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Exploratory case studies at the interface of divergent thinking and online learning

Barry Lupton MGLDA

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

2012

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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Abstract

Creativity is viewed as the engine of technical and economic growth and as playing an important role in the development of both individuals and societies: despite this, its representation in education is at best intermittent. While there is a general belief that creativity cannot be taught, there is agreement that creative performance and output can be increased through instruction in its components. One of these components is divergent thinking. With a view to providing insight into the development of successful creativity training resources, this study explores how users respond to a tool developed to enhance divergent thinking within a contemporary educational setting: online learning.

To achieve this, three qualitative explorative case studies were undertaken. Multiple data sources were drawn upon to provide a rich understanding of participant experience. Data were analysed using a variety of means centring on immersion, pattern and theme identification, narrative forming, analysis and cross-case analysis. Collected data related to participant experience of an online resource developed specifically to enhance DT. The resource was housed within a Moodle based VLE, which involved participants undertaking a number of well-established, time-constrained DT exercises over a nine-day period. The design of the learning experience was guided by the instructional model ADDIE and by Kolb's learning cycle.

The study produced a number of significant findings, most notable of which include findings that implied the experience did enhance levels of divergent thinking; undertaking placating, pre-engagement activates increased engagement and performance; the importance of immediate physical environment in mediating affective states; the positive impact of DT exercises in reducing negative emotional responses to the online environment; the positive benefits afforded by the facility to review answers in combination with the online reflection blogs. In addition, it was found that real world, social interaction and dialogue - which was not a designed aspect of the resource - played a vital role in enhancing the experience of users with low levels of computer and creative self-efficacy.

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Chapter 1 Introduction

1.0 Introduction

Creativity is commonly considered to be the second major field of human performance next to intelligence (Benedek, Fink & Neubauer, 2006). It is viewed as the engine of economic and technical growth (Akarakiri, 1998; Child, 1986, p 222; DeFillippi et al, 2007; Fong, 2006) and it is of such importance that its effects can endure for decades, centuries and millennia (Simonton, 2010, p174). Despite this, its influence in education has been at best intermittent and irregular (Feldman & Benjamin 2006). While it is generally agreed that creativity cannot be taught, it is also commonly understood that certain creative strategies can. One of these strategies, which is relatively well understood is divergent thinking (DT). Defined as the ability to produce numerous answers to open ended questions, DT is seen an essential component of creativity and one which can be enhanced through training.

While attention to creativity training in education is at best intermittent, the use of computers is increasing exponentially (Sung, Chang, & Yu, 2011). The pace of increase is such, that emerging issues related to its successful integration have become of great concern (Wang, & Woo, 2007). Of significant importance to both computer use in education and creativity training are human related issues such as user perception, attitude, personality traits and physical and socio-cultural context (Flood, 2003; Liaw, Huang, & Chen, 2007; Orvis et al, 2011; Batey, Chamorro-Premuzic & Furnham, 2009; Simonton, 2000). Considerable research has been undertaken to illuminate these areas in relation to computers and creativity in isolation, but little evidence could be found which explores their point of intersection.

The proceeding chapters of this study attempt to gain a greater understanding of this important but complex interface. It is the intention that the understanding gained will afford designers greater opportunity to create more engaging, easily adopted and ultimately successful, online training programmes for enhancing creative thinking processes.

1.1 Research question

The following research question was used to guide this investigation.

- How do participants respond to an online tool developed to enhance DT?

To answer this question a learning experience designed to enhance DT was created and the following sub-questions posed:

- Were key personality traits evident in learner responses?
- How were participant attitude, perception and affect reported in learner responses?
- How were contextual factors represented in participant responses?
- Was there evidence of enhanced ability in DT?

1.2 Roadmap

This is an exploratory investigation looking at how participants respond to an online tool developed to enhance DT. In order to achieve this, a review of current research into human related factors in online learning, creativity and DT was conducted. The reviewed literature is then followed by a design chapter. The chapter sets out how key literature findings were utilised to form a framework of design considerations, which were used in conjunction with relevant pedagogical and instructional design principles to inform the resource design. This chapter also presents a walkthrough of the learning experience.

In order to address the research question, an explorative, multiple-case study with a qualitative emphasis is described in the methodology chapter. The case procedure is described and is followed by the data collection and analysis methods used. Findings from the data analysis are presented and followed by a discussion. Finally, the conclusion attempts to address the principal research question, sets out the limitations of this study and communicates unexpected findings and recommendations for future research

Chapter 2 Literature Review

2.0 Background and context

This study is intended to investigate participant response to an online tool developed to enhance DT. To inform the investigation this review aims to identify and define the key human related factors identified in both online learning and DT. This review firstly defines the central terms of interest before rationalising the exploration of DT by placing it firmly in the context of creativity. The review then presents human/computer interface factors evidenced to play a role in online learning and DT. For clarity of understanding, human related factors are categorised as affect, personality traits, attitude, perception and contextual factors. Each subsection is concluded with a tabulated summary of possible opportunities for investigation and design considerations for the online tool.

2.0.1 Method

To facilitate this review various forms of literature were accessed through a number of web-based resources and Trinity College Library. Online journals and print media were searched using the following terms: online learning, DT and creativity. These terms were then coupled with narrowing terms of interest including: affect, personality, response, influencing factors, mediating factors, human factors.

2.1 Central terms of interest

2.1.1 Online Learning

For the purposes of this study, online learning is defined as a way of learning that can provide education and training with the use of information communication technologies (ICT) to anyone, anytime and anywhere.

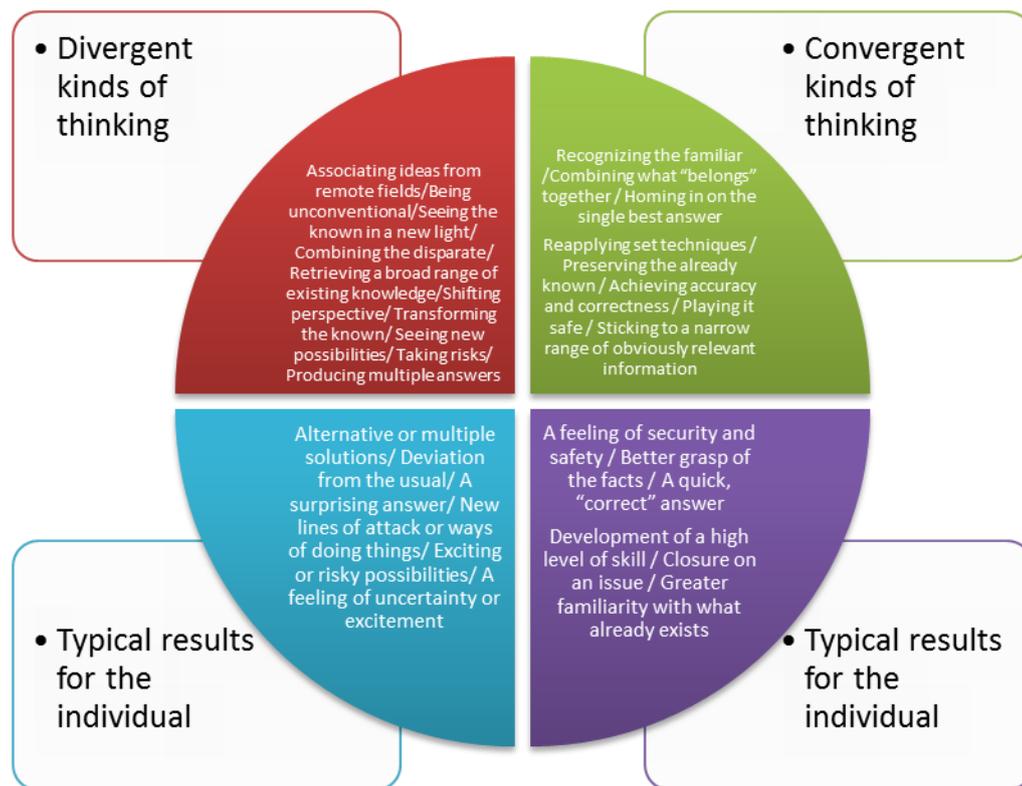
Online learning is seen as playing an increasingly important role in education (Hogo, 2010; Franceschi et al., 2009). Of particular interest to this investigation is that while the rapid pace of technological development and exponential rise in educational use (Sung, Chang, & Yu, 2011) have afforded a shift toward personalized, learner centred approaches (Shen, Wang, & Shen, 2009), the pace of change is such that emerging issues related to successful integration have become a great concern (Wang, & Woo, 2007). Of further interest is the weight of evidence which highlights learner attitude, perception, personality and affect

as central to the successful delivery and integration of online learning activities (Arbaugh, 2002; Arbaugh and Duray, 2002; Bannan-Ritland, 2002; Chen & Jang, 2010; Davis et al., 1992; Jeamu, Kim, & Lee, 2008; Lim, 2004; Rodgers & Withrow-Thorton, 2005; Saadé et al 2007; Venkatesh et al 2002; Hong, 2002; Liaw et al, 2007; Lin, 2007; Piccoli et al., 2001; Selim, 2003).

2.1.2 Divergent thinking (DT)

DT has been defined as *the ability to generate numerous and diverse ideas to open ended questions* (Guilford, 1950; Runco, 1991; Scott et al., 2004) and requires recognizing links among remote associates, making unusual combinations, and transforming information into unexpected forms (Cropley, 2006). It is seen as allowing people to view problems from many perspectives in order to discover many possible ideas and combinations that may serve as solutions (Finke et al.1992) that are often novel, unusual, or surprising (Cropley, 2006). In this sense it is viewed as being important in both creative problem solving (Mednick, 1962) and problem finding (Sawyer, 2006, p73). Several researchers have stated that it comprises of a number of interrelated components, including; fluency (the total number of ideas generated), flexibility (the number of categories in the ideas) and originality (the number of unique or unusual ideas, (Guilford, 1950; Runco, 1991; Runco, et al. 2006). DT is commonly viewed as the opposite to convergent thinking – the ability to find the one, and only one, correct solution (Benedek, Fink & Neubaur, 2006). In his review, Cropley (2006) characterised the types of thinking and results produced from each form as follows.

Figure 1: Key types of thinking and results produced in divergent and convergent thinking processes



2.2 DT in context with creativity

This section underpins the investigation focus by placing DT within the domain of creativity. This will be achieved by defining and illustrating the importance of creativity, its role within creativity and by reviewing it through the lens of contemporary education.

Creativity is of immediate interest to just about everyone (Pope, 2005, p.1). Over the last 50 years researchers have extolled the benefits of creativity in enhancing intellectual, educational and talent abilities (Plucker et al, 2004, Wheeler, Waite, Bromfield, 2002). It is viewed as the engine of technical and economic growth by the business sector (Akarakiri, 1998; Child, 1986, p 222; DeFillippi et al, 2007; Fong, 2006), as playing an important role in the development of both individuals and societies (Karakelle, 2009) and it has been suggested that some form of creative ability is required in almost every job (Shalley, Gilson, & Blum, 2000). The established importance of creativity makes it a valid, if challenging area for investigation.

While there are in excess of 100 diverse and contentious definitions for creativity in common usage (Wheeler, Waite & Bromfield, 2002) what is generally agreed upon is that

definitions fall within two camps; those that centre on the creation of new and socially useful products and those that focus on creative activities represented in day to day activities of individuals (Sawyer, 2006, p. 27). Regardless, the situation remains factious, with many researchers continuing to define creativity in many different ways (Kaufman & Beghetto, 2009) or simply avoiding definition at all (Plucker & Makel, 2010, p.48). Complicating this contentiousness is evidence that the vast majority of creativity literature is limited to the cultural perspectives of developed western societies (Craft, 2000, p.14) and drawn from a single source: The Cambridge Handbook of Creativity (Pope, 2005).

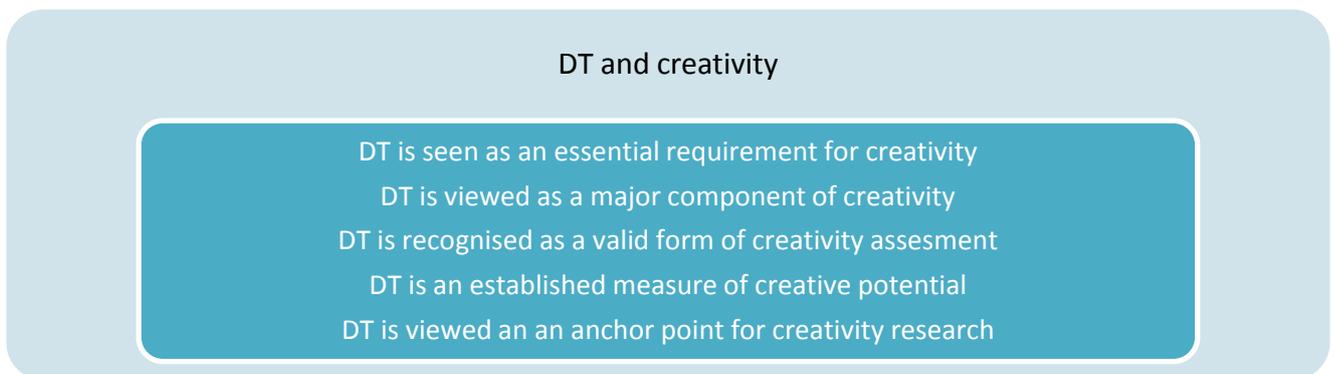
Given the complexity and contentiousness of the literature, it would be ambitious to address the full scope of creativity and a narrower focus on a critical component of creativity may represent a more pragmatic approach (Plucker, Runco & Lim, 2006). One component, with evidence to suggest useful application to creativity, is the development of requisite cognitive strategies (Scott et al, 2004). Although cognitive strategies related to creativity represent a large field of study in their own right, one specific area, DT (Benedek, Fink & Neubaur, 2006), may provide a firm foot hold for this investigation.

DT is viewed an essential requirement for creative thinking (Kilgour, 2006; Mednick 1962; Sawyer, 2006, p.44), a good predictor of creative potential (Runco, 2008) and an anchor point for the study of creativity (Schoenfeldt, & Jansen,1997, p82). It has also been reported that the majority of creativity training programs include DT as a major component (Baer, 1993, p.139). In context with this investigation, it is acknowledged that creativity is not the same thing as DT (Sawyer, 2006, p.45) nor does it derive from DT in isolation, but requires an interaction between convergent thinking (Cropley, 2006) and other factors. Two of the most significant historic roles played by DT in creativity are as a predictors and measurement of creative potential (Clapman, 1997; Scott, Leritz, & Mumford, 2004; Mednick, 1962; Runco, 1991; Runco et al, 2006). Typical DT tools used for prediction and measurement include series of open-ended questions to which the respondent is asked to generate a number of solutions or ideas (Runco, 1991). DT tests have changed little since the 1960's (Silva, et al 2008) and are still scored on the basis of ideational fluency (the total number of ideas), originality (the number of unique or unusual ideas), and flexibility (the number of categories or themes in the ideas), (Runco et al 2006); Of the three measures, fluency and originality are the most frequently used, and in specific reference to DT, verbal fluency is considered the most valid form of measurement (Chamorro-Premuzic &

Reichenbacher, 2008). This latter finding is supported by a number of psychometricians, who believe that DT scores are so highly correlated that only one aspect of DT needs to be assessed (Runco, 1999, p. 578).

Although DT tasks remain the most common form of creativity prediction and measurement, they are not without criticism. Many researchers have posited that DT had nothing to do with creativity, but this work has largely been discarded as their opinions were formed in the 1960s and 1970s when general views of DT tended to be pessimistic (Plucker, Runco & Lim, 2006). Others have suggested that DT has failed to live up to its promise of raising global levels of creativity (Sawyer, 2006; Weisberg, 2000). Vincent, Decker and Mumford, (2002) have questioned the multitude of scoring systems as structures used for assessment as possibly undermining results produced. Another significant problem identified in the use of DT in creativity prediction and measurement relates to how creativity is viewed; on one hand it is viewed as being a trait characteristic of a person while on the other it is defined in terms of a creative product (Eysenck, 1993). Figure 2 below provides a summary of the relationship of DT to creativity.

Figure 2: The key roles played by DT in creativity



2.3 DT in education and training

Despite the apparent importance of creativity and the availability and diversity of effective creativity training techniques (Scott, Leritz, & Mumford, 2004), its influence in education has been at best intermittent and irregular (Feldman & Benjamin 2006). Some of the reasons suggested for this situation include the focus of traditional education on convergent rather than DT (Runco, 1999, p577), which is manifested in teachers giving more emphasis to the enhancement of logical thinking that focuses on knowledge, recall, and

reproduction (Fryer & Collings, 1991; Furman, 1998; Westby, 1997). Torrance (1995, p.13) pointed out that opportunities for DT in education are inhibited by a general sense that creative students can cause problems in classrooms and creative teachers can cause problems for administrators. Another significant factor is oversimplified conceptions of creativity leading to it being stereotyped and mythologized; something which has limited its impact on educational psychology (Plucker, Beghetto & Dow, 2004). Concern about creativity in contemporary education is such that Robinson (2006) stated that education is in the midst of a creativity crisis.

What is of particular interest to this investigation, in context with education and training, is research which suggests that while creativity cannot be taught, creative-thinking techniques and procedures can (Lau et al 2009); and by providing a favourable environment and appropriate learning conditions, the characteristics underpinning creativity can be developed (Cropley, 1997, p.83). These positive and widely held beliefs are further strengthened by the understanding that creative output can be increased through training and practice in DT (Baer, 1993, p.17; Benedek, Fink & Neubaur, 2006; Clapman, 1997; Scott, Leritz, & Mumford, 2004; Rose and Lin, 1984). From the perspective of learning resource design, it is also worth highlighting that the numerous DT tests and measurement tools developed, can also work as effective creativity exercises in educational settings (Baer, 1993, p.18; Basadur, Pringle, and Kirkland, 2002; Benedek, Fink & Neubaur 2006; Runco, 1991; Runco, 1999, p. 581; Runco, 2010, p.415) and that it is generally agreed that DT skills are transferable across domains (Baer, 1993, p.44)

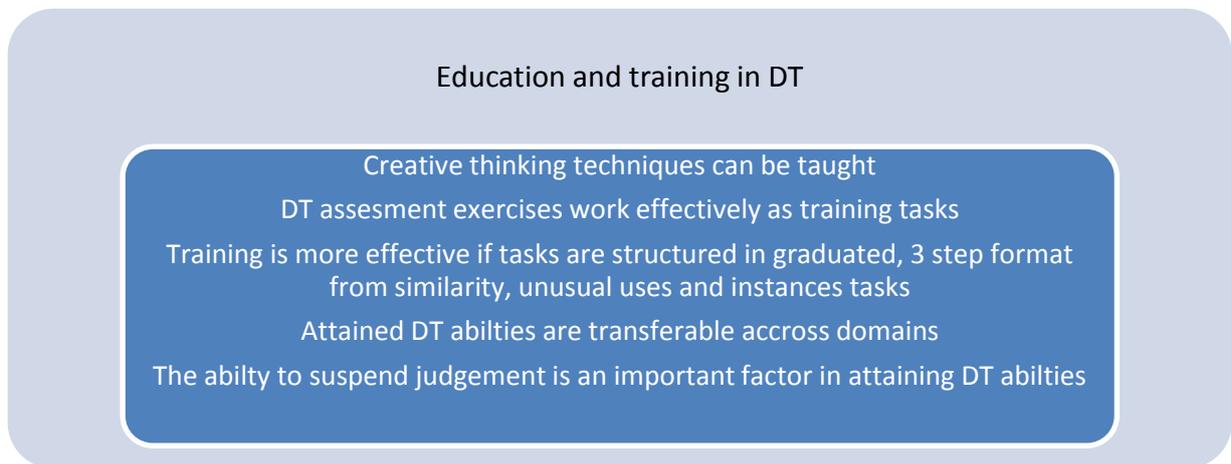
2.3.1 The structure and measurement of DT tasks in education and training

As previously mentioned, DT tasks usually involve one or more of the following; ideational fluency, flexibility and originality. Tasks typically centre on verbal or figural problem solving or finding, with participants being asked to list as many ideas as they can without concerning themselves about their value (Vosburg, 1998). Although DT tasks are used extensively in creativity training programs, many have been criticised for being too complex and encompassing too many components, which can in fact undermine their effectiveness (Benedek, Fink & Neubaur, 2006). Others state that for scores to be dependable at least 15 tasks should be used (Silva et al, 2008). Addressing issues surrounding the structure and content of DT training, Runco, (1999, p. 579) suggests a gradual, three step format, which moves from similarity tasks (e.g., ways in which milk and meat are similar) to

unusual uses tasks (e.g., for bricks, knives, newspapers) and finally to instances tasks (e.g., instances of things that are round, strong, or loud) can be successful. It has also been suggested that more effective programs tend to focus more on problem finding than problem solving (Runco, 1999, p. 580). One common strategy that seems to be employed in all creativity training programs encompassing DT tasks is simply asking participants to suspend judgment on proposed ideas (Lau, Ng, & Lee, 2009).

As stated above, DT is essential for creative thinking, functions as a good predictor and measure of creative ability, can be used effectively in creativity training and serves as an anchor point for creativity study.

Figure 2: Key findings relating to DT in education and training



2.3.4 DT and creativity in context with online learning

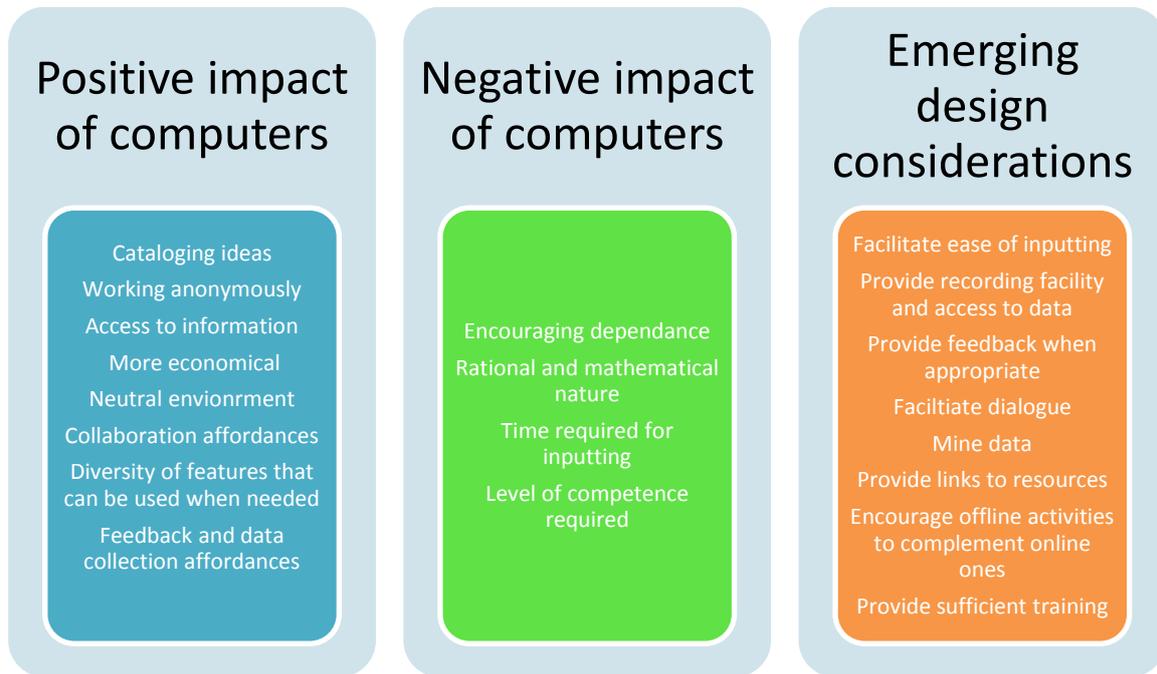
Computers have a lot to offer the field of creativity instruction. They can allow users to capture and catalogue ideas as they arise; to work anonymously or in solitude; they can afford immediate access to information thus mitigating cognitive blocks and can do so often more economically than traditional methods (Benedek, Fink & Neubaur, 2006). In respect to DT, they can provide a neutral environment, which can reduce recognised negative blocks such as apprehension and evaluation (Benedek, Fink & Neubaur, 2006). They can facilitate collaboration regardless of space, time and location (Zimring et al., 2001; Sagun & Demirkan. 2009). Computers also exhibit features of *'provisionality, interactivity, capacity, range, speed and automatic functions, which can be chosen as and when appropriate to enable users to do things that could not be done as effectively, or at all, using other tools'* (Loveless, 2002). What is also of particular interest to this investigation is that they can

facilitate a greater understanding of the influencing factors related to DT (Plucker, Runco & Lim, 2006).

However, not all the reviewed literature subscribes to the notion that computers are have a lot to offer creative activities. For instance, several researchers state that computers, as rational, mathematical, deductive and convergent machines represent an antithesis to many aspects of creative activity (Carroll, 2010; Tai 2003; Bonnardel & Zenasni, 2010). Critics assert that the presence of computers in educational settings can stifle opportunities for creativity (Healy 1998), and Ledewitz (1985) posits that the proliferation of technology is reducing independent thought and encouraging a culture of dependence. Other issues relating to computers and creativity include the amount of time taken to input information in comparison to traditional methods; the disruption to natural thought patterns (Lawson, 2004); issues related to computer competence (Chastain & Elliot, 2000); costs and stability issues of computer infrastructure (Kvan, 2001).

Despite the rapid pace of technological development, the increasingly important role being played by technology in education and learning, the importance of creativity and the diversity of creativity exercises available it may come as some surprise that only a tiny a percentage of programs established to enhance DT utilise computers (Benedek, Fink & Neubaur, 2006). Results from the same research indicated that online tools can produce better results in some aspects of ideational fluency than any other measure. While the limited literature presents certain challenges for this investigation, it also presents a wealth of opportunities for exploration and development of deeper understanding.

Figure 3: Key Findings on creativity and DT in online environments and possible emergent design considerations



2.4 Influential factors in online learning

This section will highlight a number of human related factors evidenced to play a role in influencing online learning and DT. Featured factors are broadly categorised as emotions, attitudes and personality.

2.4.1 Affect as a mediating factor in online learning

Much of the literature relating to the profile of successful online learning is relatively recent and anecdotal rather than empirical (Wang & Newlin, 2000). Research relating to successful online students has primarily focused on technology aspects (Sun et al, 2008) and on student ease with computer technology rather than their intrinsic characteristics (Gallagher, 2002). In fact, it has been suggested that little is known about why so many online learners stop after their initial experience, a situation that is having serious cost implications for institutions (Sun et al, 2008). What is certain is that as online enrolments continue to grow exponentially, it is becoming more and more important for us to gain an understanding of the factors that contribute to successful online learning (Alshare, Freeze, Lane, & Wen, 2011; Lee, Yoon, & Lee, 2009).

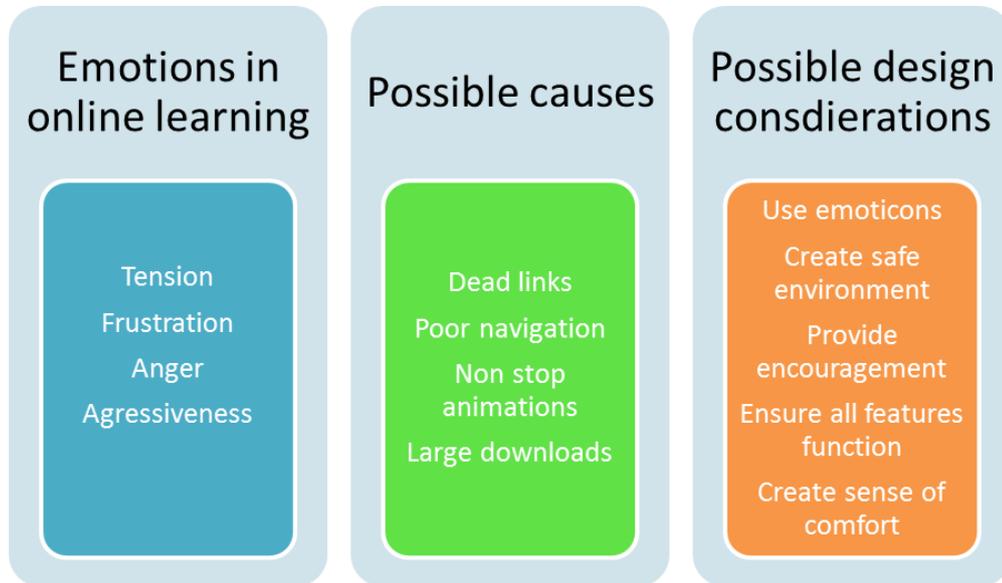
Emotion is a highly complex phenomenon and it has been reported that there have been more than 90 definitions proposed in the 20th century (Plutchik; 2001). Increasingly, emotions are being viewed as mediating all learning (Kort, Reilly & Picard, 2001; MacFadden 2008) and research has shown that students experience a rich variety of emotions in academic settings. In fact, Flood (2003) has stated that *'learning is as much a function of a person's emotional response to a learning environment as it is to the instructional method or classroom'*. Despite this, the influence of emotion is still under-emphasized (Wang, & Shen, (2009), very little research has been undertaken to investigate it (Schutz & DeCuir, 2002) and its role in learning has largely been overlooked in favour of a focus on cognition, rationality (Astleitner & Leutner, 2000) and ease of use (Gallagher, 2002).

The reviewed literature suggests that online learning can produce considerable negative emotions including tension, aggressiveness, anger, frustration, confusion, boredom and isolation (Berenson, Boyles & Weaver 2008). A situation militated by a lack of learner cues, which are less evident online than in traditional face-to-face learning (MacFadden, 2008). Somewhat conflictingly, MacFadden, (2008) states that negative emotions can also be consciously used to heighten and sustain learner motivation. Some of the causes of negative response in online learning environments include dead links, poor navigation, non-stop animations and large downloads (Redden, 2003) all of which can negatively affect successful learning experiences (Berenson, Boyles & Weaver 2008). With respect to creativity training, it is interesting to note that a slight positive mood does more than make you feel better; it also induces a different kind of thinking, characterized by a tendency towards greater creativity (Isen, 2000; MacFadden (2008)).

