An expertise study of cognitive interactions between tutors and students in design tutorial conversations

KHAIRUL ANWAR MOHAMED KHAIDZIR

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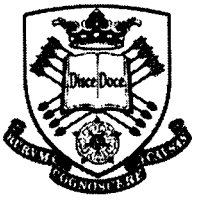

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Abstract

This thesis is an effort to determine the characteristics of expertise by studying tutorial interactions within the architectural studio environment. The aim is to establish if expert tutors and novice students employ different cognitive actions and strategies in dealing with emerging design 'situations' during tutorial conversations. This is a challenging prospect since the design tutorial is a confluence of activities generated by participants who possess disparate levels of design abilities.

To analyse and compare cognitive actions and strategies quantitatively, verbal protocol texts obtained from twelve tutorial interactions were parsed into discreet segments of cognitive actions and their accompanying attributes. What is crucial here is that every cognitive action carries a set of crucial information that has bearing on the cognitive strategies used by tutors and students during tutorial conversations.

Cognitive actions like *formulate*, *evaluate* and *move* actions serve as a primary category in encoding verbal segments since these appear to be the most explicit and common communicative propositions observed in these tutorials. In addition, various other categories of information attributes such as cognitive organisation, domain knowledge and type of transformation are then assigned to these cognitive actions. Through such a scheme, cognitive actions and their designated information attributes could be systematically analysed in terms of frequency and duration.

From the study, we found that the degree of differences in Cognitive activities between tutors and students corresponded to the way they comprehended problems, formulated 'emerging' situations and prescribed moves in order to advance design activities. By comparing situated cognitive activities in tutorial conversations, we hope to add a richer and more practical description of design expertise. One of the key contributions from this study would be to encourage deliberate and effective development and management of expertise in designers.

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CHAPTER 1
INTRODUCTION

1.1. Introduction

For many domain-specific activities, expertise is measurable through different stages of developments in skills and performances. For example, studies on chess skills strongly suggest that there are differences between master, expert and non-expert players in terms of organising, retrieving and utilising knowledge from memory (Chase and Simon 1973; De Groot 1978). Experts and novice differences were also noted in the conceptualisation, categorisation and representation of physics problems (Chi, Feltovich et al. 1981). Differences in expertise are not spontaneous phenomena. It appears that outstanding performers improve their expertise levels through the deliberate development of domain-specific skills and performances (Ericsson, Krampe et al. 1993). In the case of the chess master, De Groot (1978) suggested that expertise is the product of a 'schooled and highly specific mode of perception' (p.308).

Studying expertise in design is crucial because it lays the foundations for a more deliberate and effective development of designers. However, such effort faces several challenging prospects. Firstly, design activities, unlike task or domain specific activities, involve certain cognitive processes, behaviours and task environments that appear to be generic across most design-based professions. According to Goel and Pirolli (1992), typical of these design professions are architecture and engineering. In fact, Cross (1990) considered that some aspects of design ability are actually observable across the general human population. What then are the *core* features in design that make it such a generic phenomenon across many human activities?

Secondly, design problems are distinctly different from conventional problems. This is evident from existing studies of design and non-design interactions. In order to study design expertise, we need to analyse design activities in their corresponding environments. This would enable us to address certain inherent questions pertaining to the nature of design

problems. One of the most crucial that we could ask is whether design problems are predetermined at the start of design activity or evolve during 'problem solving' activities? How do designers then interact with such problems? These are some of the questions that would enable us comprehend the nature of design, the processes it entails and its impact on the human productive enterprise. Studying designers' *cognitive actions* is a crucial approach in understanding the way designers deal with design problems.

Thirdly, designing is largely a psychological activity that transcends beyond problem solving activities. The designer's cognitive input is necessary in providing a meaningful structure to the problems he or she is dealing with. This provides testament to the primary role of personal knowledge in human actions (Polanyi 1974). The impact of design on human activities is far-reaching. While design thinking is central to the most creative of human efforts (Akin 1990), it is also crucial in producing the 'ordinary everydayness' in human action (Winograd and Flores 1987). As such, identifying, delineating, analysing and comparing design activities that are largely a personal and psychological initiative of the designer provide many challenges to studying expertise in design.

Fourthly, design activities come across as a kind of intelligent behaviour. This was the assertion made by Cross (1990), who judged design favourably against Gardener's (1983) eight criteria for intellectual competence. Among the eight criteria, Gardener cited emerging evidence of expert-novice differences as an indicator for intelligent behaviour. This criterion is particularly relevant to the current study of design expertise. A more recent definition of intelligence by Sternberg (2006) also provides an important backdrop for this study. This definition describes intelligent activity as the ability to 'learn from experience', use 'meta-cognitive processes to enhance learning' and adapt to the environment (Sternberg 2006). These criteria are potentially present in design activities. One way of confirming this is to examine designers' cognitive *performance* and *skills* in *'concrete'* environments of action. This provides a certain outline on how we could investigate the nature of expertise in design.

