1. INTRODUCTION

"It is the supreme art of the teacher to awaken joy in creative expression and knowledge" Albert Einstein.

Creativity has intrigues the humans for a long time. Contemporary world is dependant on creativity for all innovations that are vital for meeting demands of the society from food production to apparels and transportation to energy. Since education plays a major role in nurturing creativity improving the education program to enhance creative learning outcomes are crucial for progression in any profession.

1.1. Research context: Is architectural education getting ready for the age of innovation?

Creativity has shown its significance in every discipline. The need for creativity has been felt by every industry within the turn of events of this century. According to a recent study by IBM (IBM Corporation, 2010) with 1500 CEO's it has been highlighted that "creativity is the most important leadership quality". Many other developments in creativity studies have demonstrated its significance across various fields. Europe brought creativity and innovation to fore in their cooperation where the Communication of March 2008 simply lays it as: 'Europe needs to boost its capacity for creativity and innovation for both social and economic reasons'. The decisions of the European council to establish the year 2009 as the European Year of Creativity and Innovation further strengthen their emphasis.

The knowledge economies are rapidly taking over the industrial economies making a significant place for creative and innovative businesses to thrive in global markets. Out of the world self-made billionaires majority are engaged in knowledge based industries. In economic development Asian region find it more important to develop entrepreneurship as opposed to large corporations in Europe and US (Bacon-Shone & Hui, 2009). And the degree of the regional creativity was enormous that Muhammad Yunus and Grameen bank was even awarded the Nobel Peace Award for their innovativeness. Darwin put his theory as the

survival of the fittest: in today's context it is being creative and innovative that could be classified as the fittest.

Education plays a crucial role in relation to creativity (Villalba, 2009). Education is the key to enhance creativity encouraging them to be innovative as a lifelong habit. Understanding creativity again plays a major role in fostering for creativity in education. David Bohm (1998, p. 1) states that creativity is something that is impossible to define and if the whole idea of creativity is so nebulous then an attempt to foster creativity in learning may be equally difficult. Ried & Petocz (2004, pp. 46-53) summarise many theoretical developments in educating for creativity that has been done mainly focusing on theories of creativity developed by educational psychologists.

Architectural profession specifically termed, as a creative industry would find it even more important to foster creativity. Originality is an essentiality for survival of the profession. Therefore discipline demands architects to be creative where education plays a major role in making a creative architect.

"In recent decades universities and architecture schools in particular, have made important efforts to improve design education. The goals in new ways of teaching design are mainly concerned with enriching the pure artistic vision of architecture, through the insertion of scientific knowledge and social responsibility. Environmental comfort and the question of sustainability have increased the need for exact science and technical education. Social sciences need to instil sensitivities towards the relation of human behaviour and elements of the built environment. Finally, results of studies on creativity should enrich the design process" (Kowaltowski et al., 2010).

The contemporary world with its dynamic production of knowledge and speed in technological advances, as well as obsolescence, demands professionals capable of keeping up with this pace and creativity is seen as an essential human asset. The new order also implies that design students need a deeper understanding of

background knowledge and need to acquire new abilities and attitudes towards design, with an increased demand on creativity. Producing designs that are fresh and new to the problem domain are expected of our students and of design professionals as a whole.

Concurrent to development in technologies there are drastic changes that has shaped the architectural education. Computer aided design, Sustainability overlays, virtual reality, Building Integrated Modelling (BIM) are some leading concepts that surfaced in recent times. Specifically technology-based developments have assisted in improving efficiency drastically yet the extent to which these advancements contributed in fostering creativity is doubtful. Research has even claim that technology may drive students away from creative thinking rather than nurturing it.

In this juncture we need to reflect whether we have concentrated enough on nurturing creativity. Recent study concluded that very limited creative technologies have been adopted across the architectural education. Contemporary goals in higher education and particularly design education include giving students tools to stimulate the search for creative solutions to problems, as well as a solid scientific basis for decision-making processes. In various attempts to meet such targets, the introduction of methods that may enhance creativity can be found in the discussions on educational developments and reforms.

The literature on creativity is rich, and extensive studies have been conducted on how to enhance this human skill or thought process (Cross, 1997; Boden, 1999; Runco, 2004; Siqueira, 2007; Alencar, 1996; Sternberg, 1991 and Iashin-Shaw, 1994) have emphasized the fact that higher education must teach students to stimulate their own creativity, to prepare them for the contemporary employment and professional opportunities. The same authors show evidence however, that higher education rarely adopts practices that inculcate creativity. Alencar and Fleith (2004) have outlined the fact that most graduating professionals are capable only of applying what is common knowledge in conventional ways.

Horng et al. (2005) argues that the concept of creativity must be a key factor in new teaching strategies and curriculum design. Although there is a clear consensus on the necessity of incorporating the concept of creativity in higher education, very few courses interact formally or explicitly and in a structured conscious way with the issue. In many countries, the development of creativity has become an important educational goal. In the UK, for example, a series of governmental and educational initiatives is focusing on ways of developing learner creativity at all levels (e.g. Creativity in Education, 2003; National Curriculum, 2001; The Travelling Case, 2003).

The existing literature on creativity and the methods in use that may stimulate are significant for design education but can be observed that they are not always explicitly applied in a structured pedagogical way. The UNESCO/UIA (2005) charter for architectural education stipulates that a variety of methods should be applied to improve the design-studio environment culturally and urges for adaptable teaching to relate to varied demands and design problems. However the charter does not address creativity specifically and studies on design education (Rufinoni 2002) show the lack of application of pedagogical instruments to develop critical consciousness and inculcate attitudes in students towards creative behaviour. Jeffries (2007) along with many others also reiterates the need for new teaching methods in the design-studio to increase creative thought and performance.

With increased complexity in the design world and in social systems as whole, innovation, originality or the stimulus for creative thought, could no longer rely on talent, skill or intuition alone. Creativity, broadly known as a phenomenon of generating new ideas, is seen by many as the driving force in the design process within a wide variety of fields, from architecture to mechanical design. For every design professional, originality is the prime goal, spurning repetition of ideas. ‘‘Cookie Cutter’’ architecture is the symbol of all that is wrong with our present-day society, yet the expectations of creativity in designing of buildings are not merely bringing an original product but a more complex solution resolved in a

creative manner. This in fact is finding new and original ways to tackle functional, technical, social, urban, environment and aesthetic problems in intelligent and sustainable means.

The hardest challenge of architecture today is addressing complex socio-economic desires and keeping ahead of innovations in other sectors to satisfy these needs. Now people are not merely building for pleasure but finances are a key determinant in many design decisions. Thus financial markets are innovating and construction sector value engineering is also rapidly adapting to these architects will be left behind if they could not innovate in the design process.

Green building movement has also challenged the architect to innovate rapidly while understanding the complicated technical advancements. What have been observed is that the lack of competency and innovation by architects allowing for a situation where technically competent engineering professionals to take over a lead role in construction projects. Change of urban life styles with trends such as technically driven smart cities, affordability issues in urban housing, various environment initiatives and regulations are among key concerns that threat architects. Only the ability to innovate and adapt to the changing drifts could place the architect in the driving seat. Are we done enough in pedagogy to address these pressing issues?

In their 2008 study of architectural education in Australasia, Ostwald and Williams (2008a, 2008b) found that divergence between the field of practice and technical rationality continue to mark architectural education, particularly in relation to the question of creativity. Ostwald and Williams found that there are three key issues facing architecture and design educators, namely:

- a lack of understanding of the pedagogical dimensions of creativity in design;
- a lack of appropriate strategies to understand where different levels of creativity occur and how they should be assessed; and,

- a lack of appropriate models and tools to support assessment of creative works.

This highlights the need for creativity education particularly in architectural domain calling for action to address the issue in education programs.

Giving students design tools, such as drawing, Computer Aided Design and model making, has traditionally been considered important; however, without giving specific attention to methods that may increase creativity, the design-studio is considered to be less productive in forming creative professionals. Therefore design education specifically studio should explicitly promote creative behaviour in conducting its traditional role in generating new and original ideas as well as provide solutions for the demands of the modern day context.

1.2. Research problem, Argument, questions and hypothesis

Need for creativity is apparent in architectural design but fostering it is strenuous. This requires careful investigations of how creative methods are derived not only in architecture but also in other discipline. Looking into vast array of creative methods reveals that every method is based on a theoretical understanding of creativity. Some theories have been developed on person (Amabile, 1998) and some have focused on process (Swede, 1993) whereas others have worked on the product (Sternberg & Lubert, 1995).

Across various fields of studies almost 250 methods were found used by educators to enhance creativity at different stages of creative activity mainly focusing the creative thinking process. These include simple techniques like brainstorming to very complex pedagogical models. All these are based on some factors that influence creativity in educating. Dineen, Samuel, & Livesey (2005) have identified eight factors that influence student creativity: (1) Physical environment (2) timing and scheduling (3) teaching style and approach (4) teaching methods (5) project and task (6) assessment and feedback (7) learner motivation and attitudes to learning (8) Prior relevant skills and knowledge.

Investment theory (Sternberg and Lubart, 1995) have identified six factors that influence creativity: (1) intellectual abilities (2) knowledge (3) styles of thinking (4) personality (5) motivation and (6) environment. There are many other approaches that have been developed through research both theoretical and empirical but as a whole also considering the factors they focus on these can be broadly categorised as being person oriented, process oriented, product oriented models.

Person oriented approaches primarily based on personality traits that enhance or suppress creativity. Motivations, openness, risk-taking ability, are some of the positive attributes in personality for creativity. Process oriented models are more concerned on creative process that takes place in creating. Many of these approaches are based on the process worked out by Wallas (1926) involving seven phases: Preparation, activation, cogitation, illumination, Verification, Communication, and validation. Product oriented methods are based on final products.

Thus in more complex situations such as in architectural design one would require a similar complexity in understanding the creativity as found in theoretical models developed for various creative interventions. Amabile (Amabile, 1998) have used a theoretical framework based on motivation, Sternberg (Sternberg R. , 2006) have used the Investment theory. Dineen (Dineen, Samuel, & Livesey, 2005) have used a pedagogical model called creative workshop as the theoretical framework. There are many others who have worked in this field using different theoretical approaches and there is always a need to develop a theoretical framework to explain the phenomena of creative behaviour in order foster it.

Teaching creativity in architecture would find no exemption and demands a theoretical framework to understand creativity in order to facilitate creative performance. Amidst the vast array of creativity theories to build a theoretical

framework one need to understand the particular needs and aspirations of the field of study in concern.

This need to build a theoretical framework provides basis for the **Research Problem**: What is the mechanism to foster creativity in student design performance?

Argument

A recent study argues that the main problem in teaching architectural design lies in that the assessment is focused on the product of student effort's not on the process (Bashier, 2014). The study further concludes that this has caused lack of balance between rationality and creativity in the design process. This indicates that the creativity within the design process is crucial skill that every school is emphasising in education programs. The design studio is the key in nurturing creativity in design process and design output would reflect the creativity of the student. The studio is focused on developing design through a phased out program with different stages. This is akin to a creative process based on stage models.

The architectural design process is based on a creative phase where creativity is highly valued. Although the literature on creativity is rich in ways to stimulate the decision-making process, these tools are rarely formally present in the building design process. To increase design quality and productivity stakes have been put on design methods in the last fifty years, especially in architecture. In the 1960s, systematic design methods were widely examined particularly to reduce subjectivity in design, to apply scientific knowledge more effectively and use information technology productively.

The methods brought forward by Jones (1970) were organized according to input (what designers know) and output (what designers want to know) and included a variety of methods still important today. The list of tools in relation to the enhancement of creativity included Brainstorming, analogy and attribute lists to

aid in ‘‘removing mental blocks’’. The goal in developing design methods was to improve both the process and the product outcome. Prominence was given to accumulating structure to the decision-making process in design. The argument was that, after all, most disciplines depend on tools, techniques, protocols of good practice, so design and in particular, architectural design should have the same (Kowaltowski et al., 2010). More specifically a theoretical framework that strengthens the creative process could become a tool to improve design performance.

The creative process itself is explained through many theories and multi stage models could be a source to reflect the complex design process expected from architectural students. In developing the theoretical framework firstly a working creative process model need to be identified. Once the creative process phases are identified by superimposing them onto activities that take place in the studio could assist in including domain specific tasks for the creative intervention. . This could also provide a way of transforming the design studio implicit knowledge into explicit knowledge. Particular methods that could enhance performance in creative design process should be assembled on to the working model to develop the “theoretical model of creative design process”. Then the framework could be used to develop a studio design programme.

Research Questions

The research would be based on three research questions.

1). Can a mechanism based on creative process be used to develop a theoretical model to design a creative intervention in a design project?

2) Is there a relationship between the student performance at different creative process activities and creativity in the final design mark?

3) Has the student design mark improved after the creative intervention?

Hypothesis 1 : Students marks in the design guide and their final design performance are correlated

Hypothesis 2: Design marks of the students before and after the intervention are correlated

1.3. Aims and Objectives

The aim of this study is to explore how to facilitate creativity in architectural design education to improve design performance.

In order to achieve this aim following objectives were derived for the study,

- To develop a theoretical framework that could become the basis to foster creativity in student design performance
- To explore a mechanism to incorporate implicit knowledge within design studio in strengthening creative process while transforming them into explicit knowledge.
- To explore how a creative intervention can be developed based on the theoretical model to improve student creativity in a design studio program.

1.4. Scope and Limitations

The study is focusing on broad subject areas of creativity and architecture. Therefore in each discipline it is essential to define the focus pertaining to this particular study. Creativity possesses a vast variety of areas in research and within the framework of this study it would explore the creative process. It will also attempt to explore the creativity phenomenon within architectural education context. The emphasis within the architectural education would be on the design activity and specifically design studio where both process and product are generated and evaluated.

Within this research the nature of inquiry was correlational. However the correlation is used as the basis to inform that there seem to be a causal effect. Within the scope of this study the causal relationship is not discussed and explored. Rather the correlation is established which would suffice the anticipated learning outcomes outlined by the faculty for a Master of Philosophy.

1.4.1. Setting the design programme

The scope of the design programme was taken to suit the current design module outline that limits the applicability of all relevant studio activities normally found within a design programme. The guide was also prepared to suit this scope limiting the exploration of creative methods across the creative process.

When designing the guide there are many methods to choose from. Therefore the study was limited in selecting only the methods that can assist in the given design exercise. Therefore there can be many other similar methods that can be adopted for the same output. But within the scope of this study only few exercises that can only be achieved within the given time period were selected. The design guide was developed in particular to this design. It comprises of five parts: assimilation, generation, selection, conceptualization and visualization. The justification and actual practical realization was considered beyond the scope for this study. Therefore the activities are limited and assessment was also based on this. But it could be developed into a more comprehensive design guide that could be used on varied design problems.

1.4.2. Data Analysis

The study is limited to one case study within an interior architecture bachelors degree program and the data was generated only through that particular case in one design programme.

Within the scope of this study whether there is an impact through the intervention that was done to improve the creative process within an architectural design programme was examined. In order to understand this the design mark prior and after the intervention was examined to establish a correlation. The positive correlation was taken as an indicator that the impact has helped in improvement. To further strengthen the argument the previous year marks between the two designs could also be analysed to find correlations. But within the scope of the study it will only limit to establishing

the correlation in the design of this group of students among the marks from the two semesters.

The study was limited to analysing the quantitative data of results from the design project. Where a more in depth insights could be drawn from interviews of the students. Considering the scope of the study and requirements of the level of an inquiry suitable for MPhill this limitation was exercised.

1.5. Research Methodology

Within the context of this research methodology refers to the whole research approach inclusive of Research philosophy, Design and methods. Hitchcock and Hughes (1995) suggest that ontological assumptions give rise to epistemological assumptions; these, in turn, give rise to methodological considerations; and these, in turn, give rise to issues of instrumentation and data collection. Deriving of research methodology is based on this line of reasoning and therefore ontological assumptions are taken into consideration first, then the epistemological considerations which will determine the methodological understating within an abstract philosophical thinking framework. Once philosophical context is resolved research design and methodology are worked out in detail.

Developing a philosophical framework is made a difficult task by incoherent classification of research philosophies such as epistemology, ontology, axiology and doxology and the quantitative-qualitative dichotomy debates (Mkansi, 2012). A number of studies (Saunders et al., 2009; Ritchie and Lewis, 2003; Guba, 1990; Guba and Lincoln, 1989) have used different descriptions, categorisations and classifications of research paradigms and philosophies in relation to research methods with overlapping emphasis and meanings. Whilst the scholars battle out on the foundation of philosophies or paradigms to research approach, Johnson and Onwuegbuzie (2004) argue that the differences in epistemological beliefs and logic of justification do not dictate what specific data collection and analytical methods to utilise, therefore, should not prevent the exploitation of any methods.

In support of this, Guba and Lincoln (1994) stress that the rooting of approaches is secondary to paradigm and do no limit the use of either qualitative or quantitative from any research paradigm. Differences of trivial nature paid to philosophies in relation to research approach are greatly discussed by Becker (1996). Thinking on the same line the research philosophy was understood as being without clear boundaries among different stances.

1.5.1. Research Philosophy

Prior to determining the philosophical stances the research was broadly taken as lying within the parameters of education research. Kohen et al.(2007) sets out several foundations on which different kinds of empirical research are constructed in education research :

- Scientific and positivistic methodologies
- Naturalistic and interpretive methodologies
- Methodologies from critical theory
- Feminist educational research.

The established, traditional view holds that the social sciences are essentially the same as the natural sciences and are therefore concerned with discovering natural and universal laws regulating and determining individual and social behaviour; The interpretive view, however, while sharing the rigour of the natural sciences and the same concern of traditional social science to describe and explain human behaviour, emphasizes how people differ from inanimate natural phenomena and, indeed, from each other. These contending views – and also their corresponding reflections in educational research – stem in the first instance from different conceptions of social reality and of individual and social behaviour.

Although their definitions of ontology, epistemology, and axiology have a common theme with a bit of different meaning and emphasis; there seem to be no consensus in the classification and categorisation of these conceptions. Saunders et al., (2009) and Will et al., (1997) conducted thorough literature review on these philosophical developments concluding that there are

overlapping evolutionary processes. Exploring these stances further reveals overlaps and similarities challenging the research student in orienting their research. For example, Ritchie and Lewis‘s (2003) description and classification of ontological and epistemological stances differ from that of Saunders et al. (2009). Ritchie and Lewis’s (2003) ontological perspective is inclusive of realism; materialism, critical realism, idealism and relativism; and the epistemological perspective include positivism and interpretivism. Hence, Saunders et al.’s (2009) and Guba and Lincoln (1994) indicate a perspective that views philosophies (i.e. positivism, realism, interpretism, and pragmatism) from an ontological, epistemological, axiological stance.

In search for the ontological postulations they are taken as assumptions, which concern the very nature or essence of the social phenomena being investigated. The simple question can be asked whether the social reality is external to individuals – imposing itself on their consciousness from without – or is it the product of individual consciousness? Is reality of an objective nature, or the result of individual cognition? Is it a given ‘out there’ in the world, or is it created by one’s own mind? These questions lies between the constructivists–objectivist debate. Constructivist suggests that organization and culture are pre-given and therefore confront social actors as external realities. Objectivism proposes that social phenomena confront us as external facts that are beyond our reach or influence (Bryman, 2008).

Therefore concentrating on the nature of education background in research the study is focused on an objectivism way of looking into the research. The data is taken as not constituent of social values and interpretations. Therefore the ontological standing would be that the study lies within the objectivism.

The selection of epistemological stand would follow the debate on which philosophy is for social sciences or natural sciences? The survey findings by Orlikowski and Baroundi (1991) and Alavi and Carlson (1992), for example, report that the philosophies found to be widely applied and more popular in

Information systems was positivism, and links the philosophy to the field of social sciences (Steinmetz, 2006). But, Polit and Beck (2008) associate positivism to natural sciences. In a different view, Bryman (2008) associates positivism to social research that applies natural science. This leads to subject rooting to different fields of study, for example, Information system's roots is found to be overlapping with different field of studies such as social sciences, computer science, and business studies (Orlikowski and Baroundi, 1991; Hirschheim, 1985; Steinmetz, 2006). Hence the debate boarders on whether quantitative is for natural sciences (Polit and Beck, 2008; Steen and Roberts, 2011), and the case of qualitative approach in social sciences as is widely prescribed by Babbie (2007). It is quite evident that the selection is not merely based on whether social science or natural science but rather lies in the concerns with the particular subject area.

This philosophical foundation debate gave rise to contradicting arguments as to which philosophy is best for a particular subject. For example, three different philosophical views have been identified for information systems (IS), namely, critical social theory (Ngwenyama and Lee, 1997; Orlikowski and Baroundi, 1991); Pragmatism (Agerfalk, 2010; Goldkuhl, 2008); critical realism (Hjorland, 1998; Dobson, 2002). Yet, the survey findings by Orlikowski and Baroundi (1991) and Alavi and Carlson (1992) indicate that the philosophy found to be more popular in Information systems is positivism. Similarly education research also reveals that majority of studies has taken the positivist stance making it the more reliable orientation for epistemological assumption.

These sets of assumptions identified above have direct implications selecting methodology, since the contrasting ontologies and epistemologies in turn demand different research methods. Investigators adopting an objectivist (or positivist) approach to the social world and who treat it like the world of natural phenomena as being hard, real and external to the individual will choose from a range of traditional options – surveys, experiments, and the

like. Others favouring the more subjectivist (or interpretivist) approach and who view the social world as being of a much softer, personal and humanly created kind will select from a comparable range of techniques – interviews, participant observation and personal constructs. Bryman (2008) also believe that objectivist and positivist stance could be more oriented towards a quantitative approach in methodological assumption. Hence the generated data is analysed through a quantitative analysis tools to draw conclusions.

In conclusion the research philosophy is constituted on objectivist, positivist and quantitative propositions. This will also move towards selecting a research design that could provide data to be generated to suit the philosophy n concern and therefore analysed in a quantitative objectivist methods. However not forgetting that the main research question is asked in a education setting a more common research design of an action research was adopted to conducted the research, generate data and analyse.

1.5.2. Research design: Action research in design studio

The term ‘action research’ has often been used in a similar way to other terms used to describe research undertaken by educational practitioners, such as: ‘classroom research’ (Hopkins, 1985); ‘self-reflective enquiry’ (Kemmis, 1982); ‘educational action research’ (Carr and Kemmis, 1986); and, ‘exploratory teaching and learning’ (Allwright and Bailey, 1991). You may also find it referred to as 'practitioner enquiry', 'reflective analysis' or 'evidence-based practice'. The most important component of action research is that it does include both action and reflection that lead to enhance practice. Kemmis and McTaggart distinguish it from the normal practice of teaching in the following way:

- It is not the usual thinking teachers do when they think about their teaching. Action research is more systematic and collaborative in collecting evidence on which to base their group reflection.
- Action research involves problem-posing, not just problem-solving. It does not start from a view of ‘problems’ as pathologies. It is motivated by a quest

to improve and understand the world by changing it and learning how to improve it from the effects of the changes made.

- It is not research done on other people. Action research is research by particular people on their own work, to help them improve what they do, including how they work with and for others.

Scholars also argue that it is a reliable part of good teaching. “Action research involves practitioners in studying their own professional practice and framing their own questions. Their research has the immediate goal to assess, develop or improve their practice. Such research activities belong in the daily process of good teaching, to what has been called the 'zone of accepted practice’” (Zeni,1998, p.13).

Cohen, Manion and Morrison (2000) summarise the two ends of the action research continuum as follows: ‘On the one hand are long-time advocates of action research such as Elliott (e.g. 1978; 1991) who are in the tradition of Schwab and Schön and who emphasize reflective practice; this is a particularly powerful field of curriculum research with notions of the “teacher-as-researcher” (Stenhouse, 1975, and The Reflective Practitioner, Schön, 1983, 1987.) On the other hand there are advocates in the “critical” action research model, e.g. Carr and Kemmis (1986).’

Cohen, Manion and Morrison (2000) identify three possible approaches:

- **Technical Action Research:** typically undertaken by individual practitioners on a relatively short-term basis and aimed at making ‘an existing situation more efficient and effective’.
- **Practical Action Research:** which is ‘...designed to promote teachers’ professionalism by drawing upon their informed judgement. It is akin to Schön’s ‘reflection-on-action’ and is a hermeneutic activity of understanding and interpreting social situations with a view to their improvement.’

- **Emancipatory Action Research:** '...which is political as it is educational ... [and] seeks to develop their understanding of illegitimate structural and interpersonal constraints that are preventing the exercise of their autonomy and freedom.'

What ever the approach and terminology used there are some basic features that outline its procedures. Following is an adaptation from O'leary (2004).

- **Addresses practical problems**: Action research is built in real problems and realistic situations. It involves the identification of practical problems in a specific setting and takes efforts to pursue and implement solutions in same setting. Action research is frequently used in workplaces and education settings where methodical change is a high priority to improve professional practice. It is also considered a successful strategy when there is a strong aspiration to alter both theory and practice.
- **Generates knowledge**: Action research is not merely change implementation but highly dependent on generating knowledge to produce and enact change. This method rejects linear two-stage process of knowledge first, change second, but rather promotes an integrated cyclic process. Action research practitioners believe that enacting change should not just be seen as the end product of knowledge; rather it should be valued as a source of knowledge itself.
- **Enacts change** : Action research goes outside knowledge production and combines change into its direct goals. It can be in developing academic or technical skills, facilitating more reflexive professional practice, but works towards a situation enhancement based in practice, and avoids the problem of needing to work towards change once the knowledge is produced.
- **Is participatory** : it could be termed as 'democratization' of the research process. Without relying on the purview of the expert, it consists of participation, and collaboration between, researchers, practitioners, beneficiaries and any other interested stakeholders. There is an attempt to minimize the distinction between the researcher and the researched, with

high value placed on local knowledge. Therefore with the intention of transforming implicit knowledge in the studio to a more explicit format this could be the ideal selection of research design.

Contrary to many research models, action research works *with*, rather than *on* or *for*, the 'researched', and is therefore often seen as representing democratic principles. The key is that those who will be affected by the research and action are not acted upon. Now the nature of participation and collaboration is varied and based on the action research approach adopted; the particular context of the situation being studied, and the goals of the various stakeholders. This could get 'researched' parties involved in any or all stages and cycles of the process. Meanwhile the researcher's role is to facilitate a sustainable change process that can find the researcher acting as planner, leader, catalyser, facilitator, teacher, designer, listener, observer, synthesizer, and/or reporter at various points throughout the project. In this particular research the participation of the studio tutors are taken at all stages while student participation is taken during the action cycle.

- **Relies on a cyclical process**: Action research take place in a cyclical process that develops as knowledge surfaces. Cycles converge towards better situation understanding and improved action implementation; and are based in evaluative practice that alters between action and critical reflection. Therefore it can be seen as an experiential learning method to deliberate change. The strategy is continuously refine methods, data, and interpretation progressing through each cycle.

Understanding the cyclic process is crucial in designing an action research and there seem to be different interpretations to this cycle of activities. Lewin (1951) who pioneered the action research in his original model had six iterative phases, analysis, fact-finding, conceptualising, planning, Implementation of action and evaluation. Based on the same flow of activities widely found model is from Susman (1983) with five stages as shown in

figure 1.1.

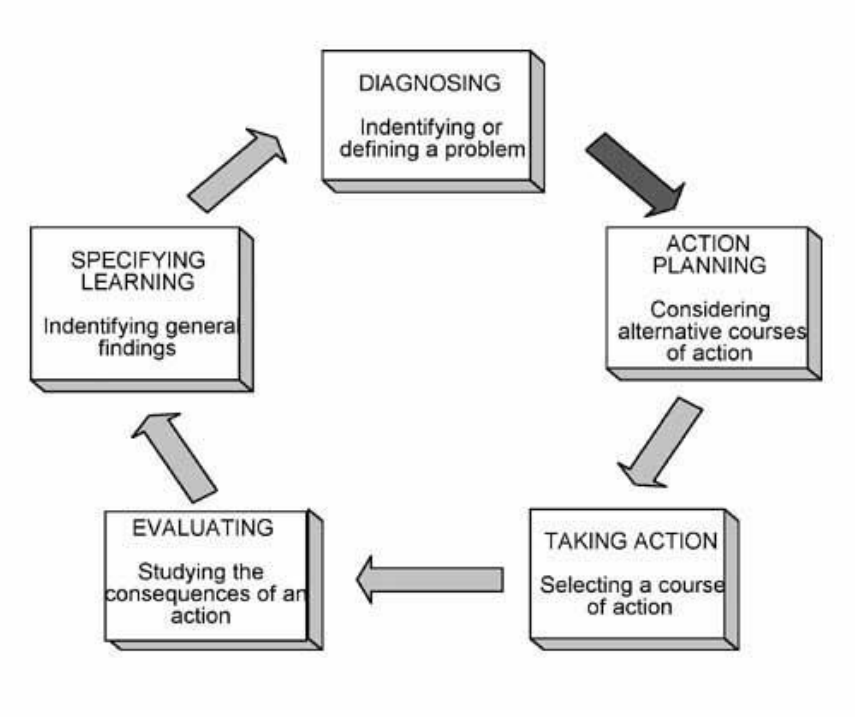


Figure 1.1- 05 phase model by Gerald Susman (1983)

Thinking on a similar line to Schon, Gibbs (1988) has derived a reflective cycle that is used to explain not only action research but broader experiences as well (figure 1.2). O'leary(2004) in more recent times shows a more iterative process as depicted in figure 1.2.

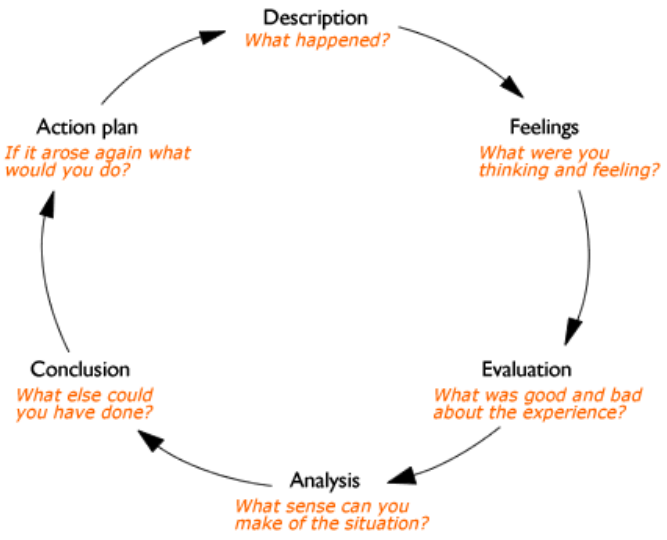


Figure 1.2. -Gibbs (1988) reflective cycle.

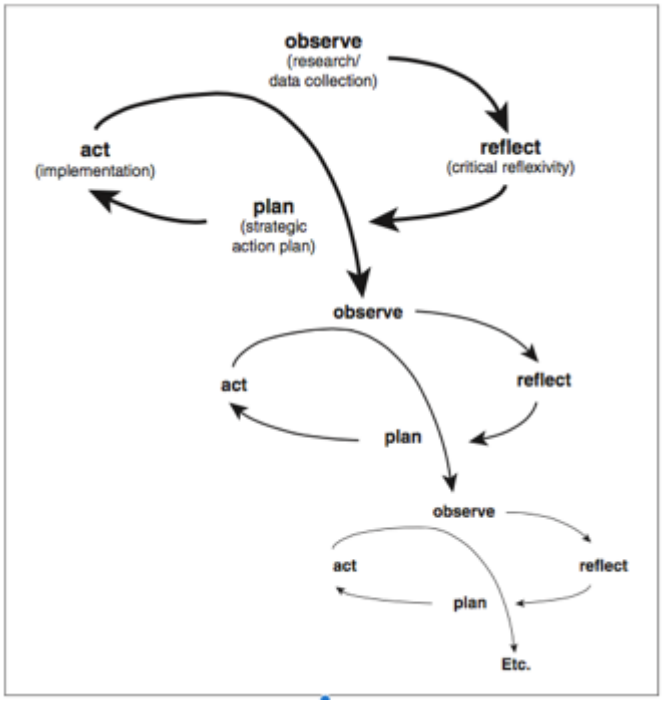


Figure 1.3 – Action research diagram form O'leary (2004)

Reflective model from Schon (1983) is more widely used in design disciplines as diagrammatically presented in figure 1.4.

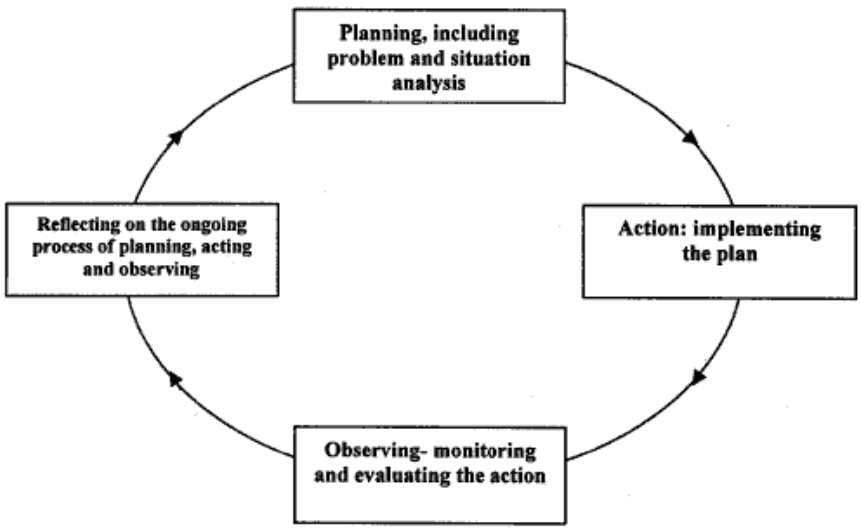


Figure 1.4- Schon (1983) reflective model

It could be observed that many differences are merely based on terminology but across the approaches four clear stages could be identified that could provide premise for this study: planning an action, acting, analysis (evaluation) and reflecting. Figure 1.5 present the action research model derived for the study considering the nature of the research question and domain specialities.

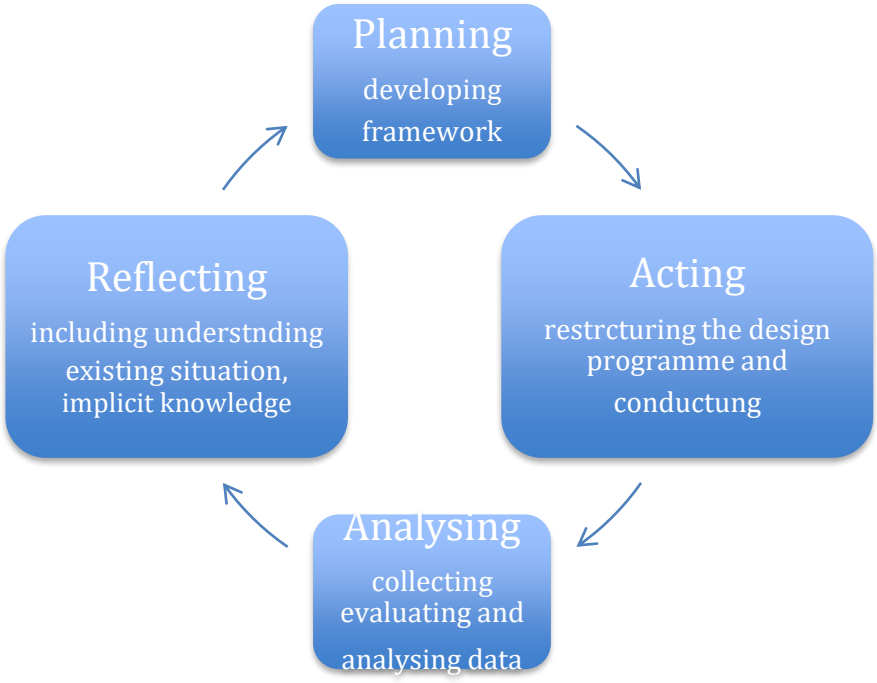


Figure 1.5- Design Studio reflective model (Author)

Within this cyclic process the research is initiated with the reflection on design studio and then planning an action. This phase result in the theoretical framework and the creative intervention that is developed based on that and conducting the studio project is actually the acting in the process. Analysing is looking into the generated data and conducting of statistical analysis. The interpretation of data and drawing conclusion is again reflecting on the design studio returning to the reflecting on the cyclic process completing one cycle. In conclusion following table summarize how key aspects of action research are addressed in this particular research design.

