2011) memorise (Low & Sweller, 2005) and interact with complex structures in a meaningful and personalised form (Vygotsky, 1978c)

1.7 Design

The learning experience consisted of three technological interventions which included computer applications to assist learners develop and deepen their understanding of procedures. Each intervention included problem solving as a mechanism of meaning making (Jonassen, 2010) based on the following rationale.

<u>Phase 1</u>

Focused on conveying basic skills to the learner, through use of online game play simulation, the display of animated processes (Park & Gittleman, 1992), and presentation of a film detaling examples (Höffler, Prechtl, & Nerdel, 2010). This phase engaged learners in online computer supported simulation to reconstruct patterns (Jansson, 2012). Learners were also presented with the opportunity to generate a series of hand knitted examples from the computer simulationed patterns.

<u>Phase 2</u>

Provided the learner with access to an online blog utility designed for use over the study duration to encourage reflection on the process (Schwalbe, 2010).

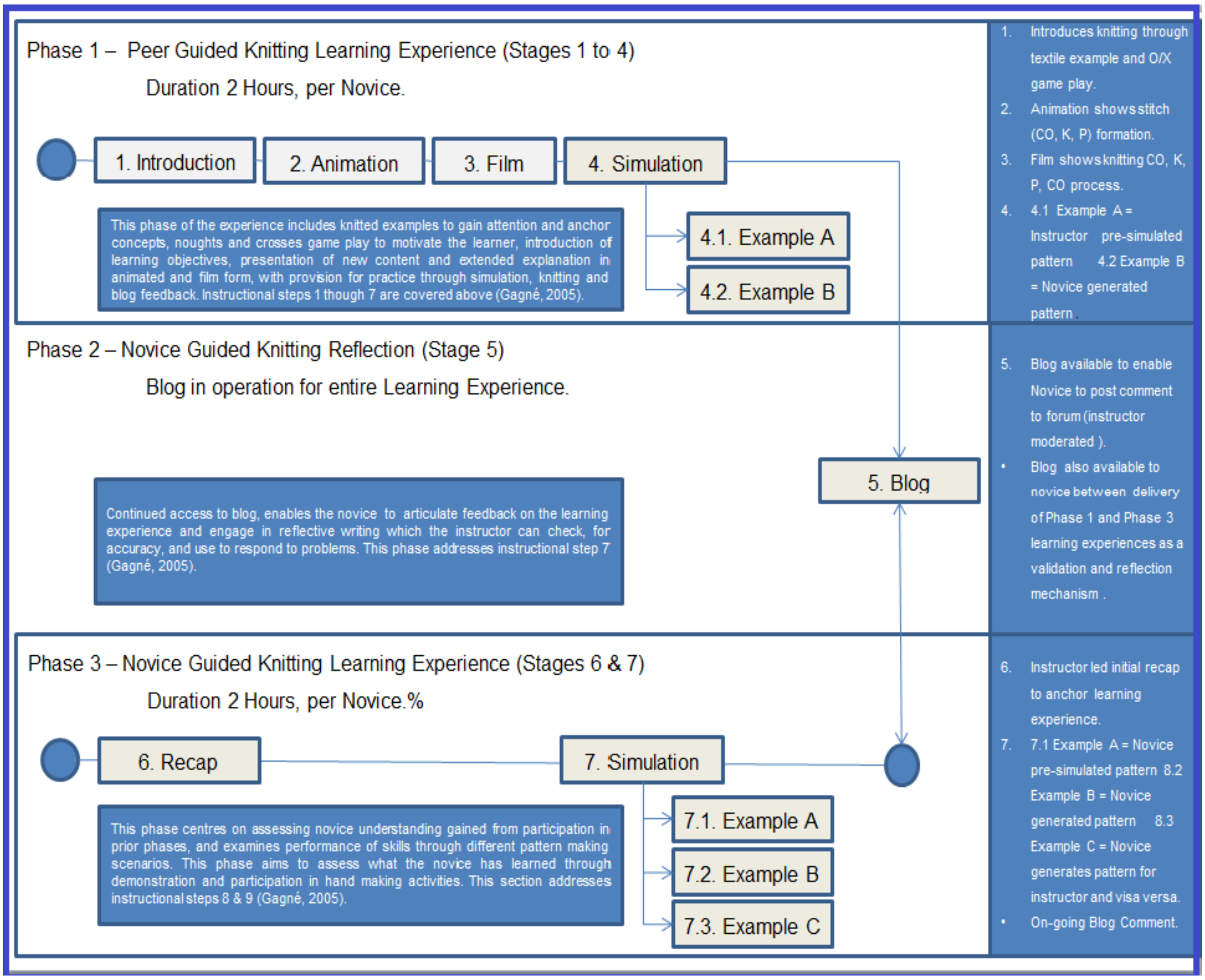
<u>Phase 3</u>

Provided the learner with access to computer supported simulation for the purpose of generating and knitting advanced patterns (Van Gog & Rummel, 2010). This activity encouraged learners to demonstrate their understanding of the process.

1.7.1 Rationale

The design of the experience aimed to guide the learner through different phases of instruction (Gagné, 2005b) to elicit understandings from the learner (Bruner, 1966b) and engage them in an experience which was meaningful and context specific (Dewey, 1934a). Chapter 3 details each of the learning objectives, steps, stages and phases. Figure 1 outlines the flow of the learning experience.

Figure 1 - Design of the Learning Experience



1.8 Implementation

On receipt of ethical approval obtained from University College Dublin, Trinity College – School of Computer Science and Statistics Ethics Committee (Appendix 4.1.1); participants received an email from the researcher, containing electronic teaching materials and a request to participate in the research (Appendix 4.1.2 - 4.1.10). A total of 6 adult learners' over the age of 18 years of age consented to participate, resulting in the collection of 36 hours of data, or an average of 6 hours of data per participant, per implementation. All participants were new to the domain of hand knitting, or had not participated in the act of hand knitting for a significant period (>30 years). The researcher applied 'opportunistic sampling' to recruit participants (Corbin & Strauss, 2008). Participants were personal associates of the researcher all of whom had an active interest in the production of craft materials. Given the small sample size, this study does not seek to make generalisations. Rather, this study hopes to obtain a more in-depth understanding of procedural learning within a subgroup (Hammersley & Atkinson, 2007a) and shine light on intricate, practices associated with applying procedural knowledge (Geertz, 1983b).

1.9 Methodology

An exploratory case study (Yin, 2002a), conducted through an ethnographic lens (Denzin, 1997) informed data collection (Miles & Huberman, 1994d), analysis (LeCompte & Schensul, 1999a) and categorisation procedures (Cresswell, 2013a). This approach helped the researcher to manage changes in theoretical positioning which emerged over the duration of the study, until a concise research statement and problem area were defined, then incorporated into the research questions (Yin, 2012). Adopting this strategy meant subjectively and continuously adjusting the research frame (Glăveanu & Lahlou, 2012) to allow for the constant reworking of data obtained from field notes, observational notes, researcher reflections, audio recorded interviews and pictorial image photographs of constructed artefacts (Emerson et al., 1995c; Maanen, 1988; Spradley, 1979c, 1980; Wolcott, 1999).

1.10 Limitations

As stated research participants were personal associates of the researcher recruited through opportunistic sampling (Miles & Huberman, 1994d). This approach may have increased the subjectivity of the study (Miles & Huberman, 1994d), but facilitated access to participants for the duration of the study (Spradley, 1979d). The duration of the study spanned several weeks, starting on the 24th of January, concluding on the 12th March 2013. To address the issue of bias, the researcher deployed internal / external validity mechanisms. To establish 'internal validity', the research sent participants anonomised copies of the study findings, to 'member check' the data (Appendix 9.4.12 to 9.4.15). Anonomised comments (Appendix 9.4.16) were then reworked into final drafts of the study findings (Guba & Lincoln, 1985b). To address 'external validity', multiple data sources where deconstructed, coded then reconstructed into themes that emerged from analysis (Schofield, 2007).

1.11 Findings

Interaction with online game play, animation and film helped learners to manipulate the display the pacing of procedural content. Learners replayed the same content continuously, as a means of helping them to explore variance and to conceptualise complicated elements of the process. Use of simulator technologies helped learners rearrange and generate content, - and apply complex notation intended to represent patterns designed to guide the construction of hand knitted materials. In terms of peer guidance, as learners developed increasing levels of expertise reliance on peer assistance diminished. As learners engaged more fully with the process, learners asked the peer to intervene less in the process, using technology more to support, verify or resolve particular hand knitting problems. Combining multimedia with simulatory tools enabled the peer to present phenomena in a form which the learner could manipulate to develop deeper meaning and understanding of the process.

1.12 Road Map

The next chapter reviews relevant literature on procedural learning. Chapter 3 presents the design of the learning experience, chapter 4 the study methodology, chapter 5 data validity and analysis processes, chapter 6 discussion on the research findings, and chapter 7 concludes by recommending further research in the area.

2 Literature

This chapter presents discussion on issues related to learning procedural knowledge

2.1 Complexity in Procedural Learning

Procedures are complex, structured phenomena that are shaped through their application over time, and embody the knowledge of others, whom have used them for the purpose of resolving particular problems that emerge within specific domain areas (Piaget, 1978). Procedures are also active systems, designed to assist others resolve particular problems which occur within systems (Bruner, 1974), and help convey meaning to others whom wish to perform modifications within their own work (Geertz, 1973). Learning procedural knowledge is problematic for learners given that they need to understand the role that procedures play in conveying knowledge about systems, and they also need to grasp how engaging with procedural forms or processes support sense and meaning making to resolve problems within systems.

2.1.1 Sense and Meaning Making

Making sense and deriving meaning from procedural forms is complex given that learners need to engage with procedures on two fronts. Firstly, procedures are ‘conveyers’ of restructured meanings used to resolve problems *within* systems (Dosi & Grazzi, 2010). Secondly, procedures are ‘vehicles’ of meaning used in learning skills and expertise which convey meanings *about* systems (Knight, 1942). This distinction is fundamental to our understanding of procedures, given that the way in which we engage with procedures may influence how we form our thoughts about their use in applied practice (Piaget, 1950d). Learning procedural knowledge then, is shaped through practice whereby our thoughts and understandings are internalised in response to meanings generated from their applied use (Jarvis, 2010a, 2010b).

2.1.2 Constructing Knowledge

Given that procedures are used in the structuring of phenomena to resolve problems, learning procedural forms of knowledge requires the learner to engage in a process of internalising and restructuring of experiences, gained through their practice (Vygotsky, 1978b). Sensory information received from our experiences are 'internalised' or transported into our conscious and subconscious mind, through a series of developmental mechanisms, which underpin the construction of knowledge (Piaget, 1950b). Knowledge construction requires the learner to engage in a process of sense making that occurs from the meaningful restructuring of thoughts and behaviours generated in response to our everyday experiences (Piaget, 1950a).

2.1.3 Influence of Experience

Constructing procedural meaning is therefore challenging, given that meaning making requires the learner to 'internalise or assimilate' experiential information into restructured forms, where new concepts are reconfigured against pre-accommodated phenomena already stored in the mind (Bringuier, 1980). The mechanisms used in the construction of procedural knowledge, relies in some part on receiving and processing multisensory information gained from our experiences (Dewey, 1934a). Being reliant on such experiences is problematic for the learner, given that although procedures convey detailed information in structured and organised formats, the interjection of experience into the process, introduces levels of subjectivity, which have significant implications for learning (Jarvis, 2002).

2.2 Mechanisms for Conveying Knowledge

Procedures contain elements of thoughts and expertise developed from our experiences (Hatano, 1982). Learning how to grasp procedural expertise therefore requires learners to enact procedures for themselves. Re-enactment takes significant time, patience and repeated practice (Gott, 1988). Repeated engagement with the same procedure over time, for example may help the learner reach a certain level of expertise which gives them the confidence to try out modifications, or develop more intuitive approaches to working with procedures in practice (Bruner, 1960a). However, reaching a ‘working’ level of conscious intuition, requires the learner to develop a meaningful, deeper, analytical relationship with procedural structures (Jarvis, 2003). One way of developing a working level of knowledge required to enact procedures is through the mechanism of trial and error learning.

2.2.1 Trial and Error Mechanisms

Participation in trial and error activities may initially help learners grasp the basic mechanics of complex procedural structures produced by others (Claparède, 1917). However, trial and error learning only cements skill at a base level and limits exploration of more complex strategies (Piaget, 1950a). Experience gained through the replication of procedures however may help learners initially build up a base level of expertise needed to identify, then resolve problems that emerge from the immediate process (Skinner, 1974). As mechanisms used in the conveyance and development of knowledge (Bruner, 1960a), trial and error approaches guide learners in more linear paths, potentially missing opportunities to develop more in-depth understandings of particular phenomenon (Singley & Anderson, 1989a). This distinction is important, given that an aim of engaging with procedural forms is the eventual acquisition of meaningful knowledge which may support modifying or problem solving behaviours (Vygotsky, 1926). Trial and error mechanisms then, enable learners to obtain a basic grasp and understanding of complex phenomena, but this approach is in part limiting in helping learners to reach deeper, more meaningful, conceptual depth needed to address complexity (Scribner, 1997b).

2.2.2. Experiential Mechanisms

Participating in programs where procedures are taught, may help learners develop a more in-depth understandings of particular areas of skill and expertise (Singley & Anderson, 1989b). However, given that, there are two elements in play during the application and practice of procedures, this presents the learner with the following choices. The learner can continue using trial and error mechanisms to help them reinforce basic understandings, or choose to extend their learning and deepen their knowledge by engaging in designed instruction that aims to present the learner with access to tasks and exercises which offer depth and reinforcement (Bruner, 1966a).

2.3 Challenges in Learning Procedural Knowledge

Acquiring expertise to perform procedures, is further complicated given the role that preferences play in meaning making. Procedures are complex systems – they embody ideas, motives, actions, behaviours, language and thoughts assigned to them through their modification and practice by others (Burke, 1966). Procedures are complex in the sense that they represent particular meanings to those engaged in their performance (Blumer, 1969b). The presence of preference within procedural learning presents many difficulties to the learner, given that learners may observe the performance of a particular procedure, then observe the same procedure enacted by others but using different strategies, techniques, ideas or language (Geertz, 1974). Reaching beyond basic understandings requires learners to engage in experiences where they can observe techniques or learn practices which may help them modify their own practice, or make choices in relation to particular strategies they wish to incorporate into their own learning (Dewey, 1934b). The individual learner not only needs to familiarise themself with strategies which help to instil basic knowledge and skills, they also need to incorporate and use developmental mechanisms which may help modify and deepen their own practice (Bruner, 1966c).

2.3.1 Developing Procedural Knowledge

Focusing now on challenges facing the individual learner, there are many aspects to consider when approaching the learning of procedures. Firstly, we have learned that learners need to engage repeatedly with trial and error processes to obtain basic understands, skills and levels of expertise (Haskell, 2000a). Trial and error processes not only help learners harness an initial levels of ‘intuitive’ thought, or sense making (Bruner, 1960a), they also lead the learner towards developing a level of exercised or practiced skill (Claparède, 1916). Secondly, although participation in trial and error strategies may initially help learners gain basic understandings, it is when trial and error approaches are combined with other developmental experiences or mechanisms, they lead the learner towards extending their knowledge to a level from which they can modify or adapt their own practice (Bruner, 1966c).

2.3.2 Peer Guidance Approaches

Peers play an important role guiding learners through areas of complexity in learning. For example, peers may show learners ‘how to’ complete procedural tasks (Scribner, 1997a). Learning with peers creates opportunities for learners to observe how procedures are practiced by others (Rogoff, 1990c). The benefits of participation in peer-guided experiences are many, given that learners can observe peer demonstration of complex issues and observe gestures and more tacit mechanisms used in the conveyance of knowledge (Rogoff, 2003b). Observation, practice and discourse are forms of knowledge sharing which may help learners understand areas of complexity or particular problems that may occur in practice. Participation in peer-guided instructional programs present learners with access to levels of expertise purposefully arranged to help them to attain a more intimate, detailed contextual understanding of procedural practices as they occur (Dewey, 1929a).

2.4 Using Technology to Learn Procedural Knowledge

Use of computer supported tools within instructional experiences provides learners with the opportunity to engage complex phenomena in a visual, nonlinear, more fluid form that may aid the learner memorise or learn particular aspects (Low & Sweller, 2005). Use of multimedia simulation tools, provide peers with the opportunity to lead or guide the learner through visual representations of particular areas (Mayer, 2011). Simulatory tasks may help the learner memorise constructs in a form which remains relevant to the domain (Jong, 2011). Tools used in this way may help the peer 'concretise' elements of abstract phenomena (Papert, 1993) in ways which help learners mimic structures and processes that are used in practice (Dewey, 1910). Embedding technology into learning experiences provide peers with the opportunity to construct activities, which focus on common problem areas and facilitate problem solving in a mode and format, which enables the learner to reconstruct problems, in the knowledge that they are designed to elicit particular meanings and understandings relevant to the domain (Jonassen, Beissner, & Yacci, 1993b). Using computer tools to explore procedural forms presents learners with the opportunity to examine elements they may not have encountered before, or have had the experience or confidence to address by themselves (Jonassen, Carr, & Yeuh, 1998).

2.4.1 Role of Multimedia Applications

Learning procedures requires the learner to engage with 'working memory' (Brunyé, Taylor, Rapp, & Spiro, 2006). Our working memory', helps us 'keep things in mind' while we engage with memorisation and sense making which occurs during the performance of a particular activity (Piaget, 1950c). Multimedia presentations support the structuring of visual content in ways which may help the learner build up sequential, 'mental' pictures of particular phenomena – that they may later recall to 'mind' when performing particular activities (Michas, 2000). The use of navigational aids within multimedia presentations in particular enables learners to engage in the control and pacing of content (Leung, 2003). These navigational aids enable learners to pause content for the purpose of reflection (Hattie & Gan, 2011), or to replay and repeat the display of pictorial content to help them perform procedural tasks (Brunyé, Taylor, & Rapp, 2008). Using visualisations as *aide memoires* in learning procedural knowledge provides learners with the opportunity to engage with representations in formats they can 'visualise' replay, or focus on depending on their specific needs (Jonassen, Howland, Moore, & Marra, 2003). Including multimedia tools into learning experiences designed to teach procedures, provides learners with access to pictures or images that visually explain elements of the process they may later wish to recall.

2.4.2 Role of Computer Simulation

Learning with peers provides learners with the opportunity to reconstruct or recall 'what they know' about 'how to' perform procedures within a supportive environment (Rieber, 2005). Use of computer simulatory tools provide both peer and learner with the opportunity to jointly share and explore gaps or inconsistencies within their knowledge (Eskrootchi & Oskrochi, 2010). Sharing problem areas or complex experiences help learners interface more easily with unexpected complexity (Rheingold, 2000). Simulatory tools which generate visual or pictorial representations of phenomena (Jong, 2011) in particular, provide both peer and learner the opportunity to engage with visual aids that can help depict the flow and structure of particular sequences, or draw attention to gaps or problem areas in learning, in a visual form which peer and learner can use in their learning (Magana, Brophy, & Bodner, 2012). For example, the peer may be able to guide the learner though visual examples of procedural processes which then act as knowledge sharing mechanisms, - where peers can change representations for the learner, or the learner can change representations for the peer (Guralnick & Levy, 2009). Using simulation tools in this way, presents an opportunity for the peer and learner to engage in a shared learning process which helps them resolve problems, using the visual attributes of an interactional technology to simplify complexity (Jong, 2011).

2.5 Problems in Learning How to Apply Knitting Procedures

Learning to hand knit is a kinaesthetic process (Tehrani & Riede, 2008). The learner uses their hands to form structures, which generate physical objects (Delong, Wu, & Park, 2012). Constructing knitted objects requires learners to learn a series of complex procedures, (Jacobson, 2001), which, although performed in varying ways (Cummins, 2008) share a common similarity, in structure and form (Prigoda & McKenzie, 2007). Within the domain of hand knitting, learners engage with structured phenomena in the form of a series of procedures that are shaped through their application in practice (Turney, 2009a). Procedures used within the domain of knitting, embody expertise accumulated over time, designed for the purpose of solving problems or resolving issues (Turney, 2009a). The challenge faced by learners is that they need to engage with procedural forms on two fronts - firstly, as conveyers of restructured meanings used to resolve problems within knitting systems (Spencer, 1989a) and secondly, as vehicles of meaning used to convey meaning about knitting systems (Spencer, 1989b). Having learned this distinction, learners are then faced with the challenge of ‘concretising’ procedural knowledge, which is demonstrated through the meaningful application of expertise to reconstruct artefacts in practice (Turney, 2009a). Knitters need to learn and then apply their knowledge.

2.5.1 Applying Procedures

Applying procedural knowledge is centred on a series of prerequisites. Not only does the learner need to engage with procedural forms to understand the type and nature of the procedures in play (Dewey, 1929b), the learner also needs to negotiate meaning making through a series of habit forming mechanisms (Dewey, 1922), designed to help the learner to internalise meaning and sense making (Bringuier, 1980). Learners can attempt to learn by themselves through trial and error mechanisms (Piaget, 1950a) or they can attempt to learn with others, by seeking out and participating in varying programs of instruction which seek to clarify particular areas of complexity (Rogoff, 1990b). These differing routes to learning may be ‘linear’ or ‘subjective’ - however both shape the way in which our experiences are transported into our subconscious and conscious mind (Dewey, 1938). Learning how to grasp then perform intricate levels of expertise required to perform procedures, is highly complex and full of influences that continue to shape the way in which we approach meaning making and the construction of knowledge (Bruner, 1996b).

2.5.2 Performing Procedures

Obtaining a ‘working knowledge’ of procedural skill is not only shaped by participation in developmental mechanisms, such as trial and error learning, but also through participation in other routes to learning which may be complex and subjective (Bruner, 1960a). Technological tools offer peers and learner the option to engage with specific procedural elements, in ways which may facilitate meaning making through varying strategies centred on exploring context and visualisation or memorisation needs (Jonassen et al., 2003; Low & Sweller, 2005; Mayer, 2011). However, working with technology may help peers present information or simulate activities aimed to focus the learning in ways which may help the learner obtain contextual and symbolic understandings surrounding the use of complex procedures (Jong, 2011), often conveyed only through explicit observation of peers over time.

2.6 Learning with Technology to Resolve Procedural Problems

Technological interventions provide peers with the option to use trial and error mechanisms to help learners develop basic understandings through the active simulation of particular elements. Simulations can present learners with a more cohesive, fluid and connected way of ‘seeing’ linkages between phenomena (Jong, 2011). Use of technology, within experiences that teach procedures, also present peers with ways in which to present complexity which may help learners engage with context and visualise or memorise particular aspects of a process (Jonassen et al., 2003). Use of simulation, may help learners engage with complexity through the practice of repetition as a means of helping them concretise meaning making (Guralnick & Levy, 2009). Technology interventions create opportunities for peers to encourage in-depth explorations of phenomena and for learners to manipulate phenomena to help support recall and the application of prior knowledge.

2.6.1 Using Multimedia Simulation in Practice

Designing and implementing learning experiences that include computer supported multimedia and interactive functionality, enable educators to replicate then construct complex sequences in formats that learners can manipulate for themselves (Hopkins, Thomas, & Bailey, 1998). Specifically, combined use of animation, video, and simulatory tools prepared or appropriated by peers and embedded within textile learning experiences, provide learners with access to materials they can interact with, for the purpose of developing an understanding of complex processes and procedures used in textile work (Hopkins et al., 1998). In both cases, technology may be used as a mechanism and means of imparting technical information in a form that enables peers to convey complex phenomena that enables learners to develop and construct knitted objects, themselves (Sayer, Wilson, & Challis, 2006).

2.6.2 Developing Knowledge through Peer Guidance

There remains a gap in the literature, which seeks to explore the combined use of multimedia simulation in teaching learners how to master knitting procedures, and apply those procedures to construct a series of complex patterns. This study hopes to add to literature that seeks to address this gap. The instructional use of technology within the domain of hand knitting is still, in many ways, viewed as a means of supporting craft production in terms of the generation of textiles using machines, or as a tool for facilitating online discussion or video documentation regarding the dissemination of techniques (Hosegood, 2009). In particular, as visual, aural and kinaesthetic experiences weigh heavily in textile construction processes, we need to be mindful that the act of ‘making’ is extremely complex and tactile (Brinkmann & Tanggaard, 2010). Peer guided use of computer tools within learning experiences, may offer one solution to support the demonstration and practice of procedural understandings which arise or occur from the production of textile materials (Sayer et al., 2006). Peer guided experiences which incorporate computer tools, provide learners with opportunities to interact with content, memorise processes, visualise and practice procedures (Sayer & Studd, 2006). While the above studies set out to explore particular applications of technology in hand knitting, the next chapter presents a solution in the form of technology-enhanced instruction designed to teach hand knitters procedures using multimedia simulation.

3 Design of the Learning Experience

This chapter presents a description of the design of the learning experience.

3.1 Problem Statement

Learning how to hand knit requires learners to reconstruct a series of procedures, which replicate the structure of a specific pattern in textile form (Meißner & Eberhardt, 1998). A problem learners face when learning such complex procedures, relates to the difficulty they experience in contextualising, visualising and memorising procedural steps (Turney, 2009b). To address this problem, the researcher implemented an instructional experience designed to help learners understand, see and remember how to apply procedures using multimedia tools and applications.

3.2 Learning Process

A process was developed to support learning in the following ways. Online game play aimed to help learners compare similarities and differences between phenomena. Animated sequences aimed to help learners form mental pictures of abstract constructs. Film content presented learners with access to visual examples designed to aid recall, while simulation provided learners with access to a facility, which supported the rearrangement of phenomena, as a form of problem solving.

3.3 Design of the Process

Working with tools and applications embedded in a learning experience acted as a facility to structure content in form designed to help learners identify similarities and differences between concepts. Specifically, combined use of words, pictures and animated sequences (multimedia) aimed to help demonstrate links between concepts to learners (Jonassen, Beissner, & Yacci, 1993a). The experience placed computer simulation at the centre the experience, providing learners with a facility to practice reconstructing and deconstructing sequences (Jonassen et al., 1998), as a means of 'concretising' their learning (Papert, 1993) in preparation for practice.

3.4 Description of the Process

The learning experience was a structured, instructional process designed and implemented by the researcher to explore issues surrounding learning and applying procedural knowledge. The rational supporting the design, was based on a series of learning objectives derived from a review of the literature which focused on contextual or symbolic issues, visualisation issues and memorisation issues.

3.4.1 Learning Objectives

The following objectives derived from a review of the literature, aimed to address:

3.4.1.1 Contextualisation

- Construct physical objects under peer observation for the purpose of learning more intimate, symbolic, tactic ad hoc procedural knowledge (Dewey, 1929a).

3.4.1.2 Visualisation

- Help the learner create a personalised route to knowledge which is contextual and meaningful (Papert, 1993), and engages learners in a process which offers control in pacing and delivery to support thought and refection (Leung, 2003).

- Help learners develop connected, sequential, in-depth understandings of the mechanical aspects of procedural forms, for the purpose of helping them replicate and incorporate elements into their work (Singley & Anderson, 1989a).
- Help learners observe changes or perform modifications in procedural practice, thus developing strategies or address modification and change (Dewey, 1934b).
- Help learners engage with procedural visualisations, either peer or learner generated for the purpose of exploring problems (Eskrootchi & Oskrochi, 2010).

3.4.1.3 Memorisation

- Help learners make sense and meaningful understandings of procedures through the repeated rearrangement of phenomena (Haskell, 2000b).
- Help learners develop intuitive approaches to problem solving, through the repeated rearrangement of phenomena (Bruner, 1960b).
- Help learners construct physical artefacts on their own using procedures and sequences which adhere to domain rules / practices (Jacobson, 2001).
- Help learners develop connected, sequential, in-depth understandings of the mechanical aspects of procedural forms, to help them replication parts or segments into the development of their own work (Singley & Anderson, 1989b).

These objectives where incorporated into the design and building of a learning experience. The researcher spent a 145 hours on the planning and development of the experience (see Table 1 below) to link learning activities to learning objectives.

Table 1 - Scope of the Learning Experience

Item	Technology	Application Type	Number of Hours
1	Online Game	Existing Application	N/A
2	Animation	Researcher Constructed	25
3	Film	Researcher Constructed	45
4	Computer Simulation 1	Existing Application	N/A
5	Blog (Postings)	Researcher Modified	5
6	Blog Examples		
7	Computer Simulation 2	Existing Application	N/A
Design and Planning			70
Total Development Time			**145 Hours**

3.5 Delivery of the Learning Experience

Prior to participation in the process, each learner received then signed copies of approved participant information sheets and consent forms (Appendix 4.1.2 & 4.1.3). On receipt of signatures, the researcher then commended to issue learners with a work pack (Figure 2). The work pack included copies of ethical content forms, participant information sheets, new knitting needles in a wrapper, two balls of hypoallergenic wool, printed hand copies of basic and advanced patterns, and sheets of graph paper, should the learner wish to draw patterns. On pack issue, the researcher then proceeded to teach the experience on a one-to-one basis with learners in the researchers' home, or – by pre agreement at a location selected by learners. The majority of learners, where taught in the researcher's home.

Figure 2 - Learner Work Pack Contents

3.5.1 Instructional Design

Each of the following phases contained sub sections designed to focus on learning and applying procedures. Using a pre-existing instructional framework (Gagné, 2005b) helped the researcher present concepts in a logical format (Bonner, 1982).

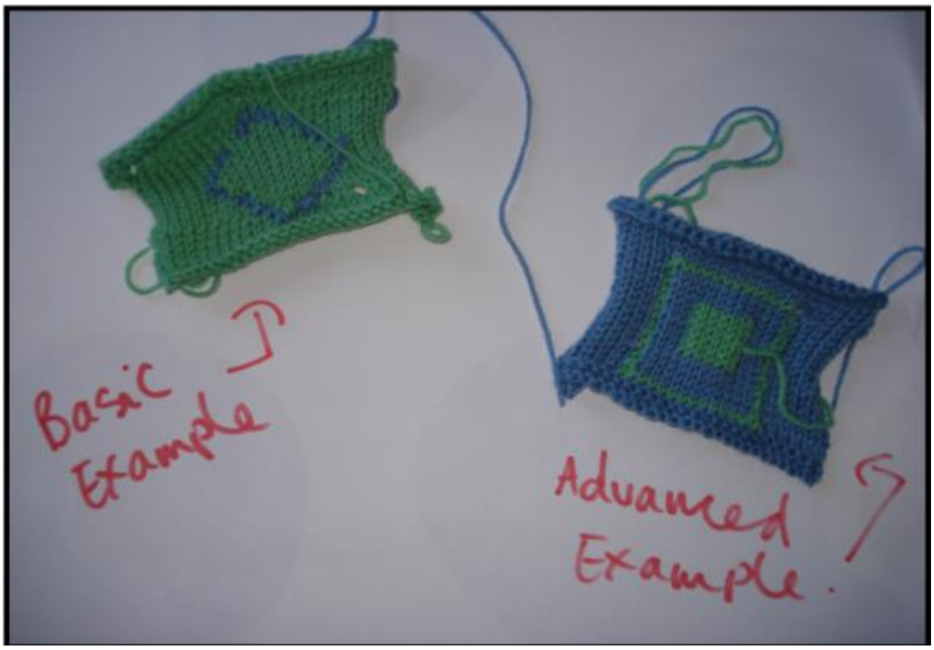
3.6 Phase 1

This phase conveyed contextual and visual elements (Mayer, 2011) designed to guide learners through online game play simulation (Rieber, 2005), animations of complex formations (Höffler et al., 2010), filmed processes (Jonassen et al., 2003), and online computer pattern simulation. Each tool presented procedures in different ways as a means of helping the learner explore procedures (Magana et al., 2012) in a way that helped link notation with content and activities (Low & Sweller, 2005).

3.6.1 Stage 1 - Knitting Examples / Online Noughts & Crosses Game

This stage created opportunity for learners to examine basic and advanced hand knitted samples (Figure 3). Presentation of samples aimed to help learners gain an understanding of what was achievable during participation in the experience and manage their expectation in terms of the level of skill required from the onset. Presentation of samples also acted as teaching aids, in helping the researcher to gain learner attention and anchor the learning in a specific domain (Gagné, 1974).

Figure 3 - Knitted Samples (Basic and Advanced)



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The researcher then invited learners to participate in a two-player online game of noughts and crosses (Cox, 2012). This activity aimed to help learners contextualise and understand how knitting codes formed patterns using O and X combinations (Figure 4). Game play acted as an entry point into the domain of knitting, to motivate learners to engage with codes and pattern making using familiar tools in a way which hoped to access prior knowledge in a familiar form (Gagné, 2005a).

Figure 4 - Online Noughts and Crosses Game (Two Player)

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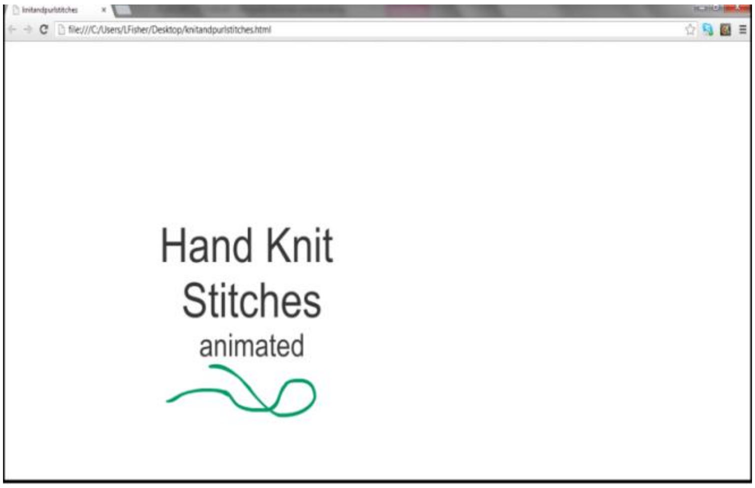
http://games.dannycox.me.uk/noughtsandcrossestwoplayer/index.htm

3.6.2 Stage 2 - Animated Knitted Loop Demonstration

This stage presented new content to learners in the form of animated looped sequences aimed to help learners visualise different loop formations (Hiatt, 2012).

Figure 5 - Online Animation Basic Hand Knitting Home Page



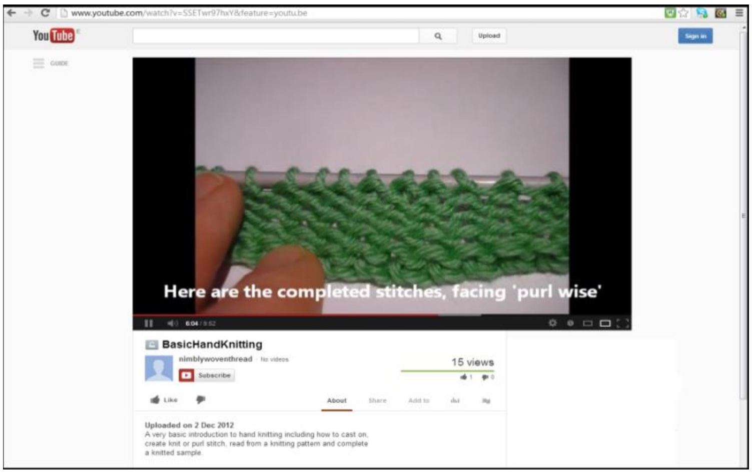
Lorraine Fisher © 2013

Five animated sequences constructed by the researcher, presented loops in an abstract form designed to help learners, '*see'* how they are formed in practice (Figure 5). Often loops are presented in static pictures (Patel, 2008), or with knitting needles present (Kagan, 2004). These representations may obscure lines of vision. The animation constructed above presented loops in a clear and unobstructed form.

3.6.3 Stage 3 - Film Demonstrating Knitting Practice

This stage introduced an instructional film (Figure 6) incorporating textual description an instrumental sound track, process snippets, loop formations and use of codes introduced in earlier stages. Film content included textual summaries, explanations of terminology (Appendix 4.3.2), placed alongside filmed examples and summaries designed to provide the learners with a context in which to see the performance of complete processes (Gagné, 2005a). Use of film intended to provide learners with access to content that enabled them to explore complete sequences in a form they could control by themselves (Jonassen et al., 2003). The film was posted into YouTube, prior to implementation of the learning experience for the purpose of providing learners, and the working community with online access to the content.

