ICT design and users' affect, cognition and creativity

Author: Minavere Bardici

Autumn 09

Supervisor: Rikard Lilijenfors

Examinator: Per Eisele

Abstract

This study set out to investigate how ICT design relates to users' affect, cognition and creativity in task performance. More specifically, the intent is to highlight how ICT design can elicit positive effective states and enhance cognitive abilities, including creative thinking in task activity within distance learning. In addition to this is to emphasize the synergies between ICT design, affect, cognition, and creativity from as well theoretical as empirical perspectives. To achieve the objective of this study, a qualitative empirical method was used. A survey questionnaire was chosen as a collection data technique. As far as analysis is concerned, phenomenology analytic strategy was espoused to explore how the participants perceive the phenomenon under inquiry. As for theory, central themes were selected for review given the synergy between them and their implication for the topic. They include: ICT; design; ICT design aspects: aesthetics, functionality, and usability; affect and cognition; and creativity; as well as the synergies between these concepts. Key findings highlight the role of affective quality of ICT design aesthetics in eliciting positive affective states among users when they acquire and use new ICT products or services regardless of their motivational needs. Most users consider aesthetics, usability, and functionality as design aspects but they tend to differ in ranking them depending on how they emotionally perceive them. Simplicity in ICT design is perceived as pleasurable aesthetic value. Further, natural colors are favored most by ICT users and positively affect their emotions so do the other aesthetical features associated with computers, software graphics, and web design. Using ICT inspire users creativity in task performance through what design affective qualities induce as positive affect in them in addition to software usability and functionality depending on the user. There are some synergies between design aesthetics, affect, cognition, and creativity. Moreover, ICT design can, depending on additional factors, ease and help users' to carry out complex task and if software applications are skillfully used, they can help stimulate users' creativity in task performance because of the built-in capabilities that are intended to enhance cognitive and emotional abilities of users. In addition, users differ on the elements they focus on when interacting with ICT depending on their inclination. Human attentional capacity and intensity can play a role in creativity. Crystallization of creativity can be triggered when various ICT design elements are perceived in a useful way.

Introduction

ICT have a strong effect on our lives and permeate our modern society. They are ubiquitously embedded in our environment and massively used in our daily life. With an increasing research interest in the relationship between cognitive psychology and ICT design and use, a new paradigm shift in ICT design has emerged aiming at empowering users and providing them with different services to better meet their cognitive, emotional, and social needs. This new direction of ICT design research necessitates deep knowledge in cognitive psychology in order to design cognitively and emotionally intelligent systems to enhance user interaction experience. It is recognized that ICT design that can touch humans in holistic ways is fundamental in ensuring a satisfying user interaction experience (Zhang, 2009). Studies in ICT design has gone through a number of milestones including the emphases on functionality, usability, and recently aesthetic and emotional computing. However, high quality of design aesthetics (pleasantness) can profoundly influence people's core affect through evoking positive affective states, such as satisfaction, gratification, and sensuous delight. Such affective states can profoundly influence cognitive processes (Schwarz and Clore, 1996) which are rarely free from affect (Scherer, 1993). According to Norman, (2002), the pleasure derivable from attractive artifacts with high aesthetic qualities increases positive emotions, which broadens thinking processes. In line with that, the ability of artifacts to trigger and mediate emotions can aid individual cognition during interaction with aesthetics (Hekkert, 2004). Therefore, emotion can be captured as a design means for developing successful ICT products or services. The sensory aspects of humans should be taken into consideration in all forms of design (Loewy, 1951).

The combination of design aesthetics, functionality, and usability features along with considering human emotional and cognitive aspects has led to a new class of intelligent ICT that can improve cognitive abilities of the user, including analyzing, conceiving, decision making, and creativity in task activity. Cognitive approach to creativity aims to understand the mental processes underlying creative thought as creative productions consist of novel combinations of preexisting mental representations (Sternberg, 1999). Further, emotions may affect the cognitive patterns in that they broaden thinking and also stimulate creativity. Positive affect broadens the thought processes, especially when the problem is best addressed through creative thinking (Norman, 2002). The affective signals impact on the way we perceive and react through changing the parameters of thought, adjusting such things as whether reason is primarily creative (Ibid).

The aim of this study is to investigate the users' experience of ICT design (aesthetics, usability, and functionality), in particular how ICT design can impact on their affect as well as their cognition and creativity in task performance in distance learning. Although, a number of studies have been carried out in recent years investigating the relationship between ICT design and affect (e.g. see Zhang, 2005; Norman, 2004), very little attention has been given to the relationship between ICT design and use and affect and cognition. Some studies approach the subject of users' affect and ICT design (Zhang, 2009) but mostly address theoretical issues leaving out other interesting empirical matters such as those addressed in this study. No studies focus directly on ICT design, affect, cognition, and creativity in distance learning. Thus, the topic of this thesis is a significant research area that merits further focus and investigation within the sphere of cognitive psychology and ICT. Indeed, there is increasing evidence that entrenching cognitive and emotional capabilities in ICT design is a significant element in order to enhance users' task performance and creativity. This deserves more attention, thus the motivation behind this thesis.

Research Purpose

This study sets out to investigate the relationship between ICT design (aesthetics, usability, and functionality) and users' affect on one hand and their cognition and creativity in task performance, on the other hand. More specifically, the intent is to highlight how ICT design can elicit positive effective states and enhance cognitive abilities, including creativity in task activity among users' (students of Master of informatics) in distance learning. In addition to this is to emphasize the synergies between ICT design, affect, cognition, and creativity.

Theoretical background

The intent of the literature background is to establish a theoretical foundation for this research study to which extensive knowledge of the literature is essential. The author reviews earlier and current studies and theories in relation to the research question she intends to answer. The basic theoretical constructs that make up this research study are: ICT and related design; cognition and emotion; and creativity. These concepts are selected as central themes for review given the synergy between them as well as the implications for the topic under examination. After discussing key definitions, the author begins with a discussion of the related literature scholarship in terms of the relationship between these concepts from a

broad perspective and then focuses more and more on specific studies associated with research question at hand.

Concepts definitions

Information and Communication Technologies (ICT)

Generically, ICT encompass all forms of technologies used to handle information and aid its communication in a digital format. Handling information basically covers processes as creation, acquisition, storage, retrieval, exchange, dissemination, etc. ICT consist of a wide variety of hardware and software technologies. For the scope of this study, hardware includes devices as: desktops, laptops, communication systems and so forth while software is concerned with: applications and services, such as e–learning, SPSS, Microsoft Office, Marrakech, videoconferencing, social e–communities, etc. ICT is an umbrella term for information technology (IT) and communication technology and commonly assumed to be synonymous with IT. IT is often used to refer to all of computing, that is, any goal–oriented activity requiring or creating computers; it thus includes designing and building hardware and software systems for a wide range of purposes; processing, structuring, gathering and managing information; making computer systems behave intelligently; creating and using communication systems; and so on (Association Computing Machinery, 2006). Communication technology is, on the other hand, concerned with the activity of designing and maintaining communication systems that are used to facilitate virtual communication between individuals or groups.

Design: general and ICT perspectives

From a broader perspective, the scholarly literature on design is as diverse as its wide applicability in several fields, including ICT design, graphic design, industrial design, etc. Walsh (1996) and Roy and Potter (1993) point out that the meaning of design is a confusing one, not in the least because the term "design" tends to cover different kinds of design activities. This apparent lack of uniformity in the definition of design reflects in part the different perspectives on the function of design along with the contribution of designers (Walsh, 1996; Gemser, 1999; Walsh et al., 1992). Design is about what designers intend to create or solve with what method in a given design process. Generally, design refers to a creative problem solving process or activity to produce products and services to fulfill different needs. Conklin (2001, p. 15) states: "any design problem is a problem of resolving tension between what is needed and what can be done." Design is the area of experience,

knowledge, and ability of humans to adapt the external environment to their needs. The premise of design is to enhance utility of artifacts such as laptop, software applications, and communication systems functionality, aesthetically, and usability wise. This is relevant to the topic under investigation. Design can be characterized as context aware (using cognitive, emotional, and social interdependencies); illustrative (creating wholes and contexts); and user–oriented (taking quality of life as its own criterion, without claiming what this is) (Wolfgang, 2001).

In the context of ICT, design is a science as it derives from both engineering science and applied science. Design science is "an inventive or creative, problem solving activity, one in which new technologies [i.e. laptops, software applications, communication systems], are the primary products." (Venable, 2006) Design in ICT often refers to a broad set of activities in the product design development. ICT design entails a wide variety of aspects, including cognitive, emotional, social, etc. The main purpose of ICT design is to increase utility through combining aesthetics, functionality, and usability dimensions. This can be an intricate task as it is associated with different users needs.

Drawing on various sources of literature review, approaches into ICT design are numerous, including user–centered design, participatory, integrated design methods, etc. For the purpose of this thesis, the focus is on user–centered design (UCD). Generally, UCD is a design philosophy that focuses on users and system use as it involves dealing directly with different specific users (i.e. students, researchers). The premise of UCD approach is to facilitate how users can perform their task activities as well as how ICT can be effectively suited to their actual learning or work practices. ICT design based on UCD philosophy should take into consideration users' emotion and cognition for better task performance outcomes. For example, in software applications, friendly and multimodal graphical user interface (GUI) improves interaction between users and systems. Goguen (1999) contend that implicit values can be found in the designs of ICT and that these values can be uncovered by techniques analogous to those used in the study of literature, such as determining what is important by examining placement, color, size, ease of access, etc.

ICT Design aspects: aesthetics, functionality, and usability

For the purpose of this study, there are three design aspects to consider: aesthetics, functionality and usability. In this context, the aesthtics is associated with affective states while functionality and usability are concerned with cognitive states in user task perfromance. The term aesthetics is sometimes used to describe a sense of pleasure, although

it is realized that its meaning is much broader including any sensual perceptions (Wasserman et al. 2000). According to Hekkert (2004), aesthetics is indeed sensory perception and understanding of sensuous information. The concept is applied to any aspect of the experience of design, such as aesthetic judgment, aesthetic attitude, aesthetic understanding, aesthetic emotion, and aesthetic value (Ibid). Lavie and Tractinsky conduct a investigation of different approaches to studying aesthetics including studies in human computer interaction (HCI) (Lavie et al., 2004) that have taken different notations of aesthetics (Udsen et al., 2005). Drawing on a variety of literature sources, one of the contentious debated issues in aesthetics studies in general and in the ICT design in particular is objectivity versus subjectivity. The objectivity view denotes that artifact in one's environment must have certain features to reveal its inherent aesthetic quality and that these attributes exist regardless of whether they are perceived by or agreed upon among people (Zhang, 2009). The subjectivity view is that, according to Dewey (1987), aesthetics is appropriated by perceivers in their own social and cultural standard as being aesthetic. That is, the same aesthetic quality of an artifact may have a different effect on different people. These two views have been considered in this study. Further to this point, several related concepts are developed to indicate the explicit meanings of subjectivity, such as "aesthetic perception" (Tractinsky et al., 2006), "perceived visual aesthetics" (Lavie et al., 2004), "perceived visual attractiveness" (Fernandes et al., 2003; Lindgaard et al., 2006), "hedonic quality" (Mundorf et al., 1993), and experienced ICT design aesthetics.

Functionality is a self explanatory term and, in ICT, refers to the ability to perform a task or function, for example, software with greater functionality is one that is capable of serving a purpose well or can provide functions which meet stated and implied needs as intended by its user. On the other hand, the term usability is concerned with the ease with which a user interface can be used by its intended users to achieve defined goals. In this context, usability is used to denote the ease with which a user can employ a PC or software in order to achieve learning goals in distance studies. In software technology, usability refers to the capability of the software to be understood, learned, used and attractive to the user under specified conditions. Usability of technology has been extensively researched in recent years by Nielsen, (1993), Norman, (1988), Botman, (1996), Davis, (1993), Hix and Hartson (1993), and Somervell et al. (2003) . ISO 9241-11 (1998) suggests measuring usability on three levels: effectiveness (i.e. information retrieval task), efficiency (i.e. usefulness of time taken to do tasks), and satisfaction (fulfillment of user's needs).