1.2. Skill-based model of expertise

For design activities, formulating a skill-based working model of expertise is crucial (Dorst and Reymen 2004). This is because design activities are realised 'in action' and through skilled application of domain knowledge. We can only infer evidence of such knowledge from designer's actions in cognition and behaviour. For example, Hubert Dreyfus's model

of general problem-solving strategies identifies levels of expertise in terms of skills in perceiving, interpreting, structuring and solving problems (Dorst and Reymen 2004). Through this model, we are told of what it means to be at 'novice', 'advanced beginner', 'competent', 'proficient', 'expert', 'master' and 'visionary' levels of expertise (Dreyfus, Dreyfus et al. 1986).

Lawson and Dorst (2005) significantly extended Dreyfus's model by incorporating skills specific to design activities. Furthermore, this study outlined two important conditions for the acquisition of design expertise. Firstly, 'triggering' a change between adjacent levels of expertise require designers to obtain sufficient knowledge or access to knowledge. Secondly, transformation between the levels of expertise might occur with designers consciously applying, through assistance by others, new methods in perceiving and acting (Lawson and Dorst 2005).

1.3. Importance of studying design expertise

How we consciously facilitate and instigate changes within and between levels of expertise respectively are important issues in educating designers (Lawson and Dorst 2005) and non-designers (Bloom 1985; Ericsson, Krampe et al. 1993) alike. Such efforts could form effective programmes in developing and managing expertise in design education and practice. Thus, differentiating levels of expertise now becomes a crucial area of research in design. We then ask; how do we identify, evaluate and differentiate levels of design expertise? Looking into previous studies in expertise might give us a clue to answering these questions.

1.4. Cognitive Skills

Conscious application and monitoring of cognitive skills and associated behaviours is a vital characteristic of expertise (Glaser and Chi 1988). The need for cognitive skills to transpire as deliberate actions has brought the design domain in line with other mainstream studies of expertise. For example, Ericsson's well established performance-based studies of non-design activities have concluded that expertise increases with *conscious* and *purposeful* acquisition of new methods and skills in performing tasks (Chase and Ericsson 1981; Ericsson and Charness 1994). This finding has been central to the promotion of 'deliberate practice' as a rigorous method in developing expertise. To underline further some key issues and challenges that may shape the parameter of study in design expertise, it will be

helpful to make a critical but brief assessment of Ericsson's 'deliberate practice' approach as an effective performance-based study of expertise.

1.4.1. Characterisation of 'expert performance'

Ericsson's studies of 'deliberate practice' were based on the clear definition of 'expert performance', which is 'consistently superior performance on specified set of representative tasks for the domain that can be administered to any subject' (Ericsson and Charness 1994). Ideally, these tasks must represent the most basic experience of 'expert performance' reproducible under standardised and controlled laboratory conditions. Monitoring them requires adequate feedbacks like instructions, tutorial and cues (Ericsson, Krampe et al. 1993). Therefore, subjects can knowingly modify their strategies upon repetition of the same or similar tasks. Following this, not casual repetition of tasks, subjects should observe improved levels in performance. These rigorous preconditions also reduce the influence of contextual factors to a minimum.

Such effort in capturing the essence of expert performance drew inspiration from the De Groot's (1978) pioneering method of testing chess players' ability in reproducing familiar board positions. The focus of De Groot's experiments was to investigate the nature of moves players make when exposed to specific chess positions, given that the latter were typical positions found in the middle of a game of chess (De Groot 1978). The ability to recognise and reproduce familiar chess positions represents a useful method in differentiating the levels of skills between players. However, there are limitations in the 'deliberate practice' approach of capturing expert performance as far as design activities are concerned. This has to do with the difference between well-structured and ill-structured task environments. The following section discusses this difference.

1.4.2. Nature of tasks and activities in expertise study

Most of the activities considered within the studies of 'deliberate practice' have come from non-design domains of expertise like music, chess play and sports. These are well-structured activities in that constraints are logical and form an integral part of the tasks. Conforming to these constraints is akin to playing by the rules of a 'game' (Goel 1992). Therefore, isolating these activities into assessable parts will be adequate in capturing the essence of expert performance so long as these actions contain the archetypical rules of the 'game'. For example, the study to differentiate expert and amateur pianists by (Ericsson,

Krampe et al. 1993) involved experimenting with typical complex finger movements and hand coordination tasks in non-music strokes and actual musical performances.

In contrast, design activities are ill-structured by nature. Constraints are 'negotiable'. Unlike the logical and rule-based decomposition of non-design problems, design problems are products of various external and internal influences related to the environment, culture and psychological disposition (Goel 1992). What the designer 'negotiates' in terms of these influences shapes the boundary of interaction for his or her 'design world'. Every design 'world' is unique. Applying general 'rules' in order to engage with these distinct 'worlds' will only prevent designers from 'seeing' new and different things out of the uniqueness of design situations (Schon 1992). As far as design activities are concerned, the definition and scope of 'expert performance' as originally outlined in the studies of 'deliberate practice' is essentially problematical. Design does not conform to 'rules'. What then is 'expert performance' in the context of studying design expertise?