In her exploration of mediating negative emotion in online classrooms, Redden (2003) states that instructors need to pay particular attention to learner emotions, and where possible, respond to learners positively and with humour when appropriate, personalizing communications, using emoticons, and providing encouragement to investigate their own meanings with the materials. MacFadden (2008) adds that a critical factor in addressing learner emotion is the provision of an environment which affords safety for user to feel free to think and express themselves freely. Similarly, research carried out by Alshare, Freeze, Lane & Wen, (2011) revealed that a sense of comfort with online learning is a significant predictor for both system use and students' satisfaction. Of specific interest to the validity of this investigation is a call by Schutz and DeCuir (2002) for more contextually orientated

qualitative research, which they state could provide greater insight into learner experience and response.

Figure 4: Key findings, possible causes and design considerations



2.4.2 The role of learner attitude and perception in online environments

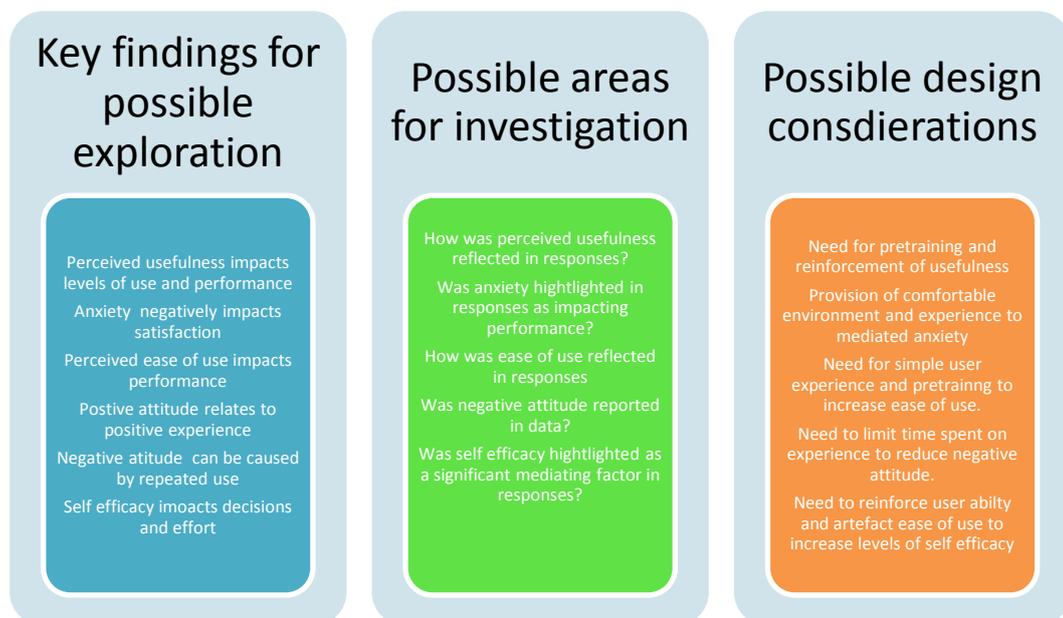
Personal attitudes and perceptions are a major influencing factor in the usage of information technology (Liaw, Huang, & Chen, 2007).

According to Kay (1993) there are at least 14 diverse definitions for the construct of human attitudes to computers and no one single definition is universally accepted. Of the various attempts to define and understand attitude to computers, the Technology Acceptance Model (TAM) has been referred to more than any other (Lee, Yoon, & Lee, 2009). TAM was introduced by Davis (1986) to explain computer-usage behaviour and was built on Ajzen and Fishbein's (1977) theoretical position, which defined computer attitude as '*A person's general evaluation or feeling of favourableness or unfavourableness toward computer technologies (i.e. attitude towards objects) and specific computer-related activities (i.e. attitude towards behaviours)*' (Smith, Caputi, & Rawstorne, 2000). The central proposition of TAM is that attitude to computers is the result of two key variables; perceived usefulness and perceived ease of use (Lee, Yoon, & Lee, 2009; Sun et al., 2008).

Another significant factor in shaping learner attitude is self-efficacy, which has been defined as one's beliefs about what one can do with the skills they possess (Johnson, Hornik,

& Salas, 2008). The same researchers, in their examination of factors influencing successful online education environments, found that self-efficacy significantly impacts on decisions about using technology and the level of effort exerted. Wang & Newlim (2002) reported that self-efficacy beliefs about technology skills correlate strongly with grade scores. More recent research has pointed out that with the maturation of computer use in education, the importance of self-efficacy in shaping learner attitude and satisfaction has reduced (Alshare, Freeze, Lane, & Wen, 2011). The study also points out that self-efficacy issues can be mediated by an online environment which emphasizes user friendliness, availability, usability, ease of learning, and response time.

Figure 5: Key findings relating to attitude in computers with possible areas for investigations and emergent design considerations



2.4.3. Learner personality and its influence on online learning success

Personality can be defined as a relatively stable and unique set of behaviours, thoughts, feelings and motives that characterise an individual (Feist, 2010) and which can be predictive of success achievement in traditional classrooms (Berenson, Boyles & Weaver 2008). Reporting on a meta-analysis in broader training literature, Orvis et al (2011) reports positive aggregate relationships between training performance and several personality traits. Despite the strong evidence linking personality to academic achievement, very few data are available about personality and online success (Berenson, Boyles & Weaver 2008; Campbell & Kuncel, 2001; Salas & Cannon-Bowers, 2001). While the lack of pertinent material

exploring the role personality in online learning presents a research challenge, it also adds validity to the inductive nature of this study.

What literature is available, is primarily orientated around the *Big Five* personality traits – or the Big Five Factors Model FFM – a framework of personality traits developed by Costa & McCrae, (1992), which has emerged as a robust and parsimonious model for explaining the relationship between academic behaviour and personality (Poropat, 2009).

Learners exhibiting conscientiousness characteristics (disciplined, organised and achievement orientated) may implicitly prefer online learning environments (Orvis et al, 2011) as these environments place more responsibilities on learners than traditional face-to-face learning systems (Alshare, Freeze, Lane, & Wen, 2011); allowing for greater opportunity for self-organisation (Orvis et al, 2011) and self-reliance rather than instructor guidance (Santo, 2001). Those exhibiting characteristics associated with openness to experience may also be well suited to online tuition as they may be afforded opportunity to explore content and learning strategies that are of particular interest (Orvis et al, 2011). Conversely, learners with low levels of openness may not be able to maximise any advantages afforded by autonomy (Orvis et al, 2011). With autonomy being important in online learning, it is interesting to note that learners with strong openness traits are more likely to be active rather than passive learners (Mount & Barrick, 1995). In a more recent study, Gully and Chen (2010) found that openness to experience may also help learners to maintain focus on training activities. Extrovert individuals (sociable, assertive and talkative) may be better placed to capitalise on interactive elements of online environments to enhance their performance (Orvis et al, 2011). Interestingly, Huang, (2009) found that individuals with a tendency toward introversion may also be able to capitalise on online learning as it can facilitate interactions that they may not engage with in traditional settings. Beyond the three personality traits identified here as influencing the success of online learning, Berenson, Boyles and Weaver (2008) report that sociability is the most important trait influencing online success. This is understandable given that learners often complain about isolation in online environments (Johnson, Hornik, & Salas, 2008). However, conflicting research has indicated that learners who enjoy the social, face to face qualities of traditional teaching environments may actually have difficulties in online learning (Ramos, 2001).

The various dimensions of affect, attitude and personality highlighted to be important in online learning do not provide this investigation with a rigid framework; instead, they illuminate possibilities and opportunities for exploration and further investigation.

Figure 6: Key findings relating to personality in computers with possible areas for investigation and emergent design considerations



2.5 Human factors in the teaching and learning of creativity and DT

This section will highlight a number of human related factors evidenced to play a role in creativity and DT. Factors are categorised as personality traits, affect, motivation and social context.

2.5.1 Personality traits as influencing factors in DT and creativity

Personality traits as influencing factors on creative behaviour represent one of the most popular and important areas of creativity research (Batey, Chamorro-Premuzic & Furnham, 2009). Early work in this area evidenced traits such as ‘*aesthetic qualities of experience, broad range of interests, an attraction to complexity, high energy, independence of judgement, autonomy, intuition, self-confidence and a firm sense on one’s self*’ as being important to creative activity (Barron, & Harrington, 1981). Recent research indicates that personality traits such as openness, extraversion, introversion and conscientiousness also play

an influential role (Chamorro-Premuzic & Reichenbacher, 2008). A number of researchers are in general agreement that personality traits such as self-esteem, independence, introversion, perseverance, tolerance for ambiguity, willingness to take risks, behavioural flexibility and emotional variability appear to be consistently associated with creativity (Barron & Harrington, 1981; Eysenck, 1993, 1994; Richards, 1994).

As with the exploration of personality in mediating the success of online learning, the BIG Five Model is viewed as being a valid tool for assessment personality traits in context with to creativity and DT (Hennessey, & Amabile, 2010; George & Zhou, 2001; Feist, 1998).

Extroversion (enthusiastic, energetic and talkative) is seen as playing a complex role in creativity (Silva, et al, 2009) and has been evidenced to be positively correlated to creative ability (King, Walker & Broyles, 1996; Sun Young & Jin Nam, 2009; Batey, Chamorro-Premuzic & Furnham, 2009). Confidence, an attribute related to extroversion, is said to play a vital role developing creative abilities (Robbins & Kegley, 2010); Self-efficacy, which is related to confidence, but viewed as a narrower, targeted perceived capacity, is also viewed as a necessary condition for creative productivity and the discovery (Bandura, 1997). In related research, Choi (2004) found personal attitudes about creative ability have a tremendous impact on actual performance. In specific relation to DT, Chamorro-Premuzic and Reichenbacher (2008) report results which suggest that extraverts have an intrinsic advantage in DT tasks and outperform introverted counterparts, especially under threat of evaluation. However, Eysenck (1995) has argued that introversion (reserved, reflective and inwardly concerned) rather than extroversion actually enhances creative interests and achievement.

Although historic stereotypes of creative people as tortured artists may well assume that they are more predisposed to neuroticism more recent research indicates that creative people are no more likely to be neurotic than anyone else (King, Walker & Broyles, 1996). However, it is interesting to note that both positive (Martindale, 1999) as well as non-significant links (King et al., 1996) between neuroticism and creativity have also been reported. In respect to DT, Chamorro-Premuzic et al., (2008) state that neuroticism relates to DT, but only under the threat of evaluation, thus supporting the idea the neuroticism is only related to investigated rather than actual creativity.

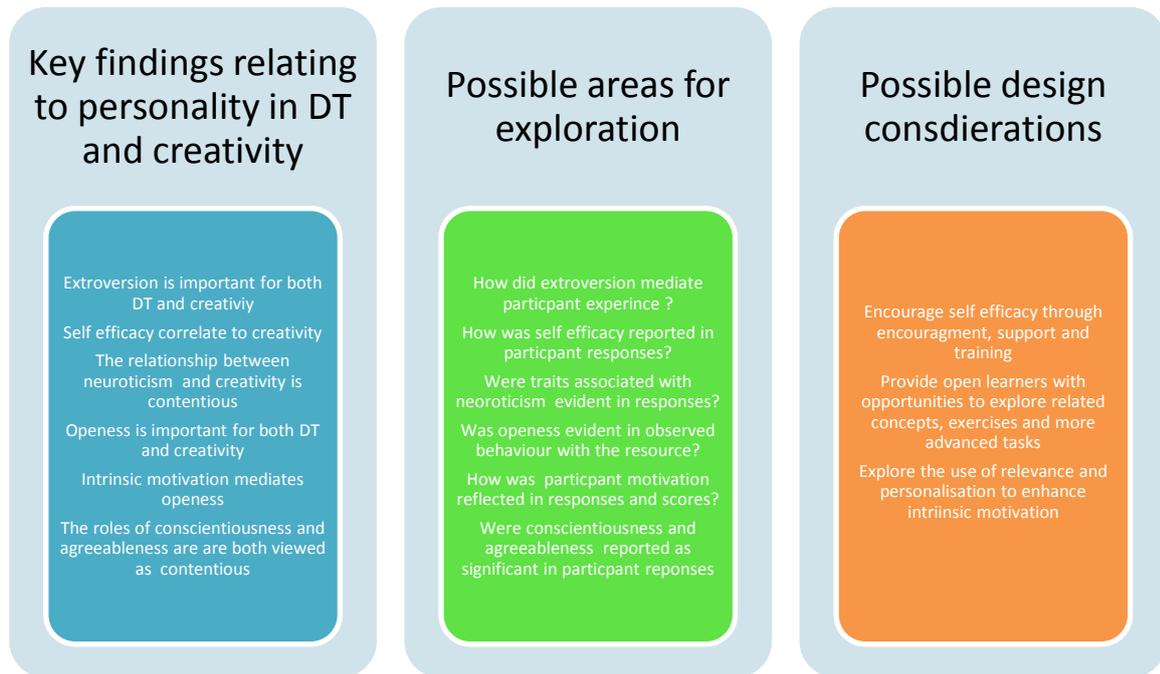
The most important personality correlate of creativity is openness to experience (Dollinger, Urban, & James, 2004; George & Zhou, 2001; McCrae, 1987); a trait said to embody imaginativeness, independence of thought (George, & Zhou, 2001), flexibility, intelligence and sophistication (Feist, 1998). The links between creativity, potential for creative achievements and openness to experience are both empirical and theoretical (King, Walker & Broyles, 1996) and in respect to DT in isolation, it is associated with strong performance (Silva, 2009). Prabhu et al (2008) have provided a qualification for the relationship between openness and creativity by suggesting that it is heavily mediated by intrinsic motivation.

Other personality traits evidenced as having an influence upon creativity include agreeableness, which is viewed as relating to individuals who are cooperative, easy going, empathic, feminine, friendly (Feist, 1998), good-natured, considerate and tolerant (Sun Young & Jin Nam, 2009). King, Walker and Broyles, (1996) place many of these characteristics as relating to conformity, which is evidenced as having a negative impact on creativity. Chamorro-Premuzic & Furnham, (2005) report that agreeableness seems largely unrelated to DT, while Batey, Chamorro-Premuzic and Furnham, (2009) state that it is negatively correlated.

Conscientious individuals are considered to be careful, responsible and self-controlled (Feist, 1998) and as such tend to be less creative (King, Walker & Broyles, 1996). Adding to this, Chamorro-Premuzic and Furnham, (2005) report that conscientiousness seems largely unrelated to DT, while Silva (2009) states that it is related to low divergent performance. Despite all this evidence, researchers still do not know a great deal about the causal role played by personality in creativity (Feist, 1998).

Although there is a wealth of evidence indicating a relationship to both neurological and psychiatric aspects of personality to creativity (Feist, 2010), due to the nature, scope and time-frame of this study, they will not be investigated.

Figure 7: Key findings relating to personality traits in creativity and DT with possible areas for investigations and emergent design considerations



2.5.2 Affect as a mediating influence in DT and creativity

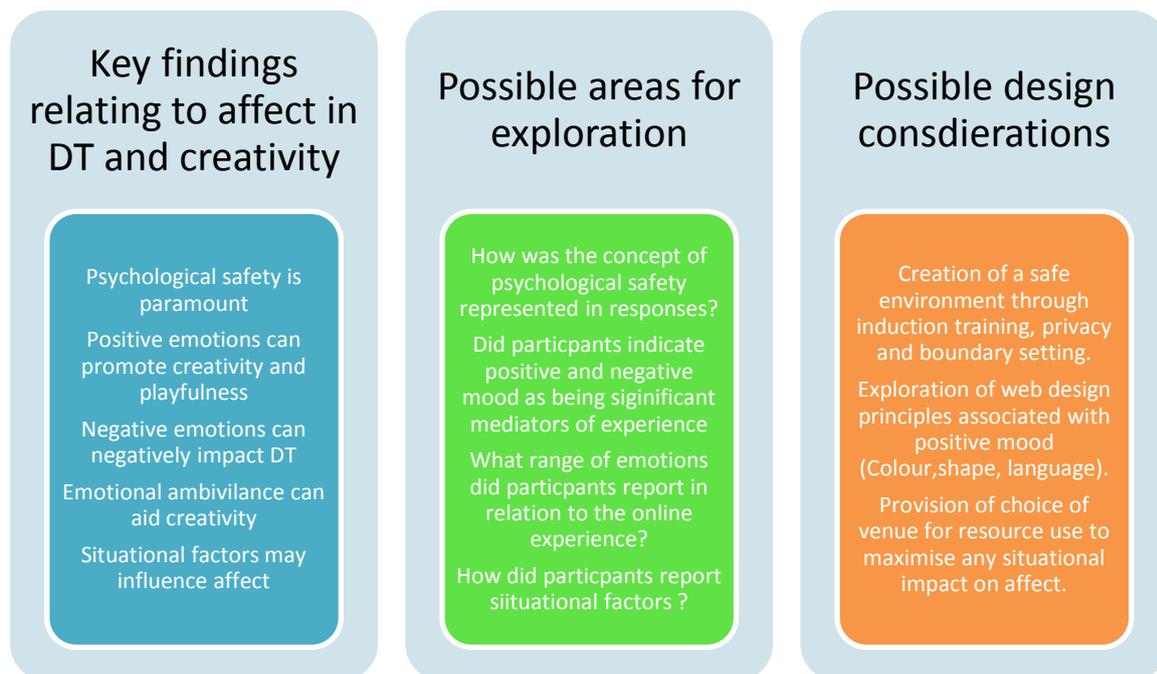
Emotion is so central to creativity that it has been described as making possible all creative thought (Greenspan, 1997). The consideration of participant cognitive and emotional characteristics when developing DT programs is viewed as being of the utmost importance (Fleith, Renzulli & Westberg 2002). Further, Bull et al (1995) argue that the most important element in creativity training is addressing the psychological safety of participants. Bull adds to this by stating that *‘the creation of a safe environment is more important than the actual creativity techniques themselves’*.

Positive emotions have been reported to facilitate creative thinking (Amabile, Barsade, Mueller & Staw, 2005) and have been associated with enhancing creative problem solving and cognitive flexibility (Vosburg, 1998). They have also been associated with the inducement of a different kind of thinking, characterized by a propensity towards increased creativity and flexibility in problem solving (Isen, 2000). It’s been noted by Fong (2006) that when people experience positive emotions, they interpret their environment as being safe, and therefore respond by being more playful and exploratory. Conversely, when people experience negative emotions they tend to be more cautious and concerned with the quality of their responses, which can negatively impact divergent abilities (Vosburg, 1998). However,

some researchers argue that the focus on positive or negative emotions is not entirely sufficient as incidences of uni-dimensional emotional states are actually quite rare (Fong 2006). Fong adds that most people react to everyday life by experiencing blends of emotions, embodied in emotional ambivalence and that this state can afford an advantage in creative activities that involve unusual associations.

What is clear from the literature is that relationship between affect and creativity is anything but straightforward (Vosberg 1998; Hennessey & Amabile, 2010), but that it is important for instructors to include students’ emotional characteristics for consideration when implementing a DT program (Fleith, Renzulli & Westberg 2002).

Figure 8: Key findings relating to affect in DT and creativity with possible areas for investigations and emergent design considerations



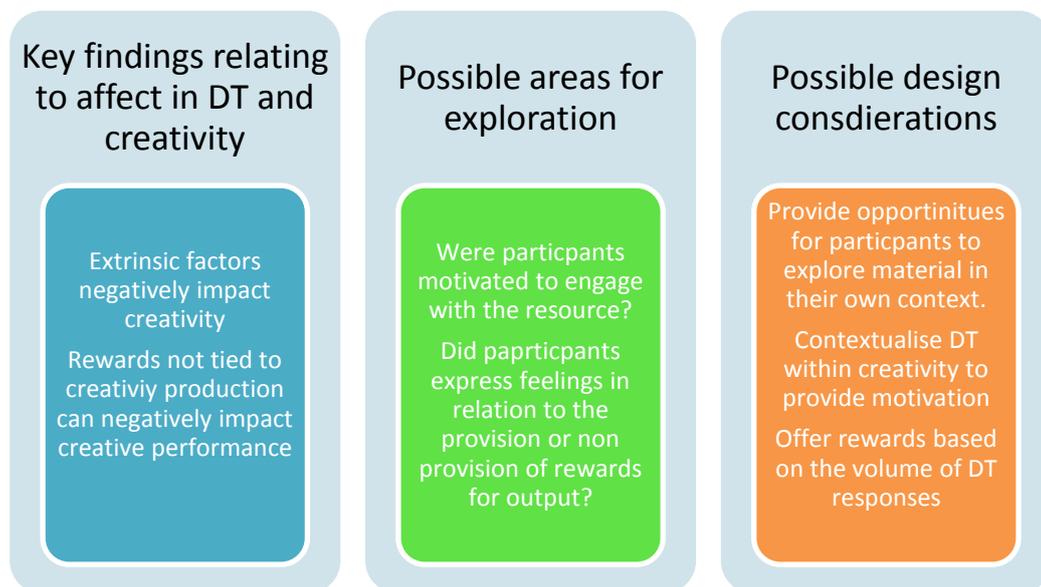
2.5.3 The role of motivation in DT and creativity

Motivation is viewed by psychologists to play a central role in creativity (Sawyer, 2006, P.53). Defined as a person’s desire to persist and be successful in an activity, it embodies traits such as persistence, ambitiousness, drive and impulsiveness (Feist, 2010). Motivation is commonly separated into two distinct subsets: intrinsic motivation, which centres on a person’s desire to undertake something for its own sake, because it is intrinsically interesting, enjoyable or satisfying (Amabile, 1990, p.62); and extrinsic motivation, where a person is motivated by an external goal, reward or expectation of

evaluation (Amabile, 1985). The two subsets are often implicitly viewed as opposite extremes of a single dimension (Eisenberger & Shannock, 2003).

A wealth of research has contributed to the general understanding that extrinsic motivational factors can negatively impact intrinsic motivation (Amabile, 1985) and that they can also undermine creativity (Amabile, 1979). In relation to reward as an extrinsic motivational factor, Tegano et al (1991) have noted that students who expect a reward will be far less likely to take risks or approach a task with a playful experimental nature. Amabile (1996) found that individuals who are not rewarded in creativity experiments perform better than those who are. Interestingly, a number of studies have revealed that creative performance in tests can be increased if participants are told that the reward is tied to creative activity (Eisenberger & Rhoades, 2001; Eisenberger, & Shanock, 2003). Perhaps obviously, there is a large volume of research which highlights intrinsic motivation as a necessary requirement for creativity (Amabile, 1983; Simon, 1985; Tierney, Farmer, & Graen, 1999; Rogers, 1954).

Figure 9: Key findings relating to motivation in DT and creativity with possible areas for investigation and emergent design considerations



2.5.4 Contextual influences on creative cognition

One of the most important influential factors on creative cognition is the context within which it takes place (Heinzen, 1994, p.130). This important variable that has been overlooked despite several creative thinkers having acknowledged its potential in influencing

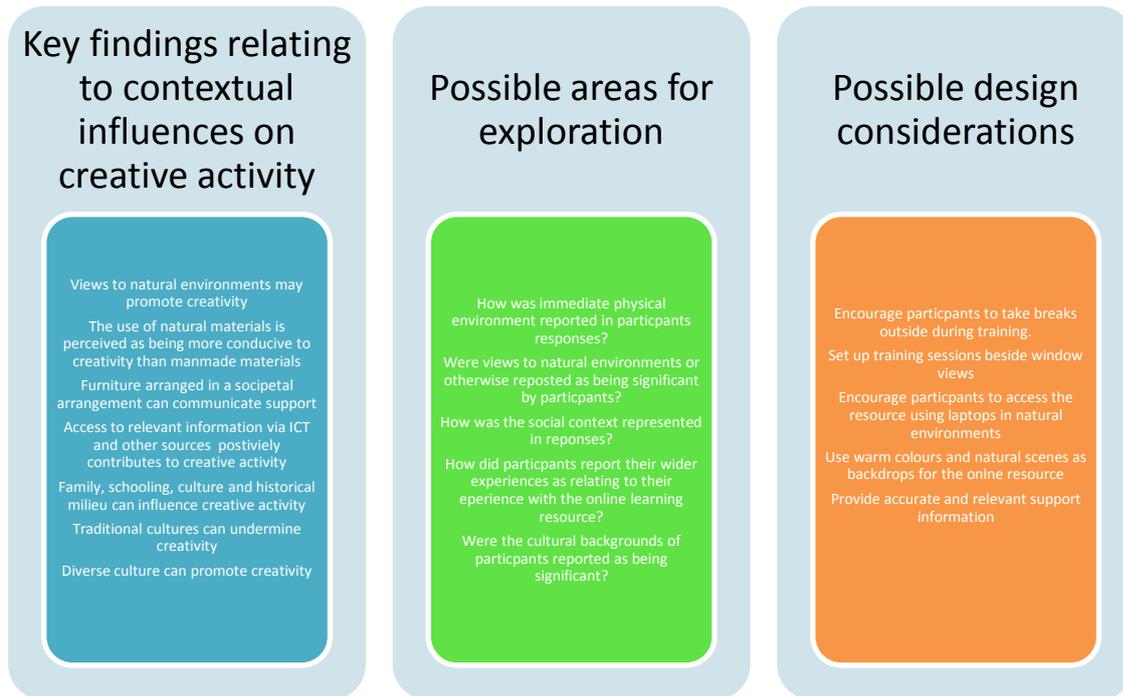
creativity (McCoy & Evans, 2002); and a number of prominent researchers reporting the importance of social context in shaping creative activities (Csikszentmihalyi, 1999; Dudek et al., 1993; Niu & Sternberg, 2003; Richardson 1988; Simonton, 2000).

Available literature highlights that affective characteristics of the external situations represents a source of affect that shapes features of the internal creative processes and resulting external products (Heinzen, 1994, p.127) and even seemingly unimportant features of the environment can be harmful or helpful to creativity in some people (Amabile, 1983). Specifically, and in respect to the physical environment, McCoy & Evans (2002) have reported that window views to natural environments may foster unconventional thought, openness to experience and a sense of freedom and in doing so may promote creativity. It has also been demonstrated that a fundamental for creative activity is the provision of spaces which afford for both reflective solitude and for sharing ideas with others (McCoy & Evans, 2002).

Moving beyond the immediate influence of the physical environment, a number of factors have been evidenced to play a role in influencing creative activity, including family upbringing, schooling experiences, cultural traditions and the historical milieu in which we happen to have been born (Runco & Pagnini, 2008). Heinzen (1994, p.127) summarizes the influence of contextual factors by stating that the optimal affective situation for human creativity seems to be when the internal supply of positive affect confronts the external demands of an appealing situation.

While much effort has been devoted to exploring the complex mechanisms that influence the development of creative ability (Choi, 2004; Zhou & George, 2001), gaining a greater understanding is still seen as being of utmost importance (Benedek, Fink, & Neubauer, 2006).

Figure 10: Key findings relating to contextual influences on creative activity with possible areas for investigation and emergent design considerations



This section has presented evidence suggesting the importance of personality, affect, motivation and context in DT and creativity. What is clear from the evidence is that it is an area that has attracted much interest, is subject to conflict, remains unresolved and warrants further investigation. As with the previous section, the evidence does not set out a framework for study, but does suggest areas that may be fruitful for this investigation.

2.6 Implications for this investigation

The purpose of this study is to investigate participant response to an online tool developed to enhance DT with a view to providing insight for designers of online resources for enhancing creative cognitive abilities. From the evidence presented, it is clear that human attributes including personality, affect, perceptions, attitudes, motivations play a vitally important role in all the areas of interest. It is also clear that these attributes do not exist in isolation and are influenced and shaped by a diversity of contextual factors. What is of additional interest is evidence which highlights similar human influences within all domains. For instance, positive and negative affect, and personality traits such as openness and extroversion are emphasized as important in both online learning and creative activities. This evidence, when seen in the light of the limited research carried out in the role of personality in online creativity training, the importance of creativity, and the rapid shift toward online

learning, illuminates an area of utmost interest and one which this investigation attempts to add to.

Given the central requirement of this investigation to design and construct an online learning resource, the presented evidence also highlighted a wide range of design considerations as presented at the conclusion of each section. Design considerations are explored and expanded on in the proceeding design chapter, while key findings are used to inform the development of an appropriate methodology and data collection instruments.

3.0 Design

3.1 Introduction

This chapter aims to describe the design, development and experience of divURGE, an online resource created to enhance DT. The chapter begins by presenting the core objectives underpinning the resource; it then describes the instructional model used to guide the process; the key considerations borne from the literature (synthesized with relevant online learning principles); the pedagogical model underpinning the learning experience; the selection of an appropriate VLE; applications used; pilot study results; a walk-through of the learning experience.

3.1.1 Core design objectives

The aim of this study is to investigate *how participants respond to an online tool developed to enhance DT*. To address this question an online tool was constructed around two core objectives;

1. To maximise potential for the acquisition of DT ability
2. To maximise opportunities for addressing the central questions at issue.

3.2 Instructional design model

Instructional design provides a systematic process for creating instructional events based on the planned arrangement of resources and procedures used to facilitate learning (Gagne et al, 2005, p.18). Emerging from various fields of study, including cognitive science, educational psychology and systems theory (Driscoll, 2005), instructional design models are used extensively by educationalists to design effective learning experiences (Seels & Glasgow, 1998). Various instructional models are in common usage and the majority share a systematic design process beginning with a goal and proceeding through an interconnected set of stages that build upon each other by means of a series of inputs, processes and outputs (Gagne et al, 2005, p.19).