Table 1.1- Responses to action research aspects

Action research aspect	**Research design response**
Address practical problem	The research is based on actual practice in design studio
Generates knowledge	The research is designed to generate data allowing for interpretation of student performance
Enacts change	The insights drawn in the research could lead to better practice in design studio initiating action
Participatory	The students, tutors and researchers participation is integral in conducting the research
Uses a cyclic process	Design Studio reflective model as shown in figure 1.5 derived by the author is used to conduct the research

1.5.3. Sampling

Traditional scientists often view non-random samples as inferior because they cannot be statistically assessed for representativeness. For these researchers, 'non- random' implies samples that are gathered through strategies seen as second best or last resort. There is a growing belief, however, that there is no longer a need to 'apologize' for these types of samples. Researchers using non-random samples may be involved in studies that are not working towards representativeness or generalizability. They may be selecting their sample for other defined purposes. Further, there is growing recognition that non-random samples can credibly represent populations, given that selection is done with the goal of representativeness in mind.

This has led non-random samples to be labelled 'purposive' or 'theoretical', which highlights the importance of conscious decision-making in non-random sample selection. While understanding the potential value of non-random samples, the use of the word 'purposive' implies that random samples are not purposive, which of course they are. All sampling strategies should

be purposive and all purposive strategies should be of value as deter- mined by their ability to meet stated research goals.

Handpicked sampling involves the selection of a sample with a particular purpose in mind. When looking for representativeness this might involve selecting cases that meet particular criteria; are considered typical; show wide variance; represent ‘expertise’; or cover a range of possibilities. Other options for handpicked sampling include the selection of critical, extreme, deviant, or politically important cases. While not likely to be representative, the selection of such cases allows researchers to study intrinsically interesting cases, or enhance learning by exploring the limits or boundaries of a situation or phenomenon.

Specifically considering an action research study, the common practice is that the classroom defines your sample. This is generally referred to as non-probability sampling, where participants are selected based on naturally occurring groups. Convenience sampling, accidental sampling, handpicked or opportunity sampling are all terms that may be used alongside action research. These terms essentially refer to the idea of using a sample that is convenient to the team of researchers, such as a classroom or a school (Jupp, 2006).

This sampling technique has disadvantages. "Although some would argue that all social research is inherently subjective and based on the politics and values of researchers and institutions, the positivist perspective maintains that social research and the methods it employs should strive to be value-free and objective. From this positivist perspective opportunity sampling is weak on external validity as it is impossible to generalize from the data it produces because it is not representative of the social world in general" (Jupp, 2006,). Specifically for teachers, it is important to consider that the results of an action research study in one school may not be representative of the behaviour of all students due to environmental, cultural, or socio-economic

factors. As such, the teacher researcher must clearly make the reader aware of the sampling techniques used so that the limitations and validity of the research conclusions are fully understood (Jupp, 2006).

Therefore the study in its methodology has selected a convenient sample by taking a total student population of an interior architecture design programme.

1.5.4. Data Generation

Since the research falls under the quantitative paradigm data generation should also assist in aligning with the philosophical stand. Premising the research in a positivist, objectivist quantitative paradigm the general data generation favours questionnaire surveys, Likert scales etc. that would provide ascertainable data.

However in an action research Coghlan and McAuliffe (2003) suggests that data-gathering tools need to be designed to fit both the organizational setting and the purpose of the research. Depending on the tools developed for the project both quantitative and qualitative data can be generated. The notes taken by the researcher, interviews with the current teachers, interviews with students, observation reports from researcher could all contribute in qualitative data. Student performance data are the quantitative data that can be taken as the source for data analysis using statistical methods. In order to generate these data students design work and the newly introduced exercises were assessed in a creative assessment scale.

1.5.5. Data analysis methods

With the development of numerous data analysis techniques selection of appropriate method could provide better insights in to the generated data. The basic criterion begins with distinguishing between the quantitative and qualitative strategies. Many research reveals that these two are interrelated and LeCompte & Schensul (1999) argues that using quantitative data analysis

techniques may be very helpful in a qualitative study and that certain research questions can only be answered by using both analytical approaches. Brighton (2009) further adds that at times to analyze data and to draw conclusions it is necessary to "Use whatever analytic methods are appropriate to the research question(s) – both qualitative and quantitative – to interpret data. This blending of analytical applications was also supported by Jick (1983) in his studies.

The nature of the data generated could provide better insights being analysed through a proper statistical analysis system. The microsoftexcel was used as the initial data analysis to just to reflect on the data and then further analysis is done to establish relationships. A step-by-step quantitative analysis was conducted using the SPSS system. The analysis was premised on the assumption that the design performance in the studio project reflects the creativity of student.

For the statistical analysis of the pairs of data for each instance a test of normality was done to explore the possibility of using the data set for SPSS analysis. Once this was done the paired sample test was administered to the data set to establish the correlation between the two data sets.

1.5.5.1. Test of Normality

Statistical methods, which depend on the parameters of populations or probability distributions, are referred as 'Parametric Methods'. The parametric methods of hypothesis testing such as two sample t tests are meaningful when underlying population is 'normal' and it provides better precision. The numerical method of testing for normality is called 'Shapiro-Wilk Test'. If the sig. value of Shapiro-Wilk test is greater than 0.05, It indicates that the dependent variables are normally distributed.

1.5.5.2. Paired Sample T Test

Paired sample T test procedure compares the means of two variables for a single group or the means from two matched groups. In this analysis procedure, each subject has two measures; in this study the measures taken are marks prior and after the creative intervention. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0.

1.6. Significance of the study

The significance of the study is outlaid in terms of disciplinary relevance, policy relevance and social relevance.

1.6.1. Policy relevance

Education in any discipline is an ever changing process. If the educating system does not respond to the rapidly changing trends of the society it become obsolete and the student output become a burden to the society. In order to reform the education system constant research should be carried out to make the appropriate policy decisions. Therefore the study, which could also be taken as an evaluation of the existing education practice, could contribute immensely in policy decisions in future.

The theoretical base could also help restructuring the systems to suit the modern student especially in designing of curriculums. The suggested creative process model could provide a base for developing design programmes at different levels that could assist in taking policy decisions regarding vertical coordination within a total education program.

1.6.2. Disciplinary relevance

Creativity literature is rich in theories to understand, measure, utilise and improve creativity. Even though architecture is a complex subject that has been in existence as long as the civilization existed theoretical developments in education context are not extensive. Especially theoretical interpretations

to understand the creativity in architecture are rare and therefore the study will become a theoretically significant to architecture discipline.

Schon (1992) who has pioneered in his philosophical studies on how designers practice states that "This capacity to do the right thing.... exhibiting the more that we know in what we do by the way in which we do it, is what we mean by knowing-in-action. And this capacity to respond to surprise through improvisation on the spot is what we mean by reflection-in-action. When a teacher turns her attention to giving kids reason to listening what they say, then teaching itself becomes a form of reflection-in action, and we think this formulation helps to describe what it is that constitutes teaching." Many researches have contributed towards his reflection in practice phenomenon yet this study is unique in terms of linking it to the creative process as well. This provides a new way of looking at design process as a creative process in a reflective education setting.

1.6.3. Social relevance

We try to understand our ancient civilizations through the architectural remaining. Therefore architecture is a key in leaving an impression of the cultural status of the society. If we do not perform well as architects in present we could not leave remarkable presence of our civilizations for our future generations to reflect and admire. Therefore our society needs creative architects. Education plays a major role in making a creative architect and research on creativity in architectural education become equally important.

In contemporary context creativity is not merely in the aesthetic sense but a far beyond needs and aspirations of the society. With the population growth and resource scarcity the sustainable development has become an integral part of every development activity. It has become more important in architecture since the built environment utilizes majority of resources in the world. Unless the architect is creative and taught to be creative he would not be able to adapt to these changes and provide innovative design solutions.

The perceptions in building industry has changed that people consider construction as an investment and it is hardly that one would build for just the aesthetic purpose. The current global economic condition has tighten the strings further and architects are given very strict budgets to work with and clients are expecting the " more from less" as a principle almost always. Therefore innovation from inception to design , from project management to detailing is essential if the architect need to survive in the industry.

As far as the need for creative architects are seen the education should reshape its focus in delivering an academic program that could foster creativity to its full potential. Thus the research impact could be felt in finding ways in architectural education to foster creativity.

1.7. Organization of the thesis

With the use of an action research as the methodology for the research the thesis was also structured to represented the stages in the proposed design studio reflective method (see figure 1.5). Following is a brief description of each chapter.

Chapter 01: This chapter provide an introduction to the study. This includes identification of the research problem and formulating research questions as well as objectives of the study. Scope and limitation of the study is also outlined in this chapter. The selection of methodology in terms of philosophy, research design , data gathering and analysis are also covered in this. Chapter also provides a brief outline on the significance of the study.

Chapter 02: This chapter is based on the problem identification and understanding phase. This includes a thorough review on existing creativity literature to map the theoretical development and finding their suitability to be used in an architectural education setting. Consequently it also review on how creative interventions are developed. The chapter constitute a reflection on

design studio as the key in nurturing and evaluating creativity in architectural education.

Chapter 03: The development of the theoretical framework "theoretical model of creative design process" is presented in three steps within this chapter. First the creative process in general is discussed and in conclusion the working model was derived with four phases. Then the studio activities are superimposed on to this and further development of the framework is presented. Finally the chapter is concluded with the derived model that includes creative methods identified for every phase.

Chapter 04: The details of the actions that have been taken, the design project were discussed within this chapter. This coincides with the action stage in the cyclic process of action research. Chapter presents the design project in three sections; the restructuring of the existing design studio using the developed theoretical framework, the basics in implementation of the project and the use of a design guide. The student work is also presented in this chapter.

Chapter 05: This discussion chapter is based on the reflection of the action being taken and the outcome denoting the reflection stage in the action research cycle. In this the data analysis is presented first as establishing correlations among student performance during different creative process phases and final design performance and then the relation before and after the intervention.

Chapter 06: The conclusion chapter presents all the research findings and concluding remarks with the directions for further studies.

2. CREATIVITY AND ARCHITECTURE: UNDERSTATING IMPLICATIONS FOR FOSTERING CREATIVITY IN EDUCATION

This chapter will attempt to build relationships among creativity, architectural education and creative process through a literature review. In order to understand creativity one need to understand the phenomenon. Reflecting through vast array of creative theories can give an insight, which could be the most applicable group of theories for the particular study. Education being the focus of the study, concurrent developments on theoretical grounds in creativity should be considered prudently. In conducting this there seem to be three distinct ways in interpreting the theoretical models that have been used in education, namely: person oriented, product oriented, process oriented. Architectural education seems to be focused integrally on process and product, which have evolved through the history. Specifically how the design process aligns with the creative process will provide an insight on how to develop an intervention to improve creative performance in architectural education.

2.1. Understanding creativity: mapping of creativity theories

This section attempts to look at a systematic way of understanding the theories of creativity. It will also provide a basis to identify which of the theories would be more relative in architectural education.

Creativity is a phenomenon that has been studied with varied intentions by every discipline. Research reveals that the most difficult task in studying creativity is actually defining it. There are numerous definitions and theoretical understandings across different fields in order to outline creativity. Looking into categorizations of definitions there are few basic areas that has been commonly focused such as four P's of creativity; person, product, process and place. Another perspective was big 'C', little 'C', mini 'C' and pro 'C 'of creativity. Creativity has also been studied with both its neurobiological considerations as well as the social aspects.

2.1.1 Development of Creativity Studies

Until late 1960s, the creativity phenomenon was dominated by the psychological foundations forwarded by Guilford, with his timeless concept of 'Divergent Thinking' predicting as the main constituent of creativity. 1970s experienced a boom of 'Creative Techniques' in the design field, creativity became an important issue in the development of organizations and in commercial success: this era marks the starting of consultancy work in creativity and the coaching for innovation. De Bono's 'Lateral Thinking' dominated the field providing a basis for corporate sector to practice creativity for business success. From 1980s the dominance on creative research psychologists and educators was abolished with the growing interest among almost every field such as physics, biology, neurology, sociology, engineering and management. Researchers such as Binnig, Amabile, Csikszentmihalyi or Guntern focused their studies on the evolutionary, social and systemic perspective of creativity. During the mid-1990s, creativity as a broad-based attribute came to be commonplace: terms such as 'Creative

Industries', ‘Creative Cities’ and 'Creative Economy' entered the political and popular vocabulary.

By this time the myth of the creative ‘genius’ with psychotic tendencies or a volatile temperament that existed until the 20th century was not accepted, but seen as a ability neither limiting to a unique gifted or insane individuals, nor to the professionals of a small part of the economy like the so-called Creative Industries (design, architecture, theatre, music, film, etc.). Today, the importance of creativity has been rediscovered, where the concept redefined and re-evaluated. Some authors even speak about a ‘Creative Age’ (Earls 2002, Manu 2007, Landry 2008). On a social and political standard, the beginning of the new millennium was characterized by the concept of the 'Creative Age', which replaces a science-obsessed era and the focus on marketing.

2.1.2. The Social Aspects of Creativity

Globalization and a faster rate of innovation are two of the most frequently mentioned trends in creative education (Frese, 2000; Rank et al., 2004), little attention has been devoted to research in social and policy issues related to creative thinking in education and society. Many studies are concluded with accounts of creativity and creative thinking. They, however, are not successful in identifying the process of creative thinking in educational management and policy area (Rank et al., 2004). From the overall perspectives of research in creativity and creative education, Dacey (1999) suggested that modern creativity research has developed across a range of disciplines as ‘psychological and

contextual influences received more recognition'. Furthermore, creativity should not be seen purely in terms of novel ideas but it is intrinsically bound with the teaching of academic disciplines (Rowlands, 2011).

Some studies on creative education and training (i.e. West & Farr, 1990; Rank et al., 2004; Xu & Rickards, 2007) pointed out that by encouraging learners to think analytically about their own learning processes, combining global and local factors in the learning processes, and providing general and specific strategies for a wide variety of learning environments, learners may be able to take greater control of their own thinking and learning in various aspects. It is, therefore, believed that students who are taught in this way have been more willingly able to characterise their successes and disappointments to factors which they can themselves control. Thus, they are increasingly independent as creative learners (Kratzer et al., 2006). Carney-Strahler (2011) suggested that creativity and creative learning can be nurtured and encouraged in various environments. For this reason, global and local factors affect the level of creativity in all societies.

Some social scientists attempt to identify the effects of globalization, imaginary and creativity by focusing on one's imagination and the way they are educated (Appadurai, 1999). Appadurai (1999) furthered his discussion by looking at the relationship between the knowledge of globalization and the globalization of knowledge. That is, globalization brings in a new role for the imagination in social life, rather than simply naming a distinctive period in the history of capital

in the biographies of nation states. To him, social imaginary can play a significant role in fostering the social development of a country. He confirmed that “social reform, culture shaped by globalization, improvements in the education system, and other initiatives directed at improving the quality of human life all require creative innovation in social visions”.

2.1.3. Four P’s of creativity

Attempts to categorize the study of creativity (e.g. Murdock & Puccio, 1993) frequently emphasize the four "Ps": person, process, product and place (environment or even press) . Generally research seems to be focusing on one aspect. "Person" approach have been dominated by *identification:* the development of cognitive and personality tests capable of identifying more or less creative people. Dunnette (1976), Gough (1976), Roe (1976) and Torrance (1974) provide comprehensive reviews of this identification movement. Guilford's work (1968) is among the best-known in the cognitive realm and MacKinnon's (1962, 1977) in the personality realm. Kirton (1976) and Myers (1962) addressed the relationship between personality and creative behavior, and Guilford (1968) addressed the cognitive aptitudes and abilities associated with various kinds of (potentially creative) thinking. The studies focusing on models understand creativity as a *process.* For example, Basadur (1979, 1982, 1992) portrayed individual, team and organizational creativity as a continuous, dynamic, circular three-phase process of finding good problems, solving them and implementing good solutions.

O'Quin and Besemer (1989) and Jackson and Messick (1964), for example, focused on understanding and assessing the product of creative efforts. Meanwhile, the study of environmental "presses" has been pursued by Amabile and Gryskiewicz (1989), Andrews and Farris (1972), and Baker, Winkofsky, Langmeyer and Sweeney (1976) among others. Creativity is viewed in different ways in different disciplines: in education it is called ‘innovation’, in business it is ‘entrepreneurship’, in mathematics it is often equated with ‘problem-solving’, and in music it is ‘performance’ or ‘composition’. A creative product in different domains is measured against the norms of that domain, with its own rules, approaches and conceptions of creativity (Reid and Petocz 2004).

2.1.3.1. The Person in Creativity Research

During the early part of the twentieth century, many scholars believed that a person was either born creative or not. The research looked at creativity from the perspective of the creative person. Psychologists focused on the individual creativity expressed by those they considered creative, noting any unique personalities of those people.

For instance, American psychologist J.P. Guilford, one of the most important contributors to creativity research, developed a person-cantered framework that analysed personal, motivational and temperamental traits, as well as backgrounds and work methods of exceptionally creative individuals. Guilford based his description of creativity on the ability to manipulate ideas in original, fluent, flexible and elaborate ways (Guilford, 1950). His traditional approach

of creativity is based on the assumption that creativity is something done by creative people.

Guilford was a strong proponent of the idea that creativity is inherent in all humans. He believed there was an interdependent relationship between human intelligence and creative abilities; in other words, the sum of a person's knowledge and intellect or how a person actually uses that knowledge to generate ideas.

In the 1960s, Guilford acknowledged that most of our problem-solving skills in everyday life involve divergent thinking. He emphasized that when people are generating ideas, they need to keep four qualities in mind. Depending on the task at hand, not all of the qualities will be used, or a few may be used more than the others. The four qualities are fluency, flexibility, originality and elaboration.

Building on this approach, E.P. Torrance (1966, 1974) analysed the process of creativity and developed his famous Torrance Tests of Creative Thinking. According to him, "creativity is a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solution, making guesses, of formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results" (Torrance (1966). However, the traditional

approach could not provide a lot of practical advice for people who wanted to become more creative in their work and was soon supplemented by different assumptions.

In the early 1970s, Abraham Maslow, another prominent American psychologist, examined human creativity. Maslow identified two stages of creativity—primary and secondary creativeness. He pointed out that primary creativeness comes out of the unconscious and that it is the source of new discovery. This is what Maslow called real novelty, and it is equivalent to the divergence component of creativity. Secondary creativeness represents logic, common sense and reasoning, and is built upon previous knowledge.

The more contemporary approach sees creativity as a capacity that lies within most humans and is influenced by the social environment. According to this standpoint, creative behaviour cannot be explained only by studying the creative skills of so-called "creative people."

2.1.3.2. The Process in Creativity Research

In addition to the dimension of person, the dimension of process deserves attention when examining creativity. One of the oldest process models was developed by British social psychologist Graham Wallas. He discovered that people could improve their creative thinking skills when they applied a specific process. In 1926, Wallas differentiated four stages in a sequential model and developed a process that became known as the "Wallas Four-Stage Creative

Process": 1) the preparation stage involves a preliminary analysis of a definite problem, defining and setting up the problem and conscious work that draws on education, analytical skills and problem-relevant knowledge, 2) the incubation stage wherein the mind continues to work on the problem unconsciously, forming trains of associations, 3) the illumination stage is reached when the promising idea breaks through to conscious awareness like a sudden enlightenment; however, it is a delicate stage that can easily be disturbed by outside interruptions or by rushing the emerging idea, and 4) the final verification stage in which the idea is further developed, evaluated and refined.

Amabile (1983) also described the creative process as having four phases: Problem or task identification, preparation, response generation, and response validation and communication. She also proposed a final phase of decision-making with regards to further work. As an outcome of the response validation and communication phase, a person may decide she is finished because a successful product is achieved or because the product was a failure, or she may return to one or more prior phases.

American psychologist Sidney Parnes in partnership with advertising executive Alex F. Osborn devoted a extensive amount of time to researching creativity and how humans are able to increase their creative problem-solving skills by applying a creative thinking process. Breakthrough Thinking by Thomas Vogel presented a more extensive seven-stage model of the creative process:

orientation, preparation, analysis, ideation, incubation, synthesis and verification with a distinction to Wallas' model in that an ideation phase entails the generation of multiple ideas. Osborn's further deductions concerning ideation focused on the search for several possible solutions and the development of various techniques for exploring them.

Some researchers have proposed a need to move beyond the overall creative process and to look further into sub-processes of creative thought. For example, Sapp (1996) developed a model that focuses on the point of creative frustration, which often occurs between incubation and the moment of illumination. If a person struggles during incubation and fails to find creative ideas, a point of frustration is reached. Then the individual can restart the process and possibly fall into the same trap again or accept a subpar idea (although it may not be optimal) or explore further directions and alternatives.

Treffinger (1983) updated Osborn's model and moved away from the concept of a fixed sequence of activities to three distinct sets of processes involving understanding the problem, generating ideas and planning for action. Understanding the problem entails mess and data finding involving searching of general information and gathering facts, as well as problem-finding processes. Generating ideas entails divergent thinking, elaboration of ideas and convergent thinking with evaluation. The last planning set involves developing and implementing ideas through evaluating, selecting and refining options

(solution-finding), and promoting an idea, seeking support and noting resistance (acceptance-finding).

2.1.3.3. The Place in Creativity Research

Other researchers have looked beyond the creative process and individual differences to the environment in which creativity takes place. Csikszentmihalyi (1996) noted that creativity cannot be studied by isolating the individual from the social and cultural milieu. He argued that creativity is the product of a system that includes the creator, the domain and the field (Csikszentmihalyi, 1996). Although Amabile (1983) suggested that all humans have a capacity for creativity, the environment is an influential determinant, especially where motivation is concerned. Mathisen and Einarsen (2004) also noted that organizations might actively create an atmosphere in which creativity and innovation are either fostered or stifled, both on individual group and organizational levels. Similarly, research has shown that the combination of supportive and challenging environment is conducive to sustaining high levels of creativity in individuals as well as teams (West & Richards, 1999).

Instruments used to measure work environments that foster creativity and innovation point to other aspects of place that impact creativity. Amabile et al., 1996) identifies five contextual components that contribute to creativity: encouragement of creativity, autonomy of freedom, resources, pressures and organizational impediments to creativity. Amabile et al. (1996) defined creativity as “the production of novel and useful ideas in any domain” and

innovation as “the successful implementation of creative ideas within an organization”. Amabile (1994, 1996) has also suggested that the social environment can influence both the level and frequency of creative behaviour, as well the creative individual’s intrinsic and extrinsic motivation.

Lubart and Sternberg (1995) describe six resources that work together with environmental assets and conative forces to form a person’s “investment” in a creative enterprise. Consistent with the importance of place, the environmental context along with motivation are two resources that influence creativity. In line with the importance of the person component, internal psychological processes are a primary resource that contributes to the “investment” in creative work. Additionally, knowledge is required in order to make an informed creative contribution in a specific domain. Further, certain intellectual styles facilitate the application of knowledge in mental processes. Three dimensions of these styles are legislative/executive, conservative/liberal and global/local. The fourth resource, the overall creative personality, is characterized by five essential attributes. Tolerance of ambiguity, perseverance, the willingness to grow, the willingness to take risks and individuality are perceived as necessary for the maintenance of high levels of creative performance over a certain period of time. In all, Lubart and Sternberg’s (1995) perspective reinforces the conceptualization of creativity as an integrative approach and points to the importance of another key component of process.

2.1.3.4. The Product in Creativity Research

The product in creativity research represents the end result of a creative activity or production in a specific discipline or domain. Experts within that respective domain can typically assess those creations and products and evaluate them.

Creativity is a key determinant in design success for any type of design product. Creativity research use different terms to express whether a product is creative. For example, it should reflect "creative thinking, ability, problem-solving, imagination, innovation, newness, originality" (e.g. Simonton, 1999; Sternberg and Davidson, 1995; Sternberg and Lubart, 1999). Additionally, researchers agree with the argument that originality is a required but insufficient condition for identifying creativity: the work must also be of value; that is, it should be "appropriate (i.e., useful, adaptive, concerning task constraints)" (Sternberg and Lubart, 1999, p. 3); a combination of "novelty" and "appropriateness" or "usefulness" (e.g. Amabile, 1983; Gruber & Wallace, 1999; Lumsden, 1999; Martindale, 1999; Mumford & Gistafson, 1988; Unsworth, 2001).

According to Brendan Ryan, president of Foote, Cone & Belding Worldwide, creativity in advertising is linked to the effectiveness of the ad as it becomes the vehicle to connect with consumers. More clients are realizing that creative ads work better; they are more memorable and make their point more effectively in the marketplace. The connection between creativity, likeability and recall would seem to be the essence of what advertising is all about:

creating likable and memorable commercials as a prelude to selling products and services (Stone et al, 2000).

Csikszentmihalyi (1999), who argued that creativity is "the ability to add something new to the culture" such that it is "sanctioned by some group entitled to make decisions as to what should or should not be included in the domain". "For someone to be creative their work must be recognized as such by those competent in the fields, who have reached higher levels of their profession" (Csikszentmihalyi, 1999). According to Simonton (1996), research has shown that "critically acclaimed producers in a field think differently and have distinctive personality structure in comparison to those peers who can only claim professional expertise in the same disciplines." Nevertheless Amabile (1983) argues that a product is creative to the "extent that appropriate observers independently agree it is creative."

In Architectural education setting the relationship between the creative person (designer), the creative place (design studio), the creative processes applied, as well as the creative product (designs) need to be identified. Specifically considering design activity in relation to the four P's, it indicates more relation to process. It contains different stages and students are encouraged to follow these steps. Therefore different models should be explored to understand which could provide a closer similarity to the design process.

2.2. Designing creative interventions

Due to the complexity in understanding creativity, fostering it in the field of education seems a near impossible task. Attempts taken to nurture creativity are consistently visible right throughout the history of education. Creativity possesses a significant position at any level of any type of education program, specifically in the current global context. From a theoretical point of view, the design of education programs is based on the taxonomy that we need to cater to knowledge, skills and attitude, and in each of these, creativity in the highest level of the learning process. Therefore, one needs to follow all the steps in order to achieve a level to actually be able to create. In this way, interventions could become useful in the facilitation of creativity. The designing of interventions, by understanding the fundamental theoretical setting for creativity as well as the domain specific implications, would become a key factor for success in nurturing creativity. Looking carefully at some of these commonly use creative interventions could provide insight in to how one could design these.

2.2.1. The need for interventions

Creativity is a captivating and stimulating aspect of human thinking. It has been defined as the ability to restructure old ideas to produce singular inventions (Heap, 1989) and to apply original thinking (Coyne, 1997). Creative thinking is also associated with the capacity to look critically at reality, explore unconventional alternatives, and perceive situations from innovative perspectives (Csikszentmihalyi 1997). Innovation is defined by Milgram and Davidovich (2006) as something unusual or statistically infrequent, notable, valuable, and of high quality. Creative thinking embraces cognitive processes

related to innovative problem-solving. The application of innovative problem-solving can lead to the generation of remarkable and helpful solutions. (Finke, Ward, & Smith, 1992; Milgram & Arad, 1981). With this importance and role of creativity every field is highly dependant on innovation to survive.

Education is a key in nurturing creativity in education and can be looked at from the basics in educating. Since its introduction in 1956 by Bloom, Bloom's Education Taxonomy has provided the basis for developing education programs with outcomes on knowledge, skills and attitudes. The taxonomy further explains how learning takes place in each of these domains, moving from one stage to another. It can be observed that in all three domains, the final step is where the leaner acquires the ability to synthesise or create. In education programs where creative output is essential and expected immediately in their task performance, following through these steps could become critical. Therefore, educators are consistently developing interventions that could shorten the learning process and facilitating for creative performance.

A solution can be any type of outcome, such as an algorithm in response to a mathematical problem, an outstanding piece of art, a breakthrough in science, or a design product. Specifically within education programs where these products are evaluated creativity is a key criterion. Therefore without allowing plenty of opportunities to nurture creativity it would not be fair to expect creativity from the students and include it in assessments.

Considering these factors fostering for creativity is crucial in every education program. Many interventions are introduced along the education system but many seem to become implicit activities rather than consciously teaching for creativity. Since continuous attempts are taken to foster creativity it is definitely a desirable education outcome.

In a broader perspective it could be concluded that we need to foster , nurture and facilitate for creativity for the following reasons:

- Creativity id crucial for survival of any discipline,
- Education outcomes are given in KSA, where creativity is at its highest levels and therefore needs intervention,
- In assessment the creative ability is usually assessed, and
- Creativity is a desirable outcome of architectural education.

Therefore every field of study should focus on fostering creativity in a conscious way to expect creative behaviour and innovative outcomes.

2.2.2. Understanding Creative Interventions

With the development of a vast amount of research literature creative interventions also take different forms within varied contexts. Creative methods, creative techniques, creative workshops are some of the key terms that have been used to identify these interventions. Some of them are focusing on the general creative abilities while others have been developed to address domain specific issues.

Research reveals that there more than 250 creative methods, techniques, interventions models that have been developed extensively across various fields. Following table 2.1 summarises some key methods with a brief description adapted by Clegg & Birch (2007).

Table 2.1. Creative interventions adapted from Clegg & Birch (2007).

Method	**Description**
Assumption Busting	• A list of assumptions about the problem is made • Correctness in relation to the problem at hand is tested • New assumptions appear and the most applicable of these are used to find solutions
CATWOE	A technique consisting of seven steps: • Appreciating the unstructured problematical situation • Understanding the worldviews of the key stakeholders • Creating root definitions of relevant systems • Making and testing conceptual models based upon worldviews • Comparing conceptual models with reality • Identifying feasible and desirable changes • Acting to improve the problem situation
Cause-Effect Diagram	Related to the concept of lean construction, where processes can be measured, analysed, improved and controlled with emphasis on customer dissatisfaction.
Crawford Slip Method	A written brainstorming method where the mediator will generate a report on the paper slips of the team members. IBIS, the planning method devised by Rittel, used this idea coupled with the Delphi method.
Delphi Method	• The Delphi method is an interactive forecasting method.

	• Relies on input of independent experts, in several rounds, with revised forecast based on output of previous round. • Results converge towards ‘‘best’’ solutions using mean or median scores. • The number of rounds, achievement of consensus and stability of results are established beforehand.
Force-field analysis Gallery Input–output	• Force field analysis looks factors (forces) that influence (hinder or help) a situation or problem. • Used mainly in management planning.
Morphological Analysis	Team members must create their gallery of ideas on a poster and hang them for contemplation and discussion by other team members.
NAF (Novelty, attractiveness and functionality)	• Developed by General Electric. • The technique identifies new ways of reaching a design goal by focusing on the input (attributes) and final output desired. • Requirements and restrictions (specifications) are structured for this purpose. • A problem-solving technique based on problem structuring and elimination of the illogical solution combinations • Solutions are analyzed as to their novelty, attractiveness and functional usefulness. • Grades are given on a 1–10 scale for each attribute.
Other people’s viewpoints PDCA (Plan, Do, Check, Act)	PDCA is a four-step problem-solving process also known as the Deming Cycle. Starting with: • PLAN: Establish goals and processes necessary to deliver results in accordance with the specifications. • DO: Implement the processes. • CHECK: evaluate the processes against the goals. • ACT: introduce action to improve the process and start the PDCA process over.
QFD	• Technique to encourage people to adopt unfamiliar viewpoints during a problem

	discussion. • Method to transform user demands into design quality, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process.
Random Stimuli	• Random stimulus is based on randomization with exploration of associations to novel non-intentional ideas. • The Random Word technique starts with a random word used to generate new associations. This helps to look at problems from unusual sides directing thought toward creative solutions.
Relational Words	• Type of forced-relationship process that uses a checklist of verbs and prepositions. Used by editors to create book titles and marketers to name new products, for example.
SCAMPER	• Comes from Substitute, Combine, Adapt, Modify, Produce or find new applications, Eliminate and Rearrange. Questions are made to transform an object or process through the above verbs.
Six Sigma (DMAIC and DMADV)	• The methodology consists of: • Define process improvement goals consistent with customer demands and enterprise strategy. • Measure key aspects of the current process and collect relevant data.

	• Analyze data to verify cause-and-effect relationships. • Determine the relationships and ensure that all factors have been considered. • Improve the process based upon data analysis using techniques like design of experiments. • Control to correct deviations from target. • Set up pilot runs to establish process capability. Finally move onto production, set up control mechanisms and continuously monitor the process.
Six Thinking Hats	The hats represent six thinking strategies identified by Edward de Bono, consciously applied in techniques to enhance creativity. • Red hat—Emotional thinking • Yellow Hat—Positive thinking • Black Hat—Critical thinking • White Hat—Facts • Green Hat—Creative thinking Blue Hat—Big Picture
SWOT (Strengths, Weaknesses, Opportunities, Threats)	A strategic planning method used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project by identifying the internal and external factors that are favourable and unfavourable to achieving that objective.
Synectics	• Synectics is a technique to generate and evaluate ideas. • In the first session the problem is analyzed. • In the second session the problems is

	described and the scope of action determined. • Ideas are generated (using other techniques). • Idea springboards are identified to focus on the solution realm. • Possible solutions are brought forward. These are analyzed and a new cycle of synectics may have to begin if the solutions are rejected until a consensus is reached.

It should be noted that this is not an exhaustive list but there are many other methods that have been used depending on the particular need of the discipline. It could also be observed that they relate to a theoretical understanding of the creative phenomenon.

2.2.3. Strategies of designing creative interventions

If one were to design a creative method, technique or an intervention careful investigation into the existing methods could provide an insight. First they have vast range from simple techniques like brainstorming to very complex pedagogical models. Since there are many facets to creativity each of these intervention is based on a particular theoretical ground. For instance the brainstorming is conducted to accrue insights for a given problem irrelevant of its applicability. In this the group may be looking at answers that that spread across the domain and also deep into a particular aspect in concern. This is based on the divergent thinking widely discussed by Guilford (1968).

Dineen, Samuel, & Livesey (2005) have identified eight factors that influence student creativity: (1) Physical environment (2) timing and scheduling (3) teaching style and approach (4) teaching methods (5) project and task (6) assessment and feedback (7) learner motivation and attitudes to learning (8) Prior relevant skills and knowledge. Investment theory has identified six factors that

influence creativity: (1) intellectual abilities (2) knowledge (3) styles of thinking (4) personality (5) motivation and (6) environment. Depending on these types of pedagogical models more complex interventions could be developed. In this instance as well these factors are derived out of theoretical ground. Therefore it is apparent that theory plays major role in developing interventions.

However since the theoretical literature is immense, one should be focusing on a classification system to understand the theories and their application in creative education. As concluded within sub chapter 2.1, the two systems of mapping creativity theories could become a valuable platform to develop creative interventions.

Contemplating on the four P's of creativity; Person, Process, Place and Product the existing methods could also be categorised on to these aspects depending on the focus. This emphasis could change within its relativity to its environment (Reid & Petocz, 2004). Some methods have been developed on person (Amabile, 1998) and some have focused on process (Swede, 1993) whereas others have worked on the product (Sternberg & Lubert, 1995). Therefore reflecting the factors they focus on, these can be broadly categorised as being person-oriented, process-oriented, and product-oriented models.

Person-oriented approaches are primarily based on personality traits that either enhance or suppress creativity. Motivation, openness and the ability or willingness to take risks is some of the positive attributes in personality for creativity. Process-oriented models are more concerned on creative process that takes place in creating. Many of these approaches are based on the process worked out by Wallas (1926) involving seven phases: Preparation, activation, cogitation, illumination, verification, communication, and validation. Product-oriented methods are based on final products.

Therefore in deriving an intervention a theoretical framework should be developed finding its focus whether process, person, place or product. Within this focus the particular factors that influence creativity are taken as the key tools to be engaged.

2.2.3.1. Facilitating creative process

Creative process is dependant on different models that have been developed over time in creativity research. Therefore if an intervention to be developed to facilitate the creative process a particular model should be identified that could best explain the creative phenomenon in that particular subject area. In more complex situations this could also be developed exploring the creative process that occurs within the pedagogy.

Creativity is defined as the capacity to produce new and original ideas (Boden, 1999). However, novelty is not sufficient to classify a solution as something original. Especially within design context the idea demands to serve a specific purpose and solve a pre-determined problem. Hence the extent of appropriate different among disciplines as well. In engineering design, for instance, the adequate structuring of problems and first principle of exploration are important parts of the creative process. In architectural design, the manipulation of possible design solutions, through models and drawings is essential while experience and repertoire analysis are paramount. According to Gero (2000) most new ideas in design are based on analogies, mutations or combinations and in some cases, first principles are applied. The experienced architect applies these concepts at times consciously and at times as experimentations to move forward in the design process.

Mumford & Hunter (2005) argues that prominent reasons that it has proven so difficult for organizations to successfully innovate is that creative idea generation and implementation are such complex endeavours. In fact, innovation is most accurately represented as a range of processes rather than a singular event or entity (Runco, 2008.)Since design is complex activity that

involves different phases this is highly relevant to any design based discipline it would not suffice to use one particular method to facilitate the creative process. Thus, to effectively innovate, organizations must perform well on a number of activities ranging from identifying high-potential opportunities to successfully implementing and monitoring creative ideas (Baughman & Mumford, 1995).