1.5. Framework for the current study in design expertise

For design and non-design domains of research, interests may overlap in terms of working towards a 'deliberate' development of expertise. However, different methods in defining, eliciting and evaluating 'expert performance' are called for due to the different nature of task environments between design (ill-structured) and non-design (well-structured) domains of research. Design tasks differ significantly with non-design tasks. Therefore, we need to develop a framework that would enable us to assess and differentiate designers' performance and skills based on the notion that design possesses its 'own things to know, ways of knowing them, and ways of finding out about them' (Cross 1982). For this reason, we propose a framework of studying design expertise that incorporates the following factors.

1.5.1. Cognitive strategies in 'situated' environments

Design activities are realised as 'situated' actions. Clancey (1997) used the expression 'situated action' to reflect the notion that 'what people perceive, how they conceive their activity, and what they physically do develop together'. Designers' actions depend on cognitive skills and strategies they have acquired and adapted through experience and training. In essence, cognitive skills and strategies are key indicators of design expertise.

By comparing them, it is possible for us to establish the nature and degree of expertise in individual designers.

1.5.2. Design conversation as medium for differentiating expertise

In this study, we regard design 'conversations' as vital constructs of 'situated' activities. They can appear in many forms. Well known examples include interactions with diagrams and sketches (Goldschmidt 1991; Schon and Wiggins 1992; Goel 1995), social interactions (Buciarelli 1994), and studio tutorials (Schon 1983). In conversations that involve certain level of social participation, references are jointly constructed by its participants (Schegloff 1972; Greeno 1998). This is particularly evident in the influential study on tutor-student studio interaction by Scion (1983), although there is an argument here that this is more akin to a study in reflection-on-action than a situated reflection of activities (Valkenberg 2003).

1.5.3. Studio tutorial as focus of observation in current study of design expertise

We consider the design studio tutorial as an archetypical example of a situated environment of cognition. This is an environment where designers' cognitive actions could reveal certain underlying strategies, skills and patterns of behaviour that transpire from their interactions with emerging design 'situations'. Studio tutorial 'conversations' contain valuable information about tutors and students' cognitive activities. For the current study of design expertise, the focus of our observation will be the second year architectural studio tutorial session. The positions of students and tutors in this particular studio year are clearly marked in view of the expertise model proposed by Lawson and Dorst (2005). In this model, novice (students) and expert (tutors) designers are at diverging levels expertise.

1.6. Assumptions and hypothesis

We initiate this study by providing a set of assumptions about the nature of expertise and its relation to designers' cognitive abilities. These assumptions lead to the hypothesis outlined as follows:

- Expert designers are more productive in cognitive activities than novice designers are. This comes from more effective organisation of knowledge and integrative application of skills and strategies acquired from experience.

- Expert designers deal more intuitively with design 'situations' than novice designers do. This relates to their instinctive and perceptive ability in linking problematic but familiar situations to corresponding solutions from experience in practice.
- Expert designers are more capable of differentiating design 'situations' than novice designers do. They do this by readily applying different cognitive 'roles' or functions when dealing with 'situated' design activities.

1.7. Research aims and objectives

The aim of the thesis is to explore and understand the nature of design expertise by analysing and comparing tutors and students' cognitive activities that transpire during design studio tutorials. To achieve this aim, we set the following objectives:

- To define core cognitive activities that could form the parameter for understanding the nature of design expertise.
- To devise a framework appropriate in representing the dialectical and 'situated' characteristics of design conversation.
- To provide a cognitive basis for observing, coding, segmenting, analysing and comparing tutor-student tutorial interactions.
- To expound the nature of differences in cognitive actions, skills and strategies that might emerge from the verbal protocol studies of tutors and students' conversations.

1.8. Research questions

In order to define the scope for eliciting the necessary information about the nature of expertise between experts (tutors) and novices (students), we postulate the following set of questions:

- Are there any significant differences in the way tutors and students employ cognitive actions, skills and strategies in dealing with 'situations' that emerge during design tutorial conversations?
- Do tutors and students differ significantly in terms of responding instinctively and perceptively to emerging situations in design activities?
- Is there any significant evidence of tutors and students' ability in performing specific cognitive roles during tutorial conversations?

1.9. Chapter Overview

This thesis is organised in nine chapters. The following are the description of each of the chapter presented

Chapter 2 introduces us to the core operations in design. These represent factors that differentiate design from non-design activities. The discussion focuses on three critical issues: problem-solving activities, perception and memory skills. Under the issue of problem-solving paradigms, we outline the inherent characteristics of design problems and compare them against those of conventional problems. Also discussed are the roles of knowledge and episodic memory structures in supporting design perception.

Chapter 3 describes how we could study design as a situated activity. The focus here is on design conversations as a manifestation of designers' interactions with emerging design situations. We also supported the notion of design as situated activity with several theoretical concepts pertaining to the paradigm of 'reflective practice'. The chapter also draw references from literature on visual cognition, thereby providing us with the crucial understanding on the processes of perception and imagery activities that designers experience during problem formulation and recognition. This provides us with the clue as to how expert designers deal visually with emerging problems in design. We then examine studio tutorials as a situated environment from which we could draw relevant conversational data for use in the current study of design expertise.