Figure 6 - Online Film Demonstrating Knitting Practice



http://www.youtube.com/watch?v=SSETwr97hxY&feature=youtu.be

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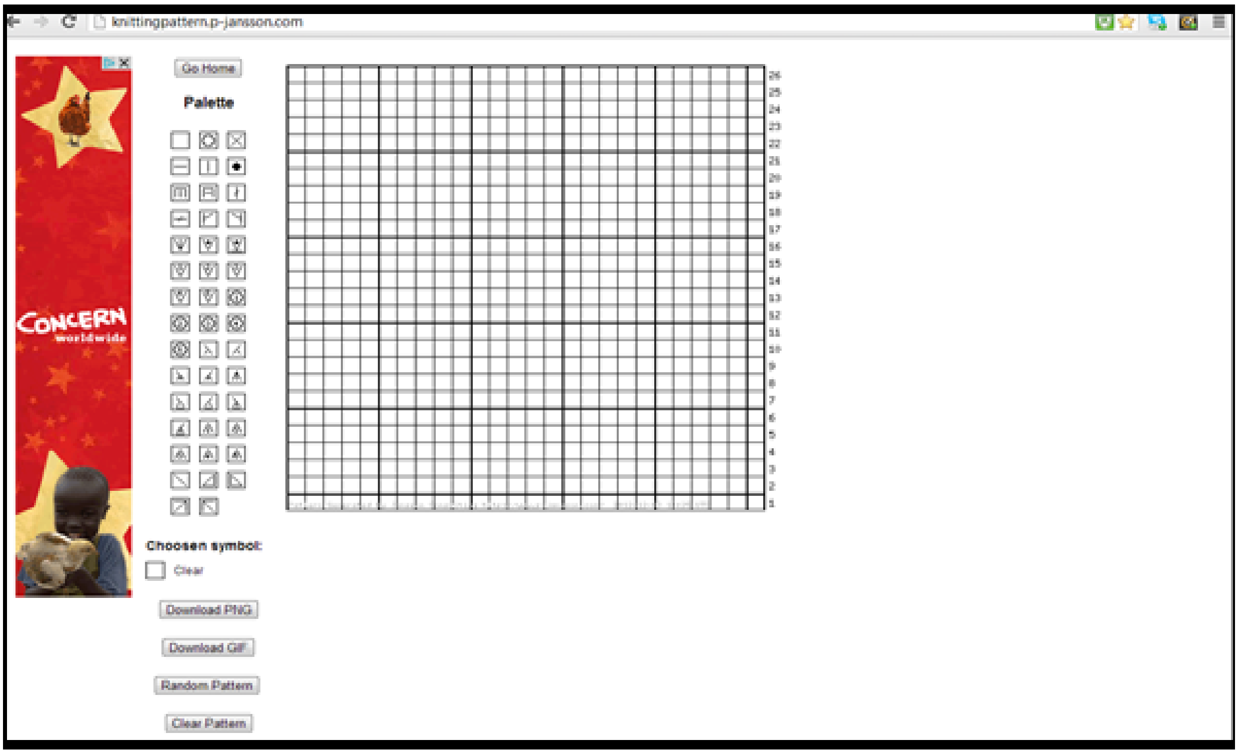
3.6.4 Stage 4 - Computer Supported Simulation (Basic)

This stage introduced online computer supported simulation (Figure 7). Simulation enabled learners to select a series of codes (already familiar through noughts and crosses game play) then practice reconstructing or deconstructing patterns using the different code combinations. The simulation provided learners with a facility to generate multiple sequences. Participation with simulation at this point in the experience created opportunity for learners to demonstrate their own understanding of constructs, they had learned thus far. Learner use of simulation in the presence of the researcher also created an opportunity within the experience for the researcher to elicit understandings from learners – for the purpose of correcting or detecting problems which emerged through use of the tool in practice (Gagné, 2005a).

Figure 7- Online Generic Knitting Pattern Generator



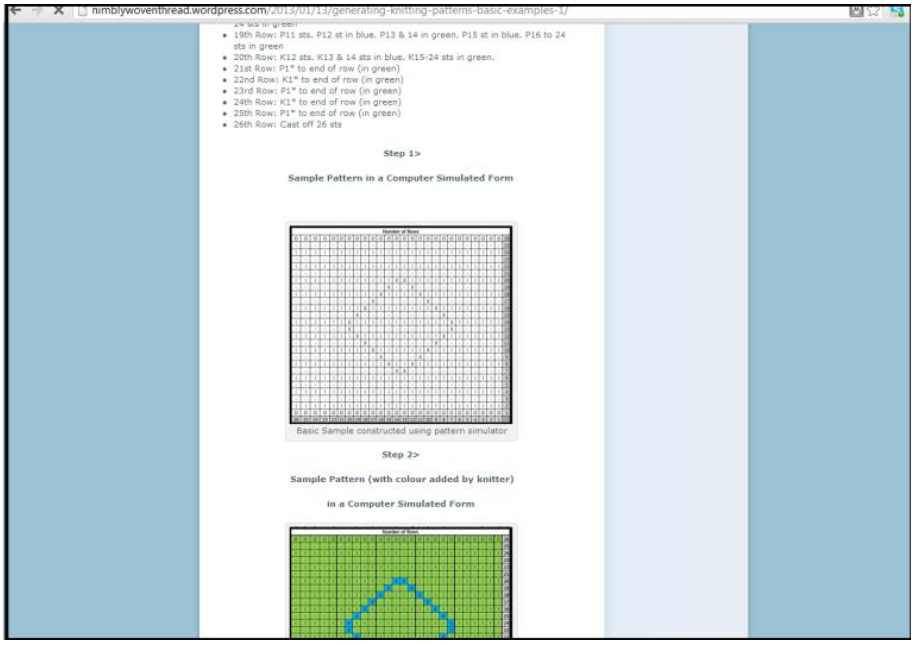
http://knittingpattern.p-jansson.com/

Different computer simulation options where presented to the learner (Figure 8). Learners where invited to select one or more of the following simulation options:

- reconstruct a pre-simulated pattern;
- simulate their own pattern;
- opt to reconstruct both a pre-simulated pattern and simulate their own pattern;
- opt out of computer generation.

By providing learners with the option to generate patterns using the computer simulator, use supplementary materials such as graph paper or use Microsoft Excel to add colour to designs, learners could select options that best met their own needs.

Figure 8 - Online Basic Pre Simulated Patterns



http://nimblywoventhread.wordpress.com/2013/01/13/generating-knitting-patterns-basic-examples-1/

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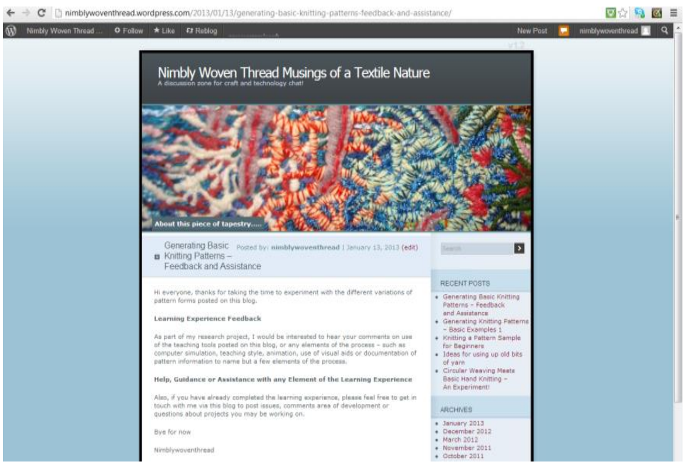
3.7 Phase 2

This phase engaged learners in the process of conscious reflection (Mead, 1934b). Reflection was encouraged by the researcher through use of an online communication or ‘blogging’ tool to document thoughts and experiences. This phase of the process aimed to help learners engage in the reflective process and think deeply about the experience(Jordi, 2011), and share experiences with others.

3.7.1 Stage 5 - Blog (as Reflection and Assessment Tool)

This stage introduced learners to an online computer supported, interactive feedback tool (Figure 9) modified by the researcher to assist learners document their experiences of learning to knit or reflect on their participation in the experience. The researcher requested that learners post comments, issues, areas of concern or load images of their work for discussion with the researcher, or wider knitting community. Provision of a blog facility provided learners with the option to leave feedback on the process, but also provided opportunity for the researcher to ‘assess’ performance in terms of reviewing comments to determine accuracy and import (Gagné, 2005a).

Figure 9 - Online Blog Utility to Support Feedback



http://nimblywoventhread.wordpress.com/2013/01/13/generating-basic-knitting-patterns-feedback-and-assistance/

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3.8 Phase 3

This phase, prompted learners to lead the learning experience (Wood, Rust, & Horne, 2009). The researcher encouraged learners to initiate task setting for the purpose of demonstrating to the researcher what they had learned during participation in the learning experience (Van Gog & Rummel, 2010). Task setting played an important role in both demonstrating to the researcher what learners' knew in terms of their own conscious or 'working memory' (Brunyé et al., 2006), and in highlighting potential gaps or areas of difficulty with the process.

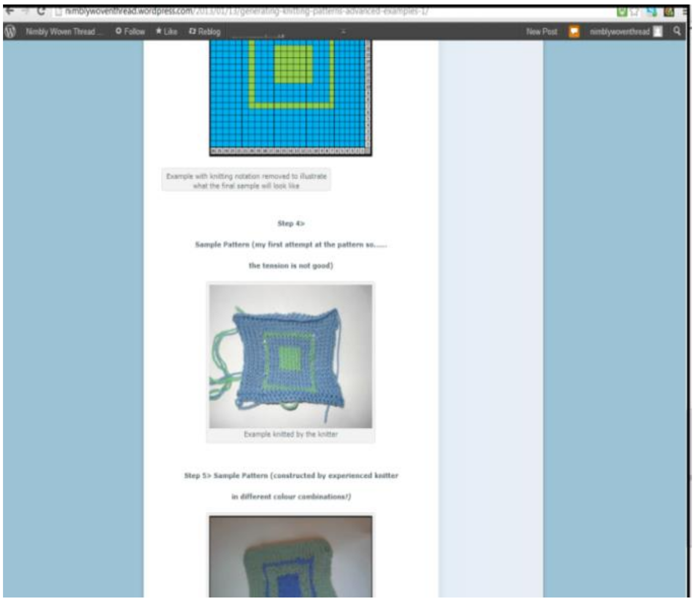
3.8.1 Stage 6 - Re-Cap - Knitting Examples (Reflection with Researcher)

A recap session, which reintroduced learners to prior tasks and activities, enabled learners to raise questions or queries, while the researcher asked questions, introduced new constructs in a form, already familiar to the learner – while prompting the learner to access prior knowledge (Gagné, 2005a). This recap phase facilitated by the researcher invited learners to participate in a further cycle of the learning following the same structure and using the same content as previous phases.

3.7.1 Stage 7 - Computer Supported Simulation (Advanced)

This stage prompted learners' to generate another set of pre-simulated patterns (Figure 10). Following the same format as previous phases (Section 3.5.4), learners where asked to construct more advanced patterns using the online computer simulation tool (Appendix 4.3.8 to 4.3.12). The introduction of new patterns, aimed to motivate the learner, by providing a facility for them to deepen their understanding through extended combinations of pattern forming. Figure 10 provides a snap shot of some of the steps and course content covered during the advanced knitting segment

Figure 10 - Online Advanced Pre Simulated Pattern



http://nimblywoventhread.wordpress.com/2013/01/13/generating-knitting-patterns-advanced-examples-1/

Lorraine Fisher © 2013

The advanced segment aimed to help learners lead the design and development of making processes. The next chapter presents the methodology applied in this study.

4. Methodology

This chapter details the methodology applied in the study.

4.1 Exploratory Case Study

An exploratory case approach informed data collection and organisation (Yin, 2012). This approach acted as a frame within which to explore theoretical concerns related to problems identified within the literature, and support construction of two research questions (Section 1.6). Using a case approach enabled the researcher to explore what learners ‘said’, ‘did’ and ‘how’ they used artefacts within a particular setting (Cresswell, 2013b). This approach also enabled the researcher to make adjustments to the process over the duration of the study in terms of amending the research questions in light of discoveries drawn from the literature (Denzin & Lincoln, 2005b). A case format provided the researcher with a structure in which to evaluate the inclusion of new ideas (Yin, 2009d) and provided a context in which to examine how or why particular phenomena may have occurred in a particular setting (Yin, 2009b).

4.2 Qualitative Strategy

A qualitative strategy was chosen by the researcher as a means of selecting tools designed to capture contextual description from the field (Denzin & Lincoln, 2013). The researcher adopted this approach in acknowledgement that quantitative methods such as questionnaires, structured interviews, or surveys many help to process large amounts of data (Miles & Huberman, 1994d), and support generalised claims based on wide ranging population based trends, attitudes or inferences (Cresswell, 2008). As this study draws accounts from smaller samples of data, this rendered the data unsuitable for generalisation (Guba & Lincoln, 1981, 1985b).

4.2.1 Data

Applying a qualitative lens to the research process changes the dynamic of the research experience to one in which all observations are treated as ‘data’ (Wolcott, 1999). Through this lens, thoughts, hunches, drawings, notes constructed prior to, during and after delivery of each learning experience along with informal learner discussions, all merited the status of ‘data’ (Denzin, 1997). This data helped the researcher gain a deeper and more localised, or personalised, understanding of difficulties, problems and complications (Geertz, 1983b) or feelings, attitudes and opinions related to participants experience of particular phenomena (Geertz, 1983c).

4.2.2 Sampling

An opportunistic sampling strategy enabled the researcher to follow leads that emerged from the process of field research while also taking advantage of unexpected outcomes that emerged from participation in the process (Miles & Huberman, 1994d). The researcher located participants on the basis that they had not participated in the process of hand knitting for some time, and had not previously used technological tools to support them in their learning of knitting or making knitted materials (Section 1.8). On fulfilment of these criteria, the researcher then proceeded to deploy a recruitment strategy designed to locate participants for the study.

4.2.3 Participants

On receipt of ethical approval to initiate fieldwork (Appendix 5.1.1), the researcher then entered the field and liaised with participants (Table 2). On receiving participant agreement to engage in the study, the researcher then emailed each participant teaching materials, which included details of the study (Appendix 5.1.2 - 5.1.9). The researcher then scheduled dates, times and places for delivery of the learning experience (Appendix 5.3.1.1 – 5.3.7.1). The researcher taught lessons to participants between the dates of the 24th of January to the 5th March 2013. Each participant was allocated a colour code that maps to related data (Appendix 9.4.3-9.4.8) to help preserve the anonymity, and protect the identity of each participant.

Table 2 - Participant Profiles

Recruitment Order	Colour Code	Age Range	Gender	Knitting Experience	Experience Location
1	**Orange**	55-65	Female	>40 Years	Researcher Home
2	**White**	35-45	Female	>30 Years	Learner Home
3	**Red**	35-45	Female	>30 Years	Researcher Home
4	**Green**	35-45	Male	None	Researcher Home
5	**Blue**	55-65	Male	None	Skype Mediated
6	**Black**	55-65	Female	>40 Years	Researcher Home

4.2.4 Constraints

Five learning sessions were delivered by the researcher on a physical one to one basis (Table 2), while one learning experience was delivered by the researcher on a one to one basis via Skype ©. There were many benefits in conducting the learning experience within a physical environment, compared to a 'virtual' one. The researcher could observe or 'see' the way in which learners interacted with physical tools during the experience (Rogoff, Paradise, Arauz, Correa-Chávez, & Angelillo, 2003). The researcher could also physically intervene in problem areas to help correct learner errors (Erikson, 1992). One learner opted to participate in the learning experience via the Skype. The researcher could 'see' levels of interaction, only as shown to them within the confines of the screen display, but could not 'see' participation with instructional tools used during the experience (Fetterman, 2010h). Also, the researcher could not physically help the learner resolve problems of technique. This participant provided a valuable account of their experience relating to using technology on their own to explore procedures and construct artefacts on their own. The perspective given by this participant provided insightful information related to the problems associated with using multimedia simulation without explicit guidance. While the majority of initial interviews were conducted with the learner in the same physical environment, follow up interviews where primarily mediated through the Skype. Technology mediated video interviewing enabled the researcher to work within learner schedules, but screen size limitations distorted the display of animated gestures or 'hand oriented' examples used when describing phenomena (Fetterman, 2010h). This restriction impeded the ability of the researcher to demonstrate procedures, and often lead to an increased reliance by the learner on the technological tools provided to them as part of the learning experience.

4.2.5 Engagement

In all cases, the researcher delivered the learning experience to each participant only once. Table 3 details participant completion of each stage of the process.

4.2.5.1 Phase 1

In terms of completing the learning experience, all learners completed phase 1 of the process. However, during this phase of the learning experience, three learners opted to follow, and then reconstruct a basic pre-simulated example, while four learners opted to simulate, and then knit a pattern of their own design. One learner opted to knit the pre-simulated pattern, then generate and knit a pattern of their own design.

4.2.5.2 Phase 2

Four learners opted to use the online blog utility to comment on their experiences. In all cases, comments were posted, after completion of the experience, and in their own time. All learners used the online resource materials (patterns / instructional materials) posted on the blog during the learning experience. In terms of volume of use, only two participants posted two comments related to the learning experience.

4.2.5.3 Phase 3

Two participants did not opt to advance their studies. Four learners did opt to reconstruct, then knit advanced pattern combinations using the computer simulator. One learner completed the pre-simulated advanced pattern, constructed their own advanced pattern and then proceeded to construct a pattern for the researcher to knit. In total, each learner engaged in a process that lasted six hours, resulting in a total teaching time of 36 hours.

Table 3 - Learning Experience Completion

Learning Experience Phases and Stages				Areas Completed per Learner					
				1	2	3	4	5	6
Phase 1 – Eliciting Visualisation and Memorisation									
	Stage 1 – Knitting Examples			✓	✓	✓	✓	✓	✓
	Stage 2 – Animated Loop Examples			✓	✓	✓	✓	✓	✓
	Stage 3 – Film Demonstration			✓	✓	✓	✓	✓	✓
	Stage 4	Computer Supported Simulation							
		Basic Example 4.1	A	✓		✓			✓
		Basic Example 4.2	B	✓	✓		✓	✓	
Phase 2 – Eliciting Memorisation									
	Stage 5 Blog / Reflection Tool			✓	✓	✓	✓		
Phase 3 – Eliciting Memorisation and Context									
	Stage 6 – Re-Cap – Knitting Examples			✓	✓		✓	✓	
	Stage 7	Computer Supported Simulation							
		Advanced Example 7.1	A	✓					
		Advanced Example 7.2	B	✓	✓		✓	✓	
		Advanced Example 7.3	C	✓					
Total Number of Data in Hours, per Learner				**6**	**6**	**6**	**6**	**6**	**6**
Total Number of Hours				**36**					

4.2.6 Follow Up

On delivery of the last learning experience, the researcher then conducted a series of audio-recorded semi-structured interviews with learners. All learners completed a one to one interview with the researcher between the dates of the 6th March until 12th March. All learners participated in this round of semi-structured interviews, resulting in a total of twelve hours of data collection, or 2 hours per participant or 1 hour per interview. The researcher used each session as an opportunity to share interim, emergent findings, explore outstanding issues, and thank learners for their participation in the process (Guba & Lincoln, 1985a) see (Appendix 9.1.4 for interview question framework). Three learners conveyed experiences of continuing to knit on their own to the researcher, having participated in the learning experience.

4.3 Bias

Methods used in this study are broadly qualitative and subjective (Lofland, 2002). Firstly, observing and reconstructing participant accounts is an inter-subjective process – accounts are reconstructed through the privileged 'voice' of the researcher (Maanen, 1988). Secondly, written accounts present a biased standpoint of phenomena under study (Denzin & Lincoln, 2013). Attributing the values of 'validity' to exploratory, qualitative accounts is therefore challenging. Claims and treatments of truth and validity are addressed in this study to ensure that the research process meets the necessary levels of criteria, which help to substantiate the study findings.

4.4 Limitations

A case based approach conducted through an ethnographic lens aimed to portray a more detailed, descriptive, holistic account of phenomena experienced by learners in the study (Maanen & Gummersson, 2000). This process did not seek to locate truths through the explicit reduction of phenomena to a series of disassociated constructs

(Denzin & Lincoln, 2005a). Rather, many different data treatments where administered to explore phenomena within a smaller sample. This approach hoped to obtain more in-depth and differing views within the data, in acknowledgement that accounts are interpretations of interpretations, which portray approximations of truths and realities experienced by those within cultural sharing systems (Geertz, 1973).

4.5 Truth Claims

Substantiating the approaches presented in this study then, required application of a framework to address issues of truth attributed to the accuracy of results (Guba & Lincoln, 1985b). There are many disagreements relating to what constitutes validity within the domain of qualitative research (Fetterman, 1987). To address these qualitative limitations, a framework consisting of construct validity internal validity, external validity and reliability were applied to data sets as validity criterion (Yin, 2009b). The next chapter presents the validity frame and analytical rationales.

5. Analysis

This chapter presents analytical processes and validity frames used in the study.

5.1 Data Collection

The researcher deployed a three phase data collection strategy, designed to establish a ‘valid’ trail of evidence that consisted of gathering a number of sources of evidence, at specific stages over the duration of the study (Guba & Lincoln, 1985b). Table 4 presents the data collecting order, performed over for the study duration

Table 4- Types of Evidence

<table>
<tr><th colspan="2">Learning Experience
Phases and Stages</th><th colspan="2">Sources
of Evidence</th><th>Appendix</th></tr>
<tr><td colspan="5">Phase 1 – Prior to Implementation of the Learning Experience</td></tr>
<tr><td>Field
Notes</td><td>Free writing (Wolcott, 2009) reconstructed in order (Fetterman, 2010c).</td><td>62 pages</td><td colspan="2">9.4.1
9.4.2</td></tr>
<tr><td>Cognitive
Mapping</td><td>Collate themes in the literature identified during the study (Ryan & Bernard, 2003).</td><td>1 Map</td><td colspan="2">9.2.1</td></tr>
<tr><td colspan="5">Phase 2 – Implementation of the Learning Experience</td></tr>
<tr><td>Participant
Observation</td><td>Reconstructed, colour coded, informal structured accounts (Spradley, 1980) compiled into free text, free flow and informal written accounts (Wolcott, 2009).</td><td>36 Hours
30 Pages</td><td colspan="2" rowspan="2">9.4.3
9.4.4
9.4.5
9.4.6
9.4.7
9.4.8</td></tr>
<tr><td>Physical
Artefacts</td><td>Artefact photographs (Lohmann, 2010), as an aid in demonstrating the process.</td><td>24
Artefacts</td></tr>
<tr><td colspan="5">Phase 3 – Data Collection – Post Completion of the Learning Experience</td></tr>
<tr><td>Semi
Structured
Interviews</td><td>Explore constructs in a semi structured form (Spradley, 1979d) to extract discourse relating to the research area.</td><td>12 Hours</td><td colspan="2">9.4.9</td></tr>
<tr><td>Blog</td><td>Views posted to learning experience internet site (Fetterman, 2010a)</td><td>30 Views
1 Posting</td><td colspan="2">9.4.10
9.4.11</td></tr>
</table>

5.2 Phase 1

Data collection commenced on receipt of ethnical approval, prior to implementation of learning experiences. Tools used to collect data in this phase are now detailed.

5.2.1 Field Notes

In this phase the researcher started to keep an unstructured note book (Appendix 9.4.2) capturing thoughts, hunches, ideas, artefacts and sketches about the phenomena under study (Wolcott, 2009). This process of 'free writing' enabled the researcher to develop thoughts about the process in a logical form (Emerson, Fretz, & Shaw, 1995a). The researcher recorded areas of interest related to the investigation which emerged from regular discussions with friends or through the act of 'thinking' transcribed into writing (Emerson, Fretz, & Shaw, 1995b). The researcher made the decision not to use formalised note taking templates as the researcher viewed these as deterministic in forcing the reconstruction of notes and inhibiting the emergence of more free forming constructs (Silverman, 2010). Free writing forced the researcher to reconstruct thoughts in a structured, organised form (Fetterman, 2010c). Table 4 presents the data collecting order for the study duration.

5.2.2 Cognitive Mapping

The researcher used cognitive mapping technologies (Byungun, 2010) to help record conceptual linkage between concepts identified within the literature (Appendix 9.2.1). Mapping technologies are online computer tools, which support the arranging, and grouping of concepts in a visual form. This form of mapping helped the researched maintain linkage between complex concepts as they developed over time.

5.3 Phase 2

This phase collected data during delivery of the learning experience using participant observation to document processes related to the construction of physical artefacts.

5.3.1 Participant Observation

Given the sensitivities surrounding the practice of participant observation the researcher physically placed their notebook on the table in front of learners for the duration of the learning experience (Fetterman, 2010f). This activity ensured that learners ‘could see’ what the researcher wrote during the process (Spradley, 1980). The researcher constructed notes using a free writing approach in front of learners, for the purpose of making learners feel more at ease. This helped the researcher establish rapport and create a sharing atmosphere between researcher and learner (Wolcott, 2010). Where learners constructed artefacts, either physically or virtually, the researcher asked learners for their permission to photograph artefacts to preserve personal anonymity and privacy. Photographs reproduced in this study are included on the basis that each learner granted permission to use them.

5.3.1.1 Further Ethical Considerations

The researcher obtained individual participant approval to observe their participation in the process (see Appendix 9.1.1). The researcher practiced participant observation in acknowledgement of significant ethical conditions associated with the applied use of this method as a means of data collection (Spradley, 1980). The researcher strived to adhered to these conditions, given its controversial nature (Hammersley & Atkinson, 2007b). In an attempt to meet these conditions, the researcher explicitly asked each learner for permission to observe and take notes regarding their participation in the process (Jorgensen, 1989). In all cases the researcher colour coded records, thus omitting participant name and identifying features from hand written accounts (Appendix 9.4.3 – 9.4.8). This strategy aimed to protect learner’s identifies and provide privacy should participants ask to look through the researchers notebook (Hammersley & Atkinson, 1983b). Finally, the researcher ensured that all notebook entries where in physical view and physically accessible to the learner at all times during the process. In terms of using observation as a data collection tool then, this practice helped the researcher record detailed contextual descriptions of the process (Emerson, Fretz, & Shaw, 2007).

5.3.2 Physical Artefacts

Incorporating a ‘making’ component into the learning experience, provided learners with the opportunity to concretise many of the more theoretical or abstract elements of the process (Bruner, 1996b) manifest through active construction of a tangible, physical products (Frayling, 2011). Each learner received their own set of tools and materials, and proceeded to construct a physical object, in addition to constructing a computer simulated, artefact. Chapter 6 presents fuller discussion on this process.

5.3.2.1 Theoretical Underpinning

In craft working, making, is a form of understanding (Sennett, 2009), where learners not only need to engage with more abstract terms, methods and processes, they are required to internalise then apply their understanding, and meanings associated to those understandings through the construction of a physical artefact (Meuli, 1997).

5.3.2.2 Observation Rationale

Observing the construction of physical and virtual artefacts, enabled the researcher to observe the learners acquisition of knowledge through the demonstration of skill, manifest through the production of their work (Dormer, 1997). Observing the process of ‘making things’, helped the researcher to explore the difficulties and challenges associated with constructing artefacts (Hammersley, 1992b). Studying the ‘making process’, as part of an instructional process, not only provided the opportunity for the researcher to observe instances of ‘actual practice’, observation enabled the researcher to exploring the intricate practice of making things in focus (Brunt, 2007).

5.4 Phase 3

This phase collected data from a series of semi-structured interviews conducted with participants on completion of their participation in learning experiences.

5.4.1 Interviewing Strategy

The researcher conducted semi-structured interviews with learners on completion of each learning experience. Questions where framed from a reading of the literature (Yin, 2002b) and designed to explore the research questions (Section 1.6) in more depth (Yin, 2002c). The researcher conducted two iterations of interviewing with participants. The researched designed five open-ended questions (Fetterman, 2010e) to allow space for learners to think about the process (Appendix 9.1.4). All learners where issued with a hard copy print out of the questions prior to interview.

Table 5 - Interviewing Strategy

Semi Structured Interviewing Framework		
Iteration 1		Iteration 2
Delivery	24th of January to 5th March 2013	5th March until the 12th January
Questions	Appendix 9.1.4	
Rationale	Extended discussion related to phenomena outlined in the study research questions (Section 1.6)	Revisit same question set, communicate interim findings to learners / explore change over time.

5.4.1.1 Conversational Approach

Adoption of a more informal, semi-structured process supported the researcher in performing a less deterministic, dominant role in the process (Hammersley, 1992a). The researcher chose this approach to help ‘put learners at ease’ (Heyl, 2007a). This approach also helped researcher to navigate the highly emotive and intimate process of asking friends specific questions, in a more direct manor than would normally be used in general conversation (Heyl, 2007b). The question frame acted as an aid memoire the researcher and learner could refer to, elaborate on, adjust or amend depending on the informal, more natural ebb and flow of the conversation.

5.4.1.2 Semi Structured Interviews

The following sub section outlines the rationale supporting an initial use of interviews

5.4.1.2.1 Iteration 1

Data derived from semi structured interviewing is often perceived as more ‘quantitative’, given that the researcher guides the learner through a series of predefined constructs aimed towards answering the research questions (Hammersley, 1992a). The researcher applied a semi-structured interview approach for the following reasons. Given that learners may not have participated in a formal research process before, the researcher took the decision to use the semi structured process as frame to support the questioning process (Spradley, 1979b). The interview fame helped to guide the leaner through a small series of open questions (Appendix 9.1.4) which not only provided the researcher with valuable information related to the research questions, but also provided an opportunity for the learner to talk about themselves and their work (Spradley, 1979d). Using a semi-structured framework provided the researcher with opportunity to capture and explore a range of topics and elements both directly and indirectly related to the research process.

5.4.1.2.2 Iteration 2

On completion of iteration 1 interviews, the researcher proceeded to conduct a further iteration of interviews using the same semi structured frame, this time to explore perceived changes in thoughts and attitudes towards the process (Hammersley & Atkinson, 1983a). This iteration enabled the researcher to not only explore the same constructs with learners, but also guide discussion towards areas that emerged during the initial round of interviews (Spradley, 1979a). A second iteration of questioning facilitated a more focused level of questioning and provided both the researcher and learner with the opportunity to verify issues, and explore further areas of interest or concern (Spradley, 1979e). Two interview iterations per learner, not only enabled the research to explore the research area, but also enabled the researcher to cross checking and link contextual with emergent phenomena.

5.4.2 Blog Notes

The researcher posted teaching materials online, to help learners access instructional content (Fetterman, 2010d), after completion of the learning experience. Construction of an online, researcher mediated web logging or blogging mechanism provided learners with a facility to document specific problem areas, draw attention to areas of interest or communicate with both the researcher, and the wider craft working community (Fetterman, 2010a). On completion of the learning experience, the researcher observed that the blog utility generated little learner-generated content. However, display of video content embedded with the blog utility, did generate ’views’, and resulted in an ‘I Like’ tag (Appendix 9.4.10). On reflection, the researcher did anticipate more steady use of the blog utility over the duration of the study given the distributed nature of the learners. However in actuality the blog utility remained dormant and underutilised, while the site operated more as a document repository and facilitated access to a wide range of electronic teaching materials.

5.4.3 Member Checking

On completion of data collection, the researcher then proceeded to implement a coding strategy across the data set, with the aim of addressing the issues presented in the research questions. During the analytical process, the researcher drafted interim findings and conclusions. The researcher emailed draft findings to each participant in turn, and sought their comment on views on the study findings (Appendix 9.4.12 to 9.4.15). A series of issues and suggestions emerged from the process (Appendix 9.4.16) which were then reworked into the final drafts of the study. One key finding to emerge at this juncture of the process was the desire expressed by learners to further engage in hand knitting. In two cases, learners designed and then proceeded to make their own ‘tea cosies’ (Appendix 9.4.5 + 9.4.8)

5.5 Data Coding

The researcher deployed a three phase coding strategy to the data set with the intention of locating emergent data, then reducing the data set to a set of themes.

5.5.1 Open Coding

This sub section details the processes used to prepare the data for initial coding

5.5.1.1 Sorting

On completion of data collection, the researcher then arranged each source into the categories of Field Notes, Artefacts, Maps, Observation, Semi Structured Interviews, and Blog Postings. Once the researcher arranged data into each category, the researcher then began the process of assigning inductive and deductive coding to data type *within* each category (Miles & Huberman, 1994b). Data were electronically compiled into the Microsoft Excel © utility (Appendix 9.5.1) for the purpose of helping the researcher to manage the allocation of codes (LeCompte & Schensul, 1999b).

5.5.1.2 Memos

Once the researcher sorted data into types, the researcher then proceeded to read, view or listen too, data within each type. The researcher proceeded to electronically, construct by typing a series of textual records or memos drawn from textual accounts (blog posting, field notes, and observations), visual artefacts (map or constructed item) or audio records (semi-structured interviews) (Appendix 9.5.2). These electronically reproduced accounts contained reconstructed, conceptual associations that helped the researcher 'make sense' of the data in a contextualised form (Miles & Huberman, 1994e) which were then used to support inductive and deductive coding.

5.5.1.3 Inductive Coding

Having compiled a series of categorised memos, the researcher then engaged in the process of sequentially, reading and rereading memos, line by line as recorded in the coding frame (Silverman, 2011). As conceptual 'code' areas emerged from the process, the researcher then hand typed each code into an designated 'space' within the coding frame (Appendix 9.5.1) designated for the capture of inductively produced codes (Appendix 9.5.3). Codes where generated as words (Miles & Huberman, 1994b), to help retain meaning and relevance to the originating memos (Miles & Huberman, 1994a). While technology was used to store and sort codes, the researcher still reviewed and analysed all data in its original format, prior to reconstruction into a memo (Cresswell, 2009), then further reconstruction into code.

Table 6 - Codes derived from Memos

Code Strategy	Number Codes	Appendix
Memos	212	9.5.2
Inductive	123	9.5.3
Deductive (Iteration 1)	104	9.5.4
Deductive (iteration 2)	14	9.5.5
Sub Themes	7	9.5.6
Themes	3	9.5.7

5.5.2 Closed Coding

This sub section details the processes used to reduce the data set to themes.

5.5.2.1 Reduction

Having established a core series of inductive codes across the data set (Table 6) the researcher then proceeded to engage in another iteration of coding to focus exploration (Appendix 9.5.4). This process required re-reading each memo, to help reassess the relationship between memo and inductive coding description (Miles & Huberman, 1994c). Re-analysis uncovered duplicates, redundant codes and helped the researcher to consolidate the data set into 'like' themes or groupings.

5.5.2.2 Further Reduction

Having conducted one cycle of deductive coding, the researcher engaged in another iteration (Appendix 9.5.5) to help further shape / merge similar codes together (Miles & Huberman, 1994c). A difficulty related to coding memos for the third time, centred on the problem of trying to retain meaning between a further reduced series of codes, and the original intended meaning encapsulated in the memo. Use of the coding frame provided an operational structure in which the researcher could organise, arrange and trace relationships between codes (LeCompte & Schensul, 2007) and helped to provide visual linkage between original concept and construct.

5.6 Sub Themes

Having completed three iterations of coding the researcher then changed the focus of the analytical process to concentrate on the generation of sub themes. This process involved working through the coding frame multiple times to establish linkage between codes (Cresswell, 2009). Given the large amount of codes generated during the previous coding iterations (Table 6), the researcher then made the decision to include an extra layer of sub theming into the coding frame (Appendix 9.5.1). This acted as a mechanism through which to reduce codes into smaller, meaningful words for investigation and explanation (Fetterman, 2010g). Table 7 below illustrates the relationship between sub themes and resulting final themes.

Table 7 - Sub Themes and Themes

Sub Themes	Themes
Contextual Complexity	Contextualisation
Guided Development	
Symbolic Meaning	Visualisation
Visual Representation	
Learner Confidence	Memorisation
Thinking and Remembering	
Problem Solving	

5.7 Themes

The analytical processes presented in this section, focused primarily on reducing large amounts of data (Table 6) into smaller and more meaningful themes (Table 7). However, in doing so, the researcher aimed to retain both the meaning and context of phenomena in the form of ‘words’ (Miles & Huberman, 1994a). Words as codes helped the researcher to work with multiple instances of data which the researcher could then rearrange into categories as the findings (Auerbach & Silverstein, 2003).