In order to maximise the potential for addressing the previously stated core objectives, the instructional model, ADDIE was used to inform this design process. ADDIE is an acronym for the five stages it encompasses: analysis, design, development implementation and evaluation. While it would be a mistake to think that there is one single best model of

instructional design (Gagne et al, 2005, p2) the simple nature of the ADDIE model, including the ease of application, flexibility and possibilities towards the cyclical features of the process, can enable an holistic view of the instructional design process (Crawford, 2004).

The four stages of ADDIE as summarized by Gagne et al (2005, p.22) are represented in table 1.

Table 1: Summary of the ADDIE instructional model

Analysis	Design	Development	Implementation	Evaluation
Determine needs	Translate performance goals into outcomes	Finalise learning activities	Promote materials	Implement plans for student evaluation
Determine skills goal	Determine topics to be covered	Prepare draft materials	Provide support	Implement plans for program evaluation
Determine base line skills	Sequence the topics	Test materials		Implement plans for revision
Analyze time available	Define learning activities	Revise and refine materials		
	Develop assessment methods			

3.3. Analysis

The primary skills goal of the divURGE learning experience is the enhancement of DT ability. More specifically, it is the enhancement of ideational fluency, which has been identified as a key component of DT and has been evidenced to be closely correlated with the other primary aspects of DT: flexibility and originality (Runco, 1999, p. 578).

To inform the development of divURGE, a number of design considerations have been drawn from the literature. These considerations have been analysed, cross-referenced and categorised within three appropriate areas of focus; the learner, the resource and the context. To further strengthen the resource foundation, a number of relevant principles derived from the cognitive theory of multimedia are cross referenced with appropriate objectives. This information, along with related multimedia principles summaries are presented in table (2) below.

Human focused	<ul style="list-style-type: none"> • Provide required pre-training in resource • Utilise pre-training to reinforce relevance and transferability of DT skills and its importance for creativity • Utilise pre-training to increase levels of intrinsic motivation by identifying and reinforcing the relevance of DT skills to participant's domain • Explaining the nature of DT in context with perceptions of psychological safety • Provide opportunities for exchange with other users • Limit time spent on resource, encourage outdoor breaks and experimentation with ideas outside the resource. • Increase the possibility of positive mood through the use of humour and by reinforcing the non-serious nature of the training • Encourage users to suspend judgement 	<p>Pre-training principle</p> <p>Avoiding information overload</p> <p>Provide a graphic interpretation of the course</p> <p>Simulate reality using case study examples</p> <p>Facilitate interaction</p>	<p>Students learn better from interactive learning environments when they receive pre-training that activates or provides prior knowledge (Moreno, & Mayer, 2007).</p> <p>Chunk instructional content into segments of ten to twelve minutes (Johnson & Aragon. 2003)</p> <p>Visually represent the course structure (Johnson & Aragon. 2003)</p> <p>Communicate the content through a realistic example (Johnson & Aragon. 2003)</p> <p>Provide opportunities for learners to communicate and share (Johnson & Aragon. 2003)</p>
Context focused	<ul style="list-style-type: none"> • Provide positive encouragement and feedback using emoticons in any online dialogue • Ensure training location is arranged to communicate openness and support • Place resource interface within view of an open window with view to natural setting • Encourage users to undertake isolated training in a location which affords views to a natural setting 	<p>Voice principle</p> <p>Create personal connections with learners</p>	<p>Using a human rather than computer voice can increase learner interest. (Moreno & Mayer, 2007)</p> <p>Feature a personalised welcome message and use first names in communication</p>

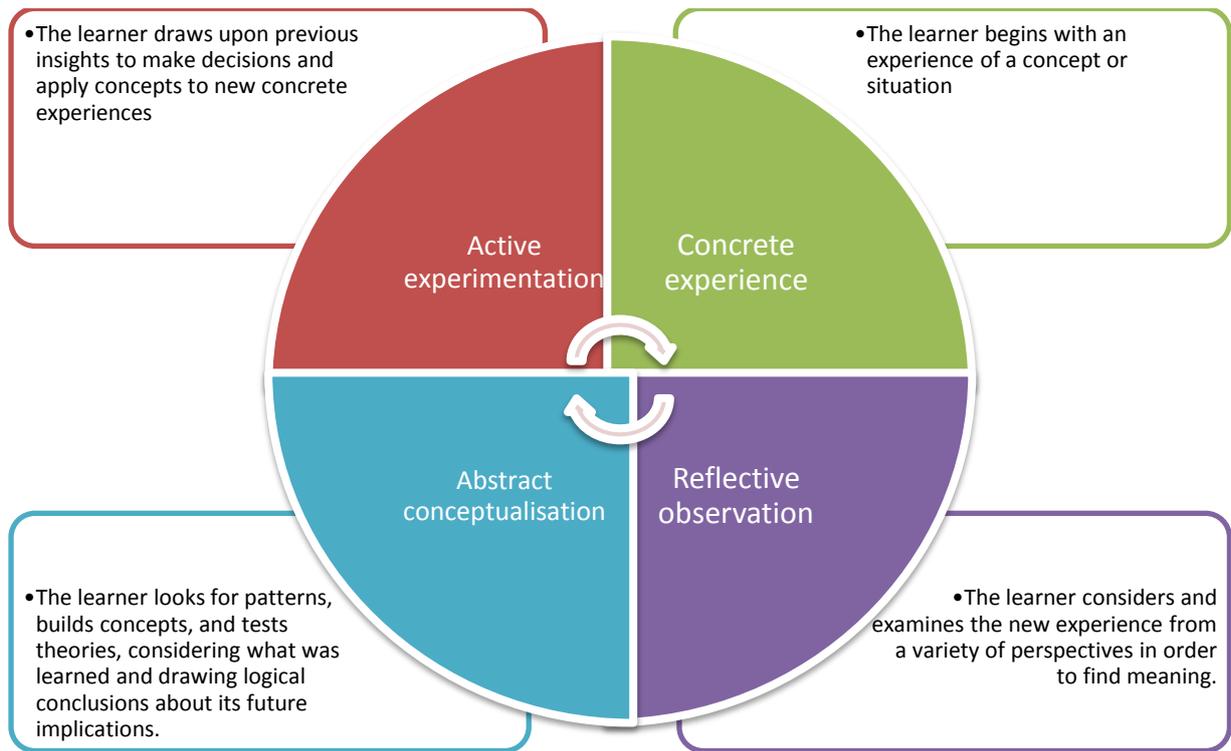
3.4 Embedding divURGE within a pedagogical model

This section supports the design objectives by embedding the learning experience within an appropriate pedagogy.

The pedagogy chosen to support divURGE was experiential learning. Experiential learning is a holistic process that has experience as its core and focus. As such, it actively involves students constructing their own experiences within the sociocultural context (Boud, Cohen, and Walker, 1993). Although there is an abundance of literature surrounding experiential learning, it is the work of David Kolb that remains a central point of discussion on the subject. Through his research, which drew and built upon the works of Piaget, Dewey and Lewin, he strived to understand the processes of sense making. What emerged from his work was a general understanding that learning is a process whereby knowledge is created through the transformation of experience (Kolb, 1984, p.41). More specifically, what emerged was a theoretical framework for learning: Kolb's Experiential Learning Theory.

Significant evidence suggests that this theory can provide a framework for designing active, collaborative, and interactive learning experiences that support the transformational process (Bolan 2003; Kolb 1984). With respect to the design and development of divURGE, Kolb's Experiential Learning Theory offers a cyclical, four stage model – Kolb's Learning Cycle - that can be used to structure and underpin learning experiences. Figure (11) below illustrates the four stages and associated learner process of Kolb's Learning Cycle (Bolan 2003; Kolb 1984).

Figure 11: Kolb's learning cycle



Although there has been some criticism of Kolb's model for failing to fully address the process of reflection and for its compartmentalised steps, which are suggested to not fully reflect reality (Smith, 2001), evidence that it provides an excellent framework for planning teaching and learning activities (Tennant 1997, p 92). More importantly, research which suggests that it can support learning in online environments (Dunlap, et al, 2008) indicates that it may be a useful pedagogy, alongside other strategies, for supporting learning activities within divURGE.

3.5 Defining learning activities.

The learning activities of divURGE centre on the use of time constrained DT tasks typically associated with measuring creative ability and predicting potential. As has been previously highlighted, such tasks can be used just as effectively as DT training tools (Baer, 1993, p.18; Benedek, Fink & Neubaur 2006: Runco, 1991; Runco, 1999, p. 581). Tasks will involve open ended questions structured around a three step format and graduating from *similarity* tasks (e.g., ways in which milk and meat are similar) to *unusual uses* tasks (e.g., for bricks, knives, newspapers) and finally to *instances* tasks (e.g., instances of things that are round, strong, or loud); with learners being asked to provide as many responses as possible to

each task within a two minute period. This gradual process of moving from instances to unusual uses and finally to similarities has been demonstrated to be more successful than other formats (Runco, 1999, p. 579);

DT skills were assessed via a pre and post-test assessment and were rated on the number of responses provided (fluency). While many creativity assessments incorporate measures of fluency, flexibility and originality, evidence indicates that correlation between scores is such that only one measure needs to be employed (Runco, 1999, p. 578). While the assessment of all three could possibly provide more robust evidence of skills acquisition, the nature and scope of this investigation did not warrant such measures.

Table 3: Summary of deliverables relating to the ADDIE model

Requirement	Deliverable
Performance goal	Increased DT ability
Determine topics to be covered	Similarity tasks Unusual uses tasks Instances tasks
Sequence the topics	1. Similarity tasks 2. Unusual uses tasks 3. Instances tasks
Define learning activities	Series of tasks under the headings above which require learners to suggest as many responses as possible
Develop assessment methods	Learner activity will be assessed on the basis of the number of responses provided (Fluency) using pre and post-test assessments

3.6 Selecting an appropriate learning environment

A virtual learning environment (VLE) is a software system designed to support teaching and learning (Weller, 2007). Over recent years, VLE's have become increasingly sophisticated, showing potential as an effective way for improving the learning process (Escobar-Rodriguez, & Monge-Lozano, 2011). There are a wide range of VLE's available and they are typically categorized as either commercial -paid for - for open source - free to use- (Brandl, 2005). Of the latter category, the most frequently used VLE in use is Moodle (Escobar-Rodriguez, & Monge-Lozano, 2011). An acronym for Modular Object-Orientated Dynamic Learning Environment, Moodle has become so popular that it has become a term in its own right (Brandl, 2005). Among the many advantages it affords are its template based structure; it is both open source and free to use; it can run within a wide range of systems; its

sophisticated learning management system (LMS) allows for the easy organisation, delivery and assessment of online learning activities; it can host a wide variety of related applications; it can facilitate online communication, and it can provide a rich source of data on learner activity (Martín-Blas & Serrano-Fernández, 2009)

Overleaf is tabulated rationale (table 4) for selecting Moodle as an appropriate VLE. The rationale is illustrated by presenting the central design objectives with Moodle affordances.

Table 4: Design objectives and associated Moodle affordances

	Core objectives	Moodle affordances
	<ol style="list-style-type: none"> To maximise potential for the acquisition of DT ability To maximise opportunities for gathering participant response. 	<p>DT tasks previously highlighted can easily be delivered via Moodle quiz features</p> <p>All activities can be recorded within Moodle and results can be presented in a variety of text and graphic forms.</p>
Focus	Objectives Derived From Literature	
Resource focused	<p>Provide idea recording functionality</p> <p>Provide links to relevant supporting information</p> <p>Ensure all features are easy to work and work as intended</p> <p>Provide opportunities for learning to extend beyond the resource and specifically in context with their own domain of interest</p> <p>Provide interactive elements</p> <p>Provide a feature that enables reflection</p> <p>Utilise a warm colour scheme with backdrop images of natural settings</p>	<p>Moodle LMS can record all activities</p> <p>Resources and links can easily be added</p> <p>The Moodle interface and functions are easy to use and amend</p> <p>Activities in Moodle can be staggered to cater for individual learner progress</p> <p>Interactive elements, such as Flash presentations, can easily be added to Moodle</p> <p>Learner comments and feedback can be recorded</p> <p>The front end Moodle interface offers a wide variety of templates which include warm colours</p>
Human focused	<p>Provide required pre-training in resource</p> <p>Utilise pre-training to reinforce relevance and transferability of DT skills and its importance for creativity</p> <p>Utilise pre-training to increase levels of intrinsic motivation by identifying and reinforcing the relevance of DT skills to participant's domain</p> <p>Explaining the nature of DT in context with perceptions of psychological safety</p> <p>Provide opportunities for exchange with other users</p> <p>Limit time spent on resource, encourage outdoor breaks and experimentation with ideas outside the resource.</p> <p>Increase the possibility of positive mood through the use of humour and by reinforcing the non-serious nature of the training</p> <p>Encourage users to suspend judgement</p>	<p>Instructional media can easily be added to the Moodle LMS</p> <p>Moodle features an existing forum for students</p> <p>Moodle learning activities can be timed and monitored</p>
Context focused	<p>Provide positive encouragement and feedback using emoticons in any online dialogue</p> <p>Ensure training location is arranged to communicate openness and support</p> <p>Place resource interface within view of an open window with view to natural setting</p> <p>Encourage users to undertake isolated training in a location which affords views to a natural setting</p>	<p>Moodle affords various opportunities for feedback provision and emoticons can be used</p> <p>Interface templates could be amended to reflect natural environments</p>

3.6.1 Applications used

The following applications were utilised in the design and construction of divURGE; Word 2010, Adobe Photoshop, Prezi, Windows Movie Maker Live, Adobe Sound Booth, Adobe Distiller and Camtasia.

3.7 Learner experience

This section provides an overall description of the learning environment followed by a step by step perspective of experience contextualised within Kolb's Learning Cycle.

3.7.1 Overview of experience

divURGE is an online, Moodle-based resource that presents learners with a number of DT tasks, an associated reflection blog and relevant support materials. Tasks consist of twenty seven, time-constrained and open-ended questions, which require participants to provide as many answers as possible within two minutes. In line with previously stated literature, tasks are structured in a staggered format graduating from similarity, unusual uses and finally to instances tasks. The course duration was set at nine consecutive days, with participants using the resource in their homes or in any environment that they felt appropriate and which had internet access. Tasks were presented in standard typed font and an open box was provided for participants to input answers. Participants had the option to review inputted responses at any stage following the completion of a task. Sample answers and general guidance were provided at the beginning of each new set of tasks. Tasks were grouped into three cycles in order to provide learners with a sufficient depth of experience. Upon completing a set of three tasks, participants were requested to add entries to their reflection blog. Reflection activities were scaffolded with suggested questions and sample responses. The learning experience was situated within Kolb's learning cycle through the cyclical nature of tasks and their associated reflective activities; which were constructed to encourage learners to move from a general understanding of the activities to sense making, analysis and evaluation and finally to experimentation.

3.7.2. Screen capture walk-through of the user experience

The following pages feature a number of screen capture images which illustrate the learning environment, how design objectives were realised and how learner activities and relate to content and the learning cycle.

Figure 12: Screen capture 1 illustrating the resource landing page



Figure 13: Screen capture 2 illustrating the primary resource environment

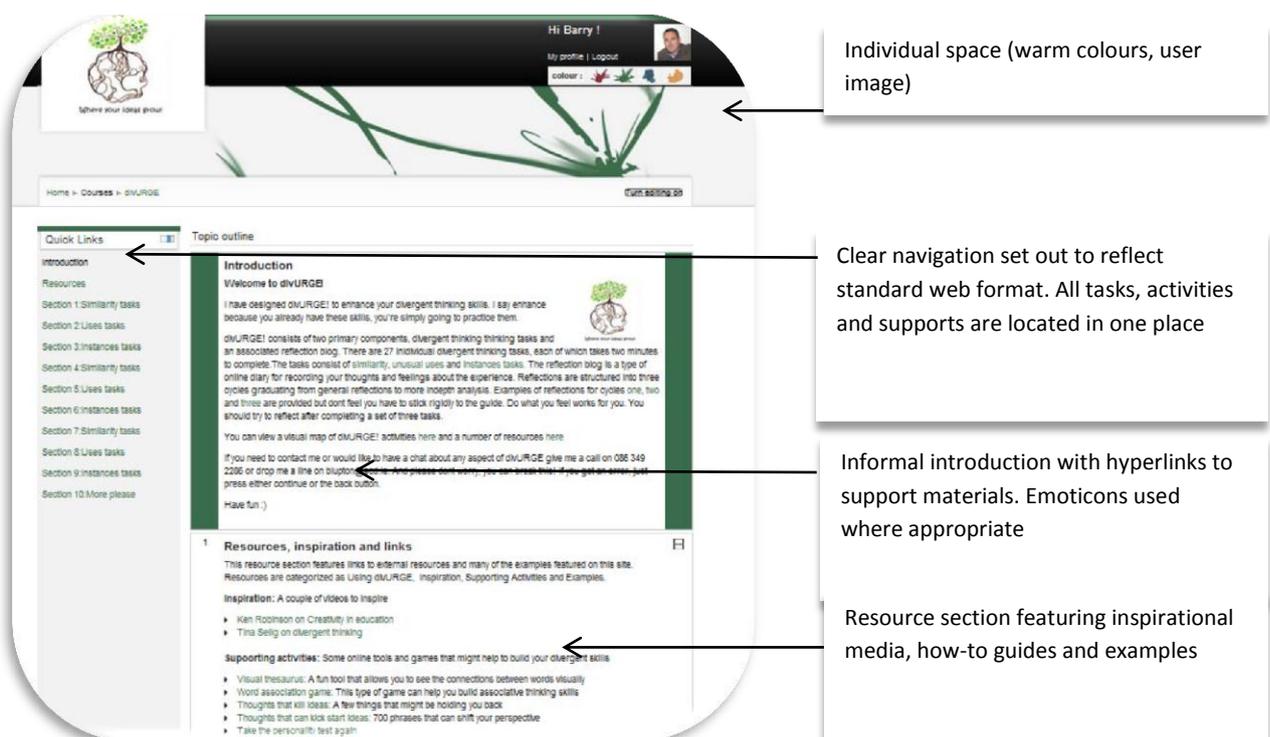


Figure 14: Screen captures 3, 4 & 5 illustrating - from left to right - navigation, resources and tasks

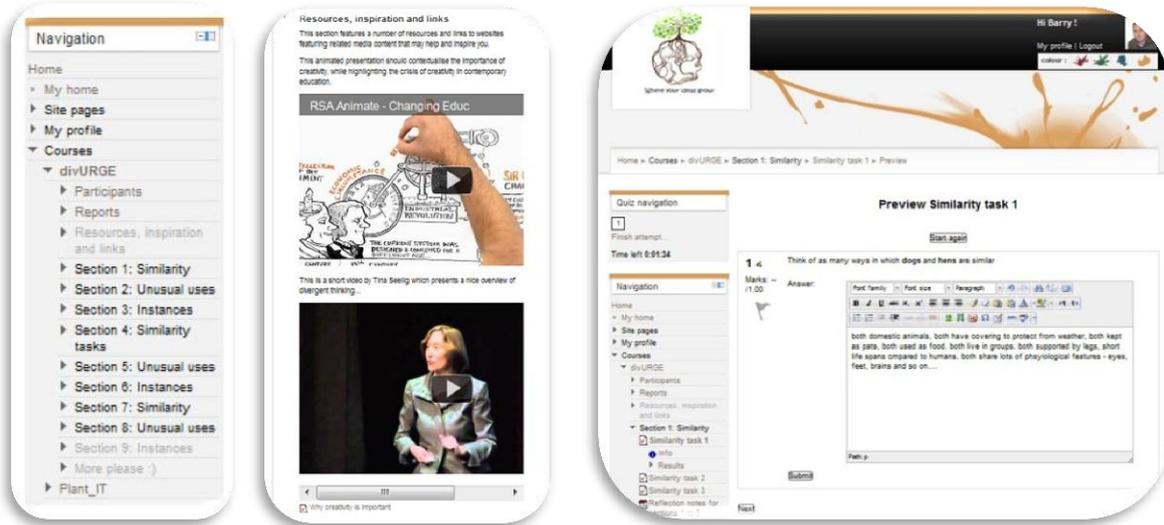


Figure 15: Screen captures 6 & 7 illustrating the reflection blog environment and reflection support material

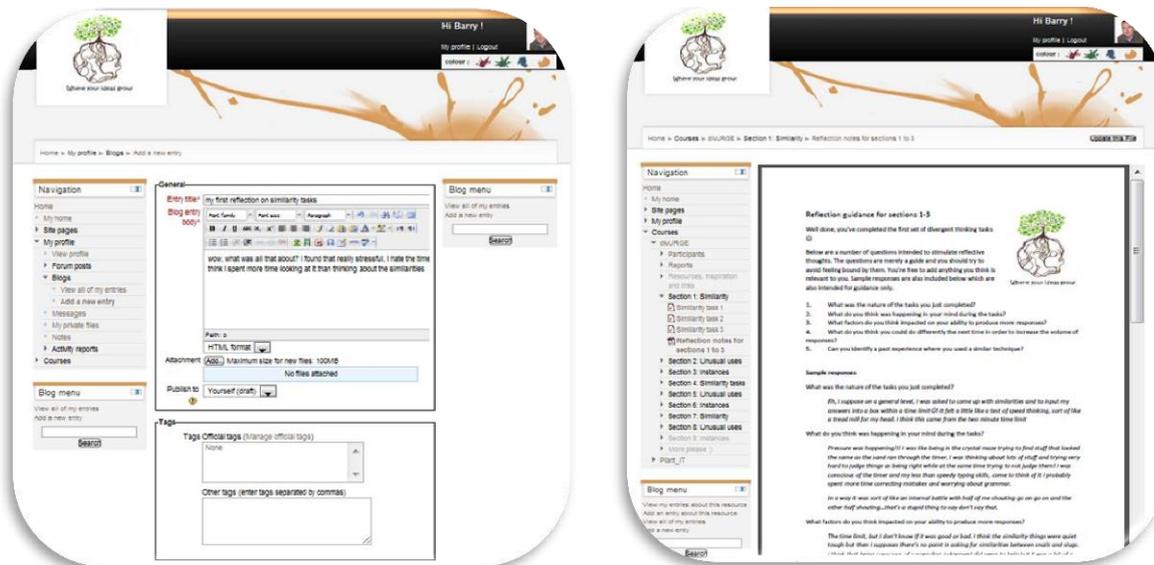
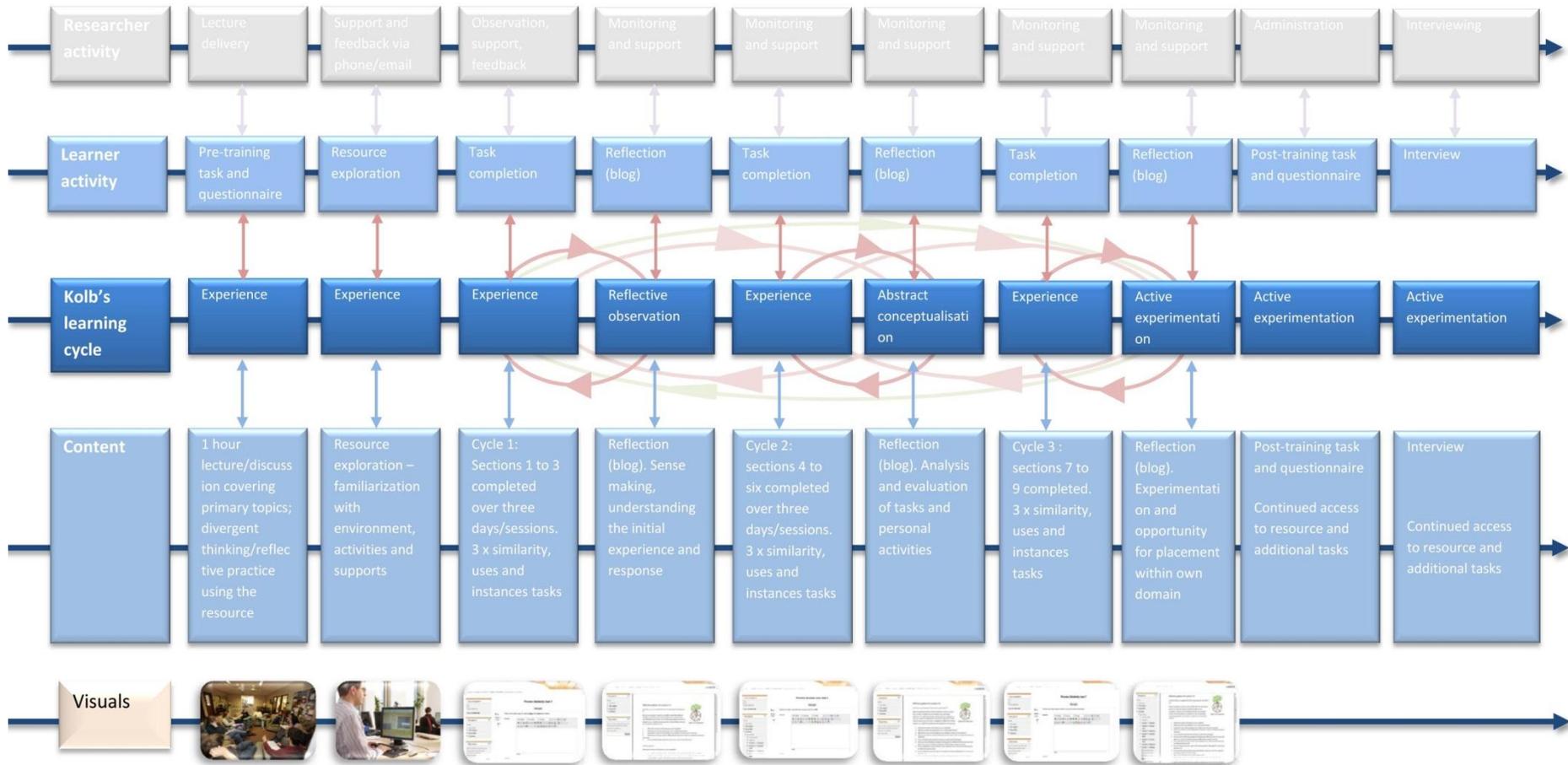


Figure 16: Diagrammatic illustration of activities and how they relate to content and the learning cycle



3.8 Pilot study findings

A pilot study was conducted using two participants to explore and test the various aspects of divURGE with a view to identifying deficiencies and areas for improvement prior to the implementation of the primary study. The pilot focused on a number of specific areas. Below is a table which reports the areas investigated, participant feedback and design actions taken.

Table 5: Feedback from pilot study with actions taken

Item for investigation	Feedback	Action
Pre-training and support media	<ul style="list-style-type: none"> Participants reported that they understood the nature of the study and that they grasped the concepts of DT Participants reported that verbal rather than computer based media explanation was preferable as it allowed for two way communication Participants reported that from the pre training they were not fully able to identify the usefulness of DT to their domain 	<p>More emphasis on pre-training lecture</p> <p>Introduction of an extended Q & A/discussion session</p> <p>More emphasis on domain relevance and possible inclusion of more 'real live' tasks.</p>
Usability	<ul style="list-style-type: none"> No issues noted 	
Tasks	<ul style="list-style-type: none"> Both participants noted they found the first tasks very difficult and that they were 'up all night' trying to think of similarities Both participants found the automated positive feedback very frustrating and annoying as they felt they were not doing well while the feedback was congratulating them. Both participants noted that the existence of scores – although highlighted in pre-training as not relating to the study – very off putting 	<p>Possible introduction of 'cognitive expectations' into the pre-training aspects to prepare participants for what 'might' occur. Need for greater emphasis on reflection in order for participants to recognise their own cognitive tendencies.</p> <p>Remove feedback - possibly set up voice chat or email feedback during the process to allow for more genuine input.</p> <p>Remove scoring function.</p>
Reflection	<ul style="list-style-type: none"> Both participants noted that this was by far the more challenging aspect of the resource. 	<p>Need for reflection aspects to be clarified. Possible inclusion of reflection exercise in the pre-training lecture</p>
Satisfaction	<ul style="list-style-type: none"> Both participants reported that the resource was simple to use and very engaging 	

Chapter 4 - Methodology

4.1 Introduction.

The previous chapter described the design and user experience of divURGE. This chapter describes the research methodology and methods used to address the research questions.

4.2 Research Design.

The aim of this investigation was to investigate participant response to an online tool (divURGE) developed to enhance DT ability. The investigation took the form of an exploratory Case Study focusing primarily on gathering and analysing qualitative data sourced through the use of psychometric tests, interviews, observations, questionnaires, semi-structured interviews and online reflection diaries. However, quantitative data was also gathered in order to assess any potential learning benefits afforded by the resource to the participants.

4.3 Case study rationale

Case study is a methodology of choice when the issue under scrutiny is contemporary, complex and inseparable from the context in which it takes place (Yin, 2003, p.1). There has been some debate over whether it is a methodology in its own right or a set of methods (Eisenhardt, 1989). However, the two seminal writers in the area (Yin and Stake) have lent much authority to the domain of case study research through application of the methodology in a number of fruitful studies and texts (Johnson & Christiansen 2008, p.406). Case study has a rich sociological history in the Chicago school, with different aspects of immigration such as poverty, and unemployment coming under study; notably in the text 'Street Corner Society' by Foote-Whyte (1943/1955). Since then, Case study has become very popular in educational research (Johnson & Christensen 2008, p.49). It is the method of choice for this investigation because of the multiple influences on learning, which are of interest to the researcher. While other methodologies can offer some more or less generalizable findings, if the outcome of the study is negative, these methodologies will tell the researcher nothing towards an understanding of why this might be.

4.4 Design rationale

The Exploratory Case Study approach was chosen because this study was primarily concerned with recording and understanding the descriptions and perceptions of participants in response to their experiences. The design was also chosen as it allows for flexibility, responsiveness, a focus on relationships and the use of a variety of data collection tools (Denscombe, 2007).