Chapter 4 sets out the methodology that enables us to deal with design conversational data. It clearly outlines the various references the current study draws from in terms of conducting protocol analysis on conversational data. In particular, this chapter includes a critical appraisal of the use of concurrent and retrospective protocol analysis in previous studies of design expertise. Following this, we discuss ways of segmenting and encoding protocols obtained from the current observation of studio tutorials. We also explain the basis for coding the protocols through the four categories: Cognitive actions, Cognitive organisation, Domain of knowledge and Transformation type. We then devise a table format based on Microsoft Excel application that enables us to filter relevant interactions between categories outlined earlier.

Chapter 5 presents the findings in relation to the analyses of interactions between the three basic types of Cognitive actions (Formulate, Evaluate and Move actions) and the expertise

groups (tutors and students). We assess these interactions based on segment frequency and duration. The aim of this exercise is to establish if there are significant differences in the way tutors and students employ Cognitive actions during tutorial conversations.

Chapter 6 presents further findings that extend the basic analysis in Chapter 5. In this chapter, we incorporate factors like transformation type category (Lateral and Vertical) and the Source of preceding segment (tutor-made and student-made segments) as variables in the interaction between Cognitive actions and expertise groups. The aim here is to determine whether the source of preceding segment and direction of transformation influence significantly the distribution, frequency and duration of tutors and students' Cognitive actions.

Chapter 7 presents the findings that compare the interactions of Cognitive actions (Formulate, Evaluate and Move actions) and Visual cognitive organisation (Structural, Symbolic and Componential) between each expert group (tutors and students). The purpose of this analysis is to establish whether tutors and students differ significantly in specific cases of interaction between types of Visual cognitive organisation and Cognitive action.

Chapter 8 presents the findings that compare the interactions of Cognitive actions (Formulate, Evaluate and Move actions) and Domain of knowledge (Process and Content) between each expert group (tutors and students). In this analysis, we determine whether tutors and students differ significantly in specific cases of interaction between Domain of knowledge and Cognitive action.

Chapter 9 concludes the thesis by discussing the direct implications of findings obtained from the current analyses. In particular, this relates to the close relationship between experts' Formulating and Move actions and other significant interactions that emerge from these actions. We also suggest how analyses from the current study of expertise might influence particularly the general direction of research in design education.

CHAPTER 2

Core operations in Design activities and its implications to the study of design expertise

2.1. Introduction

In this chapter, we look at the major determinants of design expertise. Following Gardener (1983), we identify them as the 'core operations' in design activities. These factors could serve as evaluative functions in differentiating the levels of expertise between designers. In the absence of such factors, it would be difficult for us to conduct an expertise study on design.

With the extensive involvement of design in various strata of human activities, there is always the need to 'extend the boundaries of traditional cognitive studies' when studying design (Craig 2001). Therefore, studying design expertise requires a comprehensive but meaningful definition of design to work with. Identifying core activities or operations in design then becomes a primary concern.

Three closely associated issues that have shaped design studies over the years are problem solving, perception and memory structures. Problem-solving activity, in particular, is one of the most researched subjects in the area of non-design actions. As an argument in promoting design as a form of intelligent activity, Cross (1990) identified problem-solution conjectures and the generation of solution alternatives as characteristic operations of the design process. This assertion is a profound one in that it distinguishes design 'problem solving' as a unique problem solving activity.

Similarly, Schon (1983) suggested that design practice promotes 'a kind of knowing inherent in intelligent action'. This further implies that design activities acquire and utilise different perceptual and memory structures compared to non-design activities. The development of such structures also contributes to the increase in design expertise. This

concurs with Lawson (2004), who described how design expertise evolves with the acquisition and development of knowledge schemata, repository of precedents, guiding principles and recognition skills. Akin (1990) also identified problem structuring as well as recognition skills and 'procedural knowledge' as key factors in influencing expert performance in design.

This chapter draws on the critical issues of problem solving, perception and memory structures, particularly where they relate to design activities. To give structure and purpose to this chapter, we maintain a line of inquiry based on the following question: how do designers deal with problematic situations with the perceptual and cognitive abilities and memory structures that they have acquired? Establishing the nature of design problems and activities, in contrast to conventional or general problem solving activities, seems to be an important step in defining the core activities of design.

2.2. Problem solving paradigms

The traditional line of inquiry into problem solving activities stipulates that a person experiences a problem when he or she 'has a goal but does not know how this goal is to be reached' (Duncker 1945)(p.1). Essentially, this became crucial to the development of the Information processing or Computational theory of problem solving. Chi and Glaser (1985) suggested that problem solving activities differ according to the nature of tasks to be undertaken and the knowledge brought in by the solver (Chi and Glaser 1985). From the perspective of the Information processing theory, problems could be either well structured or ill structured (Simon 1973).