5.8 Validity

To address the issue of ‘construct’ validity, the research used multiple methods of data collection (Table 4) and engaged in an iterative process of coding (Table 6) to analyse data from the field (Yin, 2009a). In terms of addressing internal or structural validity, the researcher processed all data types through a central coding frame (Appendix 9.5.1) to explore causal relationships within the data (Guba & Lincoln, 1985c; Yin, 2009e). To address external validity or the trustworthy nature of the data, the researcher acknowledges that study finding are limited and are not intended to support generalisations (Yin, 2009c). Finally, in terms of the study reliability, the researcher conducted field work and processed data according to existing literature (Yin, 2009f). By using the literature to underpin theoretical, methodological and, analytical data treatments, the researcher hopes that this will go some way towards embedding the work within a qualifiable frame, deemed appropriate and relevant to the treatment of phenomena presented in this study. Chapter 6 now presents discussion of the study themes in relation to the findings and research questions.

6. Findings

This section presents discussion of the findings, which emerged from data analysis.

6.1 Revisiting the Research Questions

This study set out to explore two questions of inquiry (Section 1.6) based on a broadly subjective, qualitative exploratory research strategy (Chapter 4). A review of the literature pointed to a series of problems associated with learning procedural knowledge, both at an abstract and conceptual level (Chapter 2). To examine these issues, the researcher designed a learning experience including a series of technological interventions to explore procedural learning, and the role that technology played in teaching learners hand-knitting procedures (Chapter 3). Findings indicate that peer guidance within a structured process helps learner to engage with issues surrounding contextual elements of the process, while use of multimedia simulation tools help learners engage with visual and memory aspects.

6.1.1 Revisiting the Learning Objectives

Development of a series of learning objectives (Section 3.3.1) shaped from the literature addressed learning processes related to the application of procedural knowledge. Trial and error strategies combined with use of visual stimuli and access to facilities which promote memorisation through the rearrangement of phenomena to support problem solving helped learners to engage with the contextualisation, visualisation and memorisation issues related to learning procedural knowledge. Each of the research questions will now be addressed in relation to the role technology played in helping learners to learn procedural knowledge and processes.

6.2 Question 1 - Peer Guided Technology Enhanced Learning

Data presented in this section sets out to address the role that engagement in a peer-guided, technology enhanced learning experience played in helping learners engage with knitting procedures through participation in an instructional process. Data excerpts are taken from field notes, observations and interview transcripts. In all cases, number relates to item entry in the data codebook, and source is given.

6.2.1 Theme - Contextualisation

Learners used multimedia simulation to support them engage with elements of the process related to the context of learning procedural knowledge. Use of online game play helped learners explore the relationship between notation and process.

- "*The pattern generator is brilliant as I am not very visual….in a very easy way, as you did the noughts and crosses thing… cross over between familiar and new" Ref: 151_Interview.*

The learner made the mental association between notation used in game play and notation used to simulate a pattern demonstrating the role that presentation of complex notation in a familiar form played in helping learners understand context. Use of animation also helped learners to make associations between abstract sequences and physical processes used in the generation of knitted textiles

- *"Watch and copy strategy adopted for mastering basic loops…significant time to explore each loop, them make each loop in practice" Ref: 119_Observations.*

The researcher observed learners use of animation to engage with the process of making. The learner watched a loop sequence, paused the animated process, then replayed the same loop until they had mastered the process. Animation was used by the learner to control the mastery of basic procedures, using navigation within the system to support participation in a trial and error strategy to concretise the learning.

Learners used the navigational features within the instructional film to help them watch, and then practice procedures related to the practice of hand knitting. The researcher used film to provide learners with a holistic view of the process, which they could then manipulate, control or change depending on their needs.

- *“The film helped me to get my brain working…I wanted to go to the next level…then went to the pattern generator …now I am finished with that, I am going to go back and copy my pattern” Ref: 163_Interview.*

Linking film with opportunity to perform simulation helped learners make associations between context and process they could use to use to reinforce their learning. When learners reached the stage of simulating patterns, the process of simulation-helped learners to engage with the domain, apply notation learned previously in the experience and problem solve issues related to work they had produced

- *“Use of simulator to construct own examples, clear, see patterns quickly, can follow on screen to guide making. Did not need to write down pattern when making. Use notation to guide making” Ref: 86_Observation.*

Use of a simulatory tool within the process provided learners with access to a facility they could use to combine their learning and demonstrate their understanding of the process. These elements combined helped to clarify the relationship between notation and process. The following sub section addresses the theme of complexity.

6.2.2 Sub Theme - Contextual Complexity

Navigational facilities embedded within multimedia components and the simulatory tools enabled learners to control, change, reconstruct and modify elements of the process in a form that supported them to learn at a pace, which met their needs.

- *[Film] 'Enabled me to go entirely at my own pace, and it also enabled me to make links that I might not have been able to have made, and helped with confidence' Ref: 133_Interview.*

Using navigation to help learners clarify aspects of the process provided them with the confidence to proceed with the learning experience. Also, having the facility to control the experience created a sense of achievement expressed by learners on completing a knitted artefact, which matched patterns, portrayed in film, indicating deep levels of thinking, engagement and significant understanding of the process

- *I never thought I would have been able to do this, I never thought I would have enjoyed it; I am knitting as I am talking to you. I just do not want to put it down (the knitting). It is not a sense of competitiveness, it is ok, this is kind of working and it is my idea, I've picked up some skills along the way and I am putting them into practice" Ref: 194_Interview.*

In summary, use of navigation helped learners engage with and control the process in a way that helped them gain levels of expertise and confidence to continue developing their skills. While the broader, more structured use of multimedia within the experience helped the learner make connections and links between phenomena. The next section addresses the theme of guided development in the process.

6.2.3 Sub Theme - Guided Development

Learners used hand-making vignettes embedded within the instructional tool to guide their learning. Learners studied filmed examples of making processes, and then used these as anchors from which to watch support the replication of a particular aspect of the process or to guide the construction of a particular sequence.

- *“I think that you want from simple stitches, to patterns, gives you the basic elements of what you need to know, because knitting patterns (ones I have seen in the past are all numbers), it just makes it far more complicates than it actually” Ref: 154_Interview.*

Using film to ‘see’ processes helped learners to learn at their own pace and control progress, at a level and speed, which matched their needs. Providing learners with a combination of film and simulation technologies together, provided learners with a facility to engage with basic process elements at a pace that met their needs, and development of more complex combinations in a form, they could control.

- *“The computer is allowing that process, in helping me to visualise, and support me making things. The experience has enabled me to get this far which I don't think I would have been able to do on my own” Ref: 160_ Interview.*

Having the facility to watch and replay processes, provided learners with a facility to locate areas of interest related to their learning, replay these and use these as supports to help them develop skills needed to make artefacts. Also act of seeing examples helped learners to visualise aspects of the process, giving them a direction and structure they could follow to develop their learning and related skills.

In terms of the role of the peer within the process, the gradually diminished into the background, as learners increased their skill levels and mastery of basic processes. This is in keeping with the fading of scaffolding as described by (Vygotsky, 1978c). In the following example, the learner expressed the importance of the role of peer in the early stages of the process, to help the learner grasp more contextual issues.

- *“There may be frameworks which enable me to learn independently, but with a craft you do need someone to help you during the early stages - if nothing else to address the one issue you may have starting off” Ref: 168_ Interview.*

In terms of progression through the experience, learners became more proficient in performing procedures; the peer became more of a ‘checker’ or ‘fixer’ of errors. The changing need of the learner is illustrated in the following example.

- *“Completed first [hand knitted] square, feel confident enough to try one, on my own” Ref: 128_Interview.*

In terms of learning development, some learners preferred to watch visual content conveyed through the use of film, then copy what they had seen on the computer screen, while others preferred to work from written instruction, practice particular procedures then use visual content as a means of verifying their approach.

- *“Process clearly demonstrated in the video…..I don't think I would be able to learn with the subject matter from a book…..I also liked to have someone on hand to keep me right” Ref: 124_Interview.*

Learners connected with the visual attributes of the technology, and used example based vignettes to help guide their progress. Interfacing with technology in this way presented information to the leaner in a way, which simplified and clarified the process. In a way "*computers took away some of the complexity*" Ref: 153_Interview. The next section presents data to answer the second research question.

6.3 Question 2 - Multimedia Simulation in Procedural Learning

Having addressed issues related to the role of peers and the application of an instructional strategy in supporting the learner engage with procedures in knitting, this section now explores the role of multimedia simulation in the learning process.

6.3.1 Theme - Visualisation

This section addresses the visual affordance of technology in learning

The visual affordances offered by the use of technology in the learning experience, helped learners to engage with procedures in the following ways. Learners use pattern-simulating tools to generate sequences and patterns, which made sense to them in a format they could see and change depending on their design. For example

- *"I would have stalled on the first line if I had just had the code and the written instructions, however building the pattern and having it in front of me - provided me with the information I needed to follow and make the pattern" Ref: 175_Interview.*

Providing learners with an interface, which combined use of complex notation with the ability to change sequences, enabled learners to personalise the learning in a way, which was meaningful to them and helped them understand the process. The facility to move, change or interact with phenomena helped learners to engage in a meaningful experience, and in a form, they could control and focus on.

- *“Actually, seeing the procedures, done - I just copied them, no amount of talking at me, but seeing it - the visual, no amount of instructions, by seeing it - by seeing it done with a hand, and even the way in which the hand was facing, was important” Ref: 211_Interview.*

In the above example, the learner expressed the importance of ‘seeing’ procedures performed. Not only did the learner need access to a facility to practice different combinations as a form of engaging with the process, the learner needed to see examples of procedures performed in practice to ground the phenomena in context.

6.3.1.1 Sub Theme - Symbolic Meaning

Use of the simulator technology enabled learners to construct their own pattern undeterred by the selection and application of complex notation. In the following example, the learner recalls the ease in which they made patterns using the simulator and the importance this activity had in helping them visualise the design.

- *“I can see how the pattern generator, can be brilliant because instead of having to write it out in pattern, you can see what it is going to look like and then you can get the thing to generate the pattern and see what it will look like” Ref: 197_Interview.*

In the above example, the learner could instantly ‘see’ the formation of a pattern, using the notation of the domain to construct a complex sequence. Using the simulator to construct an image detailing the steps required to knit an artefact-using notation helped learners to grasp the relationship between process and practice.

- *“You can see it first and then produce it, by following the pattern. Then technology helps you to design your pattern, and it makes it easy to reconstruct it” Ref: 210_Interview.*

Use of the simulator tool in practice supported the learner to engage with complex language of the domain, in a form that was clear and changeable. However, combined use of multimedia simulation tools in the process, helped learners to construct meaning associated with the use and application of notation in practice.

- *“These symbols mean these stitches, then here are the stiches…but now I can see them, and I can go back and look at them, and the animation - here is the pattern and here is now the patterns relate - that process becomes very clear in my head” Ref: 155_Interview.*

Providing learners with access to tools which facilitated interaction with notation in a number of ways (to generate sequences and structures, and relate them to game play or examples of practice) enabled learners to construct meaning related to their use, and enabled them to participate in the practice of making artefacts. The next section addresses the sub theme of visual representations in procedural learning.

6.3.1.2 Sub Theme - Visual Representations

Learners described the technology as a means of helping them to see, or construct images of phenomena. In particular, use film examples (as detailed earlier) enabled learners to use these sequences as a form of guidance in their learning. Learners watch the enactment of a procedure, then attempt to emulate the same procedure.

- *"Actually, seeing the procedures, done - I just copied them, no amount of talking at me, but seeing it - the visual, no amount of instructions, by seeing it - by seeing it done with a hand, and even the way in which the hand was facing, was important" Ref: 211_Interview.*

The above learner replicated the procedure, as displayed in the film. This learner commented on the importance of the visual representation in helping them to understand the process in a form that was meaningful to them. In other instances technology acted as a guide, - helping the learner reach a level of awareness with the phenomena under study and leading them to a more detailed upstanding.

- *"The technology helps you to see, it automatically generates the pattern for you and you can see where you are within the sequence" Ref: 208_Interview.*

In the above example, 'technology' in terms of game play, animation, film and simulation helped the learner to see, or visualise the steps in the process. However, not only did use of technology help to guide the learner towards a fuller awareness of process related phenomena, the interactive affordance enabled learners to construct items in the abstract - providing them with a facility to apply and work through ideas.

6.3.2 Theme - Memorisation

Once learners engaged in the process of making, the role of technology in the process played an increasing role in helping learners remember aspects of the process. As the pattern simulator contained a visual representation of the pattern the learner intended to make, the learner used these patters to guide the process of making, and as visual maps or tools to remind them where they were in the process.

- *"I built it, and then I want back to my knitting straight away, and then within seconds, I had lost the image in my head and I had to go back to the pattern simulator to check the pattern in order to remember what I had done, and to remember how many stiches I had to count in" Ref: 170_Interview.*

In the above example, the learner used the reconstructed images as an aide memoire, - as a means of locating where they were in the sequence. A visual representation of the process enabled the learner to locate the problem area, and then re-join the particular part of the pattern they were engaged in constructing. The next section addresses learner confidence in relation to participation in the process.

6.3.2.1 Sub Theme - Learner Confidence

The use of technology within the experience helped learners to engage with complex phenomena in ways, which enabled them to generate visual representations of patterns they intended to knit compiled from complex notation they had learned as part of the process. Learners were surprised at the short lead in time to the process.

- *"I never through I would have been able to do this, I never thought I would have enjoyed it, I'm knitting as I am talking to you. I just don't want to put it down (the knitting). It is not a sense of competitiveness, it is ok, this is kind of working and it is my idea, I've picked up some skills along the way and I am putting them into practice" Ref: 193_Interview.*

The above example captures the learners’ excitement at having had the opportunity to engage in a process, which not only taught them the basic processes required to construct artefacts, but also provided them with a facility to develop their skills. Other learners also expressed the ease with which they engaged with the technology to help them form and shape patterns they could both understand and reconstruct.

- *I found the online simulator very easy to work with, the colour use was excellent, and if I make a mistake it is very easy to change it', 'if I am interrupted, I can go away and come back and pick up where I left off” Ref: 57_Interview.*

Both of the above examples illustrate the way in which technology helped to clarify some of the more complex aspects of the process, and helped to provide learners with a structure in which they could practice and master skills, at their own pace.

6.3.2.2 Sub Theme - Thinking and Remembering

Mnemonics played an important role in helping learners remember the order, or sequence in which knit stiches where performed during the construction of artefacts. While the peer designed and embedded their own mnemonic within the film component of the learning experience (*in, over, through and off*), other types became known during the experience. Some learners recited mnemonics they had learned during participation in primarily level education (*in through the bunny hole, around the nut tree, out through the bunny hole, and out goes she*), (*in through the bunny hole, around the wee tree, up through the bunny hole and out pops she*), as a way of remembering sequence and structure of stitches. In both instances, learners recited or used these rhyming tools to help them think about and remember the order of stiches. In terms of decoding the above rhymes, both rhymes make reference to the journey that a ‘bunny’ or ‘rabbit’ makes as it scurries into a ‘burrow’ or ‘hole’ in the ground. The mnemonic was designed for use with very young children, as a means of providing them with visual images of a sequence in context. In terms of this study, learners often recited these memory tools when concentrating on the process of knitting, and engaged in producing continuous, repeated lines of stitches.

6.3.2.3 Sub Theme - Problem Solving

Learners used technology to guide their own development and understanding of the process. Using tools, which presented learners with the opportunity to interact with components, encouraged levels of experimentation and trial and error approaches to learning. In the following example, the learner describes making mistakes.

- *"I did make mistakes, but I was given the opportunity to create my own pattern, and I made a good stab at getting it started. If someone had given me the same information in symbols, there is not a chance that I would have knitted it" Ref: 178_Interview.*

In this instance, the learner viewed mistake making as an opportunity, rather than a problem. Not only did the learner take the lead in their own learning, they used the lever of technology to help them engage in a process they may not have otherwise attempted. In addition, use of technology helped them to overcome the perceived problem they had in using symbols or notations associated with the domain. The technology also enabled learners to develop their approach to learning. For example.

- *"If there was a master who said, this is the way that I do it, but that might not be the way that I would approach it, - the technology supports multiple approach's" Ref: 158_Interview.*

In the above example the learners stressed the importance of developing their own approach to the process, rather than following the lead of a particular peer or master. Finally, use of technology in the process helped learners develop approaches to problem solving and support them seek out and resolve problems on their own.

- *“Helps you to address that one problem, so that you re not struggling for hours, when you are getting started rather than just sitting with the technology” Ref: 157_Interview.*

Combined use of tools in the process helped learners to engage with problem areas related to the process in the form of video example or simulated interactions as a way of helping them reach the answers they needed to help them in their work.

6.4 Summary

Technology played a key role in helping learners resolve problems on their own. Given the structured, exampled format of the media used to convey process information, learners used the replay and pause features of video content as a means of enabling them to focus on specific aspects of the process. In some cases, learners would ‘play’ an example, practice the procedure, replay the example, practice the procedure and so on, until they had mastered the process (Block & Airasian, 1971). Often, learners opted not to proceed with the process, until they had practiced, and mastered specific elements in the process – using the relay, practice, replay technique as a mechanism through which to reinforce their learning (Skinner, 1969). Learning in this way, learners engaged directly with the process, repeating the process a number of times until they had mastered the process and reached a desired level of accuracy in the end result (Bruner, 1966b). Interestingly, assessment was not a core component of the learning experience, therefore learners desire or motivation to accurately replicate procedures, was driven more so by the learners need to complete a task based on a more personal goals or aims (Barak, 2010).

7. Conclusions

This final chapter concludes by addressing the research questions.

7.1 Question 1 - Peer Guidance within Technology Enhanced Learning

In terms of providing learners with access to a peer guided, technology enhanced learning experience; learners expressed a range of opinions in terms of the role this played in supporting their learning. As learners gained in confidence and expertise over the duration of the experience, the need for peer guidance or the need for help from the peer to resolve particular problems gradually diminished. However, the need for the peer increased where areas of technical difficulty or changes or modifications in practice occurred which the learner was not familiar with, or did not have sufficient level of expertise or skill to resolve the problems, themselves. As for participation in a structured program designed to teach procedures, learners commented on the importance that structure played in helping them to link elements of the process together in a sequence they could follow and made sense to them.

Finally, in terms of providing learners with access to a peer guided technology enhanced experience, certainly learners developed the skills necessary to perform a series of procedures, which resulted in the construction of a series of artefacts. Using technology as a support to learning enabled the peer / researcher to introduce learners to relevant tools in a meaningful way, which they could use to take control of their own learning, during the discovery and exploration phase of the process (Jonassen, 2002). Providing learners with access to such tools, but used for a purpose within an overarching structure designed to support a particular aspect of learning, helped learners to guide, shape and direct the pace of their learning (Mayer, 2005a), in ways which made sense, to them. In summary then, learners used technology to help them explore, develop and resolve issues, which they encountered in the course of their journey. Learning with technology, as a support when needed proved to not only help learners' work with complex terms and procedures, but gave them the confidence to continue learning on their own.

7.2 Question 2 – Role of Multimedia Simulation in Procedural Learning

This study set out to address the role that use of multimedia simulation tools played in assisting hand knitters learn the skills necessary to apply hand-knitting procedures in practice. Use of multimedia tools helped learners to engage with complex phenomena in the following ways. Use of game play helped learners to engage with complex notation in a form both familiar to them (noughts and crosses) and in a context, they understood. Use of animation tools helped learners to explore sequences used in the construction of knitted formations, in a clear and structured format. While inclusion of an instructional film component within the experience provided learners with access to a facility, which displayed content, they could control, and use to support the level and pace of their learning. In summary, multimedia not only provided learners with the facility to deconstruct processes, but also provided them with a facility they could control to reinforce their learning. In particular, access to images and pictures enabled learners to 'see' specific elements of the process in a form they could explore or replay to obtain deeper understanding.

Inclusion of a simulatory tool into the experience provided learners with access to a facility they could use to manipulate and change notation that generated patterns. The act of replicating or changing content enabled learners to practice different combinations and permutations depending on their level of skill and expertise. Providing learners with access to basic and advanced pre-simulated pattern combinations also provided learners with a frame of reference they could use as a base to either adapt or modify depending on their interest of confidence. Grasping the confidence and expertise to modify procedures is a core element of the process. In summary then, providing leaners with access to a tool, which facilitates the rearrangement of phenomena, acted as a frame within which learners could play out a range of combinations and sequences that had both meaning and import to them.

Combining use of computer supported animation, film and simulating technologies with digital text and audio facilities enabled the researcher to address some of the visual, memorisation contextual difficulties associated with procedural learning. Visual stimulus, facilitated through the computer supported representation of complex procedural sequences using animation and film, aimed to help the learner engage with their working memory (Brunyé et al., 2006), using pictures to recall ideas and constructs related to specific aspects of a procedure (Michas, 2000). The use of images and pictures linked to activity based stimulus, facilitated through use of a computer supported simulation tool, also aimed to help the learner engage in a more assimilatory / accommodatory cycle of sense making (Piaget, 1950a), using the action of selecting and arranging online notations in a variety of arrangements (Guralnick & Levy, 2009), to reinforce their learning. Finally, the role of peer, as a technology guide and application demonstrator, provided learners with the opportunity to address issues with an experienced peer, as they shaped, practiced and developed their own routes though the learning experience (Scribner, 1997c).

7.3 Further Research

The study concludes by pointing to further research relating to the use of technology, as a support in learning craft based work, and as a tool, which enables craft workers to develop practices. Learning procedures is complex and requires the learner to engage in a series of experiences, which help them to gain the knowledge and expertise required to perform them in practice. Simulation tools can also help learners to reconstruct sequences as a means of helping them to grasp some of the complexity, which surrounds modification or changes (Bruner, 1966b) through participation in trial and error activities (Claparède, 1917). While use of multimedia tools play many roles, their strength lies in acting as both a visual aid and as a tool to support memorisation through use of navigation tools to support the repetitive engagement of phenomena (Skinner, 1961). Use of multimedia simulation in this study helped learners to grasp / apply a series of basic procedural processes. In relation to the role of peer guidance in the process, the physical presence of peer helped learners to explore or understand more tacit aspects of the process (Scribner, 1997a). Certainly, the peer helped learners a number of times to resolve problem areas or address areas of complexity which presented problems to the learner (Rogoff, 1990a). Incorporating computer supported tools into a learning experience, also enabled the peers to simulate a series of specific procedural exercises (Papert, 1993), while use of multimedia simulations provide learners with the opportunity to manipulate information in meaningful way that made sense to them (Mayer, 2011).

7.4 Next Steps

The researcher hopes to develop research from a more digital humanities perspective, in an attempt to explore what role online tools may play in helping craft workers to develop, shape and share their understandings with others whom, wish to contribute too or participate in, the process of making textile artefacts. The researcher then, hopes that this work, will not only add to literature which seeks to examine the role technology plays in supporting the craft worker perform complicated procedures used in the construction of artefacts, but also provide insight into the motivations which may support the production of ‘good art’ (Ruskin, 1858).

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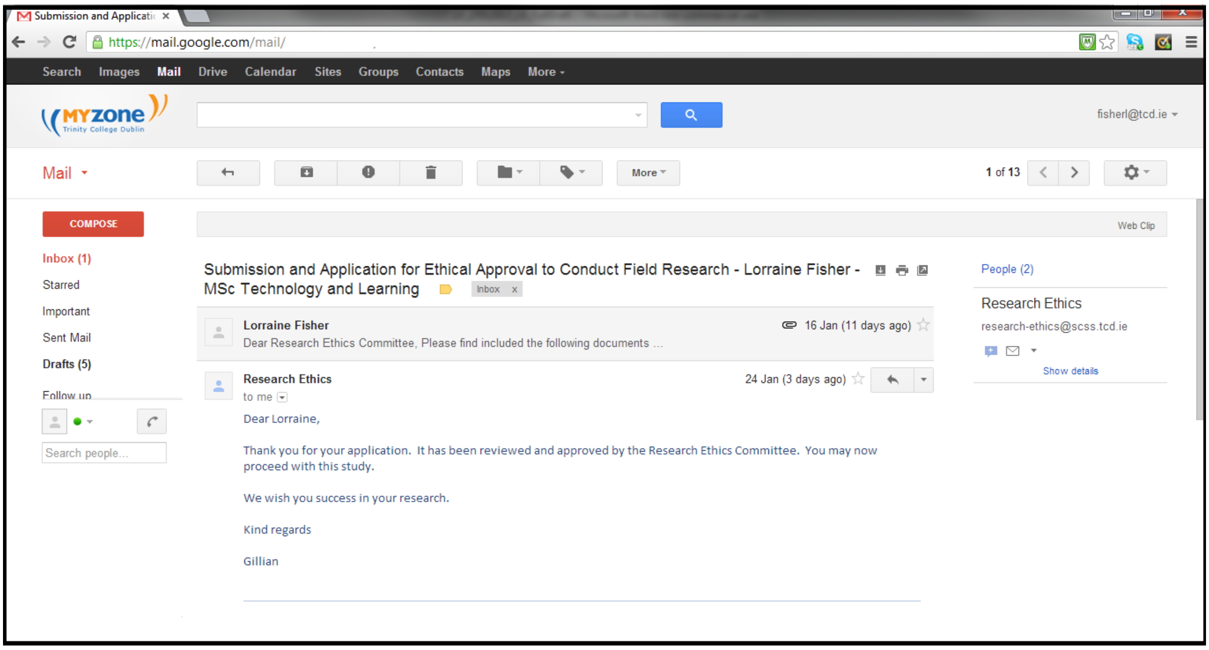
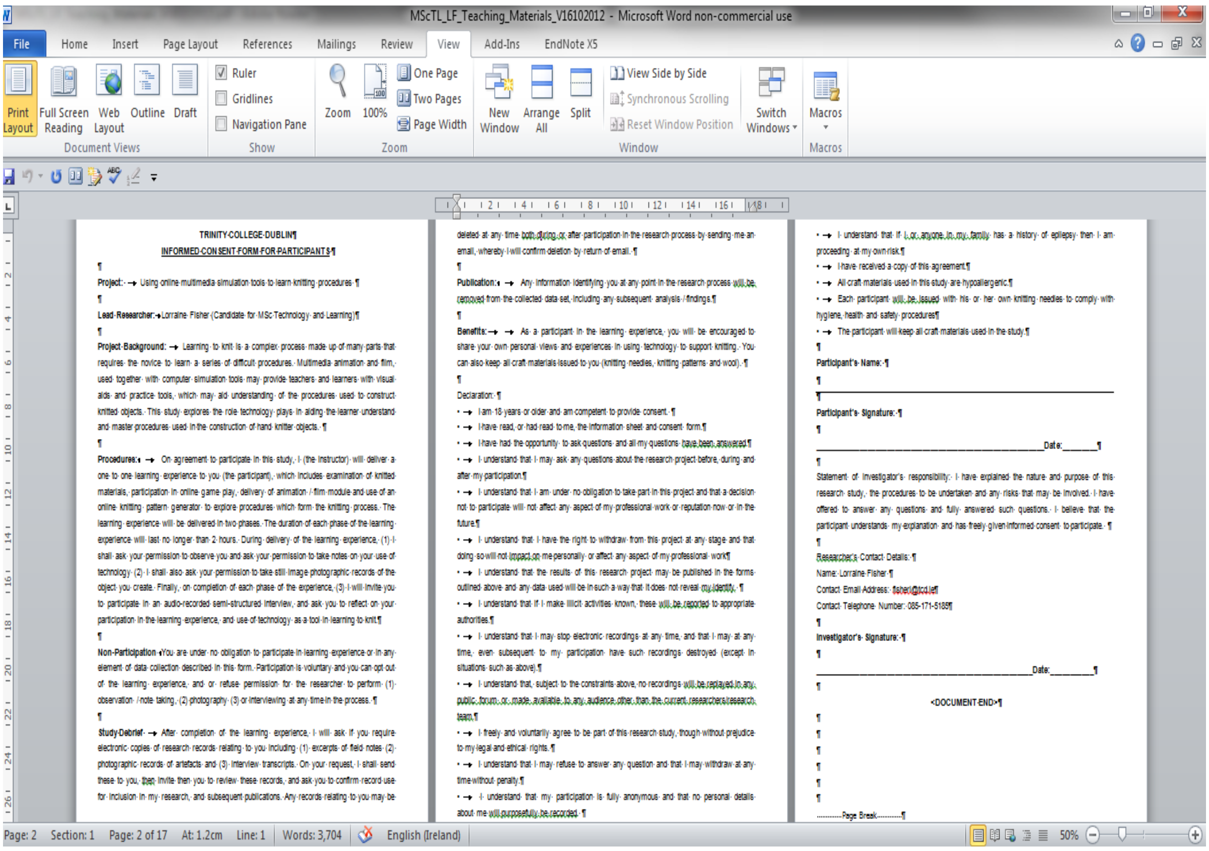
9 Appendixes

9.1 Introduction

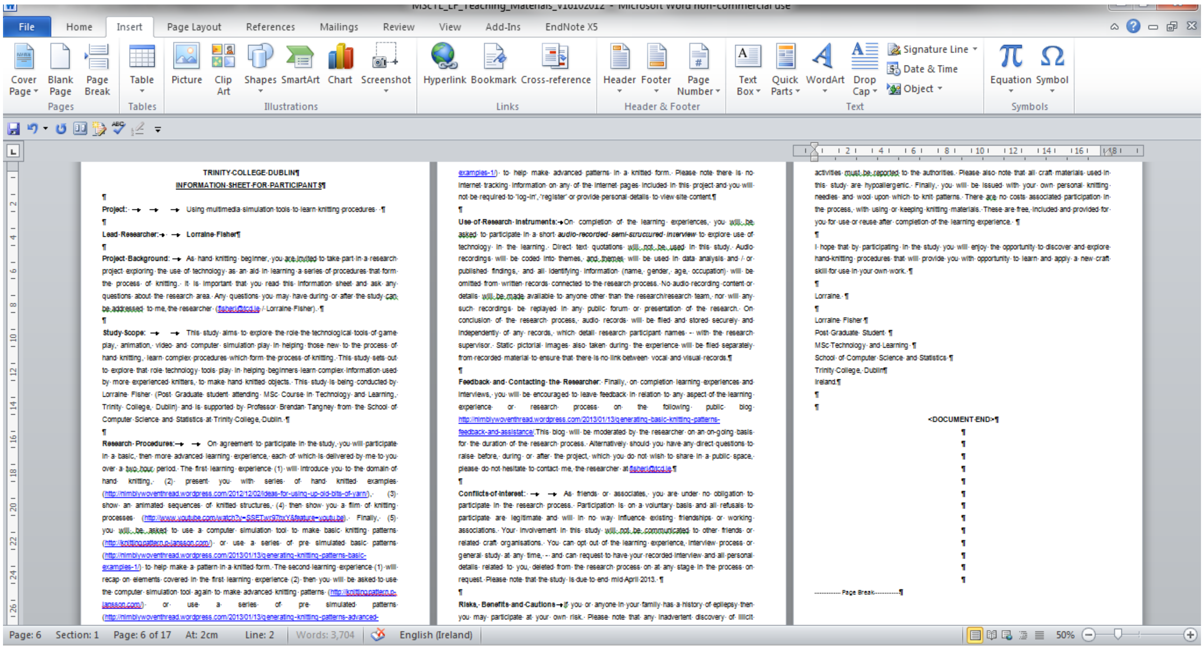
9.1.1 Intro > Ethics > Email Approval Confirmation



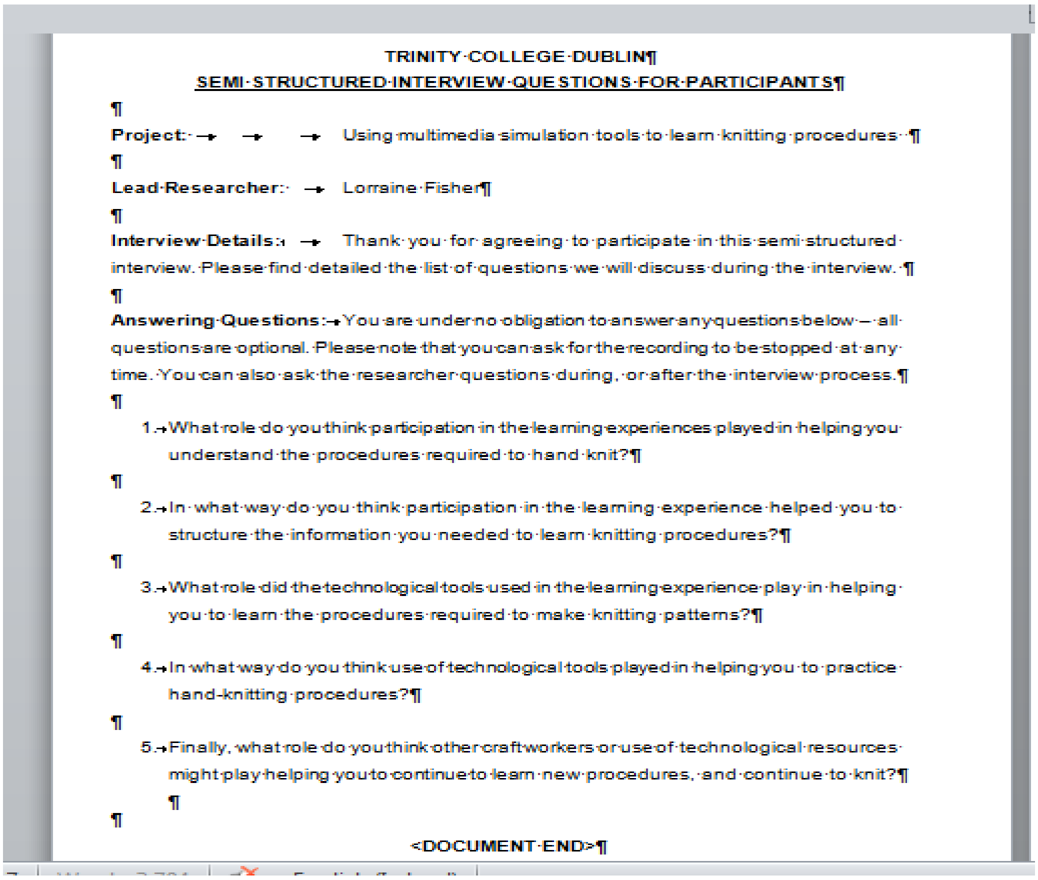
9.1.2 Intro > Teaching Materials > Informed Consent Form for Participants



9.1.3 Intro > Teaching Materials > Information Sheet for Participants



9.1.4 Intro > Teaching Materials > Semi Structured Interview Questions for Participants



TRINITY COLLEGE DUBLIN

SEMI STRUCTURED INTERVIEW QUESTIONS FOR PARTICIPANTS

Project: Using multimedia simulation tools to learn knitting procedures

Lead Researcher: Lorraine Fisher

Interview Details: Thank you for agreeing to participate in this semi structured interview. Please find detailed the list of questions we will discuss during the interview.

Answering Questions: You are under no obligation to answer any questions below – all questions are optional. Please note that you can ask for the recording to be stopped at any time. You can also ask the researcher questions during, or after the interview process.

1. What role do you think participation in the learning experiences played in helping you understand the procedures required to hand knit?

2. In what way do you think participation in the learning experience helped you to structure the information you needed to learn knitting procedures?