Cognition and affect

Generally, cognition refers to the essential cognitive processes (sensation, perception, problem solving, attention, motivation, emotion, etc.) associated with conscious or sub-conscious process of learning, thinking, and knowing. These processes are analyzed from various perspectives within different disciplines such as psychology, neurology, artificial intelligence, and computer science. Since the emphasis is on psychology in this study, cognition is concerned with the mental functions and processes such as reasoning, decision-making, judging, analyzing, learning, comprehending, etc. Affect is, on the other hand, an umbrella term for several related but different concepts and usually represents mood, emotion, and feeling. Hence, affect and emotion may be used interchangeably in this study. However, recent theoretical development in psychology by Russell (2003) has made great progress in defining a number of important affective concepts. Here the author introduces the ones necessary for the theoretical reasoning and empirical investigation.

Core affect is defined as a neuro-physiological state that is consciously accessible as a simple, non-reflective feeling (Russell 2003). Affective quality is a stimulus' ability (of an artefact) to cause a change in core affect (Ibid). Perception of affective quality is an individual's perception of an object's ability to change his or her core affect (Ibid). It is a cognitive perceptual process that estimates the affective quality of an artefact (i.e. laptop, software application). This term is also referred to as evaluation, affective judgment, and affective reaction, and it is considered a ubiquitous process (Cacioppo et al., 1999; Russell 2003; Zajonc 1980). From the perspective of studying human computer interaction (HCI), the focus is on the connection between a user's affect and the affect-eliciting quality of ICT artefacts. Perception of affective quality is a construct that makes such a connection (Zhang et al. 2004). Emotions are feeling or induced affective states that involve a pattern of cognitive, physiological and behavioural reactions to events (Galotti, 2004) or important stimuli in one's environment. Scherer (1993) describes emotion as a sequence of five state changes in: the cognitive system (appraisal), the autonomic nervous system (arousal), the motor system (expression), the motivational system (action tendencies), and the monitor system (feeling) occurring in an interdependent and interrelated fashion in response to the evaluation of a stimulus, as being of central importance to the major needs and goals of the organism. Emotions tend to be subjective experienced feelings relating to such factors as personality, mood, and environment. An emotional state is usually a transient state of mind that dynamically change based on several contextual factors. Emotions can be classified into two–tier taxonomy, from positive to negative along a quality scale (valence or hedonic tone) and

from inward to outward along a scale of activity (Yied and Mackintosh, 2005). For instance, depression combines passive, negative emotional state while resentment combines active, negative state.

Creativity

Creativity can be defined in multiple ways based on contradictory or complementary perspectives. Here the author introduces different definitional implications relevant to the empirical investigation and theoretical reasoning. In general terms, creativity involves the ability and thinking that aims to produce work or ideas that are original and appropriate (Lubart, 1994; Sternberg, 1988). Creativity involves the creation of something new and useful (Bean, 1992; Mumford, 2003; Andreasen, 2005; Flaherty, 2005). Gedo (1983) contends that creativity is a path to pursue and achieve higher human needs such as quest to understand the external environment. Creativity research is widespread in most psychological fields.

Creativity is increasingly gaining attention among psychology scholars. As a phenomenon, creativity is indeed burgeoning into a major topic in the study of cognitive psychology. There are studies in cognitive psychology that try to discover the process of creative thinking regarding whether it can be or not delineated. In the same vein, Wallas (1926) suggest a creative process that involves preparation, incubation, illumination and verification. Similarly, Plsek (1997) proposes the "directed- creativity cycle" composed of observation, analysis, generation, harvesting, enhancement, evaluation, implementation, and living with it. Indeed, the focus in this study is on creativity from a cognitive perspective as related to users' task performance in the context of the interaction and use of ICT.

Synergies between concepts

In this section, the author intends to describe and discuss the relationship between the abovementioned concepts aiming to draw a consistent picture of the phenomenon under investigation. This is intended to lead to the main research question in this study. To establish the synergies between the central themes (ICT design, affect, cognition and creativity) that constitute this study, the author follows a pattern to emphasize the subjects needed to be theoretically researched to inform the ground for empirical investigation in an attempt to ultimately achieve the aim of this study. It is worth noting to realize that these relationships are highlighted based on their relevance to this study.

Affect and cognition

Affect and cognition are two psychological processes that affect one another in a two way stage. These two information processing systems have different functions and operating parameters: the affective system is judgmental, assigning positive and negative valence to the environment rapidly while the cognitive system interprets and makes sense of the world (Norman, 2002). Affective states are driven by cognition which is in turn impacted by emotions (Norman, 2002). Cognitive processes are rarely free from affect and hence are powerfully influenced by emotions (Scherer, 1993; Schwarz and Clore, 1996; Forgas, 1995). The thoughts processes can't act solely on mental elements nor can emotions on affective elements. In the cognitive perspective, emotions require thought, and the perception of an event leads to an appraisal, which in turn leads to an emotion (Cornelius, 1996).

In addition, individuals are more likely to evoke knowledge that is congruent rather than incongruent with their current feelings (Bower, 1981). Explicitly, individuals in a negative emotional state tend to use bottom-up process, which is characterized by relatively low trust in the preexisting knowledge and an increased focus on features and external information (Schwarz, 1990; Soldat and Sinclair, 2001). While individuals who are in a happy mood are more likely to adopt a heuristic processing strategy that is characterized by high reliance on pre-existing knowledge structures (Schwarz, 2000). This process is characterized by the so called top-down process to identify things in the environment consistent with existing knowledge and concepts stored in long-term memory (Ibid).

ICT design, affect and cognition

As previously mentioned, this study is concerned with three design aspects of ICT, including aesthetics, functionality, and usability. In this section, the intent is to discuss the relationship between design from these three perspectives and affect and cognition at different levels as they relate to the research question. Aesthetics is concerned with the perceived knowledge triggered by the affective qualities (beauty, attractiveness) of an artifact. According to Hekkert (2004), only part of the full experience of sensing artifacts should be considered aesthetics, i.e. pleasurable to the senses; and the rest of the experience deals with faculties of the human mind, i.e. affect and cognition. As a human experience, design aesthetics involves such processes as sensation, perception, attention, emotion, motivation, etc. Since our emotional experience of artifacts can well be explained by an appraisal process (Desmet & Hekkert 2002), understanding this process holds a key to designing for emotion (Hekkert 2004). The sensory aspects of human being should be taken into consideration in all

forms of design (Loewy, 1951). This implies that both affective and cognitive criteria should be considered when designing artifacts (i.e. ICT) in order to sensuously gratify users mind. To better understand the specific qualities of individual experience effecting pleasure, it is necessary to understand how artifacts trigger and mediate emotions and how these processes aid individual cognition during interaction with aesthetics (Ibid). As far as colors are concerned in aesthetics, Norman (2002) states: 'although my reasoning told me that color was unimportant, my emotional reaction told me otherwise'. Like all aesthetical elements associated with design aesthetics, colors do trigger emotions that affect the cognition process. This obviously depends on each individual's preferences and visual perceptions.

Affective and cognitive states are dynamically influenced by design aesthetics, functionality and usability aspects depending on how they are perceived by individuals. Reliance on artifacts may trigger and elicit cognitive artifacts (functionality) to extend sense-making abilities (Hekkert 2004). Emotion acts as a critical component of sense making of artifact and determines how artifacts are interpreted (Rafaeli and Vilnai-Yavetz, 2003) in terms of aesthetics, functionality, and usability qualities. As functionality is about providing functions which meet stated and implied needs as intended by its user, it must relate to users' affect which in turn impact their cognition. For what it embodies - the ease with which a user can employ an artifact (i.e. software application) and the capability of that artifact to be understood, learned, used and attractive to the user as well as effectiveness, efficiency and satisfaction - usability is typically linked to users' affect and cognition, that is it affect emotion when perceived as aesthetical quality and affect cognition when interpreted as functional quality (efficiency and effectiveness).

Creativity, cognition and emotion

Cognitive approach to creativity aims to understand the mental representations and processes underlying creative thought (Stenberg, 1999). The process of creative cognition entails typical patterns of how the mental and effective processes dynamically interrelate in the brain to generate creative ideas when an individual interacts with the external environment (i.e. laptop, software application). In addition, creative cognition acknowledges that a range of factors other than cognitive processes contribute to the likelihood of any individual generating a tangible creative product (Wilkenfeld, 1995). Such factors generally include: intrinsic motivation, situational contingency, experience, knowledge, etc.

Creativity consists of making new combinations of associative elements (Poincare, 1913). It is of reason that creative performance is manifest by how original, useful a combination can be. Creative productions consist of novel combinations of preexisting mental elements (Stenberg, 1999). Producing even simple combinations could be labeled creative (Ibid). The generative power of conceptual combinations must originate from how delicately people can use their tacit knowledge and the easiness of how they form novel mental representations. In addition, Mendelsohn (1976) suggests that individuals differ in creativity because of the focus of attention: "The greater the attentional capacity, the more likely the combinational leap which is generally described as the hallmark of creativity." A set of elements need to be simultaneously present in the focus of attention so combinations and analogies can be discovered. The creative act involves the discovery of an analogy between two or more images previously thought to be unrelated which emerges as a sudden insight (Sternberg, 1999). Consistent with that, crystallization of creativity and mental regeneration are most likely triggered when various conflicting elements are perceived in an associatively useful way. Sternberg, (1999) argues that creative inspiration occurs in a mental state where thought is associative and a large number of mental representations are simultaneously active. Various studies suggest that positive emotions increase cognitive flexibility and reduce endurance, leading to unusual associations (Isen et al., 1985). In the context of ICT, users' creativity in task performance can well be stimulated by affective qualities stemming from an amalgamation of ICT design features, such as aesthetics, functionality, and usability as users can immerse in associative thinking when interacting with ICT artifacts.

Fredrickson (2001) suggests that positive affects have the effect of broadening the thought action repertoire and of building cognitive resources while negative emotions narrow the individual's thought repertoire. In line with that, the affective signals change the way we perceive and react through changing the parameters of thought, adjusting such things as whether reason is primarily creative (Norman, 2002). Further to this point, emotions can be responsively evoked as a result of gratification accompanying creative cognitive states, i.e. in task performance (that involve reasoning, analyzing, writing) through an appraisal that involves the perception of the related event.

In the study of how emotions can affect creativity, three broad lines of research can be distinguished (Baas et al., 2008): (1) the correlation between positive and neutral emotional states; (2) the correlation between negative and neutral emotional states; and (3) the correlation between positive and negative emotional states. Drawing on the latter, pleasure

derivable from the appearance of artifacts increases positive affect which broaden creativity (Norman, 2002). In contrast, negative emotional states have no leverage effect on creative performance (Kaufmann and Vosburg, 1997). These authors also demonstrate that positive affective states can lead to better results in early phase of idea generation and negative results at subsequent idea generation. In terms of problem solving, individuals who find themselves in positive emotional states generate greater number of potential solutions than those in the negative condition (Martin et al., 1993). According to Norman (2002), emotion regulates how we solve problems and perform tasks and hence positive affect can make it easier to do difficult tasks. On the creativity side of the ledger, positive affect broadens the thought processes, especially when the problem is best addressed through creative thinking (Ibid). In connection to this study, affect can impact upon users' cognitive process of problem solving, in particular when tackling complex tasks (i.e. demanding assignments).

Research Question

The above reasoning drawn from theoretical and empirical studies leads to the main research question. And as this study is concerned with phenomenological method, research question is to be framed openly and broadly. This is to explore flexibly the area of research. That said the author set out to answer the following question:

How does ICT design relate to users' affect and to their cognition and creativity in task performance?