2.2.1. Well-structured problems

Well-structured problems possess the following criteria: explicit start and goal states, a set of operators to transform these states and legal rules or constraints to work with (Chi and Glaser 1985). They range from knowledge-lean games and puzzles like the 'Tower of Hanoi' and 'Go' to knowledge-rich classroom problems like algebra, physics, mathematics, and some real world problems. For knowledge-lean activities, information that is required to solve this category of problems is at least available within the problem statement. On the other hand, knowledge-rich activities involve various cognitive structures of knowledge particularly in the conceptualisation and problem representation phase of problem solving activity.

According to Chi and Glaser (1985), problem representations like schemata crucially facilitate solution retrieval from memory. Many recent studies in expertise fall within the remit of well-structured and knowledge-rich activities like chess play (Chase and Simon 1973; De Groot 1978), medical diagnosis (Johnson, Duran et al. 1981), electronics (Egan and Schwartz 1979), and physics (Chi, Feltovich et al. 1981).

Information Processing Theory

One of the most enduring ideas behind the Information processing or Computational theory is that problem-solving activities involve the transformation between problem states. Following this theory, Newell and Simon (1972) viewed human problem solvers as symbolic information processors who search for appropriate algorithmic 'operators' in order to move from an initial problem state to a goal state. By acknowledging the limitations of human working memory, Newell and Simon (1972) proposed that problem solving activities are bounded within a 'problem space', which is theoretical space that allows for logical heuristics like means-ends analysis, forward search, backward search and generate and test to occur.

Problem solving activities occur relatively in a stable state and they interact objectively with explicit problem representations of various operating levels in the task environment. Evidently, the information processing theory looks highly suited to carrying out well-structured tasks. This is because the parameters involved in applying move 'operators' are explicit and clearly defined (Goel 1992).

2.2.2. Ill-structured problems

Many real world activities including design deal with ill-structured problems. In contrast to well-structured problems, ill-structured problems are associated with the lack of advanced definition in one or all criteria of states and functions that previously defined well-structured problems (Simon 1973). The implication for this is that the problem solver would have to redefine the parameters of a predetermined problem further by adding significant information to the problem context (Chi and Glaser 1985). Clearly, such process demands greater cognitive effort from the problem solver. This is in contrast to well-structured problem solving activities, where problem solvers only need to apply operators in transforming problem states. On this basis, it is reasonable to believe that solving ill-

structured and well-structured problems require different cognitive abilities on the part of the problem solver.

2.3. Defining the nature of design problem solving

Simon (1973) suggested that design problems are initially ill-structured problems that have become 'formalised' and well structured at the start of problem solving activities. However, it appears that design problems are more symptomatic of the designer's psychological abilities than the predetermined circumstances of a design task (Dorst 2006). The fact that there is also a learning (Hatchuel 2002) and social (Buciarelli 1994) dimensions to the design problem augments this designer-biased characterisation.

Other factors that could characterise design problems include the effects of learning from experience, use of higher order (meta-cognitive) processes in dealing with problematic situations, and adaptability to the environment. Incidentally, these factors also constitute intelligent behaviour according to Sternberg (2006). Unlike conventional problem solving, design problem solving is not constrained by the processes associated with the transformation between problem states. For design, the scope of problem solving activities is limited only to what designers can offer in terms of perceptual and cognitive abilities.

Certain comparative studies of 'prototypical' design professions such as architecture and engineering also revealed that there are significant differences between design and non-design activities. For example, Lawson (1979) found that designers apply different strategies in dealing with problematic situations from non-designers. The former tend be more solution-focussed while the latter are more problem-focussed in this respect. Many of the strategies that designers invoke during design are generic across many design disciplines (Goel and Pirolli 1992; Schraagen 1993; Ball, Evans et al. 1994).

The differences in cognitive strategies imply that designers and non-designers develop distinct cognitive abilities in their respective practices. At the same time, there appears to be a strong relationship between the nature of design problem-solving activities and specific perceptual and cognitive abilities that designers have acquired in dealing with those activities. Defining the former would be inadequate without considering the latter. What then are the crucial features in designers' perceptual and cognitive abilities?

2.4. Perceptual and Cognitive structures in problem solving activites

Perception is a complex process and involves complex structures. Nevertheless, it provides a vital 'bridge' between the external surroundings and human cognitive processes. Perceptual process itself is a continuous experience in information 'pick up' (Neisser 1976; Gibson 1986). The most basic level of perception relates to stimuli from the environment. We can call this the *basic* level perception. Based on the studies on vision, this basic perception provides 'direct' access to the crude properties of the physical world (Gibson 1986). Through this, the perceiver automatically 'sees' and registers relevant information within the environment that are 'persistent' and those that 'change' (Gibson, 1986, p.258).

In contrast, low-level and high-level perception relate to two types of knowledge structures known as *chunks* and *schemata* respectively (Gobet 1998). They represent 'learning' and retrieval mechanisms in comprehending the world (Sweller 1988; Gobet 1998; Gobet, Lane et al. 2001). They also compliment each other (Sternberg 2006). Both mechanisms are crucial in the development of skills and knowledge in any domain of activity. Since they are 'learning' and retrieval structures for human's productive actions, they serve as good indicators of expertise.