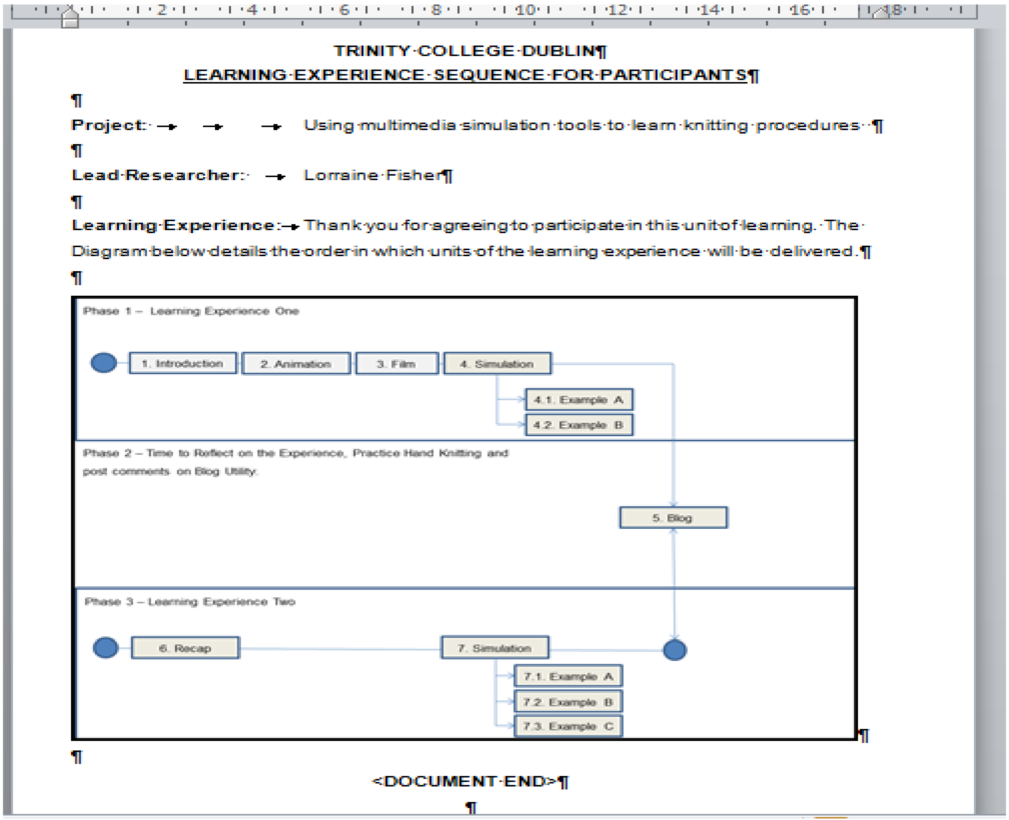
3. What role did the technological tools used in the learning experience play in helping you to learn the procedures required to make knitting patterns?

4. In what way do you think use of technological tools played in helping you to practice hand-knitting procedures?

5. Finally, what role do you think other craft workers or use of technological resources might play helping you to continue to learn new procedures, and continue to knit?

<DOCUMENT END>

9.1.5 Intro > Teaching Materials > Learning Experience Sequence for Participants



TRINITY COLLEGE DUBLIN

LEARNING EXPERIENCE SEQUENCE FOR PARTICIPANTS

Project: Using multimedia simulation tools to learn knitting procedures

Lead Researcher: Lorraine Fisher

Learning Experience: Thank you for agreeing to participate in this unit of learning. The Diagram below details the order in which units of the learning experience will be delivered.

<DOCUMENT END>

9.1.6 Intro > Teaching Materials > Resource Links used in Learning Experience for Participants

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RESOURCE LINKS USED IN LEARNING EXPERIENCE FOR PARTICIPANTS

3rd Party Online Noughts and Crosses Game

http://games.dannycox.me.uk/noughtsandcrossestwoplayer/index.html

Researcher Constructed Knitting Video

http://www.youtube.com/watch?v=SSETwr97hxY&feature=youtu.be

3rd Party Computer Based Hand Knitting Pattern Simulator

http://knittingpattern.p-jansson.com/

Researcher Constructed Course Content – Basic Knitting

http://nimblywoventhread.wordpress.com/2013/01/13/generating-knitting-patterns-basic-examples-1/

Researcher Constructed Blog

http://nimblywoventhread.wordpress.com/2013/01/13/generating-basic-knitting-patterns-feedback-and-assistance/

Researcher Constructed Course Content – Advanced Knitting

http://nimblywoventhread.wordpress.com/2013/01/13/generating-knitting-patterns-advanced-examples-1/

3rd Party Online Noughts and Crosses Game

http://games.dannycox.me.uk/noughtsandcrossestwoplayer/index.html

Researcher Constructed Knitting Video

http://www.youtube.com/watch?v=SSETwr97hxY&feature=youtu.be

3rd Party Computer Based Hand Knitting Pattern Simulator

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Researcher Constructed Course Content – Basic Knitting

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Researcher Constructed Blog

http://nimblywoventhread.wordpress.com/2013/01/13/generating-basic-knitting-patterns-feedback-and-assistance/

Researcher Constructed Course Content – Advanced Knitting

http://nimblywoventhread.wordpress.com/2013/01/13/generating-knitting-patterns-advanced-examples-1/

9.1.7 Intro > Teaching Materials > Research Proposal (Summary)

TRINITY COLLEGE DUBLIN

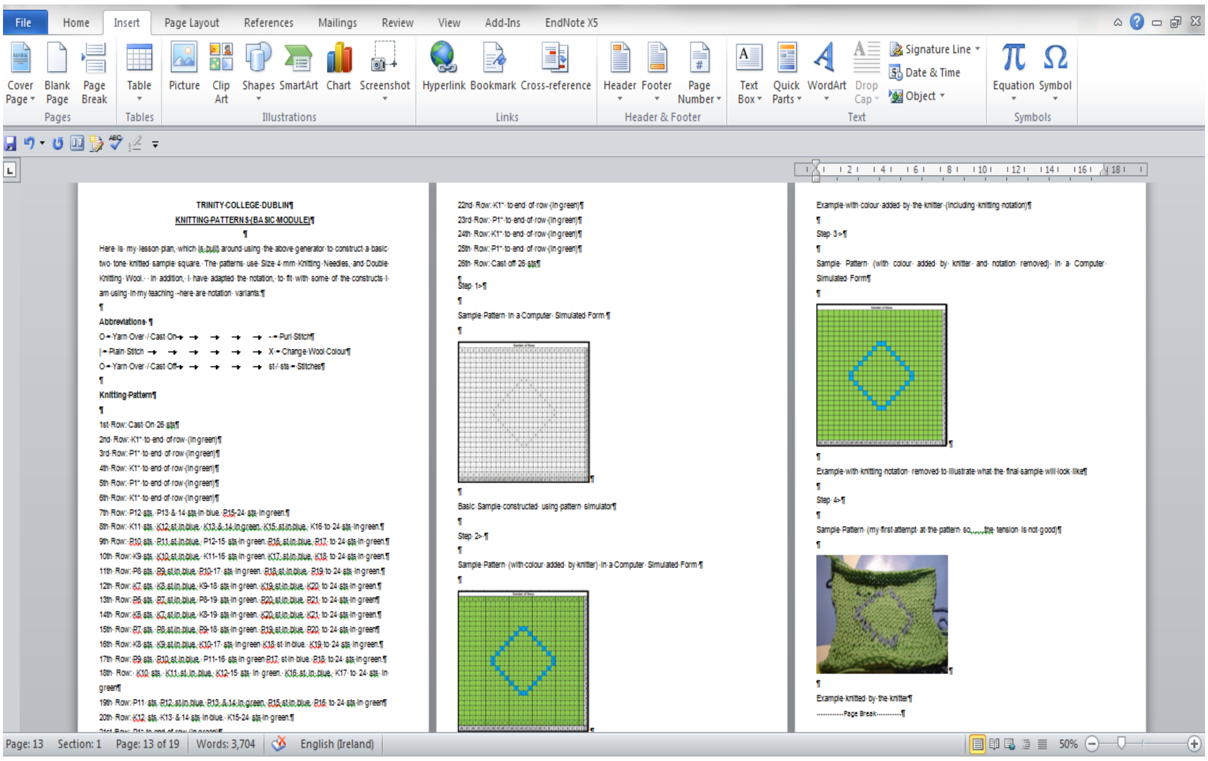
RESEARCH PROPOSAL (SUMMARY)

Title of project: Using computer supported multimedia simulation tools in a peer-guided technology enhanced learning experience to explore procedural learning with novice hand knitters

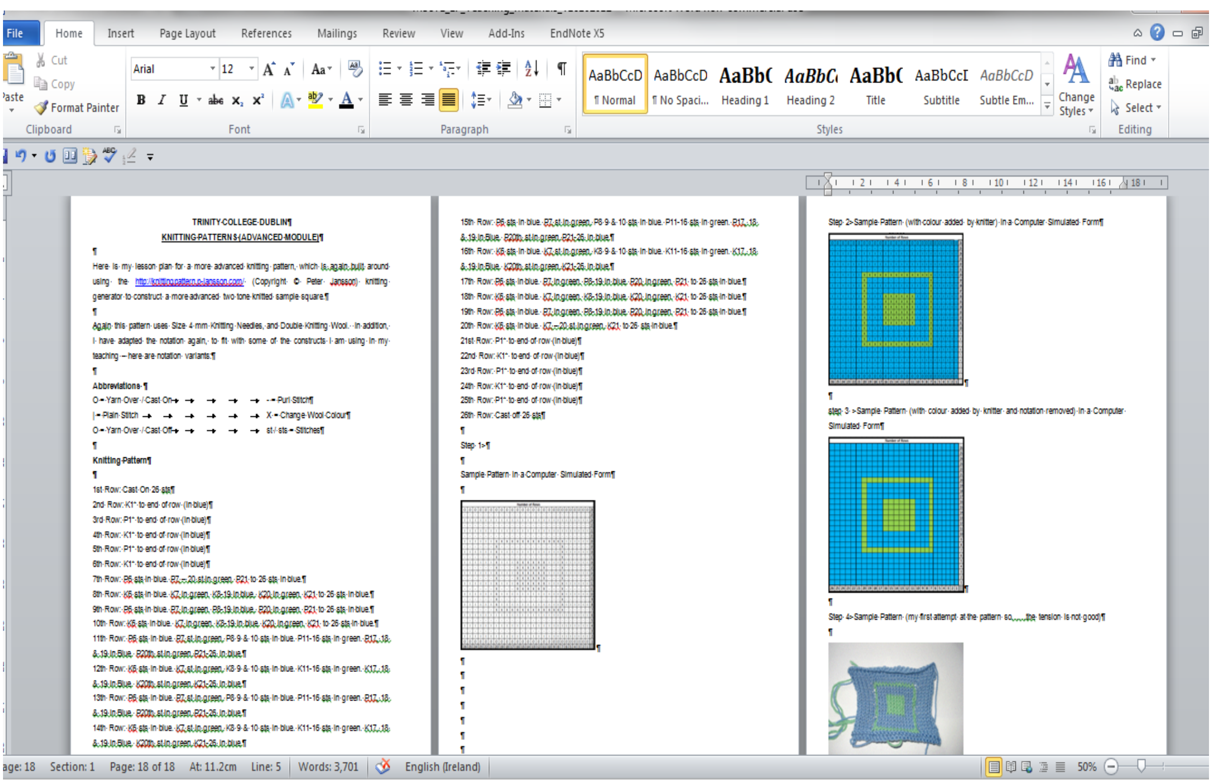
Purpose of project including academic rationale: Learning how to knit by hand is a complex process, which requires the novice to grasp and practice a series of procedures that are used to form knitted textile objects (Kraft, 2004). Procedural knowledge, is a form of tacit or context based knowledge which is often developed and demonstrated through the performance of specific tasks or activities within a process (Piaget, 1950). Hand knitting, is one such process, which requires the novice to grasp a series of complex procedures, to make hand knitted objects (Brown, 2012). While peers often guide learners through processes required to knit textiles, the increased availability of technological tools may offer novices the chance to engage with procedures in ways that may help them grasp and demonstrate procedural knowledge on their own (Bhakar et al., 2004). Specifically, use of visual and simulatory tools such as online game play, animation of sequence information, film demonstrating practices, and use of knitting pattern simulation tools offer the novice opportunity to learn / develop their own understandings of complex knitting procedures. This study aims to work with novice knitters, with no experience of the process – to help them develop understandings of the procedures used to compile knitted objects. Participation within a learning experience guided by the researcher, which uses technological tools as learning aids, hopes to help novices deepen their understanding of knitting procedures.

Page Break

9.1.8 Intro > Teaching Materials> Knitting Patterns (Basic Module)

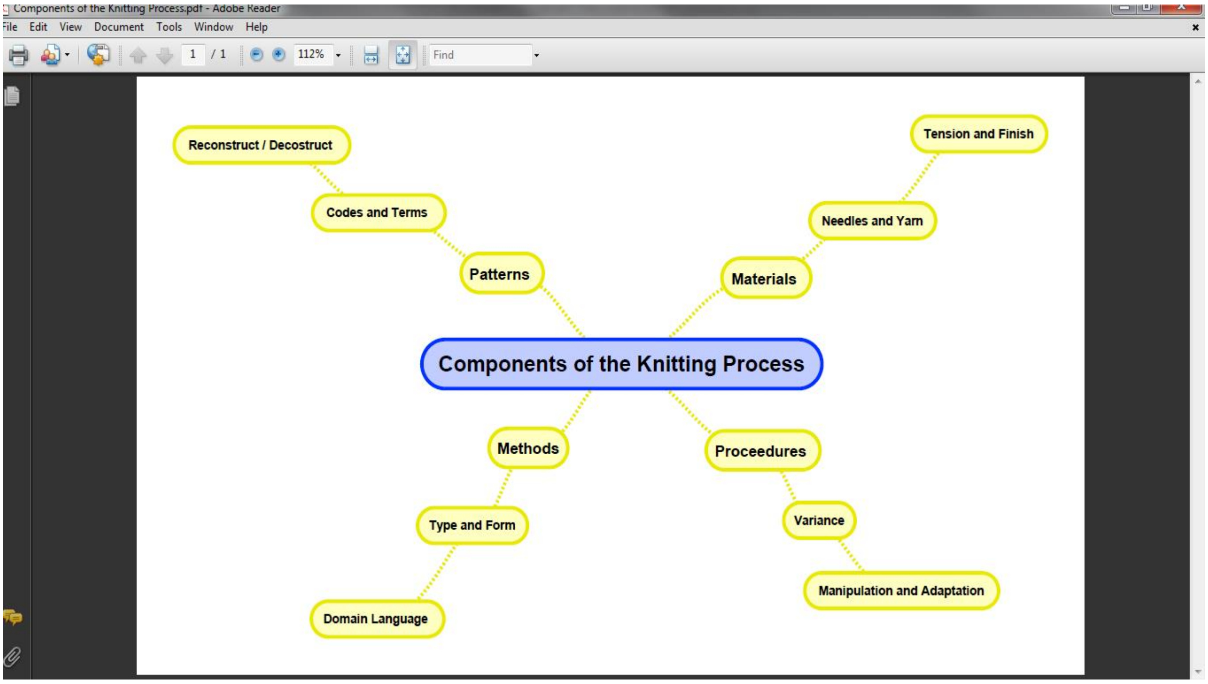


9.1.9 Intro > Teaching Materials> Knitting Patterns (Advanced Module)

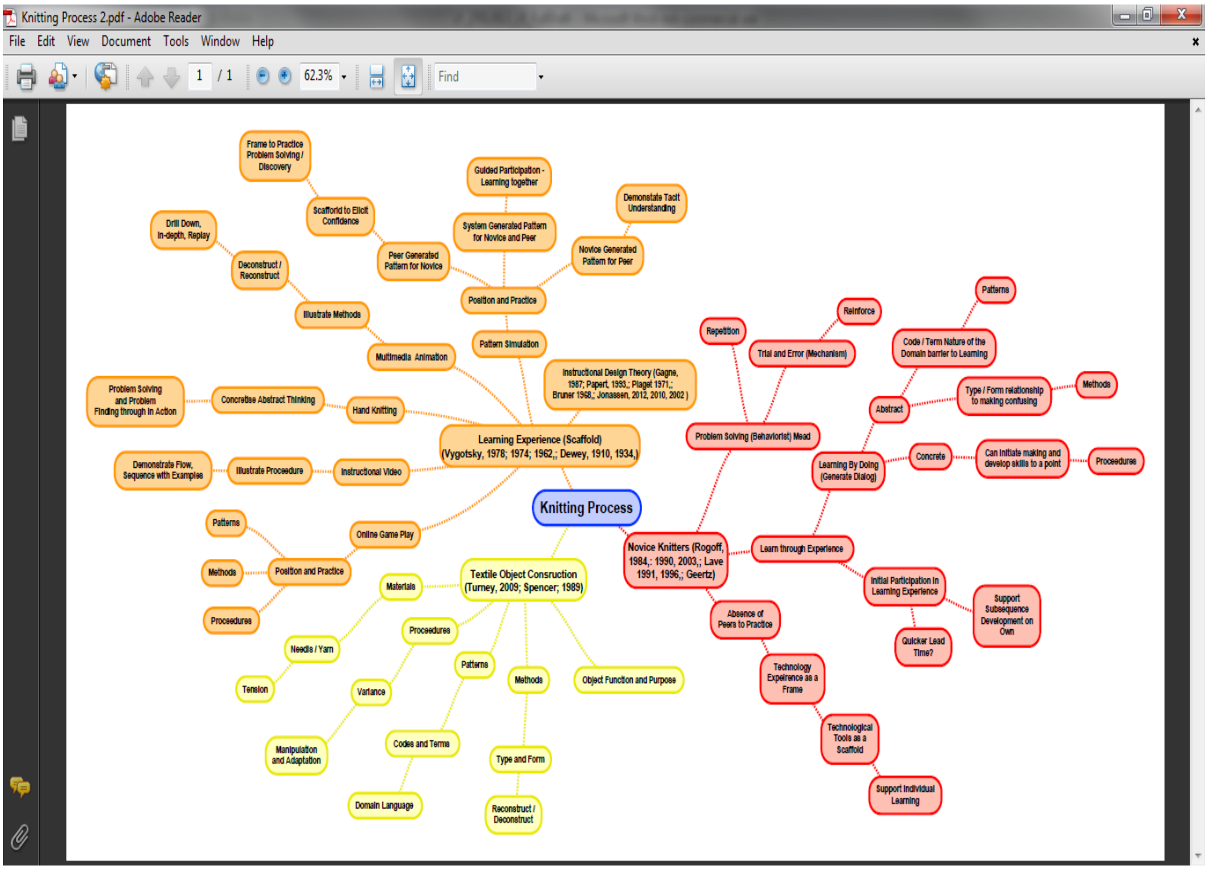


9.2 Literature

9.2.1 Literature > Mind Map> Basic and Advanced



Advanced



9.3 Design

9.3.1 Design> Script > Basic Hand Knitting Stitches > Animation

Instructional Design – Section 2

Technical Specification

- Music - Free with credit to: Music by Dan-O at DanoSongs.com
- Music Selection – easy going electronica to induce sense of relaxation
- Music Specifics – major key only to keep ‘feel good factor’
- Font – Ariel (upper and lower case) to make it easy to read.
- Text Duration – set to 20.00 per second.
- Multimedia Components –Limited to use of animated sequence with blue colour on white background so that learner could focus on animated loop sequence.
- All textile images generated by the researcher
- Song Playlist: Magicghost.mp3

Script Text and Sequence

1. Hand Knit Stitches – Animated

2. Let’s look at the structure of some knitted stitches

3. We are going to examine (5) stitches

3.1 1. Slip Knot

3.2 Cast On

3.3 Knit Stitch

3.4 Purl Stitch

3.5 Cast Off

4. Slip Knit - with animated example of looping mechanism for stitch

5. Cast On – with animated example of looping mechanism for stitch

6. Knit Stitch –

7. Purl Stitch - with animated example of looping mechanism for stitch

8. Cast Off - with animated example of looping mechanism for stitch

9. We have now looked at (5) five different stitch formations

10. Each loop performs a different function

11. We hope this tutorial was useful

12. Music by Dan-O at www.danosongs.com

13. Text and Animation – Nimblywoventhread Studios 2012 ©

9.3.2 Design > Script > Basic Hand Knitting > Film

Instructional Design – Section 3

<u>Technical Specification</u>

- Music - Free with credit to: Music by Dan-O at DanoSongs.com
- Music Selection – easy going electronica to induce sense of relaxation
- Music Specifics – major key only to keep 'feel good factor'
- Font – Segoe (36 to 28 point size)
- Text Duration – set to 10.00 per second.
- Multimedia Components –Limited to Video, Picture, Music and Text due to limitation with voice recording software
- All textile images generated by the researcher
- Song Playlist: Three Drops, Sliver Shine and The Streatham Hill Gods (http://www.danosongs.com/#music)

<u>Script Text and Sequence</u>

1. KPSSB101 - Module 1

Knitting a Pattern Sample for Beginners

NWTS 2012

2. Hand knitting is a process of making textile materials
3. This process requires the mastery of skills and techniques

4. This module steps through the process of interpreting and knitting a pattern

5. You will learn six steps:

a. How to perform two Needle Cast On / Cast Up

b. How to compile rows of Plain / Knit Stitch

6. Steps Continued….

c. How to compile rows of Purl Stitch

d. How to follow a pattern

7. Finally….

e. How to change colour of yarn within a row

f. How to perform two Needle Cast off / Bind Off

8. Before we get started please note...

• Examples are for right-handed knitters

• Plain Stitch = Garter or Knit Stitch

•Cast Off = Bind Off

9. And…

• Yarn = Double Knitting (DK)

• Needle Size = 4 mm / 25 cm length

• Cast On = Cast Up

10. At any point you can

< Go Back

"Pause"

Go Forward >

11. We are now going to start with step a:

• How to perform two Needle Cast On / Cast Up

12. First, we make a slipknot

• Let us watch the following example to see how this is done

13. Loop the yarn around your fingers

Pull the yarn through your fingers

Tighten the knot

14. Good, now we are ready to cast on / up

• Let us watch the following example to see how this is done

15. Insert the one needle behind the other

Wind the yarn around the back then pull the stitch through

16. Note: remember to transfer your new stitch to your other needle

17. Good, now repeat the process until you have cast on 26 stitches in total

18. Your cast on row should look like this

19. We have now completed section a and will now start with step b:

How to compile rows of Plain / Knit Stitch

20. The process of plain knitting creates a vertical 'V' shape in textile fabric

This is also called 'knit wise'

21. Look at the lines of vertical 'V' shapes in this 'knit wise' facing example

22. These stitches are created through looping the wool around the back of the stitch

23. Now, let's knit a row of plain / knit stitch

• Let us watch the following example to see how this is done

24. We are going to knit one row, starting by joining our new plain / knit stitches into our row of cast on stitches

25. We are going to use the following rhyme to remember the process

- In, over, through and off

26. Let us watch the following example to see how this is done

27. In, over, through and off

28. Your first plain knit row should look like this

29. A cast on row, and first row of plain or knit stitch

30. We have now completed section b and will now start with step c:

How to compile rows of Purl Stitch

31. The process of purl knitting creates a horizontal wavy line shape in textile

fabric

This is also called 'purl wise'

32. These stitches are created through looping the wool around through the front of a stitch

33. Look at the horizontal wavy lines in this 'purl wise' facing example

34. Now, let's knit a row of purl stitch

Let us watch the following example to see how this is done

35. We are going to purl one row, starting by joining our new purl stitches into our row of plain or knit on stitches

36. Remember

Turn around your Knitting at the end of each row!

You will be knitting in the opposite direction!

37. We are going to use the following rhyme to remember the process

In, over, through and off

38. Let us watch the following example to see how this is done

39. In, over, through and off

40. Your first purl row should look like this

41. A cast on row, first row of plain or knit stitch and a purl row

42. We have now completed section c and will now start with step d:

How to follow a pattern

43. You have also now completed the first three rows of a knitting pattern

44. The red area indicates the rows you have completed!

45. We are now going to use this pattern to make a knitted square

46. First, we need to know what the symbols in the pattern mean

47. Key

48. So using the key and pattern picture now complete the following

3rd Row: K1* to end of row (in green)

4th Row: P1* to end of row (in green)

5th Row: K1* to end of row (in green)

49. Your completed stitches should look like this

50. Here are the completed stitches, facing 'purl wise'

51. The red area indicates the rows you have now completed!

52. You are now ready to add a new colour to form a pattern

53. We have now completed section d and will now start with step e:

How to change colour of yarn within a row

54. Following the pattern, we start at row 7 then knit 12 stitches in purl stitch

55. The yellow area indicates the rows you have already completed!

56. Let us watch the following example to see how to change colour

57. Loop the yarn over the next stitch

Pull the new coloured stitch through the loop

You can now change colour within a row

58. Now, let's continue following the pattern

59. Here is a 'knit wise' or plain stitch-facing example - half way through

60. Knit Wise example

61. Here is a 'purl wise' facing example - half way through

62. Purl Wise example

63. We are half way through the pattern

64. Let’s continue compiling rows of knit or plain stitch and purl until you complete the pattern

65. Let’s take a look at our finished samples

66. Here is a 'knit wise' or plain stitch-facing example

67. Knit Wise example

68. Here is a 'purl wise' facing example

69. Purl Wise Example

70. We have now completed section e and will now start with final step f:

How to perform two Needle Cast off / Bind Off

71. To cast off or bind off,

Knit two stitches in plain or knit stitch

Loop the outer stitch over the inner stitch

72. Let's watch an example which will show us how to cast off our stitches

73. Knit two stitches, then loop one stitch over the other

74. Finally, let's take a look at a final 'knit wise' plain or knit stitch example

75. Knit Wise

76. Here is a 'purl wise' facing example

77. Tie off the ends and you have a sample knitted patterned square!

78. Please don't forget to leave feedback at:

http://nimblywoventhread.wordpress.com/2012/12/02/knitting-a-pattern-sample-for-beginners/

79. CREDITS

MUSIC

All music used in this presentation has been created and sourced from: http://www.danosongs.com/#music

This presentation uses the following song options from www.danosongs.com

Three Drops

Sliver Shine

The Streatham Hill Gods

ART

All knitted textile examples and artwork created by nimblywoventhread (c) 2012

PATTERNS

All knitted textile pattern examples created by nimblywoventhread (c) 2012

9.3.3 Design > Pre-Simulated > Basic Hand Knitting Written Pattern

Instructional Design – Section 4.1 – Example A

1st Row: Cast On 26 sts

2nd Row: K1* to end of row (in green)

3rd Row: P1* to end of row (in green)

4th Row: K1* to end of row (in green)

5th Row: P1* to end of row (in green)

6th Row: K1* to end of row (in green)

7th Row: P12 sts. P13 & 14 sts in blue. P15-24 sts in green.

8th Row: K11 sts. K12 st in blue. K13 & 14 in green. K15 st in blue. K16 to 24 sts in green.

9th Row: P10 sts. P11 st in blue. P12-15 sts in green. P16 st in blue. P17 to 24 sts in green.

10th Row: K9 sts. K10 st in blue. K11-16 sts in green. K17 st in blue. K18 to 24 sts in green.

11th Row: P8 sts. P9 st in blue. P10-17 sts in green. P18 st in blue. P19 to 24 sts in green.

12th Row: K7 sts. K8 st in blue. K9-18 sts in green. K19 st in blue. K20 to 24 sts in green.

13th Row: P6 sts. P7 st in blue. P8-19 sts in green. P20 st in blue. P21 to 24 sts in green

14th Row: K6 sts. K7 st in blue. K8-19 sts in green. K20 st in blue. K21 to 24 sts in green.

15th Row: P7 sts. P8 st in blue. P9-18 sts in green. P19 st in blue. P20 to 24 sts in green

16th Row: K8 sts. K9 st in blue. K10-17 sts in green K18 st in blue. K19 to 24 sts in green.

17th Row: P9 sts. P10 st in blue. P11-16 sts in green P17 st in blue. P18 to 24 sts in green.

18th Row: K10 sts. K11 st in blue. K12-15 sts in green. K16 st in blue. K17 to 24 sts in green

19th Row: P11 sts. P12 st in blue. P13 & 14 in green. P15 st in blue. P16 to 24 sts in green

20th Row: K12 sts. K13 & 14 sts in blue. K15-24 sts in green.

21st Row: P1* to end of row (in green)

22nd Row: K1* to end of row (in green)

23rd Row: P1* to end of row (in green)

24th Row: K1* to end of row (in green)

25th Row: P1* to end of row (in green)

26th Row: Cast off 26 sts

9.3.4 Design > Pre-Simulated > Basic Hand Knitting Visual Black and White Pattern

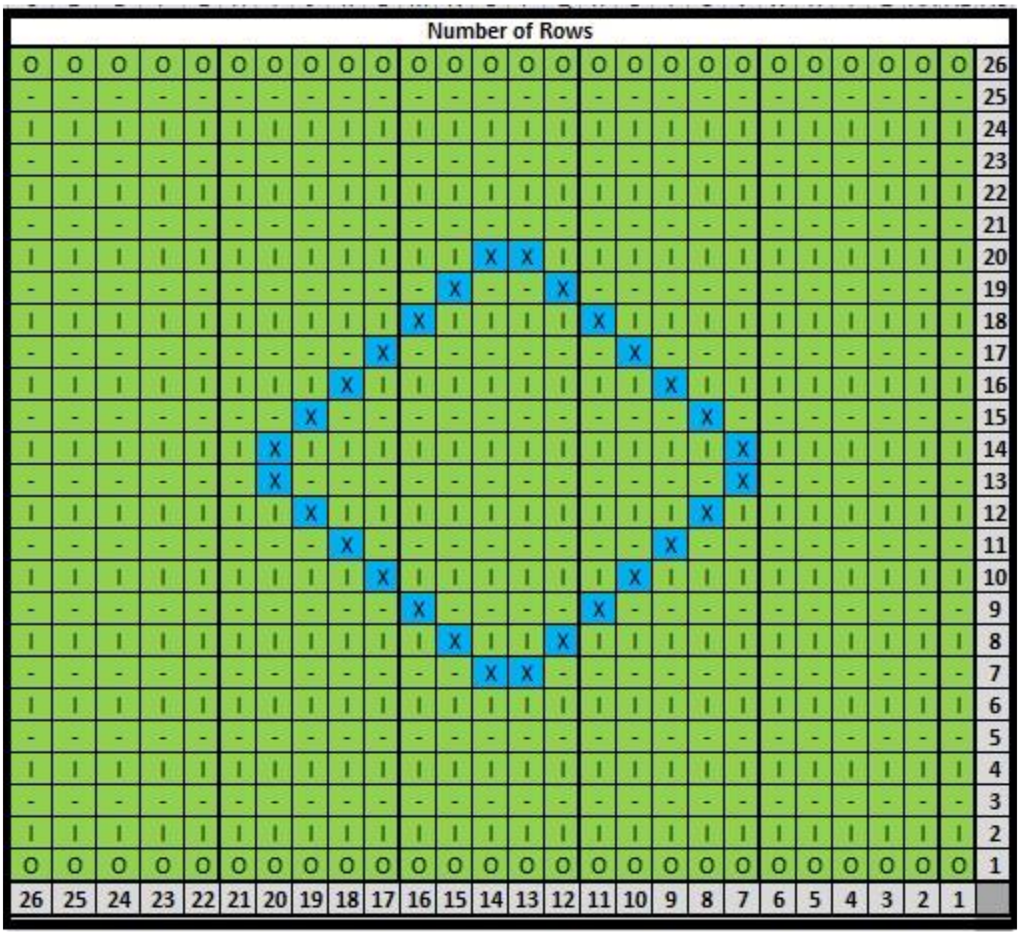
Instructional Design – Section 4.1 – Example A

Number of Rows																										
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	26
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	24
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	22
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
I	I	I	I	I	I	I	I	I	I	I	I	X	X	I	I	I	I	I	I	I	I	I	I	I	I	20
-	-	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	19
I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	18
-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	17
I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	16
-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	15
I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	14
-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	13
I	I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	I	12
-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	11
I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	10
-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	9
I	I	I	I	I	I	I	I	I	I	I	X	I	I	X	I	I	I	I	I	I	I	I	I	I	I	8
-	-	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	7
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	2
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	1
26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

Black and white symbolic, coded representation of basic hand knitting diamond pattern constructed by the researcher for teaching purposes.

9.3.5 Design > Pre-Simulated > Basic Hand Knitting Visual Colour Pattern

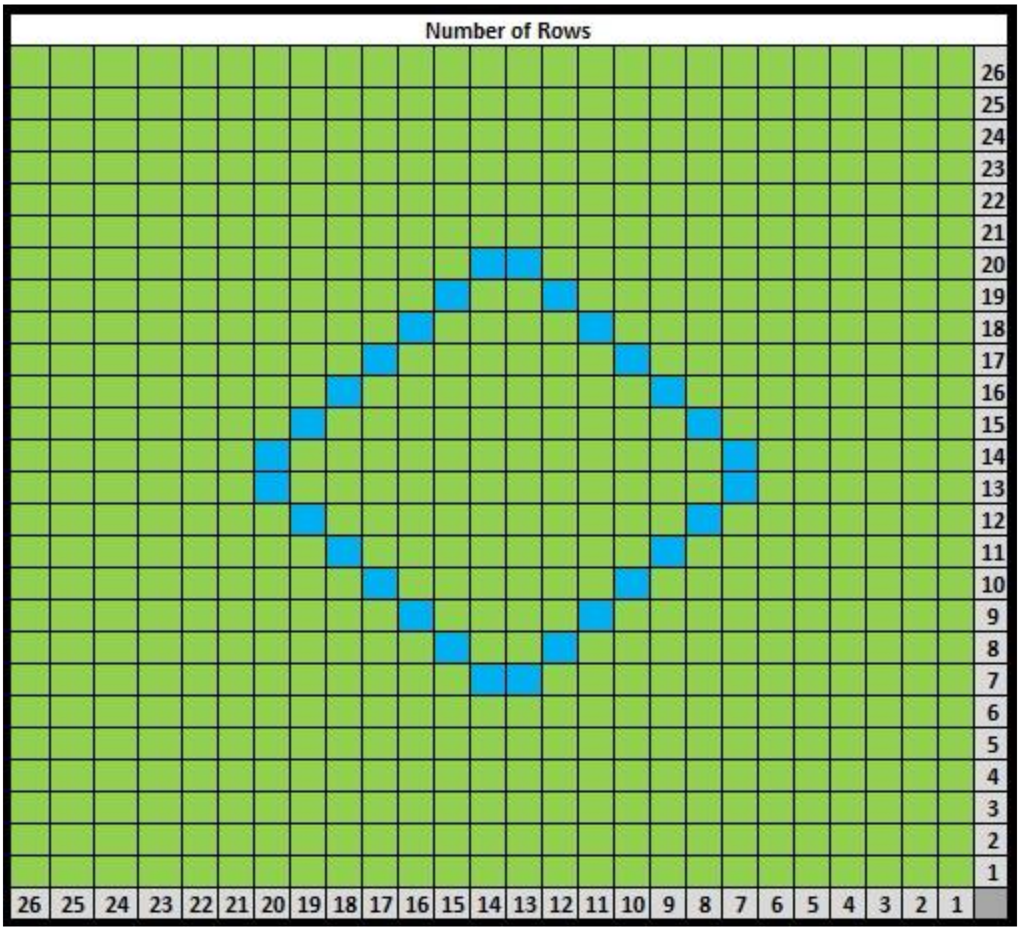
Instructional Design – Section 4.1 – Example A



Colour symbolic, coded representation of basic hand knitting diamond pattern constructed by the researcher for teaching purposes to illustrate relationship between colour and use of knitting codes.

9.3.6 Design > Pre-Simulated > Basic Hand Knitting Visual Non Coded

Instructional Design – Section 4.1 – Example A



Colour non-coded representation of basic hand knitting diamond pattern constructed by the researcher for teaching purposes to illustrate relationship between colour and structure of textiles.

9.3.7 Design > Pre-Simulated > Basic Hand Knitted Pattern

Instructional Design – Section 4.1 – Example A

Knitted pattern compiled by the researcher (whom is a less experienced peer).

Same pattern compiled by experienced knitting peer, which demonstrates mastery of technique and tension components of the knitted sample.

9.3.8 Design > Pre-Simulated > Advanced Hand Knitting Written Pattern

Instructional Design – Example A

1st Row: Cast On 26 sts

2nd Row: K1* to end of row (in blue)

3rd Row: P1* to end of row (in blue)

4th Row: K1* to end of row (in blue)

5th Row: P1* to end of row (in blue)

6th Row: K1* to end of row (in blue)

7th Row: P6 sts in blue. P7 - 20 st in green. P21 to 26 sts in blue.

8th Row: K6 sts in blue. K7 in green. K8-19 in blue. K20 in green. K21 to 26 sts in blue.

9th Row: P6 sts in blue. P7 in green. P8-19 in blue. P20 in green. P21 to 26 sts in blue.

10th Row: K6 sts in blue. K7 in green. K8-19 in blue. K20 in green. K21 to 26 sts in blue.

11th Row: P6 sts in blue. P7 st in green. P8 9 & 10 sts in blue. P11-16 sts in green. P17, 18 & 19 in Blue. P20th st in green. P21-26 in blue.