Method

Qualitative Method

To achieve the aim of this study, the author used qualitative research method. This is motivated by the fact that there is currently an increased attention in qualitative psychology. As Jonathan (2003) argues, there is a significant shift in a discipline which has hitherto highlighted the significance of quantitative methodology in psychology. Generally, qualitative research is concerned with the interpretative (descriptive) paradigm that focuses on investigating the complexity, contextualization, shared subjectivity of the researcher and the studied subject (in this case ICT user). In this study, with the qualitative approach, the author aimed to accurately describe, understand, and interpret the meanings of personal and social experiences of ICT users (participants) with regard to the phenomenon under investigation. The assumption is that psychology has to dip as much as possible into the subjective world of the participant while realizing that the means of capturing that world on the part of the

researcher is inter-subjective if not objective (Ibid), 2003). Although qualitative method has its own weaknesses, it is deemed sound in the psychology research sphere. Indeed, qualitative approach provides a holistic view of the phenomena under investigation (Bogdan and Taylor, 1975; Patton, 1980) and an ability to interact with the research subjects in their own language and on their own terms (Kirk and Miller, 1986) - within naturalistic settings. In addition, this method provides flexible ways to perform data collection, subsequent analysis, and interpretation of collected information. In this study, the data collection technique used was in the form of naturalistic verbal report through written accounts – online survey questionnaire. The analysis was, in this case, involved with the textual interpretation of the meaning of postgraduate distance learning students' experiences as ICT users, which was conveyed through relatively detailed narrative reports of participants' perceptions and understanding of the phenomenon under examination.

Selection of participants (purposive sampling)

To achieve the qualitative representation, a so–called hand-picked selection (Langemar, 2008) was applied. The author proceeded with representative rather than random sampling. The intent of purposive sampling is generally to find a more closely defined group for whom the research question will be significant. Therefore the author selected distance learning students of the Master of informatics at BTH as the target of the investigation given their acquaintance and knowledge about the use of ICT and its role in their daily study tasks. As for the specificity of the sampling, the sample of the participants surveyed was based on three criteria: participants would have at least one year of experience in distance learning (students from either 2007 or 2008 classes) and been active in e–learning platform and from Master level (informatics). One always need to be pragmatic when doing research; one's sample will in part be defined by who of the participants is prepared to be included in it (Jonathan, 2003). All in all, these students are more likely to be familiar with and more or less knowledgeable about ICT design as well as its use as a tool of learning and communication in both learning and social setting. This was intended to minimize the variation in students' experience of ICT use. For another blatant reason, this is to collect a fair amount of data about the phenomenon under investigation. Targeting students of the Master of informatics came naturally into play because the author assumed that such level of education in informatics must be associated with certain awareness developed by the researched subjects as to the potential impact of ICT design and use on their affect as well as on their cognitive and creativity in task performance.

Selection of survey

Generally, a qualitative method involves flexibility in data collection as regards to the selection of available techniques. Moreover, in qualitative method participants can better reflect and expand on their experiences, views, and suggestions. Indeed, a survey technique gives an opportunity to get a greater variation in understanding and perceptions of participants of the experienced phenomenon, thus the motivation behind its selection in this study. A key aim of using the survey questionnaire was to understand and get a clearer picture of the topic under review as well as to create an instrument to identify the appropriate subjects for this study and thus garner a greater quantity of data. Given the fact that all participants are distant learning students and familiar with ICT as an enabler of virtual communication, it was expedient to correspond by means of email using online survey questionnaire. As a matter of fact, it wasn't strenuous to find the right subjects for this study. Additionally, survey via email is regarded very useful because specific data can be obtained within a very short time through access to updated information and personal experiences communicated in a descriptive way. The alleged advantage of the questionnaire, which is in many cases, like the structured interview is control, reliability (the same format was used with all respondents) and speed (Jonathan, 2003). Besides, online survey questionnaire can more easily reach the group to go through the Internet.

Survey questionnaire process

Survey questionnaire was the primary data source for this thesis. It was emailed out to distant learning students of the Master of informatics to ask their views as ICT's users about how ICT design relate to their affects as well as to their cognitive and creativity in task performance. The survey was divided into three sets of questions in such a way to answer the research question. It contains 13 questions (see Appendix) that were formulated to cover the data sought to be garnered for the research study. The first set contains one general question whereby students could descriptively share their experiences of distance learning and the role of ICT in it. The intent here was basically to get them disclose their thoughts, feelings, benefits and outcomes pertaining to the experience in question. The second set covers six questions that concern how ICT design relate to users' affect from a general perspective. The third set includes six questions which hinge upon how ICT design affect users' cognitive and creativity in task performance. The questions were structured away from assumptions of technical proficiency so that participants not familiar with psychology and creativity could easily navigate. With redrafting the survey questionnaire, the author made sure the questions

are less loaded but sufficient to let the participants know what the area of interest is and recognize that they have something to say about it. Also, if one or more questions are too general or vague, the author resorted to constructing prompts that are framed more explicitly or infusing examples inside the text to clarify the meaning. In the survey, open questions were used in order for participants to better open up about their thoughts as well as to reflect the degree of support for each of their views and suggestions.

The overall purpose of this survey was to acquire data to complement and validate the results collected from the literature survey and gain a practical understanding of the topic aiming to ultimately answer the research question. The results from the survey were analyzed to discuss the findings and draw conclusions. They are based on a final total of three individual cases that were assessed as richer and more relevant in terms of data collected regarding the participants' experiences. The survey process was critical to the collection of first-hand data. Nevertheless, it is important to acknowledge the potential bias that surveys generally possess. The specificity of the survey bias can be found in the discussion section.

Phenomenology analysis approach

Generally, there are various approaches into data analysis with regard to qualitative psychology research. General approaches include: phenomenology and interpretive phenomenological analysis; grounded theory; discourse and conversation analysis; etc. In this study, the author chose to work with phenomenology analytic strategy. However, choosing a particular method cannot be fully justified (Jonathan, 2003). This analysis approach is concerned with exploring the life world of participants or with understanding how they make sense of their personal and social world (Ibid). The purpose of using this approach is to clarify how participants' situations are lived with regard to the use of ICT, rather than attempting to reduce the phenomenon being studied to a convenient number of identifiable variables. In other words, the intent is to capture as closely as possible the way in which the related phenomenon is experienced within the context of distance learning. However, according to Husserl (1913/1983), phenomenology entails starting with the problem of how events appear to consciousness since nothing could be even communicated verbally or nonverbally if it didn't come through someone consciousness. In this context, the consciousness involves awareness as well as preconscious and unconscious processes. This phenomenological psychological analysis approach aims to clarify experiences lived through by ICT users (studied subjects) in a distance learning setting as a part of their everyday life (life world).

The aim of using this analysis approach is to capture as closely as possible the way the researched phenomenon is experienced by users in the context of distance learning.

The life world should serve as model. Regardless of the instrument used to garner data, one, according to Jonathan (2003), can never catch up the totality of what was lived through or subjectively experienced, and this kind of limitation must be weighted in all analysis. This is due to the other contextual, critical factors that emerge in every lived experience. The aim of descriptive phenomenological analysis is the psychological meaning as experienced by the studied subjects (ICT users). Phenomenological analysis attempts to discern the psychological essence of the phenomenon (Ibid). However, achieving careful description is harder to do than to say and hence unexpected biases blatantly lurk everywhere in the life world (Ibid).

Drawing on a wide variety of literature material on phenomenological analysis (e.g. see Jonathan, 2003; Karlsson, 1995; Langemar, 2008), there are four principle steps in practice to conduct data analysis in qualitative psychology research. (1) Although it is obvious, the first step is to read through the entire description (survey responses) written by the participants (ICT users) so that you get a grasp of the whole. It is commonly critical to know the comprehensive sense of the description before proceeding further. (2) The researcher must constitute the parts of the description dividing the text into meanings that the analysis aims to discover and then uses the criteria of meaning transition to constitute the parts. Operationally, the author formed the meaning units by carefully rereading the description, and every time she experienced a transition in meaning, she places a slash in the text. (3) Interpret and reflect is the most critical. It is not to use the theoretical concepts, rather interpretive and empathic understanding (Karlsson, 1995). The researcher proceeds to transformations of original data and obviously there is no fixed number of transformations; one does whatever is necessary. Further, transformation is necessary because all science transforms raw data in some fashion either a priori the research instrument or posteriori (Jonathan, 2003). One goal of transformation is to transform what is implicit to explicit (clearly articulated), concerning particularly the psychological meaning. This is also to transition from the concrete situation (participants' understanding horizon) to the general phenomenon (the researcher's horizon of understanding) (Karlsson, 1995). Thus, the author attempted to make it explicit whenever was necessary throughout different meaning units of the descriptions as the psychological expressions that are descriptively articulated aid clarify the psychological meaning in a more direct and pertinent way. Another aim is to generalize somewhat so that the analysis is not so situation specific (Jonathan, 2003). It is argued that the

psychological significance doesn't suffer from this kind of generalization which rather clarifies the psychological significance by lifting it out of potentially confusing empirical details (described experiences) (Ibid). (4) The structure of the analysis that is gained by going over the last transformations of meaning units, attempts to determine what constituents are typically essential to account for the concrete experiences reported by participants (ICT users) (Jonathan, 2003). It is important to note that a structure refers not only to the key constituents (ICT design, users, affect, cognition, and creativity) but also to the relationships among them. The structures are rather general as they usually depend on the context. Sometimes there are different structures called typologies (Karlsson, 1995). Bearing that in mind, as it wasn't possible to obtain one structure for all of the data collected given the fairly high degree of variability, the author had three different structures.

Validity and qualitative psychology research

Validity is a primary issue in qualitative psychology research; it is more a concern of the evidence gathered, not strictly the research method itself which is only a way of gathering evidence. Validity entails the quality, credibility, and meaningfulness of qualitative research. There is no generally accepted terminology in terms of quality and validity in qualitative studies, but the same content can be divided and named differently by different researchers and in various fields (Langemar, 2008). That said there are some general guidelines for assessing the quality of qualitative psychological research (Elliott et al., 1999; Yardley, 2000). These guidelines are wider ranging and offer a spectrum of ways of establishing quality, and also offer criteria which can be applied irrespective of the particular theoretical orientation of a qualitative study. In a particular study, certain criteria are however often more relevant than others. Depending on the type of survey as the aim and method, emphasis can be on different criteria (Cho and Trent, 2006).

According to Yardley (2000), there are three principles for assessing the quality of qualitative research. The first principle is sensitivity to context which, in this thesis, can be demonstrated by the author's awareness of the existing theoretical and substantive literature. This relates to the topic of investigation as well as to the underpinning of the research method itself – phenomenological qualitative approach - through showing an awareness of the key concepts of the chosen analytic strategy. Further to sensitivity to context and at different level, the rapport between the author and postgraduate distance learning students was not established as there was no direct or close interaction between them given the nature of the instrument (online survey questionnaire) used to garner the data. Therefore, the author may

overlook how students' expectations affected their responses in the survey questionnaire and also may lack flexibility to cover novel areas of the subject (some areas considered important by the respondents but not predicted by the investigators). The second broad principle is commitment, rigor, transparency and coherence. In this thesis, commitment or the degree of engagement was met by ensuring better knowledge of the topic of investigation. Rigour which refers to the thoroughness of the study was manifest by the appropriateness of the sampling to the research question at hand and the completeness of the phenomenological analysis. Transparency and coherence are concerned with how clearly the stages of the research process are outlined in the write–up of the study. In this thesis, this was demonstrated by the fact that the purposive sampling; only distance learning students of the Master of informatics were selected as the target of the investigation given their acquaintance and knowledge about the ICT design and use in their daily study tasks. And the sampling was based on three criteria as mentioned above. In addition to this, the steps used in the analysis were based on the phenomenological analytic strategy. The third principle is impact and importance. In this context, it is possible that this thesis could bring value and make difference in the sense that it highlights the synergy and relationship between ICT design, affect, cognition and creativity in distance learning as previous works can be said to focus more on studies on ICT design and affect as pointed out previously.

Results

The analysis presented here highlights the psychological dimension of the written accounts after the necessary transformations performed by the author on the participants' experience of the phenomenon under investigation as described by their own words. The synthesis of the results was critical and subsequently certain themes were dropped as they didn't fit well in the emerging structure nor were very rich in evidence sought to be garnered. The written accounts from the survey questionnaires were assessed to select three cases for subsequent interpretation, structuring the material based on the main psychological themes pertaining to the phenomenon under investigation. Considering the degree of commitment to the individual response level of analysis and reporting, the richness of the individual responses, and the operational constraints concerning the study, the author opted to analyze three cases (transcripts) in detail for they contain rich information and clear ideas. There is no right answer to the question of the sample size in phenomenology analysis as it depends on several factors (Jonathan, 2003). However, the author aimed to respect

convergences and divergences in the data, recognizing ways in which accounts from participants are similar but also different.