These types of perception provide important theoretical support for the study of design expertise. A series of critical discussions on the implications of chunking process and knowledge schemata would be useful for the current study. The following section relates to the chunking process as crucial learning mechanism of expertise. We discuss the nature of Knowledge Schemata in a later section on recognition.

2.4.1. The role of chunking in perceptual learning

Despite certain limitations of Information processing theory in defining the nature of design problems, we need to acknowledge one of its most important contributions to the general study of expertise, which is the *chunking* activity. Chunking involves a low-level aspect of cognition and is vital to perceptual learning (Gobet 1998). The size and configuration of a chunks depends on the meaningful relations between pieces of information it could hold together as a single unit of 'learned' knowledge structure (Gobet, Lane et al. 2001).

These chunks are also organised hierarchically such that they are able circumvent the limitation of retention in the human working memory (Miller 1956). Elements collated in a

chunk have strong affinities with one another but the relationships between chunks are weak (Simon 1974). The Chunking theory provides us with the crucial understanding as to what potentially transpires between external environment and internal cognitive processes (Miller 1956; Gobet, Lane et al. 2001).

2.4.2. Study of expertise in Chess play

Chunking theory had facilitated a significant number of dedicated studies in expertise, most notably in chess play (Chase and Simon 1973; De Groot 1978). These chess studies depended considerably on memory recall experiments as means of expounding the nature of productive thinking. Through this method, we are able to assess and compare, qualitatively and quantitatively, subjects with different levels of expertise. From those chess studies, we now know a great deal about how experts from non-experts differ in terms of quantity, organisation and application of knowledge (Sternberg 2006). According to Gobet (1998), among the reasons why chess play provides an ideal platform to study expertise are:

- It offers a rich database of games played by competitors of different skill levels which may be used to study the chess environment statistically
- It permits the study of cognitive processes both at a low level and at a high level, providing valuable data for the cognitive study of both basic processes and high level aspects of expertise
- It is a relatively 'clean' domain that is easily 'formalizable' mathematically or with computer languages

Expert chess players do not use exhaustive search for appropriate strategies in playing the game. They rely on chunking activities that 'learn' about specific chessboard positions and then reconstruct productive moves drawn from experience according to the specific demands of the game. Experts can recall larger capacity of information than the non-experts because they store 'over learned' chunks in the Long Term Memory (LTM) rather than as discrete items within the Short Term Memory (STM) (Chase and Simon 1973; Gobet 1998).

In the Short Term Memory, only 'cues' for specific chunk formations are stored as propositions that could be instigated for future actions (Chase and Simon 1973). This explains why expert chess masters are able to recall larger chunk configuration, together

with blank squares that accompany them in forming specific board positions, as well as greater number of these chunks than the less expert ones. Therefore, being an expert is more about the effective organisation of knowledge rather than having greater capacity in memory.

However, considering that such a 'search' in chess play might involve thousands of specific board positions from a player's repertoire of experience in playing chess, we can only imagine the complexity in choosing the next right move for a particular game. Ultimately, experts would have to rely on specific heuristics, tactics and strategies of knowledge so that problem-solving activities become more 'manageable' cognitively. These would involve a great deal more 'personal' knowledge and judgement on the part of the perceiver than the 'production rule' approach could offer.

2.4.3. Assessing expert performance through 'production rule'

Chase and Simon's study on the memory recall in chess play took the chunking theory beyond perceptual 'learning' by suggesting that it could further explain actual problem-solving activities (Gobet 1998). For them, chunking activity performs part of the application in 'knowing how' or procedural knowledge. A chunk could fulfil the condition side of the 'if-then' 'production rule' convention. Recognising a familiar chunk in a task would then evoke a fitting response on the action side of the same production rule.

The production rule approach is the mainstay of the Information processing theory (Newell and Simon 1972). In principle, it suggests that problems and solutions form distinct phases in the problem solving activity. Chase and Simon (1973) invoked these 'production rules' in order to chart the logical functions of chess players' perceptual processes. Through this approach, they found that experts were better at recalling meaningful arrangements of chess pieces, but were no better than novices in the recall of randomly arranged ones. They further suggested that perception involves the 'mind's eye', which is a kind of spatial operator that searches for the right moves from short and long term memory once players recognise familiar and meaningful chessboard positions. The activation of chunks that offer possible legal moves automatically follows pattern recognition. Therefore, chess experts' perceptual skills relate to the ability to undertake elaborate searches for solutions.

The 'production rule' approach was particularly successful as a scientific framework in studying well-structured problems like physics problems. Chi, Feltovich et al. (1981)

performed a study that compared experts and novices' abilities in categorising and representing physics problems. They revealed how experts categorised problems based on mechanical principles that satisfy the 'action side' of the 'if-then' production rule. This meant that experts have acquired knowledge schemata that are appropriate for solving the 'deep structures' of physics problems. In contrast, the novices' superficial descriptions of physics problems revealed an understanding that is limited only to the 'condition side' of the rule. Thus, expert physicists were able to group physics problems like those related to the conversation of energy together based on their solution mode. On the contrary, novice physicists dealt with the same problems by grouping them according to 'surface' features of the problems (Chi, Feltovich et al. 1981; Chi, Glaser et al. 1982).