12th Row: K6 sts in blue. K7 st in green. K8 9 & 10 sts in blue. K11-16 sts in green. K17, 18 & 19 in Blue. K20th st in green. K21-26 in blue.

13th Row: P6 sts in blue. P7 st in green. P8 9 & 10 sts in blue. P11-16 sts in green. P17, 18 & 19 in Blue. P20th st in green. P21-26 in blue.

14th Row: K6 sts in blue. K7 st in green. K8 9 & 10 sts in blue. K11-16 sts in green. K17, 18 & 19 in Blue. K20th st in green. K21-26 in blue.

15th Row: P6 sts in blue. P7 st in green. P8 9 & 10 sts in blue. P11-16 sts in green. P17, 18 & 19 in Blue. P20th st in green. P21-26 in blue.

16th Row: K6 sts in blue. K7 st in green. K8 9 & 10 sts in blue. K11-16 sts in green. K17, 18 & 19 in Blue. K20th st in green. K21-26 in blue.

17th Row: P6 sts in blue. P7 in green. P8-19 in blue. P20 in green. P21 to 26 sts in blue.

18th Row: K6 sts in blue. K7 in green. K8-19 in blue. K20 in green. K21 to 26 sts in blue.

19th Row: P6 sts in blue. P7 in green. P8-19 in blue. P20 in green. P21 to 26 sts in blue.

20th Row: K6 sts in blue. K7 - 20 st in green. K21 to 26 sts in blue.

21st Row: P1* to end of row (in blue)

22nd Row: K1* to end of row (in blue)

23rd Row: P1* to end of row (in blue)

24th Row: K1* to end of row (in blue)

25th Row: P1* to end of row (in blue)

26th Row: Cast off 26 sts

9.3.9 Design > Pre-Simulated > Advanced Hand Knitting Visual Black and White Pattern

Instructional Design – Example A

Number of Rows																										
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	26
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	24
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	22
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
I	I	I	I	I	I	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	I	I	I	I	20
-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	19
I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	18
-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	17
I	I	I	I	I	I	X	I	I	I	X	X	X	X	X	X	I	I	I	X	I	I	I	I	I	I	16
-	-	-	-	-	-	X	-	-	-	X	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	15
I	I	I	I	I	I	X	I	I	I	X	X	X	X	X	X	I	I	I	X	I	I	I	I	I	I	14
-	-	-	-	-	-	X	-	-	-	X	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	13
I	I	I	I	I	I	X	I	I	I	X	X	X	X	X	X	I	I	I	X	I	I	I	I	I	I	12
-	-	-	-	-	-	X	-	-	-	X	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	11
I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	10
-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	9
I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	8
-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	7
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	2
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	1
26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

A more complex black and white symbolic, coded representation of hand knitting square within square pattern using two colours constructed by the researcher for teaching purposes.

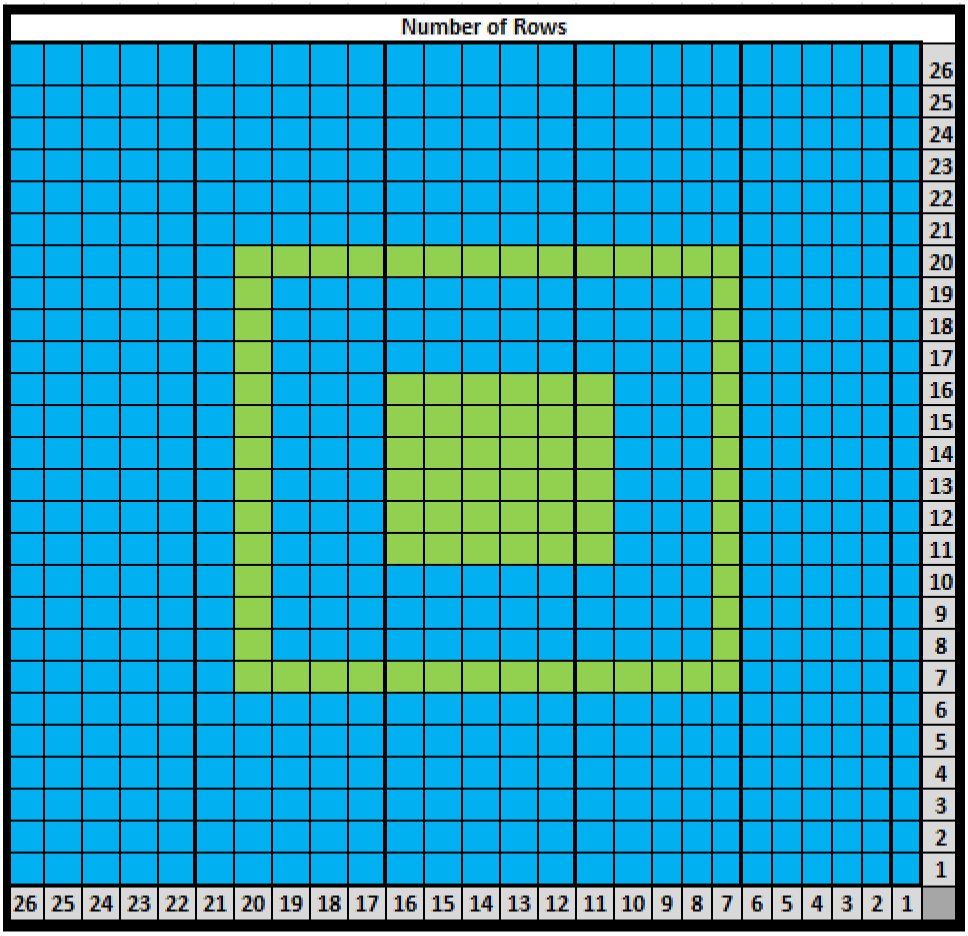
Instructional Design – Example A

Number of Rows																										
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	26
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	24
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	22
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
I	I	I	I	I	I	X	X	X	X	X	X	X	X	X	X	X	X	X	X	I	I	I	I	I	I	20
-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	19
I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	18
-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	17
I	I	I	I	I	I	X	I	I	I	X	X	X	X	X	X	I	I	I	X	I	I	I	I	I	I	16
-	-	-	-	-	-	X	-	-	-	X	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	15
I	I	I	I	I	I	X	I	I	I	X	X	X	X	X	X	I	I	I	X	I	I	I	I	I	I	14
-	-	-	-	-	-	X	-	-	-	X	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	13
I	I	I	I	I	I	X	I	I	I	X	X	X	X	X	X	I	I	I	X	I	I	I	I	I	I	12
-	-	-	-	-	-	X	-	-	-	X	X	X	X	X	X	-	-	-	X	-	-	-	-	-	-	11
I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	10
-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	9
I	I	I	I	I	I	X	I	I	I	I	I	I	I	I	I	I	I	I	X	I	I	I	I	I	I	8
-	-	-	-	-	-	X	X	X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	-	-	-	7
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	6
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	4
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	2
O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	1
26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	

Advanced colour symbolic, coded representation of hand knitting square within square pattern constructed by the researcher for teaching purposes to illustrate relationship between colour and use of knitting codes.

9.3.11 Design > Pre-Simulated > Advanced Hand Knitting Visual Non Coded

Instructional Design – Example A



Colour non-coded representation of advanced hand knitting square within square pattern constructed by the researcher for teaching purposes to illustrate relationship between colour and structure of textiles.

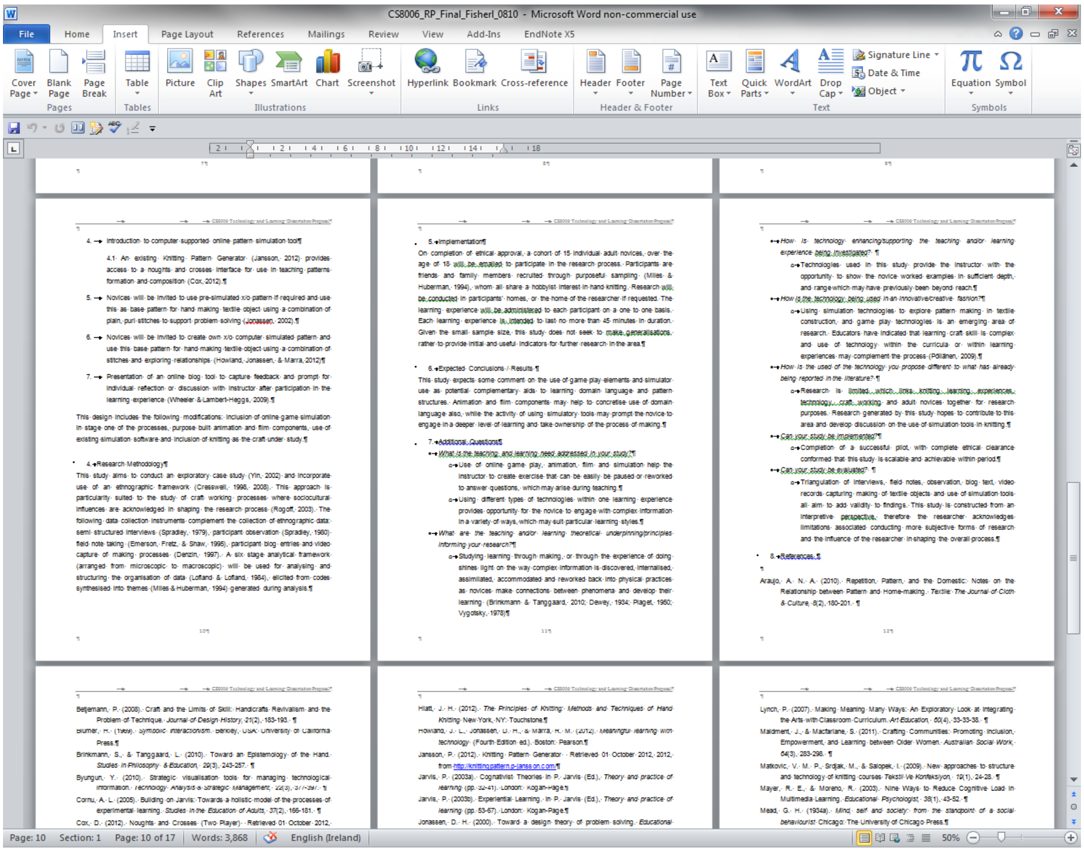
Instructional Design – Example A

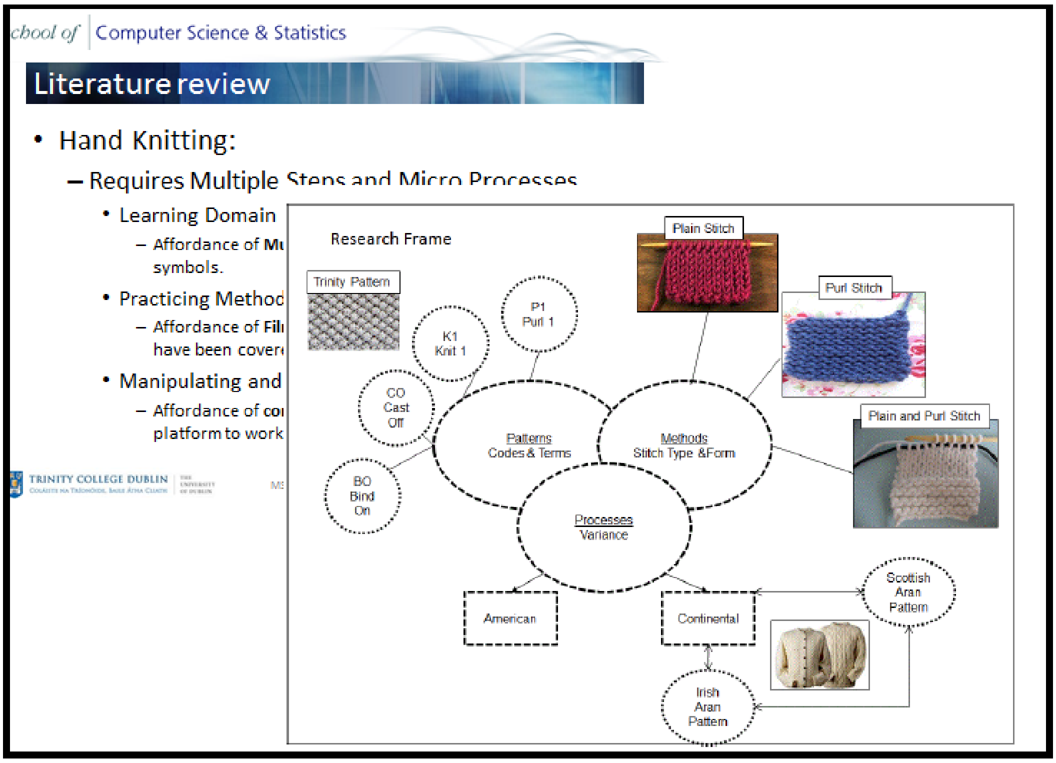
Knitted pattern compiled by the researcher (whom is a less experienced peer).

Same pattern compiled by experienced knitting peer, which demonstrates mastery of technique, tension components and ability to generate in different colours.

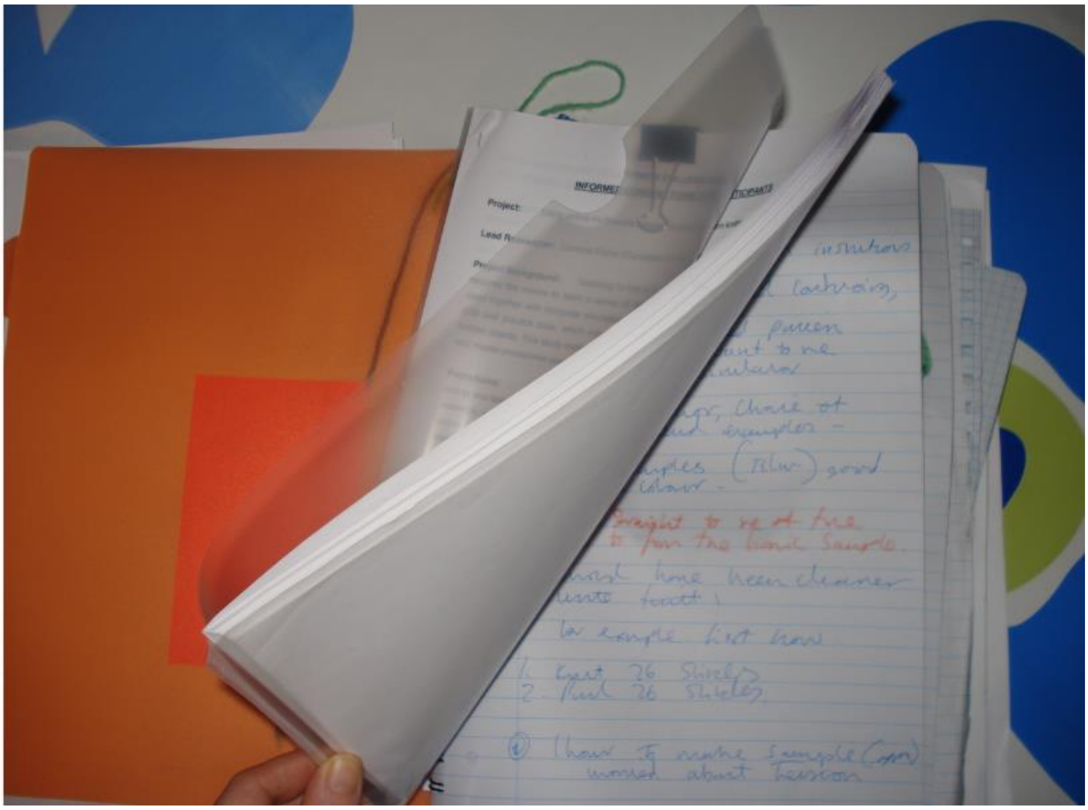
9.4 Methodology

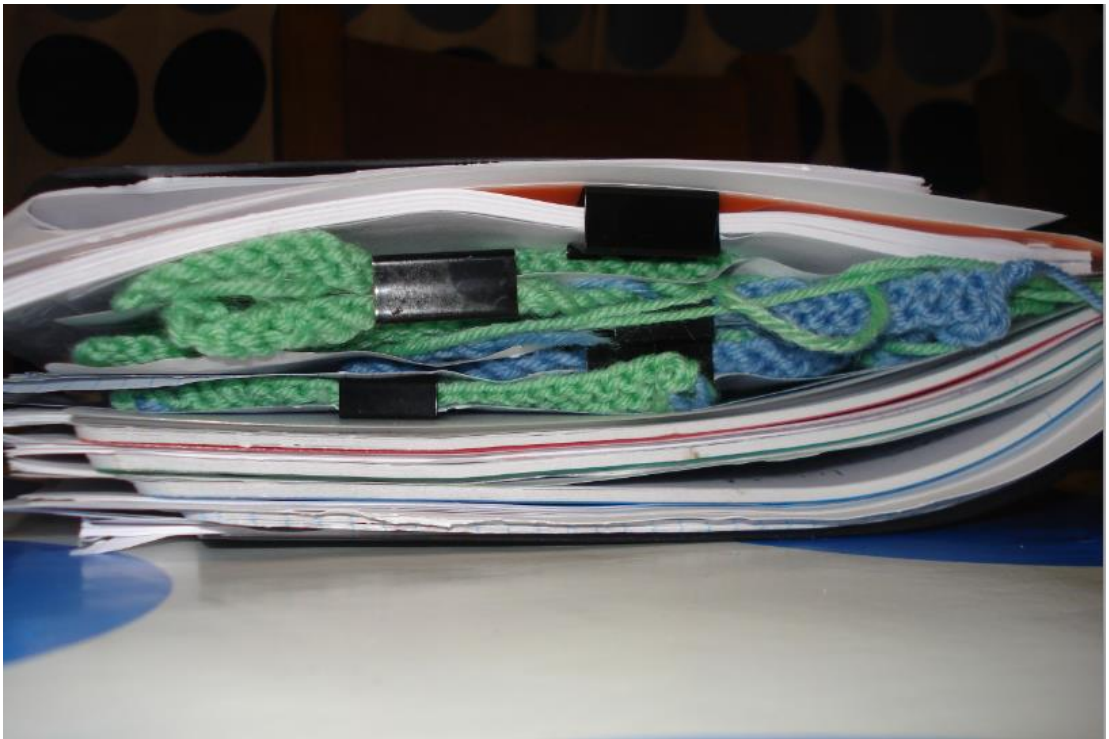
9.4.1 Methods > Field Notes > Screen Shot > Research Proposal and Presentation



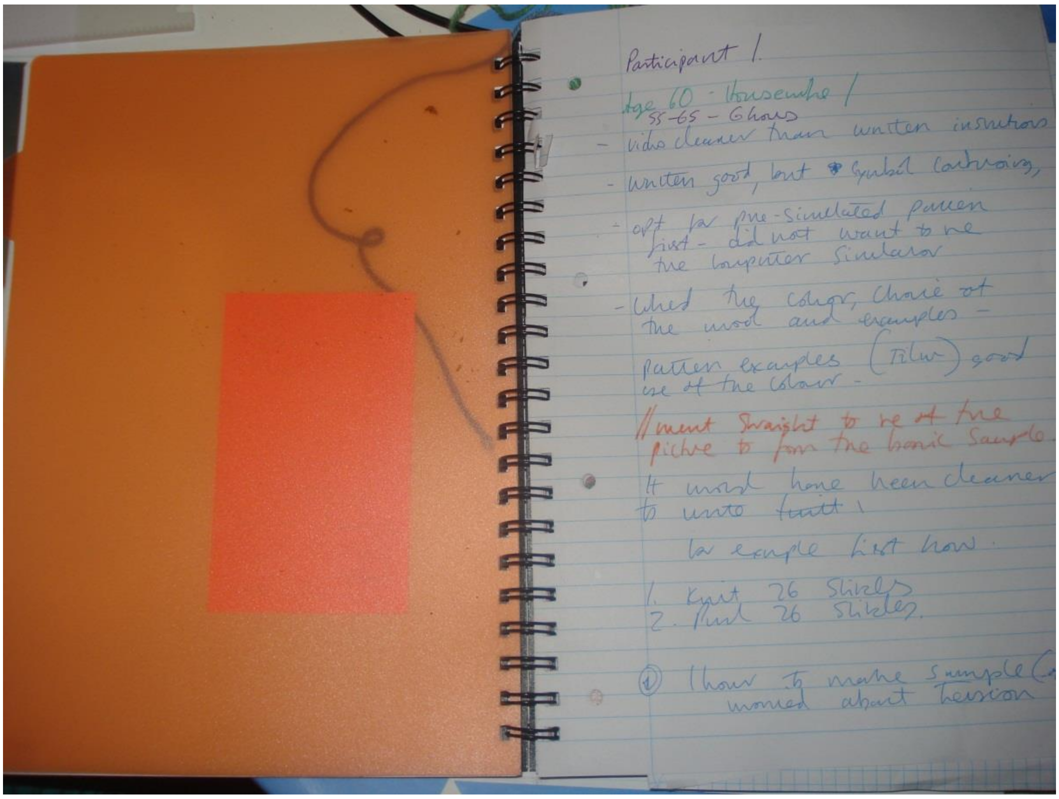


9.4.2 Methods > Field Notes > Screen Shot > Researcher Note Book

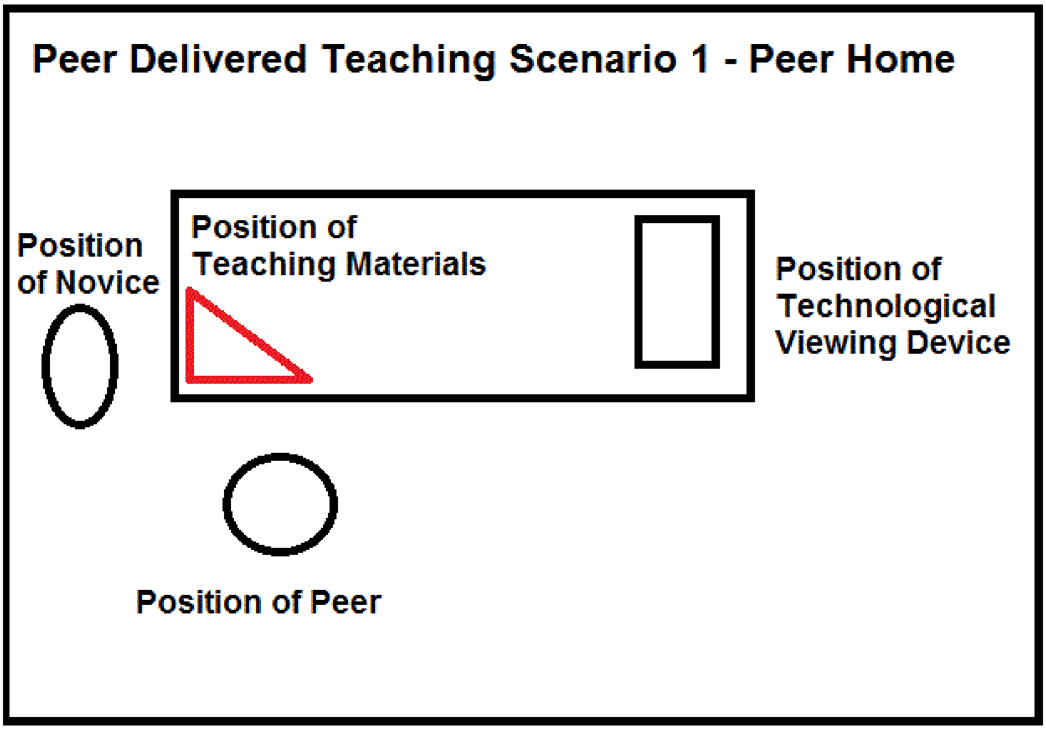




9.4.3 Methods > Orange > Observational Notes > Location > Artefacts> Participant

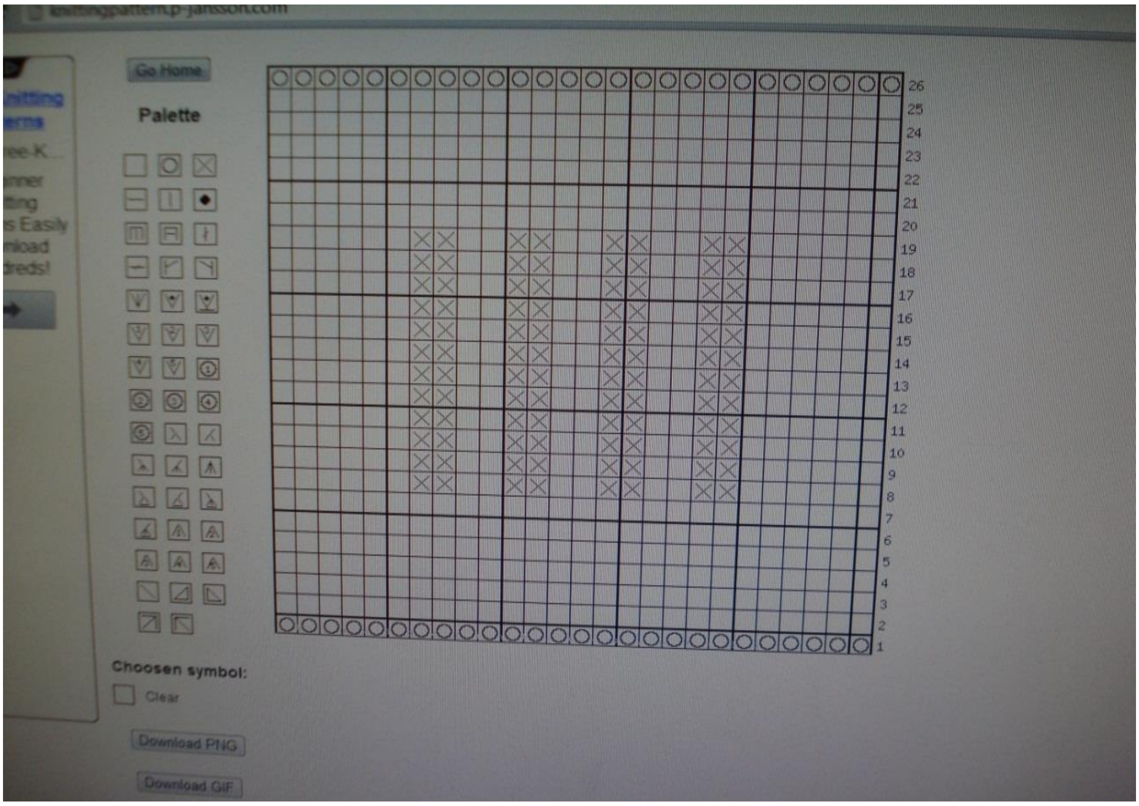


Teaching Location



Basic Example 4.1 (Pre-Simulated)

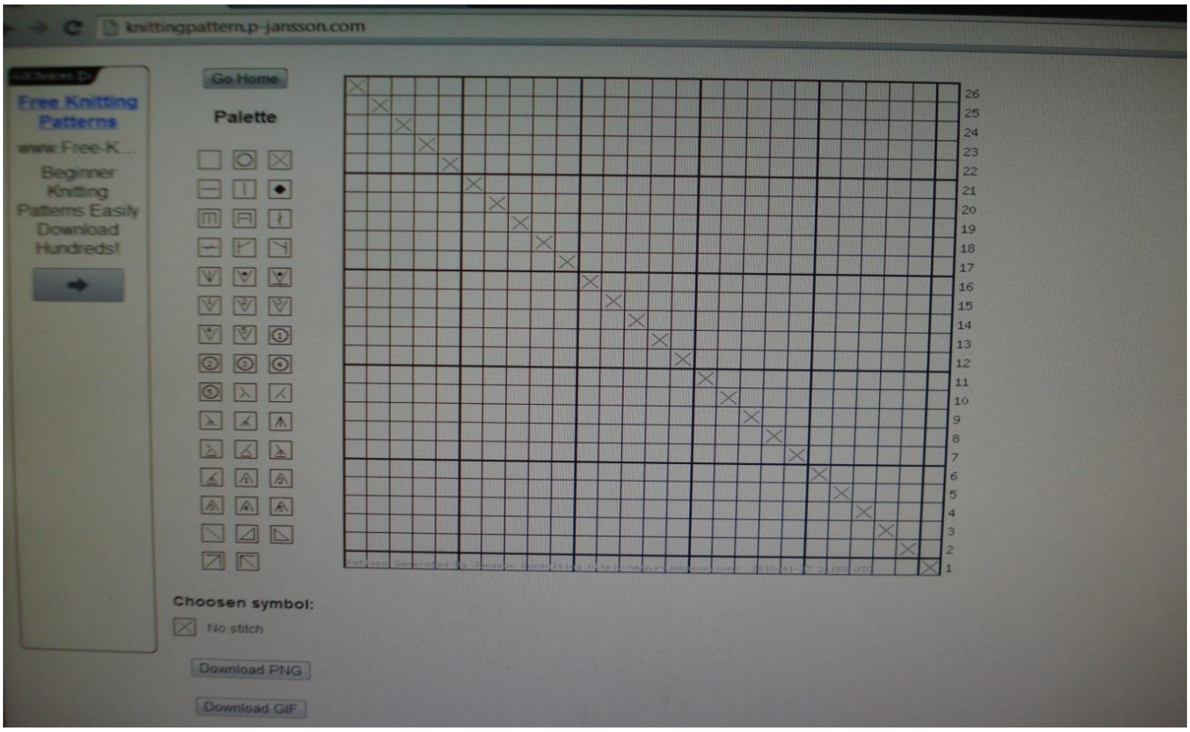
Basic Example 4.2 (Simulated)



Basic Example 4.2 (Knitted)

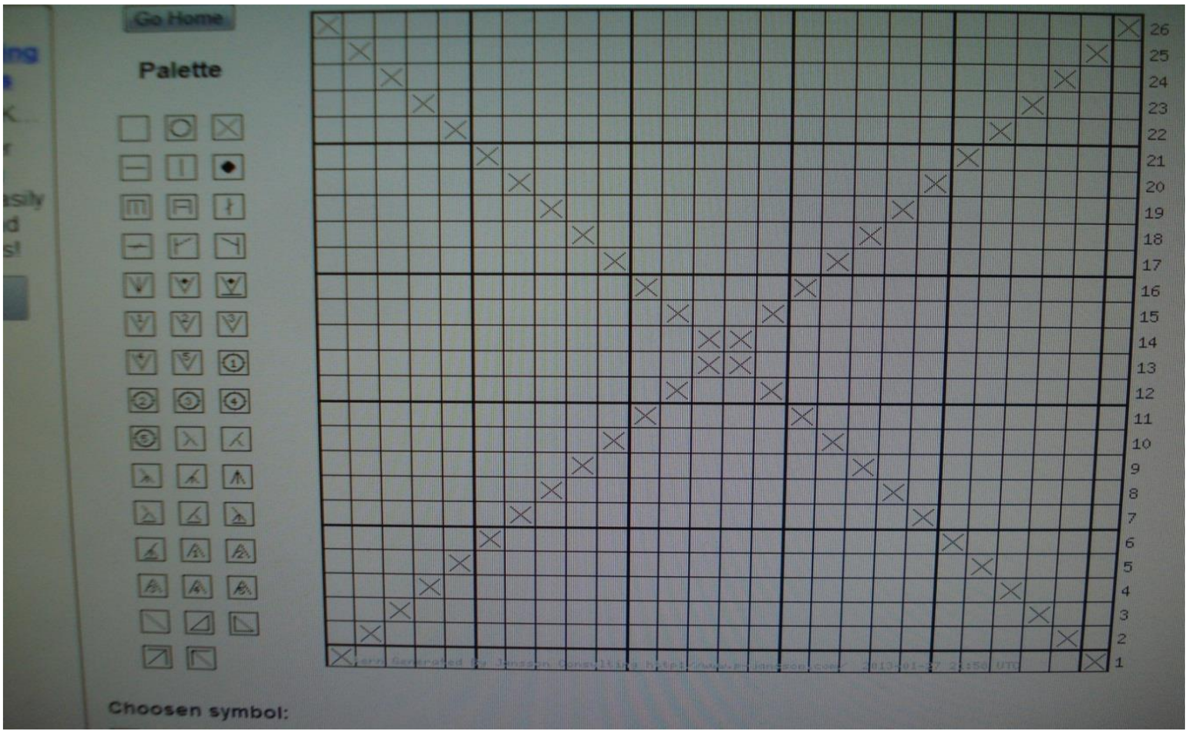
Advanced Example 7.1 (Pre-Simulated)

Advanced Example 7.2 (Simulated)



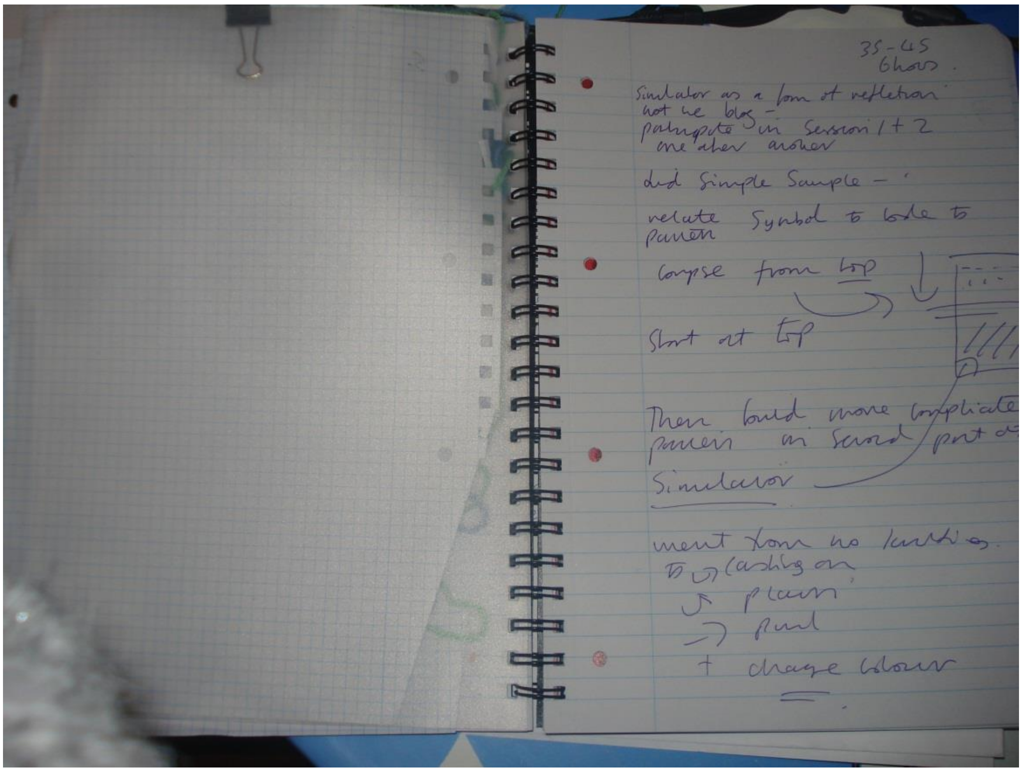
Advanced Example 7.2 (Knitted)

Advanced Example 7.3 (Simulated)