2.2.3.2.Improving creativity of the product

The identification of the creative product is highly dependant on its evaluation. The same product could be termed creative in one context and not unique in another context. A creative product could be identified in a specific sub-cultural context, which is evaluated by their peers as being creative in terms of their expertise knowledge (Csikszentmihalyi, 1999; Simonton, 1996). Amabile (1983) also argues that a product could only be termed creative that the observers independently identify it as creative within the boundaries of particular domain.

Therefore creative interventions to improve the product are highly domain specific. And it could also be argued that every intervention at the end would target to improve the creativity of the product in concern. In this scenarios it is highly unlikely that you find general creative methods to improve creative product. Close examinations of the creative interventions list given out in table 2.1 provide evidence that none of them could directly impact product improvement but postulate a background for higher creative solutions.

Within architectural design some of the existing activities within design programs can be developed as domain specific product development methods. For instance 3D modelling and visualization is a very specific method that directly impact the quality of the final product. Proper intervention on composition skills would support this endeavour. However in a holistic approach these may be stages of one integrated design process.

2.2.3.3.Developing creative personalities

Studies on the creative thought process have identified that it rests on the characteristics of an individual: receptiveness or attitudes in search of new and appropriate solutions, immersion into the problem at hand, dedication and motivation, questioning attitudes, and analysis of ideas, with special attention to flawed solutions (Kneller 1978).

Initially creativity was associated with humans with gifted talent. This has been heavily based on Plato's romanticism philosophical argument Sawyer (2006) where divinity was associated with being able to create. Prussian philosopher Immanuel Kant's (1724–1804) theory of aesthetics supported this view wit the notion that creativity is 'an extraordinary innate "gift" that is beyond the grasp of mere mortals' (Cowdroy & Williams, 2006).

Rationalism, on the other hand, refers to the idea that creativity is related to hard work, reason, knowledge and training first proposed by Plato's student, Aristotle (384–322 BCE), who emphasized that conscious work, rationality and deliberation are required in order to realise creative inspiration (Cowdroy & Williams, 2006). The modern creativity research advocates Aristotle's emphasis on creativity as rational, dispositional and contextual. Creativity is seen as a potential in all human beings that can be fostered, developed and promoted; it is generalizable, learnable, teachable and assessable (Guilford 1950; Mednick 1962; Torrance 1974; Wallas 1926).

Based on these philosophical ground development of creative personalities have been conducted extensively in education psychology. Unlike the interventions based on product personality manipulations are more dependent on general creativity. Within architectural design education few studies have been carried out on personality traits lead by Amabile(1988) and Casakin (2005) where motivation have been the centre of discussion.

2.2.3.4.Setting of creative places conducive for creativity

Numerous theories have been evolved in the research literature, which highlights the prominence of social and cultural context to creativity. For example, Amabile and her colleagues (Amabile, 1996; Hennessey & Amabile, 1988) suggest that the influence of culture and social context on creativity is mediated by one's intrinsic motivation. More specifically, creativity is promoted when people's intrinsic motivation in engaging in a certain task is enhanced by specific educational systems, school or work climates, as well as the family environment. Typically, a social context that offers minimal restraints and which encourages trust, democracy, independence and ownership is considered to be most beneficial to people's intrinsic motivation and thus to their creativity (Amabile, 1996; Amabile & Conti, 1997; Treffinger, Sortore, & Cross, 1993).

Applying to architectural design education the design studio is the integral component of creative environment from social and cultural perceptions. However there are also limited amount of studies that also discusses the physical context as an determinant of creative performance. Day lighting, volume, shape, contact to nature seem to be some prominent factors revealed through research that could impact creativity (McCoy and Evans, 2002; Higgins, et al., 2005; Anthes, 2009).

Designing an intervention in any discipline would require the understanding of the nature of the activities that take place and what education implications are dominating at each level. Only then could a total system of interventions be made. In architectural education, with its complex nature in designing, one single intervention would not be very successful. Even though architectural education does not follow rigid rules, it is important to remember that tackling a design as a complete entity is vital for the creative process.

One also needs to understand the specific activities that assist in nurturing creativity and then, through the use of design intervention, address the need to improve student creative performance. In improving the creative process through

intervention, one could anticipate a better final product, which is the primary purpose of creative interventions.

2.3. The Design Studio: Exploring creativity in architectural education

Design is an integral component of any architectural education program. Different schools use these methods to improve their creativity by utilising the design studio. The lack of integrating vast amount of implicit knowledge into the design process and trying to transform them into explicit knowledge has been criticised thoroughly. Therefore, understanding the studio activities and the nature of their particulars would assist in incorporating them into the design process.

There are many teaching and learning that place within the studio. Design is considered as a creative problem solving exercise where design studio plays an integral role in facilitating for this problem solving process. Looking into activities that take place within it shows that they seem to be functioning according to a design process. Educations programs are focusing on not just providing for a single solution for a problem but rather inculcate a creative habit to confront any similar problem within the design context. Dominowski (1995) argues that an important issue about creativity is not whether people can be instructed in how to retrieve old solutions from memory to solve a specific problem, but rather whether they can develop enough expertise to creatively solve a larger range of problems.

2.3.1 Significance of Design studio in Architectural education

Architecture education is conducted as a design studio-based curriculum. Many researchers have described the design studio as the centre (Schön, 1985) and the heart (Kuhn, 2001; Oh et al., 2013) of design education. Schön (1983) has been a leading researcher providing a solid basis to understand the significant role the studio plays in education architecture students where focus is on learning by doing. Schön (1983) further defines the architectural studio as a context wherein an active process of learning occurs through individual or group problem-based projects. Challenges include recognizing a problem, understanding its

constraints, and using creativity, reasoned judgment, interpersonal abilities, and "reflection-in-action" to solve the problem.

The reflection-in-action model of learning and teaching suggested by Schon (1983; 1988) places design studio as the centre of education in architecture schools where majority of knowledge transfer take place.

Many students actually spend most of their time in the design studio, where they work, study, eat, and even sleep (Anthony, 1991; Cuff, 1991). A casual review of any university architecture curriculum will reveal that the studio is the central activity in every architecture student's life. Specifically on a concern of nurturing creativity the creative place that supports the design is the studio in which the social context a key player in shaping the outcome of students.

2.3.2 Teaching and learning in Design studio

Especially in architectural design, majority of teaching and learning occurs through the studio system and how students respond to design questions and find solutions are based on this process. Kowaltowski et al. (2006b) identifies six basic teaching methods in the studio setting:

1. Studio teaching based on a given architectural program and site for a specific design project or architectural typology.
2. Studio teaching based on the discussion of an architectural program, elaborated by students and its appropriate urban setting.
3. Introduction into the studio of an actual, local design problem and the development of a participatory process, with problem analysis and solution justification by students.
4. Teaching design as a combination of architectural theory with practical design activities.
5. Teaching design using ''form generation'' methods and formal architectural languages.
6. Teaching design to explore specific CAD design tools.

The studio teaching and learning heavily relies on unstructured dialogue between students with experienced professionals resolving issues on specific, mostly hypothetical, design problems posed. Many studies have examined the typical design-studio teaching method in relation to diverse aspects: learning experiences, efficiency, quality of designs, etc. (Carsalade 1997; Oxman 1999a, b; Gouveia et al. 2001; Rufinoni 2002; Goldschmidt and Tatsa 2005; Kowaltowski et al. 2006b ; Nicol and Pilling, 2000).

Schon (1983) describes design as a reflective conversation with the design problem, against the human thought-processes and the language in architecture expressed through drawings and model. He further explains that interpretation in design must address two issues: preconceptions and the dynamic dialogue between the parts and the whole of a design. In design education, the question of preconception, pre-judgment or prejudice must be addressed, this is the personal approach that they bring to the studio that is judged along the design solutions that they create in the design projects. The pre-understandings students bring to their academic work come from their personal life experience and studio instructors may attempt, in vain, to free the student's mind-set of such presuppositions. A more appropriate approach to design education therefore considers engaging students in questioning such presuppositions, expanding, and at times, rejecting responses in the design dialogue which is an integral part of studio learning that could not take place in any other mode.

The design-studio teaching example conducted by Kowaltowski et al. (2007) showed that creativity enhancement techniques can be used appropriately, however allowing for restrictions. Results showed that restrictions, as design tools, could be of help to students in their search for creative design solutions. This teaching experience also revealed that most students cling to their first design solution, considered aesthetically ''pleasing'' and are reluctant to abandon this, even when problems are pointed out. The experiment indicated that further research is needed to test the introduction of other methods, which may stimulate creativity and, in parallel, may increase students' sense of

responsibility in relation to social, urban and comfort impacts of design proposals.

The teaching and learning in design studio possess an implicit nature where the tutors improvise their teaching to particular answer that students are designing for the problem given that could change from day to day as they progress. Hence during different stages of the design the guidance needed is different and same teaching cannot be continued. Therefore it is not a mere teaching method that they should be exercising rather a teaching procedure to suit the design process that takes place in the studio.

2.3.3 Creativity in design studio

With the significant role studio play in architectural education fostering creativity would also pose a higher emphasis on design studio activities. The studio culture is found to be a major influence on creative behaviour of the students. The social context and its organizations particularly the attitude toward risk taking and exploring innovative out of the box solutions has shown its correlation to creativity of the solution generated.

The nature of the problem students are faced with also provide an insight to the extent of the creative solutions that could be given thus the methodology that should be adopted to come up with probable solutions. Only of the design problem is accepted as a problem that could be resolved through creative problem solving that one could find creative solutions through a creative process.

2.3.4 Creativity in design

Creativity is a key element in design problem-solving. A major reason is that design is a complex and ill-structured activity, where problems cannot be solved through the application of algorithms or operators (Goel, 1995). In addition to

the need for qualitative knowledge and experience, the exploration of unfamiliar and unconventional design solutions requires creative skills (Cross, 1997; Hsiao & Chou, 2004; Gero, 2000b). Creativity enables the talented designer to transcend conventional knowledge domain so as to investigate new ideas and concepts, which may lead to innovative solutions.

Design creativity has been investigated in relation to the design process (Candy & Edmonds, 1996; Nagai & Taura, 2006), the design solution (Dorst & Cross, 2001; Suwa, Gero, & Purcell, 2000), and the personality of the designer (Hanna & Barber, 2001; Rubinstein, 2003). Creativity is associated with the ability to explore unconventional alternatives (Csikszentmihalyi 1997), or the capacity to restructure old ideas to produce novel outcomes (Heap, 1989; Milgram and Davidovich, 2006). Creative thinking is concerned with the application of cognitive processes related to innovative problem-solving by means of which valuable and outstanding solutions are generated (Finke et al., 1992; Milgram, and Arad, 1981).

Creativity is a fundamental aspect in design problem-solving since the development of new design solutions demands to put into practice creative skills (e.g., Cross, 1997; Hsiao and Chou, 2004; Gero, 2000; van der Lugt, 2000). Creative thinking enables to frame a problem from unconventional viewpoints. Casakin and Kreitler (2005b) empirically studied different attitudes and characteristics of students in regard to design creativity. Their purpose was to examine relationships between design creativity and the performance of students

in their academic studies concluding the significant role motivation plays in fostering creativity. In a recent work Casakin and Kreitler (2005a) investigated design problem-solving with a particular focus on flexibility as one of the major elements of creativity. They found that students with a higher level of flexibility arrived at more creative design solutions.

It is apparent that design presents problems that need to be solved through creative problem solving demanding high level of creative thinking.

2.3.5 Evaluating design creativity

The design studio providing students feed back is called critiquing, and it is the predominant way through which architecture students acquire design expertise from their instructors thus a form of evaluation. In light of this, it is remarkable that we lack an in-depth understanding of critiquing in design education. Ochsner (2000) points out: There has been surprisingly little examination in depth of design studio as an educational environment. In particular, there seems to be almost complete silence on two questions: (1) the precise nature of the creative process in which students are asked to engage in design studio; and (2) the character of the interaction between students and faculty that would best enhance the students' learning of design. Little is written on how faculty might enhance this interaction or how they might improve the quality of their design studio instruction.

Schon (1985) provides the best portrayal of design critiquing to date. In The Design Studio, he attempts to describe what design knowledge is conveyed and what a studio teacher does in a desk-crit using the concept of 'repertoire,' that is, a collection of images, ideas, examples, and actions. As professionals, designers build up repertoires from their experience. When a studio teacher re- views

student designs, the teacher scans their repertoire for similar situations, for example, a known building, or previously encountered problems. The teacher then shares knowledge drawn from his or her repertoire. The teacher seldom merely points out errors; he or she also describes examples or references to similar situations from personal design experiences and demonstrates how to solve the design problems. Feedback helps students understand their problems, eliminate errors from their proposed solutions, and eventually construct their own repertoire. Although Schon's description seems reasonable and plausible, it does not provide a sufficiently detailed account of critiquing in design.

An important issue in the creativity literature centres on how creativity in individuals can be evaluated. In a revolutionary study, Guildford (1981) operationally defined creativity through four major factors, which were put into practice to assess individual creativity. These four factors are *elaboration* (amount of detail in the responses), *innovation* (statistical uncommonness of the responses), *fluency* (quantity of appropriate responses), and *flexibility* (variety of categories of appropriate responses).

Guildford's four factors are remarkably important and quite often regarded when conducting assessments on individual creativity in different domains related to problem-solving. Therefore, they are seen to have high relevance to the design field. In this research, the four factors were included together with a group of variables used by Casakin and Kreitler (2005b) for design evaluation. These involve the following: (i) *consideration of problem constraints*; (ii) *usefulness of the design product*; (iii) *aesthetics of the design product*; (iv) *practicality of the design product*; (v*) relation of the design to the physical context*; and (vi) *value of the design product*. The study of creative ability from different psychological domains has led to numerous conceptions of what creativity entails and how it can be assessed. The presence of originality is considered to be the defining factor that is crucial to the assessment of how creative a product is. A response is usually judged to be creative to the extent that it is novel, unique or unusual.

Current debate on design creativity centres on how the creativity of individuals, design students in particular, can be evaluated. Guilford (1981) defined four main factors to assess creativity when is put into practice. These included: originality or innovation (the statistical rarity of the responses), elaboration (amount of detail in the responses), fluency (the total number of relevant responses), and flexibility (different categories of relevant responses). In design, innovation and elaboration are considered to be two critical elements to assess the creativity of the design output. Since each design problem is unique, innovation and the search for originality are essential aspects characterizing design. Furthermore, the quality of a design product is very much concerned with the ability to develop it up to a required level of detail. On the other hand, flexibility and fluency are two essential aspects of a creative design process. Before engaging in a design solution, creative process involves the ability to define a problem from unconventional perspectives, and the search of a large number of alternative solutions that differs from familiar ones.

Creativity is not defined clearly and wholly in several studies despite the necessity to do so due to different understandings of the topic. It is mostly combined with another characteristic or ability such as, ‘solution quality’ (Kruger and Cross, 2004), thus making it difficult to work on one aspect independently from the other. What complicates matters more is that, the criteria according to which creativity is assessed are not clear in many studies as Edmonds (2000) and Dorst and Cross (2001) stated, whereas they should be. Relying on individual assessments of judges - however consistent they may be- makes it difficult to replicate and thus, generalize the results of the study.

Therefore more specifically in field of architecture where evaluation could highly subjective evaluating creativity within that seem almost impossible. Yet as Csikszentmihalyi (1997) stressed the gate keepers of any domain could determine the level of creativity. In a studio environment the tutors and studio masters become the gatekeepers setting the program and assessment criterion

may provide the basis for creative judgment.

2.4 Concluding Remarks

Studio is significant in shaping architectural student. Studio activities are sequenced into a process, which depicts the design process. the teaching learning that happens within the studio is diverse and constitute various activities. This design process is highly dependent on creative problem solving processes as the products are expected to be creative that has been created through creative process. Providing a design problem in most cases as a hypothetical situation, conducting background studies, students design solutions being tutored and discussed, presentation of the drawings and the design crits as the main evaluation methodology are activities found within design studios.

Viewing architecture as pure art has often been identified as a problem and investigations of typical professional practices have uncovered that architects often lack knowledge on, or fail to anticipate, user needs (Salama 1995). Importance given to the artistic content may cause architects to ignore social aspects in architecture and to emphasize their self-expression. The aesthetic or formal bias is further reinforced by most publications, used as teaching material in design disciplines. These are often devoid of human content and directed towards the formal aspects of design (Kowaltowski et al. 2006c). Even technical aspects, evaluation results and user satisfaction rates are rarely present in journals, used by students in design classes.

In his 1983 book, Schön has "collected a sample of vignettes of practice, concentrating on episodes in which a senior practitioner tries to help a junior one learn to do something.... The heart of this study is an analysis of the distinctive structure of reflection-in-action" (pp. 8–9). Indeed, the characteristics of design that Schön presented as general were displayed in the communicative context that he used to collect his observations, that is, educational situations. Focusing on the education of reflective practitioners in the domain of design, Schön's studies examined design students learning with experienced designers (Schön,

1992; Schön & Wiggins, 1992). These studies have been conducted in "reflective practicums such as the design studio in architecture" (Schön, 1987a).

3. PLANNING THE ACTION: DEVELOPING A THEORETICAL FRAMEWORK GROUNDED ON CREATIVE PROCESS, DESIGN PROCESS AND CREATIVE METHODS

This chapter is focused on developing the theoretical framework that could provide a basis to conduct the design studio to achieve creative outcomes. Systematic development of the framework is outlined in three steps. Since the creative process has been taken as the platform to develop the theoretical framework understanding of different creative process models are done in order to conclude in an integrated model to utilise as the base. Then the design process is looked against the common stages in the integrated creative process model. During this step the activities in the

design studio is superimposed onto the integrated creative process model. This provide the creative design process working model, which within the next step is further developed by incorporating creativity methods both found within general creativity enhancements and as well as domain specific tasks encouraging creative endeavours.

3.1 Creative process: towards deriving an integrated model

Number of models has been developed overtime to understand the structure and the nature of the creative process in terms of different stages, which can be either sequential, recursive or comprising componential cognitive processes. Applicability of these models highly depends on the nature of the domain in concern and how creativity is perceived. Careful investigation into these models could provide a basis to derive an integrated model that takes an abstract form of the commonalities found within each model. This provide for deriving the basic model to start developing the theoretical framework by considering the various models and their stages and synthesising them based on their similarities. This will make it possible to reduce the steps in a model understand them in clarity.

3.1.1. Ideation-evaluation process

The most basic creativity process that incorporates divergent and convergent thinking within multiple phases or steps can also be considered a "complete" process. Basadur, Graen and Green (1982) identified a two-step mini-process called *ideation-evaluation* in which divergent and convergent thinking occur sequentially. Osborn (1963), Parnes, Noller, and Biondi (1977), and Isaksen and Treffinger (1985) provided linear three-, five- and six-step models of a complete process. Basadur (1974, 1979, 1981, 1982, 1983, 1992) used real-world, organizational application experience and field research to extend the basic Osborn-Parries three- and five-step models in two ways. The process can be represented as eight steps within the three phases. After the problem-finding phase has been divided into two stages - problem *generating* and problem *formulating* - the process can also be represented as a circular, continuous, four-stage process of generating, formulating, *solving* and *implementing.* Each of the

eight steps consists of the two-step mini-process; the entire process is called Simplex (Basadur, 1981) as shown in figure 3.1.

Ideation-evaluation occurs within each of the eight steps of the Simplex process. *Ideation*, or active divergence, is the generation of options without evaluation (deferring judgment). *Evaluation*, or active convergence, is the application of judgment to the generated options to select the most significant options. Separating ideation from evaluation is a vital aspect of this two-step process. This mini-process must be executed skillfully. For example, Basadur (1995) suggested that, in order to achieve high-quality, innovative, creative results, an individual or a group requires not only the appropriate content (i.e., the knowledge or the *what)* but a creative, innovative process (the *how)* for working on that content, as well as sufficient skills in using the process

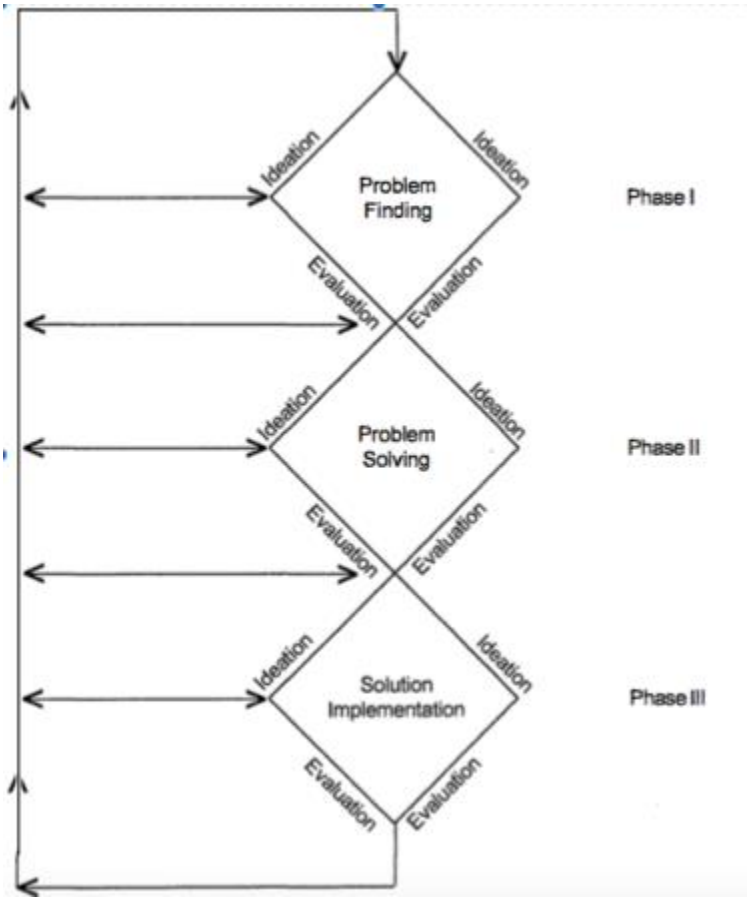


Figure 3.1. A "Complete Creative Problem Solving Process" Emphasizing Ideation-Evaluation as a Two-Step Processin Each of Three Continuous Phases adapted by Basadur (1995)

He identified four such process skills within the Simplex process:

- Active divergence - the ability to assertively generate a variety of options.
- Active convergence - the ability to evaluate and choose from among options and advance the process.
- Deferral of judgment - the ability to separate active divergence from active convergence.
- Vertical deferral of judgment - the ability to avoid un- consciously leapfrogging past steps, phases or stages of the process. Basadur incorporated these three components into a Quality Results Equation:
- Quality Results = Content + Process + Process Skills

3.1.2. Stage models

Out of these creative models the stage models are more commonly found in many studies and they are based on different stages attempting to understand the progression of creative though generation process.

3.1.2.1.Four stage model

Starting from Wallas in 1926 four stage models is the most common stage model found in creativity research literature. Based on previous work Kneller (1978) defines four indispensable stages in a creative process: preparation, incubation, illumination and verification. Preparation is an investigative phase to familiarize oneself with the problem environment. Incubation is a longer period, often unconsciously happening, preparing the mind for a solution search. Hypotheses are rejected through distancing from the problem at hand. The third stage, Illumination, occurs when perceptions are restructured and ideas are integrated in a search for solutions (Cross 1997). Finally, Verification must occur when ideas are revised, analyzed, judged and solutions tested. Each phase may be helped by specific methods to stimulate reflection, perception,

creation and finally testing ideas. Interesting prospects present themselves with available methods that may increase creativity for solving design problems intelligently (Clegg and Birch 2007; Mycoted 2007).

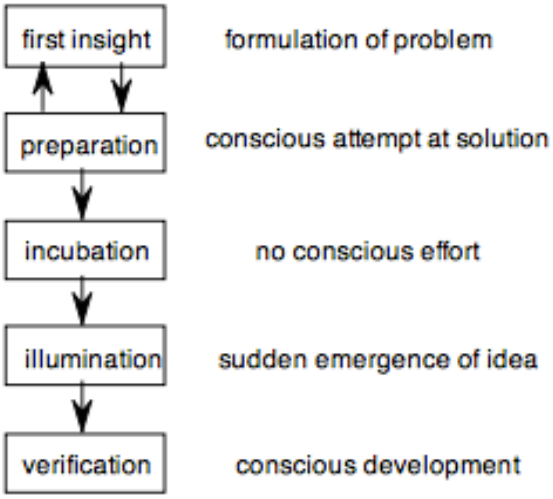


Figure 3.2. Five stage model based on the four stages of Kneller adapted by Lawson (1997)

There are many developments and adaptations from this basic four stage model that developed into five, six and eight stages. Figure 3.2 shows a development of a five stage model based on the model by Kneller.

3.1.2.2.Eight stage model

In what might be argued as the most comprehensive creative process model, Mumford and colleagues (Mumford, Supinski, Baughman, & Costanza, 1995; Mumford, Supinski, Threfall, & Baughman, 1996; Mumford, Mobley, &Uhlman, & Reiter-Palmon, 1991) developed the eight-stage model of creative problem- solving. In his review of creative process models, Lubart (2001) refers to the eight-stage framework as a "subprocess" approach. That is, whereas the Wallas (1926) four stage approach and others like it (e.g., Amabile, 1996) describe the overarching activities involved in creative idea production, the eight-stage model depicts the full range of processes characterizing creativity and innovation.

The activities are comprised of:

1) problem identification and construction,

2) information gathering,

3) concept selection,

4) conceptual combination,

5) idea generation,

6) idea evaluation,

7) implementation planning, and

8) monitoring.

The model has seen considerable support in the literature, demonstrating that skill in these processes predict creative performance over and above general cognitive ability, scholastic achievement, and divergent thinking ability (Mumford, Supinski, Baughman, Costanza, & Threlfall, 1997). Moreover, each stage of the creative process has been examined extensively across a range of studies (e.g., Mumford & Baughman, 1996; Mumford, Baughman, Maher, Costanza, & Supinski, 1997; Mumford et al., 1997).

3.1.3. Componential models

Componential models are based on different components that provide base for creative process. In this types of models the different features of different components are manipulated rather than the progression from one stage to another.

Amabile (1983) has developed the componential model of individual creativity as shown in figure 3.1. identifying Intrinsic motivation to do the task, Skills in the task domain and skills in creative thinking as key components. The broken line in the model is to indicate the influence of particular factors on others while solid lines indicate the sequence of steps in the process.

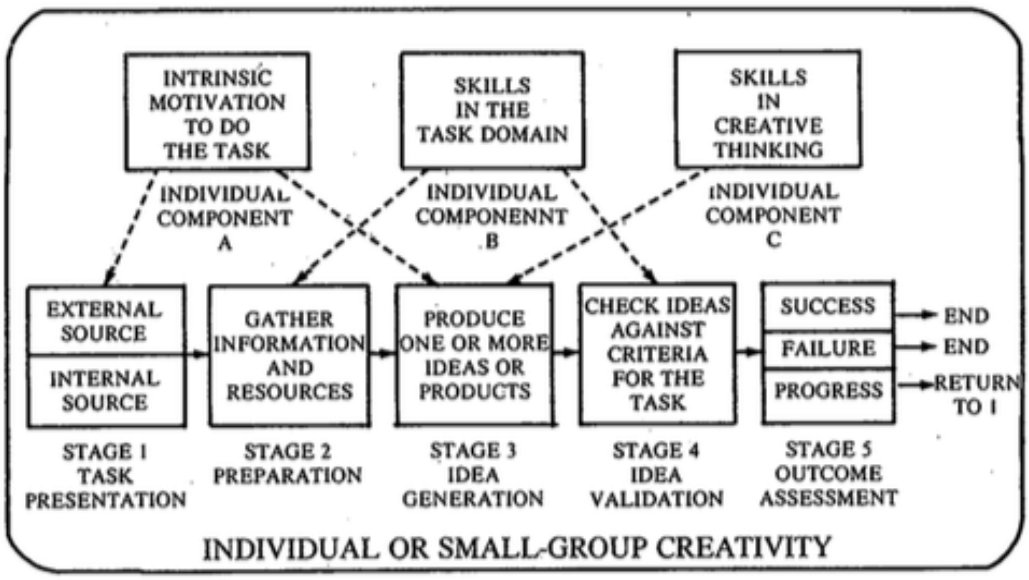


Figure 3.3. Componential model of creativity adapted by Amabile (1983)

This model is comprehensive in resembling many earlier theoretical models based on stages and showing their influence within each components.

The investment thory by Sternberg and Lubart (1995) is another comprehensive componential model that idemtifies six factors inlfuencing creativity ; knowledge, interllectual ability, thinking style, motivation, personality and envieonment. This complex model discuss hoe each component inlfuences creaitivity rather than progressing from one stage to another.

3.1.4. Problem solving models

Over the years, several different models have been presented as to explain the process of creative problem-solving. In fact, these models are not extremely different from each other, and have quite a lot in common. The first of these models was originated by Wallas in 1926, and consists of four stages (Plsek, 1997): **1. Preparation:** definition of the issue, observation, and study **2. Incubation:** laying the issue aside for a while **3. Insight or illumination:** the moment when a new idea finally emerges **4. Evaluation, revision, or**

verification: checking the generated idea.

Figures 3.4 to 3.9 show development of creative problem solving processes in a chronological order.

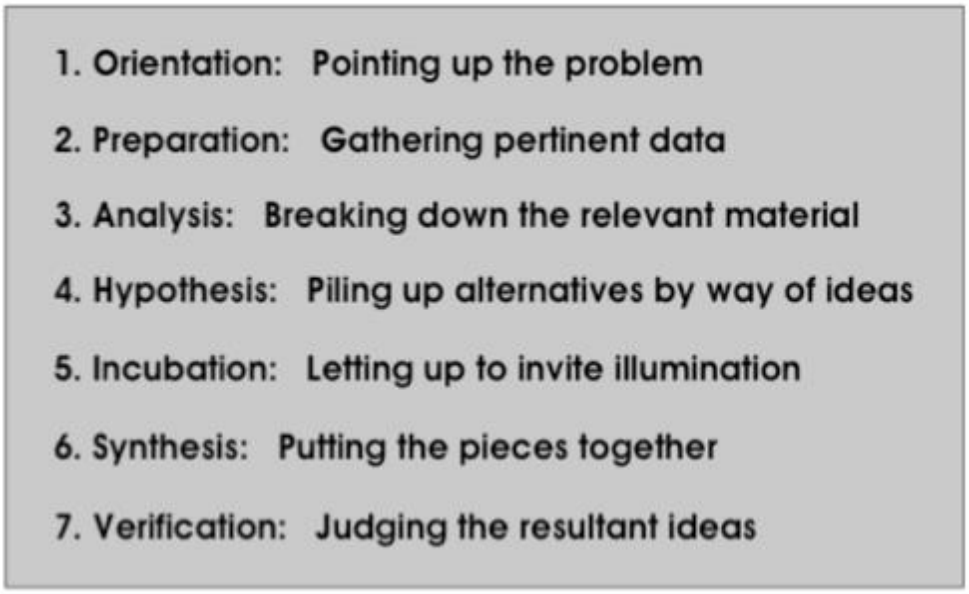


Figure 3.4. Osborn's Seven Step Creative Problem Solving Process (1953)

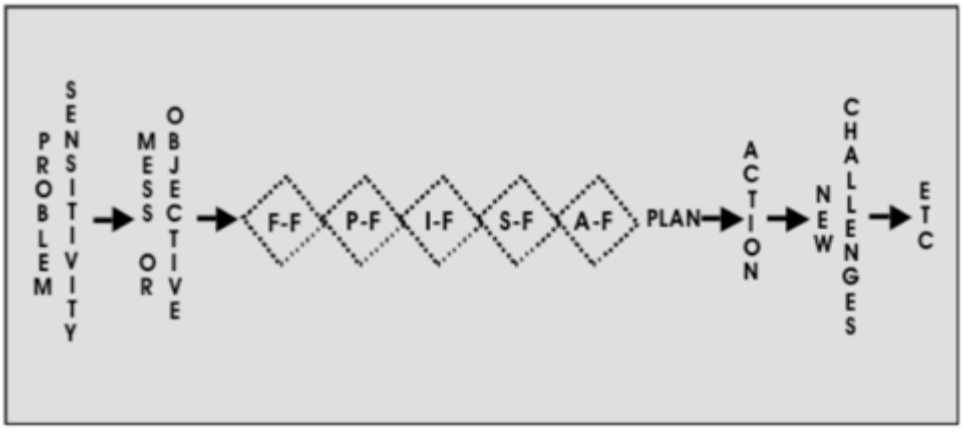


Figure 3.5. Osborn-Parnes Five stage Creative Problem Solving Process (1976)

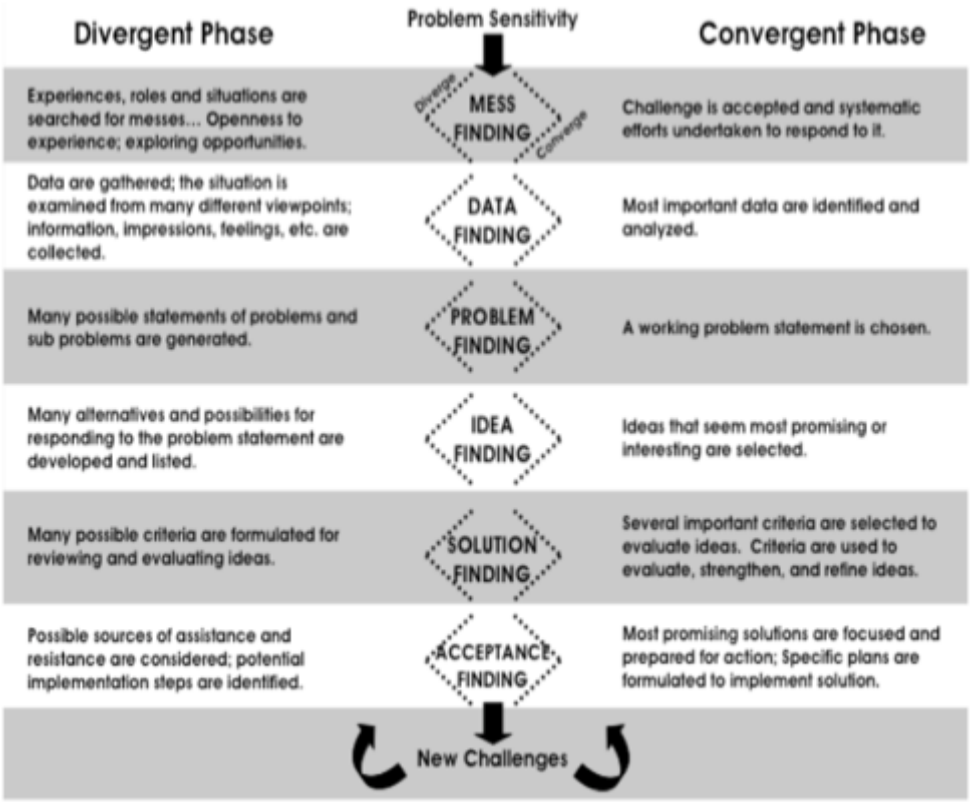


Figure 3.6. Isaken & Treffinger Creative Problem Solving Process (1985)

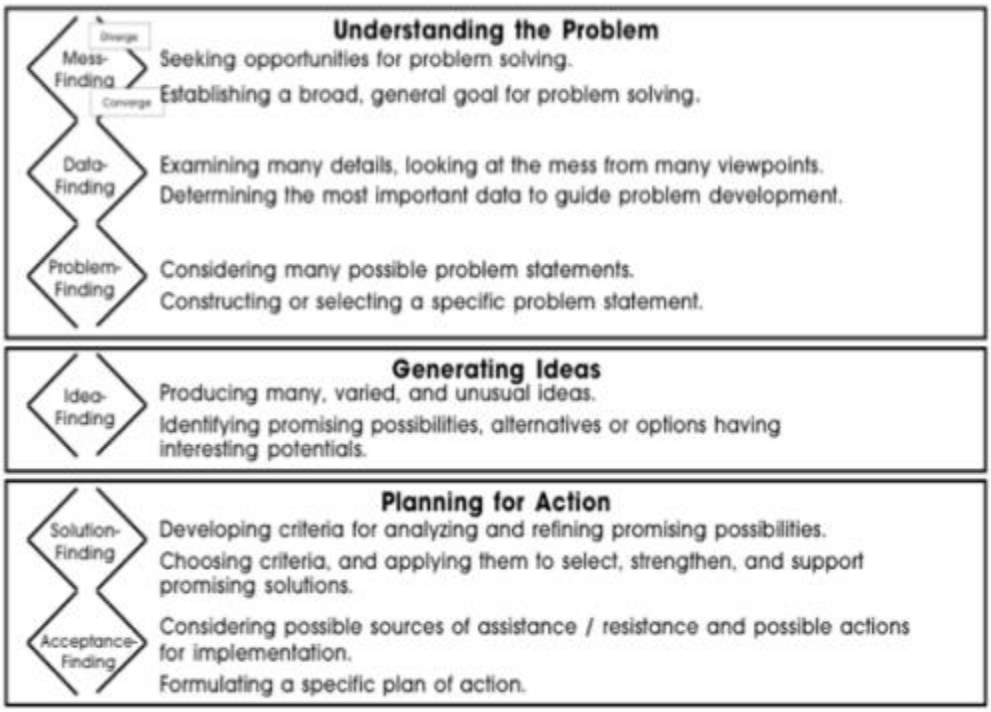


Figure 3.7. Treffinger & Isaken Creative Problem Solving Process (1992)

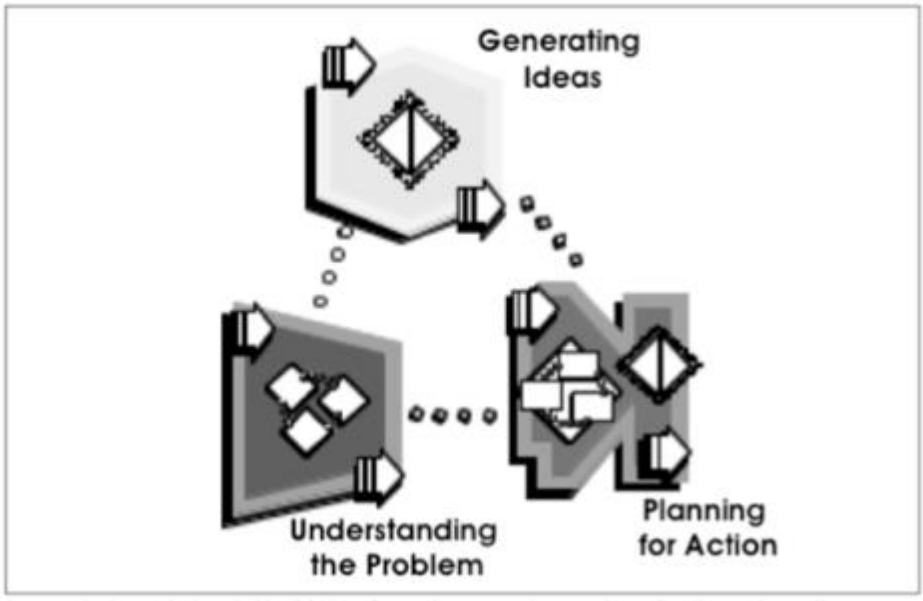


Figure 3.8 Isaken and Dorval Creative Problem Solving Process (1993)

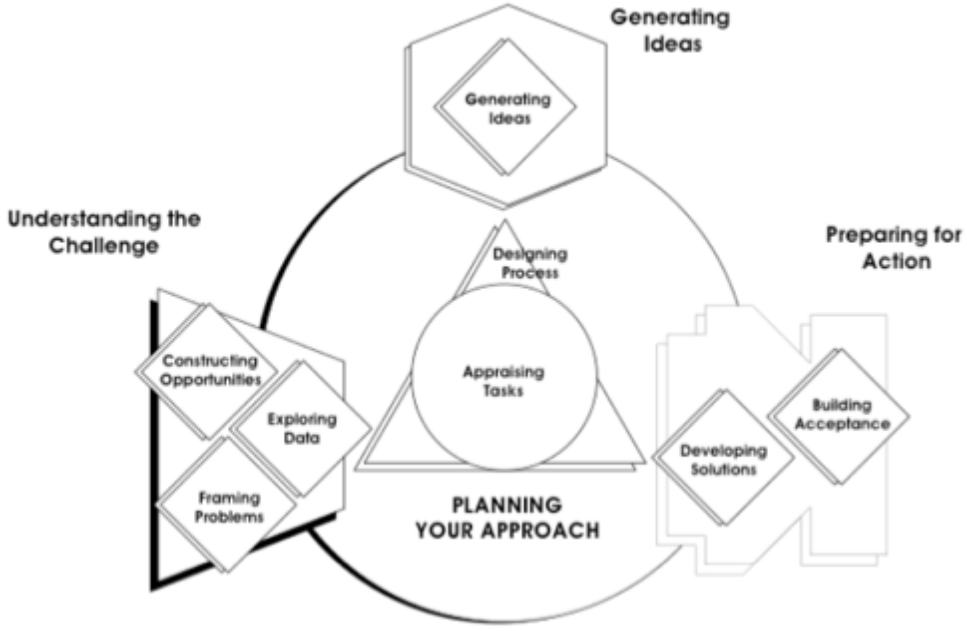


Figure 3.9. Isaken, Dorval & Treffinger Creative Problem Solving Process (2000)

All the above processes show different models that one could experience in solving creative problems. They are developed in combining stage models and

componential models while to address the specific problem they are to resolve. In identifying the complex situation of the problem these have become domain specific and latter development also depicts more cyclic nature of the creative process.