Figures 2-1 and 2-2 show examples of how a novice and an expert differed substantially in representing and categorising specific physics problems, in this case pertaining to the physical and mechanical forces required to pull a block along an inclined plane (Chi, Feltovich et al. 1981). We see in Figure 2-1 a fundamental problem faced by the novice physicist. His representation of the 'inclined plane' physics problem did not involve principles of the Conversation of Energy. Consequently, the novice only managed to produce 'surface' attributes of the main problem. Without reference to an underlying set of physics principles, the novice failed to instigate an 'explicit solution procedure' in order to deal with the problem.

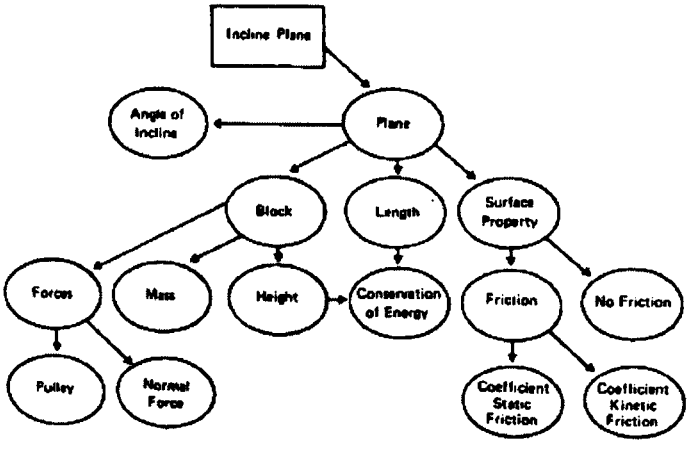

Figure 2-1 A Novice's representation of physics problem of inclined plane (Source: Chi, Feltovich et al. , 1981, p.136)

In contrast, the expert physicists' grouping and representation shown in Figure 2-2 revealed a deeper understanding of the problems in hand and the solutions required. In particular, the

expert recognised the fundamental role of Newton's laws of Force and Conservation of Energy in dealing with the 'inclined plane' problem. Once elicited, these principles generated a host of alternatives that corresponds the 'deep structures' of the problem. As observed by Chi, Feltovich et al (1981), the utility of these underlying principles was such that the expert even managed to prescribe the conditions in which these principles could be applied (dotted area). Thus, the expert's knowledge is'procedural' in nature in comparison to the novice's 'superficial' knowledge.

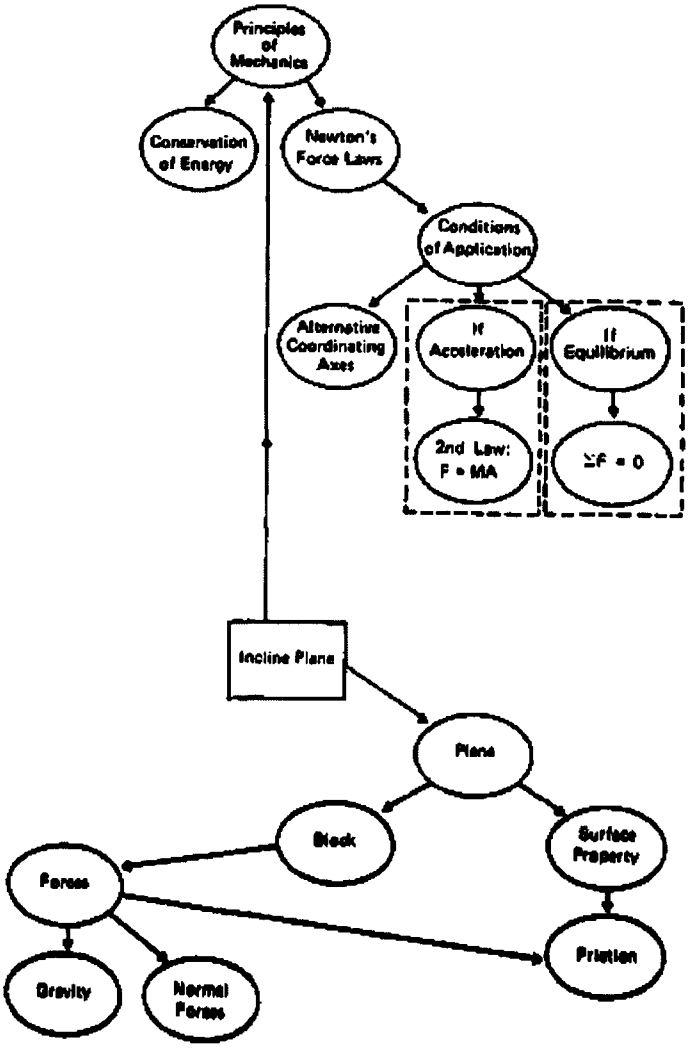

Figure 2-2 A Expert's representation of physics problem of inclined plane (Source: Chi, Feltovich et al. , 1981, p.137)

'Perceptual achievement'

In essence, the 'production rule' approach promotes a passive view of perception (Gobet 1998). For others, however, perception is a dynamic process (Bartlett 1932; De Groot 1966; Neisser 1976; Rumelhart and Norman 1985; Gobet 1998). Based on the study of chess players, De Groot (1966) linked mastery and expertise to 'perceptual achievement' instead the structure of 'operational' thinking (p.23). He also suggested that master level players are more capable of utilising specific types of knowledge or strategies of play from memory compared to less expert players.