Crucial to case study are the decisions over the unit of analysis, the data sources and the logic linking the data sources to the questions (Yin, 2003, p.21). For the purposes of this case study, the case is an individual who is exposed to the online learning resource. This investigation is a multiple case study investigating three cases followed by a subsequent cross-case analysis. In keeping with the methodology, the investigation will incorporate multiple data sources to build an understanding of the participant's response. Case study does not require rigid adherence to either qualitative or quantitative design, but advocates pragmatic decisions over the best methods to address the issues arising from the study as it evolves (Denzin & Lincoln, 2005). The study was bounded by questions arising from the available theory in the areas under scrutiny here; human factors in DT and online learning. Initial research questions were derived from the literature; however as new understandings of the subjects emerged through the investigation these evolved reflexively into the case study design. The primary, formative question of central importance to this investigation is:

- How do participants respond to a web based learning tool designed to provide instruction in DT?

To answer this question the following sub-questions needed to be investigated;

- Were key personality traits evident in learner responses?
- How were participant attitude, perception and affect reported in learner responses?
- How were contextual factors represented in participant responses?
- Was there evidence of enhanced ability in DT?

4.5 Participant selection

Purposeful sampling is the most common strategy in qualitative research (Hoepfl, 1997). Case studies can use single or multiple case designs (Yin, 2003). Multiple cases enhance the results of a case, increasing confidence in the strength of the theory.

Invitations to participate in this investigation were extended to a cohort of students currently undertaking the first year of study in the fields of interior, landscape and garden design. The invitation highlighted the purpose of the investigation and formative questions at its core. The rationale for extending the invitation to a cohort of design students centred primarily on previously established evidence highlighting the importance of relevance and motivation in creative activity. The recognised association between creative ability and design related activities (Casakin & Kreitler, 2011; Casakin & Casakin, 2007; Bonnardel & Marmeche, 2005; Wong, 2011) indicates that participants drawn from this field may well identify with the relevance of enhance DT skills; and as such, may in fact be highly motivated to participate. The cohort were also selected on the basis that, as students of the researcher, it would afford convenience and a somewhat emic perspective.

Three participants were selected from an initial pool of ten volunteers. Participants were selected on the basis that they reported significantly different, academic and socioeconomic backgrounds. The researcher felt that this would provide a rich source of data. The following criteria were also used to determine participant eligibility:

- Over the age of eighteen
- Able to provide informed consent
- Voluntary participation

4.5.1 Additional participants

During the research process concerns were raised regarding the use of three cases. It was felt that the use of three cases may not provide sufficient data to address the question at issue. In response, two additional participants were invited to participate. The two additional participants enrolled and both subsequently completed the course. However, during the on-going data analysis, it became apparent that exploration of further cases would jeopardise the depth of the case examination. Data from the additional cases have not been included.

4.6 Data collection instruments

Johnson & Christiansen (2008, p.209-219) describe a variety of data collection instruments commonly used in educationally focused case study research. These include: focus groups, interviews, questionnaires and observation. For the purposes of this investigation, the researcher determined that semi structured interviews, questionnaires and observation would provide the richest sources of data. In addition, and with respect to a number of considerations, including the explorative nature of the study; previously highlighted importance of personality characteristics; the focus upon online learning and the embedding of the learning experience within Kolb's Learning Cycle, the researcher determined that a number of additional instruments would be help to address the question under scrutiny. These included a psychometric personality test, a pre and post-test assessment of DT fluency, informal communication and online reflection diaries.

A wide range of data sources were used for this study as they can allow the researcher to address a broader range of attitudinal, behavioural and issues historical issues and the subsequent triangulation and enquiry convergence (Yin, 2003. p. 98). The following sections provide further details on the data instruments used.

4.6.1 Psychometric personality test

Psychometric tests are instruments used for the purposes of psychological measurement, which includes the measurement of knowledge, abilities, attitudes, personality traits, and educational measurement. As highlighted in the literature review, one model, The Big Five Factors Model (BFFM), has emerged as a valid model for understanding the relationship between academic behaviour and personality (Poropat, 2009); and a robust tool for assessment of personality traits in context with to creativity and DT (Hennessey, & Amabile, 2010; George & Zhou, 2001; Feist, 1998). Given the centrality of online learning and the wider nature and scale of this investigation, an adapted, web-based version of the BFFM was used to measure participant personality. The particular model of the BFFM was developed by Buchanan et al (2005), is free to use and is available to view at <http://www.personalitytest.org.uk/>. Test results were transcribed upon completion and added to the case study database for analysis.

4.6.2. Semi-structured interviews

One of the most important sources of data in case study research is the interview (Yin, 2003, p.89). Although there are many forms of interview, the most common form used for case study research, and the one used for this investigation, was a semi-structured format (Johnson & Christiansen, 2008, p.208; Yin, 2003, p.89). The rationale for selecting this form is that they can allow the researcher to enter the world of the interviewee and to gain a greater understanding from their perspective (Johnson & Christiansen, 2008, p.207).

Individual interviews were conducted with participants post interaction with the online resource. All interviews were transcribed verbatim for later analysis.

4.6.3 Observation

Observation can provide valuable insight into behaviours and environmental conditions that may be missed by other instruments (Yin, 2003, p.92) and because people often do not do what they say they do (Johnson & Christiansen, 2008, p.211). Where the issues being investigated are focused on the use of new technology, observation is seen as an invaluable data collection method (p.93). A direct observational approach (p.92) was deemed appropriate for this investigation. Participants selected a setting which they deemed appropriate and were fully aware that observation was taking place. Informal observational field notes were hand written during the observation phase and immediately corrected and edited following completion. Recorded observations were used as a source to develop the original questions guiding this investigation. Observations were then added to the case study database for analysis.

4.6.4 Questionnaires

Questionnaires are versatile data collection instruments that can be used effectively in a variety of research methods for the collection of information about thoughts, feelings, attitudes, beliefs, values, perceptions, personality and behaviour intentions of participants (Johnson & Christensen, 2008, p.170).

For the purposes of this investigation, two multi-section questionnaires were designed and administered to the participants before and after exposure to the online resource (See appendices E & F). The before and after tests included a proportion of the same material as

recommended by Johnson and Christensen (2008, p.196). The pre-experience questionnaire was divided into three sections; section one recorded general biographical data, section two recorded Likert responses in respect to perceptions and attitudes towards the use of computers for learning, levels of perceived motivation to attain DT skills and confidence in using computers in the learning process. The latter part was designed to establish a baseline measurement of DT ability and incorporated an *instances*, *unusual uses* and *similarity* task. The post-experience questionnaire contained three parts; a Likert scale response section focusing on general perceptions and attitudes towards the resource; a number of open ended questions, which recorded the following; qualitative data in relation to thoughts and feelings regarding the online resource; factors perceived as mediating the experience; and a section featuring three DT tasks similar to that completed in the pre-experience questionnaire. These tasks were used to measure any enhancement of DT ability.

4.6.5 Online reflection diaries

Reflective practice is widely held to support both teaching and learning activities (Schon, 1987; Lai, & Calandra, 2010). One method of reflective practice, with evidence to suggest that it affords multiple learning benefits, including supporting independent, deep learning and self-assessment, is the keeping of a reflective diary or journal (O'Rourke, 1998; Moon, 2003). In light of considerable evidence which suggests that online diaries are an effective reflective media (Lai, & Calandra, 2010; Lai, & Calandra, 2007) and given the context of this investigation, all diaries entries were made within the resource environment.

The rationale for the use of reflective journals was twofold; to provide an additional source of qualitative data and, in context with Kolb's Learning Cycle, to actively support the learning process. Diaries were located within the resource environment and responses were supported through the provision of reflective questions and a feature which afforded participants the opportunity to review their responses.

4.6.6 Informal communication

In context with this study, informal communication includes informal conversations and communication via email. The rationale for their inclusion in this study is that they can provide insight into emergent issues as they occur.

4.7 Data analysis

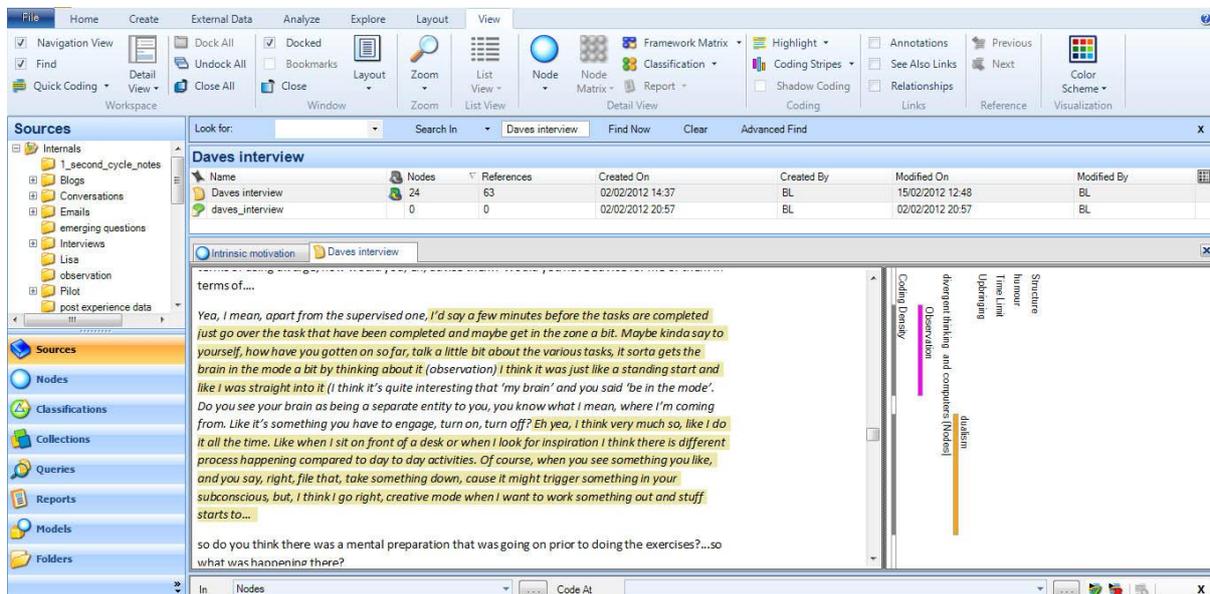
4.7.1 Analysis introduction

Data collection and analysis are on-going in case study research (Stake, 1995, p.71). The researcher is constantly interrogating the initial proposition questions to clarify understandings of the issues under study. Yin (2003), states that this process is built on two key principles; pattern identification and triangulation of multiple data sources. Evidence is described as converging when different data sources imply the same answer to a proposition question. Effectively this will involve arranging the data from the different sources in arrays so that it can be compared easily and rival explanations for the emerging evidence can be explored (Yin, 2003).

4.7.2 Analysis process

All gathered data was compiled into a case study database hosted within the qualitative analysis programme, Nvivo 2012 (see figure 19 below).

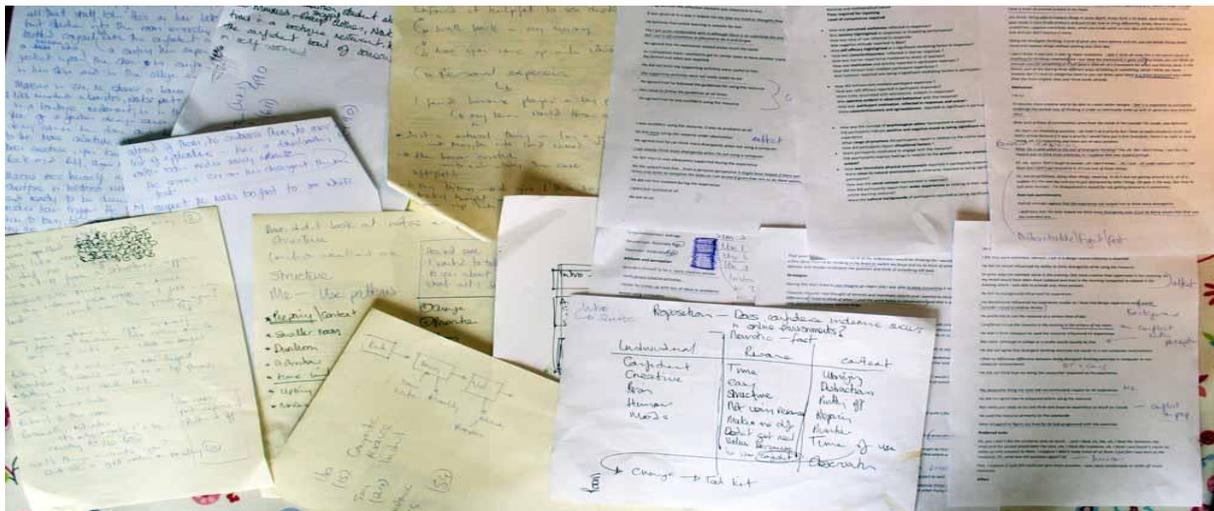
Figure 17: Nvivo screenshot showing computer based analysis environment



The integrity of the data were strengthened through a review of transcripts, audio files and observational notes. As recommended, copies of interview transcripts were forwarded to participants upon completion for fact-checking and to provide an opportunity to add to interview responses (Stake, 1995, p.66). Once reviewed, inputted data were analysed on a case-by-case basis using content analysis methods centred on the emersion of the researcher

within the data, identification and exploration of repeated patterns and reflection on how these patterns relate to the central questions of the study. This analysis was undertaken using both data analysis software as illustrated above, and more organically through in-depth, critical analysis and iteration in a non-computer environment, see figure 20 below.

Figure 18: Photo illustrating non computer based analysis material



Following initial analysis, the identified patterns were further explored, analysed and distilled through the use of a tabulated summary (see figure 21 & appendices H, I & J) and further explored through the formation of comprehensive individual narrative descriptions of each case (See appendices K, L & M). The utilisation of narratives as an analysis approach was undertaken as it can provide a more in-depth and insightful account of process, which goes beyond the individual data (Pring, 1999). The analysis process and formation of narrative descriptions were used to form tentative propositions. In context with this study, propositions are defined as provocative statements utilised to frame emergent patterns from the data. Throughout the narrative iteration process, participants were invited to comment and input, and where appropriate, comments were triangulated with existing data to refute or corroborate the emerging propositions.

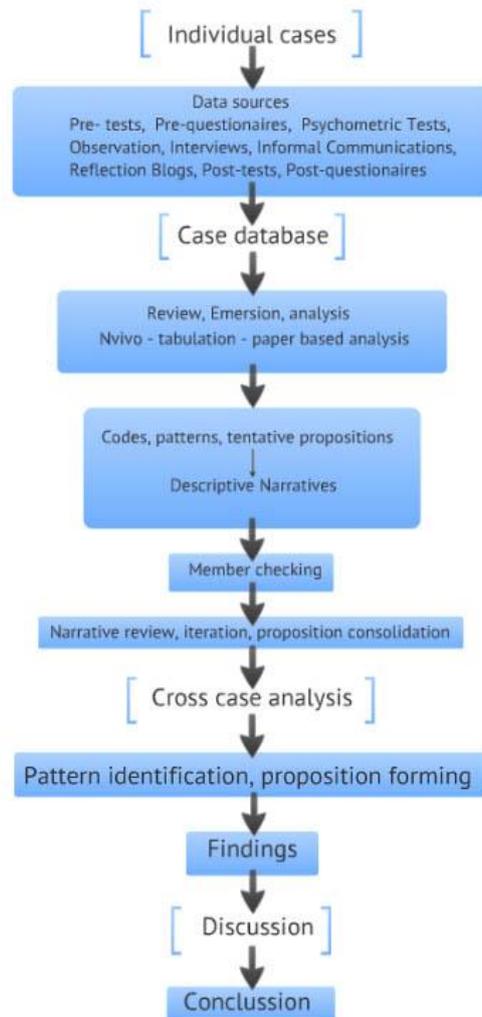
Figure 19: Image showing portion of the tabulated data summary

Bio data	Gender	Age	Education level	Divergent thinking experience	Creativity experience
	Male	42	Diploma	None	None
Personality	Extroversion	Openness	Agreeableness	Conscientiousness	Neuroticism
	Relatively average	Relatively high	Relatively high	Relatively average	Relatively low
Attitude and perception of/toward computers	Does not enjoy using computers, does not use them to learn, does not find them easy to use and experiences negative emotions when using them.				
Attitude and perception of/toward creativity	Considers himself to be somewhat creative, enjoys doing creative activities, is not concerned about what people think of his ideas, sees himself as a risk taker considers and really wants to be more creative				
Scores	Pre test 26		Post test 54		Proposition: Mark's experience seemed to enhance his divergent thinking ability
Explorative research areas from literature	Recorded in participant Reponses	Number of sources	Frequency	Sample responses	Emergent propositions
Resource focused					
Time required for inputting responses	Yes	4	6	<i>I definitely felt a bit less creative being watched and looked at the clock more</i>	
Level of computer competence required	Yes	2	4	<i>A keyboard? Probably not a key board. Probably...eh I'd want a workshop, yea a workshop,</i>	

A cross-case analysis was subsequently undertaken to explore pattern repetition across the cases. This was then followed by negative case analyses to explore elements of the data that did not support patterns or explanations that were emerging from data analysis (Creswell, 1998). Conclusions were thus drawn in the form of cross-case propositions and explored further in the discussion chapter.

Below is a diagrammatic illustration of the data analysis process.

Figure 20: Diagrammatic illustration of the data analysis process



4.8 Time and duration

The entire investigation, encompassing implementation, data collection and analysis, took place over nine weeks from January 9th, 2012. Individual, directly observed sessions were limited to 15 minutes each. The total observed sessions amounted to 45 minutes. The total unobserved sessions amounted to 360 minutes approximately. Figures relate to the three original participants only.

4.9 Ethical considerations

Prior to the commencement of the study, each participant was given the ethics information sheet and asked to sign the informed consent form. Each was advised that they may withdraw consent at any time. All participants were assured that their anonymity was protected and pseudonyms (Mark, Patrick & Raoul) were subsequently used for this study. For more information on the ethics documentation provided (see appendices A-D). Ethical approval was granted by the School of Computer Science and Statistics Committee.

4.10 Questions of rigor

The researcher attempted to ensure the rigor of the investigation by attending to all the evidence, actively seeking out data that did not corroborate emerging lines of evidence, addressing, where appropriate, all major rival interpretations; by attending to the most significant aspects of the investigation and by bringing to bare all prior knowledge and experience available to the researcher.

A emic perspective was adopted throughout the duration of the investigation insofar as the participants were students of the researcher. This allowed the researcher a greater degree of emersion and contact over the investigation period. A personal reflective journal was maintained throughout the study duration in order to mitigate possible negative impacts of this insider perspective. To add to the rigor of the investigation, exhaustive efforts were undertaken to evaluate and report all significant observations.

4.11 Conclusion

This chapter described the research methodology, data collection instruments and analysis techniques used in the study to address the central research question. The next chapter describes the data analysis findings.

Chapter 5: Findings

5.1 Introduction

The previous chapter detailed the methods used to address the central question of this study. This chapter details the findings resulting from the data analysis.

Given the in-depth nature of the explorative case study methodology and the analysis processes used, findings from both the individual and cross-case analysis are presented in narrative form with individual case propositions highlighted beside associated text.

5.2 Contextualising the cases

Each of the participants in this study was undertaking a diploma level course in landscape design during the research implementation period. A cohort of students was invited to participate and an appropriate number selected on the basis of fulfilling ethical requirements, on reporting significantly different socioeconomic backgrounds and on the basis that they afforded both convenience and an emic perspective. Prior to commencing learning activities, participants attended a one-hour lecture, which introduced them to the online resource. During this lecture they also undertook a pre-test of DT fluency, completed questionnaires, a personality test, relevant paperwork and were given the opportunity to ask questions. Following the lecture, participants were invited to engage with the resource over a nine-day period and in their homes or other suitable locations.

Below are the narratives and emergent propositions for each case, followed by the findings of the cross-case analysis. It is important to note that the narratives are a consolidation of all data sources used, and, in line with recommendations, are written in a manner which affords maximum opportunity for synthesis and readability (Yin, 2003, p.138). See appendices H, I & J for original narrative case descriptions and L, M & P for tabulated data. Original narratives are included within the appendices to afford readers the opportunity to explore the richness of data in more depth if so desired. With regard to the cross-case analysis, and in the interests of conciseness and readability, sample supporting quotations have been omitted.

5.3 Case 1: Mark

A small boy scratches a western scene on his parent's coffee table. He's excited and proud to show them: they don't see an art work, they see red. *'I thought it was fantastic...But again the reaction was...what have you done, that's wrong, you're after wrecking our table?'*

That little boy is now 42; he's a married man with three children and a mortgage. His family are everything to him. He has a name too, it's Mark.

Mark left school early and didn't go to college. It wasn't for him; it is now. He's a student of design and a good one. He's interested in creativity and volunteers for this research with gusto. But he doesn't like computers; they frustrate him and evoke negative feelings when he uses them. His pre-experience questionnaire and personality test suggest that he is agreeable and open, but not confident. He scores 26 in his pre-test of DT fluency and 54 in his post-test.

Proposition 1: Mark's experience with divURGE appeared to enhance his DT ability

Mark sets off alone to undertake his divURGE experience but he doesn't work alone; he's not confident enough; *'No, no, I didn't even try...all those emails you got from me, I didn't type any of them... typing is a huge problem'*.

Proposition 2: Mark's perceived lack of typing skills presented him with a barrier to participate.

Mark enlists his wife, Louise, to help him using the resource. A lack of confidence is Mark's constant companion. It questions his every move, undermines his decisions and shapes the path he follows. *'I do worry about if I'm saying the right thing...Eh, yea, second guessing myself all the time.'*

Proposition 3: Mark's low confidence inhibits his ability to engage with the resource

Louise, Mark's wife, allows him to shake off his companion, she motivates, encourages and provides psychological safety; *'When I knew my wife was doing the typing I looked forward to the tasks more...Yea, she'd probably guide me along the way, maybe explain what this question means'*. Mark's experience of divURGE would have been different without Louise; *'Yea, more stressful I think'*

Proposition 4: Being able to share the divURGE experience was integral to Mark's experience

Louise wasn't Mark's only support. He found security in the completed example exercises and reflection notes provided in the resource. *'When you gave the examples of say the Onion and the Radio I thought...ah so that's what it's all about, that's what we're looking for here. Another way of looking at or seeing things...'*

Proposition 5: The provision of completed examples helped Mark to overcome his lack of confidence

Mark's lack of confidence was not the only thing to challenge his experience, the time constrained nature of the tasks and the visible time clock also exert pressure upon him; *'jaysus the time thing is a killer....I was very aware of the time in the first task and had to consciously stop looking at the clock in the next two tasks...the time is something I'm always thinking about'*

Proposition 6: Time constraints and a visible timer focused Mark's attention in divURGE

Mark experienced a range of emotions during his experience. His lack of confidence needed him throughout, producing negative results; *'I found that it was frustrating cause I think, ah, I don't know the words so then what's the point?...that's a stupid way to think.'* But it wasn't all negative, the nature of the tasks and reflection activity produced positive emotions too; *'I did feel joy, experience happiness, it was exciting to eh, to think of...about the amount of different ideas I could think of...'*

Proposition 7: A low level of confidence produced negative emotions in Mark but also allowed him to experience the joy of triumph while using divURGE

As Mark...and Louise progressed, some unexpected things bubbled to the surface. Mark began to identify some long buried self-beliefs; Mark was a creative child but somehow he had lost his abilities; *'I realise now because of the divURGE thing that was always that sorta person. I was always questioning things when I was younger and I was wondering where did that go, why did I stop doing that...'*

Proposition 8: Mark's experience with divURGE enabled him to reconnect with what he felt was his natural way of thinking.

Later, Louise reviewed the first two narratives and shared her own insights; *'Mark's parents are very fearful people. They had the belief that it's better not to try than to try and fail.. It was an unconscious thing that the whole family seemed to live by, and still do. ..It's almost like he has realised that the whole world doesn't have the same view as the one he was raised with - that there is only one way, and that there is a right and a wrong way.'*

Nearing completion, Mark began to identify some changes in his DT ability; *'this time one answer triggered another one, which hasn't happened before... the answers were sparking, you could see how one answer would spark another'*. Louise also saw changes in his thinking; *'since he has done the divURGE task he has had an almost "awakening" ... And by doing the divURGE tasks he has realised his own potential for creative thinking.'*

Proposition 9: Marks experience with divURGE provided him with a new way of thinking that he can engage when needed

One other factor was identified as having a significant impact on Mark's experience with divURGE: me; *'Just because it was you, and not because I want to impress you, but I want to do well and I want you to think that Mark's doing well, he's doing ok, and he's a good student... how am I going to come across to Barry, you know what I mean? Once I started to do it, it was...'*

Proposition 10: Mark's level of engagement with divURGE was increased because of our relationship

Mark completed all the exercises and reported that he felt the experience had increased his DT abilities; he felt that online learning didn't suit him but that it was *'down to him'* and not the media. While he didn't feel confident using the resource he said he did enjoy the experience. He also reported that the experience had allowed him to understand how and why he thinks in certain ways and had provided him with a new way of thinking and seeing; or more correctly, it provided him with a way to rekindle his natural way of thinking and seeing.

The last words go to Louise; *'I agree with the propositions in Marks story. I think by doing divURGE Mark has tapped into a way of thinking that he had as a boy.... In conclusion, since doing this divergent task Mark has more confidence in his own abilities, is more open minded in general to new ideas and I know this may sound corny, but is well on the way to being the man he was born to be.'*

5.4 Case 2: Patrick

Patrick is 29, he's a design student, he lives in shared student house with four others and works part time at a boutique restaurant. He's self-assured, extrovert, open to new experience, funny and takes good care of himself. He's confident in his computer and creative abilities and enjoys using both. He volunteers for this research with a.... *'think more creatively? Yea sure, where do I sign up?'*

Despite thinking and stating otherwise, Patrick doesn't follow the resource program – *'Yes, I followed the guidelines at all times'* – he does his own thing in his own time. When pushed, he ponders and confesses; *'Well I'd plan to do it then I'd get home and I might play some football or you know'*. Patrick says he didn't find the support resources useful, but he never actually looked at them; *'eh, I just ...eh under pressure? I wish I did them but I didn't get around to it'*. Patrick is easily distracted from divURGE, by life; *'I definitely found it easier to work at night with no distractions'*. He is a popular guy and has many distractions; *'You know, friends, colleagues, stuff.'* He doesn't know what would encourage him to be more conscientious but is sure that rewards wouldn't do it; *'What like a gold watch at the end of DT? Yea, eh, like I don't know, I see like the reward was to think more creatively, so I suppose that was reward enough.'*

Proposition 1: The interplay of confidence, relatively low levels of conscientiousness inhibited Patrick's motivation to engage with it.

During follow up conversations and member checking, Patrick reflected on the proposition; *'there were some real home truths in there and that was hard to read.... I know what I need to get done but I do have a history of leaving things to the last minute.....but getting them done'*.

Patrick has a place of focus, a safe, comfortable space where he can create; *'it's just my little private space. I have a nice desk, mac, drawing board, it's where I work, where I*

create and do things and minus any distractions so you know it's just that safe environment where you can just get on'. The importance of this space truly emerges when Patrick falters while using the resource under observation; 'I suppose it was just the opposite of when I felt comfortable in the room. It was like close quarters, under supervision, ready steady go and then I just froze'

Proposition 2: Patrick's immediate physical and social environment is integral to his ability to engage with divURGE.

There's more to Patrick's performance level than physical and social environment. Patrick likes to be mentally prepared to engage in divergent activity; *'The first task that we did, which was just pen and paper, was eh, fine and you kinda teed us up for it, so I was kinda geared up for it so that wasn't too bad... I didn't have time to prepare, not even that, I needed time to prepare.'*

During follow up conversations and member checking, Patrick reflected on the proposition; *'The preparation is like to clear you mind to get rid of thoughts that are distracting... it's better to do them [tasks] maybe after you've done a bit of thinking work so you're like having a warm up, sorta like stretching'*.

Proposition 3: Mental preparedness is important to Patrick's success using divURGE

The time constrained nature of the divergent tasks and the visible time counter impacted on Patrick's experience, but he's not sure why; *'the clock ticking in the corner it can pile the pressure on and sap the creativity...I was just conscious of the short time limit so I didn't want to waste any seconds...because it put you under a bit of pressure to see if you can perform. So it was good in that sense'*. On one hand it focuses and motivates, on the other, it undermines and pressurizes.

Proposition 4: Having a visible time counter plays a significant role in participant experience

Keeping a reflection blog also impacted on Patrick's divURGE experience; helping him to gain insight into his ideational processes, to retrace his cognitive steps, to explore sources of responses and the connections between them. He enjoys it; *'I found it helpful that you could look at your answers and that made you aware of where the ideas came from ...I*

found it interesting to understand how my mind works from a creative perspective yea it was good to see what you might come with.'

Proposition 5: Structured reflection activities in association with the ability to review answers afforded Patrick the opportunity to gain greater insight into his ideational processes.

Patrick sees himself as a funny guy and he uses humour as a social and ideational tool; *'I found that humour played a big part... I think it was just a natural thing, being a joker sometimes. When I was doing the task and I found that I came unstuck or ran out of ideas I'd kind of look at the funny side of it... after a couple of answers sometimes my brain would click in or throw a joke in.'* Humour is more than a subconscious response, it is an tool to be consciously engaged when using divURGE; *'When I was doing the task and I found that I came unstuck or ran out of ideas I'd kind of look at the funny side of it.'*

Proposition 6: Humour was an important ideational strategy for Patrick when using divURGE

While humour provides Patrick with a conscious ideational strategy, his past experience and family upbringing serve as ideational wells from which he subconsciously draws; *'I think from a young age I was always colouring in, and showed a bit of creativity kinda like with writing and stuff like that...so I was encouraged you know... art classes and Christmas presents and decisions I was going to make were always supported, you know any courses I wanted to do. I suppose I was just nurtured rather than discouraged...'*

Proposition 7: Upbringing significantly impacted Patrick's ideational processes while using divURGE.