3.1.5. Working model for creative process

Plsek (1997) after conducting extensive studies on these models identified some common features presiding over the models, Some of these, according to Plsek (1997), are as follows:

- The creative process involves purposeful analysis, imaginative idea generation, and critical evaluation. The total creative process is a balance of imagination and analysis.
- Older models tend to imply that creative ideas result from subconscious processes, largely outside the control of the thinker. Modern models tend to imply purposeful generation of ideas under the direct control of the thinker.
- The total creative process requires a drive to action and the implementation of ideas. We must do more than simply imagine new things; we must work to make them concrete realities.

He also developed 'The Directed Creativity Cycle' (Plsek ,1997), that is an integrative model that combines the previously proposed creativity models, is a useful one that stresses the importance of implementation in the real world, and thus can be used for the operationalization of the concept (see Figure 3.10). The cycle involves four different 'types' of stages consisting of four separate stages each that intermingle.

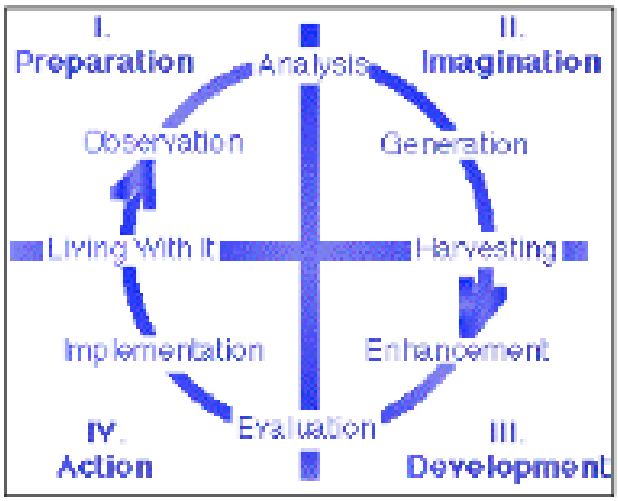


Figure 3.10. The Directed Creativity Cycle adapted by Plsek (1997)

Comprehension of the various models for the creative problem-solving process is significant in depicting the differences and similarities between them. More importantly, the progress of the models can be seen as they become more and more elaborate.

Howard, Culley and Dekoninck (2008) have extensively compared creative process models and concluded them into four main stages outlined in the following table 3.1.

Table 3.1. Comparison of creative process models adapted by Howard, Culley and Dekoninck (2008).

Illumination	X	Implications of solutions through reasoning	Verification	X
Illumination			Elaboration	Communication
			Looking Back	X
			Convergence	X
			Evaluation	Presentation
			Solution-finding	X
		Solution-finding	Acceptance-finding	Action
			Convergent	X
			Judgement	
			Hypothesis testing	Communication of results
			Solution-finding	Acceptance-finding
			Response validation	Outcome
		X		Bring up the baby
		Developing solutions	Building acceptance	Appraising tasks
		Evaluating, prioritising ideas		Developing an implementation plan
		Create		Donate (communicate)
			Plan	Acceptance
		Evaluate and select		Action
Analogies, metaphors				
		Reinterpretation		X

Carefully investigating these models the four stages: Preparation, Generation, Evaluation and Implementation could provide a broader approach to develop a theoretical model where activities within the design process could be superimposed on to these phases. Following figure 3.11. provides the basic working model for "Integrated creative process".

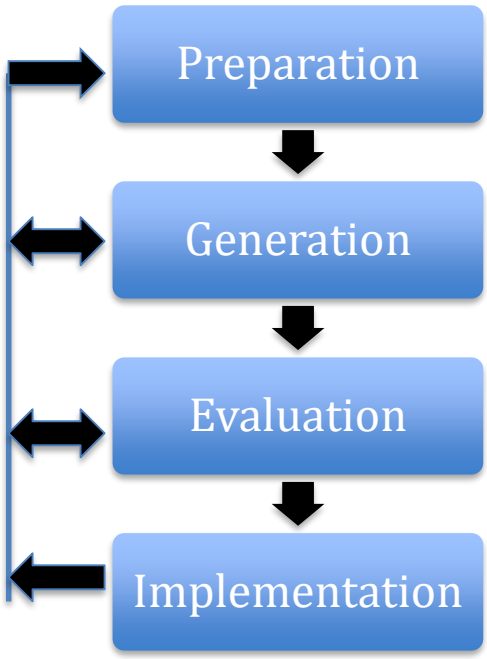


Figure 3.11. Integrated creative process (Author)

3.2 Architectural design process and the creative process: superimposing the phases

In order to facilitate the creative process within an architectural design program, it would be logical to use domain-specific tasks by understanding their applicability within the creative process. Only once the design process activities that take place within the studio are superimposed onto the creative process an intervention can be developed, beginning from the Integrated creative process.

First a look at design process models have been done to summarise them into an integrated creative model and then identifying the design studio activities that could fit into them.

3.2.1. Understanding design process as a creative process

According to Jones (1970), the designer has been described as a 'black box', because it was thought that designers generated a creative solution without being able to explain or illustrate how the solutions came out. Since the 1980s, the

paradigm of ‘design as a discipline’ has led to a vigorous discussion on the view that design has its own things to know and its own ways of knowing them. While in the past the design research community has focused on the former (related to products), nowadays the growth of interest is the analysis of designers’ cognitive activities. This interest has become a major interdisciplinary topic not only in design science, but also in psychology, computer science and artificial intelligence. .

These uncertain phases are in accordance with the question from creativity. According to well-known Walla’s (1926) four- stage model of the creative process – preparation – incubation – illumination – verification, the middle phases of how designers incubate information and how come they attain creative insight still remain incompletely as regards design in practice.

Many design process studies have also identified similar stages as in the creative process and table 3.2 clearly depicts the phases in which designers also work. These two processes have mush common grounds to be integrated in developing a model for a creative design process. How ever the domain specific tasks need to be identified in relation to each stage depending on the program.

3.2.2. Design process models

The systematic studies into design process identify design as a process that has sequential stages. Table 3.2. , Which is based on the framework developed by by Howard, Culley and Dekoninck (2008) offer an insight into these stages in scientific design processes that also provide basis for architectural design process. Following is the table 3.2. that compares the design processes found within scientific design literature in a way that they could be aligned with the architectural design process.

Table 3.2. Comparison of Scientific design processes adapted by Howard, Culley and Dekoninck (2008) modified by Author

Models	Establishing a need phase	Analysis of task phase	Conceptual design phase	Embodiment design phase	Detailed design phase	Implementation phase
Booz et al. (1967)	X	New product strategy development	Idea generation / Screening & evaluation	Business analysis / Development	Testing	Commercialisation
Archer (1968)	X	Programming / data collection	Analysis / Synthesis	Development	Communication	X
Svensson (1974)	Need	X	Concepts	Verification / Decisions	X	Manufacture
Wilson (1980)	Societal need	Recognize & formalize / FR's & constraints	Ideate and create	Analyze and/or test	Product, prototype, process	X
Urban and Hauser (1980)	Opportunity identification	Design		Testing		Introduction (launch) / Life cycle management
VDI-2222 (1982)	X	Planning	Conceptual design	Embodiment design	Detail design	X
Hubka and Eder (1982)	X	X	Conceptual design	Lay-out design	Detail design	X
Crawford (1984)	X	Strategic planning	Concept generation	Pre-technical evaluation	Technical development	Commercialisation
Pahl and Beitz (1984)	Task	Clarification of task	Conceptual design	Embodiment design	Detailed design	X
French (1985)	Need	Analysis of problem	Conceptual design	Embodiment of schemes	Detailing	X
Ray (1985)	Recognise problem	Exploration of problem / Define problem	Search for alternative proposals	Predict outcome / Test for feasible alternatives	Judge feasible alternatives / Specify solution	Implement
Cooper (1986)	Ideation	Preliminary investigation	Detailed investigation	Development / Testing & Validation	X	Full production & market launch
Andreasen and Hein (1987)	Recognition of need	Investigation of need	Product principle	Product design	Production preparation	Execution
Pugh (1991)	Market	Specification	Concept design		Detail design	Manufacture / Sell
Hales (1993)	Idea, need, proposal, brief	Task clarification	Conceptual design	Embodiment design	Detail design	X
Baxter (1995)	Assess innovation opportunity	Possible products	Possible concepts	Possible embodiments	Possible details	New product
Ulrich and Eppinger (1995)	X	Strategic planning	Concept development	System-level design	Detail design	Testing & refinement / Production ramp-up
Ullman (1997)	Identify needs / Plan for the design process	Develop engineering specifications	Develop concept	Develop product		X
BS7000 (1997)	Concept	Feasibility	Implementation (or realisation)			Termination
Black (1999)	Brief/concept	Review of 'state of the art'	Synthesis / Inspiration	Experimentation / Analysis / reflect	Synthesis / Decisions to constraints	Output / X
Cross (2000)	X	Exploration	Generation	Evaluation	Communication	X
Design Council (2006)	Discover	Define	Develop		Deliver	X
Industrial Innovation Process 2006	Mission statement	Market research	Ideas phase	Concept phase	Feasibility Phase	Pre production

The six headings in the table 3.2 comprise the four major design phases: 'analysis of task, 'conceptual design', 'embodiment design' and 'detailed design'. Preceding these four phases is the 'Establishing a Need' phase, where the driver for the design is recognised. With just few exceptions (Urban and Hauser, 1980; Baxter, 1995), it is noticeable that nearly all processes assume a market driven process as opposed to a technology driven process. Following the four major phases is the 'implementation phase', which is included by several authors, explaining what happens when the final engineering 'drawings' and instructions are completed.

The comparison done by Howard, Culley and Dekoninck (2008) are more focused on engineering design process therefore RIBA Plan of Work (Annexure I) , the most common design procedure followed in architectural work is also integrated onto the comparison. This provides opportunity to understand the architectural design activities that are more related to each phase in design process.

3.2.3. Creative process phases Vs. Design process activities

A comparison between the table 3.1 and 3.2 clearly indicates that the creative phases and the design process phases can be superimposed. Following table 3.3. is a brief conclusion on the main stages that has been overlaid.

Table 3.3. Creative process stages against design process phases

Analysis phase Saturation	Establishing a need phase
Generation phase Incubation Illumination Develop some possible solutions	Analysis of task phase
Evaluation phase	Conceptual design phase Embodiment design phase Detailed design phase
Communication / implementation phase	Implementation phase

In the first stage, the person tries to understand the problem and collects necessary information that seems relevant. This is the preparation stage. Then s/he tries to solve the problem, but may not be able to even by spending a certain amount of time on it. As a result, s/he may suspend the process for a while, thinking that s/he will be more successful in the future, and this is called the incubation stage. It is a stage that necessitates internal evaluation and commonly a private space that enables this personal activity (Kristensen, 2004).

In the illumination phase, grasping of the whole process can be observed, and the

network suddenly adopts a pattern that works with the inputs and looks like it will solve the problem after having tried and failed so many times before. The thinker then has the feeling of 'a-ha!', and at this point, a solution that is novel, at least to the thinker, is produced by way of the thought process. In the evaluation, the thinker assesses her or his idea, and if s/he decides that it does not work, the whole process is repeated. Additionally, sometimes the idea is correct or works in principle, but needs adjustment in certain parts (Morgan, 1977; Jones, 1992; Verstijnen et al., 1998; Kristensen, 2004).

3.2.3.1.Preparation

In design this is the information gathering stage and these external information could impact the final outcome. Design research depends on specific activities from empirical studies; the link between external information and representation in sketching and drawing is well established (Coley, Houseman and Roy, 2007). In design practice, even though the purpose of information categorisation might be different depending on the context of application, the activity of information categorisation provides a unique opportunity to observe how the designer's need for information is shaped by the information already accessed (Restrepo, 2004). Also it is very specific inasmuch as it includes the ability to diverge and generate new categories and to converge and classify images resources to fit into existing categories at once. Moreover, in observing designers' activities, it was shown that designers try to discover a 'new' or 'previously hidden' association between a certain piece of information and what they want to design (Sharples, 1994). At times, expertise can serve as a rich source of information on the problem, helping to guide later idea generation (Sweller, 1989). There is also evidence that access to a wider range of information – even irrelevant information – can lead to novel solutions (Alissa, 1972; Hunter et al., 2007).

Alencar (1996) shows that relevance to a context is of extreme importance for a product to have scientific, technological, social and aesthetic value. From this, it follows that creative thinkers are specialists in their fields alone, and specific

in-depth knowledge is vital for creative thought.

In architectural studio these are the activities that involve background information assimilation. This included in depth context studies, site studies and analysis, finding anthropometrics and ergonomics data, precedence studies, literature reviews, user studies, technology studies and gathering any other information relevant to the project. For the development of the model this stage will be taken as the assimilation stage.

3.2.3.2.Generation

The commonly found incubation in creative models include the ideation-evaluation process that was widely discussed my many creativity researchers. Basadur (1995) has conducted extensive studies on the area and it is quite evident that the incubation phase where thoughts are generated is a complex activity. In this generation is the stage where new ideas are generated. Inmost cases the knowledge or the gathered information would support this activity. The ability to diverge is the basic creative skill that would require to succeed in this phase.

Specifically considering the design studio once all the information is assimilated the design brief is finalised. Then in order toe generate various ideas a students may be asked to identify the design process, which may have to take place by conducting a brief interpretation. These interpretations are the original thoughts students are generating in response to the design forces they have identified. Within the developed model this phase is termed interpretation to reflect a more domain specific activity both students and tutors are familiar with.

3.2.3.3.Evaluation

With a sizable pool of information in place from both assimilation and generation phase, the creative task changes from gathering data to choosing which aspects of the data pool to focus on. This process of narrowing down is

known as concept selection (Baughman & Mumford, 1995; Mumford, Supinski, Threlfall, & Baughman, 1996). Yet again in architectural design this is not merely selecting one option but rather a complex process that needs integrated knowledge on domain specific criterion as well as creativity in idea selection.

In identifying the studio-based activities within the interpretations they have generated students are first asked to select one predominant idea and state the design objective. Then only the concept formulation is encouraged. Therefore contemplating on this most significant stage in the design process the evaluation is actually takes as two steps: identification and conceptualization.

Identification is where the student is selecting the most appropriate and valuable interpretation to find their design objective. This is crucial in finding such an objective that could be achieved through the architecture they are creating.

The conceptualization stage is where the actual concept is generated in response to the design objective. This clearly reflects the student creativity in design and architecture in coming up with a verbal explanation, a metaphor or even an abstract image.

3.2.3.4.Implementation

This stage again is not merely one step but in architectural a design a series of steps that includes visualization of the design, design development and then justifying as well as implementing on a site. However identifying the academic program and the specific activities the stage is divided into two phase; visualization and verification.

Visualization is the designing and detailing the building with its physical form. This includes conceptual design transformed into a actual functional piece of architecture. Studio activities include different stages of design development

from conceptual design, outline proposal, schematic design, detail design and technical design.

In academic work verification is generally the justification of the design. Therefore, this will include how one presents one's scheme and being convinced that it can be presented. The critiques and their impacts and the assessment criterions will take a major role in this phase.

3.2.4. Working model for creative design process

Starting from the integrated creative model as depicted in figure 3.11 considering the design process phases the model could be further developed. Figure 3.12 shows the working model that is based on the creative process and then integrating the design process activities making it domain specific so the design studio activities could also be mapped on to the working model.

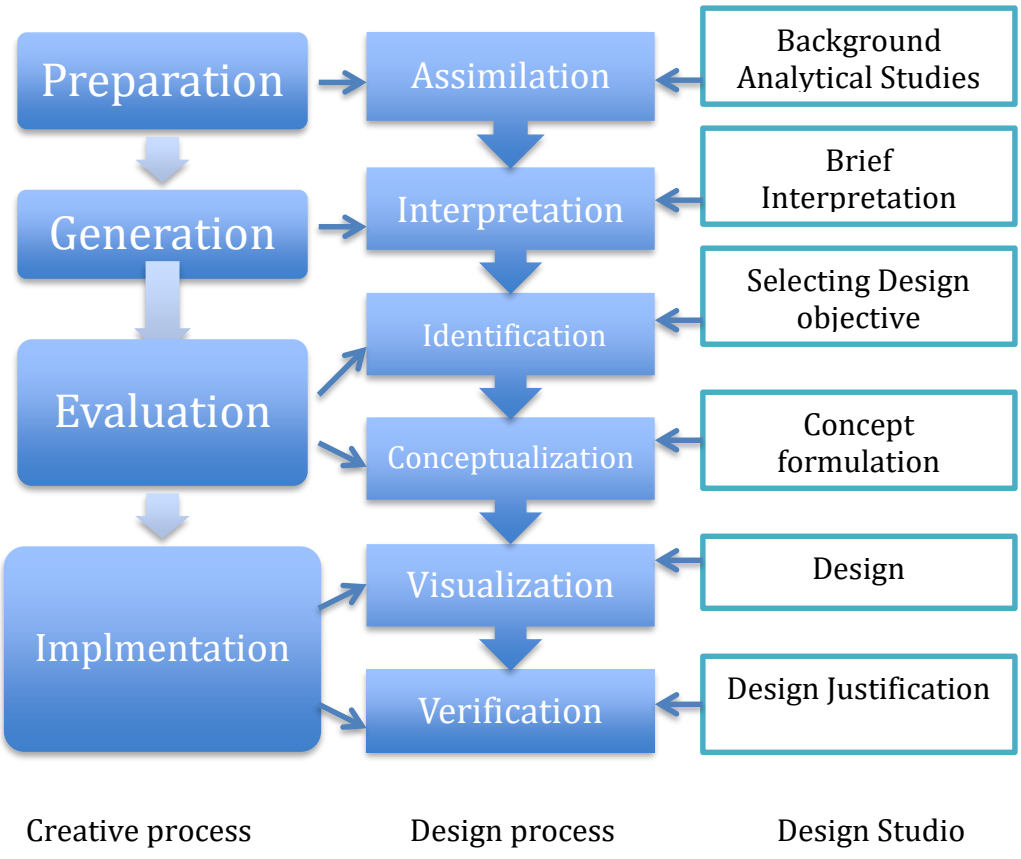


Figure 3.12. Working Model for Creative Design Process (Author)

In this model the four phases of the integrated creative process model namely; Preparation, Generation, Evaluation and Implementation was further developed into six-phase model considering the design process found in design thinking. Generation within the creative process is divided into interpretation and identification reflecting the more detailed idea generation in design. Implementation also is developed into visualization and verification stages that involve developing of the design and justification of the design as well.

This working model that is being developed could be the basis of development for the theoretical framework integrating the theories, which could provide a platform to design an intervention to facilitate creativity.

3.3. Assembling creative methods into creative design process

The developed working model provides the basis to understand the different phases in the creative process, unified stages within the design process as well as typical education activities that could take place in design studio. However it is also necessary to map the creative methods, techniques or more commonly termed creative interventions on to this theoretical framework to use it as a tool to develop creative interventions in architectural design studio.

Different stages of creative design process require varied methods to improve

creative performance; they could become general creative methods or domain specific ones. In a previous study Clegg and Birch (2007) conducted an evaluation of creative methods in terms of their use in architectural design studios. The identified methods across creativity research was outlined in the table 2.1 where the methods that could be used in different phases of creative process is given in table 3.4.

Table 3.4 Classification of various methods that may stimulate creativity in relation to phases of the creative process (Clegg & Birch, 2007)

Creative Process Phase	**Methods**
Problem Definition	Assumption Busting; Assumption Surfacing; Backwards Forwards Planning Boundary Examination; CATWOE; Chunking; Five W's and Hs; Multiple Redefinition; Other Peoples Definitions; Paraphrasing Key Words; Why Why Why
Idea Generation	Analogy; Attribute Listing; Biomimicry; Mind Mapping; Morphological Analysis; Nominal Group Technique; Pictures as Idea Triggers; Pin Cards; Random Stimuli; Talking Pictures; TRIZ
Idea Selection	Advantages, Limitations and Unique Qualities; Anonymous Voting; Consensus Mapping; Idea Advocate; NAF; Plusses Potentials and Concerns;

	Sticking Dots; Unique Qualities
Idea Verification	PDCA; QFD; Six sigma

From the literature search Clegg and Birch (2007) found most significant tools that have been adopted in architectural studios. these are: Analogies; Attribute Listing; Axiomatic design method; Bio-Mimicry; Brainstorming; Browsing; Charette; Component Detailing; Do Nothing; Doodling; Drawing; Exaggeration; Excursions; First Principle; Focus Groups; Mind Mapping; Other Peoples Viewpoints, TRIZ; Think Tank; Using Crazy Ideas; Using Experts; Visual Brainstorming; Visualizing a Goal; Working with Dreams and Images. Many of these methods are traditionally part of the design process, such as Charrettes, and those that emphasize visualization of ideas (Goldschmidt & Smolkov, 2006), (van der Lugt, 2005). Other methods such as "Do nothing" need no formal introduction into the typical teaching studio, as this attitude is one of the many complaints of design instructors.

For the purpose of developing the theoretical framework these common methods were integrated into the already developed working model for creative design process while understanding their implication in different six stages of the model.

3.3.1 Assimilation

Referring to the list of available creative methods that can stimulate creativity specifically set out in table 3.4. it could be observed that methods commonly focusing on analytical ability were used during this phase. Considering the more domain specific tasks SWOT (strength weakness opportunity and threat) , mind mapping, brain storming , bubble diagramming are among key tools used in this process.

Some activities such as precedent studies could also become tools assisting in generating ideas and increasing performance during this stage. Precedent-based design (Oxman, 1999a) is accepted as one of the cognitive phenomena in design creativity as a source of ideation, and although the importance of intricate and

detailed knowledge as being essential to designing is well recognized, little is known about how the knowledge base of the (novice) designer affects the quality or creativity of the design (Christiaans & Venselaar, 2005). Howard-Jones (Howard-Jones, 2002) has shown many pitfalls and potentials of methods to stimulate creativity and recommends the need for investigations on the application of specific methods.

3.3.2. Interpretation

Working on idea generation De Bono (de Bono, 1992) describes many different ways to produce creative ideas through techniques with descriptive names such as: “The Creative Pause,” “Focus,” “Challenge,” “Alternatives,” “The Concept Fan,” “Concepts,” “Provocation,” “Movement,” “Setting Up Provocations,” “The Random Input,” and “Sensitizing Techniques.” A large number of the methods found in the literature on creativity relate to a wide variety of areas: psychology, pedagogy, business administration, marketing, industrial design, fine arts and architectural and engineering design (Clegg & Birch, 2007) (Mycoted, 2007). For that reason, not all of the methods found in the literature on creativity are necessarily useful in typical architectural design processes, for example the ‘‘QFD’’ method rarely applies.

Using the psychometric approach, J. P. Guilford (Guilford, 1967) was the first researcher who both systematically theorized and experimentally investigated creativity. Creative or “divergent thinking” was held to be principally synonymous with the level of fluency, flexibility and novelty of generated ideas, followed by the elaboration and redefinition of ideas. Divergent thinking refers to unbound ideational searching or open-ended thinking that is typically evoked in creativity tasks where solutions need to be generated for problem situations that do not have any right or wrong answers. Using such ideas as a foundation and by elaborating on one or more of these predefined variables, a number of tasks and test batteries were devised to gauge and quantify creative ability or divergent thinking (Torrance, 1974), (Wallach & Kogan, 1965).

One of the most widely employed tasks in the assessment of divergent thinking over the decades has been the alternate uses task, which was introduced by Wallach and Kogan (Wallach & Kogan, 1965) in their investigations of creative potential in children.

Brainstorming is probably the best-known method to stimulate creativity, where experts from many fields put their ideas forward without prior ruling. There are basic rules to Brainstorming: Focus on quantity; In Osborn's (1957) definition, Brainstorming is a conference technique by which a group of people attempt to find a solution for a specific problem by amassing ideas spontaneously.

3.3.3. Evaluation: Identification and conceptualization

This comprise two stages of Identification and Conceptualization. Across creativity techniques there are many methods to enhance performance yet as with in other stages every method may not be useful in architectural design. Using the basis from table 3.4 the methods given within selection is adapted in this phase.

Conceptual expansion, as the term suggests, refers to the ability to expand concepts (Ward, 1994). One method of classifying analytical problems is by distinguishing between insight and non-insight or incremental problem solving (Metcalfe, 1986), (J. Metcalfe, 1986), (Schooler J. F., 1994), (Schooler J. M., 1995), (Weisberg, 1995). Both problems types have well-defined means, or conditions of the task at hand, and a specified goal, which is the solution that is to be reached. What makes problem solving strategies 'incremental' in an analytical task is that the goal is attained in a stepwise manner and generally follows an incremental pattern (Davidson, 1995), (Metcalfe & Wiebe, 1987).

Solving an insight problem, in contrast, requires restructuring or a vital change in the representation of the elements of the problem (Duncker, 1945), (Ohlsson, 1984). The progression during the problem solving process is, therefore, not incremental, but involves a sudden discovery of a solution, a phenomenon that

is also commonly referred to as the “aha” experience.

Relative to the other stages of the creative process, idea evaluation has tended to receive less research attention (Hunter et al., 2006). It is proving to be, however, one of the more critical aspects of the innovation process (Lonergan, Scott, & Mumford, 2004). Ideas that are sent out for production without being properly vetted and tested are doomed to fail, thereby limiting the likelihood of success from the project team in the future.

3.3.4. Implementation: Visualization and Verification

In this phase the focus in on visualising the project and verifying the visualization. According the study by Clegg and Birch (2007) very few methods were identified within main creativity methods. However looking to the architectural works there are many activities that take place within this phase and many tools could be adopted to simulate creativity in studio work.

The use of digital tools is one large contribution in this area where it has made possible for visualization to experience in a very realistic context. Computational support tools, such as Computer Aided Design (CAD), rapid prototyping and applications of artificial intelligence have sprung from the design method movement to enrich and facilitate the design process during this stage. In architectural design, Post-Occupational-Evaluations (POE) or Building Performance Assessment gains importance as design quality evaluation and verification methods are developed.

3.3.5. Theoretical framework

Following is the developed model; the platform to design an intervention to facilitate creativity:

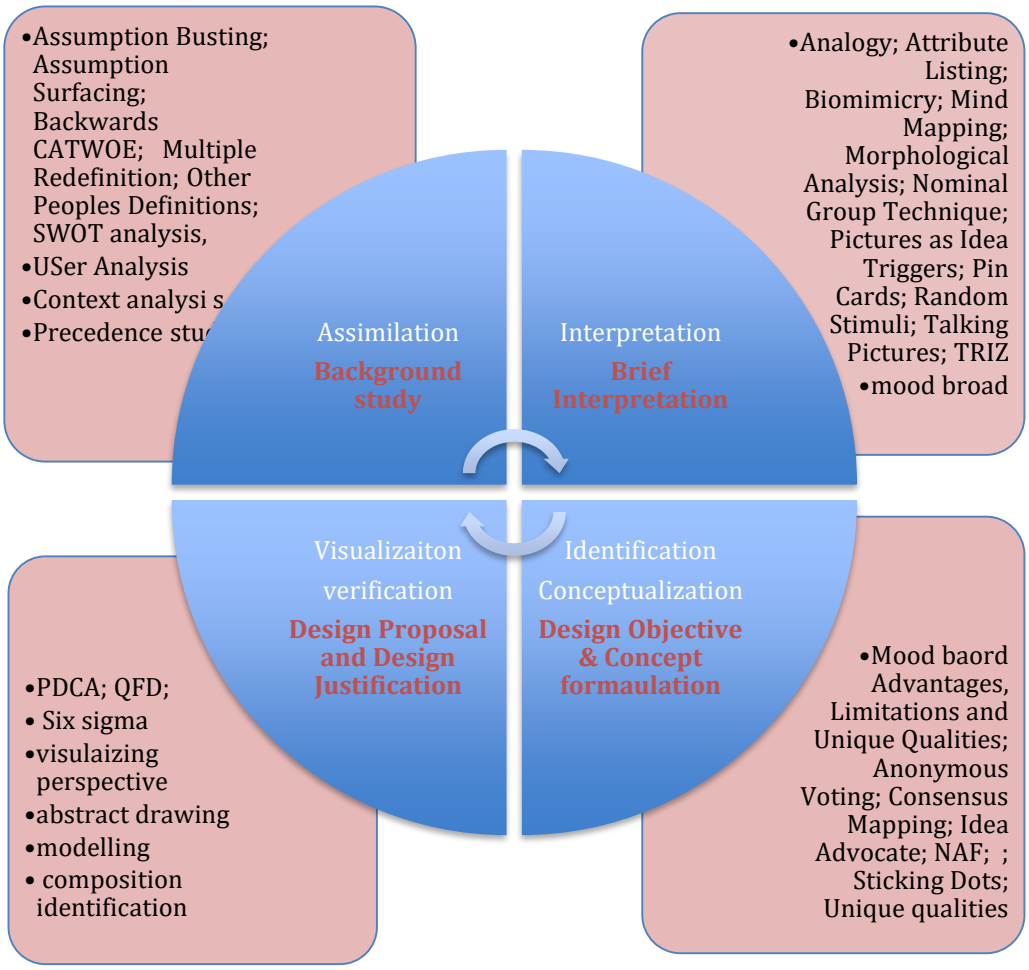


Figure 3.13. Theoretical model for creative design process

3.4. Concluding remarks

The main objective of identifying a mechanism to stimulate creativity and improve design performance was achieved by developing a theoretical framework in three stages: 1) integrating creative process models 2) super imposing creative process with design process 3) mapping creative methods both general and domain specific on to the working model.

Through exploration of the different types of models that have been developed in order to understand the creative process, an integrated creative process model was derived. This model has drawn from the foundation of a four stage creative process including preparation, generation, selection and verification. While identifying the studio activities along the design process and mapping them into the working model paved way for the implicit knowledge generated in the design studio to be

mapped into a systematic model transforming them into explicit knowledge that could be used in the future.

The relevant skills for each stage have been identified and each area looked into in detail. Thereafter, through the theoretical information gathered, the working model has been further developed with the use of previously discovered theories on education, and the final model consists of five stages – assimilation, Interpretation, Identification, conceptualization and verification, which, when combined, could be used as a basic foundation for the design of a creative intervention.

During the three stage theoretical framework development during both identifying design studio activities and then developing and selecting tools for creative simulations allowed to transform the widely used design studio activities to be incorporated in to a scientific education model. This was the key in achieving the research objective of transforming implicit knowledge in the design studio into explicit knowledge in architectural education.

4. CREATIVE INTERVENTION: CONDUCTING OF A DESIGN PROGRAM TO FACILITATE THE CREATIVE PROCESS

The design studio is the main component in any architectural design programme where setting the design project itself is challenging. Therefore a guide that is based on creative process providing a platform to develop design programme possessing supporting activities could provide a better opportunity for more creative outcomes.

The creative intervention was conducted on a student group from an Interior Architecture Bachelors degree program. This was designed to suit the particular design program that was given for students in the first year second semester based on the developed "theoretical model for creative architectural design process". Once a through study has been conducted on the current program the activities were identified with their relationship to the creative process to assist in restructuring the design programme for the purpose of the study.

4.1. Restructuring the design programme

In order to use the developed theoretical framework the design studio program was restructured to reflect the sequencing found in the developed framework. Restructuring in education program should be done in a systematic manner and Jackson and Shaw (2005) also basing their studies on McGoldrick (2002) and Oliver (2002) synthesised the responses to the question asked 'what does being creative mean when you design a course?' ,

Creativity as personal innovation – something that is new to individuals. This is often about the transfer and adaptation of ideas from one context to another creativity as working at and across the boundaries of acceptability in specific contexts: it involves exploring new territory and taking risks.

Creativity as designs that promote the holistic idea of graduateness – the capacity to connect and do things with what has been learnt and to utilise this knowledge to learn in other situations.

Creativity as making sense out of complexity, i.e. working with multiple, often

conflicting factors, pressures, interests and constraints.

Creativity as a process of narrative-making, in order to present the 'real curriculum' in ways that conform to the regulatory expectations of how a curriculum should be framed. (Jackson & Shaw, 2005)

Within the scope of this study the creative process as being taken as the basis the discussions with the tutors were based on the questions of how each activity or phase is contributing positively or negatively to the creative process.