In this analysis, the author intends to make connections between different elements emerging in the participants' responses. Although the analysis follows the sequence with which these elements come up in the written accounts, the author tried, in attempts to make sense of these connections, to cluster them according to the analytical ordering. This process was iterative and involved a close interaction of the author, engaging in an interpretive relationship with the transcripts to understand the content and complexity of participants meaning. This is to coherently order the analysis through identifying and reorganizing themes trying to capture most strongly the respondents' meaning of the topic under inquiry. This served later in the writing of the structure of each of the three cases (fourth step of the phenomenological analytic strategy). Interpretive stance of the results had an emphatic hermeneutics nature. That is, to some degree, the process of interpretive activity was dynamic and based on the author' own conceptions, assumptions and pre-understanding in an active role in order to make sense of participants' life world. The qualitative analysis is inevitably a personal process, and the analysis itself is the interpretive work done by the investigator (Ibid).

It is noteworthy that some parts of the questionnaire were richer than others and so warrant more interpretation. In so doing, some of the author's statements were attempts at summarizing and paraphrasing, some were associations, articulations, or generalizations that came to mind and others were final interpretations (involving psychological terminology) whereby recurring themes were documented. Now, the author proceeds to the write up and final statements outlining the meanings inherent in the participants' experiences of the phenomenon under investigation. At this phase, the analysis is to be expanded as the author tackles case by case translating the main themes into a narrative way.

Participant 1

P1 states that the distance-learning experience was still new and thus challenging to him although he had been studying the Master of Informatics for two years. It was implicit that P1 experience was short compared most likely to his colleagues. He explains that he didn't first have the same feeling coming to classes as in traditional learning, but after getting used to It's Learning platform, he found the new experience to be interesting and realized the importance of ICT in the distance learning setting. Also, P1 acknowledges that he was a bit inactive at the beginning of distance studies due to his long habit of coming to

classes, listening to lectures, and waiting for assignments, but later he became fairly proactive and disciplined. Although it was relatively difficult to adapt to the new environment, P1 seemed to be inclined to take on the new challenging experience. It is argued that humans may find it hard to change depending on several factors, including psychological, intellectual, and social. In addition, P1 explains that he had set learning oriented goals and developed the strategy to achieve them before even he embarked on the distance learning experience (Master of Informatics). P1 claims that the new setting (distance learning) enabled by ICT helped him to acquire new knowledge and skills. Yet, he notes that self motivation and discipline played also a pivotal role in this new learning journey.

ICT design (aesthetics and usability) and affect

P1 states that when he purchases a new computer or install a new version of a software application he feels pleasure, excitement and satisfaction. He articulates that getting a new computer or a software service is usually for the purpose of fulfilling his needs relating to the performance of his study tasks when it comes to efficiency and accuracy. It is implicit that the participant was aware of the benefits of using ICT in order to ease and optimize the task performance. It is likely that P1 could experience the advantages of using his laptop or software applications to cognitively better perform his assignments. However, he adds that usually if the old version of software works he tended to maintain using it, but if the new version has more advantages then he would consider it. P1 states that he usually considers functionality and usability more than aesthetics criteria when acquiring a new computer or a software application. He acknowledges that he uses HP computer and prefer Windows applications but he focuses more on how computers and applications can help him to efficiently perform his tasks. It is possible that aesthetics aspect is taken for granted given that the participant has been using HP mark and dealing for long with windows applications. He adds that usability is also an important criterion to consider when acquiring new software applications. In ICT design and use, usability is of paramount importance for ensuring easier user interaction, which influence users' affective states. This requires a successful blend of psychological (affect) and technological perspectives. P1 states:

"...most software are easy enough to use nowadays, it is just how far HCI design has advanced."

P1 emphasizes the importance of the advancement of human computer interaction (HCI). HCI entails designing software with friendly user interfaces to improve user interaction. This is to minimize the interaction barriers between emotional and cognitive processes and computer

systems in that to enhance their responsiveness and usefulness with regard to need satisfaction of users. Further, P1 says that he certainly finds pleasure in simplicity when it comes to ICT design and complicated ICT products don't appeal to him at all, stating Apple products as an example of such type of design. Also, P1 says:

"I think it is rather a range of criteria that when I look at things, I will have the emotion of either like or dislike something, but simplicity is something that I always get attracted to".

He offers an interpretation of his emotional response to simple design by suggesting that there is a set of complex factors involved in the sensation of design aesthetics that determine whether to positively or negatively appraise it. The experience of feeling pleasure from simple design seems to be in line with familiar self-interpretation on the part of P1 that seems to make it satisfactory.

P1 states that when it comes to PCs and software graphics he prefers bright colors stating blue and white as an example, but not so bright as orange, green, or red. He explains that strong bright colors cause him annoyance and irritation because of the so high contrast. It is clear that colors elicit positive or negative affective states. In response to the question regarding how aesthetical features associated with computers, software graphics, and web design affect his feelings, he states:

"Indeed, aesthetics is very rich when it comes to ICT design. This makes me sometimes feel a sort of delight when interacting with such artefacts, though they'd rather be neither too catchy nor too complex, if the user interfaces are simple and easy to use then I emotionally resonate with them.

P1 implicitly iterates his interest in simple design and usability and the meaning of the word 'rich' in his statement implies a positive affect associated with the perceived aesthetics value.

Furthermore, P1 claims that using communication systems as Marratech or videoconferencing to attend virtual meetings or take part in online discussions with his colleagues is the same as talking in real life; the connection is overall of good quality as the voice and the image are clear. It is implicit that P1 is satisfied with the design (aesthetics and usability) of communication technology he uses to communicate in the distance learning. In the description of his feeling about the kind of e-community he uses as a designer, he says:

"I use a typical design e-community that involves students, researchers, professionals, practitioners, and experts sharing the passion of design in different areas. This is very important because it allows me to share innovative ideas, knowledge, best practices, and new discoveries; participate in discussions and blogs; collaborate on design project, and build social contacts."

The experience of P1 using communication technology (design e-community) for studies and social purposes is perceived as very important to nurture his design skills, enrich his creativity, enhance task proficiency and build social contacts. It is very likely that P1 is satisfied with the outcomes of ICT design and use as he expects to fulfill intellectual, emotional, and social needs.

ICT design (functionality), cognition, and creativity

P1 states that using his laptop had inspired him in many occasions in the performance of his tasks, especially writing and designing. P1 describes a typical occasion where he was satisfied with his creative performance. He says:

"For example, when I write or design, the PC helps me focus better through the small screen and enjoy the beautiful graphics along with the functionality, which, as a result, makes me feel more explorative and contemplative. Thus I find it easy to generate new ideas and insights and make combinations that end up enriching my task activity. I think focus is very important in the pattern of creatively performing tasks and the PC provides that for me…"

This experience seems in line with familiar self-interpretation of the part of P1 that seems to make it easier to be creative in writing and designing. For P1, focus is a very important factor to write and design creatively and the PC is a means of providing this creative, cognitive ability. It is apparent that design aesthetics also plays an important role in his inspiration experience. This is implicit in his statement as he notes that the focus process is combined with the enjoyment he feels from the computer design and the graphics.

Moreover, P1 claims that by means of using the PC frequently in studies and at work, he could easily carry out complex assignments; however he sometimes experiences difficulties when he deals with something completely new to him or requires very special knowledge. He maintains that the PC helps him to organize, process, and manage information through importing, downloading, searching, retrieving, and storing information in a more efficient and accurate ways. Additionally, he adds that the PC enables him to flexibly use his own tacit knowledge through making associations and reflecting better. It is conspicuous that computers can cognitively ease the tasks for users and enable them to think associatively and reflectively. P1 states:

"ICT are valuable in enhancing users' task performance, which would otherwise be daunting to perform without ICT..."

P1 theorizes that ICT are useful in aiding users to perform rather demanding tasks.

P1 states that there was a situation where a software application stimulates his creativity in doing his work as a software developer. He describes the situation saying: "

"As a software developer, I usually use SOA (service oriented architecture) to develop information systems. This technology has an architectural style of building software applications by merging all software components together and using service-oriented programming development methodology. Working with such platform-independent interfaces usually stimulates my creativity in devising and combining agents and components. I wouldn't otherwise be capable to do this without SOA technology."

This experience shows the level of the complexity inherent in the design of ICT and the enormous benefits of the software technology with regard to cognitively enhancing users' task proficiency and creativity.

P1 says that when it comes to his inspiration in task performance, it is more to functionality than to the attractiveness of computers but the underplaying amalgam of being creative must involve both, yet in a varying degree and depending on the mood and context. It is implicit that being creative entails different ingredients (i.e. task goals, aesthetics, device and affective state, ambiance). Furthermore, P1 says that the elements that most attract his attentions when interacting with ICT are colors, shapes images, and text. P1 states:

"When interacting with my laptop, I like to focus on different elements because it helps me to make associations and connections."

Attention on various elements during interaction with ICT may stimulate creativity. It is argued that the degree and subtlety of human attentional capacity may play a role in creative cognition.

Participant 2

P2 states that he had an interesting, momentous experience regarding distance learning and the application of ICT in the new leanring setting. P2 acknowledges that distance learning had brought a lot of benefits to his learning through the increased utility associated with ICT desing and use as he relied on it to carry out his tasks and achieve his learning outcomes. In the distance learning context, P2 says:

"ICT not only enhance efficiency, effectiveness, and accuracy when it comes to task performance, but also eliminate barriers of communication between students and teachers. This helps overcome emotional problems that might otherwise happen in traditional education setting (class) as fear, hesitation, embrassement, disconfort, etc. Additionally, through ICT, I can submit assignments, receive and respond to feedbacks, be notified of due

dates by emails, attend virtual meetings and lectures, as well as participate in interactive discussions, to name a few advantages as the ICT benefits are countless in this regard..."

It is clear from P2's experience that the use of ICT has cognitive and emotional implications for users' task performance and communication in distance learning. However, P2 notes that a variety of universities that provide e-learning face enormous difficulty in achieving successful strategies, including the delivery, effectiveness and acceptance of the courses. He alledged that offering any conceivable course online may not always meet the students' needs and, inadvertantly, may cause unexpected dropouts, or sometimes students suffer from persistent frustration in web-based education for some reasons as my colleagues had told me. Exprience shows that some students indeed feel frustration in such circumtances and, subsequently, end up droping out probably because of being newly introduced to new technologies, lack of self going attitudes, or unfamiliarity with learning platform interfaces.

ICT design (aesthetics, functionality, and usability) and affect

P2 says that when he acquires a new computer or install a new version of a software application he feels eager to explore new design features and enjoy the moment. He also states that he has worries that ICT products might not work properly, introduce viruses, or have some hardware deficiencies or software bugs. He describes a related situation stating:

"… I was really curious and enthusiastic to explore and enjoy new features of Windows vista when I first bought it because of what I had heard about it from friends, but then after working with it for a couple of weeks and using more advanced functionalities, it turned out to be a complete chaos and full of bugs. As a matter of fact, the new release of Windows 7 by Microsoft addresses those issues due to users' complaints."

The state of purchasing new software applications left him with an unresolved ambivalent feeling state - alternately eager and worried. P2 was enthusiastic because he bought a new software application yet worried because he realized that the state of Windows vista wasn't as well-designed as he originally expected it would be. Anxiety is another emotional state P2 feels due to his negative anticipation to potential problems that might emerge during the installation of new software applications.

P2 acknowledges that he considers aesthetics and functionality design criteria when he acquires new ICT products and services. P2 emphasizes that design of laptops and user friendly interfaces are very important elements when it comes to ICT systems, especially if the user interfaces are multimodal and context aware. P2 says:

"ICT systems equipped with context aware features can sense, understand and react based on the recognized surrounding, including users' emotional and cognitive states. Such systems can evoke a basic emotional response (affective reaction), produce complex appraisal (i.e. agreement in decision making), enhance task performance, or behave appropriately during social interactions..."

P2 makes even a valid point that the design of ICT systems based on context awareness technology is increasingly concerned with user interfaces endowed with cognitive and affective abilities to better meet users' needs. The premise of such technology is to develop and enhance affective and cognitive competencies of systems so they can intelligently sense, perceive and accordingly elicit emotions or respond to users' cognitive context such as decision making and writing pertaining to task performance. P2 acknowledges that current ICT systems can be very effective in sensing emotional and cognitive human related contexts and be capable of validating such contexts.