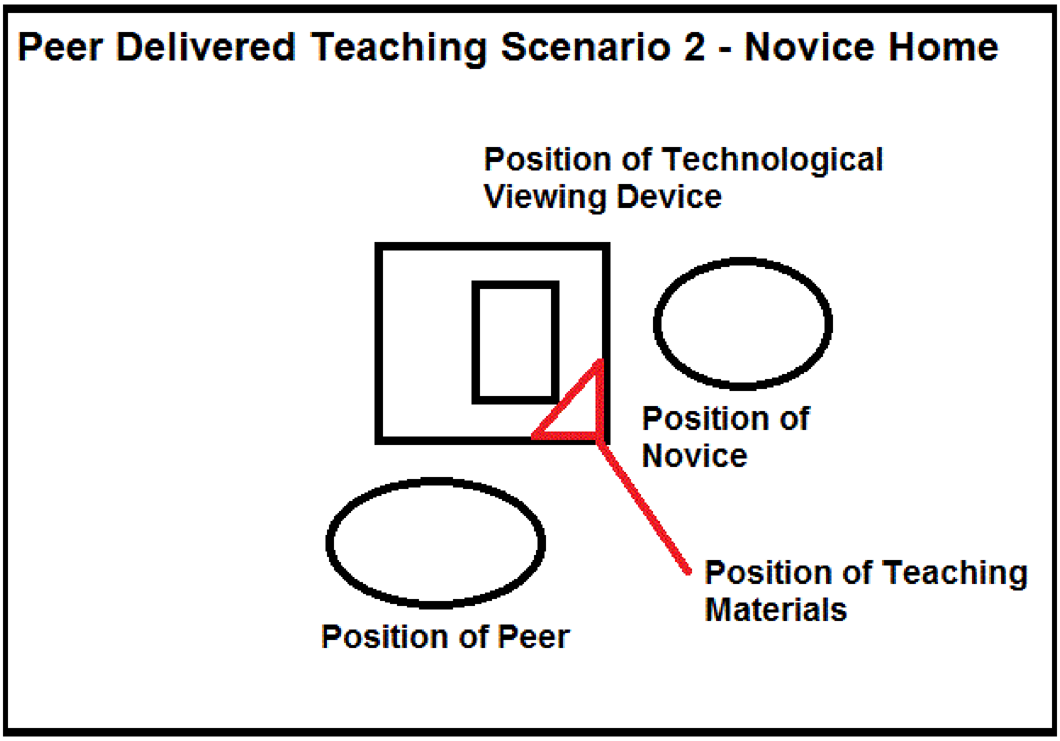


Advanced Example 7.3 (Knitted)

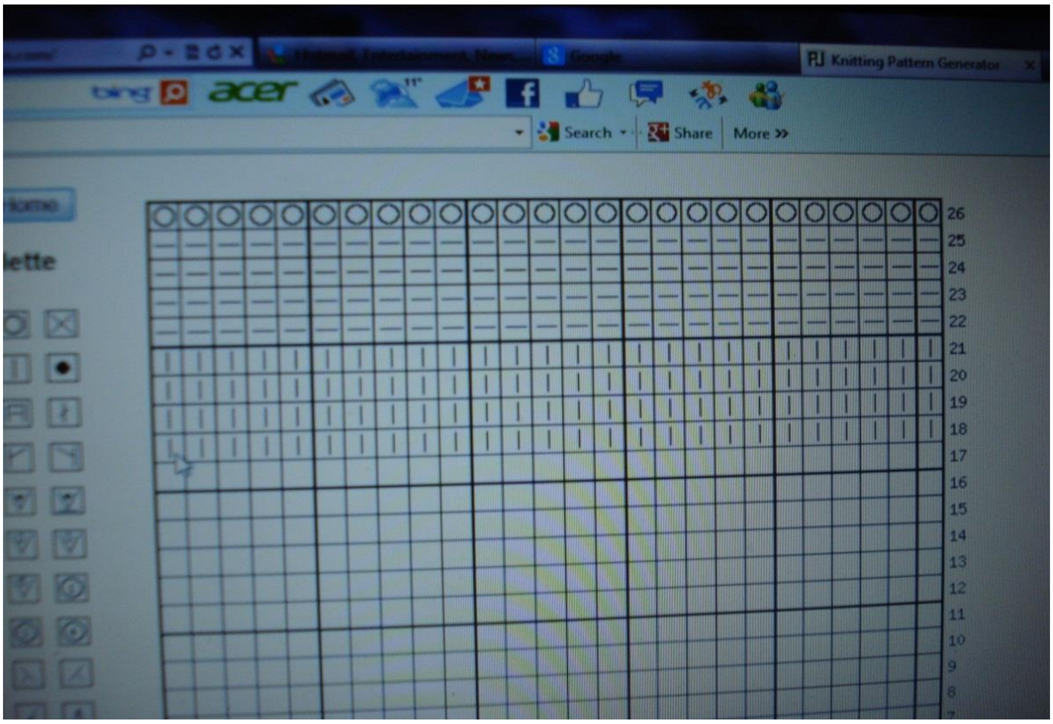
9.4.4 Methods > White > Observational Notes > Location > Artefacts> Participant



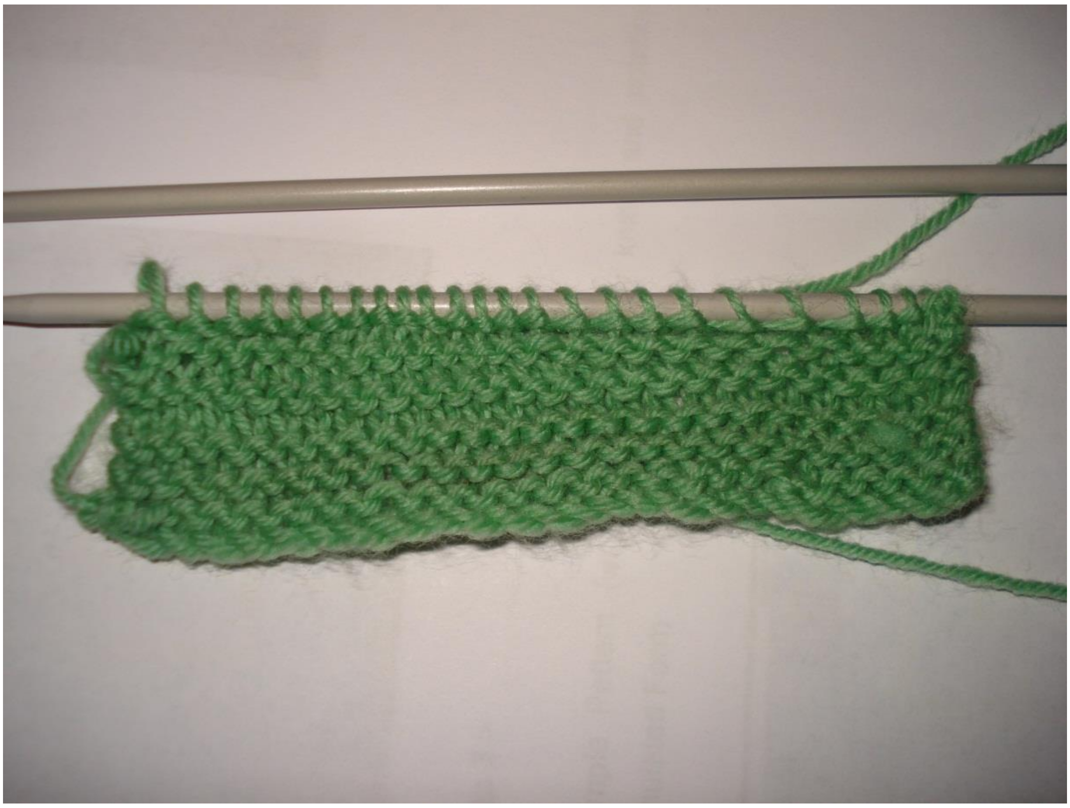
Teaching Location



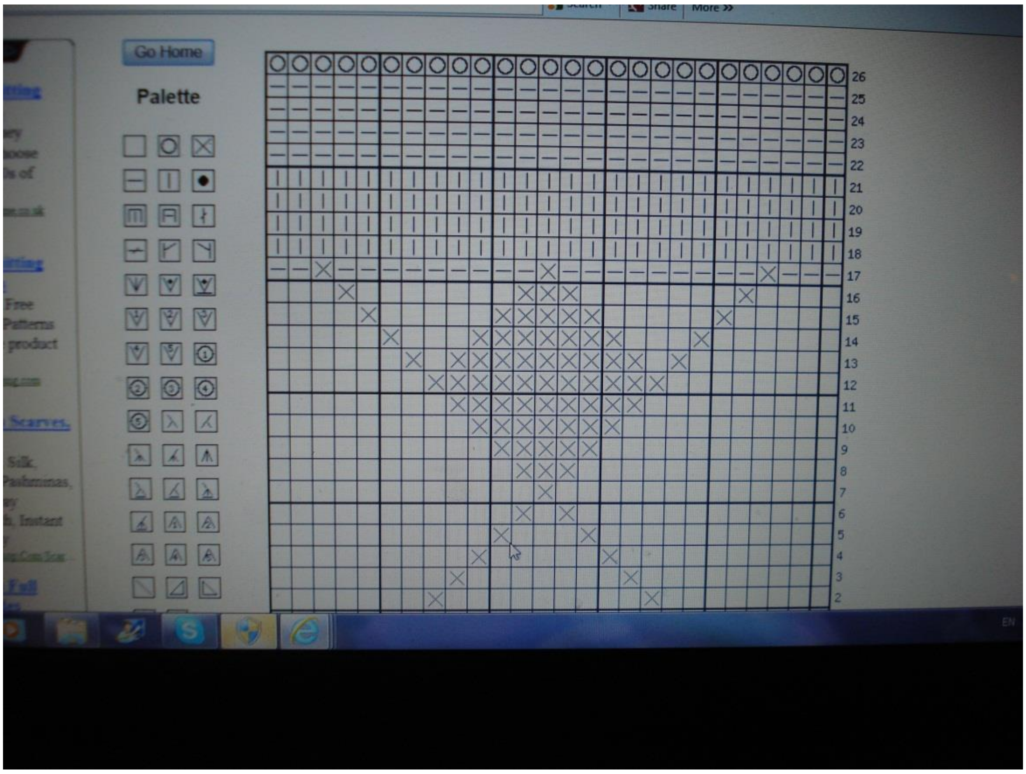
Basic Example 4.2 (Simulated)



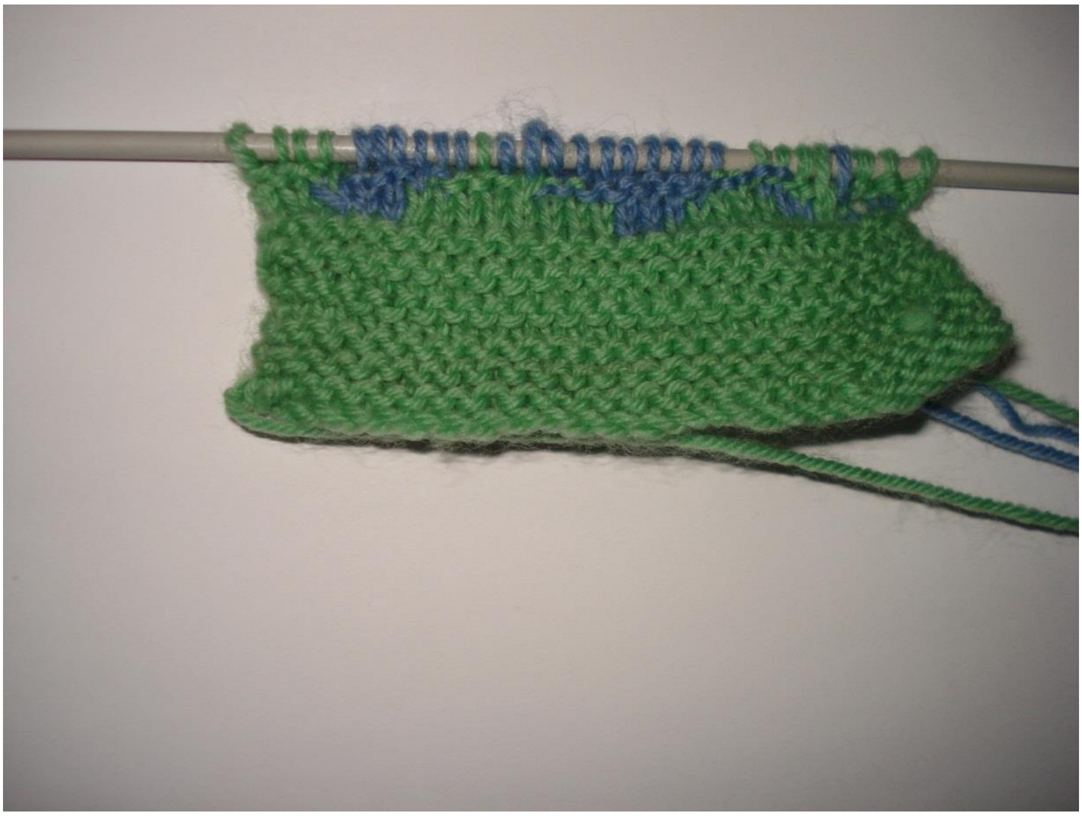
Basic Example 4.2 (Knitted)



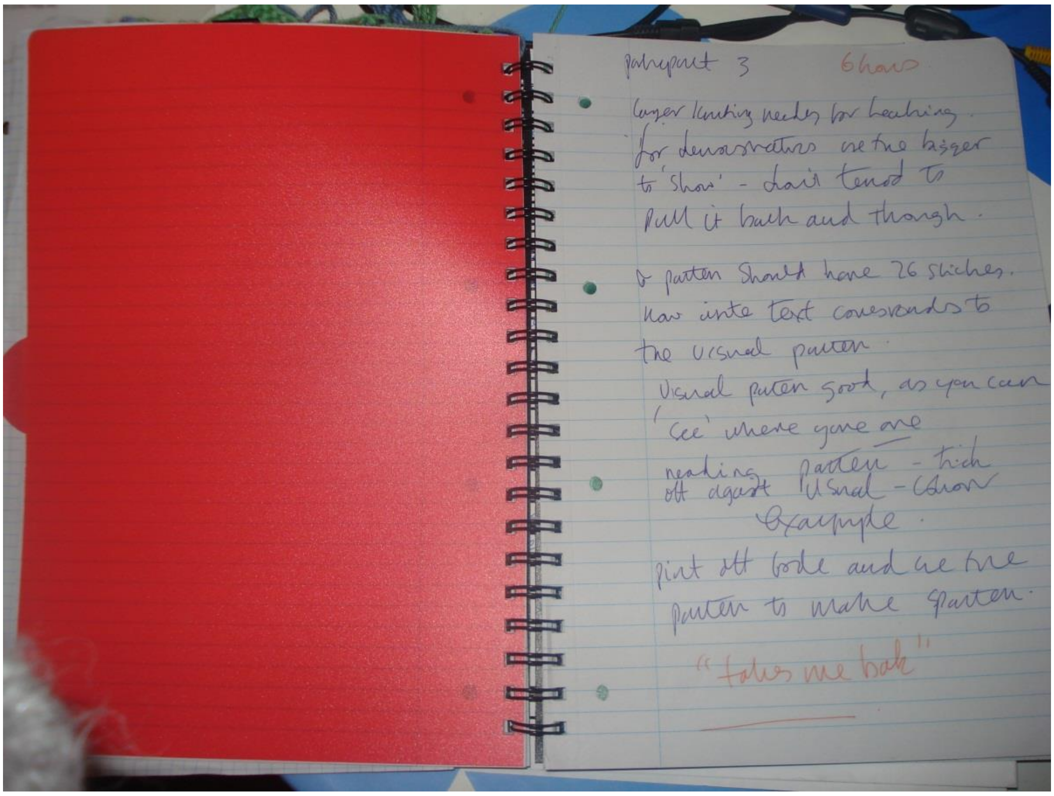
Advanced Example 7.2 (Simulated)



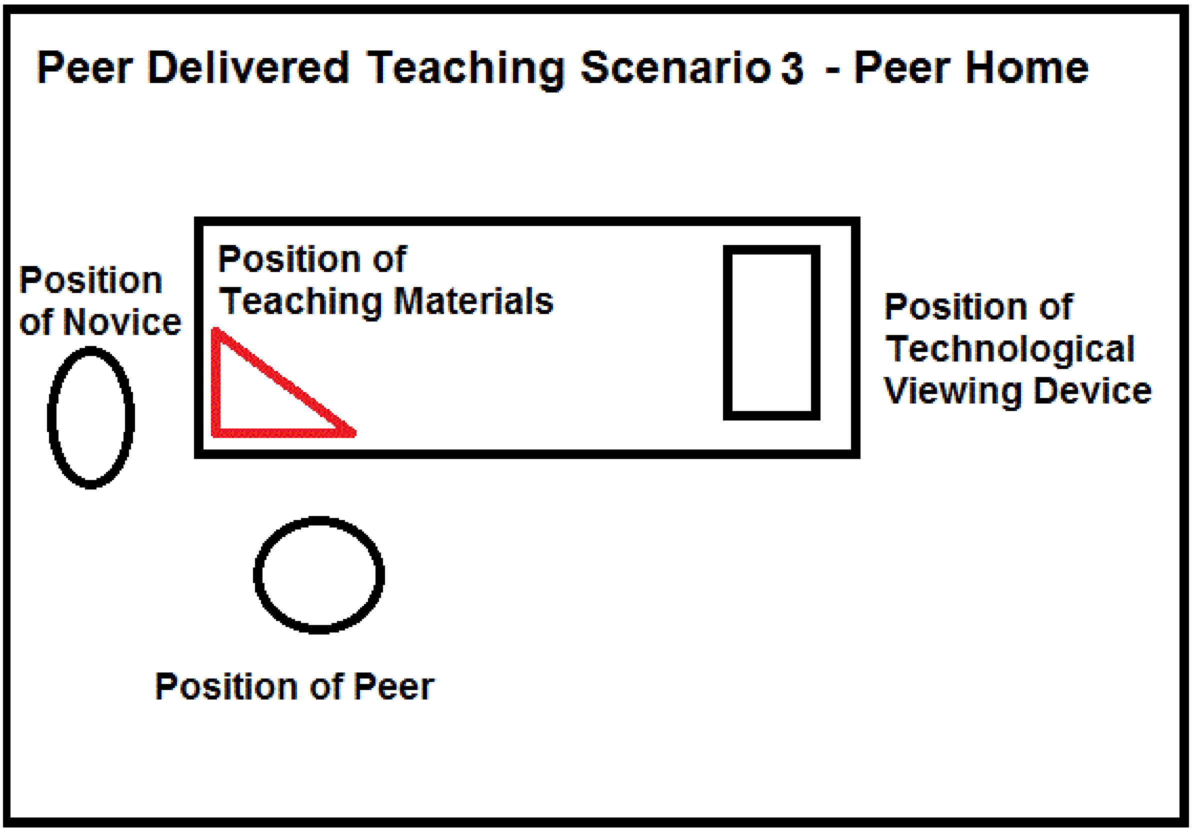
Advanced Example 7.2 (Knitted)



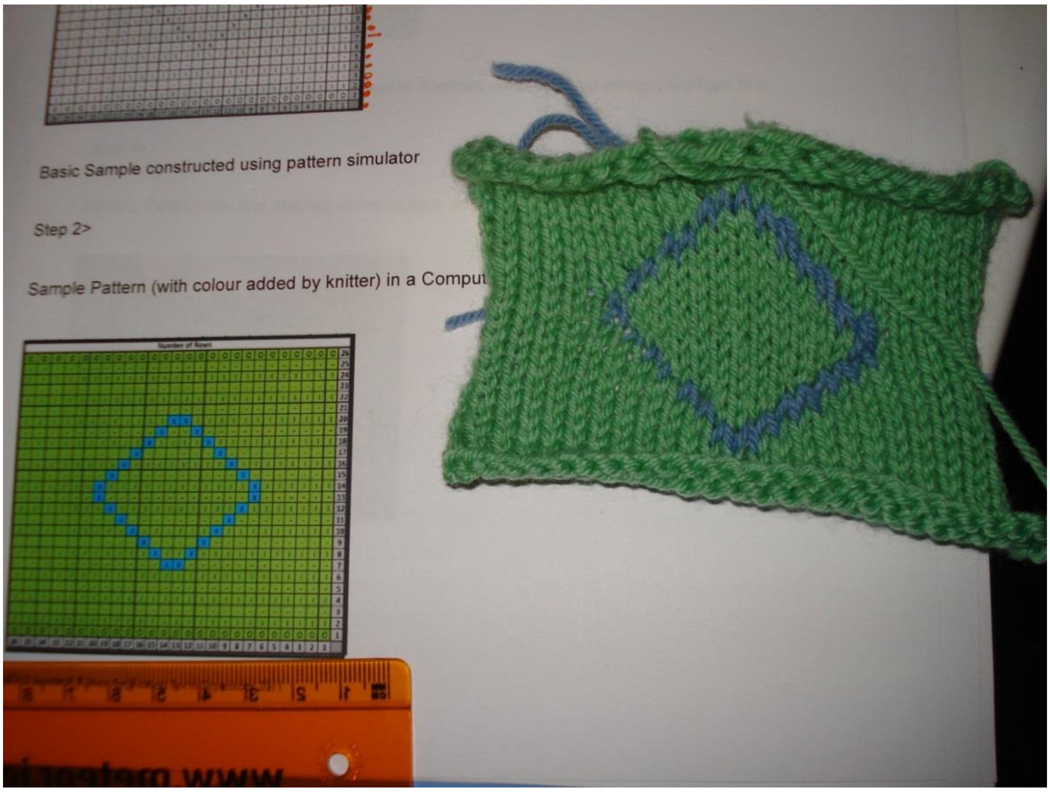
9.4.5 Methods > Red > Observational Notes > Location > Artefacts> Participant 3

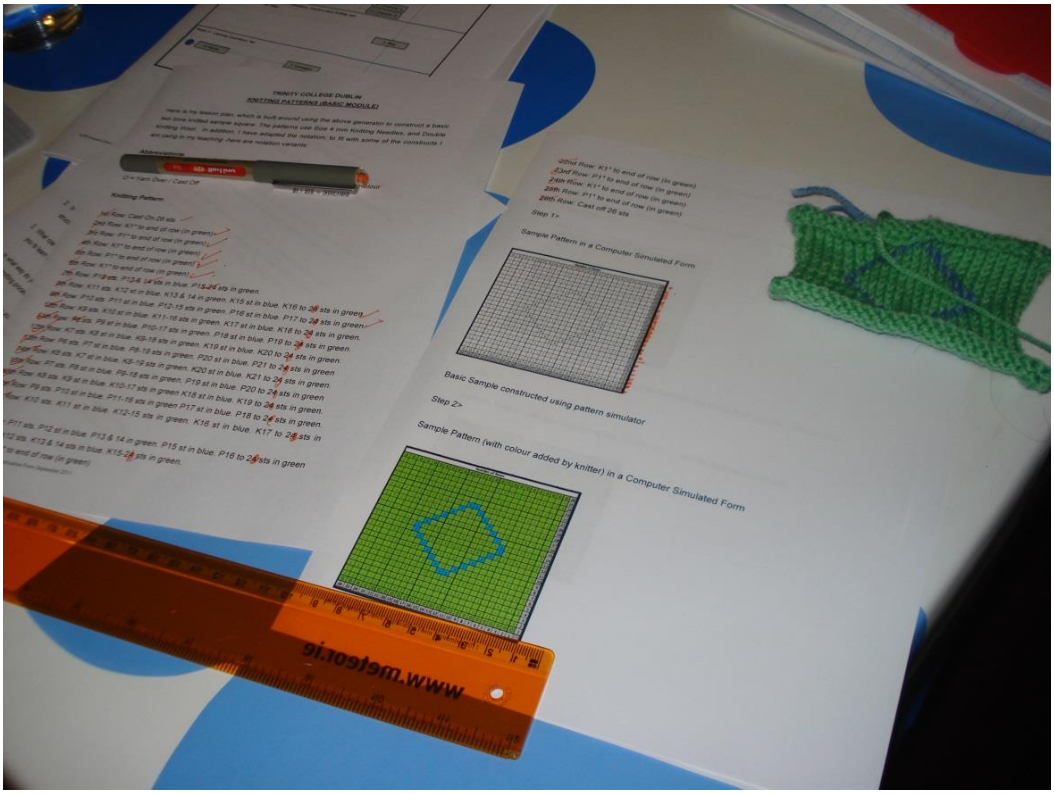


Teaching Location

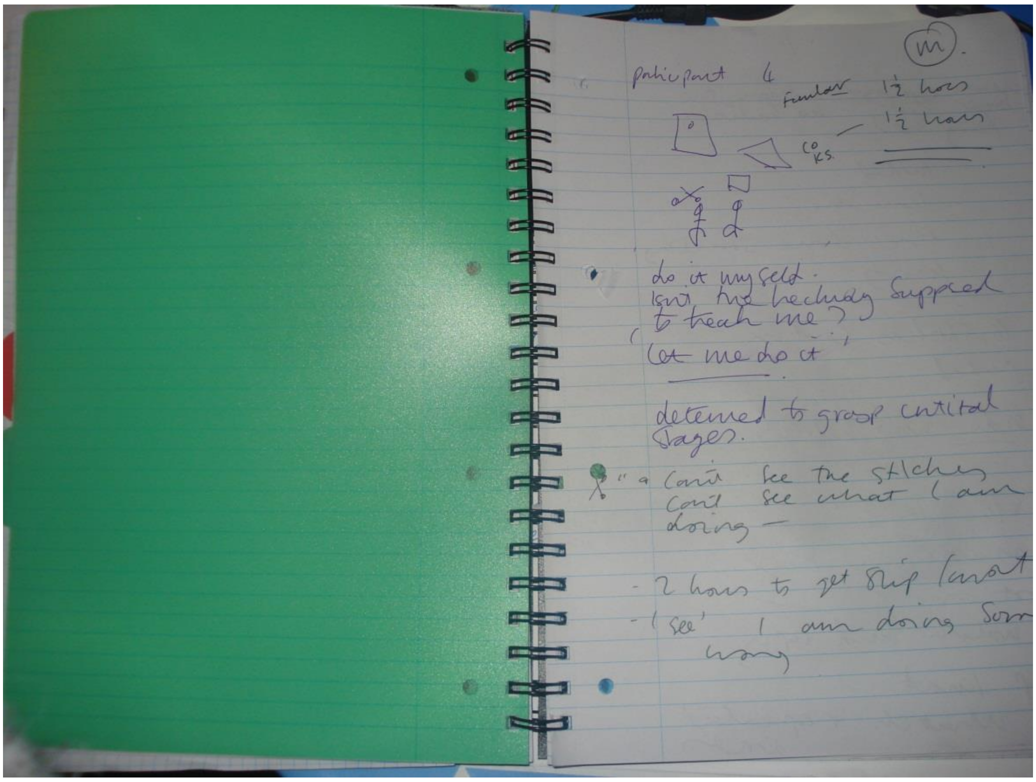


Basic Example 4.1 (Pre-Simulated)

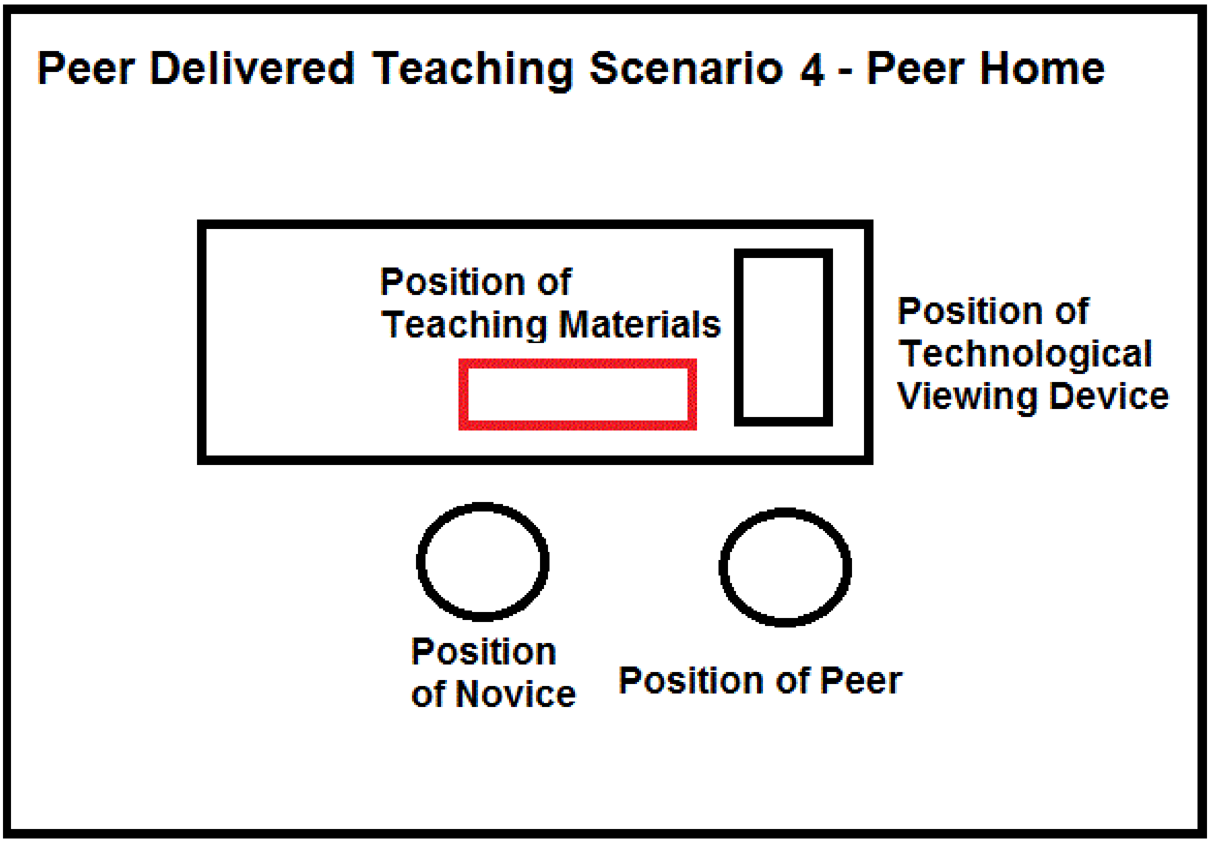




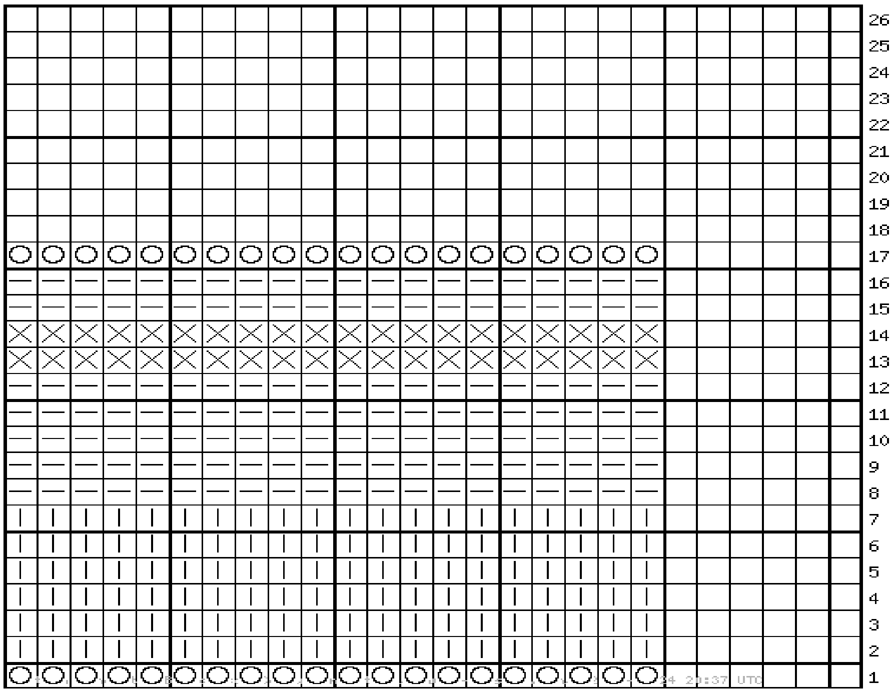
9.4.6 Methods > Green > Observational Notes > Location > Artefacts> Participant 4



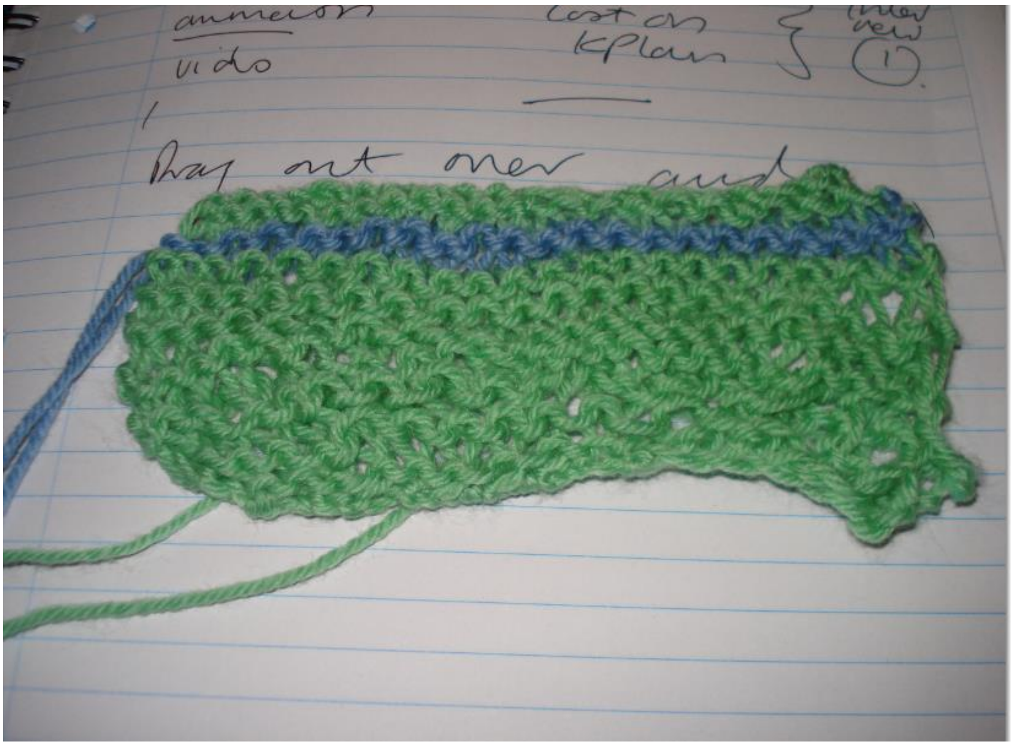
Teaching Location



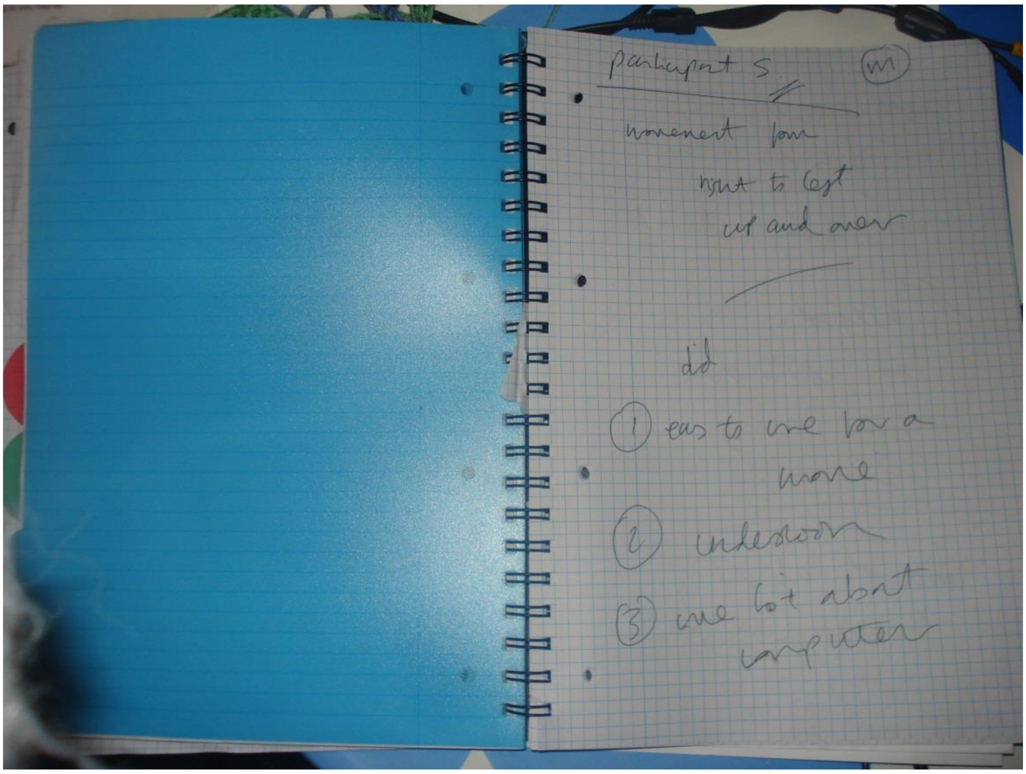
Basic Example 4.2 (Simulated)