Selected case study is from an Interior Architecture undergraduate degree program. Interior Architecture is the core module, which comprise of two design projects per every semester. The practice in the program is one semester is focusing on one type of designs. The first semester in the year one was focused on residential designs where students were given to design a bed room and then a cooking and a dining space for a particular client. During the Second semester the focus was on designing office spaces. Usually students are given an interior space of around 1000 to 2000 square feet to design an office function. In restructuring the design programme first the existing situation was analysed discussed with tutors and then restructuring strategy was proposed and used. Within the restructuring some existing activities were arranged differently while new activities were also introduced.

4.1.1. Project Scenario

Research reveals that setting the project itself encourages creativity. Specifically the strength of realistic restrictions, imposed on the design solution realm, was tested in the previous study by Kowaltowski et al (2010). The results showed that restrictions could enhance creativity in students, especially through the challenge of breaking the imposed barriers by adopting new and original solutions. It was found that with restrictions made clear, students were more confident in their design proposals and the design process as a whole (Kowaltowski et al, 2010).

An important factor in stimulating creativity is the imposition of restrictions

(Boden 1999). In the building design process, restrictions are present through codes, site conditions and costs, to mention just a few aspects. Although often seen negatively as impositions, restrictions can be positive challenges for new ideas to flourish. Restrictions, as stimuli, can thus be applied in the design-studio to challenge students in breaking imposed barriers with creative and appropriate solutions.

It was observed that mostly project locations were given from their immediate surrounding or students were asked to select their own location. With the view that a it would provide better options for handling practical situations and to set clear limitations it was decided to provide them with realistic project location. They were also advised to consider the actual ground realities they identify. They were also asked to conduct a through site study assuming that it would lead to better insights.

In selecting the particular project students were given the flexibility to select their own client representing a real organization. This again was given them a challenge as well as providing for better design solutions with actual restrictions from a realistic situation. Students were also expected to justify the client selection in relation to the site potentials. This also gave an opportunity for students to come with creative solutions for finding a suitable activity for the site.

The selection and justification was given as part of the design programme so that students were given opportunities to start their creative thinking from the inception itself.

4.1.2. Project introduction

Within the existing programme structure program introduction was just introducing the project and students were asked to work on it immediately afterwards. But within this the project was introduced with a comprehensive guideline for submission along the design process. The schedule of the work program and the different guidelines supported by presentation were

communicated to them for a holistic idea of the total program. The introduction was structured as a series of presentations on the design programme, design guide activities.

The intention was that students were aware of the expected creative performance and how they could achieve it rather than expecting students come up with their own method of providing creative solutions for a given design problem. Students were also made aware of the absence of time restrictions. They were given the task outline but flexibility was given within the project to select their own timeline.

4.1.3. Daily discussions and presentations

Existing practice was to conduct tutoring during studio on individual basis. However the new restructuring was that student are guided along the progress of the design project. This included of an introduction to a particular topic everyday that assist them in creative performance.

This was done in the form of a presentation and a discussion that follows. Thereafter students were actually working in the studio as a group. This also encouraged students to attend the design studio and work within the studio all day and get exposed to the designs of others. The daily topics were given as presentations and sometimes included some exercises that required active participation of the students.

One example activity was to conduct a presentation of typical examples of office interiors and asking students to respond with the probable office for that. The objective was to build sensitivity to architectural language of office interiors. Figure 4.1. and 4.2 shows a typical pictures given for students to respond with a most suitable office function for it.

Figure 4.1. Office Interior 1 for student configuration

Figure 4.2. Office Interior 2 for student configuration

This is a new addition to the design programme that was not practiced prior to this project. Some of the design guide activities were also conducted within these sessions. Table 4.1 summarises the presentations that were conducted with the relevant design phase.

Table 4.2. Presentations conducted during the design programme

Topic	Phase	Objective
Project Introduction	Assimilation	Provide a holistic picture for the total program
Office interiors –planning implications	Assimilation	Aware on planning aspects such responding to organization structures, basic regulations, typical layout, understanding functional processes I n different office environments
Office interiors-architectural characteristics	Assimilation	To aware on the corporate ambience. Build sensitivity to different character in varied sectors, this was done as an interactive session.
Bubble diagram	Assimilation	Introducing to effectively using a bubble diagram as a planning tool
Zoning diagram	Assimilation	Introducing to effectively using a zoning diagram as a planning tool
Generators in architecture	Generation	To assist in idea generation, to find various design forces
Resolution of contrary forces	Selection	To select and prioritise the design process and identifying the key force to base the design objective
Concept making	Conceptualization	Explaining the notion of concept in architectural framework , a guide to generate a concept in an analytical process
Conceptual models	Conceptualization	To aware on conceptual modelling, its application, need and actual making of it, this was conducted in the studio
Design development: concept to design	Visualization	To showcase with case studies how conceptual idea is developed into a design

4.1.4. Peer reviews

In the current situation only the site studies were done in a group that allow for peer interactions. But through this project the program highly encouraged peer reviews. This is an integral part of higher education learning and specifically in design disciplines where the evaluation is highly subjective. Therefore peer insights become very important of students to understand how others perceive their designs.

Peer critiquing may occur either in informal discussions or in group crits conducted by students themselves. Students are encouraged to discuss personal experiences and viewpoints with their peers who are engaged in solving the same design problem. Although generally peer-critiquing sessions do not involve tutors, they can play a role by providing students with the opportunity to critique each other's work and by demonstrating how to critique appropriately. Several researchers detail the merits of the peer-to- peer critique (Bailey, 2004). Looking at their peer's work exposes students to alternative approaches to the same design project. Peer critiquing also enables students to participate more actively in debates or discussions. Students learn to formulate a critique and to take responsibility for what they learn. In addition, peer critiquing supports collaborative learning and encourages students to value peers opinions.

Further in these peer discussions they will also identify the common problems and potential solutions that they can all agreed into. To encourage this some of the activities were given on the classroom to do as groups. Then input from others and how their peers were addressing issues became a learning exercise for them. This became effective than an outsider form their sub group attempting to provide solutions for them.

The tutoring was also conducted in groups for every student the group is to be present for discussions and other students were also allowed to comment on the designs.

4.1.5. Submissions

The current program requires only one interim submission at conceptual level. Within the restructuring process several interim submissions along the process that represent the creative design process were introduced. However there was no particular date for these interim submissions. They were to take their own time and submit prior to the final presentation date. This allowed for provision of different length of time students take in different stages of within creative design process.

Submissions were required according to the theoretical framework process reflecting different stages. Within assimilation submissions included, site Studies, Precedence study, Anthropometrics data report, bubble diagram and zoning diagram. In divergence student needed to submit the standard divergent thinking test, interpretations for given scenarios. Within convergence phase a standard convergent thinking test was included with an exercise to select an interpretation with rationale from another students interpretations and write a design objective.

During their working in illumination stage they were asked to submit the conceptual proposal and also to provide concepts for given scenarios. To assist in the visualization stage exercises were given to draw abstracts for given scenarios and as the domain specific activities they were asked to make a conceptual model in the studio. Further to strengthen the visualization an exercise was given where they had to draw plans sections and elevations for three dimensional images given in the design guide. This was again conducted during studio. Details of the design guide are given in sub chapter 4.3. and the program brief and design guide are given in the appendices as Appendix I and II.

4.1.6. Assessment

Common method of assessment within design studio is design crits, which is a form of a viva voce where students present their schemes to jurors. Existing system depended on these crits where students display their panels and explain

the schemes and marks were given on a predetermined criterion. In this criterion creativity was just one aspect within so many other aspects.

However conducting of this studio project adapted an assessment that was based on a creative assessment criterion apart from the traditional assessment sheet. There was an assessment panel and two marks were given. One is a total mark taking into consideration all the aspect whereas the other one is a breakdown mark. The marking during the crits were done using the existing criterion while the introduced supporting activities were marked using the creative aspects set out by Torrance. These assessment sheets were also included into the design brief and the design guidebook.

The creativity-based assessment introduces by Torrance (1990) has four aspects: Fluency, Flexibility, Originality and Elaboration. Fluency is the ability to generate a lot of options. Flexibility is the ability to find options in as many different categories as possible. Originality is the ability to think of unique and novel ideas. Finally, elaboration is the ability to expand upon an option in order to make it more interesting and rich (Isaksen, Treffinger ,2004). These four qualities refer back to the idea generation basically but could be adopted in different settings. Guilford (1968) also argued that educational practices tend to emphasize teaching students how to find conventional answers rather than using these four qualities when generating ideas.

Hudson (1966) took a similar approach. In asking students how many uses they could think of for a brick, he collected all the answers and gave higher scores to the answers, which were rare (which occurred only infrequently) than to common answers. Fluency, flexibility, and originality thus form one dimension of the model, one which, can be described as being a personality trait, the characteristics of the creative person. Runco (1991) argues that although divergent thinking is no longer considered to be synonymous with creative ability, it is nevertheless an important component of creative potential allowing for the use of the testing as a way of looking at student creative potential.

In order to suite varied activities within a complex subject area the assessment has also included applicability in some instances. Commonality and humour were also included within the assessment of convergent thinking. Assessment sheets are included in the Appendices as Appendix III- VII and further discussion could be found in sub chapter 4.3.

Table 4.3. Summarises the restructuring activities whether they are new or change in the original program.

Activity /phase	**Restructuring**	**Change /new activity in the design programme**
Project scenario	Realistic situation given	Submission of a project sheet, providing a rationale and a justification fro selecting the project scenario
Project Introduction	Detail introduction with presentation and materials given	Students were provided with all communication material including crit sheets and assessment forms.
Daily discussions and presentation	Studio was conducted as a lecture/workshop series	Students were given design guide activities to get involved within the discussions.
Peer reviews	Introduction of activities for peer interaction	The background study was done as a studio group work and the peers were asked provide marking.
Submissions	New schedule of submissions with no time barriers in between.	New activities were included for submission where students select their timing.
Assessment	Combined creative and holistic assessment, students are made aware of the assessment criteria	Assessment sheets were given for students in the guide as well as with the design brief.

4.2. Implementation of the design program

Within the implementation students were taken through the designated activity path expecting a better performance from them. The restructuring was also made aware for the tutors so that everyone is familiar with the amendments and their intended expectations.

4.2.1. Project

With the semester focus on office interiors students were given to design a office at the Le Cube Building, Kirulapone. By the time students are given this project the building management Connaissance de Ceylon (Pvt) Limited had ground and first floor vacant and were already engaged in the process of finding potential tenants. Therefore students were also given an opportunity to explore their creativity in suggesting a potential client for the project. This required for a context study understanding the land use patterns, already established businesses in the vicinity and service gaps that could be filled with their site. They were strictly advised to find potential office spaces not focusing on retail activities.

Students were taken on a site visit where the management themselves communicated their needs and the process of designing the building to suit their particular needs. Figure 4.3. show an exterior view of the building. During the site visit students have taken physical measurements and the drawing of the measured floor places were conducted within the studio group work session.

4.2.2. Communication Materials given

For students to effectively follow the design programme a detailed program brief was given long with many other communication materials. Following is a list of documents given for students at the introduction of the programme.

- Design brief (Appendix I)
- Design guide (Appendix II-VII)
- Assessment sheets (Appendix VIII)
- Tutoring sheet (Appendix IX)
- Final crit sheet (Appendix- X)

- Assessment cover sheet

The design brief included particular instructions on the design programme. Site information, project scenario, background of the design, group work requirements were included in this.

The design guidebook included specific instructions for various activities. It was given in a way to take them through the designated creative design process. This was divided into five parts as follows:

- Part I- Assimilation : Background studies
- Part II- Interpretation : Brief Interpretation
- Part III- Identification: Design Objective
- Part IV- Conceptualization: Concept formulation
- Part V- Visualization: Design Proposal

Assessment sheets were given that included assessment criterion for design guide activities as well as expected design tasks. This allow for students know beforehand what to expect and become target oriented in addressing design needs.

Tutoring sheet was not a mere sheet for tutors comments but a comprehensive sheet that support the student to prepare for the final submission and to evaluate their progress.

The rationale behind providing the students with the final crit sheet at the inception again is for them to gain a holistic view into the expectations of the design project and so they prepare themselves accordingly.

Assessment cover sheet is the submission declaration format that is mandatory requirement for all submissions from an administrative point of view and has no implication on the design programme.

4.2.3. Understanding the sample

First year second semester was selected for the study. They have been selected so that

- They have basic knowledge on design,
- They are not filled with lot of technical details and prior knowledge,
- It is at a time they are exploring their way of designing therefore not fixed on a particular method, and
- Manual Drawing was mandatory requirement.

The sample selected comprised of males and females with ages ranging from 20 to 29.

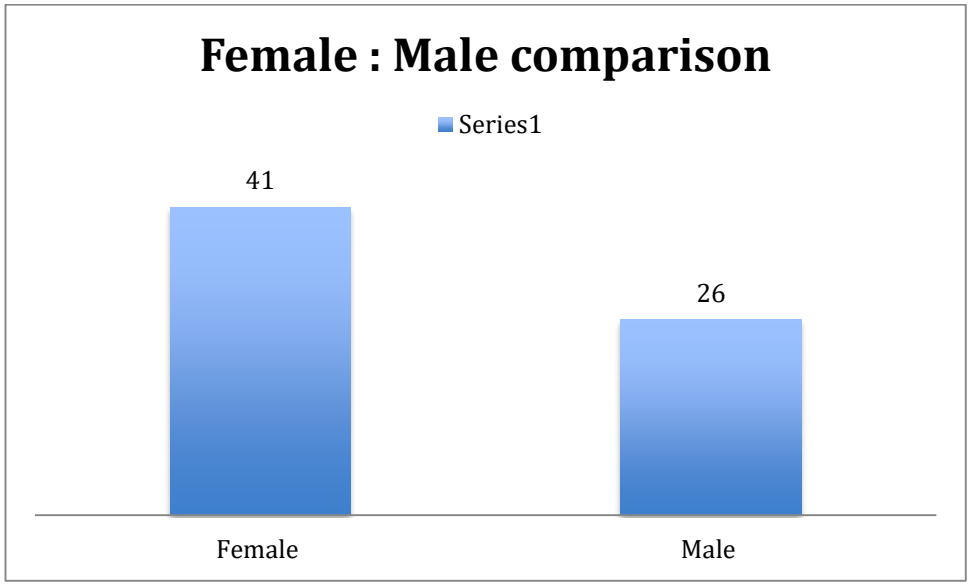


Figure 4.3. Male to Female comparison bar chart

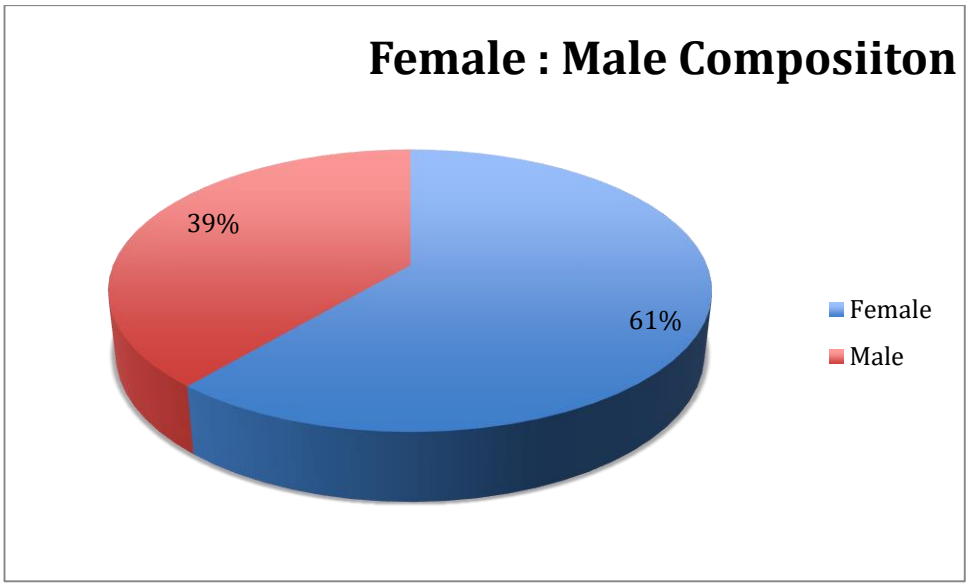


Figure 4.4. Male to Female composition pie chart

They have completed their secondary education on varied subject areas. Some of them have also completed the foundation course offered by the institution.

4.2.4. Program Time scheduling

The program consisted of a particular timing for student submission. However the implementation of the program had a different timing schedule. It comprised of phases that represented the creative process phases and students were made aware of this. Therefore the students were given the same time as previous year but there were no restrictions for submissions. This was done in order for them to allow for flexibility within the creative process.

The tutoring sheet given was divided in accordance with the activities and tentative time scheduling so that students were able to keep a track on their tasks and submission requirements.

4.2.5. Data collection

Data collection was based on the design guide activities students were engaged during the design programme and the final design mark they got for the design.

These activities were given an individual marking by tutors and these marks were the primary data used in data analysis.

While conducting the program all the design guide activities were collected with their relevant marking and some examples were included within the next section. Final design proposals were also photographed and recorded to get a holistic view of student performance throughout the design programme.

4.3. Design Guide: developing a guidance on a theoretical framework based on creative design process

In developing the design guide the theoretical framework developed was used as a tool for phasing the activities according to the stages and then providing guideline for each phase activities. Aligning with stages in the Theoretical framework it was divided into five parts: Background Study, Brief Interpretation, Identifying Design Objective, Concept formulation and Design Proposal. Within the scope of this study the verification was looked at as how students are visualizing the design. Each part comprise of guidance notes, activities and assessment criterion.

Within the design program the design guide was a key element it provide the additional support for the student to develop their design in par with better creative performance. As for tutors it provides an understanding of how students are progressing and assessment criterion was given for them to assess the students at each stage.

4.3.1. Part I: Assimilation: Background study

Assimilation plays a key role in architectural design since every design has its own defined problem and every time a design is encountered certain amount of information gathering is essential prior to getting into the design. Generally students are required to gather information on site, function, user and objectives of the client. To support the students during the information gathering stage they were required to conduct different tasks outlines in the design brief and the design

guide was given to further clarify and provide supportive activities. Following are some of the outcomes of key activities during this phase.

4.3.1.1.Anthropometrics and Ergonomics Report

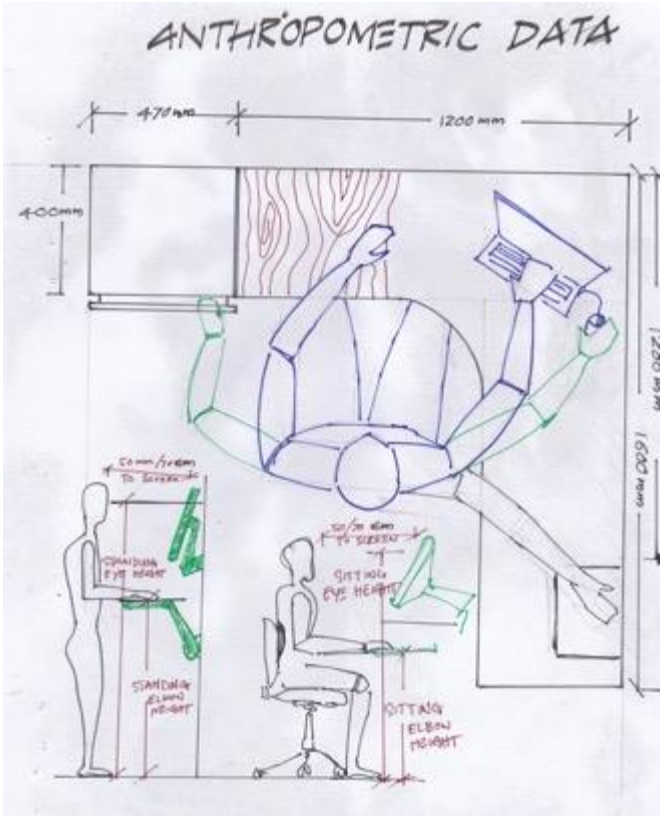


Figure 4.4. Student response in anthropometrics report 1

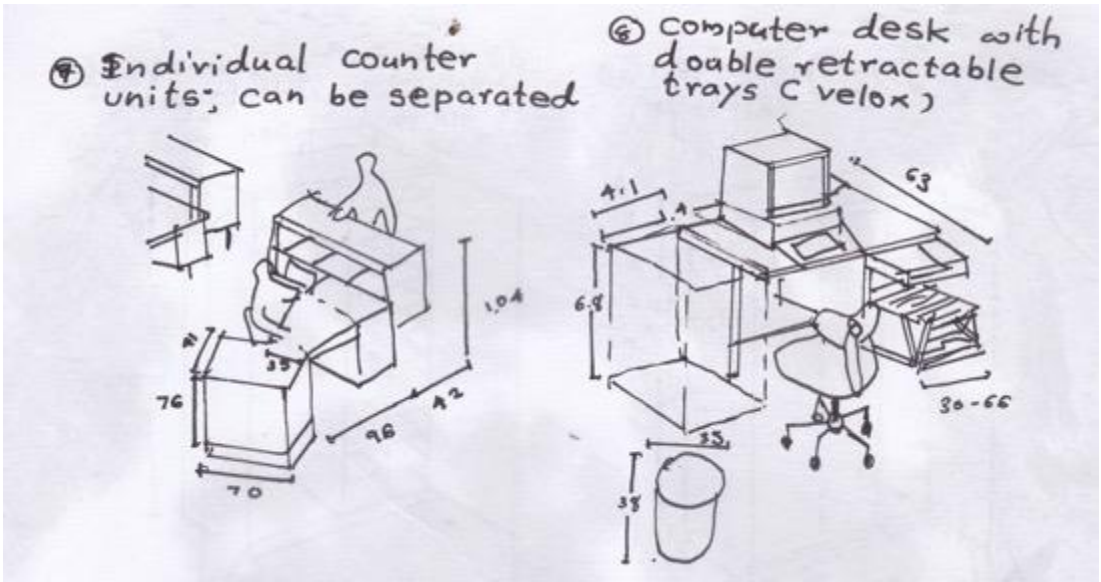


Figure 4.5. Student response in anthropometrics report 2

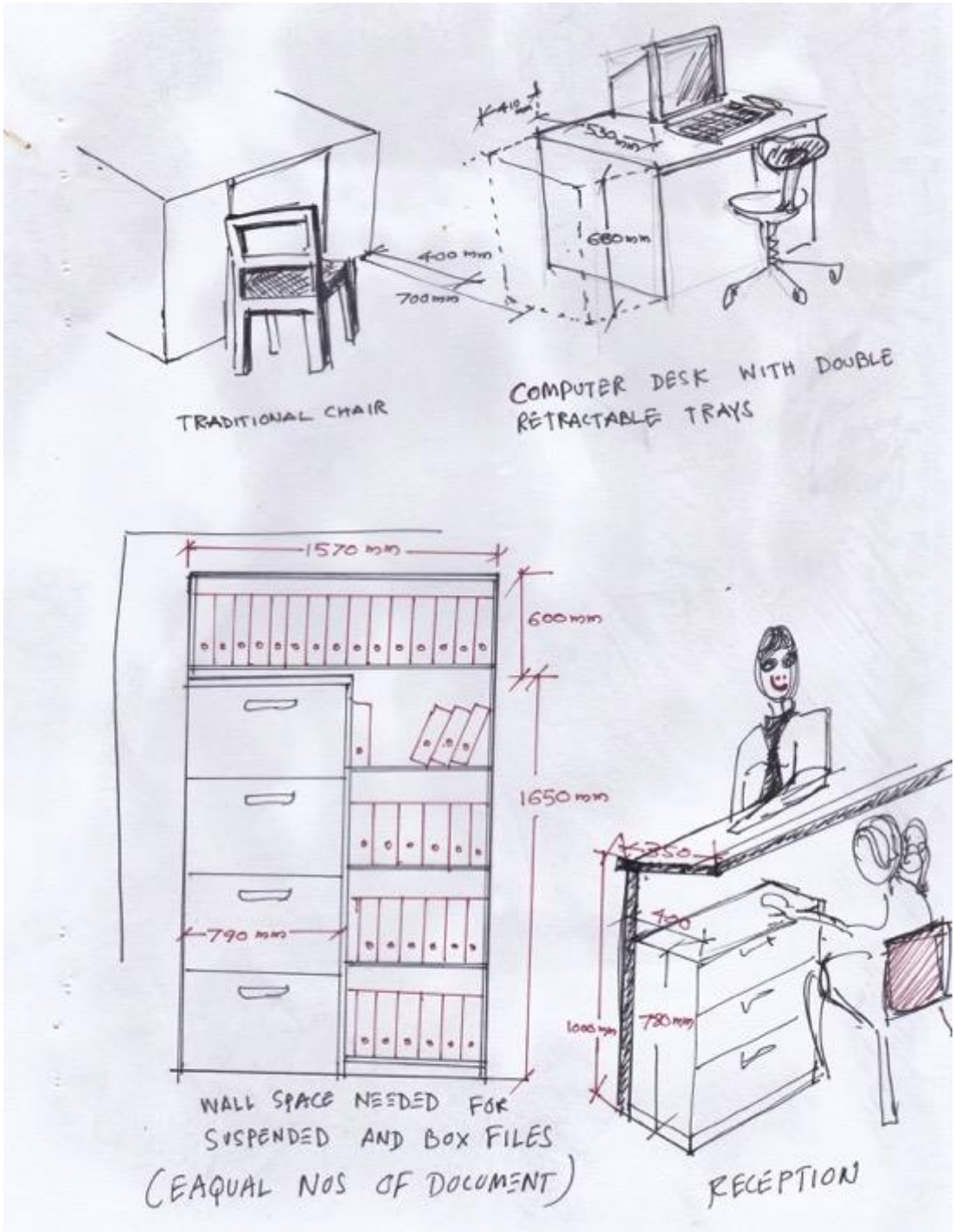


Figure 4.6. Student response in anthropometrics report 2

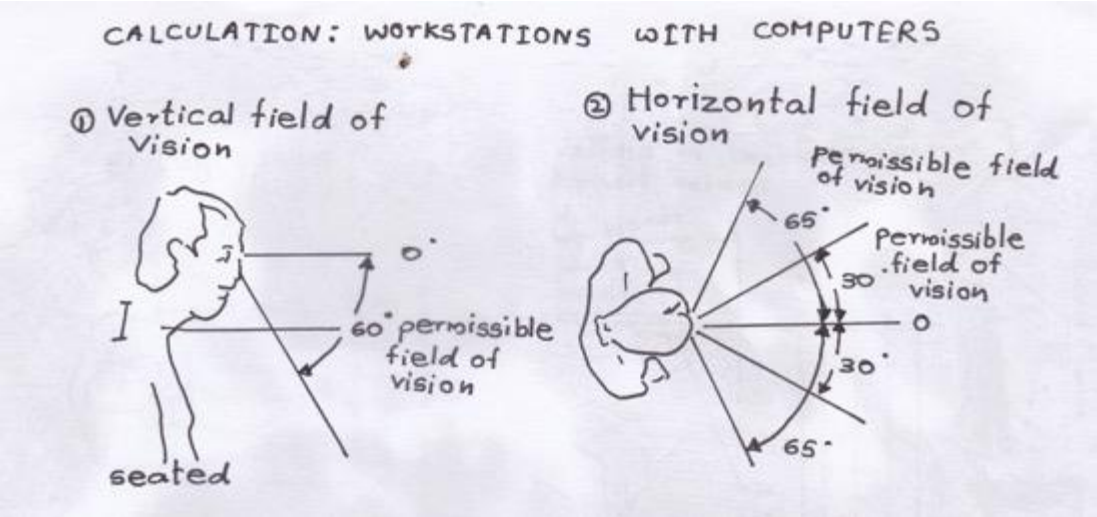


Figure 4.7. Student response in anthropometrics report 3

4.3.1.2.Bubble Diagram

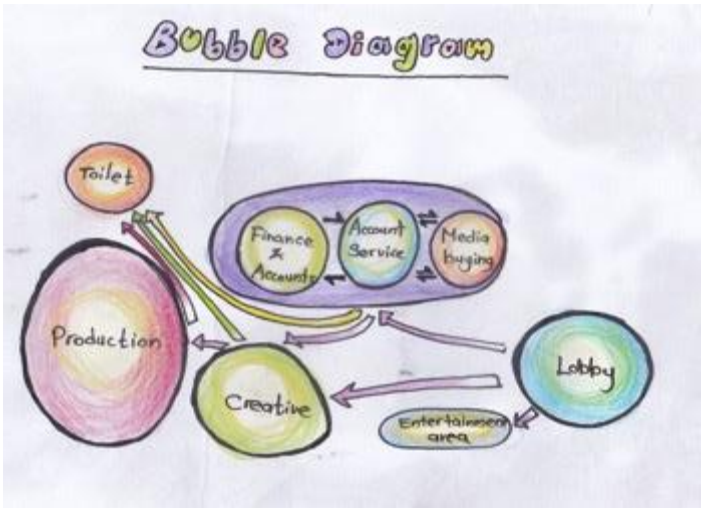
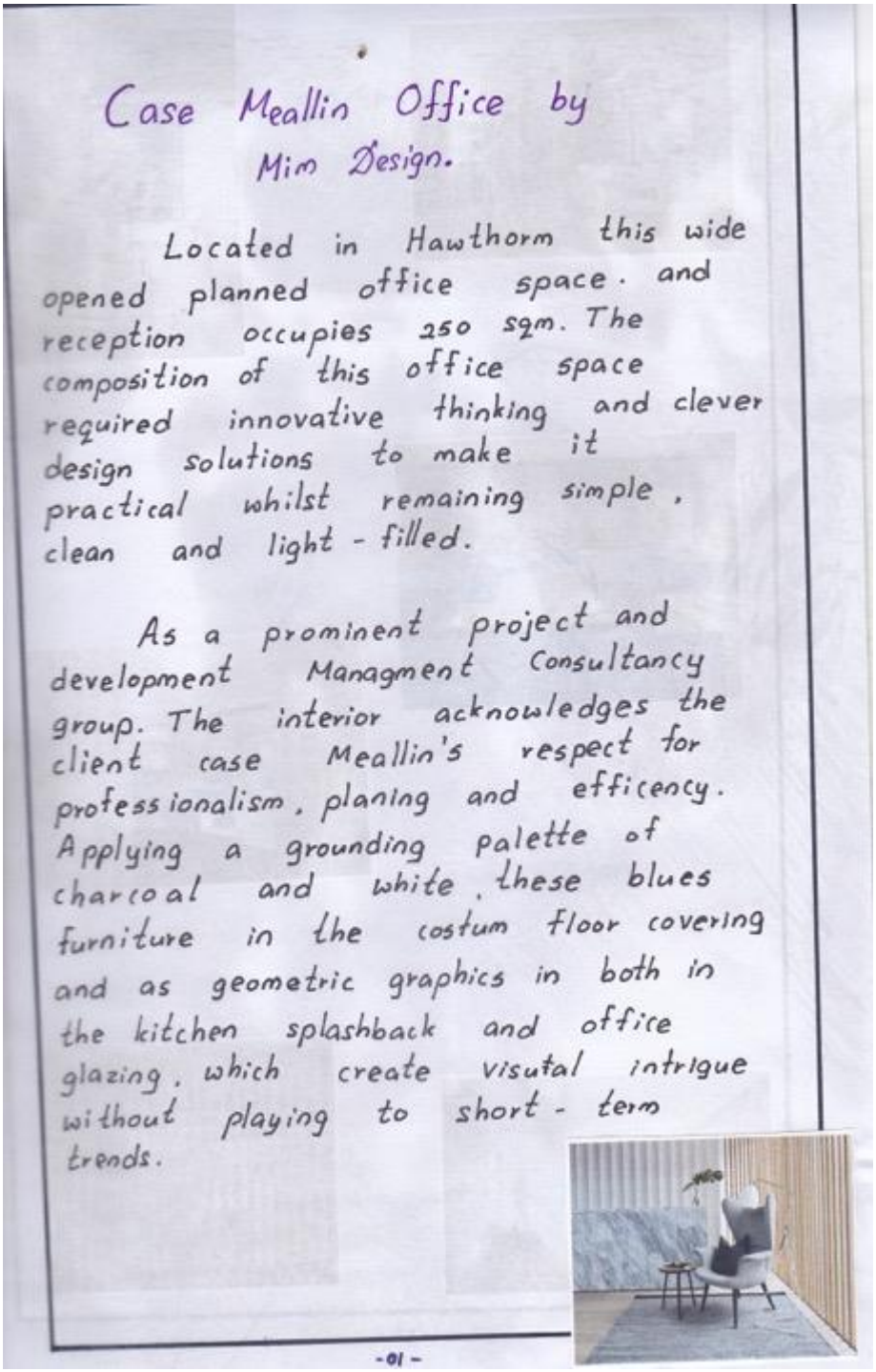


Figure 4.7. Student work on bubble diagram 1

Figure 4.8. Student work on bubble diagram 2

4.3.1.3.Precedence Studies



Case Meallin Office by
Mim Design.

Located in Hawthorm this wide opened planned office space. and reception occupies 250 sqm. The composition of this office space required innovative thinking and clever design solutions to make it practical whilst remaining simple, clean and light - filled.

As a prominent project and development Managment Consultancy group. The interior acknowledges the client case Meallin's respect for professionalism, planing and efficency. Applying a grounding palette of charcoal and white, these blues furniture in the costum floor covering and as geometric graphics in both in the kitchen splashback and office glazing, which create visutal intrigue without playing to short - term trends.

Figure 4.9. Student work on Precedence Studies 1

Interpublic Emerging Media Lab.

Los Angeles (2006)

Robin Donaldson & Russell Shubin

This company provides all interpublic companies and their clients with a physical and virtual space in which to experience the trends and technologies that are shaping the consumer media experience. The environment includes a digital living room, 'a smart kitchen', conference room and brainstorming area.

Figure 4.10. Student work on Precedence Studies 2

COMODO SCI-FI INSPIRED I.T OFFICE

ong Kong based COMODO, Founded by Alian Wong (a Judge at perspectives
and D Trophy awards 2016, has unveilied its new design for this project
To reference the nature of the business, the designer wanted to create
a kind of Sience fiction - themed environment,
with a minimalistic interior work space. sleek lines connect the
entire space, and black and white colour platte has been used.
throughout to heighten the contrast.

As there are only few staff working out in the office, meetings are
usually held internally. for this reason, the office was devided into
two main open areas. the working space and the meeting area.
these areas are devided by a grey partition, which makes the office

Figure 4.11. Student work on Precedence Studies 3

more spacious, and also lets the natural light through into the meeting room.

each member of the staff requires two large computer moniters to complete the daily tasks, so bigger work desk were specifacaly designed to accommodate them,

Figure 4.12. Student work on Precedence Studies 4

4.3.2. Part II: Interpretation: Brief Interpretation

This phase is for idea generation. For this students were made aware of all the design forces that they could encounter and a mind mapping was exercised. The introduction to mind mapping was conducted as a presentation part of the series of presentations. Following are the list of tasks encouraged and activities conducted during this stage.

- Standard divergent thinking exercise
- Introduction to mind mapping
- Identification of design forces in response to brief
- Mood boards for different design forces
- Precedence studies for responding to particular design force

The activities were included into the design guide where guidance was given through presentations. Since the assessment sheets were given with the criterions they were able to carryout the tasks with an understanding of the required outcomes.

4.3.3. Part III: Identification of Design Objective

The objectives of this section is to support the convergent thinking abilities in selecting the most appropriate interpretation arising out of the various design forces. The students are expected to rationalise their decision. To develop this skill and to get an understanding a standard divergent thinking test was given in the guide while students were also asked to select appropriate interpretations from other students. The design guide comprised of following activities to guide at this level.

- Standard convergent thinking test
- Select most appropriate interpretations
- Mood board for a particular rationale

Figure 4.13. Student work on convergent thinking test 1

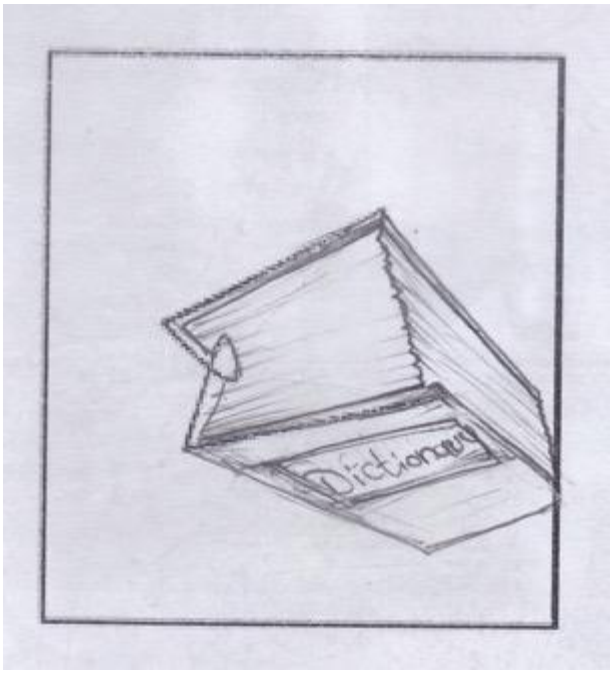


Figure 4.14. Student work on convergent thinking test 1

4.3.4. PART IV: Conceptualization: Concept Formulation

This stage is a primary function within the creative design process that guides the total design. Concept formulation provides students to approach design in a rationale as well as a creative framework. Concept supports the total decision making process in filtering every design item to achieve the required spatial quality. To assist student's thinking process the guide is inclusive of following activities.