P2 points out that he likes simplicity in design when it comes to ICT because complicated systems may require more time to manipulate which would compromise task completion time in his studies while simply designed systems provide smoothness in interaction which gives pleasure. P2 says:

"It is very useful to design ICT systems with high level of hardware sophistication (i.e. sense-based) that are intended to enhance users' emotional and cognitive adaptation and responsiveness but such systems should simultaneously be simple, easy to use, and implicit so to avoid frustration and dissatisfaction."

To clarify the matter, P2 adds:

"For instance, the interaction with software systems is often affected by many types of barriers that may induce users to make errors. As a consequence, negative feeling states, such as frustration, dissatisfaction, and anxiety may arise, so to address this problem, new software systems should be designed to ensure simplicity and usability, thereby becoming more acceptable and favoring positive affect of users when performing tasks."

P2 focuses on usability and implicit user interfaces as two criteria when it comes to simplicity of ICT design, especially software applications in order to avoid negative emotions that users might encounter during their interaction with systems. P2 shows high expectations regarding the design of future software applications, highlighting the critical value of new design criteria to users in performing their tasks with the avoidance of associated negative emotions.

P2 states that when it comes to laptops he prefers silver and grey colors and for graphics (software) he likes blue, white, light green and grey. He explains that he doesn't

favor bright colors like yellow, purple and pink in graphics because they are not pleasant to his eyes and make him feel annoyed whereas his favorite colors give him pleasure and affective balance and enable him to perform his tasks in a more tranquil and pensive way. In this regard, P2 states:

"Usually my preferences of natural colors in ICT design aesthetics carry a meaning and value for me because they positively affect my feelings. They resonate with my spirit and make it easy for me to use my tacit knowledge during the process of performing my study tasks. For example, in connection with reading, I feel that my thought processes are congruent with what I feel emotionally because of the beautiful colors reflected in graphics and my laptop..."

It seems that the perception of natural colors creates positive feelings - emotional activation – that, in turn, help stimulate cognitive processes. In his response to the question regarding how the aesthetical features associated with computers, software graphics, and web design affect his feelings, he says:

"The aesthetical features obviously affect my feelings because I enjoy interacting and working with ICT in general; ICT become a part of my daily life. Indeed, I just can't imagine how life would be without a computer and Internet service. In this respect, my laptop becomes the medium of my e-everyday transforming me into e-me..."

It is clear that attractiveness of high aesthetic qualities of ICT elicits positive affect in users.

P2 claims that using communication systems to attend virtual meetings or take part in online discussions makes him feel like the distance varnishes as communication, more often, occur in seamless way due to the advancement regarding video and voice in teleconferencing technology. Also, he acknowledges that by using communication technology, he now has the opportunity to share knowledge and experiences, collaborate with students, and participate in diverse discussions regardless of the location. P2 acknowledges that all these activities contribute significantly to his learning as well as social interaction, which is very important to keep up in his distance studies. It seems that communication technology plays a key role in P2's experience of distance learning and the outcome of using such technology is a motivational drive for enjoying that experience. It is implicit that P2 is satisfied with the way communication systems are designed because of the affective satisfaction he shows when virtually interacting with his colleagues.

ICT design (functionality), cognition, and creativity

P2 states that he, by means using his laptop, gets sometimes inspired when performing assignments (i.e. reading and analysis) or searching for information in online

databases. P2 describes a typical occasion where he was satisfied with his creative performance saying:

"Once, I had to do an assignment that required a great deal of literature material to collect, so I divided the task into subtasks and started the search strategy. I initially opened one database (ELIN BTH library) and started downloading few relevant articles and as I continued doing the process, I found myself navigating other databases where I happened to come across other relevant themes that I didn't plan to do at the outset of the process. Consequently, I ended up doing other task activities in the middle of the search process such as reading, clustering ideas and themes, analyzing, discussing, making connections, etc. This so called cross processing of information inspired my thinking as I started generating ideas that didn't occur to me before the search process took place, which led to a satisfied outcome at the end ..."

Depending on the type of tasks and user's cognitive ability to manipulate information flow, ICT can play a role in stimulating users' inspiration as to performing activities. It is implicit that the design aesthetics involved in how smoothly interactive user interfaces can be plays a pivotal role in the stimulation of the P2's creative cognition. With respect to users' cognition, context awareness technology in software applications are today being used to increase the precision of information retrieval, enhance task proficiency, and make the user interaction implicit. Further, P2 states that using the PC facilitates the performance of complex assignments but it depends on other factors, including how complex the assignment is, mood, motivation, and environment. P2 acknowledges that ICT aids in carrying out complex assignments but other criteria are to be considered for more effective outcomes. In addition, P2 says that using the PC helps him to perform tasks better because he can easily concentrate by being in a small hosting physical environment. He also acknowledges that using software applications makes it easy for him to efficiently organize his daily activities as well as handling information. He says:

"Today I tend to computerize all my daily activities (studies, work, social interaction) relying mostly on my laptop because of the flexibility enabled by the mobility feature, size, light weight, expediency, etc. The laptop is the most amazing artifact ever made as it is designed to accommodate different settings and respond to different users' needs...Distance learning wouldn't be possible without ICT. My studies are getting easier and easier, owing to ICT as an enabling technology"

It is implicit that P2 is aware of the advantages ICT offer and hence he tries to perform all his daily activities and tasks using his laptop. He seems to be satisfied with the design features of

his laptop. He generalizes (obviating) that laptops are designed to be used in different setting and respond to different needs. The perception of the fact the distance learning initiative wouldn't transpire without the enabling role of ICT seems to be in line with familiar self-interpretation on the part of P2 that seems to make it useful and of assistance in his life.

P2 describes a situation where a software application helped enhance his creative thinking:

"I am taking another distance Master program and I am using an interactive learning media that, as it is assumed to be, provides dynamic feedbacks to human behaviors and emotions in real time. This software has so many good features that help be active in participation and facilitate my expressivities so I feel more inspired and creative in handling learning tasks and acquiring new knowledge as well as interacting with various implicit user interfaces..."

This experience highlights the advantages of software applications for aiding creative cognition among users. It seems like ICT are increasingly becoming crucial when it come to performing tasks that require high cognitive abilities.

P2 states that both functionality and aesthetics of computers and software applications stimulates his inspiration when he carries out his study tasks. He explains that functionality can't stand alone as design aspect of ICT; rather it should be completed by aesthetics. He maintains that since functionality is nowadays taken for granted, he tries to focus more on design aesthetics as it can differ greatly from a manufacturer to another stating:

"As far as I am concerned, I don't look for more in terms of functionality if the computer is equipped with multiprocessor, high memory capacity, webcam, software applications, etc, whereas design aesthetics changes from an ICT company to another (Sony versus Dell)..."

P2 adds that to have inspiration in performing tasks, he needs an array of combined design elements from both functionality and aesthetics design aspects. It is implicit that functionality is ncessary for P2 but not a sufficient condition; hence aesthetics is also needed for his inspiration.

P2 says that the elements that capture his attentions most when interacting with ICT are colors, texts and shapes. P2 claims that the process of paying attention to different elements helps him make new combinations and connections when he, for instance, reading off computer screen or writing his assignments. P2 says:

"This occurs more often when I use my laptop more generally. Though, this rarely happens to me when I do tasks manually, reading a book or using a notebook and a pen in analyzing..."

P2 adds saying:

"I must say that the beautiful colors, graphics and display images in my laptop are considered as a source of inspiration for me. Focusing my attention on them stimulates my generative abilities. Hence, I try more often to pay attention to more elements at the same time so that I can discover new combinations through resourcefully using my tacit knowledge... I sometimes feel that paying attention to every piece of my laptop enrich my imaginative capacity, which provides an ambiance that is conducive to creativity where I usually immerse in associative thinking..."

The focus on these elements seems to be a trigger for associative thinking or forming combinations. Again, the attentional capacity can play a role in creative thinking if skillfully explored during task performance.

Participant 3

P3 states that she had acquired new knowledge through doing and learning realizing how determining ICT were in her experience of distance learning studies. She claims that distance learning studies was a radical change and hoped it would replace totally the traditional classroom setting as well as traditional teaching methods. This could be a subjective view as there are other views that oppose to the idea of distance learning because of the frustration and stress some students usually encounter in this regard. Her assumption relaxed on the idea that she has enjoyed this experience, owing probably to the desired outcomes she achieved from pursuing distance learning studies compared to her previous education experience. In addition, P3 generalizes (theorizes) that the distance studies brought innovative tools for knowledge acquisition, highliting the role of ICT in this respect. The distance learning experience seems in line with familiar self-interpretation on the part of P3 that seems to make it enjoyable and rewarding as a new way of learning. She claims that 80% (not referenced) of academic materials online could easily and quickly be accessed as well as be faster to read compared to traditional ways. It seems that using ICT can cognitively help users to search for information and read faster.

ICT design (aesthetics, functionality, and usability) and affect

P3 states that when she acquires a new computer or install a new version of a software application she feels impatient and enthusiastic to explore new design and functionality features. She says:

"For instance, when I installed the latest update of Skype I liked the new interfaces as well as the new introduced features like high definition-based video calls that enable you to

participate in virtual conference and discussions. Such new features usually give me some sort of pleasure because I get the chance to learn more and explore new options that help enrich my virtual interaction with colleagues..."

P3's positive effective state tends to be triggered by a combination of two elements, satisfaction from design affective qualities and enjoyment of having virtual meetings through video or teleconferencing. In addition, P3 states that she considers aesthetics, functionality, and usability criteria when purchasing new ICT products or services. For aesthetics, she emphasized user friendly interfaces, conventional colors (i.e. blue, white and grey), overall design of the laptop. Regarding functionality and usability, she suggested up-to-date and easy-to-use and to-learn software services as well as high memory capacity and multitasking.

Moreover, P3 says that she prefers simplicity in design when it comes to ICT. She states:

"I think ICT should be designed in a simple way for users to be able to use without any prior technical knowledge and also without intense colors and graphics but with friendly and smooth interfaces."

P3 suggests that simplicity in ICT design is about usability, less colors, intelligibility, and user-friendliness. Indeed, these criteria are important as affective qualities that may evoke users' core affect. Speaking of colors, P3 points out that when it comes to software graphics she prefers blue and white, and for laptops her preferences range from light pink, to grey and silver. She says that these colors are pleasant to her eyes and make her feel harmonious and, more importantly, reflective. The colors seem to elicit positive affective (pleasure) and even help her think in a contemplative way. In this case, it can be said that colors trigger both emotional arousal and cognitive stimulation. In response to the question regarding how the aesthetical features associated with computers, software graphics and web design affect her feelings, she states:

"Certainly these features affect my feelings but this depend on whether or not they come in colors and characteristics I resonate with. This is very important for me to find pleasure in my interaction with ICT."

The meaning of attractiveness of artifacts tends to be subjective. Hence, it is not about the beauty of design as much as it is about how a person perceives affective qualities in design aesthetics, which determines whether or not their appearances would evoke positive affect.

P3 acknowledges that using communication systems to attend virtual meetings or take part in online discussions is the same as chatting face to face with her colleagues. P3 elaborates that by using communication technology, she had the opportunity to collaborate,

provide services to friends, participate in discussions, share ideas and inputs, etc. In an attempt to emphasize the emotional and social role of communication technology, she says:

"The use of communication technology goes beyond distance learning studies to include social activities. In this respect, when I use communication technology for social purposes, I usually have very positive feelings as I talk to friends and colleagues from my class, foster friendships, build and nourish new relationships with teachers as well as express and share emotions sometimes."

It seems that communication technology provides an environment when people can do different activities, including studies and social interactions. Notably, this is important for users to feel positive emotions. It is implicit that that P3 is satisfied with the way these communication technologies are designed in terms of functionality and aesthetics aspects.