Despite Patrick's levels of self-efficacy, his relatively high scores in traits associated with DT and his strong belief that the experience enhanced his ability to think divergently- *'I definitely feel the tasks helped me think more divergently'* - his post experience score (27) differed only slightly from his pre experience score (25), thus indicating very little enhancement of DT ability. While his score did not improve, he did feel that the experience had provided him with a DT strategy that he could engage when required; *'It gave me a more structured process in my head...I like the fact I am aware of different tools to think divergently...it will be part of my thought process or idea generating process from now on.'* In addition to being recorded across multiple sources, his conscious awareness of divergent

approaches was also evidenced in his desire to move beyond ideational fluency to focus ideas which had value; *'I wanted to think of good similarities and not just random things that they both contain.'*

Proposition 8: DivURGE did not appear to enhance Patrick's DT ability but did appear to provide him with a valuable ideational strategy.

Upon completing his divURGE experience Patrick reflected positively upon it and noted its relevance to him. Although he perceived improvement in his ability to think more divergently in a non-computer environment, in terms of the specific tasks, he thought there would be little difference in performance; *'I don't think it makes a difference. If I'm typing, It's the same idea generation process...I wouldn't see writing or typing, eh, not a huge amount of difference. Probably marginally quicker writing them down'*. It is interesting to note that despite his computer and creative self-efficacy, Patrick still thinks that computer based instruction is second to traditional methods; *'I think I'm on the cusp of the old school, eh, I'm just kinda, eh, you know, even now if I'm writing an essay or something I'll always write short hand with a pen first then transcribe it on the computer... there is no substitute for one on one teaching'*.

5.5 Case 3: Raoul

Raoul is a professional chef; *'A very good chef, a very good cook, a very creative cook.'* But he wasn't always a chef, in his early years he attended a strict Jesuit boarding school and subsequently pursued a career in economics: but it didn't motivate him; *'when I realised that no one was going to listen to me I knew I had to change direction.'*

Raoul is still a chef, but now he's also undertaking a Diploma in Garden Design. Beneath both he's still an economist.

He volunteered to participate in this study out of a general interest in education, to undertake some self-assessment and to develop new ideas. His personality assessment revealed him to be relatively neurotic, open and neither conscientious nor agreeable: Ironically, he completely agreed; *'Well I'm always aware of not being very conscientious, I'm aware of the fact that I'm neurotic, em, agreeable is more to do with the fact that I'm an arrogant snob.'* Raoul has strong feelings about computers: he really doesn't like to use them; doesn't enjoy using them and finds they stimulate negative emotions. Despite this, he

uses them frequently for communicating with friends, for reading newspapers, occasionally to support learning; *'I use Facebook...mostly to play Farmville though!! LOL.'*

He scores 31 in his pre-test of DT fluency.

Raoul does use computers but he eyes them with suspicion, as basic tools and as obstacles to overcome; *'I suppose what I really can't get passed is the computer, the box...'* Such is Raoul's negative perception of computers that it restricts his progress, he sees the computer as his foe; *'Sometimes I tried to sneak up on it obliquely by putting it off...aaah, I'll plan the moment when I start this...I'll start massaging my brain in this direction.'* During observation he displayed visible discomfort, openly tutting at an onscreen error and exclaiming *'oh for God sake Raoul'* when reviewing his progress.

Proposition 1: Raoul's negative perception of computers significantly limited his ability to engage with the experience

Raoul is overtly self-critical - *'it's the story of my life, high expectations, low delivery'* – and he has little confidence in his computer abilities; *'I don't have a level of confidence in terms of computers'*. His low levels of computer self-efficacy manifests as a keyboard battle; *'the typing challenge was the challenge... it was like patting my head and rubbing my belly'*.

Proposition 2: Raoul's perceived low level of typing skills represented a physical and mental limiting factor

Another negative aspect of the experience was the presence of the visible timer. It served to distract, annoy, frustrate and challenge him; *'Funny what happens when time constraint is introduced....all the clever stuff that I think of at 4am disappears and I'm floundering...if I paid any attention to the clock at all I became too obsessed with the clock ticking...at the beginning it was surprise, that moved to frustration and that moved to downright anger.'*

Proposition 2: Having a visible timer negatively impacted Raoul's ability to focus on responses.

Not all of Raoul's experience was negative; in fact, he experienced many positive thoughts and feelings over the duration of the process; *'Well it's actually very emotionally*

freeing in one sense...I mean I'm still enjoying that feeling...' On one level, the nature of the divergent exercises demanded Raoul orientate himself toward a positive, light hearted outlook; *'That's a very enjoyable thing....on a kind of a flip level, the idea of doing silly exercises and at the same time being able to justify them with an end result for educational purposes is very enjoyable.'*

Proposition 3: The nature of DT exercises mitigated some of the negative aspects of Raoul's experience

Although Raoul felt that the environment in which he undertook the exercises had little or no impact on his experience - *'I'm actually quite happy to be in that room, I have good vibes about that house* - elsewhere he highlighted negative associations; *'I mean the computer looks strange in the room... you feel you're tucked behind the door when you're using it, you feel in a very cramped space...wrong location, wrong thing, wrong everything.'* The importance of physical environment also emerged when he was asked to describe a 'perfect place' for undertaking DT exercises; *'A big space, white walls, quite high, a wall of floor to ceiling glass, very loft like space, very floaty furniture. There is a mixture of furniture.'*

Proposition 4: Immediate physical environment played an important subconscious role in mediating his experience with the resource.

Raoul is not motivated by external factors; *'so the motivation for me was that I was just curious and eh, am I going to do any better....It was all about me and that's always a good motivation for me.'* While intrinsic motivation is extremely important for Raoul, contact with other people is a significant catalyst for raising his motivational spirits; *'by the time she [Mary, Raoul's housemate] gets home in the evening she is thoroughly exhausted...but sometimes she gets home and is feeling quite energised...and it's; what are you doing, why are you doing it, show me what you are doing, and it's like ten hours of energizing...It's like a total top up of the battery in about six minutes.'* Mary provides Raoul with more than a simple battery boost, she quells his self-criticism, his doubts and boosts his confidence; *'it's almost like I feel confident to try things...so I can stand back from that and throw it away and start again.'*

Proposition 5: Having somebody to share the experience with has a positive impact on Raoul's experience.

The idea of sharing and interacting with people through spoken rather than written words is a frequently occurring theme with Raoul; *'if you had said there is an option of spending your Saturday mornings interacting with people that would have been a huge motivation...I felt that I would enjoy doing this in a group situation with people.'* His preference for spoken words is also evidenced in his choice of narrated videos over typed instructions; *'I found them [the videos] very helpful because, I can process that information very well.'* Interaction with others was also represented in how Raoul contextualised, or at least was not able to contextualise, his own performance; *'I don't know how well I did, for comparison, you need comparative data... oh I'm sure everybody is doing this so much better than me...I have picture of Patrick flashing through my mind with his perfect technology and his wonderful mind and his great vision... Jealously.'*

Proposition 6: Affording Raoul the opportunity to verbally dialogue with other participants could have significantly enhanced his experience

Although he felt that he didn't undertake and preparation, and wasn't sure what sort of preparation he could have undertaken, he frequently made reference to its importance elsewhere; *'I'm beginning to think I need to prepare for these tests... before you do the exercises, do things that you are confident doing, and comfortable with, things that make you feel good. I don't care if that's going for a walk, having a bubble bath, watching csi Miami...what's important is that it makes you feel good, comfortable and confident.'* When questioned more deeply about the nature of activities which he felt would be conducive to the resource, he highlighted physical activity; *'So I had been...say cooking or I had been looking at art or gardening books...as opposed to watching the news.'* As to how he felt this would positively impact upon his experience with the resource he said; *'So there is an element of that physical activity maybe draining that extra tension away or something like that...it isn't so much that it's a focusing activity, it's that it's a calming activity.'*

Proposition 7: Undertaking preparation activities which stimulate feelings of calmness and comfort significantly increased Raoul's ability to engage with the resource.

Raoul completed all of the resource activities with a feeling that online learning doesn't suit him, that he could think more divergently in a non-computer environment and that the experience did not increase his DT abilities.

He scored 40 in his post-test, which was an increase from his pre-test score of 31. The score indicates a small but not insignificant enhancement.

Proposition 8: Raoul's experience with the resource may have marginally enhanced his DT ability.

5.6 Cross-case analysis

This study centred on the exploration of how participants respond to an online tool developed to enhance DT. It was bounded but not wholly restricted by a number of formative questions relating to personality traits, attitude and perception, contextual factors and enhancement of DT abilities.

The study involved the participation of three individuals - Mark, Patrick and Raoul – who were selected on the basis of reporting significantly different socio economic backgrounds and who later revealed themselves to have considerably different personalities, attitudes, motivations and levels of both creative and computer skill self-efficacy. All three were keen to participate and as the previous narratives explored, each had a very different experience. While participant experiences were unique, complex and inseparable from their particular set of circumstances, they did share some areas of commonality. Below is a cross-case narrative description, which explores commonality to form cross-case propositions; each of which is placed at the end of the related body of narrative text. As previously highlighted, supporting case quotations have been omitted.

Mark and Patrick participated in the research on the basis of being motivated by a wish to increase their levels of DT; Raoul on the other hand was motivated by a more general interest in education and to pursue some self-analysis. Analysis of the pre and post-test scores inferred that Mark significantly enhanced his abilities; Raoul showed a moderate enhancement and Patrick none at all. Although not integral to this study but of general interest, the two additional participants who were not included in the primary data analysis scored 23 and 28 in their pre-tests and 32 and 45 in their post-test. It is interesting to note that both Patrick and Mark felt their DT abilities had been enhanced while Raoul felt his hadn't. It

is also interesting that beyond their perceptions of enhancement, both Patrick and Mark repeatedly referred to the development of new thinking strategies, ones that could be engaged when appropriate. This would seem to infer that the experience gave two participants new thinking skills. Further analysis of the data suggests that this adoption of new skills was far more meaningful for Mark, who experienced a somewhat cathartic experience. For Patrick, the experience was more a prosaic framing of existing knowledge. In contrast, Raoul felt he had neither adopted new thinking strategies nor improved his DT abilities.

Based on the similarities existing between Mark and Patrick, in terms perceived performance and adoption of thinking strategies, it is possible to infer that initial motivations for participation played a significant role in post experience perceptions, regardless of actual recorded performance.

Proposition 1: Motivations for participation played a significant role in shaping the post experience perceptions of participants using divURGE

Mark, Raoul and Patrick came to the study with varying levels of computer skills. Patrick considers himself proficient, while Mark and Raoul both have limited experience and see their levels of skills as barriers to engagement. In terms of using the resource, all three found it easy to use and were able to navigate throughout the resource with no difficulty. In relation how skill level manifested in experience, both Mark and Raoul reported that typing responses presented a serious barrier to engagement. It is interesting to note that despite Mark and Raoul's frequent highlighting of typing as an impediment to engagement, both appeared to type at a reasonably comfortable level during observation. On further probing, neither could identify an explanation, but Raoul did suggest that my perception of comfortable level is probably very different from his.

Proposition 2: Perception of computer skills was more significant than observed skills in mediating participant experience and levels of engagement.

In addition to skills level, the participants also brought with them existing levels of computers and creative self-efficacy. Patrick was by far the most confident participant, perceiving himself to be very creative and someone who finds computers and creative activities easy and enjoyable. On the other hand, Mark has very low-level of computer self-efficacy, dislikes using computers but is reasonably comfortable doing creative activities.

Raoul considers himself moderately creative, enjoys creative activities but finds them, and using computers quite challenging.

Levels of self-efficacy played important but different roles in shaping the experience of all three participants. For Mark it produced negative emotions such as tension and frustration but also a sense of accomplishment when he became more comfortable with the environment and what he perceived was expected. For Patrick, with his high levels of computer and creative self-efficacy, it appeared to undermine his experience. Rather than serving as a stimulant to engage, it served to undermine his ability to exploit the resource. This was manifest in his ignoring of the suggested usage guide, his non completion of the additional exercises and his ignoring of supports (despite saying otherwise). In Raoul's case, issues relating to self-efficacy were more complex; he stated that he wasn't confident using the resource and yet did not report problems, saying it was easy to use. He also stated that he was fundamentally disinterested in other people's criticism and yet appeared to regulate his levels of confidence through comparison with others; something he was unable to do within the resource experience. From the data it would appear that being very confident can serve to undermine levels of engagement with potentially beneficial resources, while low levels can be mediated by perseverance to possibly produce positive response.

Proposition 3: Confidence is a complex phenomenon which can significantly influence participant experience of divURGE and should be attended to on an individual basis.

One of the features of the resource was a timer that counted down the two minutes allotted to each DT exercise. While it was not expected to contribute in any significant way to the experience, in practice it produced a variety of responses across the three cases. Patrick felt that its presence placed him under pressure, undermined his ability to be creative but also focused his attention. Mark also felt that the timer placed him under pressure and undermined his confidence, but he managed to contextualise it through reflection. Raoul considered his own response to the timer in more depth and when questioned he noted that he felt there was a relationship between the difficulty of the task and how much attention he paid to the time. From the reported evidence it can be inferred that presence of a timer focuses attention, becomes unimportant during tasks perceived as easy and highlights specific points of challenge during tasks.

Proposition 4: The visible timer significantly influenced participant experience.

Proposition 5: If used in a more integrated way, the visible timer could have afforded participants greater insight into their DT processes.

The preconceptions, attitudes and perceptions of participants significantly mediated their experiences. Raoul perceives computers as simple tools and has fixed views about what they do and the relationship he has with them. His relationship is not positive and produces a variety of negative emotions which infected every aspect of his experience. Mark also experienced less than positive affective states but unlike Raoul, Mark's negative responses were not borne from attitude or perception of computers: rather his self-image. Although his perceived lack of typing skills also produced some tension, the primary source of negativity was an internal sense, or need, to get it right. What is interesting is that both trace their attitudes and perceptions to their upbringing, schooling, relationships with their fathers and perception that they should be doing better. In contrast to Mark and Raoul, Patrick reported having a more positively focused experience. It is interesting that Patrick grew up in an open and supportive environment in which his creativity was fostered and that he was the only one of the three not to show an improved score.

Proposition 6: Affective responses to the resource were to some extent shaped by the nature of participant upbringing

Proposition 7: An upbringing perceived as negative can help to shape perceptions and attitudes that produce negative affective states while engaging with online resources such as divURGE.

All three participants also experienced positive emotions over the course of their experience. Raoul in particular, who had a tendency toward negativity, found the nature of the exercises amusing and fun. Mark too, also highlighted joyous moments both at the fun nature of the questions and his responses to them. Patrick's positive responses were drawn from internal sources and from his more light hearted nature. He loves to laugh and make people laugh and humour represented an important ideational strategy for him

Proposition 8: The perceived unusual nature of the divergent tasks within the resource produced positive emotions in participants allowing them to reduce the negative impacts of pre-existing attitudes and perceptions.

Looking on the light side seemed to support positive engagement within the resource but being mentally prepared was reported as a very significant factor in mediating performance. From the outset participants reported the sense that preparedness was key and when questioned as to what advice they would give to other participants, all three referred to the need for preparation. Raoul reflected more deeply on the concept of preparation, stating that it was a necessity and that, at least for him, physical activity – cooking, drawing, walking the dogs – would have a positive impact, while passive activity – watching TV, reading the newspaper - was negative.

Proposition 9: Undertaking placating activities prior to engaging with the resource may afford positive performance benefits.

Mark never interacted with the resource on his own; he shared every moment with his wife, Louise. He did so because she makes him feel confident, because she can type faster and because they are inseparable. Mark was not alone in sharing his experience, Raoul too found great comfort and inspiration from sharing his experience with his house mate, Mary. Patrick on the other hand, had no interaction with anyone about the resource; he didn't need to too, he was confident enough on his own. What he did refer to was the need for more input to keep him focused. While Patrick felt that he needed an external nudge to maintain focus, both Mark and Raoul strongly felt that social interaction was and could be of huge benefit. It is interesting that the two participants with low levels of computer self-efficacy both felt that they needed a social element to make sense of what was happening, while it was less important to Patrick. Even still, he did feel that something was missing and that external input would have assisted him.

Proposition 10: A learning experience that incorporates social interaction and support could enhance participant engagement with divURGE.

Raoul, Patrick and Mark all stated that their immediate physical environment did not impact on their experience. Elsewhere, all three identified that it did, and significantly so. While Raoul said he felt comfortable in his work room, he went on to describe it in wholly negative terms. When asked to describe his perfect DT exercise room it bore no characteristics in common with his actual space. Mark frequently made reference to his to the sense of comfort and security derived from the lounge space in which he worked with his wife, while Patrick made numerous references to his work space. Patrick describes his work

space as his creative hub, a place he arranges, controls, which contains all his things and where he can shut himself off to focus on creative work.

Proposition 11: Physical surroundings which evoked a sense of comfort enhanced participant experience

An integral element of the resource was its utilisation of Kolb's Learning cycle, and in particular, a focus on the use of reflection to support learning. All three participants engaged in reflection activities but on different levels and with different results.

Raoul reported no perceived benefits, besides the uncovering of unrelated and buried issues, Patrick felt they provided him with a useful tool and Mark found them extremely beneficial. It is interesting, that despite attending an instructional lecture, viewing supporting media and having sample reflections to draw from, that Raoul viewed reflections as simple musing rather than a focused activity. His reflections all remained on this level and as previously highlighted, his tendency toward negativity meant that when he reflected he couldn't move on.

Patrick on the other hand engaged with reflection on a far more functional level, using the process to identify relevant positive and negative occurrences. Using the reflection process, he managed to direct himself past the intended purpose of enhanced ideational fluency toward flexibility and originality. In follow up discussions he stated that the reflection element, when coupled with the ability to review his answers, was of significant benefit to him

While Patrick gave only cursory attention to the reflection supports, Mark followed the guide to a tee, answering questions in sequence to understand and direct his actions. More significantly, the reflection process brought to the surface a deeper understanding of how and why he thinks the way he does, which in turn helped to motivate him to engage.

The benefits derived by participants from reflection activities appear to correlate with their understanding of their purpose. In follow-up discussions, participants were asked if they felt their experience would have been enhanced by more reflection support; all three said yes.

Proposition 12: Reflection activities were an important aspect of learning in divURGE but only when their purpose was understood.

In conclusion it is worth addressing the issue of my role within the experience. The three participants were all students of mine at the time of the research and as such I had a close, tutor-student relationship with them. While it was expected that I would have a significant influence upon their experience, Patrick and Raoul were emphatic that I did not, stating that the only impact related to being initially receptive to participate. Mark, on the other hand, clearly identified that I influenced his experience in both a positive and negative way. I provided him with motivation to participate but our relationship also placed him under pressure.

Chapter 6 Discussion

The previous chapter presented the individual and cross-case analysis findings. This chapter discusses the findings in context with the central research question and the principle literature used to inform the study.

6.1 The research question.

This study was guided by the following question and sub-questions.

- How do participants respond to an online tool developed to enhance DT?

Sub-questions

- Were key personality traits evident in learner responses?
- How were participant attitude, perception and affect reported in learner responses?
- How were contextual factors represented in participant responses?
- Was there evidence of enhanced ability in DT?

6.2 Discussion context

The research findings explored in the previous chapter presented a number of challenges in relation to addressing the key sub-questions. Not least of which was how each could or should be dealt with in isolation. The nature of case study research, and as evidenced by the data already presented, are that findings are complex and inseparable from their context. With a view to addressing this, the following discussion is presented under three headings. The headings, which were used to disseminate the primary literature into design objectives, and which encompass the sub-questions are; individual focused, resource focused and context focused. Key findings and possible implications for future research are placed beneath relevant sections of text.

6.3 Individual focused: Incorporating user personality, perception, attitude, confidence and affect.

The literature used to guide this study highlighted a number correlations between personality traits and both online learning and DT (King, Walker & Broyles, 1996; Sun Young & Jin Nam, 2009; Batey, Chamorro-Premuzic & Furnham, 2009). Traits such as openness to experience and extroversion were evidenced to be positively correlated with increased creative thinking (Dollinger, Urban, & James, 2004; George & Zhou, 2001;

McCrae, 1987) and traits such as conscientiousness and low levels of agreeableness were evidenced as being negatively correlated (Premuzic and Furnham, 2009). It was also suggested that conscientious individuals may prefer online learning, while open and extrovert individuals would be more engaged and active in online learning environments (Orvis et al, 2011) and better able to focus (Gully and Chen , 2010). While there is correlational evidence connecting traits with DT and online learning, the nature of this case study did not facilitate their exploration in isolation from their context.

However, findings from this study did imply that low levels of agreeableness appear to undermine both DT ability and the ability to positively engage with the resource. Rather than simply a result of low levels of agreeableness, the reduced engagement would appear to result from negative affective states stimulated by the confluence of factors including levels of agreeableness, confidence, perceptions and skill levels.

Finding: Low levels of agreeableness negatively impacted the response of users to divURGE, but the impacts were themselves mediated by user confidence, perception and skill level.

Area for further research: To what extent can low level of agreeableness be mediated by other user related factors to afford positive benefits for users of online DT training resources?

All three cases considered themselves relatively open and extrovert and neither was reported or evidenced as having a significant impact. The positive correlation between conscientiousness and online learning was supported in this study, while its negative relationship with DT ability was not. From the evidence, it appears that a high level of conscientiousness – manifested in a participant as perseverance and a sense of obligation to finish the course – enabled them to reduce the negative effects that conscientiousness may have had on their ability to think divergently.

Finding: Having a high level of conscientiousness can help to mitigate negative impacts that the same trait may have on an ability to think divergently while using divURGE.

Literature suggests that factors such as dead links and poor navigation in online learning can produce considerable negative emotions including tension, aggressiveness,

anger, frustration, confusion, boredom and isolation (Berenson, Boyles & Weaver 2008). In relation to creative cognition it has been reported that emotions make possible all creative thought (Greenspan, 1997) and that positive emotions can facilitate creative thinking (Amabile, Barsade, Mueller & Staw, 2005). It has also been noted that negative emotions can stimulate concern and cautiousness, which undermine creative activity. Findings from this study would generally support these results. Moreover, the findings indicate that negative responses during the experience were to a large extent shaped by broader contextual factors rather than the resource itself. In particular, it was found that the nature of family upbringing significantly influenced the degree to which participants responded either positively or negatively. It was also found that although participants experienced a range of negative emotions, similar to those highlighted in the literature, they also experienced unexpected positive emotions such as joy and excitement; both of which resulted from participants feeling a sense of pride and accomplishment in their own capabilities. These findings corroborate previously stated research highlighting the importance of upbringing in creative activities (Runco & Pagnini, 2008) and more generally, the rarity of uni-dimensional emotional states (Fong, 2006).

Finding: The nature of participant upbringing significantly shaped the nature of emotional responses to divURGE.

Further research: How can an understanding of participant upbringing be utilised to increase levels of positive emotions in user of online tools developed to enhance DT?

Personal attitudes and perceptions are major influencing factors in the usage of information technology (Liaw, Huang, & Chen, 2007). Attitudes toward computers are commonly agreed to result from two key variables; perceived usefulness and perceived ease of use (Lee, Yoon, & Lee, 2009; Sun et al, 2008). While this research was generally supported by this study - particularly perceived usefulness – it is interesting to note participants responses were more focused on their own beliefs about themselves and their abilities, than relevance or ease of use of the technology. From a wider perspective, what was deemed particularly significant was the role of participant confidence in mediating experience. The reviewed literature highlighted the strong correlational link between high levels of computer self-efficacy with the amount of effort exerted and increased grade scores in online environments (Wang & Newlim, 2002) but this was not supported by this study. What the findings revealed was that high levels of self-efficacy – perhaps more easily

understood as over-confidence – undermined levels of engagement with the resource. A possible explanation for this is that over confidence created a false sense of security and a sense that full engagement was not required. This was most evident in one case, who reported being very confident in both creativity and computers, but who subsequently did not fully engage with all the elements of the resource and did not show any improvement in test scores. Conversely, cases with low levels of confidence, but who were motivated to participate, followed the structure, engaged with all the elements and show improved scores.

Finding: High levels of computer and creative self-efficacy undermined levels of engagement with divURGE.

Implications for further research: How can participants with high levels of creative and computer self-efficacy be encouraged to engage with online resources developed to enhance DT?

What is of additional interest in relation to the possible detrimental effects of participant attitude, perception and affect is that the effects seemed to be mitigated by the perceived unusual nature of the DT tasks. In particular, undertaking tasks such as *instances of things that are fluffy*, or *unusual uses for an umbrella*, produced a range of positive emotions including joy, surprise, wonder and excitement. These responses seemed to assist participants in understanding and overcoming their own preconceptions and beliefs.

Finding: The unusual nature of divergent thinking tasks mitigated negative emotional, perception and attitudinal impacts.

Implication for further research: Can the unusual nature of divergent thinking tasks be utilised to mitigate negative emotional, perception and attitudinal impacts in more general online training?

6.3 Resource focused

Positive and negative factors relating to the resource as identified in the literature were dealt with – insofar as possible - during the design and development of the resource. As a result, potential negative issues relating to dead links, poor navigation and large downloads (Redden, 2003) were not reported in participant responses. However, the time taken to input answers (Lawson, 2004) was reported as a negative factor by cases with low levels of

perceived keyboard skills. On the other hand, positive factors such as the ability to catalogue ideas and the affordance of a neutral environment were reported as being of positive importance.

Finding: Low levels of perceived typing skills reduced the ability of participants to engage with divURGE.

Implications for further research: What alternative inputting features could be utilised to increase levels of engagement with online tools developed to enhance DT?

What was also reported as being significant was the inclusion of a visible timer, which counted down the two minutes allotted to each task. While not highlighted in the literature, nor considered in the design process, its presence produced a number of effects including negative emotions; increased focus during exercises perceived as easy; distraction during challenging tasks and an aid for understanding ideational processes. This unexpected finding gives rise to a number of possible areas for further in-depth exploration.

Finding: The visible timer and time-constrained nature of the tasks significantly impacted participant experience.

Area for further research: How can a visible timer be utilised to enhance focus on specific DT tasks in online environments?

Area for further research: Can timing of tasks and recorded responses be utilised to provide beneficial insight into DT processes?

Another element of the resource which was also reported as significant in participant responses was the use of reflection blog activities to support learning. While no literature was found to connect reflection activities with DT, there is strong evidence to suggest that people learn better in online environments when given the opportunity to reflect (Moreno, 2006; Lai, & Calandra, 2010). Evidence from this study would tend to support this research insofar as participants reported it as a beneficial aid. In addition, and in specific relation to DT, it was interesting to note that the ability to reflect was enhanced by the inclusion of a feature which enabled participants to review their answers. So, rather than simply relying on recall, participants were able to trace their responses to identify how they make connections and associations and where they hit ideational obstacles in order to develop divergent strategies.

Finding: Reflective practice gives positive performance benefits in online environments developed to enhance divergent thinking when coupled with an ability to review responses.

Implication for further research: How can a combination of reflective practice and response review be effectively harnessed to enhance the development of DT abilities in online environments?

6.4 Context focused

Computers can provide users with the opportunity to work in a neutral environment (Benedek, Fink & Neubaur, 2006) and to collaborate with others over space and time (Zimring et al., 2001; Sagun & Demirkan, 2009). In relation to DT, it is interesting to note that creative activity has been posited as being mostly, if not entirely, a socio-cultural phenomenon (Bull et al. 1995); and that external situational factors can be harmful or helpful to some people undertaking creative processes (Amabile, 1983). Other studies have demonstrated the connection between historical and cultural environment to creative activity (Runco & Pagnini, 2008) and how views to natural environments can promote creative cognition (McCoy & Evans, 2002). While historical and cultural influences were not reported in this study, a number of other contextual factors were. The immediate physical environment in which activities took place was reported as significant insofar as participants felt they performed better in places where they felt comfortable. This would tend to confirm research on the paramount importance of creating a sense of psychological safety for online users (Bull et al. 1995) and the need to reduce adverse feelings of apprehension brought on by the threat of evaluation (Benedek, Fink & Neubaur, 2006).

Finding: An immediate physical environment, which evokes a sense of comfort and safety, can increase perceived performance in participants using an online DT training tool.

Implication for further research: How can participant performance be increased through the manipulation of immediate environmental factors?

The influence of immediate physical environment was also linked to previously stated research highlighting the benefits to DT – via the promotion of unconventional thought – of views to natural settings (Benedek, Fink & Neubaur, 2006). While this was not specifically reported, the idea of undertaking activities which involved the outdoors prior to engaging

with the resource was. In fact, mental preparation involving any activity which would help to clear and calm the mind was highlighted as important. The rationale for this is possibly due to the dual challenge of engaging with a computer while undertaking testing and unconventional cognitive processes.

Finding: Undertaking placating activities prior to engaging with an online DT training tool can increase engagement and performance.

Implications for further research: Can findings relating to the undertaking of placating activities prior to engaging with an online DT training tool be replicated in more general online creativity training?

The final significant contextual finding relates to social interaction, or more specifically, the lack of social interaction while using the resource. Literature indicates that online environments can produce feelings of isolation (Berenson, Boyles & Weaver 2008). Conversely, it shows that the ability to think creatively, which is often viewed as risky, can be undermined within groups of people (Runco, 2010, p. 416). In respect to this study, it was very interesting to note how important concepts such as sharing and interaction became for participants. Despite guidance on working on their own, one case actually shared the entire experience, while another made numerous references to how sharing and interaction helped. Beyond mitigating feelings of isolation, possible explanations for this include; a need to compare responses, ability and progress, to share the challenging nature of DT, to gain insight into ideational strategies and to assist with overcoming the limiting and often negative impacts of low confidence, computer ability, attitudes, perceptions and personality traits. In retrospect, a more blended approach may have produced more significant levels of enhancement.