- Writing of concept for a given scenario
- Concept formulation mind map
- Conceptual model making
- Mood board

4.3.4.1.Conceptual Model

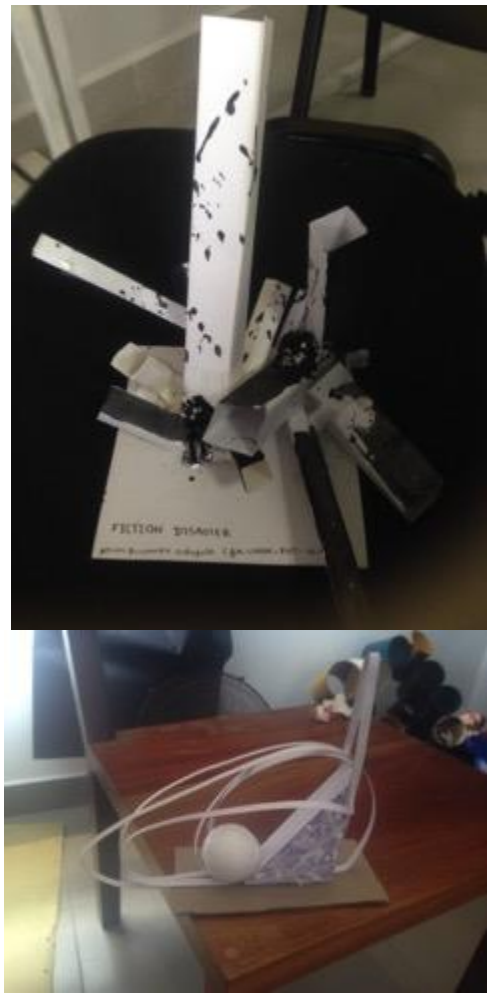


Figure 4.15. Student conceptual models

4.3.4.2.Mood Board

Physical modelling, as a design communication method, was previously used only during the final representation phase. However, an experiment has verified that physical models are also effective during the form creation phase of conceptual design (Abdelhameed, 2011). Conceptual model making was conducted within the studio, which provided students with an exiting learning experience.

Figure 4.16. Student mood boards

4.3.5. PART V: Visualization: Design proposal

This is the stage where students are actually designing the scheme in a realistic context. More emphasis was given in this stage thus the design guide also comprise of several activities to guide them. Deriving from the theoretical framework following activities were included into the design guide.

- Drawing plans for given perspectives
- Drawing of abstracts
- Furniture design

Sketching is also a skill for capturing fleeting ideas, recording new ideas, and evaluating generated design ideas (Ferguson, 1992).

4.3.5.1. Visualising Perspectives

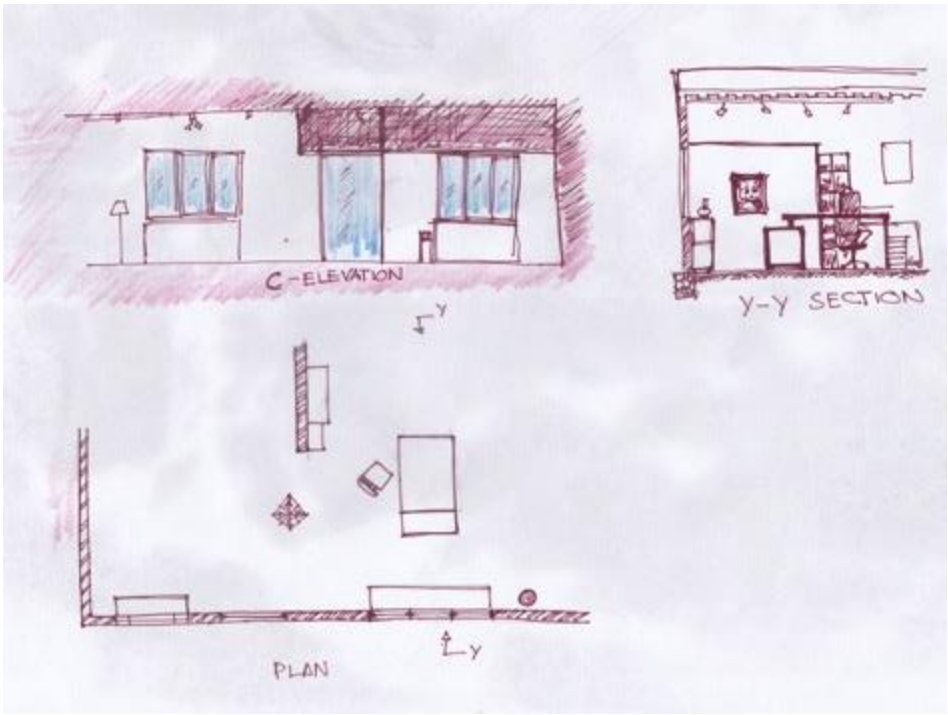


Figure 4.17. Student work on visualising perspectives 1

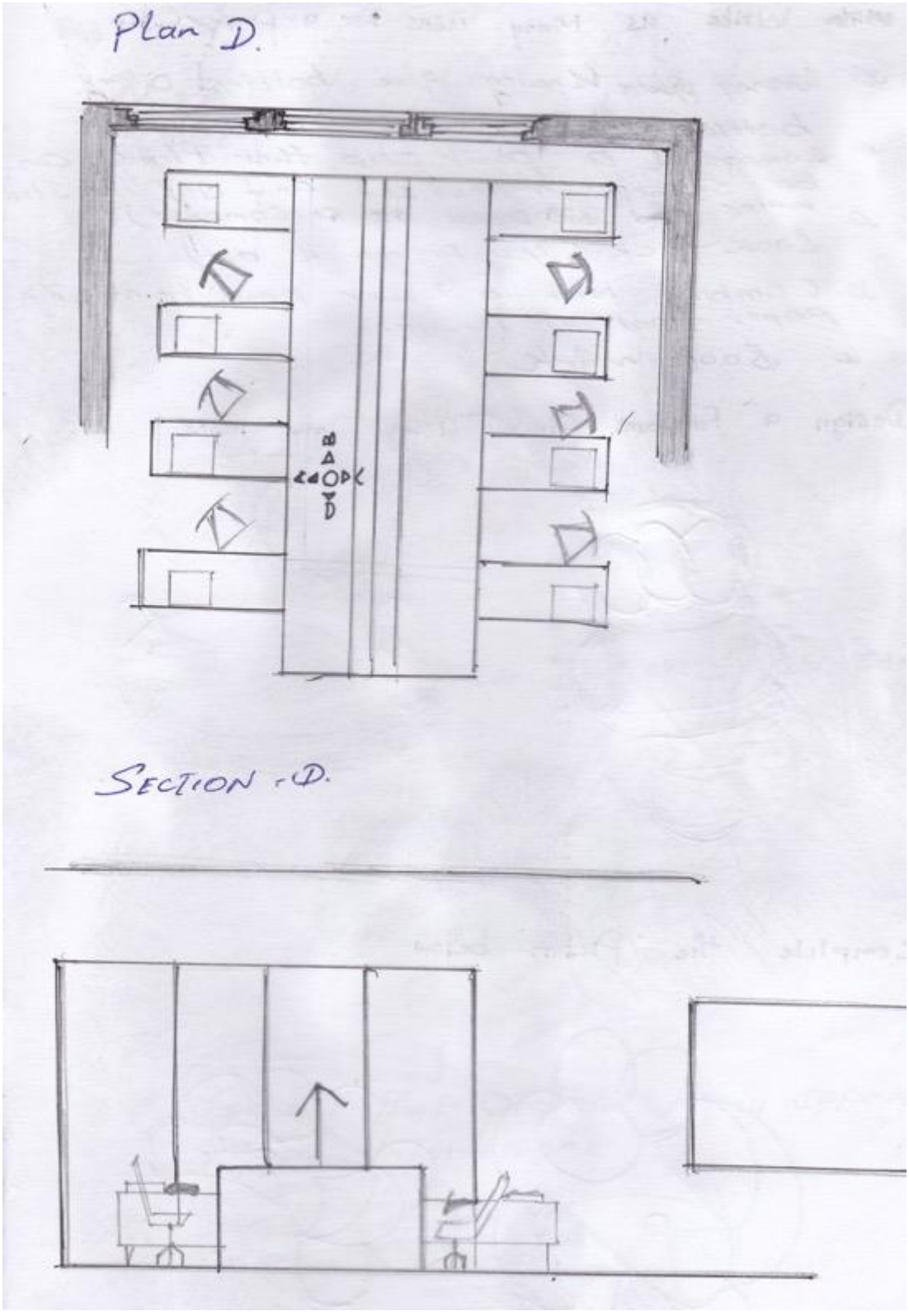


Figure 4.18. Student work on visualising perspectives 2

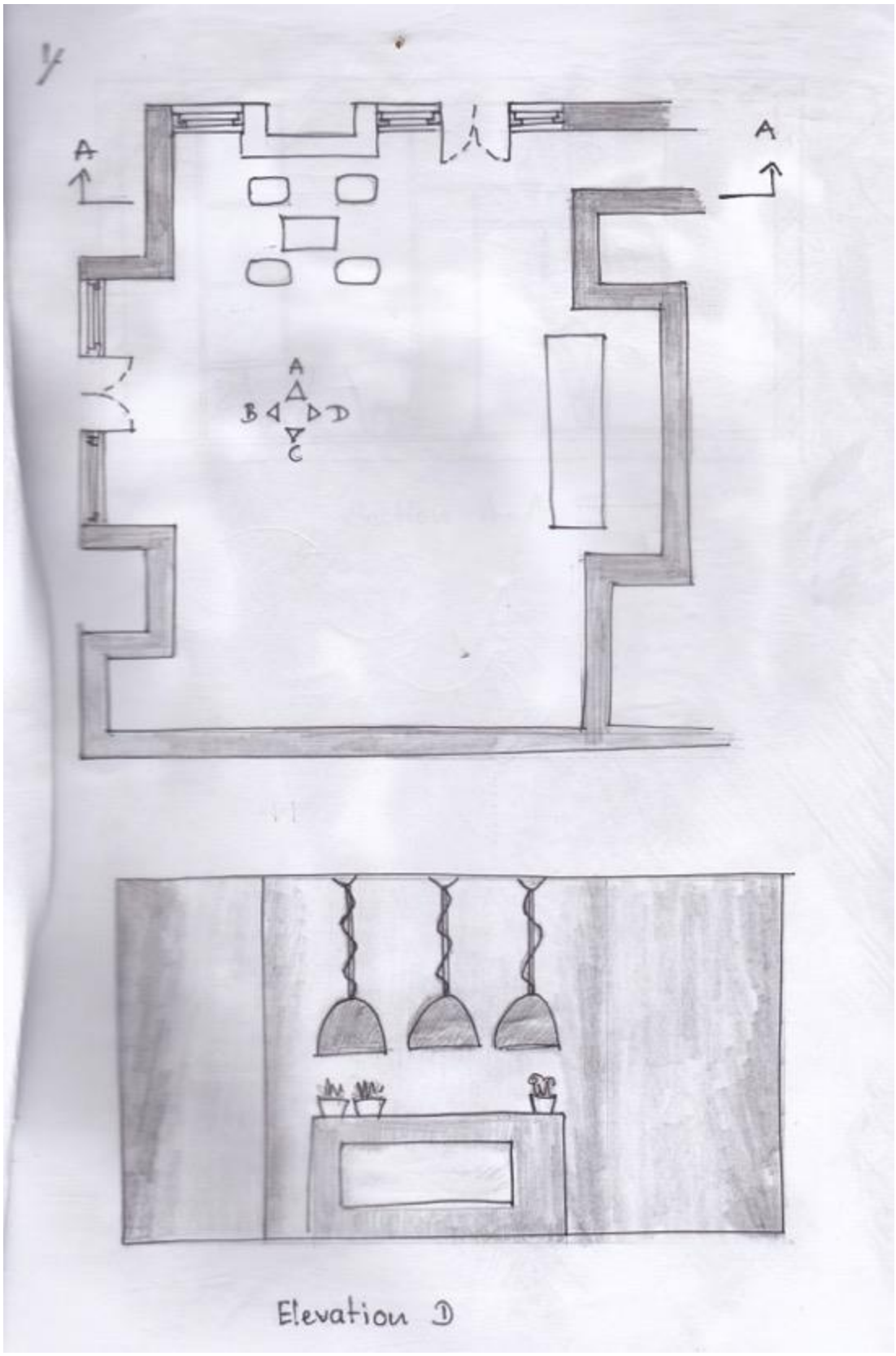


Figure 4.19. Student work on visualising perspectives 3

4.3.5.2.Drawing of abstracts

Place for meditation

Figure 4.20. Abstract drawings for meditation place

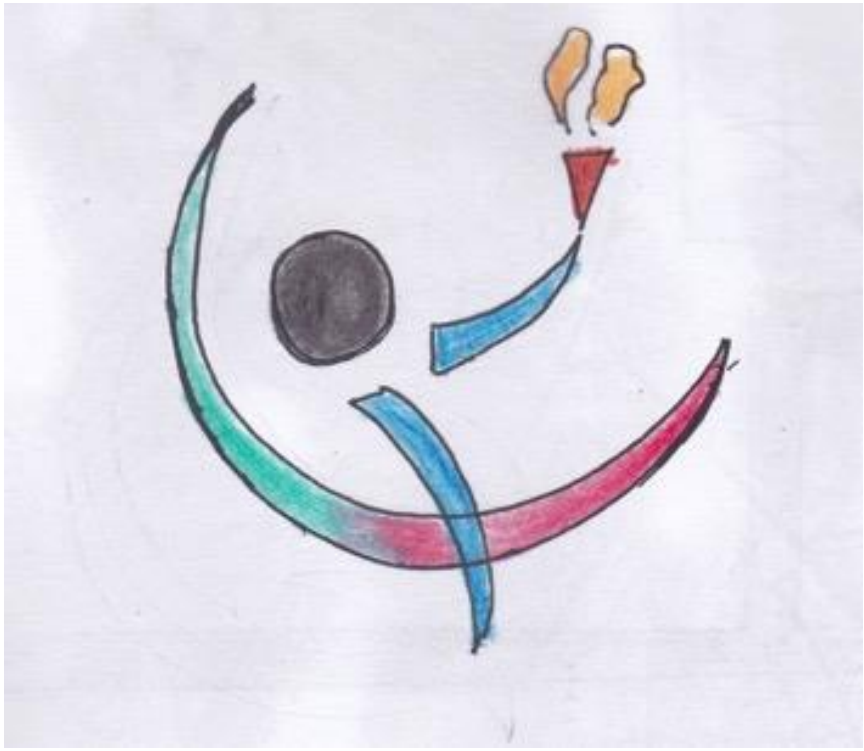


Figure 4.21. Abstract drawings for sporting place

Place for social interaction

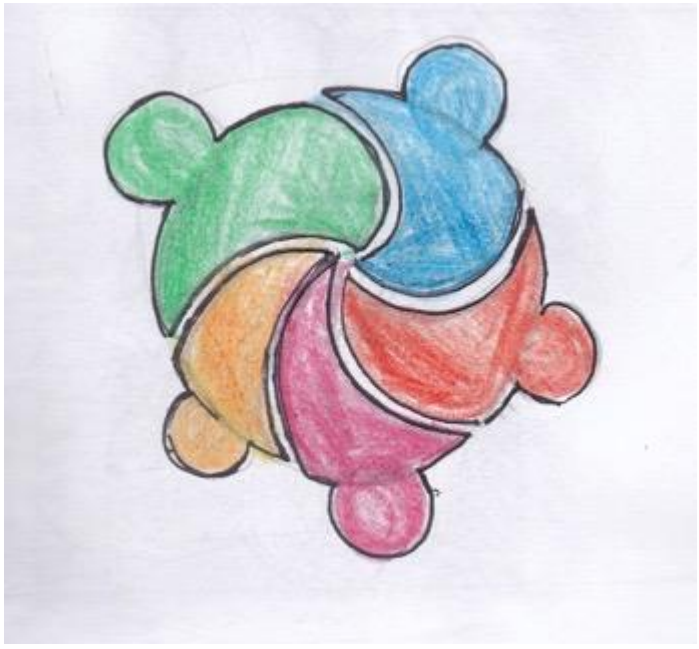


Figure 4.22. Abstract drawings for social interaction space

4.3.5.3. Furniture design

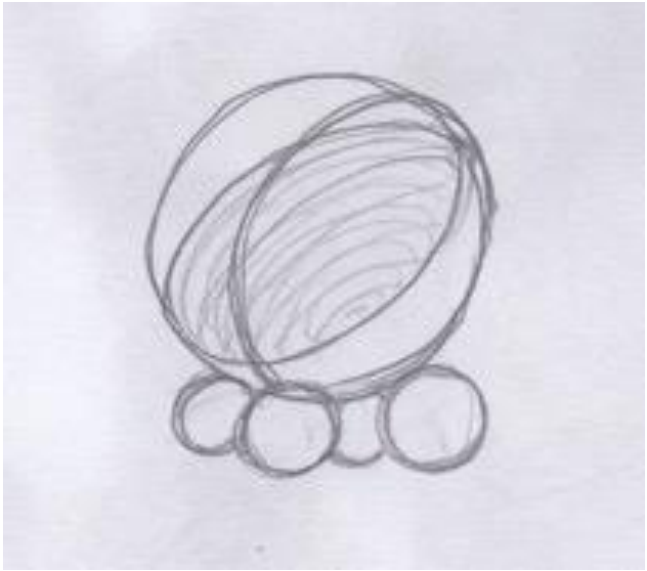


Figure 4.23. Furniture using circles 1

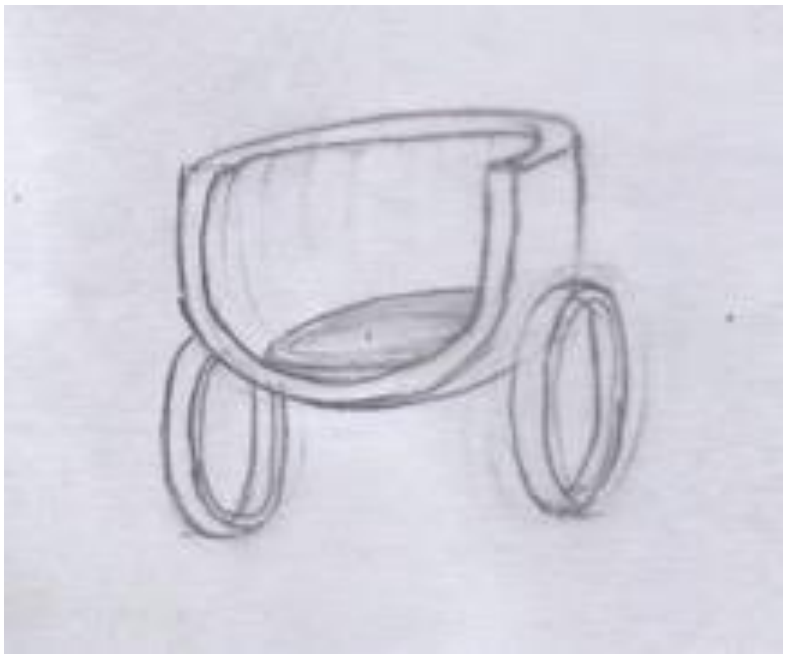


Figure 4.24. Furniture using circles 2

4.3.5.4. Design Proposals

Figure 4.25. Student design proposal: nest

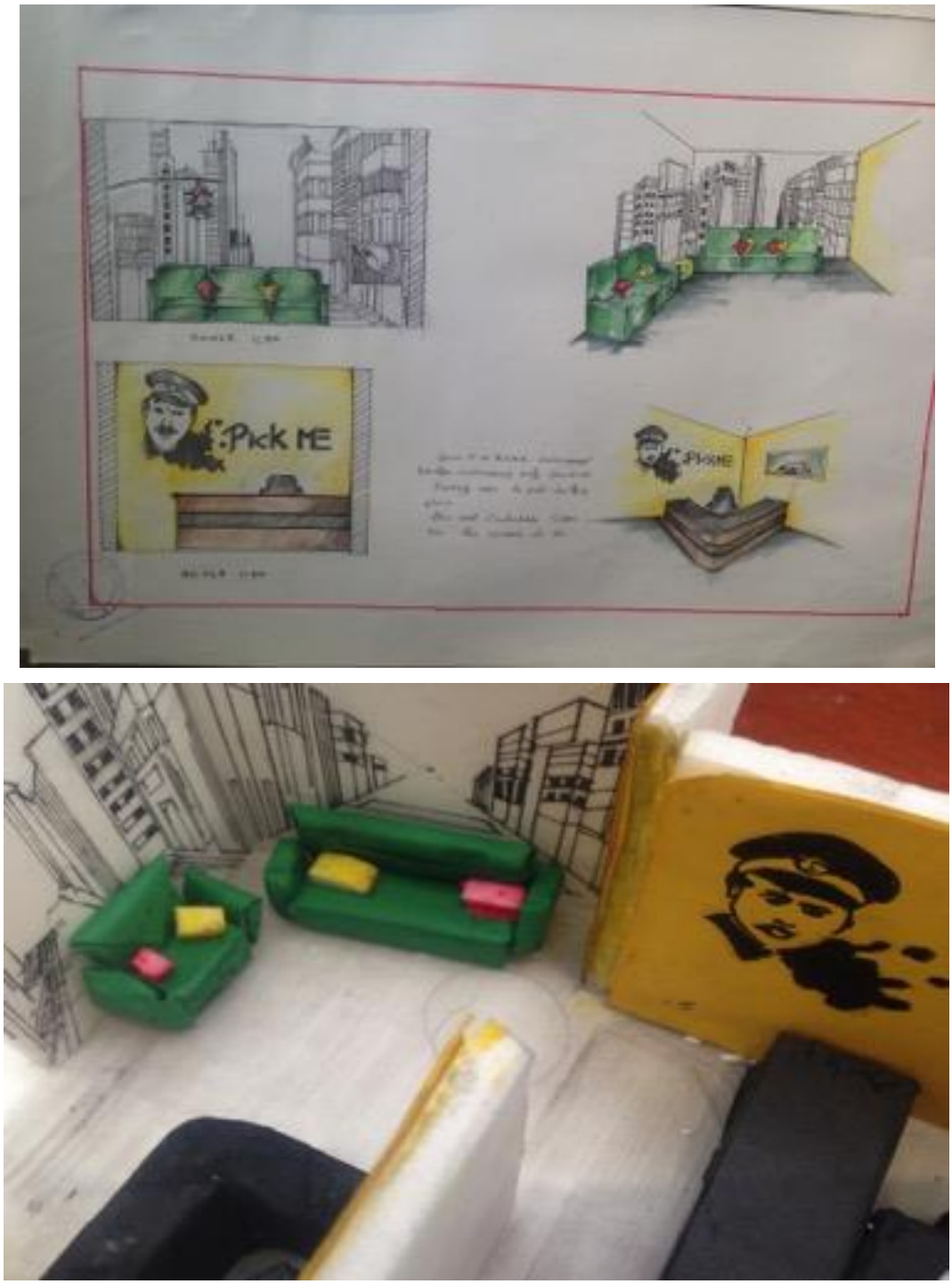


Figure 4.26. Student design proposal: pick me

Figure 4.27. Student design proposal: nature

Figure 4.28. Student design proposal: cityscape

Figure 4.29. Student design proposal: elegance

Figure 4.30. Student design proposal: interaction

Figure 4.30. Student design proposal: street art

4.4. Concluding remarks

The design program development is always challenging in design teaching. By using the framework the programme was developed in a manner to deliver the program in a more interactive approach where student participation was higher than previously experienced.

It was also observed that the flexible timing allowed for students to adapt to the program while trying understanding their own potentials. Most significant factor was that the final design output was significantly better than the previous years not only in terms of idea generation but presenting a total scheme.

Another key factor was that students were able to create effective concepts that could be transformed into built forms with the guidance they got from the design program guide.

5. REFLECTION: EXAMINATION OF AN IMPACT BY A CREATIVE INTERVENTION ON IMPROVING STUDENT PERFORMANCE IN DESIGN STUDIO

Whether the creativity can be enhanced by interventions is a question that has been raised for many centuries by educators in every discipline. Yet it will be a question that will be raised in future centuries as well. The ambiguity in creativity is such that finding the improvement is also impossible. Therefore the development in creative performance could only be measured relatively within the limits and definitions of that particular subject area. This chapter is exactly attempting such exercise understand data and reflect on the causes that may have resulted in such behaviour, however it would not bring to light neither concrete conclusion nor a confirmed methodology in developing creativity. The reflection will only throw a light onto the dark mystery of creative performance within a group of Interior Architecture Students based on an assessment of their design within a pre-set criterion premised on definitions of creativity.

5.1. Creative process phases Vs Design performance

This part of the analysis is to establish a correlation between the successes of different activities students were required to engage against their final mark. This will provide an understanding whether the performance in different phases has an impact on the final performance. For this the creative process phases, Assimilation, Interpretation, Identification, Conceptualising and visualization were taken to establish relationships against the achievement in the final design.

5.1.1. Assimilation Vs Design performance

Assimilation is the stage where information gathered prior to generate ideas. The design guide has included many activities and guides the students during this phase. The attempt from this analysis is to find whether there is a correlation between the student achievements in general assimilation activities and the final mark they get in the design crit.

5.1.1.1. Identifying Data Set

Since the design guide was developed with activities that could assess the student assimilation skills used for particular design and general skills the data set was carefully selected not to duplicate same mark within both sides. Therefore from the assessment sheets the marks given for anthropometrics report, precedence study and bubble diagram was taken as the marks for total Assimilation. The assessment sheet was given with sub-divisions of workload, efficiency, analysis and synthesis so that the particular assimilation skills are evaluated. The design mark from the final crit sheet was taken as the Design performance mark. Both marks were taken out of hundred.

5.1.1.2. Preliminary analysis

Prior to conducting the analysis using SPSS system the data was administered to a preliminary analysis using Microsoft Excel. Figure 5. 1 and 5.2 shows the generated graphs using the two data series.

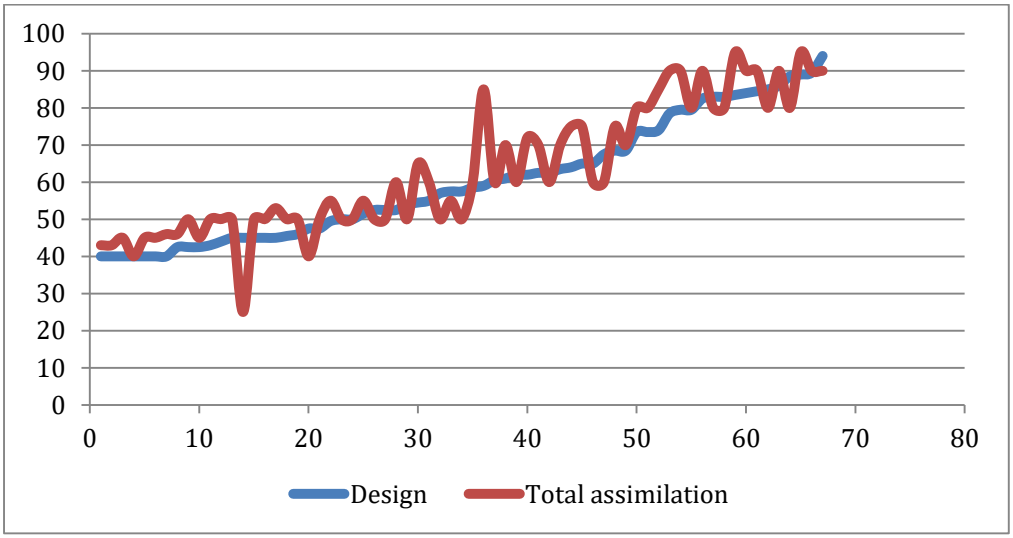


Figure 5.1. Comparison of Design Mark and Total Assimilation Mark

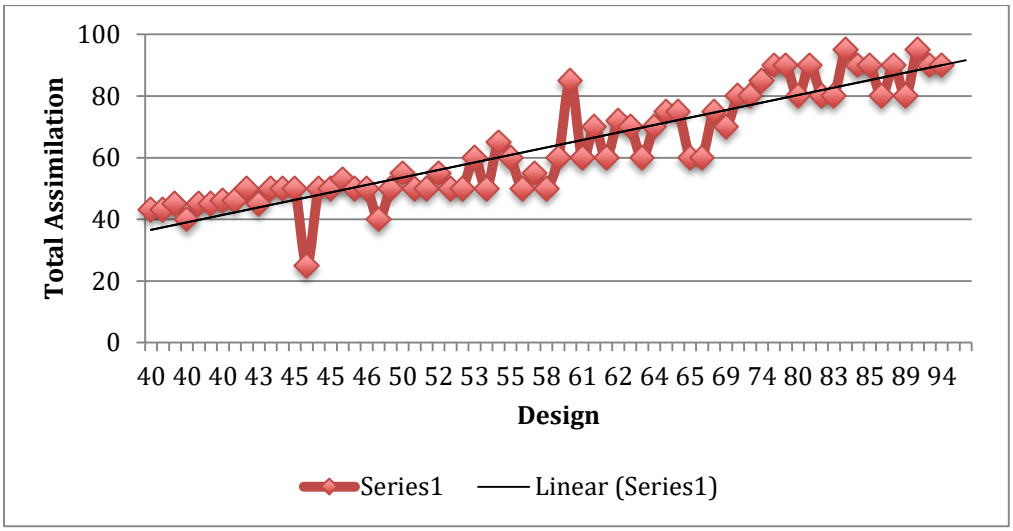


Figure 5.2. Design Mark Vs Total Assimilation Mark in a Graph

As the Figure 5.1 shows the both marks for assimilation tasks and the design task are in a similar except for few variations. Across the graph the assimilation marks are slightly higher than the design mark.

5.1.1.3.Test of normality

Statistical methods, which depend on the parameters of populations or probability distributions, are referred as 'Parametric Methods'. The parametric methods of hypothesis testing such as two sample t tests are meaningful when underlying population is 'normal' and it provides better precision. The numerical method of testing for normality is called 'Shapiro-Wilk Test'. If the sig. value of Shapiro-Wilk test is greater than 0.05, It indicates that the dependent variables are normally distributed.

Generated Data

Table 5.1. Generated data for normality test between assimilation mark and design mark

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Assimilation Mark	.195	24	.019	.939	24	.152
Design Mark	.142	24	.200*	.961	24	.459

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Testing for Normality

Hypothesis of Normality test;

H_0 : Performance of the students is normally distributed

H_1 : Performance of students is not normally distributed

According to the normality test results (Shapiro-Wilk Test),

Assimilation mark

Sig. =0.152

0.152> 0.05

Sig.> 0.05

Design performance mark

Sig. =0.459

0.459> 0.05

Sig.> 0.05

Thus, H_0 cannot be rejected. So the dependent variables are normally distributed. Since the performance is normally distributed, data can be analysed using parametric tests.

5.1.1.4.Paired sample T Test

Paired sample T test procedure compares the means of two variables for a single group or the means from two matched groups. In this analysis procedure, each subject has two measures; in this study the two measures are the student mark for assimilation tasks and the design tasks. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0, which is termed a two-tail test.

Following conditions and assumptions for Paired Sample T tests are clearly met in these data sets;

- The sample size to be smaller than the population size
- Sample should be representative for the target population
- The dependent variable under the interest is either interval or ratio scale

- Independent variable should consist of two categorical ‘related groups’ or ‘matched pairs’
- Distribution of the differences in the dependent variable between the two related groups should be ‘normally distributed’

Testing Hypothesis

When testing for hypothesis using SPSS software, first Null Hypothesis and the Alternative Hypothesis should be stated. The hypothesis that need to be proved is stated under ‘ H_1 ; Alternative Hypothesis’.

H_0 : Design performance and assimilation performance are not correlated

H_1 : Design performance and assimilation performance are correlated

If null and alternative hypothesis statistically elaborated they would be **,**

$H_0 : \mu_1 - \mu_2 \leq 0$

$H_1 : \mu_1 - \mu_2 > 0$

μ_1 = Mean of Design Performance

μ_2 = Mean of Assimilation performance

Table 5.2. Paired sample statistics for assimilation marks and design marks

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Assimilation mark	66.04	67	17.288	2.112
	Design Mark	60.55	67	16.097	1.967

Table 5.3. Paired sample correlations for assimilation marks and design marks

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Assimilation mark & Design Mark	67	.843	.000

The Paired sample statistics output repeats the data that is entered. And the above data adds information that design performance and assimilation

performance are significantly positively correlated with the correlation of 0.843.

Table 5.4. Paired sample test for assimilation marks and design marks 1

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	Assimilation mark - Design Mark	7.788	4.777	66	.000

Table 5.5. Paired sample test for assimilation marks and design marks 2

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	Assimilation mark - Design Mark	5.493	9.410	1.150	3.197

Since the test is one tail test where which variable is 'greater than' or 'lesser than', is not figured out but the result gave the following p-values. p-value is a function of the observed sample results that is used for testing a statistical hypothesis.

p-value = sig/2

p-value = 0.000/2

p-value = 0.000

0.000 < 0.05

p-value< 0.05

If the p-value is lesser than 0.05, Null Hypothesis can be rejected therefore H_0 can be rejected. Thus, the 'H_1', the alternative hypothesis can be accepted.

This provides adequate evidence to conclude that assimilation mark and design mark are correlated. In a more specific interpretation this implies that the students who performed well in the tasks that required assimilation stage skills have also received the better final mark in their design.

5.1.2. Interpretation Vs Design performance

The Interpretation phase is where ideas are generated irrelevant of their validity or applicability. Within the design program students were given activities to evaluate their idea generation ability and the analysis is done to find whether ability to generate ideas are correlated the final mark they achieve in design.

5.1.2.1.Identifying Data Set

For the purpose of data analysis using SPSS system the specific data sets required be identified. For the design performance the final design mark was taken collected through the crit sheets. For the interpretation marks the marks they achieved for particular tasks that reflected their idea generation skills were taken. This included the standard divergent thinking test, writing interpretations for the given scenario. The marks that were recorded in the assessment sheet were taken from these two activities and then percentage was taken to get a mark out of hundred. In the assessment of their divergence ability the marking criterion was based on the typical parameters suggested by Torrance in his creative testing studies.

5.1.2.2. Preliminary analysis

Prior to conducting the SPSS analysis data sets were used to generate basic graphs using Microsoft Excel as shown in figure 5.3 and 5... These graphs were used get a more graphical presentation of the data behaviour.