ICT design (functionality), cognition, and creativity

P3 states that she more often gets inspired when performing assignments using her laptop. She says that this occurs usually when she writes her assignments (i.e. analysis and reflection). She describes a typical occasion where she was satisfied with her creative performance stating:

"For instance, friendly user interfaces and colors are the source of inspiration for me, especially when I write. In addition, my laptop makes it easy form to focus. This usually stimulates my analytic skills and idea generation...besides I can't imagine working without a laptop, especially when I perform tasks due simply to the benefits I get from using it"

For P3, user interface friendliness and colors seem to be key factors to better focus. It is likely that the ICT design aesthetics plays a pivotal role in the stimulation of the P3's creative cognition. Further, P3 states that using the laptop certainly facilitates performing difficult assignments, but this depends also on how complex the assignment can be. It is implicit that prior knowledge may, in addition to ICT use, be needed for carrying out complex tasks. She acknowledges that she can't do without it. In addition, P3 says that using a laptop helps her do tasks in a more effective and organized way through easily structuring ideas, searching for information, and synthesizing data. She moreover says:

"People can better concentrate by using their PCs because they need only a small physical space to study or work. There is no distraction in the surrounding so long as you focus on your task."

P3 theorizes that people can better focus on their tasks when using laptops. This experience seems to be in line with familiar self-interpretation on the part of P3 that seems to make it

advantageous and expedient. Furthermore, P3 describes a situation where a software application helped enhance her creative thinking:

"Using new design software makes it easy for me to analyze and understand design problem situation, which enable me to come up with creative relevant design solutions, owing to the rich software tools intended to stimulate insights during the design process. When the software is, for example, completely automated, the design process becomes simple as text describing a planned sequence of events. This actually gives me space to think creatively. It is about the capabilities software application has to enhance the inspiration of the designer."

It is clear that software applications with advanced features can help enhance creative cognition among users. It seems like ICT are increasingly becoming important mostly in tasks that require high and creative cognitive abilities like design.

P3 states that using attractively designed computers or software applications stimulates her inspiration, yet *"multitasking and processing power features in computers are still important I guess."* She is more concerned with aesthetics of design than functionality. She acknowledges that functionality is important however. P3 says that the elements that she pays attention to when interacting with ICT are mostly colors, images, and shapes. P3 claims that this process of paying attention to different elements aids her sometimes, depending on the ambiance, to be creative in performing her tasks. The focus on these elements seems to be a source of creativity. The focus ability differs from one person to another in a way that it can determine how cognitively that person can actively be creative in performing tasks.

General structure for P1, P2, and P3

As previously pointed out, the structure of the analysis is gained by going over the last transformations of meaning units in order to determine the essential constituents as brought up in the written descriptions by participants to reflect their experience of how ICT design can have an effect on their affect, cognition, and creativity. Given the nature of the study and the high degree of variability of descriptions as a central issue in this case, it is obvious to obtain different structures (typologies). Therefore, a structure was written for each of the three participants.

For P1, the experience of how ICT design involves his affect occurs when he purchases or acquires new ICT products or services as he feels pleasure, excitement and satisfaction. In addition, P1 was aware of the benefits of using ICT in order to optimize task performance. When acquiring new ICT products or services, P1 focuses on functionality more than aesthetics and usability as design criteria. For P1 simplicity of design means a pleasure

and satisfaction to him. P1 prefers blue, white, and grey in software graphics and PCs while he dislikes bright colors such as orange, green and red. For P1, strong bright colors cause him annoyance and irritation because of the high contrast. Regarding the aesthetical features associated with computers, software graphics and web design, P1 claims that such features affect his emotions positively as he sometimes feels delight when interacting with ICT. P1 acknowledges that using communication systems such as Marratech or videoconferencing to attend virtual meetings or take part in online discussions is the same as talking in real life as he was satisfied with the design of communication technology. Also, for P1 communication technology is deemed prominent in his studies and social activities as it nurtures his design skills, enrich his creativity, enhance task proficiency, and build social contacts.

The experience of how ICT affect his cognition and creativity in task performance occurs when he uses his laptop that inspires him in many instances relating to his study tasks, especially writing and designing. Also for P1, focus is a very important factor to creatively write and design and the PC is a means of providing this cognitive ability. Also, design aesthetics plays an important role in his inspiration experience. P1 claims that by means of using the PC in studies and at work, he finds it easily to carrying out complex assignments should they not very complex or require special knowledge. P1 describes a situation where a software application stimulated his creativity in doing his work as a software developer. This experience shows the level of the complexity inherent in the design of ICT and the enormous benefits of the software technology with regard to cognitively enhancing users' task proficiency and creative thinking. P1 confirms that his PC can help him better perform his tasks through organizing, processing and managing information by means of the available functions, such as import, download, search, retrieve and store information in a more efficient and accurate way as well as creatively use his own tacit knowledge through making associations and reflecting better. For P1's inspiration to emerge during task performance there is more to functionality than to attractiveness of computers or graphics. P1 adds that the underlying amalgam of being creative include both factors, yet in a varying degree and depending on the mood and the ambiance. For P1 the elements that most capture his attention when interacting with ICT are colors, shapes images, and texts. In the P1 case, attention on various elements during interaction with ICT may stimulate creativity.

Participant 2

P2 acknowledges that ICT enhance proficieny, efficiency and accuracy when it comes to task performance and eliminate barriers of communication between students and

teachers, which can avoids emotional problems that happen in traditional education setting (class) as fear, hesitation, embrassement, disconfort, etc.

For P2, the experience of how ICT design can influence his affect occurs when he acquires new ICT products or services as he feels eager to explore new features and enjoy the moment; however, he has worries that ICT products or services might not work properly or have some hardware deficiencies or software bugs. It is more of an ambivalent feeling state for him - alternately eager and worried. P2 considers aesthetics and functionality design criteria when it comes to new ICT products and services. In this regard, he emphasized hardware design and user interfaces, especially emotion- and cognitive-context aware interfaces. For P2, simplicity in design is preferred because it provides smoothness in interaction which gives him pleasure. For P2, simplicity in design is about usability and implicit user interfaces in order to avoid negative emotions that he might encounter during his interaction with ICT. P2 prefers silver and grey colors as to laptops and blue, white, light green and grey for graphics (software) as they give him pleasure and affective balance and stimulate his cognitive processes in task performance whereas bright colors are not pleasant to his eyes and make him feel annoyed. The aesthetical features of computers, software graphics, and web design affect his feelings in a positive way (delight). For P2, using communication systems to attend virtual meetings or take part in online discussions makes him feel like the distance varnishes as virtual communication occurs in a seamless way. Also, he acknowledges that using communication technology enables him to share knowledge and experiences, collaborate with students, and participate in diverse discussions regardless of the location.

For P2, the experience of how ICT design can affect his cognition and creativity in task perfromance occurs by means of using his laptop, which stimulates his inspiration when performing assignments (i.e. analyzing, reading, information searching) due to the functionality, aesthetics, and usability aspects embedded in ICT. P2 claims that using the PC facilitates the performance of complex assignments but it depends on other factors, including mood, motivation, and environment. Using the PC helps him in addition to perform tasks better because he can easily concentrate by being in a small hosting physical environment while using software applications makes it easy for him to efficiently organize his daily activities as well as handling information. P2 describes a situation where a software application helped enhance his creative thinking, highlighting the advantages of the latter for aiding his creative cognition. For P2, both functionality and aesthetics of computers and software applications matter for his inspiration when he carries out his tasks. Regarding the elements that capture his attentions most when interacting with ICT, P2 mentions colors,

texts, and shapes. P2 claims that the process of paying attention to different elements stimulates his creativity when reading or writing assignments. In this case, the attentional capacity can play a role in creative thinking if skillfully explored during task performance.

Participant 3

P3 was aware that using ICT can cognitively help users to search for information and read faster. For P3, the experience of how ICT design can influence her affect occurs when she acquires new ICT products or services as she feels impatient and enthusiastic to explore new design and functionality features. For P3, positive affective states involve a combination of two elements, satisfaction from design aesthetics and enjoyment of having virtual meetings through teleconferencing. P3 considers both aesthetics and functionality criteria when purchasing new ICT products or services. She also likes simplicity in ICT design. She highlights that simplicity is about accessibility, intelligibility, user-friendliness and usability. Regarding colors, P3 prefers blue and white when it comes to software graphics and her preferences for laptops include light pink, grey, and silver. She points out that these colors are pleasant to her eyes and make her feel harmonious and, more importantly, reflective. P3 finds pleasure in interacting with the aesthetical features associated with computers, software graphics and web design. For P3, using communication systems to attend virtual meetings or take part in online discussions is the same as talking face to face with colleagues and also gives her the opportunity to collaborate, provide services to friends, participate in discussions, share ideas and inputs, etc. She uses communication technology for both distance learning studies and social activities, which enable her to foster friendships, build and nourish new relationships with teachers as well as express and share emotions.

For P3, the experience of how ICT design can affect her cognition and creativity in task performance occurs through using her laptop that sometimes stimulates her inspiration when performing assignments, owing to friendly user interfaces and colors in graphics, in addition to the fact that her laptop makes it easy for her to focus better. This stimulates her analytic skills and idea generation. Furthermore, P3 maintains that, it is easier to perform complex assignments using the laptop, except that she sometimes find it difficult to carry out some assignments due to the lack of acquaintance with some topics. In line with that, for P3, the laptop helps to do tasks in a more effective way through easily structuring ideas, searching for information, and synthesizing data and moreover to better concentrate since there is no distraction in the surrounding so long as she focuses on her task through being in a small physical space. She describes a situation where a software application helped enhance her

creative thinking. It was clear that software applications with advanced features can help enhance creative cognition among users, especially in tasks that require high cognitive abilities. For P3, using attractively designed computers or software applications stimulates her inspiration but functionality is deemed important as well. Furthermore, the elements that P3 pays attention to when interacting with ICT are mostly colors, images, and shapes. She was aware that paying attention to different elements helps her, depending on the ambiance, be creative in performing her tasks. In P3 case, the focus ability may determine how a person can cognitively actively be creative in task activity.

Discussion

This section discusses the key findings in relation to the research question. First attention is given to the relationship between ICT design and users' affect and then the relationship between ICT design and users' cognition and creativity in task performance. It is worth noting that the author intends to discuss the key issues that are relevant to this study. In addition, indications of the findings for current theories are proposed. The discussion is divided into two subsections based on the two main topics that are covered in the results section:

- The relationship between ICT design and users' affect
- The relationship between ICT design and users' cognitive and creativity in task performance

The relationship between ICT design and users' affect

It was found that users exprience positive affect when they acquire new ICT products or services. Such positive affects include: pleasure, excitement, satisfaction, eagerness, and enthusiasm. This is usually elicited by the affective quality (pleasantness) of ICT design aesthetics as perceived by users. Zhang (2009) contends that perception of affective quality (PAQ) is a user's perception of an object (i.e. ICT)'s ability to change his or her core affect. The positive resulting feelings emerge according to the context and are also determined by the motivational needs of users to acquire ICT, i.e. needs for task efficiency, aesthetics pleasure, or exploring new features. This is consistent with Zhang (2008) who indicate that using ICT involves our motivational needs, and when it satisfies our motivational needs, we feel enjoyment (thus want more). Further, when it comes to ICT products and services, users more often opt for functionality (i.e. multitasking, processing power, memory capacity), aesthetics (i.e. friendly user interfaces, colors, hardware shapes), and usability (i.e.

easy-to-use, easy-to-learn) as design aspects. Functionality, aesthetics, and usability design dimensions have signified a movement from being instrumental orientation to experiential orientation and from a cognitive paradigm to a more affective centric paradigm (Norman 2002, 2004; Zhang et al. 2004, 2005). These design aspects must have an impact on users' affect; they are a motive for their behaviors of being drawn to them as affective qualities. This is aligned with (Zhang, 2008) who points out that emotion relates to motivation as one type of motives that energize and direct behaviours. Moreover, it was shown that the aesthetical features associated with computers, software graphics, and web design positively influence users' core affect through affective qualities of the attractiveness and beauty of ICT artifacts through visual appeal, perceived aesthetic quality, aesthetics interaction, hedonic usability, affective reactions, etc. This sides with Zhang (2009)'s view who argues that an artifact in a user's environment must have certain features to reveal its inherent quality, or with aesthetic potential and aesthetics is concerned to have an effect on the perceiver's senses.