Finding: The ability to socially interact should be considered an important component in the design of online DT training resources.

6.5 Limitations of this study.

This study was limited in a number of ways. The chosen methodology – explorative case study – has been extensively critiqued and stereotyped as the weak sibling in social science research (Yin, 2003) and may by some be viewed as a limiting factor. It is not within the scope of this study to deal with these arguments in detail. However, the position taken is that

there is a need to match an appropriate methodology to a research question. So, rather than seeing methodologies hierarchically, the disadvantages of limited generalizability are offset by the value of rich context based insights. The study was also limited by the scope and nature of the thesis brief; the time available for its undertaking; the author's novice experience as a researcher and the use of the researcher's own students as participants. This insider perspective allowed for greater depth of analysis, however, it would be interesting to extend the study to a wider cohort of participants.

6.6 Conclusion

This study set out to illuminate the interface of humans, divergent thinking training and online learning, and to a large extent this has been achieved.

While the study findings support much of the existing literature on human factors related to DT and online learning, the illumination of their interface should provide designers of online DT resources with a number of useful findings and areas for future research. Of particular note are the findings which show that DT skills can be enhanced through online training; that the unusual nature of DT tasks can mitigate negative affective and attitudinal states; the roles that immediate physical environment, social interaction and pre-use activities have in mediating engagement and performance; the significant impact of including a visible timer, and the positive benefits of incorporating reflective practice with response review features.

In conclusion, the importance to humanity of fostering individual creative ability is undeniable; as is the exponential rise and adoption of technology within education. Such is the pace and seductive nature of technological development that it may serve to distract us from what is truly important: us. Without the innately human ability to see and solve problems in creative new ways, there is no technology, no development, no progress. We relegate the enhancement of individual creative ability at our peril; we embrace the challenges and complexity of creative cognition, computers and human phenomenon to deliver to our children a planet at least as rich as the one we inherited.

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Appendices

Appendix A: Research Proposal

1. Title of project	Case studies in online learning: Teaching DT
2. Purpose of the study	This study proposes to investigate participant response to a technology enhanced learning environment. The environment will be developed to support creative activity by enhancing DT. The investigation will take a case study approach involving multiple data sources with a focus on developing an in-depth and context rich understanding of the participant's response including their motivational, cognitive, affective and discursive reactions to the learning environment.
3. Academic rationale	<p>Creativity is a necessary and fundamental ability that is neglected in contemporary education. DT is a component of creative ability that can be taught through online learning environments. While much is known about human factors related to both creativity training and online education, very little is known about human factors in online creativity training. This project is focused on investigating human factors at this interface.</p> <p>Please see appendix 1.0. <i>Literature Review</i> for further details</p>
3. Brief description of methods and measurements to be used	<p>This investigation utilises a case study methodology as the issues under scrutiny are contemporary, complex and inseparable from the context in which they take place. The data instruments used for the purposes of this investigation are questionnaires, semi-structured interviews, online diaries and a psychometric personality test.</p> <p>Please see appendix 2.0 <i>Methodology</i>, 2.3-2.6 <i>Data Collection Instruments</i> and 2.8 <i>Data Analysis</i> for further details.</p>
4. Participants - recruitment methods, number, age, gender, exclusion/inclusion criteria, including statistical justification for numbers of participants	<p>Invitations to participate in this investigation will be extended to a cohort of students currently undertaking the first year of study in the fields of interior, landscape and garden design. Three participants will be selected from an initial pool of volunteers. Participants will be chosen on the basis of reporting significantly divergent, academic and socioeconomic backgrounds. The following criteria were also used to determine participant eligibility:</p> <p>Over the age of eighteen</p> <p>Able to provide informed consent</p> <p>Voluntary participation</p> <p>Please see appendix 2.2 <i>Participant Selection</i>, for further details.</p>
5. Debriefing arrangements	A debriefing session has been arranged for Tuesday February 7 th ,

	2012 at 9am.
6. A clear concise statement of the ethical considerations raised by the project and how you intend to deal with them	<p>The ethical issue of this investigation relates to the familiarity of the participants to the researcher. The participants are students undertaking a course within which they have occasion to receive instruction from the researcher. Issues emerging from this relate to possible influence exerted by the researcher and perceptions that participation may impact on course experience. These ethical issues are dealt with in the following ways:</p> <ol style="list-style-type: none"> 1. Senior management being made fully aware of the nature and scope of the research and written permission being sought prior to undertaking any activities. 2. Participants being explicitly informed that participation will in no way impact upon their course, that participation is voluntary and that they are free to withdraw from the research at any time. <p>Please see appendix</p>
7. Cite any relevant legislation relevant to the project with the method of compliance e.g. Data Protection Act etc.	<p>This research will involve the audio recording of semi-structured interviews and the recording of diary entries within the resource environment. As such, specific measures will be put in place to ensure compliance with the Data Protection Act. These measures include; the acquisition of explicit informed consent from participants, the anonymisation of all collected data, the secure storage of data for the period of time required to undertake this research and its subsequent safe destruction.</p>

Appendix B: Ethical approval form

**School of computer Science and Statistics
Research Ethical Approval Form**

Part A

Project Title Case Studies in Online Learning: Enhancing DT

Name of Lead Researcher (student in case of project work): Barry Lupton

Name of Supervisor: Nina Bresnihan

TCD E-mail: luptonb@tcd.ie Contact Tel No.: 086 349 2286

Course Name and Code (if applicable): MSc Technology and Learning TRS54

Estimated start date of survey/research: Monday 9th January 2012

Estimated finish date of survey/research: Monday 23th January 2012

I confirm that I will (where relevant):

- Familiarize myself with the Data Protection Act and the College Good Research Practice guidelines http://www.tcd.ie/info_compliance/dp/legislation.php;
- Tell participants that any recordings, e.g. audio/video/photographs, will not be identifiable unless prior written permission has been given. I will obtain permission for specific reuse (in papers, talks, etc.)
- Provide participants with an information sheet (or web-page for web-based experiments) that describes the main procedures (a copy of the information sheet must be included with this application)
- Obtain informed consent for participation (a copy of the informed consent form must be included with this application)
- Should the research be observational, ask participants for their consent to be observed
- Tell participants that their participation is voluntary
- Tell participants that they may withdraw at any time and for any reason without penalty
- Give participants the option of omitting questions they do not wish to answer if a questionnaire is used
- Tell participants that their data will be treated with full confidentiality and that, if published, it will not be identified as theirs
- On request, debrief participants at the end of their participation (i.e. give them a brief explanation of the study)
- Verify that participants are 18 years or older and competent to supply consent.
- If the study involves participants viewing video displays then I will verify that they understand that if they or anyone in their family has a history of epilepsy then the participant is proceeding at their own risk
- Declare any potential conflict of interest to participants.
- Inform participants that in the extremely unlikely event that illicit activity is reported to me during the study I will be obliged to report it to appropriate authorities.

- Act in accordance with the information provided (i.e. if I tell participants I will not do something, then I will not do it).

Signed:
6/12/2011

Date:

Lead Researcher/student in case of project work

Part B

<i>Please answer the following questions.</i>		<i>Yes/No</i>
Has this research application or any application of a similar nature connected to this research project been refused ethical approval by another review committee of the College (or at the institutions of any collaborators)?		No
Will your project involve photographing participants or electronic audio or video recordings?		Yes
Will your project deliberately involve misleading participants in any way?		No
Is there a risk of participants experiencing either physical or psychological distress or discomfort? If yes, give details on a separate sheet and state what you will tell them to do if they should experience any such problems (e.g. who they can contact for help).		No
Does your study involve any of the following?	Children (under 18 years of age)	No
	People with intellectual or communication difficulties	No
	Patients	No

School of Computer Science and Statistics

Research Ethical Application Form

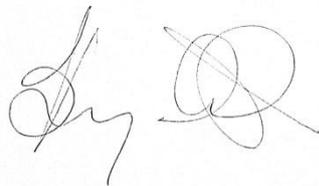
If you answered 'Yes@ to any of the questions above, details of the Research Project Proposal must be submitted as a separate document to include the following information:

1. Title of project
2. Purpose of project including academic rationale
3. Brief description of methods and measurements to be used
4. Participants - recruitment methods, number, age, gender, exclusion/inclusion criteria, including statistical justification for numbers of participants
5. Debriefing arrangements
6. A clear concise statement of the ethical considerations raised by the project and how you intend to deal with them
7. Cite any relevant legislation relevant to the project with the method of compliance e.g. Data Protection Act etc.

Part c

I confirm that the materials I have submitted provided a complete and accurate account of the research I propose to conduct in this context, including my assessment of the ethical ramifications.

Signed:



Date: 6/12/2011

Lead Researcher/student in case of project work

There is an obligation on the lead researcher to bring to the attention of the SCSS Research Ethics Committee any issues with ethical implications not clearly covered above.

Part D

If external ethical approval has been received, please complete below.

External ethical approval has been received and no further ethical approval is required from the School's Research Ethical Committee. I have attached a copy of the external ethical approval for the School's Research Unit.

Signed: Date:

Lead Researcher/student in case of project work

Part E

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

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

Signed: Date:

.....

Supervisor

Completed application forms together with supporting documentation should be submitted electronically to research-ethics@scss.tcd.ie Please use TCD e-mail addresses only. When your application has been reviewed and approved by the Ethics committee hardcopies with original signatures should be submitted to the School of Computer Science & Statistics, Room F37, O'Reilly Institute, Trinity College, Dublin 2.

Appendix C: Participant consent form

Participant Consent Form

Project: Case Studies in Online Learning: Teaching DT

Researchers: Barry Lupton

Project background: Creative problem finding and solving are increasingly seen as fundamental and necessary skills. Despite this, it is evidenced that developing these abilities is not adequately reflected in contemporary education. Reasons for limited focus on developing creative abilities include cost, time, the scale and conflicting nature of creativity research and the complexities surrounding human attitude, perception and motivation in education. One possible approach to addressing some of the issues is to focus on a specific, well defined and understood component of creativity and to do so within a technology enhanced learning environment. DT is one such component, which has been identified as important in both problem finding and solving. The intention of this project is to gain a greater understanding of human response to a tool developed to teach DT.

Procedures: You will be asked to attend an explanatory lecture in which you will be introduced to the multimedia learning application and to the broad concepts beings explored in the investigation. You will also be asked to complete a questionnaire which covers biographical data, which explores attitude and perception of the investigation topics and which evaluates existing levels of DT. This should take approximately an hour. Following the lecture you will be asked to participate in a number of short sessions in which you will have the opportunity to interact with the resource under observation. Engagement with the resource will involve you answering questions created to stimulate DT. Following exposure to the resource, you will be asked to reflect on the experience and to record your responses. Upon completion of the instruction period, you will be asked to complete a post-experience questionnaire and to take part in a semi structured interview. An audio recording of this interview will be made and the researcher will transcribe this into text format. Upon completion of the research you will be afforded an opportunity to attend a debriefing session.

Publication: No personally identifying information will be used in analysis, publication or presentation of data and findings. Audio recordings will be stored in a secure environment for the duration of the research and subsequently destroyed. All data will be treated in line with the specific requirements of the Data Protection Act.

Benefits: While no guarantee can be made in relation to specific benefits afforded to you, participation may help to improve your DT ability. It may also provide you with insights into your personality and how you learn. Both of which may provide benefits.

Declaration:

- I am 18 years or older and am competent to provide consent.
- I have read or had read to me the information sheet and consent form.
- I have had the opportunity to ask any questions and had them answered.
- I understand that I may ask any questions about the research project before, during and after my participation.

- I understand that I am under no obligation to take part in this project and that a decision not to participate will not affect my assessment now or in the future.
- I understand I have the right to withdraw from this project at any stage and that doing so will not affect my assessment.
- I understand that the text based communication and images collected as part of this research will not be used to affect the results of my assessment.
- I understand that interview and questionnaire data will not be used to affect the results of my assessment.
- I understand that the results of this research project may be published in the forms outlined above and any data used will be in such a way that does not reveal my identity.
- I understand that identity includes reference to both my real life identity and avatar identity.
- I understand that if I or anyone in my family has a history of epilepsy then I am proceeding at my own risk.
- I understand that I will be observed while interacting with the resource.
- I understand that participation in this research will in no way impact upon the course I am currently undertaking
- I understand that an audio recording will be made of a semi-structured interview but that I can choose to opt out of having interviews recorded.
- I understand that in the extremely unlikely event that illicit activity is reported the researcher will be obliged to report it to the appropriate authorities.
- I understand that I can choose to opt out of having audio semi structured interviews record

Participant's name:

Participant's signature:

Date:

Researcher's signature:

Date:

Project contact details: Barry Lupton

Eblana Avenue,

Dún Laoghaire,

Dublin,

Ireland

Phone 01 2800385,

Fax: 01 2800386

Email: blupton@scd.ie

Appendix D: Participant information sheet

Participant Information Sheet

You are invited to take part in a research project investigation participant response to an online resource developed to enhance DT. The research is being carried out as a requirement of an MSc in Technology and Learning that I am currently undertaking. It is important that you read this information sheet and ask any questions you feel necessary. Any questions you may have during or after the study should be sent to Barry Lupton (blupton@scd.ie).

Please do not be concerned by the formal structure of this information sheet. It is set out this way in order to comply with ethical regulations.

Background

Creative ability is increasingly seen as a fundamental and necessary skill. Despite this, it is evidenced that developing these abilities is not adequately reflected in contemporary education. Reasons for limited focus on developing creative abilities include cost, time, the scale and conflicting nature of creativity research and the complexities surrounding human attitude, perception and motivation in education. One possible approach to addressing some of the issues is to focus on a specific, well defined and understood component of creativity and to do so within a technology enhanced learning environment. DT is one such component, which has been identified as important in creativity.

DT

DT has been defined as the ability to generate numerous and diverse ideas to open ended questions and requires making unexpected combinations, recognizing links among remote associates and transforming information into unexpected forms. It is seen as allowing people to view problems from many perspectives in order to discover many possible ideas and combinations that may serve as solutions. DT is commonly viewed as the opposite to convergent thinking – the ability to find the one and only one correct solution.

The intention of this project is to investigate human response to an online resource developed to enhance DT. Participation in the project is completely voluntary and will in no way impact or be reflected in your grades for the remainder of your course. If you or anyone in your family has a history of epilepsy you may participate at your own risk. You may refuse to answer any question and can withdraw from the research project at any time.

Procedure

If you wish to take part in the research project you will be asked to attend a short explanatory lecture after which you will be given a questionnaire to complete. You will also be asked to undertake a short, online personality test. Following the lecture you will be provided with a link to a website, which features the project content. You will be invited to access the website outside college hours over the following 10 days. On three separate days you will be invited to complete one of the tasks within college and while being observed. The online tool will consist of supporting media and resources, a succession of tasks created to enhance DT and a reflection questionnaire. One week following the project launch, you will be invited to complete a follow-up, paper based questionnaire, which will features questions relating to the experience of using the resource and a number of short tasks similar to those contained within the resource. All of the above will be discussed at the explanatory lecture.

While no guarantee can be made in relation to specific benefits afforded to you, participation may help to improve you DT ability. It may also provide you with insights into your personality and how you learn. Both of which may provide benefits.

This project follows the guidelines set by both Trinity College Dublin and the School of Computer Science and Statistics, including appropriate ethical approval from the latter. Any personal information collected as part of the study will be stored in accordance with the Data Protection Act at Trinity College, Dublin. No marks awarded as part of the formal course assessment will be stored for the purposes of this study. In the unlikely event that any information pertaining to illegal activities should emerge during the study, the researcher will be obliged to report it to the appropriate authorities. No personally identifying information will be used in analysis, publication or presentation of data and findings. Please note that you are under no obligation to complete any aspect of this study and that you are free to opt out at any time.

Upon conclusion of the research you will be afforded an opportunity to be debriefed on the project findings.

If you have any questions before, during or after the project, please do not hesitate to contact Barry Lupton, blupton@scd.ie.

Appendix E: Pre-Experience questionnaire

This questionnaire is divided into three parts and should take no longer than 15 minutes to complete. Please take your time to answer questions on each of the following 6 pages (double sided).

Participation in this research is on a voluntary basis. Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to.

Please do not name third parties in any open text field. Any such replies will be anonymised.

Part 1:

Background. Questions 1-10 cover general background information relating to your age, educational experience, computer usage and knowledge. Please mark/highlight the appropriate answer and where indicated provide a concise response.

1. Gender							
Male				Female			
2. Age							
24-29	30-35	31-36	37-42	43-48	49-54	55-60	61-66
3. Highest level of academic achievement							
Inter/junior Certif	Leaving certifi	Diploma	Degree	Post grad diplom	Masters		
4. Please list what (if any) computer applications you use regularly?							
5. Have you previously completed any course, which involved DT training?							
Yes				No			
6. If you answered yes to the above question, briefly outline the nature and duration of the course.							
7. Prior to the commencement of your current studies, were you ever been involved in							

Yes	No
<p>8. If you answered yes to the above question, please provide a brief description of the Job and context within which creative ability was required</p>	
<p>9. Have you ever undertaken any training in creative thinking?</p>	
Yes	No
<p>10. If you answered yes to the above question, please provide a brief description of the course and contents</p>	
<p>11. What would you like to achieve by taking part in this research?</p>	

Part 2.

Questions 11-23 include questions relating to your attitude, experience and perceptions of computers and creativity. There are no right and wrong answers. Please answer truthfully the degree to which you agree or disagree with the statement on the left hand side of the page in the relevant box opposite, use and X. If you have no opinion on the statements please tick the no opinion column.

		No opinion	Strongly Agree			Agree			Disagree			Strongly disagree		
	Question	0	1	2	3	4	5	6	7	8	9	10	11	12
11	I consider myself to be a creative person													
12	I find creative activities easy													
13	When presented with a problem I usually come up with lots of ideas													
14	I enjoy undertaking creative activities													
15	I enjoy using computers													
16	I use computers frequently to help me learn													
18	I often experience negative emotions when using computers													
19	I enjoy taking risks													
20	I work logically through problems													
21	I find computers easy to use													
22	I would like to be more creative													
23	I feel self-conscious about sharing ideas in front of others													

Appendix F: Post-Experience questionnaire

Post-experience questionnaire

Case Studies in Online Learning: enhancing DT

This questionnaire is divided into three parts which include questions on the resource, on your experience and the context of the experience. Questions are structured on a scale from strongly agree to strongly disagree and a comment box is located beneath every question just in case you have some additional information to add. Please note that you do not have to add comments. To answer questions simply 'bold' the relevant number. When completed please return to blupton@scd.ie

NB. Participation in this research is on a voluntary basis. Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to. Please do not name third parties in any open text field. Any such replies will be anonymised.

Many thanks

Underline the relevant number and leave and comment if desired

divURGE and you														
		No opinion	Strongly agree			Agree			Disagree			Strongly disagreed		
	I felt confident using the resource		1	2	3	1	2	3	1	2	3	1	2	3
Comment														
	I experienced positive emotions while using the resource		1	2	3	1	2	3	1	2	3	1	2	3
Comment														
	I was concerned about spelling and grammar while using the resource		1	2	3	1	2	3	1	2	3	1	2	3
Comment														
	I can think more divergently when not using a computer		1	2	3	1	2	3	1	2	3	1	2	3
Comment														

	I could have been better supported during my experience with the resource		1	2	3	1	2	3	1	2	3	1	2	3	
Comment															
	I undertook preparation before using the resource		1	2	3	1	2	3	1	2	3	1	2	3	
Comment															
	I didn't see the relevance of the tasks to me		1	2	3	1	2	3	1	2	3	1	2	3	
Comment															
	My mood influenced my ability to think divergently while using the resource		1	2	3	1	2	3	1	2	3	1	2	3	
Comment															
	My family background influenced my experience		1	2	3	1	2	3	1	2	3	1	2	3	
Comment															

divURGE and its context														
		No opinion	Strongly agree			Agree			Disagree			Strongly disagreed		
			1	2	3	1	2	3	1	2	3	1	2	3
	I preferred to use the resource at a particular time of day													
Comment														
	I felt the place I used the resource influenced my experience													
Comment														
	I arranged the space in which I interacted with divURGE													
Comment														
	The course duration was appropriate for me													
Comment														
	DT exercises are easier in a non-computer environment													
Comment														

			1	2	3	1	2	3	1	2	3	1	2	3
	I sought out information relating to DT that wasn't included in the resource		1	2	3	1	2	3	1	2	3	1	2	3
	The researcher being my tutor impacted on my experience		1	2	3	1	2	3	1	2	3	1	2	3
Comment														
	I worked alone while using divURGE		1	2	3	1	2	3	1	2	3	1	2	3
Comment														
	I used the resource more on the weekends		1	2	3	1	2	3	1	2	3	1	2	3
Comment														

Any other comments?

Appendix G: Semi structured interview questions (guide)

Core question: How do participants respond to an online tool developed to enhance DT?

Primary sub questions

Were key personality traits evident in learner responses?

How were participant attitude, perception and affect reported in learner responses?

How were contextual factors represented in participant responses?

Was there evidence of enhanced ability in DT?

Case Studies in Online Learning: enhancing DT

Introduction: Thanks you very much for participating in this investigation. As you know the focus of the research is to investigate your response to using the tool. I have a number of questions that I wish to ask but each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to.”

Introductory questions

1. When did you last use the resource?
2. How did you get on using it?
3. Did you enjoy the experience of using divURGE?

How do you think your experience with computers influenced your experience with divURGE?

The resource

- What was your favourite part of using the resource?

Why do you think you preferred this aspect?

- Where there any elements of the resource that you found particularly beneficial?
- Did you utilise any strategies to overcome challenges presented by using the resource?
- How do you feel using computers influenced your ability to think divergently?
- If you were to design your own tool for enhancing DT, how would it differ from divURGE?
- Did you try undertaking an exercise on pen and paper, if so, what how did the experience differ for you?
- Would your divURGE experience encourage you to participate in more online learning?
- If you were advising somebody else on how they might maximise using divURGE, what would you tell them?
- Where you aware of any significant impacts of using the resource?

The learner (personality/perception/attitude/motivation/affect)

- You seemed very motivated to participate in the project, did your levels of motivation change during the experience and if so why?
- What do you feel was the most rewarding aspect of your participation?
- You undertook a personality test prior to starting and perhaps learned something about yourself. How do you think this knowledge impacted on your experience?

- How do you feel the process of reflection influenced your experience?
- o How much reflection did you undertake?
- o Did you feel it was beneficial...if so how so?
- You had fairly strong views of computers, have they changed at all as a response to the experience?
- Did you find any aspect of using the resource frustrating?
- If I asked you to list as many emotions you associate with the divURGE experience, what would you list?

The context

- Can you talk to me about what was happening prior to logging in to the resource (how did you feel?)
- Did you set up an exercise space or make any physical preparations prior to starting? If so why did you do so?
- Did you undertake the exercises at any particular time of day?
- How do you think your back ground influenced your experience?
- How do you think our relationship influenced your participation?
- Did you take the recommended breaks between exercises? Why?
- How did you feel after using the resource...what did you do when you finished...how did you know when to finish?
- How do you think the college context influenced your experience?
- Did you use the resource at the weekend?
- o Why not?

Learning

- What do you feel you have learned from participating?
- Did you employ any of your own techniques during the exercises, if so why do you think they worked for you?
- Have you been able to utilise DT in another environment?

- How do you think the experience matched up to the way you like to learn?
- Do you think you could have been better supported during the experience, if so, how?
- Do you think the experience has impacted your ability to be more creative?

Appendix H: Case 1 (Mark) data analysis summary table

Bio data	Mark				
	Gender	Age	Education level	DT experience	Creativity experience
	Male	42	Diploma	None	None
Personality	Extroversion	Openness	Agreeableness	Conscientiousness	Neuroticism
	Relatively average	Relatively high	Relatively high	Relatively average	Relatively low
Attitude and perception of/toward computers	Does not enjoy using computers, does not use them to learn, does not find them easy to use and experiences negative emotions when using them.				
Attitude and perception of/toward creativity	Considers himself to be somewhat creative, enjoys doing creative activities, is not concerned about what people think of his ideas, sees himself as a risk taker considers and really wants to be more creative				
Scores	Pre test 26		Post test 54		Proposition: Mark's experience seemed to enhance his DT ability
Explorative research areas from literature	Recorded in participant Reponses	Number of sources	Frequency	Sample responses	Emergent propositions
Resource focused					
Time required for inputting responses	Yes	4	6	<i>I definitely felt a bit less creative being watched and looked at the clock more</i>	
Level of computer competence required	Yes	2	4	<i>A keyboard? Probably not a key board. Probably...eh I'd want a workshop, yea a workshop,</i>	
Level of perceived usefulness	No				
Ease of use	Yes	3	3	<i>Louise would be sitting beside me an Louise would be doing all the typing so I just thought this would be the best way for me.</i>	
Learner focused					
Personality traits as a mediating factor	Yes	6	10	<i>I'm always trying to come across as intelligent as or more intelligent than I believe I am, you know what I'm saying?</i>	
Self-efficacy as a mediating factor	Yes	5	12	<i>No, no, I didn't even try. Straight away I didn't even want to try it.</i>	
Negative attitude	No				
Anxiety impacting performance	Yes	5	5	<i>Yea, cause I found that it was frustrating cause I think, ah, I don't know the words so then what's the point?</i>	
Motivation as a mediating factor	Yes	4	6	<i>Well i was very excited about using it, especially after watching the videos and links that you asked us to watch.</i>	
Feelings of isolation	Yes	2	3	<i>Louise was always with me so that was good</i>	
Sense of psychological safety	Yes	2	4	<i>She really supported me all the way</i>	
Mood as a mediating factor	Yes	2	3	<i>I was tired and wasn't really in the mood to do the test but i want to get some done every day.</i>	
Emotion as a mediating factor	No				
Context focused					
Situational factors	Yes	6	7		
Provision or non-provision of rewards	No				
Immediate physical environment	Yes	5	8	<i>We'd always sit together on the couch, Louise would have the laptop on her lap</i>	
Views to natural landscapes	No				

Social context	no				
Personal experience	Yes	4	11	<i>I remember seeing the coal bucket and thinking it'd look good with some holes in it</i>	
Socio cultural background	Yes	5	7	<i>I did everything with me da, that's the way it was</i>	
Unexpected/emergent themes					
Upbringing	Yes	4	15	<i>There was only one way to do things in our house</i>	
Louise	Yes	6	10	<i>Yea, I don't know, I done it on my own, come up with the answers on my own. But Louise was still present, sitting beside me.</i>	
Strategies	Yes	3	5	<i>Somebody closes the door...sorry no more ideas in here...or they're not available to you. Then you'd try to open the shutter a little bit.</i>	
Time constraint	Yes	3	5	<i>The time is something im always thinking about. Worried that I wont get enough answers in the amount of time I have</i>	
Awareness of thinking processes	Yes	2	3	<i>Before it would have been more natural while it doesn't feel so natural now, I'm actually deciding consciously to think this way</i>	
Change	Yes	3	6	<i>I would say there is something different, simply because of the fact that I'm making a conscious decision to think this way.</i>	
Support	yes	3	3	<i>Yea. That was helpful. It leads you in the proper direction and it shows you exactly what can be achieved and what's expected</i>	
Reflective practice	Yes	4	5	<i>its a challenge because its sometimes hard to put a finger on how you were actually feeling while doing the task. It can be hard to verbalise.</i>	
Divergent tasks in a computer environment	yes	3	3	<i>I tried to come up with a few myself and I didn't find, exactly the same as when Louise was typing I was coming up with around 20-25 answers so pretty much the same results.</i>	
Routine	Yes	5	6	<i>No, there was no routine, we'd always just be in the sitting room.</i>	
Researcher	Yes	4	9	<i>so that question worries me straight away. Like, eh, Barry's doing that, Barry has a masters, I wouldn't even know how to do that.</i>	
Sources drawn from	Pre questionnaires/post questionnaires/interviews/reflection blogs/emails/conversations/pre test/post test/ psychometric tests				
Samples additional codes identified but not sufficiently represented	Affect and divergence, perception of the resource, expectations				

Appendix I: Case 2 (Patrick) Data analysis summary table

Bio data	Patrick				
	Gender	Age	Education level	DT experience	Creativity experience
	Male	29	Diploma	None	Graphic design course
Personality	Extroversion	Openness	Agreeableness	Conscientiousness	Neuroticism
	Relatively high	Relatively high	Relatively average	Relatively average	Relatively high
Attitude and perception of/toward computers	Likes technology/comfortable using it/uses it all the time for learning, working and socialising/rarely experiences negative emotions while using it				
Attitude and perception of/toward creativity	Consider himself a really creative person, really enjoys creative activity/thinks he comes up with lots of ideas to problems/wants to be more creative				
Scores	Pre test 25		Post test 26		Proposition: Patrick's experience of using divURGE did not appear to enhance his DT
Explorative research areas from literature	Recorded in participant Responses	Number of sources	Frequency	Sample responses	Emergent propositions
Resource focused					
Time required for inputting responses	Yes	2	3	<i>In terms of typing I suppose I'm still marginally quicker when I'm writing.</i>	
Level of computer competence required	No				
Level of perceived usefulness	Yes				
Ease of use	Yes	1	2	<i>I couldn't access that instruction video from the link you sent, it said it was private. I logged in myself and didn't have any problem using it</i>	Patrick's high level of computer skills made resource related issues redundant
Learner focused					
Personality traits as a mediating factor	Yes	3	5	<i>it's not a trait I'd be particularly proud of but you can kinda leave things to the last minute sometimes or life gets in the way sometimes, you know what I mean?</i>	
Self-efficacy as a mediating factor	Yes	5	8		Proposition: Patrick's self-efficacy served to negatively mediate his experience
Negative attitude	No				
Anxiety impacting performance	Yes	3	3	<i>I suppose I just felt a little bit more under pressure to come up with eh, answers.</i>	
Motivation as a mediating factor	Yes	3	5	<i>'yea, think more creatively? Where do I sign up?'</i>	Proposition: motivation
Feelings of isolation	Yes	1	1	<i>No, no, I never felt isolated at all</i>	
Sense of psychological safety	Yes	2	2	<i>I suppose it was just the opposite to when I felt comfortable in the room</i>	
Mood as a mediating factor	Yes	2	3	<i>Yea, eh moods are different in terms of well if you're in a good or bad mood then you also have relaxed or frustrated mood, like a kinda, I think you perform best when you're in a relaxed mood, without something bothering you.</i>	
Emotion as a mediating factor	No				
Context focused					
Situational factors	Yes	4	8	<i>the last time, the time in the morning, I think I just wasn't ready'</i>	Proposition: Context plays an important role in Patrick's cognitive processes.
Provision or non-provision of rewards	Yes	2	2	<i>What like a gold watch at the end of DT? Yea, eh, like I don't know, I see like the reward was to think more creatively so I suppose that was reward enough.</i>	Proposition: Context plays an important role in Patrick's cognitive processes.
Immediate physical environment	Yes	4	8	<i>It's just my little private space. I have a nice desk, mac, drawing board, you know, another screen and pencils, books</i>	