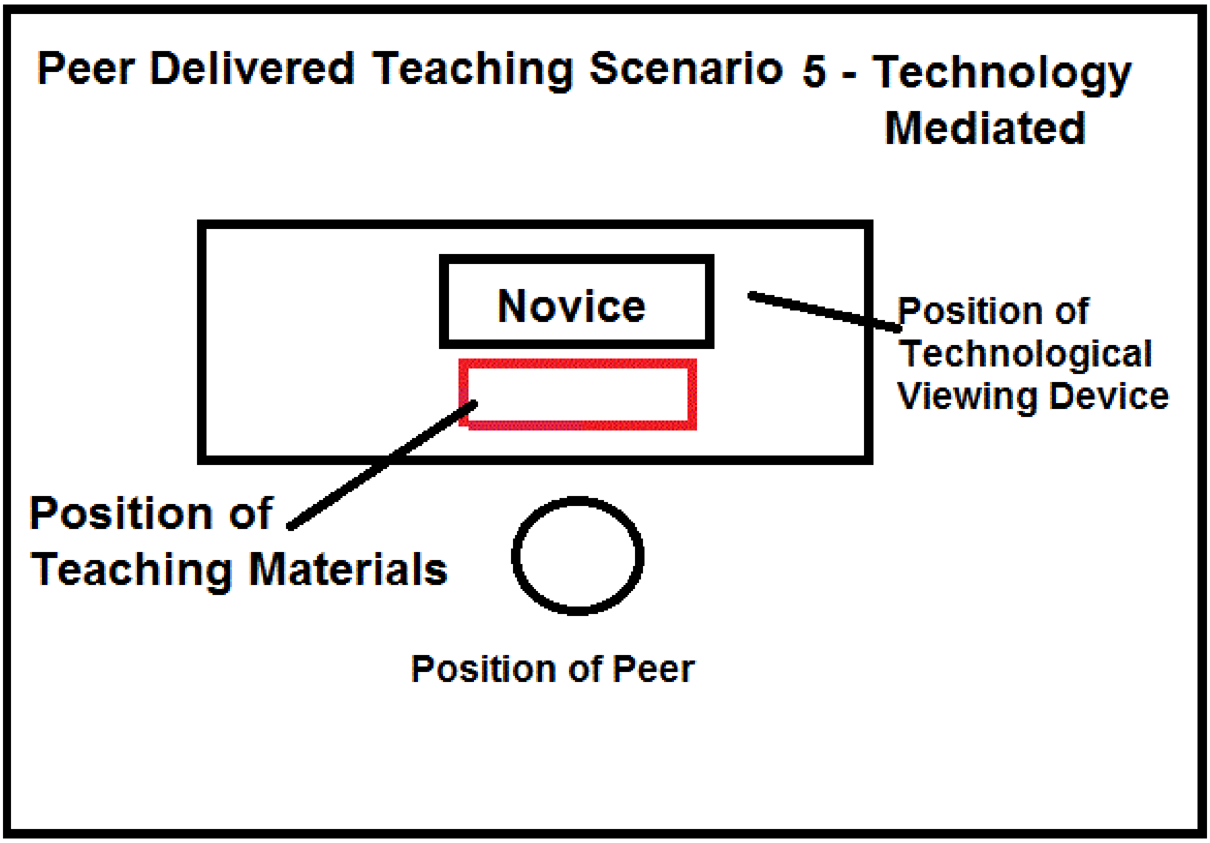
Basic Example 4.2 (Knitted)



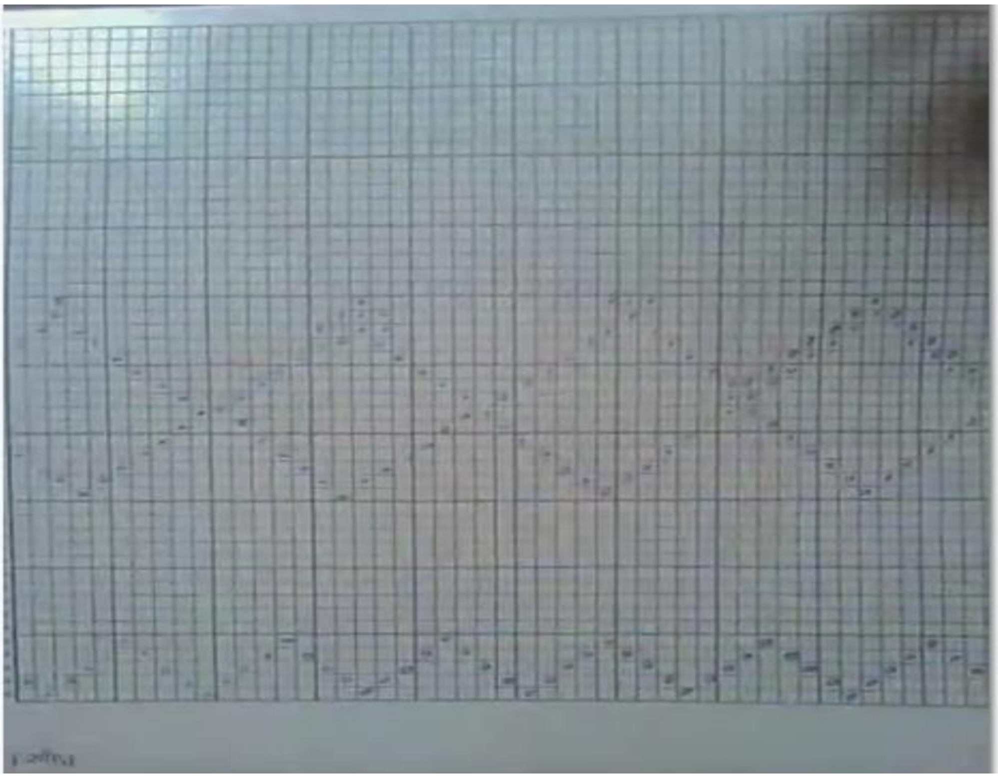
9.4.7 Methods > Blue > Observational Notes > Location > Artefacts> Participant 5



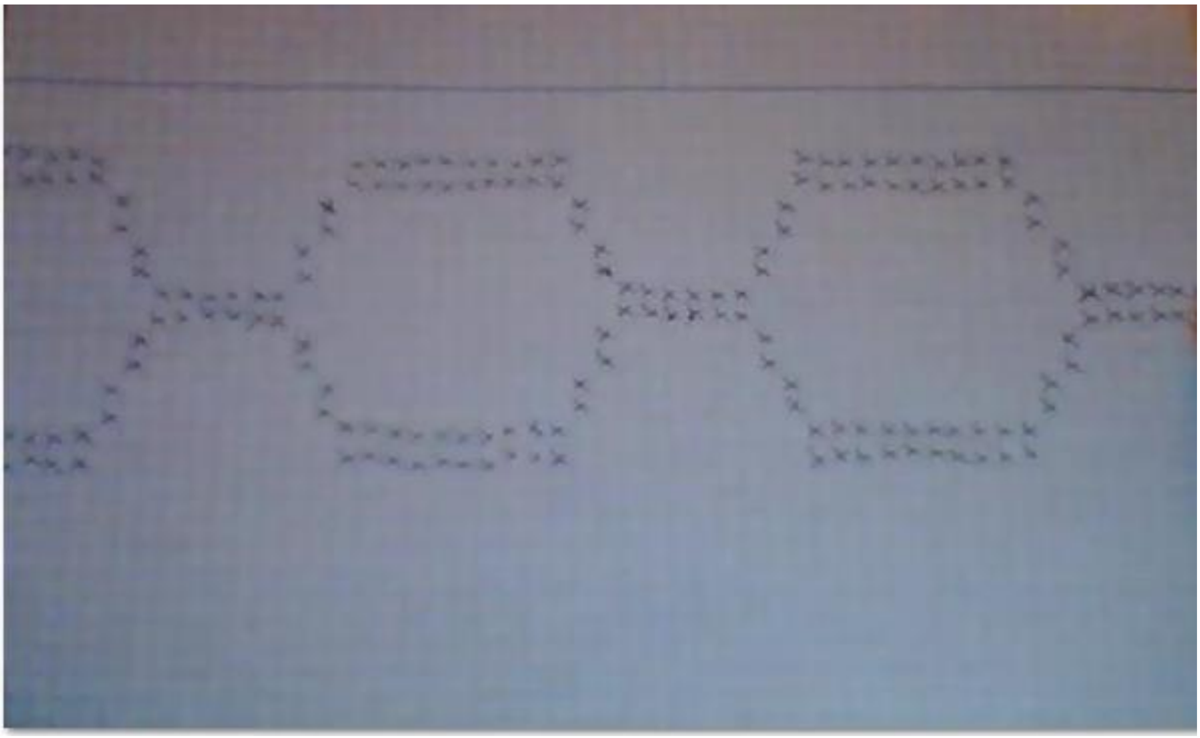
Teaching Location



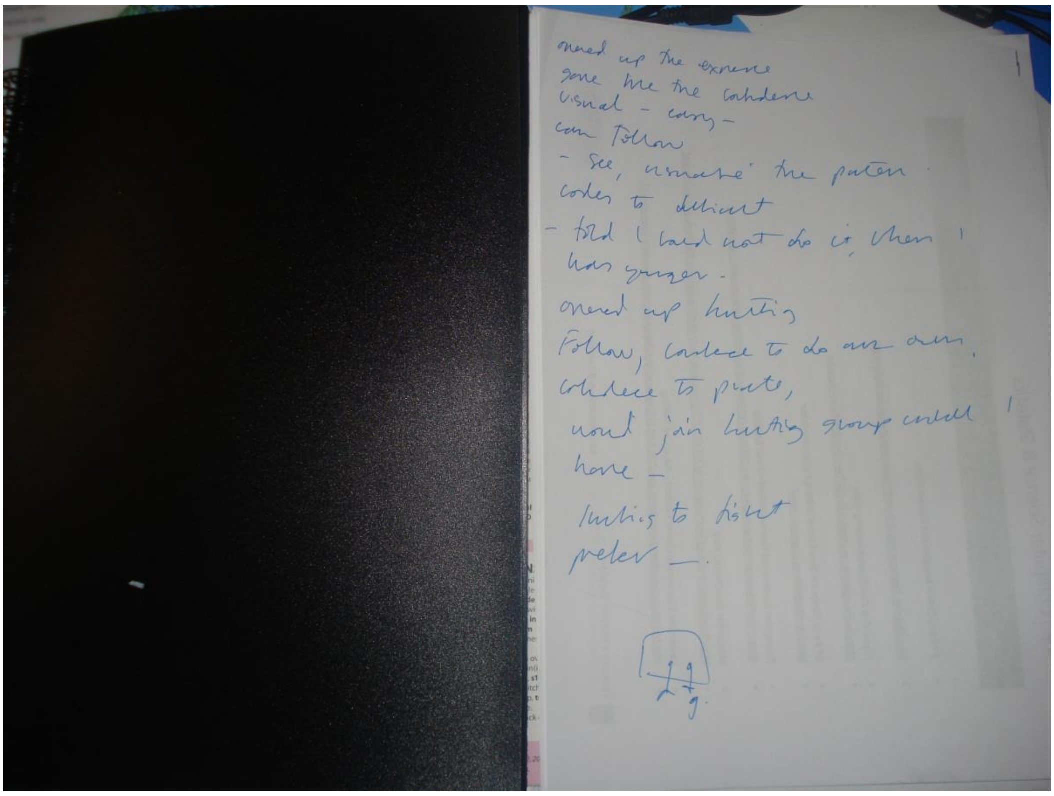
Basic Example 4.2 (Simulated)



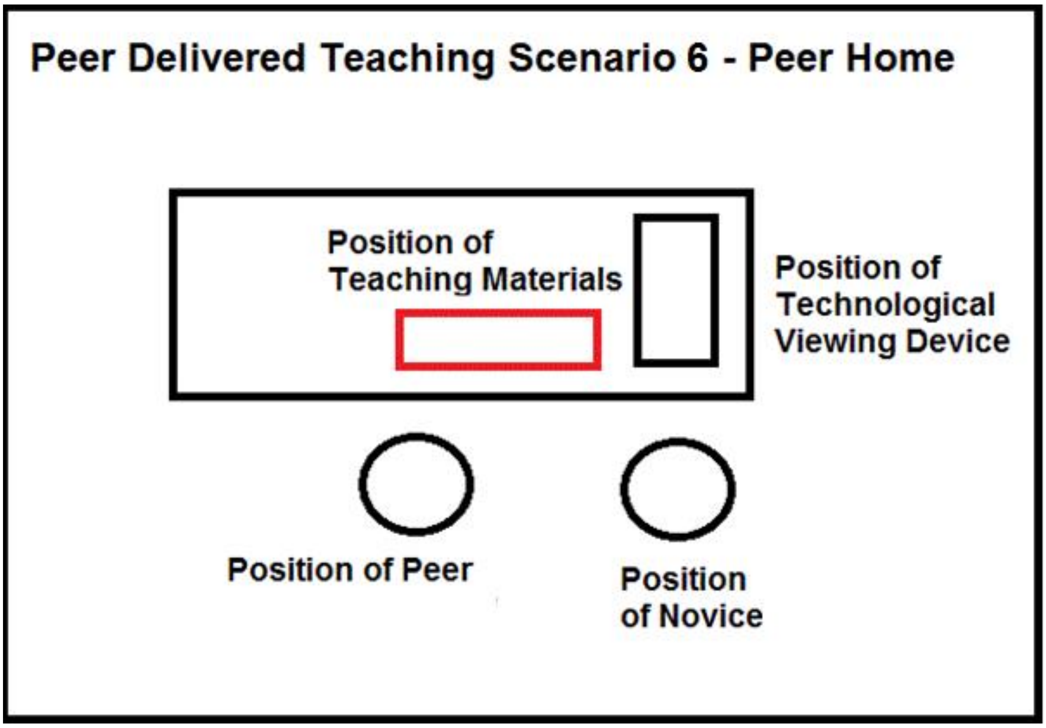
Basic Example 4.2 (Simulated)



9.4.8 Methods > Black > Observational Notes > Location > Artefacts> Participant 6

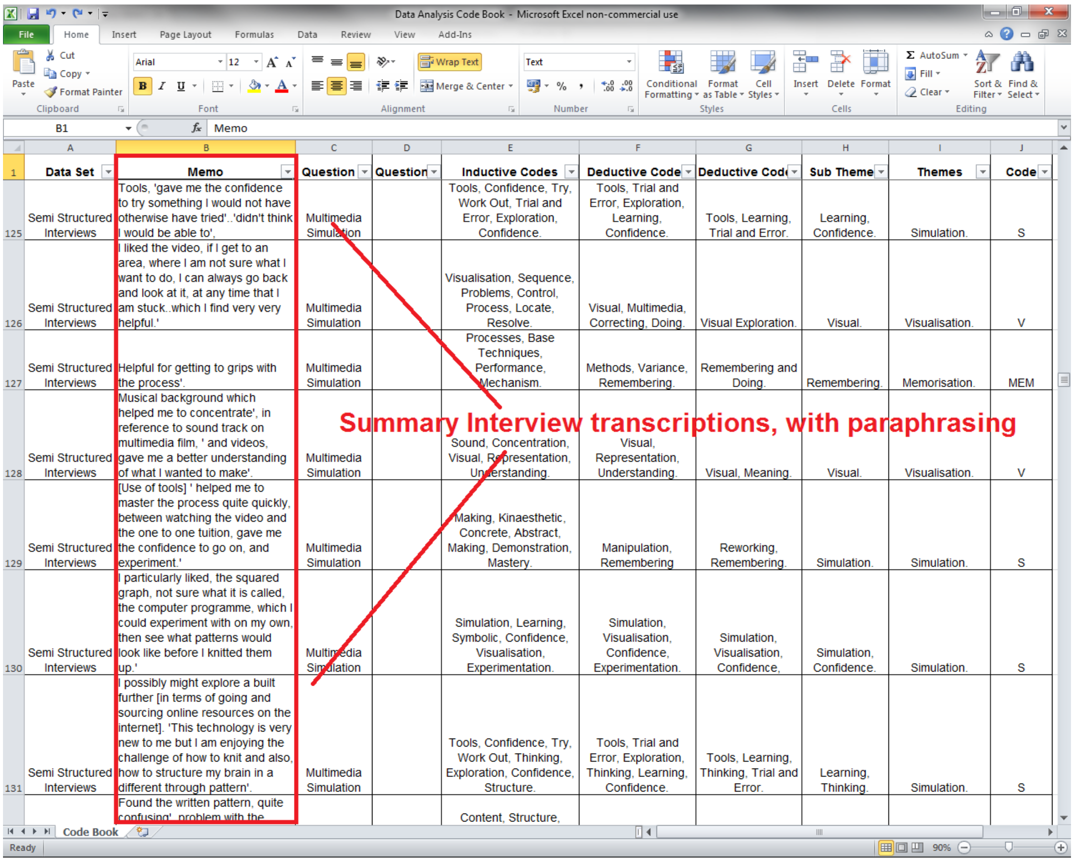


Teaching Location



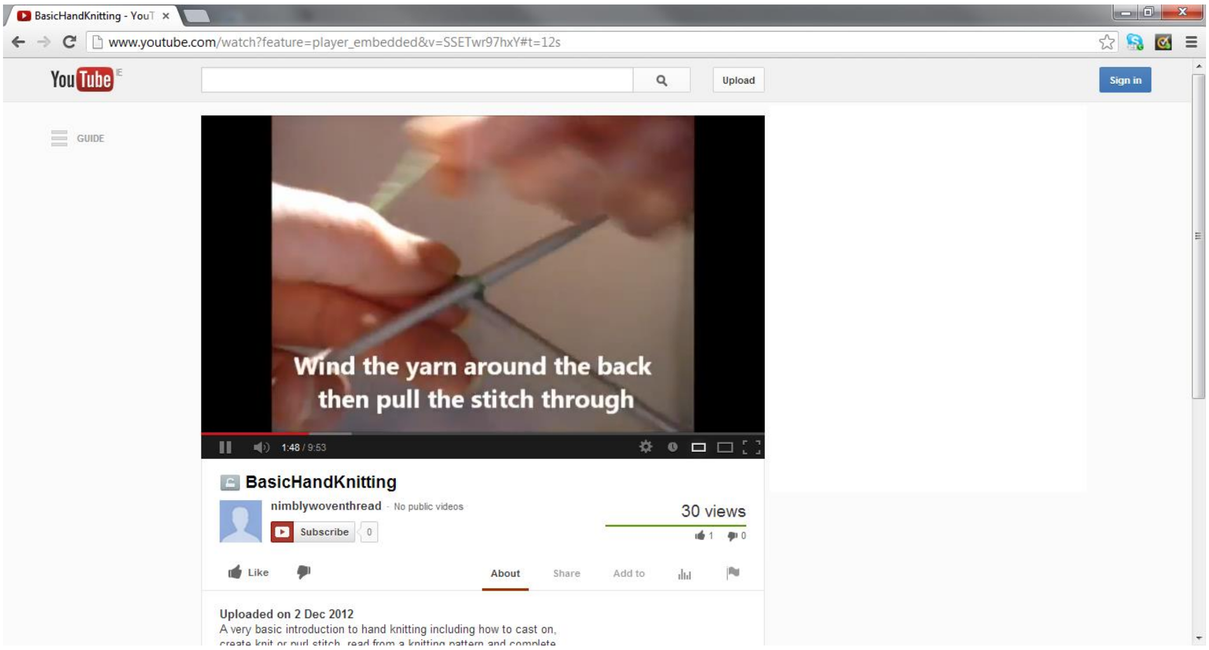
Basic Example 4.1 (Pre-Simulated)

9.4.9 Methods > Interview Transcription > Memo Style

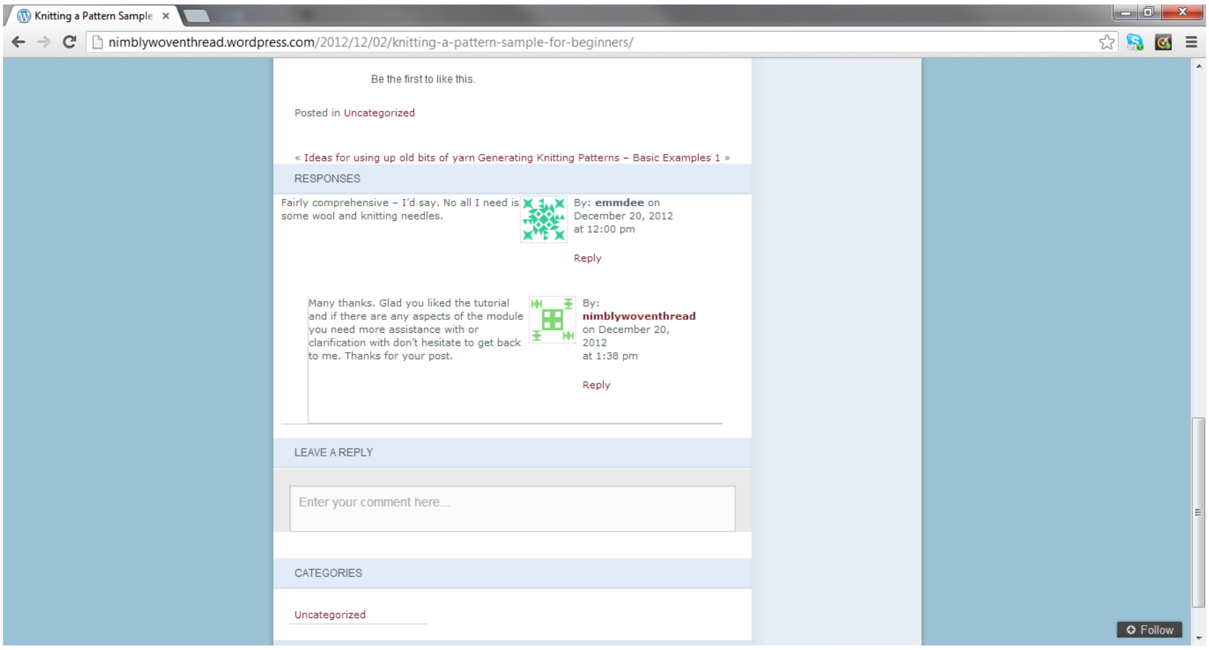


	Data Set	Memo	Question	Question	Inductive Codes	Deductive Code	Deductive Code	Sub Theme	Themes	Code
125	Semi Structured Interviews	Tools, 'gave me the confidence to try something I would not have otherwise have tried'..'didn't think I would be able to'.	Multimedia Simulation		Tools, Confidence, Try, Work Out, Trial and Error, Exploration, Confidence.	Tools, Trial and Error, Exploration, Learning, Confidence.	Tools, Learning, Trial and Error.	Learning, Confidence.	Simulation.	S
126	Semi Structured Interviews	I liked the video, if I get to an area, where I am not sure what I want to do, I can always go back and look at it, at any time that I am stuck..which I find very very helpful.'	Multimedia Simulation		Visualisation, Sequence, Problems, Control, Process, Locate, Resolve.	Visual, Multimedia, Correcting, Doing.	Visual Exploration.	Visual.	Visualisation.	V
127	Semi Structured Interviews	Helpful for getting to grips with the process'.	Multimedia Simulation		Processes, Base Techniques, Performance, Mechanism.	Methods, Variance, Remembering.	Remembering and Doing.	Remembering.	Memorisation.	MEM
128	Semi Structured Interviews	Musical background which helped me to concentrate', in reference to sound track on multimedia film, ' and videos, gave me a better understanding of what I wanted to make'.	Multimedia Simulation		Sound, Concentration, Visual, Representation, Understanding.	Visual, Representation, Understanding.	Visual, Meaning.	Visual.	Visualisation.	V
129	Semi Structured Interviews	[Use of tools] ' helped me to master the process quite quickly, between watching the video and the one to one tuition, gave me the confidence to go on, and experiment.'	Multimedia Simulation		Making, Kinaesthetic, Concrete, Abstract, Making, Demonstration, Mastery.	Manipulation, Remembering	Reworking, Remembering.	Simulation.	Simulation.	S
130	Semi Structured Interviews	I particularly liked, the squared graph, not sure what it is called, the computer programme, which I could experiment with on my own, then see what patterns would look like before I knitted them up.'	Multimedia Simulation		Simulation, Learning, Symbolic, Confidence, Visualisation, Experimentation.	Simulation, Visualisation, Confidence, Experimentation.	Simulation, Visualisation, Confidence.	Simulation, Confidence.	Simulation.	S
131	Semi Structured Interviews	I possibly might explore a built further [in terms of going and sourcing online resources on the internet]. 'This technology is very new to me but I am enjoying the challenge of how to knit and also, how to structure my brain in a different through pattern'.	Multimedia Simulation		Tools, Confidence, Try, Work Out, Thinking, Exploration, Confidence, Structure.	Tools, Trial and Error, Exploration, Thinking, Learning, Confidence.	Tools, Learning, Thinking, Trial and Error.	Learning, Thinking.	Simulation.	S
		Found the written pattern, quite confusing', problem with the			Content, Structure,					

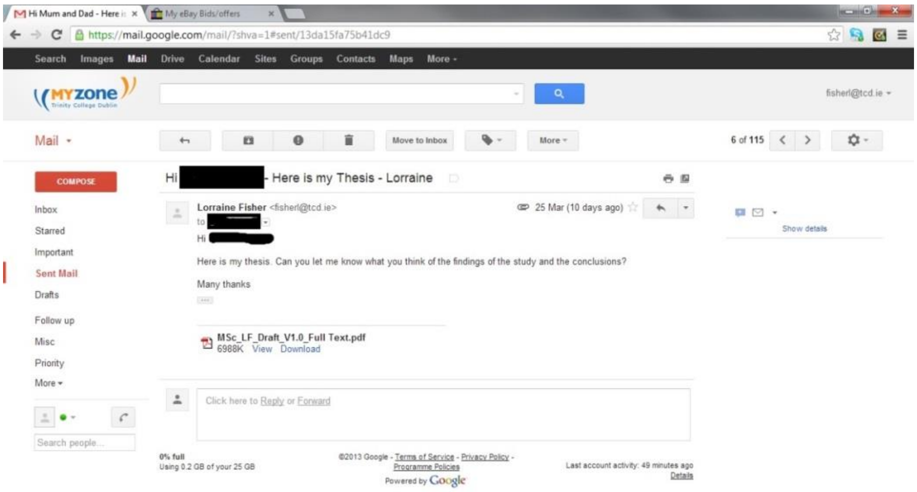
9.4.10 Methods > Field Notes > Screen Shot > YouTube Instructional Video Usage



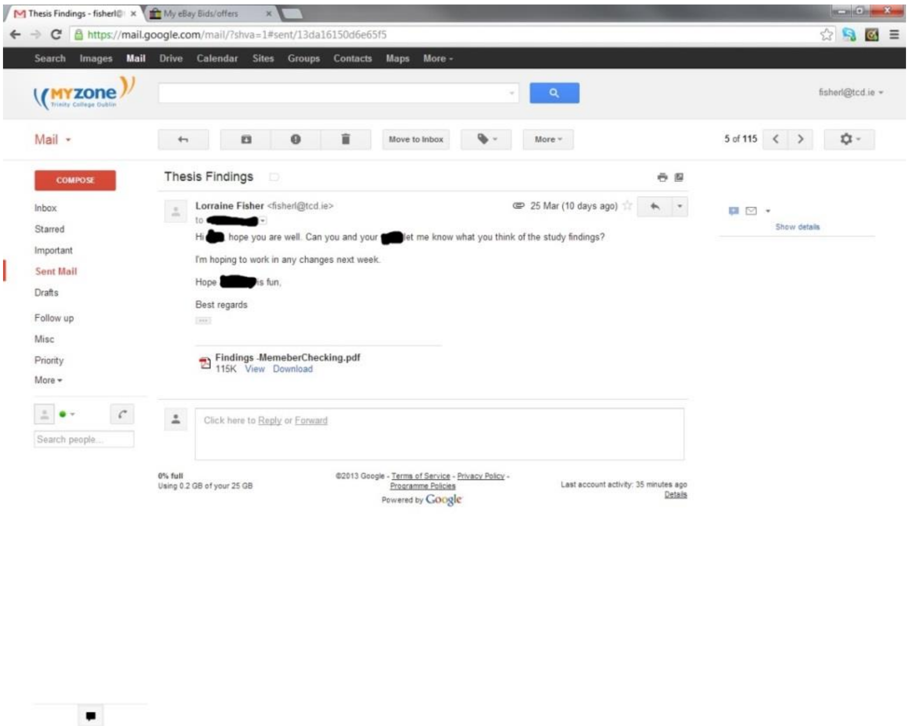
9.4.11 Methods> Field Notes > Screen Shot > Blog Usage



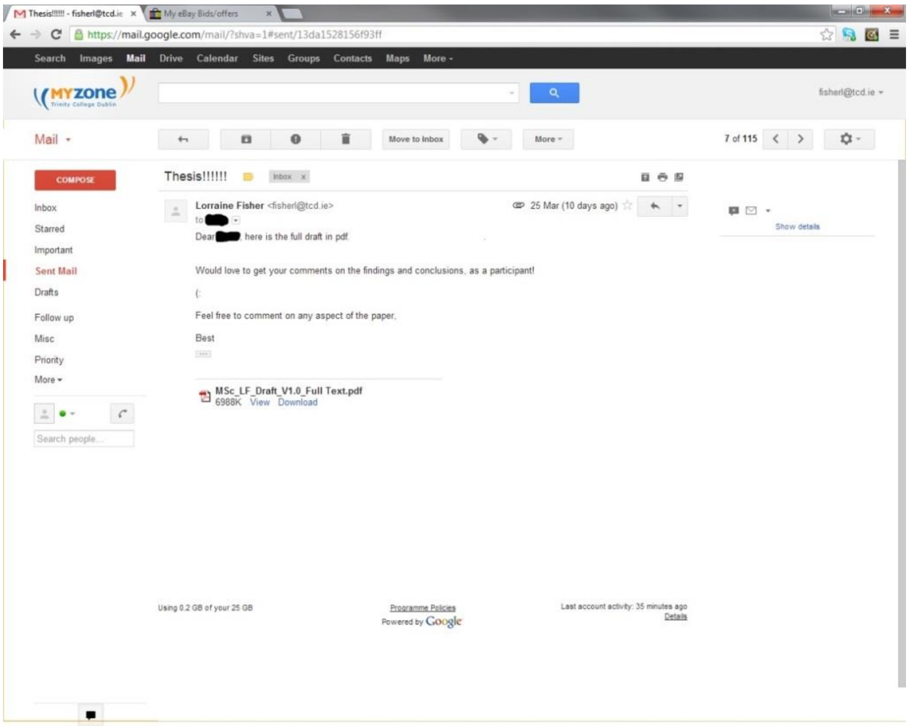
9.4.12 Methods > Member Checking > Invitation > Feedback > Participant 1 & 2



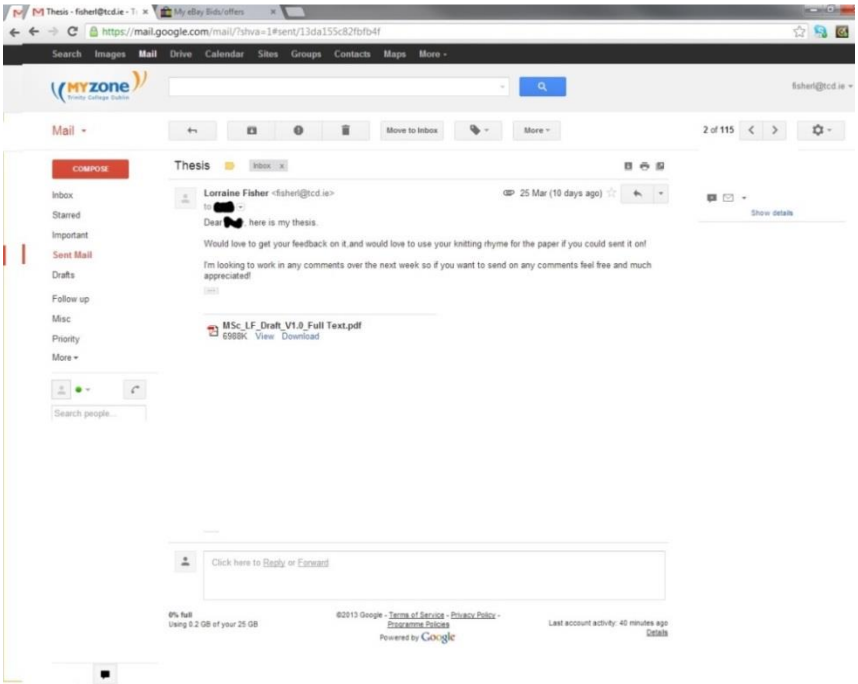
9.4.13 Methods > Member Checking > Invitation > Feedback > Participant 3 & 4



9.4.14 Methods > Member Checking > Invitation > Feedback > Participant 5



9.4.15 Methods > Member Checking > Invitation > feedback > Participant 6


Thesis

Lorraine Fisher <fisherl@tcd.ie> 25 Mar (10 days ago)

to [redacted]

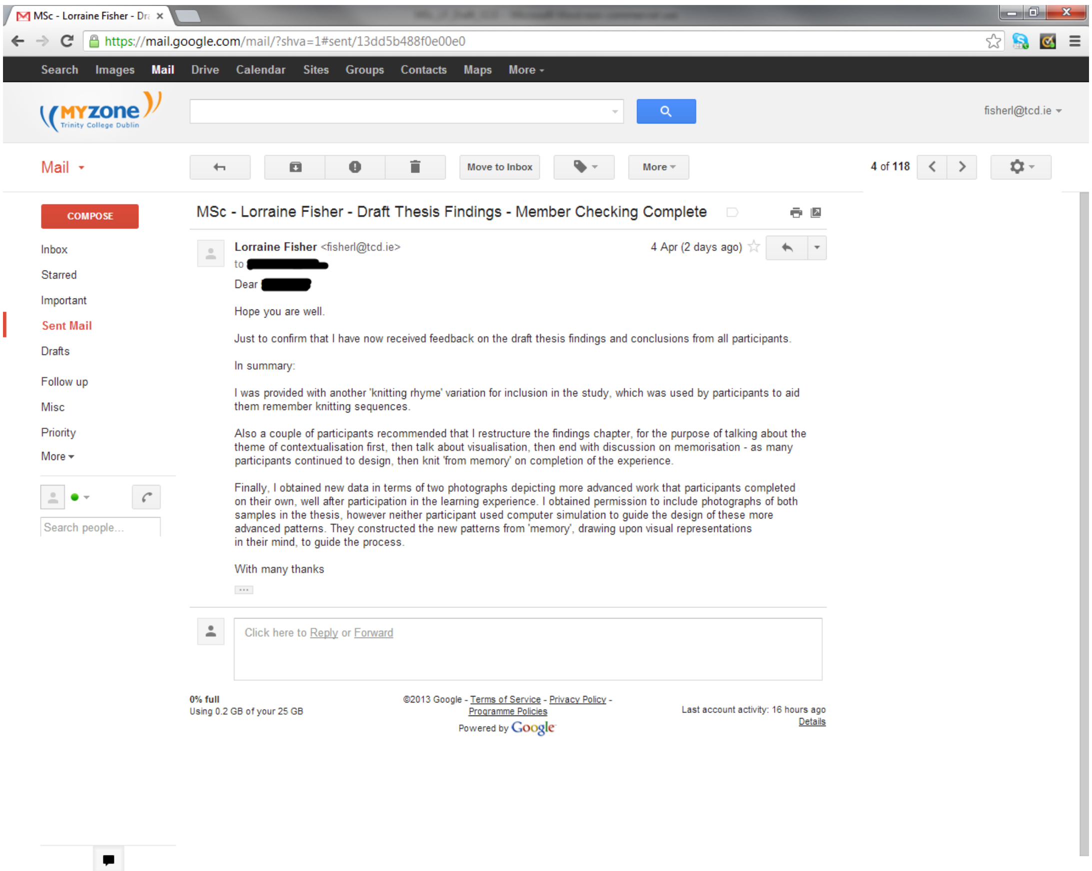
Dear [redacted], here is my thesis.

Would love to get your feedback on it,and would love to use your knitting rhyme for the paper if you could sent it on!

I'm looking to work in any comments over the next week so if you want to send on any comments feel free and much appreciated!