In addition, it was found that simplicity in ICT design aesthetics epitomizes pleasantness and evoke pleasure among users. Simplicity was expressed by such criteria as accessibility, intelligibility, user-friendliness, and usability. Indeed, these are very important aspects when it comes to generating positive affective states among ICT users. This finding is in line with Hekkert (2004)'s who argues that a visual pattern is pleasing to the eye when relatively simple design features reveal a wealth of information. Generally, the emotional space is defined by several dimensions including attractiveness and simplicity. Conversely, complicated design can lead to negative affective states such as frustration, dissatisfaction, and anxiety. It was moreover shown that natural colors (i.e. blue, white, green, and grey) reflected in laptops and software graphics are favored most by ICT users because they are pleasant to the eye as well as provide harmonious and inspiring environment. Thus, they are important as a part of affective qualities in ICT design aesthetics because they affect the users' mood depending on individual preferences. In line with this, Norman (2002) says that if his reasoning told him that color was unimportant, his emotional reaction told him otherwise. In contrast, strong bright colors cause negative affect such as annoyance and irritation. On the cognitive side of the ledger, colors can also stimulate cognitive processes among ICT users as they enable them to perform their tasks in a more contemplative way. It can be argued that colors as an aspect of affective qualities of design aesthetics may not be determining when it comes to user task performance, but can certainly trigger positive affect that influence cognitive operational parameters. In a sense, this sides with the view of Schwarz and Clore (1996), Forgas (1995) and Scherer (1993) who contend that emotions can

profoundly influence cognitive processes. Furthermore, using communication systems such as Marratech and videoconferencing significantly contribute positively to users' emotions in different settings, including distance learning and social activities. This is due to the fact that these users are satisfied with the way these systems are designed in terms of both functional and aesthetical aspects, in particular voice and image. Hence the rationale behind designing ICT artefacts with high positive aesthetic quality is to evoke positive affect in the users or viewers. Zhang (2009) argues that the perception of an object's aesthetic quality is much connected to the viewer's affective reaction to the object, that is, aesthetics emphasizes the quality of an object (or stimulus) and the perception of such quality in one's environment, while affect emphasizes the innate feelings people have that are induced by the object (i.e. affective evaluations).

The relationship between ICT design and users' cognitive and creativity in task performance

Using ICT was shown to inspire users when performing tasks, such as writing, reflecting, analyzing, information searching, etc. This can occur, depending on the task, through users being contemplative, explorative, generative, focused, or creative as they interact with natural colors, software graphics, friendly user interfaces, and computer hardware design, or sometimes submerging in the interaction itself. Design aesthetics plays a key role in influencing the core affect of users. This may in turn influence cognitive processes which can, in turn, spur creativity in task performance. This is consistent with Norman (2002) who argues that pleasure and derivable from the pleasantness of artifacts increases positive affect and mood which broaden creativity. Further, software may have high usability features or context aware capabilities that can enhance users' task proficiency and effectiveness as well as elicit positive emotional responses among users. The Software Usability Measurement Inventory (SUMI) aims to analyze users' reaction to software applications and measure, among other things, efficiency, affect and helpfulness (Kirakowski, 1996). As for task proficiency, the study of Palmer et al., (1975) suggest that feeding contextual information into ICT can be useful in increasing the task proficiency of users.

In addition, using ICT (with the way software applications are designed) was found to overall bring easiness and helpfulness, in a varying degree, to users' while carrying out complex tasks. However, this sometimes depend on other critical factors, such as the degree of tasks complexity (how demanding they can be); mood; motivational needs; and prior knowledge to tackle a given task; in addition to the affective qualities of design aesthetics. Affect regulates how we solve problems and perform tasks and hence positive

affect can make it easier to do difficult tasks (Norman, 2002). Apart from using ICT that enable users to easily concentrate on their tasks and be flexible in performing them; ICT facilitate users' task performance through effectively structuring activities, searching for information, synthesizing information, handling information, etc. There is a general agreement that context aware applications can enhance the accuracy of information search and retrieval and adapt interfaces based on interaction dynamics. Indeed, research on user interfaces has been increasingly addressing the design of systems endowed with mental abilities to increase users' cognitive processes. Context aware systems are systems that sense, understand and anticipate the users' activities. Such technology in interaction design aims to provide richer and easier interaction between users, ICT and the surrounding milieu.

It was shown that software applications, if used intelligently and professionally, can help stimulate users' creative cognition in task performance. This is because of design capabilities embedded in such technologies that are intended to enhance cognitive abilities or activate positive emotional responses during users' interaction, which influence cognitive processes. Indeed, interactive software applications become more acceptable and favouring positive emotional states if correctly perceived and interpreted by end users (Fogli and Piccinno, 2005). There is a wealth of new advanced features being considered in the design of software applications that can help increase creative cognition in task performance, interaction with interfaces, learning, communication, etc.

It was found that users' inspiration in task performance involves both functionality and aesthetics as design criteria. Users tend to favor one over the other or consider them as being on the same footing depending on other involved factors, such as affective state, task goals, context, perceived aesthetic value, etc. Creative cognition acknowledges that a range of factors other than cognitive processes contribute to the likelihood of any individual generating a tangible creative product (Wilkenfeld, 1995). Thus, inspiration in task performance needs an array of combined design elements from both functionality and aesthetics. This stems from the fact that affective qualities of design aesthetics may activate positive emotional responses of users when interacting with ICT, which may broaden creative cognition. This is consistent with Fredrickson (2001) who suggests that positive emotions have the effect of broadening the thought action repertoire and of building cognitive resources.

When interacting with ICT design aesthetics, users tend to focus on an array of elements (i.e. colors, shapes, graphics, texts, dimensions) depending on their inclination; how they subjectively visually perceive aesthetics; how they (culturally) define aesthetics; and

how they experience aesthetics. Indeed, the same aesthetic quality of an artifact may have a different effect on different users (Zhang, 2009). In addition to this aspect is how an assortment of these elements can enable users to be meditative; make useful associations; discover new combinations and analogies, or stimulate generative abilities or inspiration. This relates also to how to employ tacit knowledge as well as how conducive the ambiance is to creative thinking. However, it can be argued that the subtlety of human attentional capacity may play a role in creative cognition. And interacting with ICT design as a contextual situation may contribute to stimulating creativity. Such phenomenon might seldom occur in an environment where there are no aesthetics features around. However, the attentional capacity needs to be skillfully explored during task performance in order to bring creative outcomes for users. Therefore, ICT design aesthetics can be a generator of creative inspiration depending on the focus intensity on conflicting elements and how they permeate thought processes in order for a person to be creative. Mendelsohn (1976) suggests that individuals differ in creativity because of the focus of attention and suggest that the greater the attentional capacity, the more likely the combinational leap - the hallmark of creativity. A set of elements can be simultaneously combined in a focus of attention so combinations and analogies can emerge or be discovered. Consistent with that, the creative act involves the discovery of an analogy between two or more images previously thought to be unrelated which emerges as a sudden insight (Sternberg, 1999). Therefore, crystallization of creativity or mental regeneration is most likely to be triggered when various conflicting elements are associatively perceived in a useful way.

Qualitative method and phenomenological analysis

Like all research methods, qualitative method has both weaknesses and strengths. Key strengths have already been covered in the method section. In this section the author thus discusses some weaknesses of qualitative method, survey data collection method, and phenomenological analysis approach in relation to this study. Although the online survey questionnaire was used as a data collection technique in this qualitative psychology research (to understand the relationship between ICT design and users' affect on one hand and the relationship between ICT design and users' cognition and creativity in task performance on the other hand), it is important to highlight the related biases in this regard. Below is the specificity of weaknesses and biases pertaining to the questionnaire, the study, and the qualitative research, they include:

- Asking the right questions can be difficult in this qualitative research.

- To identify the right persons to participate in the survey may still be an issue.
- The variation in students' experience of ICT use can influence the results.
- Unfamiliarity with some concepts may create ambiguity (thus affect the answers).
- Students could feel that the questions may not accurately reflect their views.
- It can be difficult to fully identify participants' perceptions in a questionnaire.
- Self-reflection on one's own emotional or cognitive states can be a maturing process that may require time to articulate.
- The study involves sweeping areas: ICT design, affect, cognition, and creativity in task performance.
- The study of such areas may lead to the inconclusiveness of results.
- The study is limited to a small purposive sampling.
- Qualitative data can be manipulated unintentionally through leading questions and biases that translate directly into the survey questionnaire.
- Researcher becomes subjectively immersed in the subject matter.
- High level of experience is required to obtain the targeted information from the participants.
- Inability to investigate causality between research subareas of a phenomenon.

In terms of the phenomenological analytic strategy, it is valuable to highlight some related issues that have been patterned in this study. Primarily, it is important to realize that there is no perfect analytic strategy to follow as each approach has strengths and limits which applies to the phenomenological analytic strategy. As far as the interpretation process is concerned, the assumption is that in phenomenological analysis, the author has to dip as much as possible into the subjective world of the participant while realizing that the means of capturing that world remains, at best, inter-subjective and objectivity tends to be almost unattainable. Indeed, epistemological claims are based solely on how situations were experienced or remembered by the participants in this study - how situations presented themselves to the experiences rather how they in reality occurred. In a similar vein, there is a vulnerability that is rather transparent with this strategy which is the fact that the whole interpretive process seems to be dependent upon the author's subjectivity, especially with respect to the third step of the phenomenological analytic strategy, the one in which written expressions take on phenomenological sensitivity. In addition, some critical issues arise when participants describe their perceptions of the experiences. For example, deceit can be more problematic in the sense that an author can be deceived with descriptions that are as coherent

and articulate as the writing expressions where a participant can, for some reason, construe the phenomenon to be what it is not. Moreover, participants may, for psychological reasons like being stressed, pressured, or bored, just respond briefly or simply are not inclined to expand further on their experiences of the phenomenon which might affect the course of results analysis as the author would miss what might be critical in leading to robust findings. All in all, it would be fair to point out that these vulnerabilities are not unique to phenomenological analysis or research; rather they concern all qualitative research methods that are dependent upon participants' accounts of situations as equally vulnerable.

Further research

It is acknowledged that the study is preliminary; although it delivers a differentiated picture of the relationship between ICT design, users' affect, cognition and creativity in task performance. Also, as more psychological and theoretical detail is required, in addition to the complex nature of the topic in terms of the synergies and relationships identified in this study, further research is necessary for a fuller understanding of the phenomenon under investigation. Thus, the author calls for further research efforts in order to extend the findings and enrich the general understanding of this phenomenon. There are several potential directions for future research. Special emphasis may be given to software applications design aspects - aesthetics, usability, and functionality - to enhance affective quality, improve ease-of-use, and stimulate creativity, especially within distance learning. Additional theoretical investigation is needed to provide even more detailed guidance on research in the area of ICT design and use and creativity in task performance from a psychological perspective. The measurements for affect, cognition, and creativity constructs and ICT design constructs need to be developed with a clear theoretical understanding as well as to be validated in various ICT contexts. Exploration of the neurobiological perspective is needed to understand how ICT design aesthetics and creative cognition connect so to inform future ICT and equip them with relevant capabilities that support users' activities. Enhancement of meta-cognitive understanding of ICT design benefits among users may raise awareness and mindfulness that will help ensure richer and easier interaction and, eventually, improve users' emotional and cognitive intelligences. Further examination of the impacts of negative affects (such as stress, anxiety, and frustration) in distance learning and how they affect users' cognition in task performance is needed. Formal investigation of e-learners' perception of, perceived usefulness of, and attitude towards e-learning and ICT is needed.

References

ACM & IEEE. (2006). Computing Curricula 2005. *The Overview Report.*

Andreasen, N. (2005). *The creating brain.* New York: Dana Press.

Ashby, F. G., Isen, A. M., & Turken, A. U. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review*, 106, 529 –550.

Baas M., Carsten De Dreu, K. W., & Nijstad, B. A. (2008). A Meta-Analysis of 25 years of mood – creativity research: Hedonic tone, activation, or regulatory focus? *Psychological Bulletin by the American Psychological Association*, 134(6), 779 – 806.

Bean, R. (1992). *How to develop your children's creativity.* Los Angeles: Price Stern Sloan Adult.

Bogdan, R., & Taylor, S. J. (1975). *Introduction to qualitative research methods*. New York: John Wiley.

Botman, H. (1996). *Do-it-yourself usability evaluation: Guiding software developers to usability*. London: Taylor & Francis.