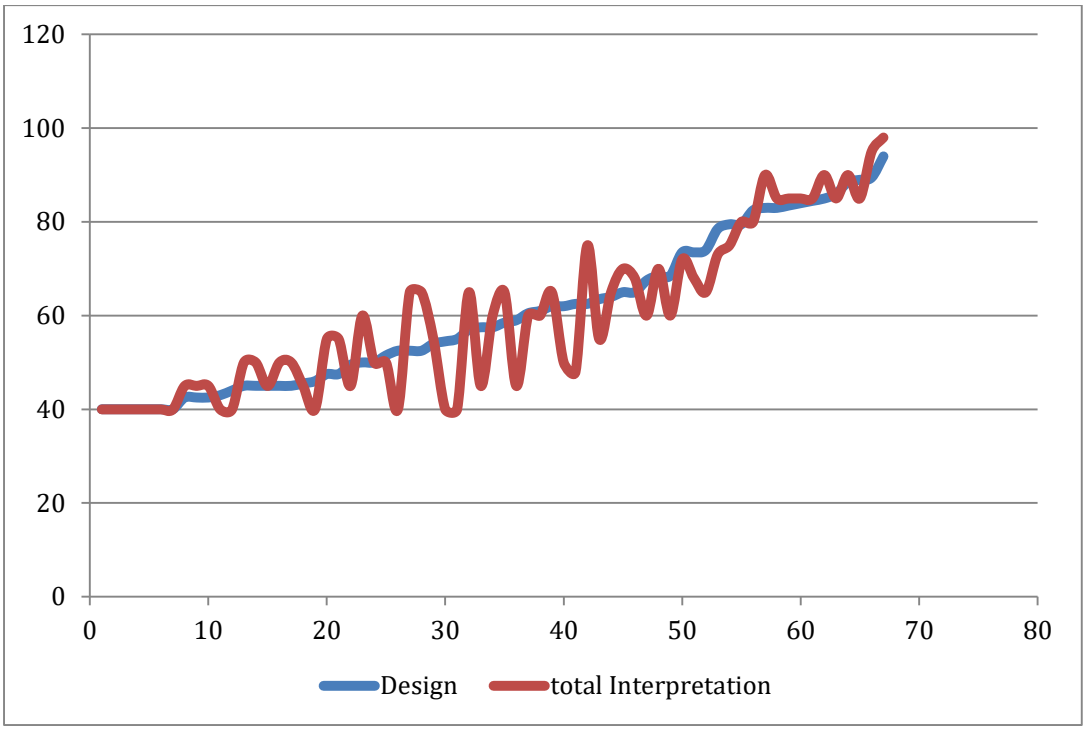


Figure 5.3. Comparison of Design mark and Total Interpretation mark

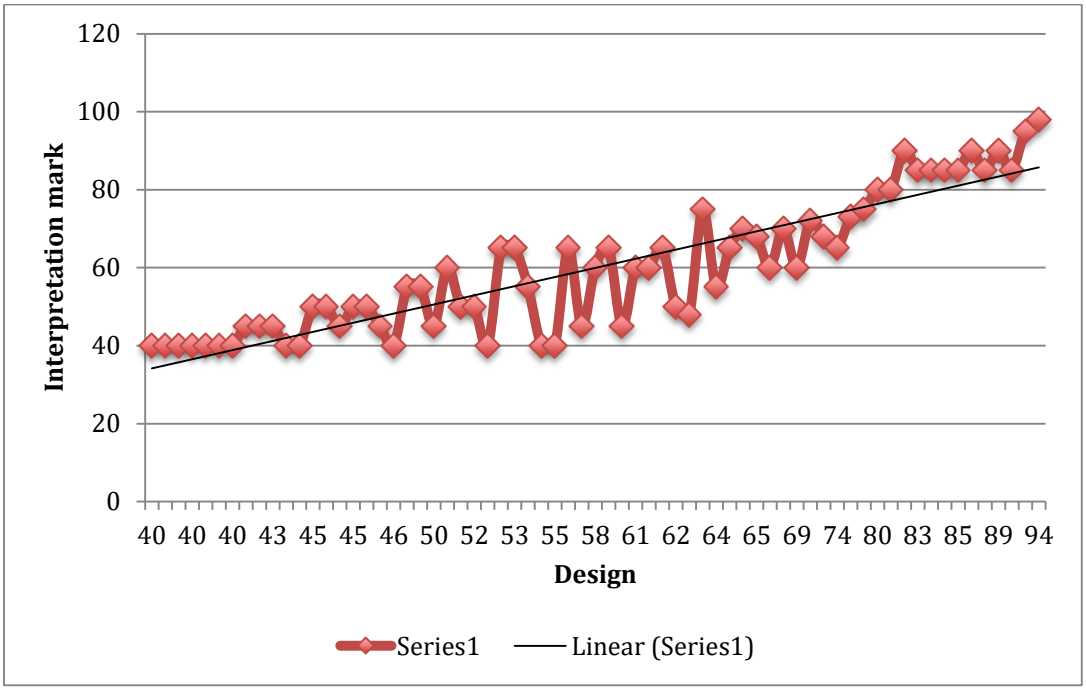


Figure 5.4. Design Mark Vs Total Interpretation Mark in a Graph

The graph in figure 5.3 is showing the two marks students achieved in comparison. The marks obtained for generation seem to be less consistent

lesser than the design marks in most of the cases. However a similar graph inclination is observed. The figure 5.4, which shows the relationship between the design mark and interpretation mark also reveals some discrepancies in the centre of the data distribution but a clear relationship, is shown.

5.1.2.3.Test of normality

Statistical method is a Parametric Method in the analysis could only conducted if the data distribution is 'normal'. 'Shapiro-Wilk Test' which could determine the distribution of the data is administered to the data prior to running through SPSS paired sample test. If the sig. value of Shapiro-Wilk test is greater than 0.05, It indicates that the dependent variables are normally distributed.

Generated Data

Table 5.6. Generated data for normality test between interpretation mark and design mark

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Interpretation mark	.195	24	.019	.939	24	.143
Design mark	.142	24	.200*	.961	24	.459

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Testing for Normality

Hypothesis of Normality test;

H_0 : interpretation Performance of the students is normally distributed

H_1 : interpretation Performance of students is not normally distributed

According to the normality test results (Shapiro-Wilk Test),

interpretation mark

Sig. =0.143

0.143> 0.05

Sig.> 0.05

Design mark

Sig. =0.459

0.459> 0.05

Sig.> 0.05

Thus, H_0 cannot be rejected. So the dependent variables are normally distributed. Since the performance is normally distributed, data can be analysed using parametric tests

5.1.2.4.Paired sample T Test

Paired sample T test procedure compares the means of two variables for a single group or the means from two matched groups. In this analysis procedure, each subject has two measures; in this study the measures are the marks achieved for interpretation activities and design mark. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0.

Following conditions and assumptions for Paired Sample T tests are clearly met in these data sets;

- The sample size to be smaller than the population size
- Sample should be representative for the target population
- The dependent variable under the interest is either interval or ratio scale
- Independent variable should consist of two categorical 'related groups' or 'matched pairs'
- Distribution of the differences in the dependent variable between the two related groups should be 'normally distributed'

Testing Hypothesis

When testing for hypothesis using SPSS software, first Null Hypothesis and the Alternative Hypothesis should be stated. The hypothesis that need to be proved is stated under ' H_1 ; Alternative Hypothesis'.

H_0 : Design performance and interpretation performance are not correlated

H_1 : Design performance and interpretation performance are correlated

If null and alternative hypothesis statistically elaborated they would be ,

$H_0 : \mu_1 - \mu_2 \leq 0$

$H_1 : \mu_1 - \mu_2 > 0$

μ_1 = Mean of Design Performance

μ_2 = Mean of Interpretation performance

Table 5.7. Paired sample statistics for Interpretation marks and design marks

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Interpretation mark	59.96	67	17.024	2.080
	Design Mark	60.55	67	16.097	1.967

Table 5.8. Paired sample correlations for interpretation and design marks

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Interpretation mark & Design Mark	67	.922	.000

The Paired sample statistics output repeats the data that is entered. And the above data in the table 5.8 adds information that Design Performance and Interpretation performance are significantly positively correlated with a correlation of 0.992.

Table 5.9. Paired sample test for Interpretation marks and design marks 1

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	Interpretation mark - Design Mark	-.597	6.594	.806	-2.206

Table 5.10. Paired sample one test for Interpretation marks and design marks 2

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	Interpretation mark - Design Mark	1.011	-.741	66	.461

Since the test is one tail test in which variable is 'greater than' or 'lesser than', is not figured out and the computed p-values is given below. p-value is a function of the observed sample results that is used for testing a statistical hypothesis.

p-value = sig/2

p-value = 0.000/2

p-value = 0.000

0.000 < 0.05

p-value< 0.05

If the p-value is lesser than 0.05, Null Hypothesis can be rejected therefore H_0 can be rejected. Thus, the 'H_1', the alternative hypothesis can be accepted. This provides adequate evidence to conclude that interpretation mark and design mark are correlated. In a more specific interpretation this implies that the students who performed well in the tasks that required interpretation stage skills have also received the better final mark in their design.

5.1.3. Identification Vs Design performance

This is the stage where student are selecting the design objective in response to their varied number of brief interpretations in response to the design forces.

5.1.3.1.Identifying Data Set

For the purpose of data analysis using SPSS system the specific data sets required be identified. For the design performance the final design mark was taken collected through the crit sheets. For the Identification marks the marks they achieved for particular tasks that reflected their idea selection skills were

taken. This included the standard convergent thinking test, selecting interpretations for the given scenario written by other students. The marks that were recorded in the assessment sheet were taken from these two activities and then percentage was taken to get a mark out of hundred. In the assessment of their convergence ability the marking criterion was based on the typical parameters as humour, commonality, originality and applicability in creative testing studies.

5.1.3.2. Preliminary analysis

Prior to conducting the SPSS analysis data sets were used to generate basic graphs using Microsoft Excel as shown in figure 5.5 and 5.6. These graphs were used get a more graphical presentation of the data behaviour.

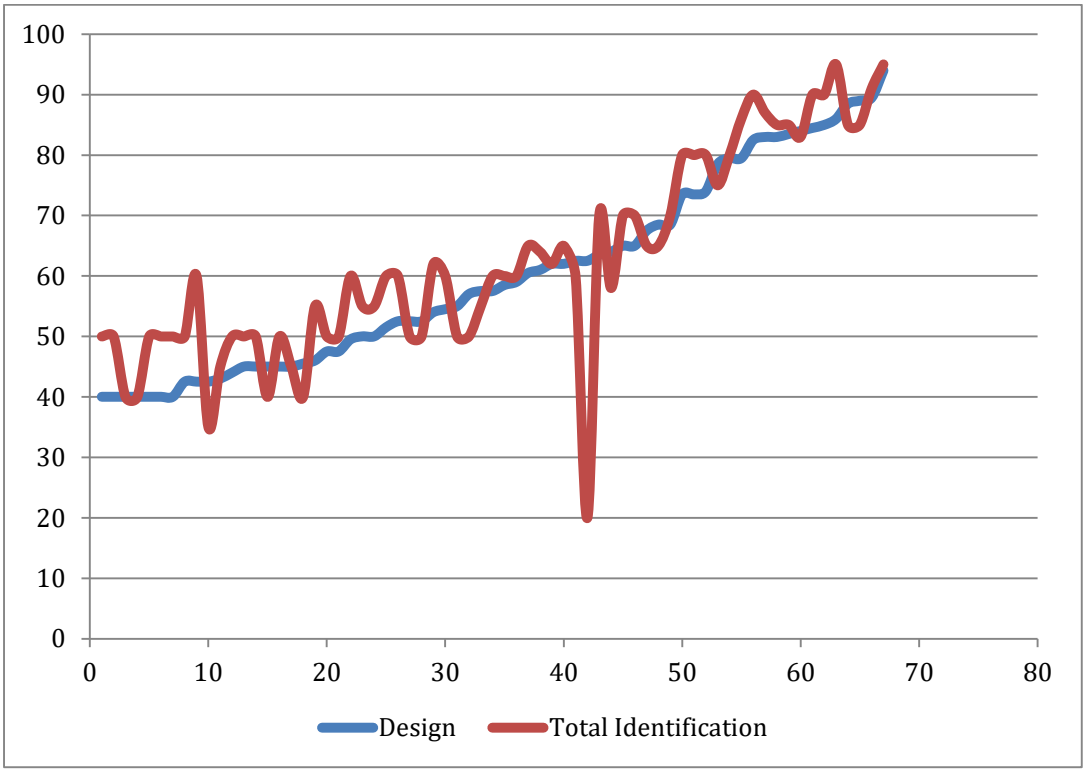


Figure 5.5. Comparison of Design Mark and Total Identification Mark

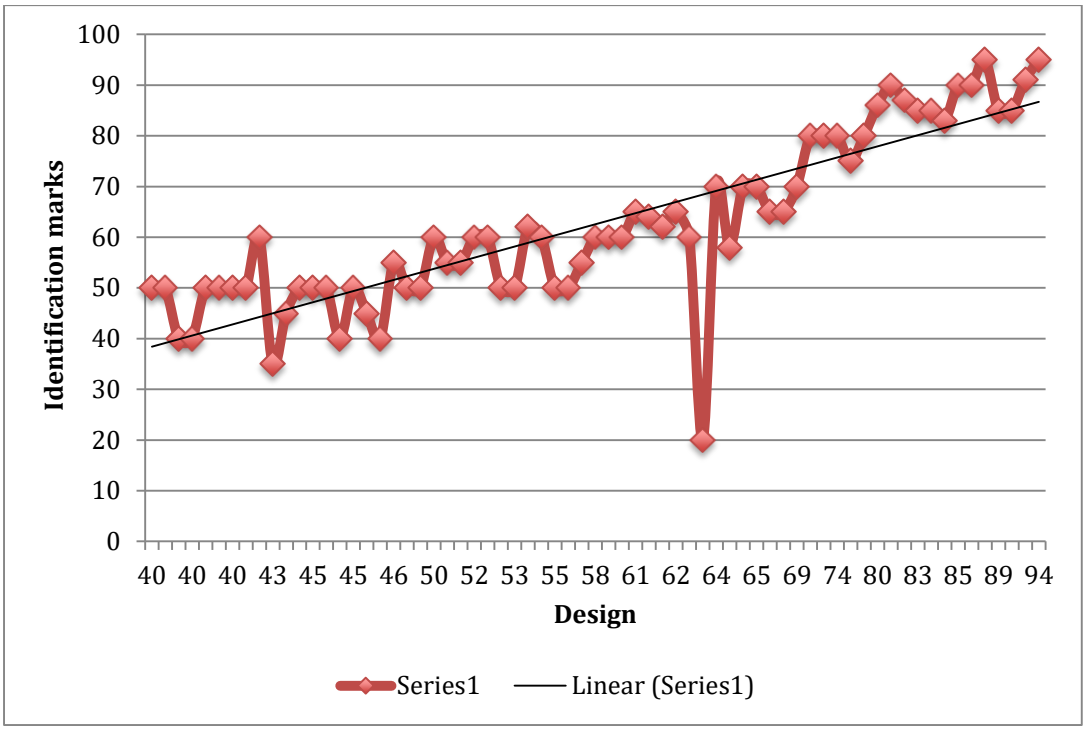


Figure 5.6. Design Mark Vs Total Identification Mark in a Graph

The above two graphs indicates that the Identification mark and the design mark possess similar data patterns. Expect very few cases according to the graph 5.5. is it evident that both marks when taken out of hundred have closer values. Within the graph 5.6 also this relationship is visible with the one or two exceptions in the data set. Since the initial data analysis reflects relationship between the two data sets the SPSS data analysis was conducted.

5.1.3.3.Test of normality

Statistical methods, which depend on the parameters of populations or probability distributions, are referred as 'Parametric Methods'. The parametric methods of hypothesis testing such as two sample t tests are meaningful when underlying population is 'normal' and it provides better precision The numerical method of testing for normality is called 'Shapiro-Wilk Test'. If the sig. value of Shapiro-Wilk test is greater than 0.05, It indicates that the dependent variables are normally distributed.

Generated Data

Table 5.11. Generated data for normality test between identification mark and design mark

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Identification mark,	.195	24	.019	.939	24	.161
Design mark	.142	24	.200*	.961	24	.459

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Hypothesis of Normality test;

H_0 : Performance of the students is normally distributed

H_1 : Performance of students is not normally distributed

According to the normality test results (Shapiro-Wilk Test),

Identification mark

Sig. =0.161

0.152> 0.05

Sig.> 0.05

Design mark

Sig. =0.459

0.459> 0.05

Sig.> 0.05

Thus, H_0 cannot be rejected. So the dependent variables are normally distributed. Since the performance is normally distributed, data can be analysed using parametric tests.

5.1.3.4.Paired sample T Test

Paired sample T test procedure compares the means of two variables for a single group or the means from two matched groups. In this analysis procedure, each subject has two measures; in this study the measures the design mark and

identification mark. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0, which is known as a two-tail test.

Following conditions and assumptions for Paired Sample T tests are clearly met in these data sets;

- The sample size to be smaller than the population size
- Sample should be representative for the target population
- The dependent variable under the interest is either interval or ratio scale
- Independent variable should consist of two categorical 'related groups' or 'matched pairs'
- Distribution of the differences in the dependent variable between the two related groups should be 'normally distributed'

Testing Hypothesis

When testing for hypothesis using SPSS software, first Null Hypothesis and the Alternative Hypothesis should be stated. The hypothesis that need to be proved is stated under ' H_1 ; Alternative Hypothesis'.

H_0 : Design mark and identification performance are not correlated

H_1 : Design mark and identification performance are correlated

If null and alternative hypothesis statistically elaborated they would be **,**

$H_0 : \mu_1 - \mu_2 \leq 0$

$H_1 : \mu_1 - \mu_2 > 0$

μ_1 = Mean of Design Performance mark

μ_2 = Mean of identification performance mark

Table 5.12. Paired sample statistics for Identification marks and design marks

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Identification mark	67.76	67	16.681	2.038
	Design Mark	60.55	67	16.097	1.967

Table 5.13. Paired sample correlations for identification marks and design marks

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Identification mark & Design Mark	67	.580	.000

The Paired sample statistics output repeats the data that is entered. The results shows a correlation of .580, which cam be considered significant. Therefore the above data is evident that that Design Performance mark and identification marks are significantly positively correlated.

Table 5.14. Paired sample test for identification marks and design marks 1

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	Identification mark - Design Mark	7.209	15.035	1.837	3.542

Table 5.15. Paired sample test for identification marks and design marks 2

Paired Samples Test

	Paired Differences	t	df	Sig. (2-tailed)

		95% Confidence Interval of the Difference			
		Upper			
Pair 1	Identification mark - Design Mark	10.876	3.925	66	.000

p-value is a function of the observed sample results that is used for testing a statistical hypothesis and to find the behaviour of the hypothesis through the paired sample t-test this need to be calculated. Following is the computed value based on the generated data from the statistical analysis.

p-value = sig/2

p-value = 0.000/2

p-value = 0.000

0.000 < 0.05

p-value< 0.05

According to analysis methods if the p-value is lesser than 0.05, Null Hypothesis can be rejected therefore the null hypothesis that design mark and identification mark are not correlated can be rejected. Thus, the Alternative hypothesis denominated by ' H_1 ' () can be accepted. This provides evidence to conclude that identification mark and design mark are correlated. In a more practical understanding the student who performed better during the identification phase have also shown significantly better mark in the final crit. However it is also observed that the correlation is not strong as in the interpretation phase.

5.1.4. Conceptualization Vs Design performance

This is the phase where the students are generating a concept in response to the selected design objective. The main domain specific activities include verbalising concept, conceptual imagery, conceptual modelling and mood board preparation for the particular concept. Within academic design programmes this is the main phase that could determine student performance. First a preliminary

analysis was conducted using Microsoft excel and then the statistical analysis was conducted. Within SPSS analysis first normality test was administered to find the distribution of data and then the paired sample test for correlations.

5.1.4.1.Identifying Data Set

Prior to the data analysis the data sets were selected and processed for better insights in the statistical data analysis. The main data set is the design mark, which was taken from the final design crit sheets. To establish the relationships during concept formulation stage the activities that assisted the conceptualizing process given in the design guide was selected. These mainly included the making of conceptual models and the mood boards for different concepts. Using the assessment sheet for conceptualization stage where originality, philosophy, appropriateness and practicality were taken as the criterions in assessing the tasks that were performed the final marks were determined for each activity. And for the data analysis both marks were taken out of hundred marks.

5.1.4.2.Preliminary analysis

Prior to use of the statistical data analysis package SPSS the data was scrutinised to a preliminary data analysis using the basic functions in the Microsoft excel. Figure 5.7 provides a comparison of the two marks against each student where the figure 5.8 shows the relationship between the conceptualization and the design mark.

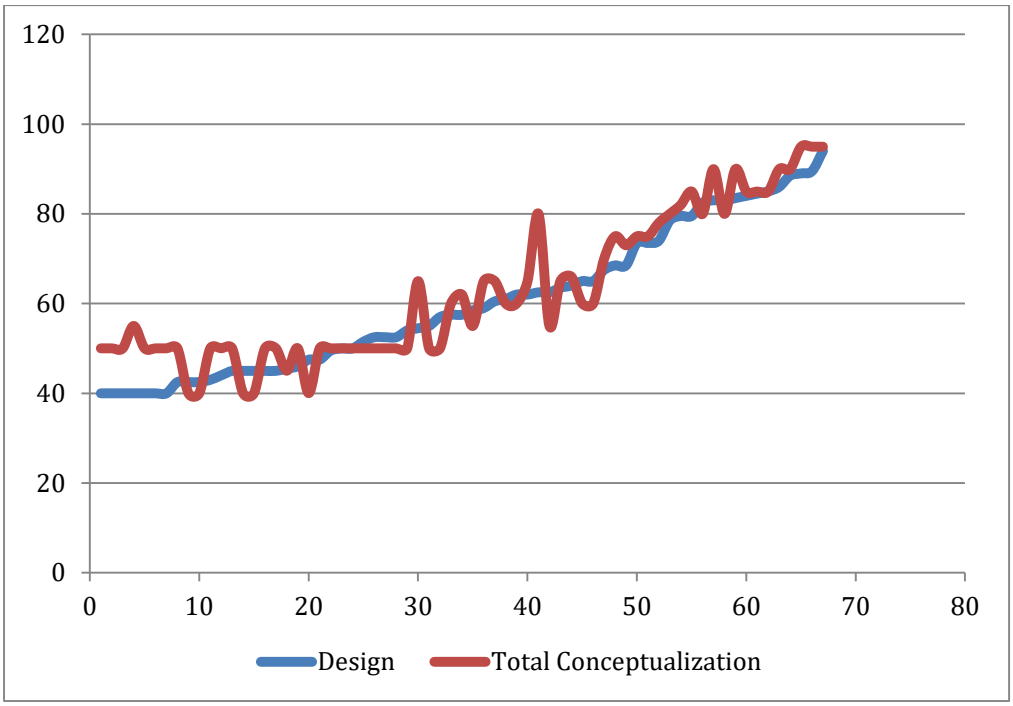


Figure 5.7. Comparison of Design mark and Total Conceptualization mark

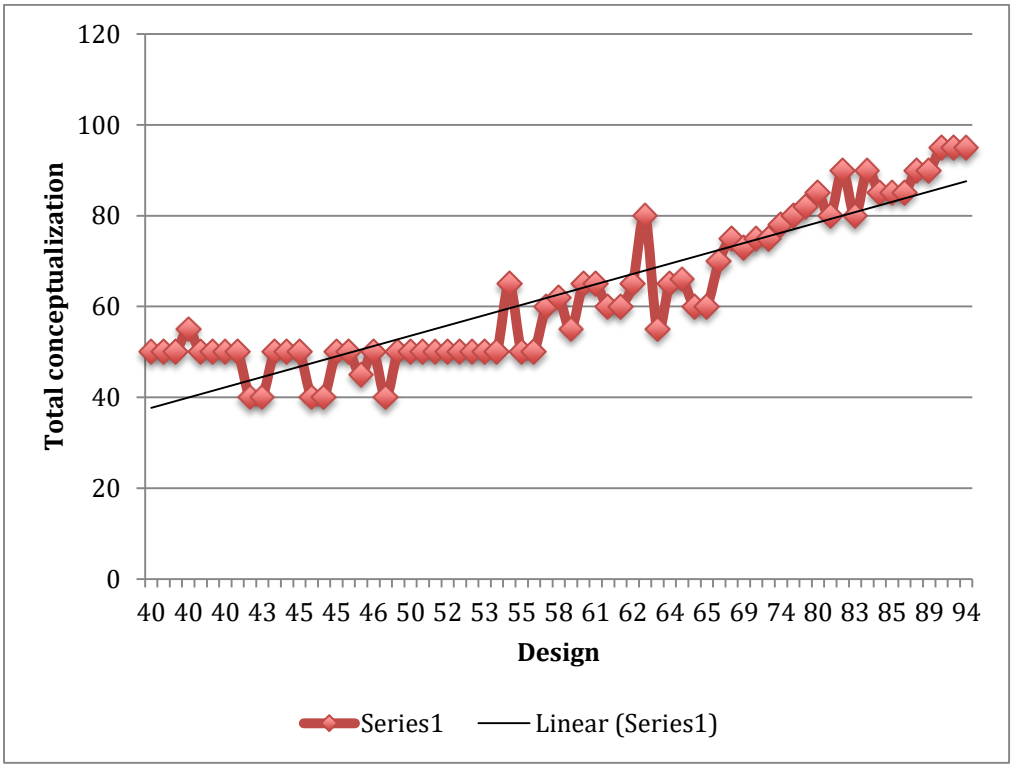


Figure 5.8. Design Mark Vs Total conceptualization Mark in a Graph

From investigating the two figures it could be identified that the design mark and the mark achieved for conceptualization are in the same range. Further the graph in figure 5.8. shows a positive correlation between the two data series. With this basic understanding of the behaviour of the two data sets the statistical analysis was conducted for further clarifications.

5.1.4.3.Test of normality

Statistical method is a Parametric Method in the analysis could only conducted if the data distribution is 'normal'. 'Shapiro-Wilk Test' which could determine the distribution of the data is administered to the data prior to running through SPSS paired sample test. If the sig. value of Shapiro-Wilk test is greater than 0.05, It indicates that the dependent variables are normally distributed.

Generated Data

Table 5.16. Generated data for normality test between conceptualization mark and design mark

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Cocneptualization mark	.195	24	.019	.939	24	.159
Design mark	.142	24	.200*	.961	24	.459

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Testing for Normality

Hypothesis of Normality test;

H_0 : Conceptualization mark of the students is normally distributed

H_1 : Conceptualization mark of students is not normally distributed

According to the normality test results (Shapiro-Wilk Test) given in the table 5.16 following can be computed,

Conceptualization mark

Sig. =0.159

0.143> 0.05

Sig.> 0.05

Design mark

Sig. =0.459

0.459> 0.05

Sig.> 0.05

Since sig. is larger than 0.05 H_0 cannot be rejected. So the dependent variables are normally distributed. Since the performance is normally distributed, data can be analysed using parametric tests.

5.1.4.4.Paired sample T Test

Paired sample T test procedure compares the means of two variables for a single group or the means from two matched groups. In this study the matched groups are the design mark and the conceptualization mark for each student. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0.

Following conditions and assumptions for Paired Sample T tests are clearly met in these data sets;

- The sample size to be smaller than the population size
- Sample should be representative for the target population
- The dependent variable under the interest is either interval or ratio scale
- Independent variable should consist of two categorical ‘related groups’ or ‘matched pairs’
- Distribution of the differences in the dependent variable between the two related groups should be ‘normally distributed’

Testing Hypothesis

When testing for hypothesis using SPSS software, first we have to state Null Hypothesis and the Alternative Hypothesis. The hypothesis we need to prove is stated under ' H_1 ; Alternative Hypothesis'.

H_0 : Design mark and conceptualization mark are not correlated

H_1 : Design mark and conceptualization mark are correlated

Elaborating the null and alternative hypothesis statistically provide the following ,

$H_0 : \mu_1 - \mu_2 \leq 0$

$H_1 : \mu_1 - \mu_2 > 0$

μ_1 = Mean of Design mark

μ_2 = Mean of conceptualization mark

Table 5.17. Paired sample statistics for conceptualization marks and design marks

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Conceptualisation mark	65.30	67	19.577	2.392
	Design Mark	60.55	67	16.097	1.967

Table 5.18. Paired sample correlations for conceptualization marks and design marks

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Conceptualisation mark & Design Mark	67	.862	.000

The table 5.28 indicates that the correlation is 0.862, which in terms of data analysis is highly significant and positive. Therefore it could be concluded that design mark and conceptualization mark are significantly positively correlated.

Table 5.19. Paired sample test for conceptualization marks and design marks1

Paired Samples Test

		Paired Differences		
		Mean	Std. Deviation	Std. Error Mean
Pair 1	Conceptualisation mark - Design Mark	4.746	9.967	1.218

Table 5.20. Paired sample test for assimilation marks and design marks2

Paired Samples Test

		Paired Differences		t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference				
		Lower	Upper			
Pair 1	Conceptualisation mark - Design Mark	2.315	7.177	3.898	66	000

Considering the generated data values given in table 5.20 it could the p-value can be computed where p-value is a function of the observed sample results that is used for testing a statistical hypothesis.

p-value = sig/2

p-value = 0.000/2

p-value = 0.000

0.000 < 0.05

p-value< 0.05

In statistical analysis if the p-value is lesser than 0.05, Null Hypothesis can be rejected therefore the data in this instants provide a basis to reject H_0 , the null hypothesis providing for the , ' H_1 ' , alternative hypothesis to be accepted. In a more applicable ways the data can be interpreted as to provide evidence to the established correlation between the mark obtained for conceptualization activities and the design in the final crit. Hence the students who are good in conceptualizing could also perform better in their designs.

5.1.5. Visualization Vs Design performance

Visualization is the stage where the actual design proposal is developed. During this phase student's ability to transform a conceptual image into a realistic architectural design is evaluated. The design guide included activities to improve general skills in the visualization tasks and also to assess their ability.

5.1.5.1. Identifying Data Set

For both preliminary data analysis and the statistical data analysis the two data sets were identified and processed. As for the previous cases the design marks students obtained during the final assessment was taken as the design mark and the total of all the marks they received for the activities in the design guide. From the assessment sheet their performance in abstract drawing, visualising perspectives and furniture design are considered as visualization skills in the data processing. Originality, creativity, applicability and quality are four criterions used in this phase for students to score marks.

5.1.5.2. Preliminary analysis

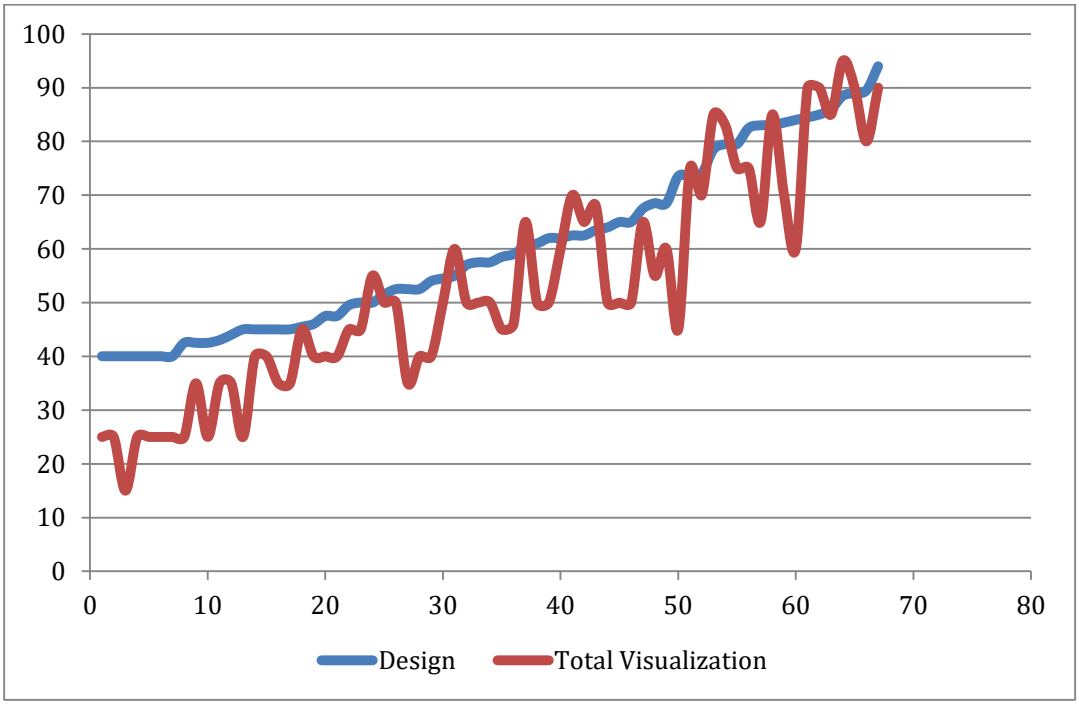


Figure 5.9. Comparison of Design Mark and Visualization Mark

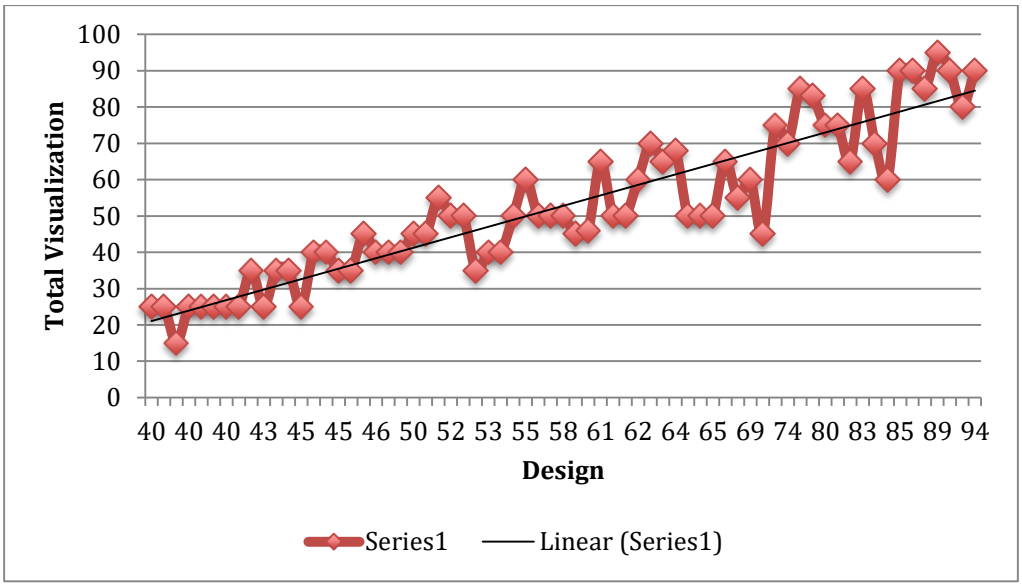


Figure 5.10. Design Mark Vs Total Visualization Mark in a Graph

The preliminary analysis of the student's marks shows a correlation in the two data series. According to figure 5.9 the students have received lessor marks for visualization in compared to their design mark. However the same pattern was observed. Figure 5.10 also provide evidence to a positive correlation between the two data sets of design marks and visualization marks. To explore further the data was processed through a statistical analysis.

5.1.5.3.Test of normality

Statistical method is a Parametric Method in the analysis could only conducted if the data distribution is 'normal'. 'Shapiro-Wilk Test' which could determine the distribution of the data is administered to the data prior to running through SPSS paired sample test. If the sig. value of Shapiro-Wilk test is greater than 0.05, It indicates that the dependent variables are normally distributed.

Generated Data

Table 5.21. Generated data for normality test between Visualization mark and design mark

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Visualization mark	.195	24	.019	.939	24	.164
Design mark	.142	24	.200*	.961	24	.459

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Testing for Normality

Hypothesis of Normality test;

H_0 : Visualization mark of the students is normally distributed

H_1 : Visualization mark of students is not normally distributed

According to the normality test results (Shapiro-Wilk Test),

Visualization n mark

Sig. =0.164

0.143> 0.05

Sig.> 0.05

Design mark

Sig. =0.459

0.459> 0.05

Sig.> 0.05

Thus, H_0 cannot be rejected. So the dependent variables are normally distributed. Since the performance is normally distributed, data can be analysed using parametric tests.

5.1.5.4.Paired sample T Test

Paired sample T test procedure compares the means of two variables for a single group or the means from two matched groups. In this analysis procedure,

each subject has two measures; in this study the two measures are the marks students obtained for the visualization tasks and the design. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0.

Following conditions and assumptions for Paired Sample T tests are clearly met in these data sets;

- The sample size to be smaller than the population size
- Sample should be representative for the target population
- The dependent variable under the interest is either interval or ratio scale
- Independent variable should consist of two categorical 'related groups' or 'matched pairs'
- Distribution of the differences in the dependent variable between the two related groups should be 'normally distributed'

Testing Hypothesis

When testing for hypothesis using SPSS software, first we have to state Null Hypothesis and the Alternative Hypothesis. The hypothesis we need to prove is stated under 'H_1 ; Alternative Hypothesis'.

H_0 : Design mark and visualization mark are not correlated

H_1 : Design mark and visualization mark are correlated

Expanding the alternative hypothesis statistically provide the following equations**,**

$H_0 : \mu_1 - \mu_2 \leq 0$

$H_1 : \mu_1 - \mu_2 > 0$

μ_1 = Mean of Design mark

μ_2 = Mean of visualization mark

Table 5.22. Paired sample statistics for Visualization marks and design marks

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean

Pair 1	Visualization mark	49.85	67	24.463	2.989
	Design Mark	60.55	67	16.097	1.967

Table 5.23. Paired sample correlations for Visualization and design marks

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Visualization mark & Design Mark	67	.766	.000

Table 5.23 shows the generated data for paired sample correlation test. The correlation figure of 0.766 indicates a significant amount providing the ability to conclude that Design mark and visualization mark are significantly positively correlated.

Table 5.24. Paired sample test for Visualization marks and design mark 1

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	Visualization mark - Design Mark	-10.701	15.954	1.949	-14.593

Table 5.25. Paired sample test for Visualization marks and design mark 2

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	Visualization mark - Design Mark	-6.810	-5.491	66	.000

p-value is a function of the observed sample results that is used for testing a statistical hypothesis and following is its computation based on the generated data from table 5.25.

p-value = sig/2

p-value = 0.000/2

p-value = 0.000

0.000 < 0.05

p-value< 0.05

From a statistical point of view if the p-value is lesser than 0.05, null Hypothesis stated at the beginning can be rejected. In this case it is the H_0 , which stated that design mark and visualization mark are not correlated. Thus, the 'H_1' the alternative hypothesis can be accepted where the design mark and visualization marks are correlated. This is an indication that students who performed well in their visualization tasks also perform better in the design.