MSc_LF_Draft_V1.0_Full Text.pdf
6988K View Download

9.4.16 Member Checking > Closure > Participant Feedback Summary


MSc - Lorraine Fisher - Draft Thesis Findings - Member Checking Complete

Lorraine Fisher <fisherl@tcd.ie> 4 Apr (2 days ago)

to [redacted]

Dear [redacted]

Hope you are well.

Just to confirm that I have now received feedback on the draft thesis findings and conclusions from all participants.

In summary:

I was provided with another 'knitting rhyme' variation for inclusion in the study, which was used by participants to aid them remember knitting sequences.

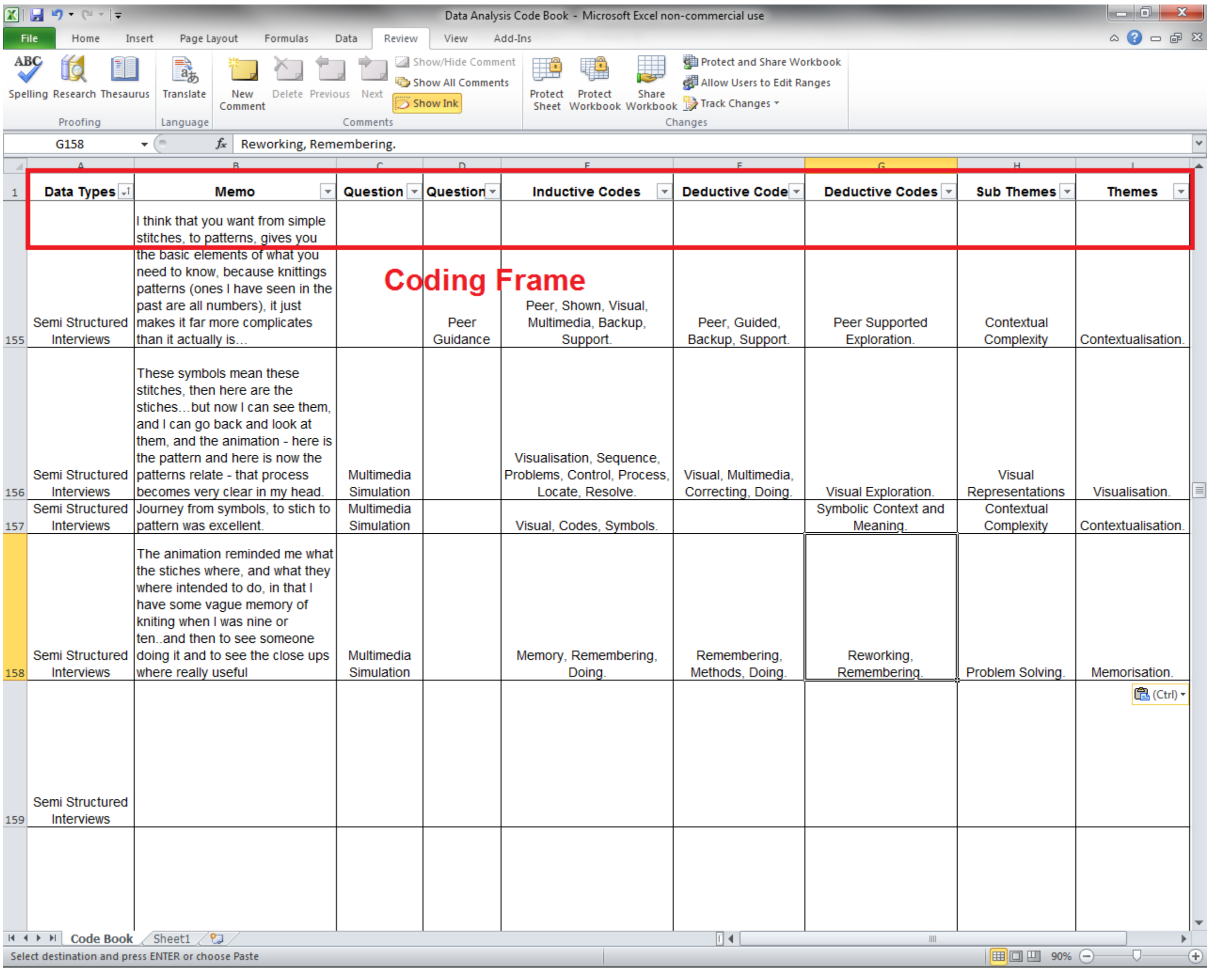
Also a couple of participants recommended that I restructure the findings chapter, for the purpose of talking about the theme of contextualisation first, then talk about visualisation, then end with discussion on memorisation - as many participants continued to design, then knit 'from memory' on completion of the experience.

Finally, I obtained new data in terms of two photographs depicting more advanced work that participants completed on their own, well after participation in the learning experience. I obtained permission to include photographs of both samples in the thesis, however neither participant used computer simulation to guide the design of these more advanced patterns. They constructed the new patterns from 'memory', drawing upon visual representations in their mind, to guide the process.

With many thanks

9.5 Analysis

9.5.1 Analysis > Data Set > Frame

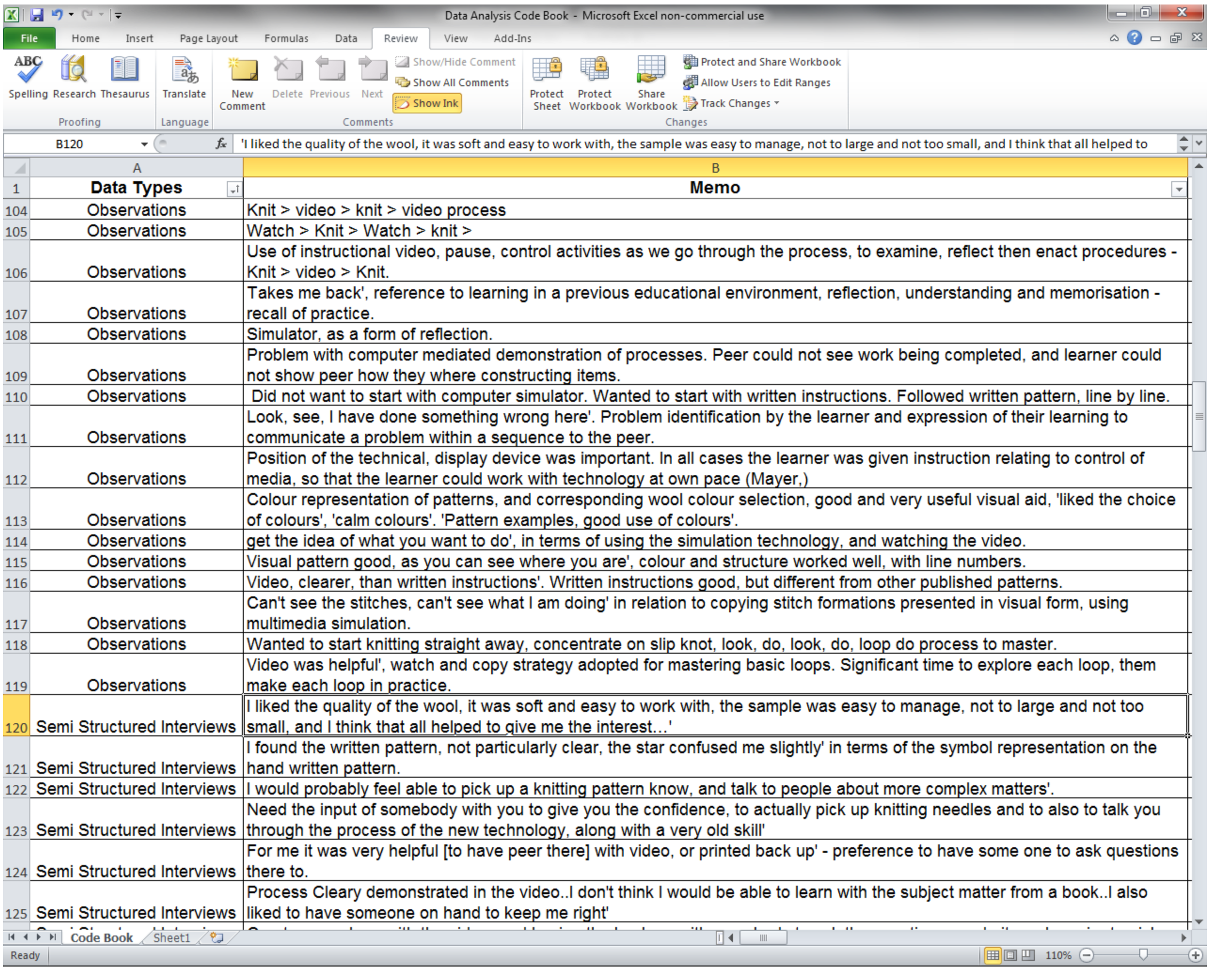


	Data Types	Memo	Question	Question	Inductive Codes	Deductive Code	Deductive Codes	Sub Themes	Themes
155	Semi Structured Interviews	I think that you want from simple stitches, to patterns, gives you the basic elements of what you need to know, because knittings patterns (ones I have seen in the past are all numbers), it just makes it far more complicates than it actually is...		Peer Guidance	Peer, Shown, Visual, Multimedia, Backup, Support.	Peer, Guided, Backup, Support.	Peer Supported Exploration.	Contextual Complexity	Contextualisation.
156	Semi Structured Interviews	These symbols mean these stitches, then here are the stiches...but now I can see them, and I can go back and look at them, and the animation - here is the pattern and here is now the patterns relate - that process becomes very clear in my head.	Multimedia Simulation		Visualisation, Sequence, Problems, Control, Process, Locate, Resolve.	Visual, Multimedia, Correcting, Doing.	Visual Exploration.	Visual Representations	Visualisation.
157	Semi Structured Interviews	Journey from symbols, to stich to pattern was excellent.	Multimedia Simulation		Visual, Codes, Symbols.		Symbolic Context and Meaning.	Contextual Complexity	Contextualisation.
158	Semi Structured Interviews	The animation reminded me what the stiches where, and what they where intended to do, in that I have some vague memory of kniting when I was nine or ten..and then to see someone doing it and to see the close ups where really useful	Multimedia Simulation		Memory, Remembering, Doing.	Remembering, Methods, Doing.	Reworking, Remembering.	Problem Solving.	Memorisation.
159	Semi Structured Interviews								

Headings are:

Data Types, Memo, Question 1, Question 2, Inductive Codes, Deductive Codes 1, Deductive Codes 2, Sub Themes, Themes.

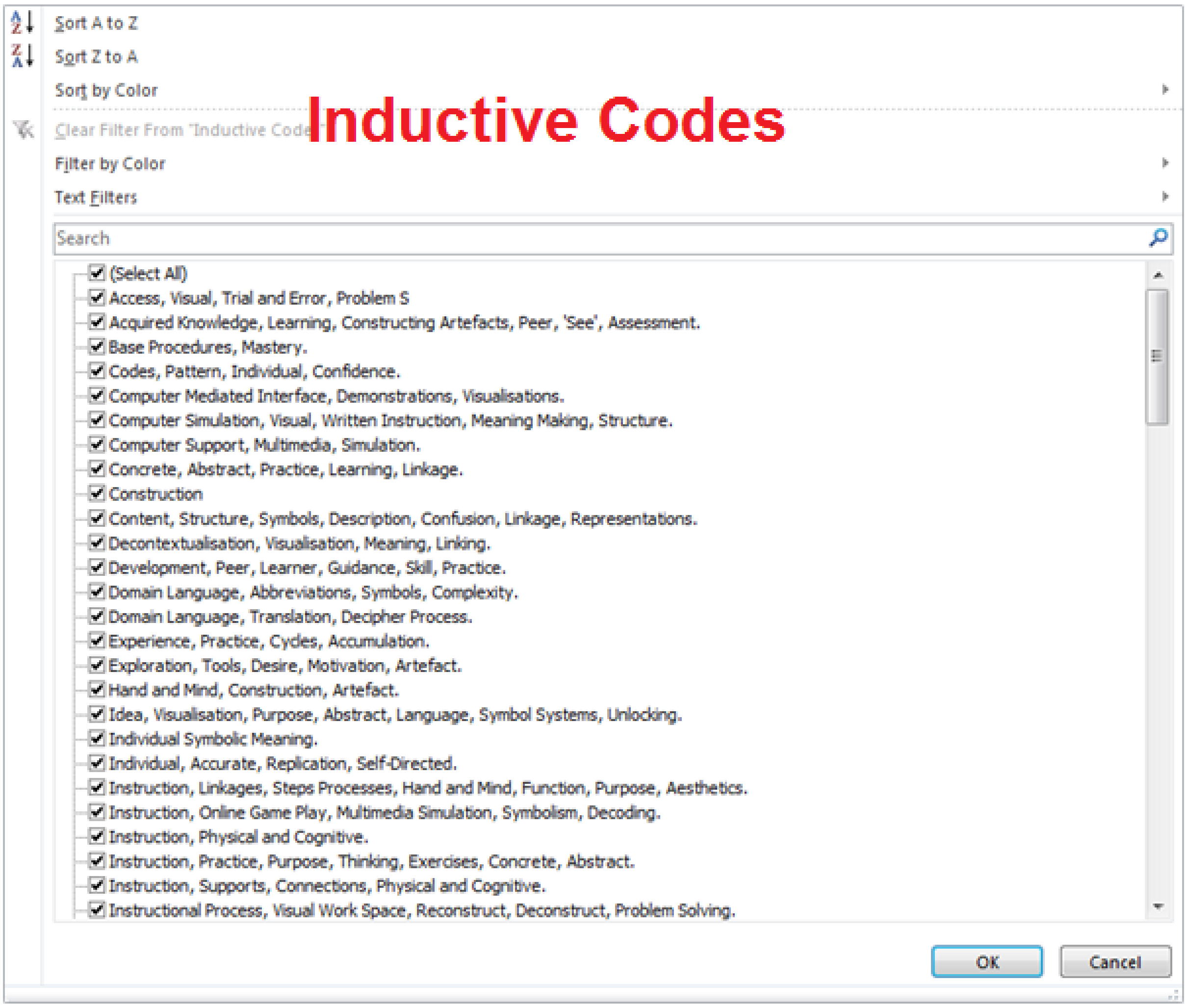
9.5.2 Analysis > Memos



	Data Types	Memo
104	Observations	Knit > video > knit > video process
105	Observations	Watch > Knit > Watch > knit >
106	Observations	Use of instructional video, pause, control activities as we go through the process, to examine, reflect then enact procedures - Knit > video > Knit.
107	Observations	Takes me back', reference to learning in a previous educational environment, reflection, understanding and memorisation - recall of practice.
108	Observations	Simulator, as a form of reflection.
109	Observations	Problem with computer mediated demonstration of processes. Peer could not see work being completed, and learner could not show peer how they where constructing items.
110	Observations	Did not want to start with computer simulator. Wanted to start with written instructions. Followed written pattern, line by line.
111	Observations	Look, see, I have done something wrong here'. Problem identification by the learner and expression of their learning to communicate a problem within a sequence to the peer.
112	Observations	Position of the technical, display device was important. In all cases the learner was given instruction relating to control of media, so that the learner could work with technology at own pace (Mayer,)
113	Observations	Colour representation of patterns, and corresponding wool colour selection, good and very useful visual aid, 'liked the choice of colours', 'calm colours'. 'Pattern examples, good use of colours'.
114	Observations	get the idea of what you want to do', in terms of using the simulation technology, and watching the video.
115	Observations	Visual pattern good, as you can see where you are', colour and structure worked well, with line numbers.
116	Observations	Video, clearer, than written instructions'. Written instructions good, but different from other published patterns.
117	Observations	Can't see the stitches, can't see what I am doing' in relation to copying stitch formations presented in visual form, using multimedia simulation.
118	Observations	Wanted to start knitting straight away, concentrate on slip knot, look, do, look, do, loop do process to master.
119	Observations	Video was helpful', watch and copy strategy adopted for mastering basic loops. Significant time to explore each loop, them make each loop in practice.
120	Semi Structured Interviews	I liked the quality of the wool, it was soft and easy to work with, the sample was easy to manage, not to large and not too small, and I think that all helped to give me the interest…'
121	Semi Structured Interviews	I found the written pattern, not particularly clear, the star confused me slightly' in terms of the symbol representation on the hand written pattern.
122	Semi Structured Interviews	I would probably feel able to pick up a knitting pattern know, and talk to people about more complex matters'.
123	Semi Structured Interviews	Need the input of somebody with you to give you the confidence, to actually pick up knitting needles and to also to talk you through the process of the new technology, along with a very old skill'
124	Semi Structured Interviews	For me it was very helpful [to have peer there] with video, or printed back up' - preference to have some one to ask questions there to.
125	Semi Structured Interviews	Process Cleary demonstrated in the video..I don't think I would be able to learn with the subject matter from a book..I also liked to have someone on hand to keep me right'

Memo’s include researcher compiled reflections, extracts from field notes, quotations from interviews, included on the bases that they are relevant to the research questions.

9.5.3 Analysis > Inductive Codes



Inductive Codes Extracted from Coding Frame

1. Access, Technology, Connected, Community.

2. Access, Visual, Trial and Error, Problem Solving

3. Acquired Knowledge, Learning, Constructing Artefacts, Peer, 'See', Assessment.

4. Base Procedures, Mastery.

5. Codes, Pattern, Individual, Confidence.

6. Colour, Basic Pattern, Assign Colour, Simulator.

7. Colour, Interpretation, Confidence.

8. Computer Mediated Interface, Demonstrations, Visualisations.

9. Computer Simulation, Visual, Written Instruction, Meaning Making, Structure.

10. Computer Support, Multimedia, Simulation.

11. Concrete, Abstract, Practice, Learning, Linkage.

12. Construction

13. Content, Structure, Symbols, Description, Confusion, Linkage, Representations.

14. Control, Animation, Embarrassment, Replay, Recall, Confidence.

15. Control, Pacing, Recall, Confidence, Links, Working Out.

16. Decontextualisation, Visualisation, Meaning, Linking.

17. Development, Peer, Learner, Guidance, Skill, Practice.

18. Domain Language, Abbreviations, Symbols, Complexity.

19. Domain Language, Translation, Decipher Process.

20. Experience, Practice, Artefact, Process, Motivation.

21. Experience, Practice, Cycles, Accumulation.

22. Exploration, Tools, Desire, Motivation, Artefact.

23. Hand and Mind, Construction, Artefact.

24. Idea, Visualisation, Purpose, Abstract, Language, Symbol Systems, Unlocking.

25. Individual Symbolic Meaning.

26. Individual, Accurate, Replication, Self-Directed.

27. Instruction, Linkages, Steps Processes, Hand and Mind, Function, Purpose, Aesthetics.

28. Instruction, Online Game Play, Multimedia Simulation, Symbolism, Decoding.

29. Instruction, Physical and Cognitive.

30. Instruction, Practice, Purpose, Thinking, Exercises, Concrete, Abstract.

31. Instruction, Supports, Connections, Physical and Cognitive.

32. Instructional Process, Visual Work Space, Reconstruct, Deconstruct, Problem Solving.

33. Internalisation, Meaning, Individual Symbolic Meaning.

34. Kinaesthetic Learning, Demonstration, Performance, Process, Procedure, Re-enactment.

35. Learning Experience, Structure, Access, Support.

36. Learning Experience, Structure, Visualise, Connections.

37. Learning Strategy, Trial and Error, Problem Solving, Symbolic

38. Learning, Codes, Symbols, Systems.

39. Learning, Confidence, Self-Directed, Motivation, Access.

40. Learning, Experience, Accommodation, Assimilation, Connections, Linkages.

41. Learning, Interpreting Symbolic Codes, Meaning, Context.

42. Learning, Process, Practice, Making, Constructing Artefacts.

43. Learning, Repetition, Over Time.

44. Learning, Repetition, Process, Looking, Doing.

45. Learning, Understanding, Procedure.

46. Making, Kinaesthetic, Concrete, Abstract, Making, Demonstration, Mastery.

47. Memory, Remembering, Doing.

48. Methods, Processes, Procedures

49. Methods, Stitch Type, Combinations, Loop Formations, Base Practices.

50. Multimedia Simulation, Multiple Representations, Problem Solving.

51. Multimedia Simulation, Structure, Support, Problem Solving.

52. Multimedia, Technology, Representations, Meaning, Codes, See.

53. Operational Process.

54. Patterns, Codes and Terms, Domain

55. Patterns, Symbol Systems, Codes .

56. Patterns, Symbol, Codes, Abstract, Sequenced, Complex.

57. Peer Guidance, Confidence, Manual Process, Technology, Assistance.

58. Peer, Guidance, Confidence, Self-Directed Learning.

59. Peer, Shown, See, Support, Visual, Ask, Learn, Process.

60. Peer, Shown, See, Visual, Process.

61. Peer, Shown, Visual, Multimedia, Backup, Support.

62. Peer, Visual, Demonstration, Support, Validation.

63. Peers, Instruction, Assistance, Individualism, Activity.

64. Peers, Instruction, Structure, Linkages,

65. Preference, Problem Solving, Difficulty, Resolution, Combinations, Replay.

66. Problem Solving, Cognitive, Working Out, Thinking Through.

67. Problems, Guiding, as Helping, Approach, Knowledge

68. Procedures, Linkages, Context, Trial and Error, Learning Development, Peer Guidance.

69. Process, Expectation, Non use of Technology.

70. Process, Problem Solving, Visualisation, Communication, Peer.

71. Processes, Base Techniques, Performance, Mechanism.

72. Processes, Variance, Physical, Artefact Construction.

73. Reflection, Understanding, Memorisation, Recall.

74. Replicate, Reconstruct, New / Omitted Processes.

75. Replicate, reconstruct, relationships, simulation, Process Reflection.

76. Reworking Practices, Problem Solving, Replication.

77. Self-Directed Problem Solving, Visual Reconstruction, Arrangement, Demonstration.

78. Sequences, Formation, Abstract.

79. Simulation, Learning, Symbolic, Confidence, Visualisation, Experimentation.

80. Simulation, Learning, Symbolic, Guidance, Making.

81. Simulator, Reflection, Remembering, Process, Trial and Error, Abstraction, Concretisation.

82. Simulator, Reflection.

83. Skill, Expertise, Variance, Learning.

84. Sound, Concentration, Visual, Representation, Understanding.

85. Steps, Processes

86. Structure, Process, Explore, Performance.

87. Symbols, Adapt, Modify, Linkage, Abstraction, Concretisation, Individual, Motivation.

88. Symbols, Complexity, Language, Process, Mastery, Simulation, Understanding.

89. Symbols, Complexity, Process, Adaptation, Modification, Mastery, Simulation, Individuality, Confidence, Understanding.

90. Symbols, Guided, Codes, Terms, Visualise, Structure, Map, Mastery.

91. Symbols, Individual, Artefact, Construction, Abstraction, Motivation.

92. Symbols, Language, Visual, Codes, Terms, Simulation, Structure, Control, Mastery.

93. Symbols, Language, Visual, Codes, Terms, Simulation, Structure, Control, Motivation, Individual.

94. Symbols, Pattern, Confusion, Terminology.

95. Symbols, Pattern, Terminology, Technology. Confidence.

96. Symbols, Sequencing, Constructing, Manipulation, Mastery, Simulation, Understanding.

97. Symbols, Simulate, Abstraction, Assistance, Translation, Visualise, Master.

98. Symbols, Visual, Master, Individual, Motivation, Perception, Achievement.

99. Symbols. Codes, Language, Structure, Process, Replication, Control, Mastery.

100. Technology, Access, Thinking, Learning, Need.

101. Terms, Explanations, Verbalisation, Use.

102. Tools, Confidence, Try, Work Out, Thinking, Exploration, Confidence, Structure.

103. Tools, Confidence, Try, Work Out, Trial and Error, Exploration, Confidence.

104. Trial and Error, Learning Strategy, Experience, Problem Solving.

105. Variance, Complexity, Change, Unexpected, Accommodation, Flexibility.

106. Video, Film, Clarity, Visual, Understanding.

107. Visual Media, Control, Direction, Content, Pace, Learning.

108. Visual Media, Representations, Process, Exploration.

109. Visual Presentation, Symbolic Presentation, Restructuring.

110. Visual Representation, Patterns, Structure, Ambiance.

111. Visual, Code, Term, Symbol, Entry Point, Language, Symbol Systems, Multimedia.

112. Visual, Codes, Symbols.

113. Visual, Multimedia, Manipulation, Simulation, Mistakes.

114. Visual, Structure, Aesthetic, Individual.

115. Visual, Symbolic Representation, Pattern, Structure, Instruction, Understanding.

116. Visual, Symbolic Representation, Pattern, Structure, Instruction, Variance.

117. Visualisation, Activity, Repetition, Learning, Individual, Problem.

118. Visualisation, Activity, Repetition, Learning, Individual.

119. Visualisation, Difficulties, See, Artefact, Simulation, Projection.

120. Visualisation, Realisation, Construction, Symbolism, Representation, Making.

121. Visualisation, Referring, Checking, Confidence, Ownership.

122. Visualisation, Sequence, Problems, Control, Process, Locate, Resolve.

123. Watching, Visualising, Support, Making, Repetition.

9.5.4 Analysis > Deductive Codes > Iteration 1

Deductive Codes – Iteration 1 - Extracted from Coding Frame

1. Access, Connected, Technology.
2. Base Procedures, Linkage
3. Capture Context, Examples, Illustrations.
4. Computer, Visual, Simulatory, Learning
5. Construction
6. Control, Replay, Confidence.
7. Co-Production, Development, Sharing, Skills, Guidance.
8. Development, Variance, Trial and Error.
9. Domain Language, Symbolic, Complexity.
10. Exploration, Motivation, Artefact.

11. Explore Context, Peer Guided, Discovery.

12. Facilitated Instruction, Interaction, Decoding.

13. Guidance, Linking, Process, Aesthetics, Function.

14. Guiding, Assisting, Solving Problems, Helping.

15. Individual, Accuracy Linking, Process, Aesthetics, Function.

16. Instruction, Organised, Structure, Practice.

17. Instruction, Practice, Structure, Thinking, Concrete,

18. Internalisation, Individual Symbolic Meaning.

19. Interpretation, Confidence.

20. Knowledge, Constructing, Visualisation, Assessment.

21. Language Translation, Decipher. Meaning.

22. Learner Directed Problem Discovery / Resolution.

23. Learning, Process, Linkage, Making.

24. Learning, Repetition.

25. Learning, Symbolism, Context.

26. Learning, Understanding, Process, Replication.

27. Learning, Variance, Meaning.

28. Limitations, 'see', Demonstration, Visual.

29. Linkage, Remember

30. Manipulation, Remembering

31. Meaning Making, Written Process, Structure.

32. Methods, Variance, Remembering.

33. Peer Guidance, Process, Technology, Assistance.

34. Peer, Guided Learning, Connections, Confidence.
35. Peer, Guided, Backup, Support.
36. Peer, Guided, Support.
37. Peer, Guided, Visualisation, Process.
38. Peers, Guidance, Practice, Linkage,
39. Peers, Guidance, Self Determination.
40. Person 2 Person sharing of content. No Technology.
41. Practice, Artefact, Motivation.
42. Practice, Thinking, Doing.
43. Problem Solving / Discovery
44. Problem Solving / Discovery / Understanding.
45. Procedural Understanding.
46. Procedural Understanding. Context, Peer Guidance.
47. Remembering, Methods, Doing.
48. Repetition, Process, Learning.
49. Reworking, Simulating Complexity.
50. Simulating Problems.
51. Simulation, Visualisation, Confidence, Experimentation.
52. Simulator, Remember, Trial and Error, Abstraction, Concrete.
53. Strategy, Problem Solving, Symbolic, Contextual
54. Structure
55. Structure, Process, Control.
56. Structure, Visualisation, Memorisation, Context.

57. Structure, Visualisation.

58. Supports, Guidance, Linkage, Connections, Physical, Mental.

59. Symbol Descriptions, Context, Confusion.

60. Symbolic Meaning.

61. Symbolic, Context, Confidence.

62. Symbolic, Meaning, Context, Restructuring.

63. Symbolic, Representation, Guidance.

64. Symbolic, Representation, Understanding.

65. Symbolic, Representation, Variance.

66. Symbolism, Verbalisation,

67. Symbols, Assistance, Visualise, Master.

68. Symbols, Context, Confusing.

69. Symbols, Domain, Visualise, Understanding, Mastery.

70. Symbols, Individual, Abstraction, Motivation.

71. Symbols, Individual, Adaptation, Mastery, Simulation, Understanding.

72. Symbols, Linkage, Abstract, Concrete, Meaning, Motivation.

73. Symbols, Mastery, Complexity, Simulation, Understanding.

74. Symbols, Meaning, Abstract, Context.

75. Symbols, Meaning, Abstract.

76. Symbols, Technology, Confidence.

77. Symbols, Understanding, Context, Simulation, Control.

78. Symbols, Visual, Simulation, Process, Mastery, Achievement.

79. Symbols, Visual, Simulation, Process, Mastery.

80. Technology, Access, Thinking.

81. Tools, Trial and Error, Exploration, Learning, Confidence.

82. Tools, Trial and Error, Exploration, Thinking, Learning, Confidence.

83. Trial and Error, Problems

84. Understanding, Memorisation.

85. Variance, Change, Accommodation, Adapting.

86. Variance, Change, Accommodation, Making.

87. Visual Presentation, Representations, Convey Meaning, Multimedia.

88. Visual Representation, Exploration, Control.

89. Visual Representation, Exploration.

90. Visual Structure, Ambiance.

91. Visual Symbolism, Codes, Access, Unlock Meaning, Multimedia.

92. Visual, Aesthetic, Structure.

93. Visual, Colour, Simulator.

94. Visual, Decontextualisation.

95. Visual, Memorisation, Structure, Problem Solving.

96. Visual, Multimedia, Correcting, Doing.

97. Visual, Representation, Understanding.

98. Visual, Understanding.

99. Visualisation, Artefact, Projection.

100. Visualisation, Exploration, Confidence, Ownership.

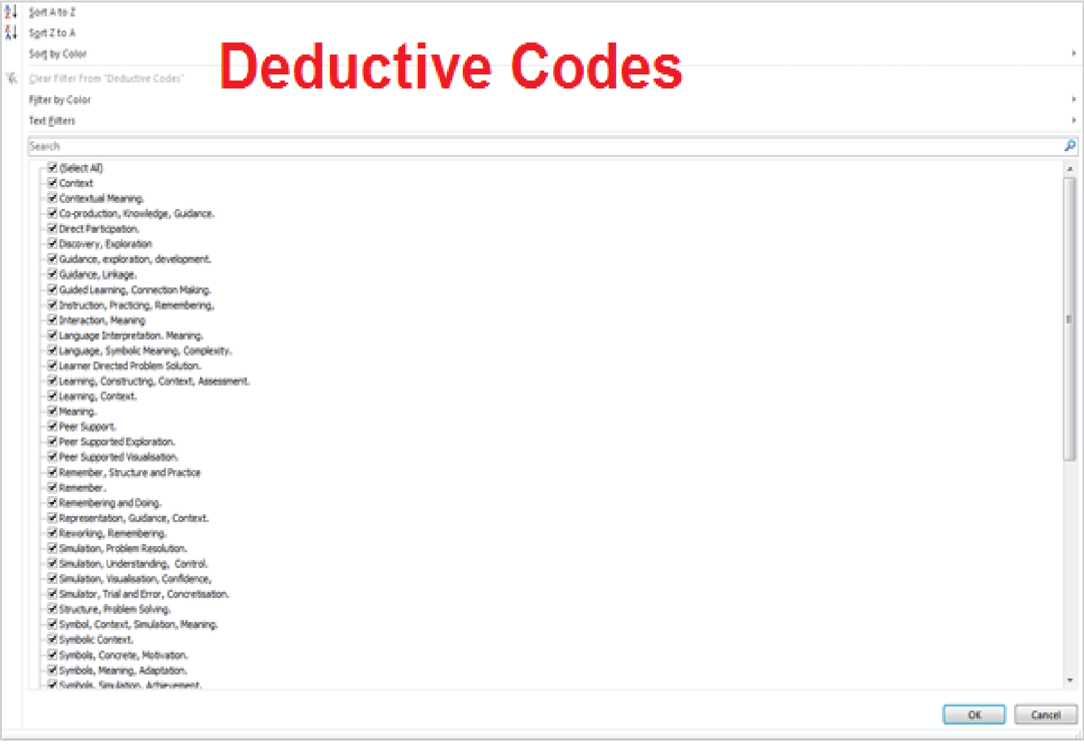
101. Visualisation, Seeing, Barrier, Problem.

102. Visualisation, Seeing, Context, Symbolism.

103. Visualise, Memorise.

104. Working Out, Practice, Thinking, Remembering,

9.5.5 Analysis > Deductive Codes > Iteration 2



Deductive Codes – Iteration 2 - Extracted from Coding Frame

1. Artefact, Exploration.

2. Confidence Building.

3. Contextual Meaning.

4. Co-production, Knowledge, Guidance.

5. Guidance, exploration, development.

6. Learner Directed Problem Solution.

7. Peer Supported Exploration.

8. Recall and Reflection

9. Representation, Guidance, Context.

10. Reworking, Remembering.

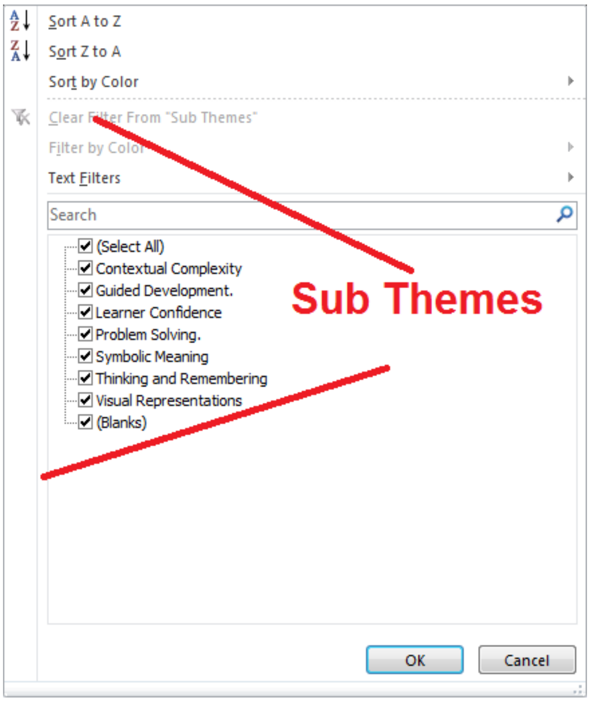
11. Simulation, Problem Resolution.

12. Simulation, Visualisation, Confidence.

13. Symbolic Context and Meaning.

14. Visual Exploration.

9.5.6 Analysis > Sub Themes



Sub Themes Extracted from Coding Frame

1. Contextual Complexity

2. Guided Development.

3. Learner Confidence

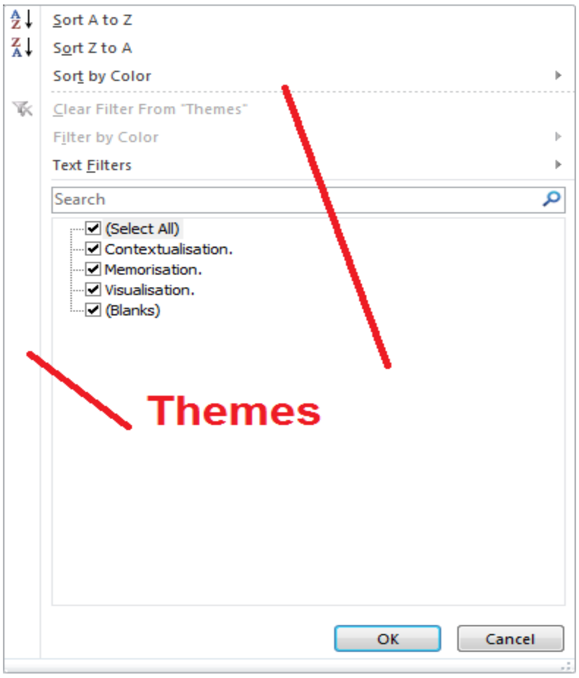
4. Problem Solving.

5. Symbolic Meaning

6. Thinking and Remembering

7. Visual Representations

9.5.7 Analysis > Themes



Themes extracted from Coding Frame

1. Contextualisation.

2. Memorisation.

3. Visualisation.