Views to natural landscapes	No	0	0		
Social context	Yes	4	6	<i>yea forgetfulness, doing other things, meaning to do it but not getting around to it, all of a sudden it's the next day and you're just distracted by other things, life gets in the way.</i>	Proposition: Context plays an important role in Patrick's cognitive processes.
Personal experience	Yes	2	2	<i>I'm like in my brain I have a flash of me swinging on a tree or roller skating in my back garden that I remember from my childhood</i>	
Socio cultural background	Yes	2	3	<i>Yea I think from a young age I was always colouring in, and showed a bit of creativity kinda like with writing and stuff like that, so I was encouraged you know.</i>	
Unexpected/emergent themes					
Working to the guide	Yes	4	8		
Mental preparation	Yes	5	10	<i>the preparation is like to clear you mind to get rid of thoughts that are distracting</i>	Proposition: Mental preparation is important to Patrick's success using divURGE
Strategies	Yes	2	6	<i>it kind of gives you more options and em, you can break things down more and explore things without settling your first idea</i>	
Time constraint	Yes	3	7	<i>I liked it in a way because it put you under a bit of pressure to see if you can perform. So it was good in that sense</i>	Proposition: having a visible time counter played a significant role in Patrick's experience
Awareness of thinking processes	Yes	3	9	<i>I found the task a bit tricky because there are so many that I wanted to think of good similarities and not just random things that they both contain.</i>	
Humour	Yes	4	10	<i>after a couple of answers sometimes my brain would click in or throw a joke in</i>	Proposition: Humour was an important ideational strategy for Patrick when using divURGE
Observation	yes	2	5	<i>It's not something I thought would have any impact on me but I don't know, I really struggled there'.</i>	
Reflective practice	Yes	5	8	<i>It was helpful because I could walk back in my memory and look at how I perceived each answer</i>	Structured reflection activities in association with the ability to review answers afforded Patrick the opportunity to gain greater insight into his ideational processes.
Divergent tasks in a computer environment	yes	2	3	<i>I think actually carrying out the tasks it doesn't make any difference</i>	
Sources drawn from	Pre questionnaires/post questionnaires/interviews/reflection blogs/emails/conversations/pre test/post test/ psychometric tests				
Samples additional codes identified but not sufficiently represented	Dualism/expectations/response to online learning/risk aversion/routine/tutor participant relationship /learning cycle/putting it off				
The case narrative (Abridged version, see appendix xxx)					
<p>I'm in', was Patrick's two word email response to being invited to take part in this research. He's a creative guy, is doing a design course and wants to be more creative. He's smart and identifies early on the relationship between DT and design activities; <i>I feel it is important to constantly challenge the normal way of thinking in order to continually come up with or generate new and fresh ideas.</i></p> <p>Patrick is a young 29, he lives in shared student house, works part time in a boutique restaurant, has a large network of friends and like to socialise. He's an extrovert and a funny one. Humour is part of who he is.</p>					

Appendix J: Case 3 (Raoul) data analysis summary table

Bio data	Mark				
	Gender	Age	Education level	DT experience	Creativity experience
	Male	42	Diploma	None	None
Personality	Extroversion	Openness	Agreeableness	Conscientiousness	Neuroticism
	Relatively average	Relatively high	Relatively high	Relatively average	Relatively low
Attitude and perception of/toward computers	Does not enjoy using computers, does not use them to learn, does not find them easy to use and experiences negative emotions when using them.				
Attitude and perception of/toward creativity	Considers himself to be somewhat creative, enjoys doing creative activities, is not concerned about what people think of his ideas, sees himself as a risk taker considers and really wants to be more creative				
Scores	Pre test 26		Post test 54		Proposition: Mark's experience seemed to enhance his DT ability
Explorative research areas from literature	Recorded in participant Reponses	Number of sources	Frequency	Sample responses	Emergent propositions
Resource focused					
Time required for inputting responses	Yes	4	6	<i>I definitely felt a bit less creative being watched and looked at the clock more</i>	
Level of computer competence required	Yes	2	4	<i>A keyboard? Probably not a key board. Probably...eh I'd want a workshop, yea a workshop.</i>	
Level of perceived usefulness	No				
Ease of use	Yes	3	3	<i>Louise would be sitting beside me an Louise would be doing all the typing so I just thought this would be the best way for me.</i>	
Learner focused					
Personality traits as a mediating factor	Yes	6	10	<i>I'm always trying to come across as intelligent as or more intelligent than I believe I am, you know what I'm saying?</i>	
Self-efficacy as a mediating factor	Yes	5	12	<i>No, no, I didn't even try. Straight away I didn't even want to try it.</i>	
Negative attitude	No				
Anxiety impacting performance	Yes	5	5	<i>Yea, cause I found that it was frustrating cause I think, ah, I don't know the words so then what's the point?</i>	
Motivation as a mediating factor	Yes	4	6	<i>Well i was very excited about using it, especially after watching the videos and links that you asked us to watch.</i>	
Feelings of isolation	Yes	2	3	<i>Louise was always with me so that was good</i>	
Sense of psychological safety	Yes	2	4	<i>She really supported me all the way</i>	
Mood as a mediating factor	Yes	2	3	<i>I was tired and wasn't really in the mood to do the test but i want to get some done every day.</i>	
Emotion as a mediating factor	No				
Context focused					
Situational factors	Yes	6	7		
Provision or non-provision of rewards	No				
Immediate physical environment	Yes	5	8	<i>We'd always sit together on the couch, Louise would have the laptop on her lap</i>	
Views to natural landscapes	No				
Social context	no				
Personal experience	Yes	4	11	<i>I remember seeing the coal bucket and thinking it'd look good with some holes in it</i>	
Socio cultural background	Yes	5	7	<i>I did everything with me da, that's the way it was</i>	
Unexpected/emergent themes					
Upbringing	Yes	4	15	<i>There was only one way to do things in our house</i>	
Louise	Yes	6	10	<i>Yea, I don't know, I done it on my own, come up with the answers on my own. But</i>	

				<i>Louise was still present, sitting beside me.</i>	
Strategies	Yes	3	5	<i>Somebody closes the door...sorry no more ideas in here...or they're not available to you. Then you'd try to open the shutter a little bit.</i>	
Time constraint	Yes	3	5	<i>The time is something im always thinking about. Worried that I wont get enough answers in the amount of time I have</i>	
Awareness of thinking processes	Yes	2	3	<i>Before it would have been more natural while it doesn't feel so natural now, I'm actually deciding consciously to think this way</i>	
Change	Yes	3	6	<i>I would say there is something different, simply because of the fact that I'm making a conscious decision to think this way.</i>	
Support	yes	3	3	<i>Yea. That was helpful. It leads you in the proper direction and it shows you exactly what can be achieved and what's expected</i>	
Reflective practice	Yes	4	5	<i>its a challenge because its sometimes hard to put a finger on how you were actually feeling while doing the task. It can be hard to verbalise.</i>	
Divergent tasks in a computer environment	yes	3	3	<i>I tried to come up with a few myself and I didn't find, exactly the same as when Louise was typing I was coming up with around 20-25 answers so pretty much the same results.</i>	
Routine	Yes	5	6	<i>No, there was no routine, we'd always just be in the sitting room.</i>	
Researcher	Yes	4	9	<i>so that question worries me straight away. Like, eh, Barry's doing that, Barry has a masters, I wouldn't even know how to do that.</i>	
Sources drawn from	Pre questionnaires/post questionnaires/interviews/reflection blogs/emails/conversations/pre test/post test/ psychometric tests				
Samples additional codes identified but not sufficiently represented	Affect and divergence, perception of the resource, expectations				

Appendix K: Case 1 (Mark) Original descriptive narrative

From a Brave Indian to Doubting Thomas and Back Again

It's the summer of 1978 and a five year old boy sits wide-eyed gazing a wooden coffee table. But he doesn't see a coffee table; he sees a blank canvas onto which rides a band of Indians being mercilessly chased down by a posse of steely-eyed cowboys on horseback. *"I had a compass and I done this whole Indian cowboy thing, I scrapped it in to the table...cowboys and Indians, having this big battle, I can still picture it today in my mind. And I thought it was fantastic...look what I created. But again the reaction was...what have you done, that's wrong, you're after wrecking our table, but I didn't see it that way, I thought, look at what I'm creating here, it's fantastic and I was engulfed in it, I spent hours scrapping in little Indians and cowboys"*.

The Autumn of 2011, the wide eye boy finds himself sitting in a lecture room of a design college. He's a man now, a married man with his own wide- eyed children. He's got a house, a wife, and

responsibilities. He's considered to be a friendly and agreeable person by his colleagues and considers himself to have an open and relatively extrovert personality. He's got a name too, it's Mark.

Mark went to school but not to college, he would have liked to, but it wasn't really the thing to do: but it is now. He's enrolled in a garden design diploma course, a two year, full time course. He's not really sure why, but feels it's right as he's always liked drawing, art and being creative: but these weren't things that were encouraged in his family. *'I was artistic as a child. I remember once wanting to design and build and create shelves in my bedroom and I was told point blankly, no you can do it, there's no way you can do it. There was no creativity. Me da done everything. I wasn't tempted to do anything myself. I wasn't encouraged at all.'*

Mark is invited by his tutor to participate in research relating to DT. He's asked to view some videos, which explain DT and he expresses an interest in taking part. *'I watched those videos last night. Jaysus, I was up all night thinking about it...hahaha. Very interesting though'*. He attends an introductory lecture, signs up to participate, scores 26 in a pre-test of DT fluency and completes an attitudinal questionnaire; he doesn't like to use computers, finds them difficult to use and says they evoke negative feelings in him... but he's willing to try. He considers himself creative, enjoys creative tasks and really wants to be more creative. He's ready to begin and is left to work on the exercises, on his own, and in his own time.

He doesn't work alone. He's doesn't feel confident enough to. *'No, no, I didn't even try. Straight away I didn't even want to try it. So there it is again, back to the same thing again. I've been putting typing off for years...every email you get from me, I don't type them. I tell Louise what to say.'* Louise is Mark's wife. She is drafted in to assist with the exercises. Mark says she really enjoyed being part of it.

A lack of confidence is Mark's constant companion. It questions his every move, undermines his decisions and shapes the path he follows. *'I do worry about if I'm saying the right thing and its very strange cause it's just my criticism. I got to the stage were I'm not worried about being foolish or silly or people laughing or doing the wrong thing.'.... 'No but I do think it's a failure thing, fear of failure or doing it wrong or not achieving what you set out to achieve and looking foolish maybe so that has a huge part of it... Eh, yea, second guessing myself all the time. How was I feeling, is this the right way to explain how I was feeling at that time? Is this going to make sense? Louise provides security for Mark, enough for him to engage with the exercises. He works through the exercises with Louise, following the guidelines in so far as he can. He begins to relax and enjoy them. 'I did feel joy, experience happiness, it was exciting to eh, to think of...about the amount of different ideas I could think of. That was quite pleasing, exciting and to see things...things that you wouldn't necessarily relate together, to think that you could actually find differences. So it was exciting. It's almost like it's energy, it's something in the brain, something triggers, you start to think in a different way and it does...yea I found it a very positive thing....I get excited when I'm doing the tasks and it makes me happy. It's fun to do.'* But not everything Mark experienced was so positive; he also experienced negative emotions while doing exercises. *'Negative emotions? Ah, I can definitely talk to you about them'*. His lack of confidence surfaced and he found himself being self-critical, being frustrated with his performance *'I should have come up with more ideas'*, his *'lack of computer skills'* and his *cognitive abilities*; *'Yea, cause I found that it was frustrating cause I think, ah, I don't know the words so then what's the point? That's a stupid way to think, it's silly, obviously it's good cause it's making you look for words and solve the puzzle'*.

The wide eyed boy is not so brave anymore, his companion is always there, ready to tap his shoulder, to sow seeds of doubt: not too many mind, but just enough.

Mark's companion is not alone, other things, things related to the resource and his computer self-efficacy, serve to undermine his progress; *'jaysus the time thing is a killer....I was very aware of the time in the first task and had to consciously stop looking at the clock in the next two tasks...the time is something I'm always thinking about. Worried that I won't get enough answers in the amount of time I have: typing is a huge problem.'* The exercises Mark is doing are time constrained and a clock counts down the seconds: he doesn't type. Mark reflects on his challenges and offsets his typing issues by enlisting Louise, he overcomes concerns about timing by consciously letting go of concerns about making mistakes; *'I notice the less I think about the time, the more time I seem to have...I'm relaxing a bit with it and not worrying so much about getting it wrong'*.

The wide eyed boy struggles with his companion. They're not friends.

Reflection too presents Mark with challenges, but not in relation to discussing what might be viewed as private insights. Mark's challenge with reflection stems from his lack of confidence. He questions himself constantly about the correctness and accuracy of his reflections; it takes him much longer than he expects to articulate his thoughts. He enjoys the process but once again enlists Louise to help... so he'll be understood, so he'll write what's expected. He writes his reflections for me. *'The reflection part is a bit challenging simply because it is time consuming. But also it's a challenge because it's sometimes hard to put a finger on how you were actually feeling while doing the task. It can be hard to verbalise...i wrote to be understood by somebody else and the fact that I'm not typing means that this is persistently challenging.'*

Louise supported Mark throughout the experience. Herself and Mark are always together and the fact that she assisted provided Mark with many things: She provided motivation and psychological safety; *'When I knew my wife was doing the typing I looked forward to the tasks more'*; she provided structure *'Well I'd say to Louise, I have to do the divURGE thing now and she'd say; ok, right let's just go, let's get it done. And Louise is fantastic, she's brilliant, she supports me in everything that I do. It's a credit to her, she's brilliant. So we'd sit down, Louise would have the laptop out and she'd say, ok, it's going to come on now, you're going to have 2 minutes, are you ready? So I'd say, ok, I'm ready.... I haven't really been thinking about the differences between things but we've decided we're going to do this and Louise is going to hit that button on the screen and I'm going to have two minutes to answer'; and she provided guidance 'Yea, she'd probably guide me along the way, maybe explain what this question means, what I'm supposed to say...no, not what I'm supposed to say but what is being asked of me here. I sometimes have a difficulty with that'*. She may also have provided Mark with intrinsic motivation *'Sometimes there are some awkward silences because she can type quicker than i can think.'* Without Louise, Mark thought he would have had a more challenging experience... *'Yea, more stressful I think. I do worry about if I'm saying the right thing and its very strange cause it's just my criticism'*.

Louise knows the wide-eyed boy well. She doesn't like his companion either.

Louise wasn't Mark's only support. He found security in the completed example exercises and reflection notes provided in the resource. The examples may have Mark to quell his companion's disquiet and constant questioning and concern about being perceived as getting it right *'When you gave the examples of say the Onion and the Radio I thought...ah so that's what it's all about, that's*

what we're looking for here. Another way of looking at or seeing things... Yea. That [reflection guide] was helpful. It leads you in the proper direction and it shows you exactly what can be achieved and what's expected.' But some resources were not as supportive as intended, a short inspirational video - one which inspired me - actually had a negative impact on Mark... *'I remember hearing, i think it was on one of the videos that someone got 200 responses, and I wasn't getting anywhere close to that so that knocked me a bit...this is terrible, I'm doing terrible.'*

Marks companion loved this. 200 responses?...you've no chance.

As Mark...and Louise, continued with the exercises and the reflection. They settled into a routine; have dinner, clean up and sit in the living room on the couch with the laptop on Louise's knees. But Mark didn't see it that way and strongly disagreed with the idea.... *'No, there was no routine.'* Although Mark felt that there was no routine, and that the place where he did the exercises didn't impact on this experience, this was not reflected elsewhere; *'we'd always just be in the sitting room...we'd sit in exactly the same positions...if I were advising somebody else how to use it I'd tell them to think about being ready, think about the exercises, make sure you're ready, comfortable before you sit down and do it.'* When he was asked about why he didn't undertake the tasks on his own, even after being asked to not concern himself with spelling and grammar issues he said...

Well that's just habit, that's just falling back in to me and what you're used to doing. Just family routine. I need to break that, I need to work on it.'

Nothing escapes Marks companion.

As time passed and Mark drew closer to the end of the learning experience, some things began to emerge that were not expected. The wide eyed-boy who scrapped the cowboy and Indian battle on his parent's coffee table peeped his head out from behind the curtain. *'I realise now because of the divURGE thing that was always that sorta person. I was always questioning things when I was younger and I was wondering where did that go, why did I stop doing that, you know what I mean?'* Through challenging his thinking processes and reflecting on them, Mark began to gain a greater understanding of himself and of the journey that took him from a brave Indian to a doubting Thomas. *'I suppose because of my family background and my upbringing, there was one way or, well my da especially was sorta, you do it one way, my way or you. And I suppose that sorta crept into me a little bit in later life...in our house there is only one way to do things. And if you were doing things you'd be told, don't be acting the eejit, that's stupid, that's completely wrong so.'* Through his experience, Mark gained a greater understanding of what has made him who he is *'everything I done I did with me da. I never went out and took that leap and went out and did my own thing. Me da would always say no you can't do that and I'd always want to know why, why can't I do that. He'd always say no, no, no and he'd never tell my why, why, why can't I do that.'* But he doesn't reflect negatively upon his childhood or how it shaped his thinking, he looks back with pragmatism and humour... *'sure me da was just a man with his own insecurities and I was crazy, enthusiastic, energetic.... cause I remember at other times, me ma and da had this coal bucket beside the fire and I remember thinking that if that had holes in it it'd look better. So I got the poker stuck it in the fire and put holes all the way around it, I was thinking it looks fantastic, brilliant, they're going to be so happy with it when they get home from the pub. Of course they went, they went ballistic!'*

Proposition 1: DivURGE provided Mark with a mechanism to identify what he believed to be his natural thinking processes.

Nearing completion, Mark began to identify some changes in his DT ability, *'this time one answer triggered another one, which hasn't happened before... the answers were sparking, you could see how one answer would spark another, but that took a while to actually start to happen.'* He also began to visualise and use his own ideation strategies... *'It would all come at the start then the big shutter would come down. Somebody closes the door...sorry no more ideas in here... I'd have to, I'd have to start picturing them, I mean stop picturing them because you'd only see obvious things... I suppose it was just letting go and not being worried about saying the wrong thing and just saying it, just shouting it out. And something mightn't be similar but it might spark off something else and that might take you off in another direction'.*

When Mark preserves his companion goes silent... *'yea once I get stuck in I'm grand'*

Mark also began to notice more general changes in his thinking, *'I would say there is something different, simply because of the fact that I'm making a conscious decision to think this way. Before it would have been more natural while it doesn't feel so natural now, I'm actually deciding consciously to think this way.'* Extending beyond the virtual confines of the resource, Mark's thinking began to manifest in his day to day activities; *'Well I was looking at things, for instance when I was walking to the train station I would be looking at things and trying to see similarities.* In relation to his personality and possible impacts, Mark was less certain; *I really think it did change my personality.... It did make me question my personality more, why am I making these decisions, why am I putting things off? So in that way my personality has changed... ah, I don't know if it influenced me directly. I don't think I'm a changed person.'*

Proposition 2: DivURGE provided Mark with a new way of thinking that he can consciously engage when appropriate

Reflecting on his experience it became apparent that my role was pivotal across many areas of his experience. Mark did appear to take personal ownership of the experience and viewed it as something to be completed for me. He felt, at least partially, obliged to complete the tasks, *'life is busy, things are always going on and your always thinking, ok, I've to do Barry's divURGE thing... Once I started do it, it was...I have to have this done for Barry...once I'd started, once I'd agreed and started and had done or two days I knew I had to do it.'* Mark's view of it being for me may well relate to his lack of confidence and his wish to be viewed by others as being intelligent, *'Just because it was you, and not because I want to impress you, but I want to do well and I want you to think that Mark's doing well, he's doing ok, and he's a good student...you're my tutor and I know you, I think there was a little bit, aw, how am I going to come across to Barry, you know what I mean? I'm always trying to come across as intelligent as or more intelligent than I believe I am, you know what I'm saying? It's almost like, oh, I'm going to be found out, I'm not going to be any good at this.'*

Mark completed all the exercises and reported that he felt the experience had increased his DT abilities; he felt that online learning didn't suit him but that it was *'down to him'* and not the media. While he didn't feel confident using the resource he said he did enjoy the experience. He also reported that the experience had allowed him to understand how and why he thinks in certain ways and had provided him with a new way of thinking and seeing; or more correctly, it provided him with a way to rekindle his natural way of thinking and seeing.

Mark's post experience DT score was 54: A 100% increase on his pre-test score. Whether this means he'll allow his own children to scratch western scenes on his own coffee table is yet to be seen.

Proposition 3: through using divURGE, Mark's DT ability was enhanced

Appendix L: Case 2 (Patrick) Original descriptive narrative

Cartesian confidence trick

'I'm in' ...Patrick's two word email response to participate in this research.

'Sorry I'm late. You know...buses, traffic, all that stuff...lol....what I miss?' He arrives an hour late for the introductory briefing about the project, but his good humour and apparent enthusiasm quell my internal doubts.

Patrick is confident. He strides rather than walks. He enters a room with his head held up. He's not afraid to meet anyone's gaze. He takes care of his appearance, his hair is neatly trimmed, his clothes are smart. He looks like someone who spends time coordinating, he thinks about it. He's 26, lives in a shared student house and works part time in a boutique restaurant. He likes to socialise and has a lot of friends. His friends think he's funny, he does too. He is funny...or maybe he's just a smart arse?

Patrick likes technology. He's comfortable around it and uses it all the time for working, learning and socialising. He embraces technology, it's part of who he is, his smartphone is like a holstered gun and he's got a hair trigger.

Patrick considers himself a really creative person; he loves creative activity, finds it really enjoyable and thinks that he comes up with lots of ideas to problems. He wants to be more creative...it's why he volunteered. He came to this research confident in his creative and computer abilities... *'yea, think more creatively? Where do I sign up?'*

Patrick joined the briefing session an hour late but wasted no time getting started. Casting his jacket and scarf onto a chair, he confidently took his seat, clapped his hands, and looked up as if expecting a starting pistol to sound. Completing the pre questionnaire and personality test he couldn't but help to crack wise about coming up with similarities between pencils and planes. Perhaps he needs to laugh in order to feel comfortable. His questionnaire and test results entries confirm what his demeanour already revealed. Patrick is an extrovert, he is very open to new experiences, he considers himself a risk taker and much to his amusement, he scored highly on a rating for neuroticism. Patrick agreed that he finds computers easy to use, uses them all the time and rarely, if ever, experiences negative emotions while using them. He says he's unconcerned about what people think. He scored 25 on his DT pre-test.

Patrick sets off from the briefing, confident that he'll have no problems following the structure.

Patrick doesn't follow the structure. But he doesn't see that it that way - *'Yes, I followed the guidelines at all times.'* – But the user logs tell another story. He does his own thing, a little bit here, a little bit there, a flurry of activity, followed by days of inactivity. When pushed, he ponders; his hand clasps his chin as if it were a switch for turning on the blarney. He capitulates, tips his head as if caught in the cookie jar, then lets out a resignatory laugh... *'eh, I don't know, eh, yea, it's not a trait I'd be particularly proud of but you can kinda leave things to the last minute sometimes or life gets in*

the way sometimes, you know what I mean? I wish I was more diligent when it comes to stuff like that, especially kinda studies and focusing on things that need to be done so they tend to be put on the long finger sometimes and it wouldn't be for the want of doing them'. His humour is a good defence but it doesn't stand up to intense fire. He's motivated to enhance his creative thinking abilities but not so that it's a priority over other things 'Well I'd plan to do it then I'd get home and I might play some football or your know, hang around with my mates or doing this or the other, or it would be just put off or just pushed back a bit and it wouldn't be your top priority for the evening, you'd mean to do it then'. He doesn't know how he prioritized divURGE and expresses some unease about being asked; I do hold it as a priority but I have an awful tendency to eh, but that's wrong because if it was a priority I would have put it first'. I enquire further into how he prioritizes his life, what motivates him, what could motivate him...'What like a gold watch at the end of DT? Yea, eh, like I don't know, I see like the reward was to think more creatively so I suppose that was reward enough.'

Much later, five weeks after he'd finished the exercises, I asked him again about his priorities; *'I did find it a bit difficult I suppose I would like to spend more time studying and learning plants for example and it can be hard to admit that fact. I know what I need to get done but I do have a history of leaving things to the last minute.....but getting them done'*. He's just like everybody else I suppose.

He wants to be more creative, but only to a point. He tells me that he doesn't find the additional DT resources contained in divurge useful. But he never even looked at them. I'm quietly frustrated. Doesn't he know how much work I did. For a change, I say nothing. Well almost nothing. I ask about the resources and once again it's a fair cop gov...'Eh, aw, again, lol, that's tough to answer...eh I don't know.....eh, I just ...eh under pressure? I wish I did them but I didn't get around to it. it's just one of those things....Eh, yea forgetfulness, doing other things, meaning to do it but not getting around to it, all of a sudden it's the next day and you're just distracted by other things, life gets in the way. But they're just poor excuses....I'm disappointed in myself for not getting around to it sometimes.

Patrick is easily distracted. Distraction forms an integral part of his experience with divURGE. Distractions keep him from completing the tasks, they undermine his ability to come up with answers, *I think i perform best when I'm in a relaxed mood, without something bothering me... things that distract me?...Eh, classmates, background noise, tutors, eh... based on my experience, if I was to advise somebody on how to use divURGE I'd tell'm to do it late at night with a minimum of distractions'*.

Proposition: DivURGE was not interesting enough for Patrick to hold his attention.

Patrick likes to work at night. He has a safe space, a zone, a retreat in which he works his creative magic, free from the distractions of life; *it's just my little private space. I have a nice desk, mac, drawing board, you know, another screen and pencils, books, you know it's just, em, it's where I work, where I create and do things and minus any distractions so you know it's just that safe environment where you can just get on... I definitely found it easier in the evening, nice and relaxed, in the comfort zone, my little creative hub, my little area where I work, minus any distractions...I preferred to use the resource in the evening in the privacy of my room.'* Patrick's hub is more than just a bedroom with a desk, it's a bigger space, a space that provides different uses, it's arranged, ordered and decorated with items that confirm his identity; *'My bed at one end in the middle in the middle of the room is a couch and a coffee table at the other end is a shelf across the whole room with books and my stereo. Beside my bed I have a wood desk with my Mac and a flat screen tv, a nice 70's office*

chair. I have pictures I like surrounding my desk. My room is my creative hub it has everything I need from books to a good internet connection and my hard drive. Over the last while it's where I have completed things, so if I need to get something done I can retreat and hibernate for a few hours.' He loves his creative space, but felt that it did not impact on his experience, adding... 'room, class, design studio...it's all fine with me'.

*'Ja know, the way you just pull a blank sometimes?' said Patrick, with a disappointed look in his eye as he completed his first task under observation. He was late that morning... 'buses, traffic, you know?' He appeared a little harassed, a faint sheen of sweat covered his forehead but he laughed it off with a clap of his hands and 'what should I do?' Log in and do a couple of exercises. 'OK, no probs'... 'eh, do you have my password?...eh, no worries, hold on, I can get it from my email'. His password was safe and secure, tucked up in his creative hub. He had a go at another exercise but couldn't recall where he was up to, I told him to do any one he wanted, which he did and with similarly - in his eyes - disappointing results. I asked him about how he felt being observed had impacted his ability to perform the tasks; 'it's not something I thought would have any impact on me but I don't know, I really struggled there'. Later, reflecting on the observation experience he noted that he felt less creative being watched and felt far more conscious of the time then when on his own; *I imagined the roller skate then i imagined you could move furniture and use the skate to move things but I got a bit stuck after that maybe because it was early and I was being monitored... I think it was just like a standing start and like I was straight into it... I felt a little less inspired and a bit more distracted, like eh, I suppose I just felt a little bit more under pressure to come up with eh, answers. And actually I just went blank and then got frustrated with myself for going blank. Eager to get gain a deeper understanding of his own surprising behaviour he mentally retreated to his creative hub for reference; 'I suppose it was just the opposite to when I felt comfortable in the room. It was like close quarters, under supervision, ready steady go and then I just froze. I couldn't stop thinking that I could think of anything, you know, so it was like (ok so you were focused on not coming up with ideas?). eh, yea, I think had you said,...you've got five minutes, take your time and go for it, but it was like...just two minutes and two minutes is just so quick and you're conscious of the time ticking away and it just like, yea.'**

Proposition: Context plays an important role in Patrick's cognitive processes.