5.2. Impact of the creative intervention: exploration of the change in design performance

The objective of conducting the creative intervention is to expect an improvement on the design performance. Thus the overall design mark was taken as an indicator of the creativity of the students. Therefore the marks obtained prior to the intervention was compared with the design marks after the intervention. Prior to the data analysis was performed data was processed to make them into a comparable data sets. To draw the correlations a statistical analysis was done using the SPSS system. Again the normality test was conducted initially to find whether the data are normally distributed and in confirming this the paired sample test was conducted. It was assumed that of the two sets of data are positively correlated then the performance after the intervention was better in terms of design marks.

5.2.1. Identifying Data Set

Identifying the data sets was important to obtain more accurate results in the data analysis. The same design mark that was used in previous analysis was used as the design mark 2. For the design mark 1 the marks that they obtained during the previous semester was taken. Since there were two designs the average of the marks were taken. By doing this it was expected that students overall performance will be evaluated.

5.2.2. Test of normality

Statistical method is a Parametric Method in the analysis could only conducted if the data distribution is 'normal'. 'Shapiro-Wilk Test' which could determine the distribution of the data is administered to the data prior to running through SPSS paired sample test. If the sig. value of Shapiro-Wilk test is greater than 0.05, It indicates that the dependent variables are normally distributed.

Generated Data

Table 5.26. Generated data for normality test design mark 1 and design mark2

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Design mark 1	.195	24	.019	.939	24	.155
Design mark 2	.142	24	.200*	.961	24	.459

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Testing for Normality

Hypothesis of Normality test;

H_0 : Design marks of the students are normally distributed

H_1 : Design marks of students are not normally distributed

According to the normality test results given in table 5.26 following computations can be derived,

Design mark 1

Sig. =0.155

0.143> 0.05

Sig.> 0.05

Design mark 2

Sig. =0.459

0.459> 0.05

Sig.> 0.05

Considering the computation where sig. is greater than the 0.05 H_0 cannot be rejected. So the dependent variables are normally distributed. Since the performance is normally distributed, data can be analysed using parametric tests.

5.2.3. Paired sample T Test

Paired sample T test procedure compares the means of two variables for a single group or the means from two matched groups. In this analysis procedure, each subject has two measures; within this study the subject is students where every one has two design marks as the measures. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0.

Following conditions and assumptions for Paired Sample T tests are clearly met in these data sets;

- The sample size to be smaller than the population size
- Sample should be representative for the target population
- The dependent variable under the interest is either interval or ratio scale
- Independent variable should consist of two categorical ‘related groups’ or ‘matched pairs’
- Distribution of the differences in the dependent variable between the two related groups should be ‘normally distributed’

Testing Hypothesis

When testing for hypothesis using SPSS software, Null Hypothesis and the Alternative Hypothesis are stated at the beginning. The hypothesis that need to prove is stated under 'H_1 ; Alternative Hypothesis'.

H_0 : Design performance is better before the creative intervention

H_1 : Design performance is better after the creative intervention

This null and alternative hypothesis can be statistically elaborated as follows,

$H_0 : \mu_1 - \mu_2 \leq 0$

$H_1 : \mu_1 - \mu_2 > 0$

μ_1 = Mean of Design Performance after the creative intervention

μ_2 = Mean of Design Performance before the creative intervention

Table 5.27. Paired sample statistics for design mark 1 and design mark 2

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Design mark 1	60.67	67	17.661	2.158
	Design Mark 2	60.55	67	16.097	1.967

Table 5.28. Paired sample correlations for design mark 1 and design mark 2

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Design mark 1 & Design Mark 2	67	.929	.000

The table 5.28 shows the generated results for the paired sample correlations test that gives a 0.929 correlation figure. This is a highly significant correlation with a positive relationship. However this is not a finding to conclude the causal effect yet the strong correlation could be observed. In order to explore more and test the hypothesis paired sample test was conducted.

Table 5.29. Paired sample test for design mark 1 and design mark 2 -I

Paired Samples Test

		Paired Differences			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
					Lower
Pair 1	Design mark 1 - Design Mark 2	.119	6.563	.802	-1.482

Table 5.30 Paired sample test for design mark 1 and design mark 2 -II

Paired Samples Test

		Paired Differences	t	df	Sig. (2-tailed)
		95% Confidence Interval of the Difference			
		Upper			
Pair 1	Design 1 mark - Design Mark	1.720	.149	66	.882

p-value is a function of the observed sample results that is used for testing a statistical hypothesis. Using the data given in the table 5.30 the p-value can be calculated.

p-value = sig/2

p-value = 0.000/2

p-value = 0.000

0.000 < 0.05

p-value< 0.05

According to statistical analysis if the p-value is lesser than 0.05, Null Hypothesis can be rejected, which is the design performance is better before the creative intervention. Therefore the alternative hypothesis; ' H_1 ' can be accepted. This provides statistical evidence to conclude that performance after the intervention was better than before.

5.3. Concluding remarks

The focus of the chapter is to provide data analysis and its findings. By taking each of the creative design process phases and establishing correlations with the design provide for a better understand of the impact from the five phases.

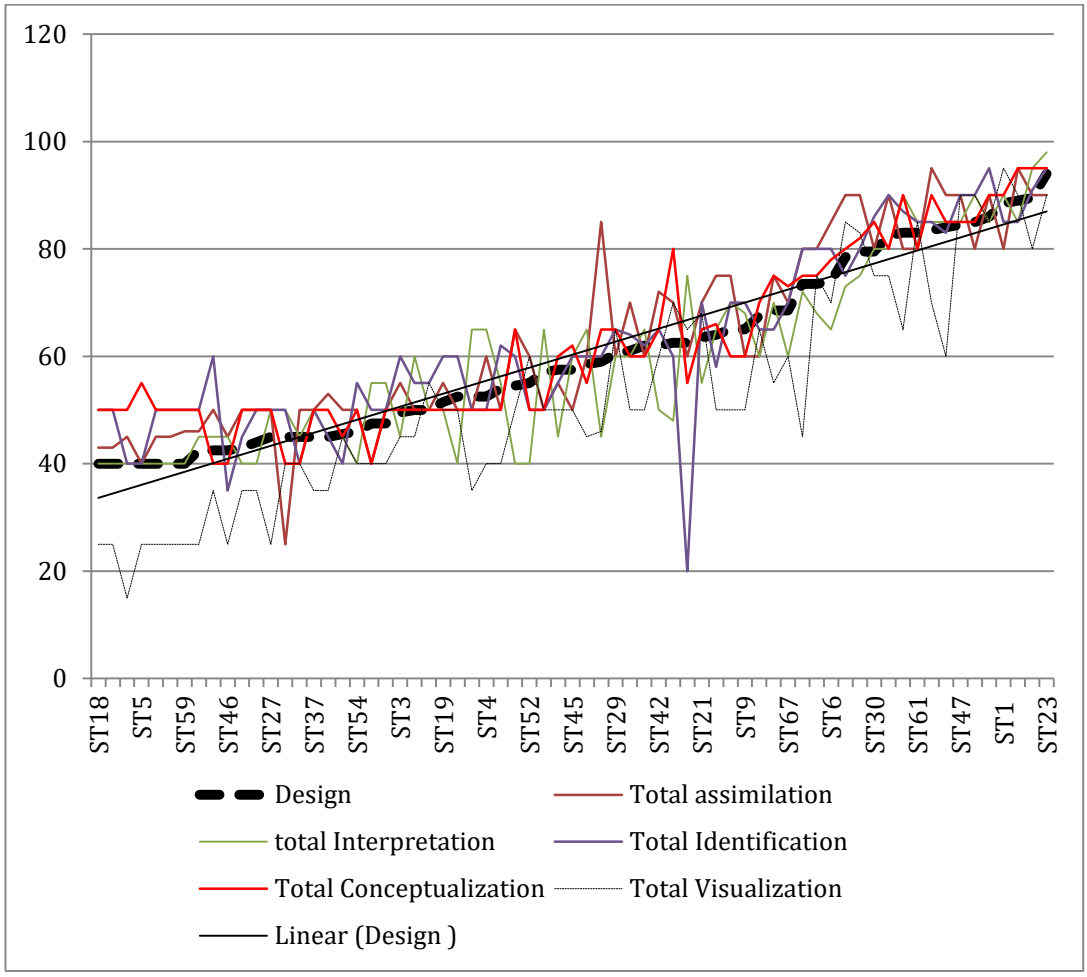


Figure 5.11. Creative design process stages performance

The figure 5.11 shows the mapping of the marks in every design phase and also the design mark. The graph clearly indicates the similar behaviour of the student's marks for various activities in the design guide along the design mark. Therefore it could be concluded that every design phase along the creative process has a relationship with the final design mark. If students creative process is improved the design performance would become better.

6. CONCLUSIONS

Creativity uncovers itself in our ability to face new problems, to look at realities in a different way, to perceive new patterns beyond the existing ones, to find new solutions, to produce new knowledge and to design new forms of being and living. With identification of its significance in almost every field the creativity research has spread its wings resulting a wide variety of research literature. Yet the most prominent development was the practical and scientific inquiry into creativity breaking away from the myth of the divine element associated with creativity.

The research is totally based on the philosophical premise that creativity can be nurtured with systematic interventions. Starting from identifying theory and reflecting on the outcome are based on finding ways to nurture creativity in education programs.

The conclusions are given under separate topics in par with the structure of the thesis while some aspects found across are synthesised for better understanding of the implications. Under the research findings the theory identified in relation to the total study, development of the theoretical model, use of the developed model in a design program, and the findings from the data analysis are given under separate headings.

The impact on validity and reliability of the research is presented under conclusions rather than in the methodology to provide a holistic view of how they were achieved within the study. Validity and reliability in action research was discussed in general and then the implications within this specific study were outlined in terms of adapting to the particular scenario.

Achieving of the anticipated education outcomes of MPhil level research as stipulated by the Faculty of Architecture, University of Moratuwa was also included in to the conclusions to clarify some of the decisions and limitations in the study.

6.1. Research findings

Creativity is an intriguing phenomenon yet to be explored in its full potential as a

human capacity. Education research on creativity is crucial since it pays a major role in nurturing and inculcating the habit of creative performance in the student. This research was also conducted in building empirical evidence on a developed framework that could enhance the creative performance in architectural design. However the findings are not concrete testing of a hypothesis but rather a reflection on the design activity in the background of a new approach to studio teaching.

Starting from understanding the problem the research literature on creativity studies are almost limitless. To identify the relevant theoretical development a systematic way of mapping the creativity became essential. After pooling through this vast ocean of theories the study adopted the basic categorization of four P's of creativity as the building platform to build its theoretical framework.

Out of the four Ps the component of process has been taken as the basis within its similarity to the design process that takes place in the design studio. Careful investigation into the process models revealed that stage models have some common factors and they could be integrated into a four stage model. This integrated creative process identified comprised of preparation, generation, evaluation and implementation.

The design process was found to share many features with creative process and superimposing these two provided the working model for creative design process. This expanded the four stages into six stages, assimilation, generation, identification, conceptualization, visualization and verification. The terminology that was more familiar to the design studio was used in par with these stages. They were renamed as background study, brief interpretation, identifying design objective, concept formulation, design proposal, and design justification.

Identifying the creative methods that are useful in these stages gave the final theoretical model " theoretical model of creative design process". This model included the familiar design studio activity, what tools can be used during the

phase and how assessment could be done.

The data analysis was done to test the hypothesis that student performance in each stage has an implication on the final mark and the student performance has a correlation before and after the intervention.

6.1.1. Identifying theory

Bryman (2008) identifies theory as an integral component in relation to conducting research. Especially in an area that theoretical developments are almost limitless identifying pertaining theory was a challenge in this research. Within the framework of this study theory was identified in four criterions: first creativity theories were identified to derive a categorization to construct a basis for the theoretical model; secondly, theoretical models used to understand the creative process were explored; thirdly, creative methods and their underlying theories were selected in relation to the design process; and fourthly, theoretical developments in research methodology were used to develop a the appropriate methodology to conduct the research.

Careful investigation of vast number of multidisciplinary studies of creativity lead us to two prominent paradigm changes: the first from the original paradigm of the "supernatural creative genius" to the creative thinking individual who can improve his cognitive processes by using exploratory methods and techniques to create something new and original in a strategic way. With the rapid development of scientific inquiry into creativity since 1950s it was seen as a cognitive ability and research was conducted to develop and assess various tools supporting creative performance.

The second paradigm change could be observed with the systematic developments since 1990s: an individual with creative thinking abilities is not alone a guarantee for original results and innovation and there are number of other factors which influence the creative process and the creative outcome. These include the motivation of the individual or team, their thinking abilities

and characters, their biographical stories, the working ambience, as well as the bio-social, the cultural, the economic and political environment, the state of the specific knowledge domain and of the field of experts, etc. But it is not enough that most of these factors are in a positive state: the important thing is that all these elements are connected in a way which permit the emergence of useful and innovative products, images, services or processes. This is the basis of the emergence of System theory that depicts the complex and dynamic characteristics owned by individuals as well as working in groups with the cognitive abilities and other necessary social contexts that could result in various levels of creative endeavours.

These developments concretised the four aspects of creativity: Person, Product, Process and Place. Specifically with the development of design research and the desire to explore the relation between design methods and creativity the design disciplines were highly concentrated on these creative aspects and attempting to adopt these more psychological grounds to everyday design activities.

While identifying the creativity theories On a social and political scale, the beginning of the new millennium is characterized by the concept of the 'Creative Age' (Earls 2002), which replaces a science obsessed era and the focus on marketing. The present creativity movement has been taking root since the internet-based New Economy, when societies moved from physical labour to brainwork, and where added value is generated by ideas that transform into service and process innovations, and copyrights. During the mid-1990s, creativity as a broad-based attribute came to be commonplace: terms such as 'Cultural Industries' are replaced by 'Creative Industries' and 'Creative Economy'. The idea of 'Creative Cities' (Landry 2008) emerged and is one of the key concepts of innovation politics in many countries. With the rise of the digital media and the increased focus on design, the concept of the 'Creative Class' emerged (Florida 2002), where arts and technology are linked. This, in turn, encouraged movements where scientific, industrial and artistic thinking are combined to innovate in the domain of entrepreneurship.

Out of these theoretical developments for the development of theoretical model the creative process based theories were studied in detail. In identifying theories on creative process several models were explored in finding their applicability to design studio. The creative process models were identified as two-stage ideation-c model, four stage models, eight stage models, componential models and creative problem solving models.

In identifying creative methods the problem of variety and categorization was critical. In this the categorising was done based on the identified four stages of the creative process. The mapping done by … was used as the basis and the identified and developed methods that could stimulate creativity were identified. The theoretical developments in divergent thinking, convergent thinking, idea generation, visualizing were used in selecting creative methods.

In identifying theoretical development in research methodology more emphasis was given on to the action research models. Particularly concerning the architectural design the reflective model developed by the Donald Schon was used as the premise to develop the model for the action research cycle in this study.

6.1.2. Development of a Theoretical model

A systemic approach was used to develop a theoretical framework that could be used as source of a guide to nurture creativity in architectural design studio. Mapping through the immense amount of creativity theories few ways of looking at theory was identified. Most dominant and broadest way is to look at in terms od creative process, creative product, creative person or creative place; more commonly known as four P's of creativity. This mapping of theories also revealed that design process also has its base on creative process. Therefore a more in-depth review was done on creative process.

Along the evolution of creativity literature, creative process has been presented by different models. The main two types are stage models and componential models. The literature further revealed that design process found in architectural education is more akin to a stage model. As a basis a four-stage model was identified as the working model for creative process, which comprised of preparation, generation, evaluation and implementation.

It was found that design studio activities could be aligned within a creative process this gave the working model creative design process. In doing consistent discussions were done with the tutors to identify which activities would best reflect the particular stage in the creative process.

Then the creative methods were mapped onto the model after categorising them according to the creative process stages. This theoretical model for creative design process is inclusive of creative process stages, design process phases and creative methods that can be used at each phase. The action research was conducted after developing a design programme based on this model.

In the process of developing the aforesaid theoretical model following conclusions could be drawn;

- Considering the four P's of creativity, creative process is more prominent in design education,
- Amidst the vast variety of creative process models similarities were found in the phases allowing them to be integrated into a four stage model of; Preparation, Generation, Selection and Implementation,
- Design process models could also be integrated based on similar phases,
- Common phases found in creative process and design process have similarities.
- Creative methods are based on manipulating a factor that contributed in enhancing the performance within the creative process,

- Creative methods across various fields could be aligned with the common phases of creative design process, and
- The design programme that was developed using this theoretical framework has given better performance in design.

Even though drawing concrete conclusions are beyond the scope of this research the reflection on the design programme developed on the theoretical model conducted clearly indicates the ability of the model to be used as a source to develop creative interventions in design studio.

6.1.3. Re-Structuring of the design program

Re-Structuring of the design program was a key component in the study that utilised the developed theoretical model. Project scenario setting, time scheduling the program, introducing daily presentations and discussion, peer reviewing, creative stimulating activities are the main areas impacted within the restructuring process. Table 4.2 provide a summary of these interventions.

The realistic project given made the design interesting as well as providing more opportunities for adopting a creative process. From studies on creativity, we know that specific conditions, such as well-defined problem limits, as challenges, can foster the creative design process (Kowaltowski et al. 2007).

Flexible program allowed students to submit at their own phase understanding the different time spent in each of the creative process. The additional creative stimulating activities assisted students to understand the creativity as well as improve their creative performance. Conducting of the studio as a total intervention with every activities improved participation creating an encouraging environment.

The design studio taking a form of an active learning environment with daily interventions was a novel experience to the student while it increased the workload for the tutors. While conducting the activities several measures were also taken to ensure validity and reliability of the research, which is discussed in detail under 6.3 and 6.4 in this chapter.

6.1.4. Creative process phases Vs design performance

Through the developed theoretical model for creative design process a design programme was developed which included extra activities introduced to stimulate the student creativity. Thereafter a data analysis was done to find relationship among the performance in creative activities and the final design. Based on the generated data output from the statistical analysis following table 6.1. summarises the correlations from each phase.

Table 6.1. Correlations among creative design process phases and design mark

Creative design Process phase	Correlation
Assimilation	.843
Interpretation	.922
Identification	.580
Conceptualization	.862
Visualization	.766

Investigating the data in table 6.1. following conclusions can be drawn,

- Marks for Assimilation phase activities and design marks of the students are highly correlated with the .843 correlation
- Marks for Interpretation phase activities and design marks of the students are highly correlated with the .922 correlation
- Marks for identification phase activities and design marks of the students are highly correlated with the .580 correlation
- Marks for conceptualization phase activities and design marks of the students are highly correlated with the .862 correlation
- Marks for visualization phase activities and design marks of the students are highly correlated with the .762 correlation
- Comparing the five factors the most significant phase is the generation phase with the correlation of .922.

Therefore it can be concluded that student performance in every phase is correlated to the final design mark achieved where generation phase is prominent in its impact. The identification shows the least amount of correlation indicating that the option they select our of all scenarios is not very significant once it has been detailed.

6.1.5. Impact of the intervention

The objective of the creative intervention is to assist students in developing their creative performance. As a measure of student creativity the design mark was taken from the project with the intervention and without the intervention. A statistical analysis was conducted on the data set for each student and correlations established.

The design mark in previous semester was termed design mark 1 and design mark 2 is the student performance with the intervention. The data clearly indicate that the correlation is 9090 and the two data sets are correlated. It could also be concluded that it is a positive correlation, which provide evidence to the increase in the overall design marks.

The large amount of positive comments given in the final crits were also evident to the improvement of the students but analysing them as qualitative data was considered out of the scope of this study.

However a common criticism in action research as opposed to a controlled experimental research is that exact isolation of the impact from the action research intervention. The whole concept of action research is to experience an improvement through an action therefore controls were not given prominence in research design. But the measures taken to improve the validity and the reliability of the research are discussed in 6.3. and 6.4. of this chapter.

6.2. Use of theoretical model: limits and adaptations

The foremost mission of the research was to develop the theoretical framework and discussing how it could be used in varied conditions that are vital for its future practice and expansion. It can be adapted in different education settings. The same aligning can be used in different cultural settings, for diverse complexities of function and contextual differences. The usage of the model is discussed in three basic criterions; use in architectural design, use in other design disciplines, use in design studio, and applicability in curriculum design. Limitation will also be discussed within these three distinct uses.

6.2.1. Adaptation in architectural design studio

The primary objective of the development of the theoretical model is to be used within the architectural design studio and it included aspects that are more domain-specific for the design projects. The advantage of using the model is that it could be easily phased out along the design process and the typical expected submissions from the students.

The most remarkable use of the model would be for the design studio to incorporate the activities they conduct into the model which provide the intended knowledge transformation tool to convert the immense amount of implicit knowledge in the studio to explicit knowledge that could be utilized in a systematic framework.Use of the model to develop very small projects can be challenging where extra exercises may take longer time that the project itself. Use may also be limited in some typology of designs that require functional response rather than a more philosophical conceptual approach.

6.2.2. Use in other design disciplines

Since the model is developed based on creative process it could be relevant to any design discipline in a theoretical perspective. However the specific activities and their terminology may differ depending on the particular field under consideration. In such instances the levels of the creative process needs to be taken as the basis.

6.2.3. As a source of curriculum design

Integrating theoretical and practical courses into the design studio is one of the most successful teaching strategies because of its significant role and direct impact on teaching architectural courses (Gelernter, 1988). Students from Bilkent University recognized three types of connections between a design project and other courses. First, technical courses were considered highly significant, whereas courses that dealt with theoretical, historical, and social subjects were of secondary importance (Turkan et al., 2010). Second, the course intended learning outcomes (CILOs) were important in design studios to produce satisfactory projects. The students were also aware of how the relations between technical knowledge originating from theoretical and practical courses (e.g., construction, lighting design, and building services) could produce a successful project in a design studio. Third, the students acknowledged how visual presentations could contribute to the successful evaluation of their design projects.

The developed theoretical model is a valuable source that provide a basis to understand the design process and which subject could become more dominant in each stage through the design studio.

6.3. Improving Validity in research

The validity in action research cannot be understood in isolation from the researcher and the participants. There are many studies and varying opinions in providing judgment of validity not only in action research but also in general terms. Joppe (2000) provides the following explanation of what validity is in quantitative research: “Validity determines whether the research truly measures that which it was intended to measure or how truthful the research results are. In other words, does the research instrument allow you to hit "the bull’s eye" of your research object? Researchers generally determine validity by asking a series of questions, and will often look for the answers in the research of others”. McNiff (1994) claims that validity in action research is not about methodology, but is concerned with personal and interpersonal issues. This view is supported by Clark

(2000), suggest that presenting an analysis of decision taking process in the action research provide basis for judgement for validity in action research. Waterman (1998) describes this aspect of validity as reflexive validity, where the information on researcher's influence will assist in determining the extent of achieving validity in the research. Many other researchers also believe that pride and dignity of the participants specially in education settings the benefits to the participants should also be considered under the validity in action research (Kelly and Gluck ,1979 ; Stringer, 1999; Anderson and Herr ,1999).

With regards to validity, most commonly it is to find whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure. Within the context of this study the main implication concerning validity is whether the measurement taken as the creative performance is the true indicator of student creativity. In order to overcome this the final crit sheet given for tutors were developed where the assessment is more based on a creative testing criterion rather than the typical assessment sheet given during previous years. As a control the previous design was also measured using the same assessment sheet but without conducting the intervention.

Another aspect that improves the internal validity of the study is using an actual project within the curriculum rather than conducting an extra curriculum design. Therefore in both design exercises the student motivation was at similar levels.

6.4. Enhancing Reliability in research

Joppe (2000) defines reliability as: The extent to which results are consistent over time and an accurate representation of the total population under study is referred to as reliability and if the results of a study can be reproduced under a similar methodology, then the research instrument is considered to be reliable. Further elaborating this Kirk and Miller (1986) identify three types of reliability referred to in quantitative research, which relate to: (1) the degree to which a measurement, given repeatedly, remains the same (2) the stability of a measurement over time; and (3) the similarity of measurements within a given time period . Charles (1995)

proposed the test-retest where the same test could provide similar result in any data collection. This testing could be done at two different times. Technically this is called stability of the data and when higher stability is observed the reliability of he measurements also are considered to be higher. Joppe, (2000) detects a problem with the test-retest method, which can make the instrument, to a certain degree, unreliable. She emphasise that when a test is repeated the respondent can get sensitized to the questions or the tasks ad therefore the measurements can be influenced and not be accurate.

Similarly, Crocker and Algina (1986) also emphasised that when respondents are answering a test only a limited behaviour is experienced and therefore measurements cannot be trusted. And it is the responsibility of the researcher to ensure the accuracy and consistency of the results they are taken for research.

Looking at the research literature it could be concluded that regards to reliability, whether the result is replicable. In the context of this research the results could be easily replicated in other design programs using the same methodology. However administering the intervention to a group that has already being involved in a earlier design may not be able to provide a significant change in improvement from the previous design. In order to improve on the reliability the assessment was done by two individual assessors other than the researcher. The average mark from the two assessors was taken for the data analysis. Figure 6.4. shows the two marks from the tutors.

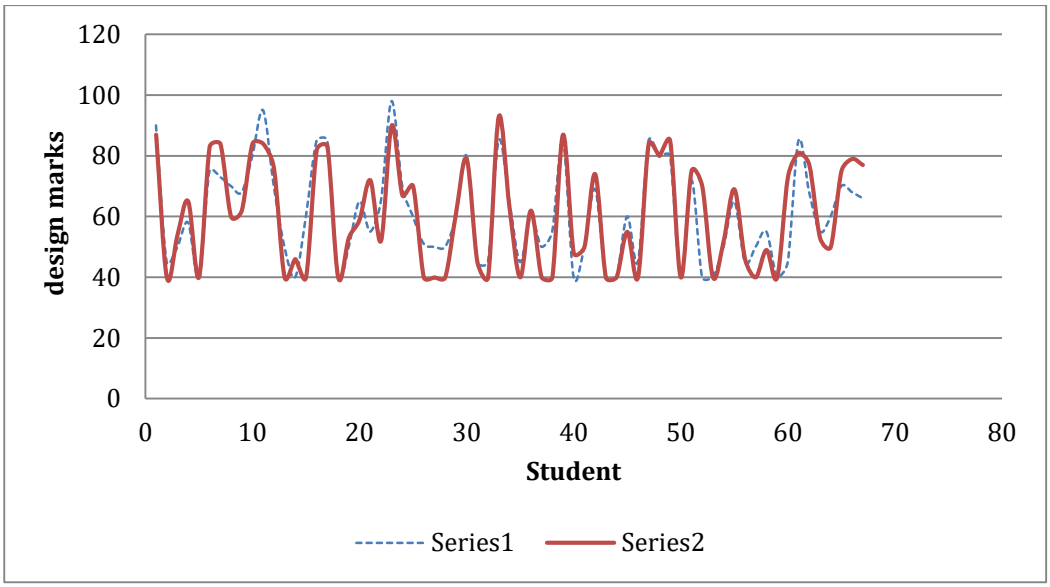


Figure 6.4. Comparison of the two design marks from tutors

The graph given in figure 6.4 clarify the closeness between the marks given two evaluators, which indicate the data is consistent and reliable to be used for the data analysis. Not involving the researcher in assessment also supports in improving the validity of the measurement. Students using different project scenarios and not allowing for repetition of the same scenario also assisted in improving the reliability where the marks were scored under different projects objectives, users, clients and functions.

6.5. Achieving learning outcomes

Through this study it was intended to achieve the learning outcomes anticipated by the MPhill level within the faculty. The learning outcomes achieved are given by displaying the ability to; identify a research gap, formulate research questions, select appropriate research methodology, develop research tools, conducting research with control over measurement, data analysis, drawing conclusions, writing up the research.

6.5.1. Identifying a research gap

Therefore basic consideration was given to derive a research question in relation to an interesting issue within a specific subject area. For the study creativity and Architectural education was taken as the two broader subject area and the issue

was taken as how to foster creativity in education from a teaching point of view. In identifying a research gap it was observed that creative interventions that are consciously done in architectural education are not very common given the significant role creativity plays in developing architects that could withstand the contemporary needs and aspirations. The study was developed to fill this research gap.

6.5.2. Formulating research questions

The next major concern was to understand thorough the study to narrow down the issue into a specific research questions. Since literature in creativity education and design studio are immense identifying the specific research problem and questions was a challenging task. However three research questions were identified that narrowed down the study into specific focus; 1) Can a mechanism based on creative process be used to develop a theoretical model to design a creative intervention in a design project? 2) Is there a relationship between the student performance at different creative process activities and creativity in the final design mark? 3) Has the student design mark improved after the creative intervention?

These questions were also used to set the objectives and also to structure the thesis. Careful consideration was also given in formulating research questions that could be answered with ascertainable research evidence.

6.5.3. Select appropriate research methodology

In the realm of understanding research methodology to showcase the aptitude for conducting research at a higher level, a thorough study has been conducted on action research and a new model was developed that could be adopted in design education. Figure 1. 4 the reflective model of creative education was based on the studies by Schon (1983) who pioneered the reflective thinking process as the way architectural designers design and converse in the design studio.

Specifically looking at how education interventions are conducted as a systematic research the methodology was selected and then modified to suit the demands and salient features of design education.

6.5.4. Develop research tools

Within the framework of the study research tools were taken as the data collection methods specifically developed for the project. Keeping in par with the action research in education context the data collection was primarily based on task performance. However the tools were developed to suit the theoretical framework as well as the design task to be carried out by the students.

Restructuring of the design program while including a design guide with extra activities was the main data collection tool developed for this particular project. The developed assessment sheets facilitated for the collection of the marks that were used as the primary data for the data analysis.

6.5.5. Conducting the action research

Further exploring on the research methodology the action research was carried out completing one cycle. The cyclic process was redefined to suit the domain specific concerns inspired by the reflective model introduced by Schon (1983) in his research.

Within the research a basic action research model was also adopted to suit the actual design studio circumstances while retaining the integral components of the cyclic process.

6.5.6. Controlling over measurement

One key aspect in learning research is the ability exercise proper control over measurements in order to achieve higher level of validity and reliability. Providing for adequate levels of controls for validity and reliability is not an easy task in action research with many implications on researcher's influences within the process. However a study has been done to understand the measures taken

by others in similar research and precautions were taken to improve validity and reliability, which was discussed in detail under 6.3. (Validity) and 6.4. (Reliability).

6.5.7. Using appropriate data analysis methods

Data analysis is the key in interpreting data and drawing conclusions and therefore determines the quality of the research. Considering the nature of the study as a education research the primary data generated was quantitative thus requiring for computational quantitative data analysis. Therefore SPSS data analysis was conducted once the preliminary analysis was done using Microsoft excel. Normality test and the paired sample tests were the two test used for analysing data.

In presenting data analysis tables generated by the SPSS were directly used and the Microsoft excel was used to generate graphs.

6.5.8. Drawing conclusions

The expectation from the conclusions as a learning exercise was not to provide concrete evidence for the hypothesis but to understand the behaviour of the data and what information can be drawn from the outcomes. In achieving this conclusions were drawn based on the hypothesis testing using of statistical analysis methods for the action research conducted.

However within the conclusion chapter a comprehensive account was given on conclusions that could be derived through the study starting from the methodology selection, identifying mechanism and developing theoretical model to conducting studio project.

6.5.9. Writing up the research

The writing of the research is somewhat different from actually conducting the research. The study attempted to structure the thesis according to the action research cycle, which provides clarity in presenting the process. The learning

objective anticipated in this aspect is to explore the structuring of a thesis, which reflects the line of reasoning as well as the procedure taken in conducting the study.

Concluding all the literature review on theories was a major challenge displaying the synthesis skills while also incorporating the systematic referencing.

6.6. Direction for further studies

More studies on different design schools could assist in further developing the theoretical model. Different relationships and data sets could strengthens the assumptions made in this model or even suggest modifications for a more generalised model to be used in varied contexts.

This exercise was focusing on the creative process but studies can be done to incorporate the creative personality, creative product and improvement in creative environment. An integrated study could also provide a more complex theoretical model that focus on all four P's of creativity.

Specific studies focusing on building relationships among the different stages and the final design mark could provide better insights into phases that demand more attention. Even within one stage the activities and their relationship to the final outcome could be assessed to find more significant activities in relation to varied design disciplines. This could include in-depth studies during each of the phase finding relationship among different activities and how they could impact the final creative performance. For example one interesting study would be to identify how precedence studies enhance the design performance then the performance in the assimilation could be assessed against the final outcome. Similarly every activity could be evaluated against the design performance to identify their impact and a factor analysis could provide an insight into which activity is the key player. This would provide the ability to focus more on that particular activity.

Further studies could lead to developing a standard design guide could be developed so that tutors can select from the basic and interpret into their own projects.

Course modules within a total design programme could arranged in a creative process using the same theoretical model. This could also incorporate different skill requirements deriving from various educational theories. This study could lead to more broader education approach based on creative process.

It would be worthwhile to conduct studies on assessment as well. Within the scope of this study the assessment was conducted to generate relevant data but the assessment criteria and its behaviour was not scrutinised.

6.7. Concluding remarks

The inadequacy of the implicit design methodology has caused students to lose interest in the design process and to jump to form making while relying only on intuition and artistic skills. According to McAllister (2010), the real danger is the fact that students pay too much attention to the end product that they ignore the development of essential design process skills. In the 1960s, the design method movement created the need for design activity to be based on the scientific method. In the words of Cross (2007), "The reasons advanced for developing new methods were often based on the assumption that modern, industrial design had become too complex for intuitive methods". In this light the research conducted was significant in exploring a scientific basis for conducting design studio that could yield better creative outcomes from the students.

The studio as Schon rightfully identified is the place where reflective practice of design takes place. There was, he explained, a growing concern amongst professional educators 'about the gap between the schools' prevailing conception of professional knowledge and the actual competencies required of practitioners in the field' (Schön 1987). Every tutor in the design studio provide instructions in reflection to the situations they are faced with in answering varied design

questions posed by students based on the experienced gained by practice. Yet this implicit knowledge is not properly absorbed into the education system. Since creativity is one of the key concepts when judging a designer or a design solution, the main question that still has to be answered is how knowledge that enhances creative designing can be taught using explicit instruction (Christiaans & Venselaar, 2005). Understanding the criticality of innovation in this new age the developed model provides a framework to map these activities on to a mainstream teaching model where conscious manipulations can take place.

In order to intervene educators should be equipped with tools that can be adapted to stimulate creativity. The theoretical model also assist in providing basic guide in tool selection understanding the development of these tools and their applicability in design education. The development of design methodology and systematic studies on design technology contributed remarkably for development of many domain specific tools and interventions. The goal in developing design methods was to improve the process and the product outcome emphasising the decision-making or problem solving activity in design. It was argued that since many other fields develop tools to enhance process and product architectural design should depend on those same tools.

Numerous studies could be found since the 1960s, providing for both understanding design process and developing tools and techniques for improvements. The main exponents of this movement were Christopher Jones, Christopher Alexander and John Luckman in the 1960s of the last century. In the 1970s Horst Rittel and Henry Sanoff are leading while Alexander published his "Pattern Language" in 1977. Scientists from other fields contributed as well to the understanding of design processes. Herbert Simon published "The Science of the Artificial" in 1969 and Donald Schon contributed to the understanding of design education in 1983 with his "The Reflective Practitioner". In the last two decades, Brian Lawson and William J. Mitchell have contributed to the understanding of design thinking and the logic of architectural design as well (Moreira 2007).

Most studies on the design process in architecture show that it does not follow rigid rules. Designers do not apply universal methods and rarely externalize their thought process (Kowaltowski et al. 2006a). Research in design methods considers the creative process complex, solving what are termed wicked or ill-structured problems (Rittel and Webber 1973). In order to answer these kinds of problems creative methods were used. In such early texts Brainstorming, Synectics, Morphological Charts and Removing Mental Blocks are mentioned as appropriate tools in research. With the rapid development in creativity research there are more than 250 methods that could be found as creative methods and the developed theoretical model will assist in identifying these methods to suit the situational needs.

The expectation of the research is simply to explore the possibility of conscious creativity fostering in the architectural design studio. With the drastic changes in social systems adaptation is crucial for any industry to survive. The outcome of the study is not merely to develop a solid model but a living mechanism that could adapt to changes in scenarios may it be social, contextual or functional. With this flexibility there is potential for further development yet to be unravelled. Working across three distinct areas of creativity, education and architectural design has given a complex model that draws merits from research literature and making the study contemporary in all fields.

It is evident that architecture is a reflection of the prevailing socio-cultural and economic status of a civilization and the extent of innovative thinking that goes into making of architecture would recite the capacity of human creativity. There is no argument that creativity is the most desirable outcome of any architectural education program. This brief encounter of action research is an eye opener for design studio as a place to nurture creativity and to explore the already existing tools and methods to assist students in reaching their design goals.