Bower, G. H. (1981). Mood and memory. *American Psychologist,* 36, 29-148.

Cacioppo, J. T., Gardner, W. L., & Berntson, G. G. (1999). The affect system has parallel and integrative processing components: Form follows function. *Journal of Personality and Social Psychology,* (76), 839-855.

Conklin, J. (2001). Wicked problems and social complexity, Dialogue mapping: Building shared understanding of wicked problems. Viewed 1 October 2009, http://www.cognexus.org/wpf/ wickedproblems.pdf.

Cornelius, R. (1996). *The Science of Emotions*. New Jersey: Prentice Hall.

Davis, F. D. (1993). User acceptance of information technology: System characteristics, user performance and behavioural impacts. *International Journal of Man-Machine Studies*, 38, 475-487.

Desmet, P. M. A., & Hekkert, P. (2002). *The basis of product emotions*. London: Taylor & Francis.

Dewey, J. (1987). *Art as experience.* Carbondale, IL: Southern Illinois University Press.

Elliot, R., Fischer, C., & Rennie, D. (1999). Evolving guidelines for publications of qualitative research studies in psychology and related fields. *British Journal of Clinical Psychology,* 38, 215-29.

Fernandes, G., et al. (2003). *Judging the appeal of web sites: The 4th World Congress on the Management of Electronic Commerce.* Hamilton: McMaster University.

Flaherty, A. W. (2005). Frontotemporal and dopaminergic control if idea generation and creative drive. *Journal of Comparative Neurology,* 493, 147-153.

Fogli, D., & Piccinno, A. (2005). Environments to support context and emotion aware visual interaction. *Journal of Visual Languages & Computing*, 16 (5), 386-405.

Forgas, J. P. (1995). *To appear in: hearts and minds: affective influences on social cognition and behavior.* New York: Psychology Press.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: the broaden-and-build theory of positive emotions. *American Psychologist*, 56, 218-226.

Galotti, K. M. (2004). *Cognitive psychology in and out of the laboratory*. Wadsworth.

Gemser, G. (1999). *Design innovation and value appropriation*. Rotterdam: Ph.D. Thesis Erasmus University.

Gedo, J. (1983). *Portraits of the artist*. New York: Guilford Press.

Goguen, J. A. (1999). *Notes on the Ethics of database*. Annenberg Center of the University of Southern California, San Diego, California. Retrieved from http://www.cs.ucsd.edu/users/goguen/papers/4s/4s.html

Hekkert, P. (2004). *Design aesthetics: principles of pleasure in design*. Department of Industrial Design. Delft: Delft University of Technology.

Hix, D., & Hartson, H. R. (1993). *Developing User Interfaces: Ensuring usability through product and process*. New York: John Wiley and Sons.

Husserl, E. (1913/1983). *Cartesian Meditations: An introduction to phenomenology*. Martinus Nijhoff: The Huge.

Isen, A. M., et al. (1985). The influence of positive affect on the unusualness of word associations. *Journal of Personality and Social Psychology*, 48, 1413–1426.

Jonathan, S. (2003). *Qualitative Psychology: A practical guide in research method*. London: Sage Publications.

Karlsson, G. (1995). *Psychological qualitative research from a phenomenological perspective*. Stockholm: Almqvist & Wiksell International.

Kaufmann, G., & Vosburg, S. K. (1997). "Paradoxical" effects of mood on creative problem solving. *Cognition and Emotion*, 11(2), 151-170.

Kirakowski, J. (1996). *The software usability measurement inventory: Background and usage*. McClelland: Taylor & Francis.

Kirk, J., & Miller, M. L. (1986). *Reliability and validity in qualitative research, Qualitative Research Methods Series*, Beverly Hills, CA: Sage Publications.

Langemar, P. (2008). *Kvalitativ forskningsmetod i psykologi: Att låta en värld öppna sig*. Stockholm: Liber förlag.

Lavie, T., & Tractinsky, N. (2004). Assessing dimensions of perceived visual aesthetics of web sites. *International Journal of Human-Computer Studies*, 60(3), 269-298.

Lindgaard, G., et al. (2006). Attention web designers: You have 50 milliseconds to make a good first impression. *Behaviour & Information Technology*, 25 (2), 115-126.

Loewy, R. (1951). *Never leave well enough alone*. New York: Simon and Schuster.

Lubart, T. I. (1994). *Product-centered self-evaluation and the creative process*. Unpublished Doctoral Dissertation. New Haven: Yale University.

Martin, L. L., et al. (1993). Mood as input: People have to interpret the motivational implications of their moods. *Journal of Personality and Social Psychology*, 64, 317–326.

Mendelsohn, G. A. (1976). Associative and attentional processes in creative performance. *Journal of Personality,* 44, 341-369.

Mumford, M. D. (2003). Where have we been, where are we going? Taking stock in creativity research. *Creativity Research Journal*, 15, 107-120.

Mundorf, M., Westin, S., & Dholaski, N. (1993). Effects of hedonic components and user's gender on the acceptance of screen-based information services. *Behaviour & Information Technology,* 12(5), 293-303.

Nielsen, J. (1993). *Usability engineering*. Boston: Academinc Press Inc.

Norman, D. A. (1988). *The psychology of everyday things*. New York: Basic Books.

Norman, D. A. (2002). Emotion and design: attractive things work better. *Interactions*, 4, 36-42.

Norman, D. A. (2004).*Emotional Design: Why we love (or hate) everyday things*. Cambridge, MA: Basic Books.

Palmer, S. E. (1975). The effects of contextual scenes on the identification of objects. *Memory and Cognition,* 3, 519 - 526.

Patton, M. Q. (1980). *Qualitative evaluation methods*, Newbury Park, CA: Sage Publications.

Plsek, P. E. (1997). *Creativity, innovation and quality*. Quality Press.

Poincaré, H. (1913). *The foundations of science*. Lancaster, PA: Science Press.

Rafaeli, A., & Vilnai-Yavetz, I. (2003). *Emotion as a connection of physical artifacts and organizations*. Retrieved from http://www.si.umich.edu/ICOS/Rafaeli-Vilnai-Dec-3-2003.pdf

Roy, R., & Potter, S. (1993). The commercial impacts of Investments in design. *Design Studies*, 14(2), 171–193.

Russell, J. A. (2003). Core Affect and the Psychological Construction of Emotion, *Psychological Review,* 110 (1), 145-172.

Sangjun, K., Euiho, S., & Keedong, Y. 2007, A study of context inference for Web-based information systems. *Electronic Commerce Research and Applications,* 6, 146–158.

Scherer, K. R. (1993). Neuroscience projections to current debates in emotion psychology. *Cognition and Emotion,* 7, 1-41.

Schwarz, N. (1990). *Handbook of motivation and cognition foundations of social behavior.* NY: Guilford Press.

Schwarz, N., & Clore, G. L. (1996). *Social psychology: Handbook of basic principles.* New York: Guilford Press.

Schwarz, N. (2000). Emotion, cognition and decision making. *Cognition and Emotion,* 14(4), 433-440.

Soldat, A. S., & Sinclair, R. C. (2001). *Colors, smiles and frowns: External affective cues can directly affect responses to persuasive communications in a mood-like manner without affecting mood.* Social Cognition.

Somervell, J., et al. (2003). Enlarging usability for ubiquitous displays. *Human Development*, 31, 197–224.

Sternberg, R. J. (1988). Mental self-government: A theory of intellectual styles and their development. *Human Development*, 31, 197–224.

Sternberg, J. R. (1999). *Handbook of creativity*, Cambridge: Cambridge University Press.

Tractinsky, N., et al. (2006). Evaluating the consistency of immediate aesthetic perceptions of web pages. *International Journal of Human Computer Studies,* 64(11), 1071-1083.

Udsen, L. E., & Jorgensen, A. H. (2005). The aesthetic turn: unraveling recent aesthetic approaches to human-computer interaction. *Digital Creativity,* 16(4).

Venable, J. (2006). *The role of theory and theorising in design science research*, First International Conference on Design Science Research in Information Systems and Technology, Retrieved from http://ncl.cgu.edu/designconference/DESRIST%202006%20Proceedings /2A_1.pdf

Wallas, G. (1926). *The art of thought*. New York: Harcourt Brace and World.

Walsh, V., et al. (1992). *Winning by design, technology, product design and international competitiveness*. Oxford: Blackwell.

Walsh, V. (1996). Design, innovation, and the boundaries of the firm. *Research Policy*, 25, 509-529.

Wasserman, V., Rafaeli, A., & Kluger, A. N. (2000). Aesthetic symbols as emotional cues. In Emotion in Organizations, S. Fineman (ed.), London: SAGE.

Wilkenfeld, M. J. (1995). Conceptual combination*: Does similarity predict emergence?* Unpublished Master´s Thesis, Texas: University A&M. College Station.

Wolfgan, J. (2001). A scenario for design. *Design Issues MIT*, 17(2), 64–80.

Yardely, L. (2000). Dilemma in qualitative health research. *Psychology and Health,* 15, 215-28.

Yiend, J., & Mackintosh, B. (2005). *Cognition and Emotion.* Oxford University Press.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist,* 35(2), 151-175.

Zhang, P., & Von Dran, G. (2000). Satisfiers and dissatisfiers: A two-factor model for website design and evaluation. *Journal of American Society for Information Science,* 51(14), 1253-1268.

Zhang, P., & Li, N. (2004). Love at first sight or sustained effect? The role of perceived affective quality on users: Cognitive reactions to information technology, *International Conference on Information Systems* (*ICIS'04*), 283-296.

Zhang, P., & Li, N. (2005). The importance of affective quality. *Communications of the ACM,* 48(9), 105-108.

Zhang, P. (2008). Motivational affordances: Reasons for ICT design and use. *Communications of the ACM*, 51(11).

Zhang, P. (2009). Theorizing the relationship between affect and aesthetics in the ICT design and use context. *Proceedings of the International Conference on Information Resources Management.*

Appendix

QUESTIONNAIRE BACKGROUND

Objective

This questionnaire is sent out to distance learning students (Master of Informatics). This is to seek your views as users about how ICT design relate to affect, cognition, and creativity in task performance. A Bachelor student at Blekinge Institute of Technology (BTH) in Karlskrona is doing this as a part of her thesis in the area of behavioral science. Your responses are absolutely confidential and will be used solely to contribute to this study.

Format – The questionnaire should take approximately 25 minutes to complete.

QUESTIONNAIRE

I. Preliminary

1. Can you describe your experience concerning distance learning and the role of ICT in your studies? Please write as much as you like and feel free to disclose your thoughts and feelings.

II. ICT design and Users' Affect

1. What feelings do you usually have when you acquire a new computer or install a new version of a software application?

2. What design criteria do you usually consider when you acquire new ICT products or services?
   Prompt: functionality, aesthetics, usability, etc.

3. If simplicity in ICT design means pleasure to you, how would you describe this feeling?
   Prompt: what words come to mind, what kind of feeling, etc?

4. What colours appeal to you most regarding PCs and software graphics? And in what way do they affect your feelings when interacting with them?

5. It is known that computers, software graphics, and web design are associated with a wealth of aesthetical features, how do these features affect your feelings generally?
   Prompt: delight, satisfaction, frustration, dissatisfaction, etc.

6. How would you describe your feelings when using communication systems (i.e. videoconferencing, Marratech, e-communities) to attend virtual meetings or take part in online discussions?

III. ICT Design and Users' Cognitive and Creative Task Performance

1. Has using your PC inspired you when performing tasks? If so, can you describe a typical occasion where you were satisfied most with your creative performance?
   Prompt: generate new insights and ideas, creative associations, tacit knowledge, etc.

2. Are there any specific occasions where you feel that your PC makes it easy for you to carry out complex tasks or perform them in a better way?

3. Can you describe a situation where a software application stimulates your creativity or enhance your proficiency in performing your tasks?

4. What would stimulate your inspiration most when you carry out tasks; using powerfully functional or attractivelly designed computers or both? How does this happen?

5. Can you list two or more elements you usually pay attention or focus on when interacting with ICT generally?
   Prompt: element may include images, colours, shapes, layouts, menus, etc.

6. How does the process of focusing on different elements help you generate new combinations and associations that would otherwise not leap to your mind?

Additional comments and suggestions:
Is there anything else you want to address or add to the content of this survey?