But Patrick had done his first divergent tasks under observation, surely there must be more to it than being outside his creative hub, missing a bus and close quarters creative thinking? *'I don't know, the first task that we did, which was just pen and paper, was eh, fine and you kinda teed us up for it, so I was kinda geared up for it so that wasn't too bad. The most difficult one was the supervised one, I just felt a little bit under pressure, a little bit eh....You explained the whole reasoning behind it so my mind was in the zone and I knew that this was what it was going to be about and the second time it was just kinda one on one and was kinda...sit down, go for it and I didn't have time to prepare, not even that I needed time to prepare it was just early, smaller room, eh or something, I just felt a bit eh, well all of a sudden I found myself trying to come up with ideas and hitting a blank and just clock watching and just thinking about the time ticking away.'* Asked if he felt my being his tutor had impacted on his performance he said; *Not really, I don't think it did, to be honest, once the time started I was in the zone was trying to come up with ideas, you know. Who was setting the task was irrelevant and didn't have any bearing on it at all.*

Proposition: Mental preparation is important to Patrick's success using divURGE

The concept of mental preparation is something that occurred and reoccurred in Patrick's responses. Upon completing the experience I enquired as to what advice he'd pass to other potential resource users and once again the idea of being ready, in the zone, being mentally prepared arose; *Yea it's kinda like, eh, the preparation is like to clear you mind to get rid of thoughts that are distracting, so you like you know, sit down and say ok, and your sort of ready for the task and you just go.... I would say, yea, quiet, no distractions, and em maybe after you've done a bit of thinking work so you're like having a warm up, sorta like stretching. I'd say if you were like cooking the dinner I wouldn't just sit down and try to do it.... I think you need to be nice and relaxed and that you brain is in thinking mode...the last time, the time in the morning, I think I just wasn't ready'.*

The time constrained nature of the exercises impacted on Patrick's ability but he's not sure whether it was good or bad; *'I'm getting on fine although with the clock ticking in the corner it can pile the pressure on and sap the creativity...I was just conscious of the short time limit so I didn't want to waste any seconds on thinking about something that's not relevant to the task'. The visible time clock serves to focus, distract, motivate and undermine his performance. 'I liked it in a way because it put you under a bit of pressure to see if you can perform. So it was good in that sense, but you know I couldn't get away from when the time was running out you only had so much time left.'* It also served to inform him how his ideational processes worked. *'I'd like have this burst of creativity at the start, sorta boom, boom boom, then the well would dry up and then you'd go, ok, what time have I got left? And then sometimes you'd go...oh a minute, that's brilliant cause I'm after getting loads out for a minute then you'd get a second wind ten you'd look and you'd only have 20 seconds and you'd go, 19, 18, 17... and you might just. You might come up with one or two more but the fact that your time was almost up would sap you creativity sometimes as well cause you'd be like, oh your time is running out.*

Proposition: having a visible time counter plays a significant role in participant experience

Another aspect of the experience, the ability to review responses to DT tasks, also played a role in providing Patrick with an insight into his ideational processes; *'I found it helpful that you could look at your answers and that made you aware of where the ideas came from... Yea, looking back at my answers to the tasks...It was helpful because I could walk back in my memory and look at how I perceived each answer... I found it interesting to understand how my mind works from a creative perspective yea it was good to see what you might come with'* This positive aspect was also supported with the reflection blogs, where Patrick traced back over his thinking to gain an understanding of how he was thinking; *'Straight away I was thinking of raw materials like steel and rock but then I began to think of things I had carried that were just outside what I can be comfortable with... Towards the end I had thought of animals and inanimate objects and I wanted to think of something different so I tried to think of when I used the word heavy in conversation and that is when chocolate cake and emotions came into my head... At first I just imagined both from a birds eye view and that brought me to how they are filled with living things. I also thought of the structures and how they are both places where routine is important.'*

Proposition: Structured reflection activities in association with the ability to review answers afforded Patrick the opportunity to gain greater insight into his ideational processes.

Patrick views his ideational processes from the outside. His brain, like his creative hub, is a place, a thing, a tool to be harnessed, engaged, visited and retreated to; *'I don't know, after a couple of answers sometimes my brain would click in or throw a joke in... I suppose when you just read*

something you just sorta resort back to your inner brain... you just sort of organically work on it in your brain... I would be thinking that I would come up with a few ideas then I'd be thinking in my brain to switch my focus and try to think of something not as obvious and maybe reinterpret the question and think of something left field... you know, I'm like in my brain I have a flash of me swinging on a tree or roller skating in my back garden'. As to the significance of Patrick's mind/body split, he is unsure, as am I; 'I don't know, it's a kinda tricky question. My brain, my thoughts, my identity, likes what in my head. It's your inner monolog'. Perhaps viewing ideational process from the outside facilitates easy organisation, compartmentalisation and access to what he perceives to be different cognitive activities?

Humour is important to Patrick, it's part of his personality, his identity, it's a way he communicates with the outside world and dialogues in his inner brain. Humour is a strategy he uses in ideation; *I found that humour played a big part... I think it was just a natural thing, being a joker sometimes. It's like, maybe it's hardwired or something, I just look at the funny side of things sometimes. When I was doing the task and I found that I came unstuck or ran out of ideas I'd kind of look at the funny side of it... after a couple of answers sometimes my brain would click in or throw a joke in... You know, after I would be thinking about a couple of stock answers or obvious one then the humour thing would jump in. it would help cause it could be, you know, sarcastic or outrageous or something. Humour is a tool for Patrick that allows him to shift perspective, to loosen his thinking and to overcome ideational roadblocks; *When I was doing the task and I found that I came unstuck or ran out of ideas I'd kind of look at the funny side of it. but humour is not Patrick's only conscious strategy he also uses mental he also engages in manipulating mental images and drawing on past experiences... I tried to just imagine an object and I was able to keep converting it into things... I tried to think of when I used the word heavy in conversation and that is when chocolate cake and emotions came into my head.'**

Proposition: Humour was an important ideational strategy for Patrick when using divURGE

The idea of revisiting and drawing upon past experience also provides Patrick with a route to new ideas. Within his reflections, our conversations, mails and interviews he frequently refers to the past; *without a doubt, I think, well you can't help it. Like eh, I think one of the tasks mentioned roller skates or a swing or something, you know, em, straight away, you know, I'm like in my brain I have a flash of me swinging on a tree or roller skating in my back garden that I remember from my childhood, and just like I mentioned earlier on, drawing on past experiences'. The past does more for Patrick than merely provide visual stimuli for new ideas, it provided him with his confidence, his belief that he can be creative, that he is creative and that he should pursue it; *Yea I think from a young age I was always colouring in, and showed a bit of creativity kinda like with writing and stuff like that, so I was encouraged you know... art classes and Christmas presents and decisions I was going to make were always supported, you know any courses I wanted to do. I suppose I was just nurtured rather than discouraged...'**

As Patrick's experience with divURGE drew to a close he began to understand in more depth what it meant to him. Through various forms he communicated what was happening; *I think in a very basic form it was kinda spelled out that you can think and observe things in different ways... I'll definitely use it again when trying to come up with ideas so I'll step back rather than just come up with ideas organically and explore things. It'll just have a more structured process in my head... it kind of gives you more options and em, you can break things down more and explore things without settling your first idea... you know, being able to explore things in more depth, kinda think a bit more, have more options in your head, in your kinda armoury and just kinda look at things differently... It made me*

think about the bigger picture and where your ideas come from... I like the fact I am aware of different tools to think divergently for example the different uses for things it will be part of my thought process or idea generating process from now on.’. Perhaps most significantly, in his final exercises he began to challenge himself, to move beyond the mere fluency of ideas in search of originality; *I found the task a bit tricky because there are so many that I wanted to think of good similarities and not just random things that they both contain.*’

While it may appear that Patrick had made significant gains during his experience, it is interesting to note that his pre and post scores were practically identical; and while the scores are not a rigorous form of assessment they do infer little increase in DT ability. This is interesting insofar as Patrick is confidently creative, comfortable with computers, had no difficulties using the resource and scored highly on personality traits associated with creativity; *‘I don’t know, it was just, it was no major revelation, I didn’t think... ah wow this is the secret sauce or anything for thinking creatively, but I just liked the framework it gave you. You know you can think of unusual uses for something so it just gave a little bit of a framework for when you having ideas in the future, sort of like having three different ways of looking at something, which I think you have anyway but it’s nice to categorise them so you can draw upon them in a more structured way rather than the more organic way your mind works already*’. Despite the non-change in score, Patrick strongly agreed that the experience increased his DT ability; *I definitely feel the tasks helped me think more divergently, even if just by being aware that that was the intended aim...I think so as the tasks challenged conventional thinking and made me try to push my ideas.*

Proposition: Patrick’s experience with divURGE did not appear to increase his DT ability.

Patrick may not have appeared to gain in terms of DT ability, but did attain a structure for thinking divergently which may take longer to manifest in increased fluency. However, he did speculate on how a tool such as divURGE could be better developed to suit his particular thinking style; *I think something visual would be interesting. Like for example, the unusual uses, one of them was like for an airplane, if you had a picture of an airplane, it was like, it would like trigger more of the sorta spatial reasoning rather than just thinking in your brain like, whereas if you actually saw it you could almost see it and maybe manipulated with a pencil into different things. Like the thing I sent you, finish this off, or turn this into this, you know, something maybe eh, where you actually sketch or used, maybe like colour or something like that...I suppose when you just read something you just sorta resort back to your inner brain, em, I just think if you had something visual it might trigger something different.*’ He also made indirect reference to what I evidenced as not working to the structure and suggested a possible mitigating solution; *From a personal perspective I can be a bit scatty and putting things on the long finger, maybe if there was a sort of gentle deadline or rigidity to it, like you know, maybe a little less open ended and maybe say here’s the target, say, I need them in three days’ time you’d fit them into your schedule over the next three days. I just kinda would like to have done more, but you know, sometimes if you are given too much freedom, you can em, it just slips by...it might have helped if there were specific times and dates to complete the tasks as I am brutal if given free rein to do them whenever.* This last comment is interesting insofar as the resource did have a guide timetable for activities and recommended daily activities.

On a more general level, Patrick summed up his experience as positive, saying that the only negative emotion – tension – was experienced under observation and noted that he thought he performed better in a relaxed mood. He agreed that the exercises were extremely relevant to him; *‘I felt they were extremely relevant...I am in a design course creativity is essential.*’ Although he was adamant that he

had no difficulty using the resource, that online learning suits him and that he thought he could only be marginally quicker writing rather than typing - *I don't think it makes a difference. If I'm typing, It's the same idea generation process...I wouldn't see writing or typing, eh, not a huge amount of difference. Probably marginally quicker writing them down* – it is interesting to note that he still prefers traditional approaches to learning and feels he can think more divergently when not using a computer... *I think I'm on the cusp of the old school, eh, I'm just kinda, eh, you know, even now if I'm writing and essay or something I'll always write short hand with a pen first then transcribe it on the computer... there is no substitute for one on one teaching*

Appendix M: Case 3 (Raoul) Original descriptive narrative

The illusive social ingredient

Raoul is a professional chef; *'A very good chef, a very good cook, a very creative cook.'*

The passing of his previous employer, a man of international standing, brought Raoul to a new junction in life and his chosen direction was to pursue a course in garden design. He is an educated man and holds a Master qualification. As a child he was sent to boarding school, a Jesuit seminary of strict tradition and a reputation for analytical thinking. As a teen Raoul pursued an education in economics, an education he paid for himself by working part time in catering. Dissatisfied with the fruits of his endeavours into the world of economics – *when I realised that no one was going to listen to me I knew I had to change direction* – he focused his attention on becoming a chef. He spent the next 30 years working as a chef across the globe, in several high profile establishments and ultimately as the personal chef to his previous employer.

He is now a full time garden design student. He still cooks on a professional level, but not full time. He lives in a house owned and shared by a close friend. His friend works two jobs: Raoul spends a lot of time alone.

Raoul's motivation for participating in this research was to further his education, to undertake self-assessment and to develop new ideas. He did not volunteer because I am one of his tutors, but it did partially influence his decision to get involved; *'I was obviously receptive to the idea because you had thrown out the idea and I had already been in your classes so I was receptive to anything you were going to suggest.'*

Raoul's personality assessment revealed him to be relatively neurotic and open, it also indicated that he is not particularly conscientious or agreeable: Ironically, he completely agreed; *'Well I'm always aware of not being very conscientious, I'm aware of the fact that I'm neurotic, em, agreeable is more to do with the fact that I'm an arrogant snob.'* Raoul has strong feelings about computers: he really doesn't like to use them; doesn't enjoy using them and finds they stimulate negative emotions. Despite this, he uses them frequently for communicating with friends, for reading newspapers, occasionally to support learning and... *'I use Facebook...mostly to play Farmville though!! LOL.'*

He scores 31 in his pre-test of DT fluency.

He is buoyant during the pre-experience lecture; he laughs and quips about questionnaire semantics... *'ha!, can you define liberal for me please?'* He sets off to start his divURGE experience and has little difficulty using the resource; *'It was very easy to use, it was very understandable... I found it easy to use, I understood the layout on the screen... I could navigate around.'* He finds the resources and supports useful and is able to utilise them to find his way round; *'I found them very helpful because, em, I can process that information very well...I went back several times to see where you, to see where the cursor moved to and clicked on things as opposed to drifting and listening'.*

Proposition 1: Narrated instructional videos positively supported Raoul's experience.

Raoul does not use the resource as prescribed and sets his own usage patterns; *'I thought the whole idea was to have free reign to see what happens.'* He works his way through the exercises, engages with the reflection activities but doesn't identify any tangible benefits in relation to DT; *'I don't think I ever reached a point where I said, oh, that was interesting, if I altered this I could do that at the drawing board...nothing like that happened... I mean I didn't have any huge, all-encompassing thoughts about the purpose of education, that didn't come into it. It was all about me'.* When questioned about his understanding of the reflection activities in divURGE, Raoul hints that he interpreted it more as a pondering exercise than a deliberate, focused activity; *'I didn't see much point in sitting there contemplating my navel and thinking how I can alter my feelings about using computers... I think that reflective activities in general are about recording your feelings and emotions those sorts of things in a moment'.* Although Raoul's reflections did allow hidden and unrelated issues to bubble to the surface, his reflective experience appeared to be directed by a focus on negative thoughts and feelings; *'I don't think I ever made any positive comments really'.* His reflective comments are hued with self-criticism and serve to undermine his progress; *'If I did an exercise and commented that was going to immediately colour my attitude towards the next exercises... the commenting on it was a sense of finality and then I felt that there was no point in moving on to another one because I had made the mistake of putting myself in this frame of mind... it was almost as if the act of adding the comment was closure'.*

Proposition: Non supported reflection activities appeared to undermine Raoul's experience and progress

Later, when asked if he had his reflection activities had been supported with feedback, Raoul said not in the context of this project but maybe in another; *'that sort of sounds like directed. Eh...in a more structured environment I think it would be necessary, yes definitely'.*

Negative thoughts and feelings seemed to play a significant role in shaping Raoul's experience. They were evident in numerous sources and related to a number of different areas, the most significant of which were his perceptions of computers and levels of computer self-efficacy; *'I suppose what I really can't get passed is the computer, the box... I see computers as basically being a library, basically another way of reading a book'.* His fixed belief in computers as basic tools seemed to present him with an unmoveable obstacle, one which frustrates and closes him down; *'This kind of anxiety that I immediately develop and I don't know what it is I was finding it very hard to move passed initial frustration.... I don't think it did anything for me because of that block, that wall, that the computer created...I didn't find that I was hugely engaged with it because I was blocked by the technology, or because I felt blocked by it, I wasn't blocked by it but I felt blocked by it.'* Such was Raoul's frustration with the *box* that he began to see the experience as a battle, one which he could win by outwitting it; *'Sometimes I tried to sneak up on it obliquely by putting it off, putting it off until*

it became a larger and larger thing occupying space in my mind... I was actually sitting there thinking...aaah, I'll plan the moment when I start this...I'll start massaging my brain in this direction.' He traces the origins of his negative perception to a number of sources; *'I think that is to do with the way I was educated... it has to do with where I come from and the age I was at when I reached computers'*.

Other factors that contributed to the stimulation of negative thoughts and feeling included Raoul's predisposition to self-criticism; *'it's the story of my life, high expectations, low delivery'*. During observation, the computer produced an error and he openly tutted, on reviewing his exercises responses he exclaimed in disappointment; *'oh for God sake Raoul'*.

Proposition: Raoul's perception of computers represented a significant limitation on his ability to engage with the resource

Raoul's perception of computers as a frustrating box was militated by a number of other factors. The most frequently reported of which was the necessity to type responses. Even before starting, he had flagged it as an issue; *'Can I use the services of a typist? I'm not very fast at typing'*. As he progressed it become an increasingly significant challenge; *'the typing challenge was the challenge... it was like patting my head and rubbing my belly...but when it came to my block, my using a keyboard, that's me breaking down... I'm more aware of my typing skills than my answers'*. When it was suggested to him that he focus on responses rather than typing he said; *'it's as hard for me to not focus on spelling, punctuation and grammar as it is not to.'*

Proposition: Raoul's perceived low level of typing skills undermined his performance and experience

Later, when questioned about what might have helped, he wondered if voice recognition might have helped; *'I've always wanted that sort of experience rather than having a box with a keyboard...I wonder sometimes, ever since I watch star trek as a child, I've hankered after the sort of technology they had... I wonder if I could have interfaced better if I could have spoken to the computer and that the computer just transcribes what I was saying... we'll all I'm looking for is a cassette recorder so yea, and I think I am much more confident doing anything on a verbal level.'*

Proposition: The provision of a verbal based interface may have afforded Raoul with more opportunities to positively engage with the resource.

It is interesting to note that Raoul is unconvinced by his own placement of blame upon computers for his negative responses; *'I think maybe it's an escape mechanism... I suspect that I wouldn't be much better at all but it's very handy for me to waste my energy and my time and my essence being angry with the computer rather than actually going upstairs and getting a Dictaphone and let's do this... I'd just like to believe that I could have done better. It's almost like coming up with excuses... half of me is saying that bloody computer it's stymying me, it's putting a stop to what I'm capable of the other half is saying it's handy...there is always a handy fall guy and it's never anything that can speak back.... Em, it's much easier for me to invent an entire world around that person that may or may not be true and then be competitive with that and feel jealousy, entirely negative, wasteful, useless...and I'm aware of that but it never stops.'*

Raoul's low level of computer self-efficacy further undermined his experience; *'I don't have a level of confidence in terms of computers, in terms of technology, in terms of interface, so I have that block going on anyway...I'm already entering that zone of dread before I do anything'*. And although he states that he is confident doing the exercises - *I think I was quite confident doing the mental processes* – this not represented elsewhere; *'I couldn't get over that and I suppose it became more about that...I'm useless at this, I'm not giving enough examples or my brain is working fast enough. It was a competition with the computer as opposed to interacting with the resource... It's as if I expect to be in some perfect place where answers will flow and I will be brilliant, the truth is I'm flummoxed every time.'*

Although Raoul stated that he is unconcerned about what others think – *fundamentally, I am disinterested in the criticism of others... I feel I can criticise myself better, harder, deeper than anybody else* - he measures his progress through both internal examination and criticism and also through external comparison; *you're wasting your time, em, and you're not clever as you thought you were. This is exposing the fact that you're not as clever as you thought you were, oh why don't you go to the bed and look at the wall right now... oh I'm sure everybody is doing this so much better than me...I have picture of Patrick flashing through my mind with his perfect technology and his wonderful mind and his great vision... Jealously...it's a case of how do I know, I have nothing to compare it with. You need comparative data to make a comparison.'*

Proposition: affording Raoul the opportunity to contextualise his progress with respect to other users may have served to mitigate the negative impacts of low confidence.

Reading this you might assume that Raoul had an entirely negative experience. This is not the case. In fact Raoul did experience positive emotions during his time using the resource and generally found it to be positive; *'Well it's actually very emotionally freeing in one sense. You know, to be given, that you can actually, on a broader sense that you are allowed to do things which are not exactly monetised and productive. I mean I'm still enjoying that feeling... That's a very enjoyable thing. Em, on a kind of a flip level, the idea of doing silly exercises and at the same time being able to justify them with an end result for educational purposes is very enjoyable. I wish I could do more of them.... this is an interesting exercise I can spend eight hours on it.'*

While Raoul may well have liked to spend eight hours doing a single exercise, he was time constrained to 2 minutes for each one, a constraint which produced a variety of responses; *'Oh, damn, it's gone again LOL, really...two minutes already!... Funny what happens when time constraint is introduced..... all the clever stuff that I think of at 4am disappears and I'm floundering.'* Over the course of the experience he began to understand the impact of the time constraints; *'if I paid any attention to the clock at all I became too obsessed with the clock ticking and as we got closer to the time limit I got more panicky and unable to think if anything or double thinking or just putting down things because you can see the clock ticking... if I pay no attention to the clock ticking, then I just let it flow and I didn't care when the time ran out.'* When questioned more deeply about his responses to the time limit he highlighted a correlation between time fixation and the difficulty of an individual exercises; *'if something came up that I felt was a real curve ball for whatever reason and I looked at it and thought, that's ridiculous...I'm not doing this one, you know what I mean.'* Summarizing his experience of time constraint over the experience Raoul reflected; *'I think my emotional response to the time limit changed. At the beginning it was surprise, that moved to frustration and that moved to downright anger...and take a hammer and smash the computer, I hate the world...really intense sort*

of annoyance about it, too well sort of cue la vie and then going back to the level of oh, surprise, the two minutes is gone again.'

Proposition: Having a visible timer negatively impacted Raoul's ability to focus on responses.

Raoul felt that the environment in which he undertook the exercises had little or no impact on his experience and although he used the same place each time, a place which he has positive feelings about - *I'm actually quite happy to be in that room, I have good vibes about that house, and I feel good about that house* – his precise description of the room tells a somewhat different story; *'Rectangular box, large window at one end, north facing, em, fireplace, em, pseudo Georgian bookcases each side of the fireplaces, awful couch and two armchairs that will eventually go to the skip, a little work station made of this kind of material in a corner, very incongruously put on it, wrong location, wrong thing, wrong everything, I mean the computer looks strange in the room you feel you're tucked behind the door when you're using it, you feel in a very cramped space.'* When asked to provide a description of a room in which he thinks he would perform best in, he says; *'A big space, dark wood or polished reclaimed red brick floors, white walls, quite high, a wall of floor to ceiling glass, very loft like space, very floaty furniture, em, (minimalist?). The space is minimalist but the things in it are not. There is a mixture of furniture, it just has to be floaty, I mean there would be some nice Georgian furniture in it but Georgian furniture is very floaty.'*

Proposition: Providing a bright, open and airy space may have afforded Raoul with a greater opportunity to benefit from using the resource.

Providing a suitable space to perform may well have enhanced Raoul's experience, the provision of extrinsic motivation would not; *if I thought it would involve a grade it would have made it worse...if I thought I had to do it, I think I would have become more and more resentful and I would have hated the entire process... I think it would have been a negative in terms of potential grade.'* Raoul is not motivated by external factors; *'so the motivation for me was that I was just curious and eh, am I going to do any better....It was all about me and that's always a good motivation for me.'* While intrinsic motivation is extremely important for Raoul, contact with other people is a significant catalyst for raising his motivational spirits; *'by the time she [Mary] gets home in the evening she is thoroughly exhausted...but sometimes she gets home and is feeling quite energised and then she is very excited and very interactive and it's; what are you doing, why are you doing it, show me what you are doing, show me what you are doing, how does that work, why does that work, why don't you try that and it's like ten hours of energizing...It's like a total top up of the battery in about six minutes.'* Mary provides Raoul with more than a simple battery boost, she quells his self-criticism, his doubts and boosts his confidence; *'it's almost like I feel confident to try things...so I can stand back from that and throw it away and start again.'*

Proposition: Having somebody to share the experience with has a positive impact on Raoul's experience.

The idea of sharing and interacting with people is a frequently occurring theme with Raoul; *I actually spend a huge amount of my time alone and I find I can see myself and feel myself unwinding, not in a, and I don't mean in a positive sense, relaxing or becoming more calm. So then I can be wound up very quickly again just by simple interaction.'*

If there was anything that could be used to enhance his experience of the resource it would involve social interaction; *'if you had said there is an option of spending your Saturday mornings interacting with people on a Saturday morning to chat about things over coffee that would have been a huge motivation... it was the sort of thing that I felt that I would enjoy doing in a group situation with people... a dynamic situation with people sitting around a table or sitting on chairs, sort of a charades type of game ...that's the way I like to be, that sort of human interaction.'*

Proposition: Having a social element to the resource would have significantly increased Raoul's motivational levels.

The provision of a future social interaction could well have helped to keep Raoul motivated while undertaking exercises, but being mentally prepared could have improved his performance. And although he felt that he didn't undertake and preparation, and wasn't sure what sort of preparation he could have undertaken, he frequently made reference to the importance of preparation elsewhere; *imp beginning to think I need to prepare for these tests, up till now I have approached them blind to see how I respond in the moment... I like leading time, I don't like the starter gun anymore you know...before you do the exercises, do things that you are confident doing, and comfortable with, things that make you feel good. I don't care if that's going for a walk, having a bubble bath, watching csi Miami...what's important is that it makes you feel good, comfortable and confident.'* When questioned more deeply about the nature of activities which he felt would be conducive to the resource he highlighted physical activity ; *'So I had been...say cooking or I had been looking at art or gardening books or I had been at the drawing board or whatever as opposed to watching the news. I tend to get quite agitated watching the news, angry about things so therefore, or if I'd been sitting at the computer reading a newspaper and then decided to switch over to divURGE, it didn't do anything for me at all.'* As to how he felt this would positively impact upon his experience with the resource he said; *I always feel better after walking the dogs (link to positive impacts of natural landscape views). So there is an element of that physical activity maybe draining that extra tension away or something like that. And certainly I always feel very relaxed after cooking. That's always a good time for me to do anything... it isn't so much that it's a focusing activity, it's that it's a calming activity; I mean relaxing activity you know...so I don't know if it's washing stuff out of my system so I'm calm.'*

Proposition: Undertaking preparation activities which stimulate feelings of calmness and comfort significantly increased Raoul's ability to engage with the resource.

Raoul completed all of the resource activities with a feeling that online learning doesn't suit him, that he could think more divergently in a non-computer environment and that the experience did not increase his DT abilities.

He scored 40 in his post test which was an increase from his pre-test score of 31. Although not robust the score does indicate a small but not insignificant enhancement.

Appendix N: Tabulated cross case data summary

Case	Emergent proposition	Human focused	Resource Focused	Context Focused	Enhancement	Attitude Perception	Skill	Confidence	Time	Support	Preparation	Sharing	Physical environment	Background
Mark	Proposition 1; Marks experience with divURGE appeared to enhance his DT ability	x	x	x										
	Proposition 2: Mark's perceived lack of typing skills presented him with a barrier to participate	x												
	Proposition 3: Mark's low confidence inhibits his ability to engage with the resource	x												
	Proposition 4: Being able to share the divURGE experience was integral to Mark's experience	x			x									
	Proposition 5; The provision of completed examples helped Mark to overcome his lack of confidence			x										
	Proposition 6; Time constraints and a visible timer focused Mark's attention in divURGE			x										
	Proposition 7; A low level of confidence produced negative emotions in Mark but also allowed him to experience the joy of triumph while using	x												

	divURGE														
	Proposition 8: Mark's experience with divURGE enabled him to reconnect with what he felt was his natural way of thinking.	x													
	Proposition 9: Marks experience with divURGE provided him with a new way of thinking that he can engage when needed	x													
	Proposition 10: Mark's level of engagement with divURGE was increased because of our relationship	x		x											
Case	Emergent proposition	Human focused	Resource Focused	Context Focused	Enhancement	Attitude Perception	Skill	Confidence	Time	Support	Preparation	Sharing	Physical environment	Background	
Patrick	Proposition 1: The interplay of confidence, relatively low levels of conscientiousness and the nature of the resource inhibited Patrick's motivation to engage with it.	x													
	Proposition 2. Patrick's immediate physical and social environment is integral to his ability to engage with divURGE.			x											
	Proposition 3: Mental preparedness is important to Patrick's success using divURGE	x		x											

	Proposition 8: DivURGE did not appear to enhance Patrick's DT ability but did appear to provide him with a valuable ideational strategy.	x	x	x										
	Proposition 5: Structured reflection activities in association with the ability to review answers afforded Patrick the opportunity to gain greater insight into his ideational processes.	x		x										
	Proposition 6: Humour was an important ideational strategy for Patrick when using divURGE	x												
	Proposition 7: Upbringing significantly impacted Patrick's ideational processes while using divURGE.			x										
	Proposition 4: Having a visible time counter plays a significant role in Patricks experience		x											
Case	Emergent proposition	Human focused	Resource Focused	Context Focused	Enhancement	Attitude Perception	Skill	Confidence	Time	Support	Preparation	Sharing	Physical environment	Background
Raoul	Proposition 1: Raoul's negative perception of	x												

computers significantly limited his ability to engage with the experience														
Proposition 2: Raoul's perceived low level of typing skills represented a physical and mental limiting factor	x													
Proposition 2: Having a visible timer negatively impacted Raoul's ability to focus on responses.		x												
Proposition 3: The nature of DT exercises mitigated some of the negative aspects of Raoul's experience	x	x												
Proposition 4: Raoul's experience could have been enhanced by providing a more open space to undertake exercises			x											
Proposition 5: Having somebody to share the experience with has a positive impact on Raoul's experience.			x											

Proposition 6: Affording Raoul the opportunity to verbally dialogue with other participants may have significantly enhanced his experience			x											
Proposition 7: Undertaking preparation activities which stimulate feelings of calmness and comfort significantly increased Raoul's ability to engage with the resource.			x											
Proposition 8 : Raoul's experience with the resource may have marginally enhanced his DT ability.	x	x	x											