The idea that perception is dynamic is appropriate for studying expertise in design activities. In design, parameters to problems and solutions are 'constructed' in the course of action rather than through optimised 'search' (Zimring and Craig 2001). As such, there would be limitations to the use of the 'production rule' approach as means of describing and evaluating the nature of expertise in design. From the perspective of information processing theory, it typifies 'learning' as an accumulation and articulation of 'rules'. However, such a process firmly discounts the progressive integration and reorganisation of knowledge (Kolodner 1983).

Case-based reasoning

Kolodner (1983) also suggested that expert reasoning is more concerned with 'cases' than it is with 'rules'. Because of this, evidence of rules is difficult to elicit from human activities. Therefore, if expert reasoning is primarily case-based as opposed to rule-based, then some high-level, organising mechanisms in perception and memory could account for this.

Dealing with multifarious information

One prevailing problem with the 'production rule' approach is how it deals with multifarious information that filters through into the problem space, which is common in design activities. Concerning the issue of information proliferation in design, Goldschmidt (1997) expressed that:

> what makes this phenomenon especially fascinating and at the same time difficult to model, is the fact that 'imported' information obeys no rules whatsoever; it may come from any domain, be represented in any medium and penetrate any existing information structure at any point. The designer and especially the expert designer, has some control over adding information (Goldschmidt 1997) p.442

The ability to select and add information that is required for a particular design activity reveals how designers maintain a degree of executive control over crucial aspects of the design process. We might then ask by what strategies or methods do designers then exercise such control. One of the ways to establish this is by looking at 'deviant' actions that occur from planned activities or tasks at various stages of problem solving activities (Guindon 1990; Visser 1990).

2.4.4. Deviations from 'plans' or rules

The study by Visser (1990) describes how a mechanical engineer deviated from an intended hierarchical plan of work in writing functional specifications for a machining task in a factory. This occurred as the subject attempted to interpret a familiar schematic mode in representing a problem of engineering into the formal language of software program called GRAFCET. In this process, the engineer made several modifications and added new inputs. It transpired that the engineer's actual activity did not reflect the description of the original plan of work. It also appeared that the engineer only followed the plan as long as it was 'cognitively' economical. As opportunities arose, he would deviate from the original plan.

Guindon (1990) also observed various types of modifications and deviations made by three expert software designers assigned to design a lift control system. In particular, these designers introduced constraints that reduced the level of ambiguity and incompleteness found in the original problem statement. In most cases, this led to the total revision of existing goals. The subjects also took the opportunity to work immediately on the potential solutions afforded by these constraints. This was evident in the way solution development interspersed with problem simulations in the verbal protocols.

2.5. Unique characteristics of the Design problem solving

Studies undertaken by Guindon (1990) and Visser (1990) showed that expert designers modify 'plans' according to the needs of performing tasks in the real world. However, 'opportunistic' behaviour did not only occur at the start of problem structuring, when problems are still largely unrefined, but also at the latter stages of a particular activity, when problems are deemed more resolved (Ball, Evans et al. 1994). Using basic and deterministic 'problem space' criteria of start-end states, operators, evaluation functions, and search strategies to describe 'opportunistic' action might not be appropriate in dealing with unconventional and unexpected turns of problem solving activities. It seemed

formulating the nature of problems in design activities required a more generic level of abstraction.

Accordingly, Goel (1995) advocated the idea of 'design problem space' as a unique psychological construct of the designer. This concept utilises salient features that represent generic characteristics of design rather than using the basic 'problem space' as promoted by the Information Processing theory to expound the nature of design problem. Some of the generic characteristics 'design problem solving' indicate how:

- Solutions are only deemed complete and acceptable based on personal rather than logical grounds. In addition, experience, professional standards and practice, and client expectation also contribute to the shaping the boundary of acceptable solution.

- Solving design problems is more reliant on memory retrieval and modification and non-demonstrative inferences rather than the logical deduction process. This is because design problems have only few logical constraints

- The designer can modify or change problem parameters through negotiation. Again, this indicates how personal preferences and biases play an active role in design solving problems. The designer is at liberty to 'stop and turn a round' along the trajectory of an ongoing design activity, as well as possessing substantial flexibility in modifying original problem conditions as seen fit in terms of acquired expertise and experience. In a way, we can refer this as the 'rhetorical' feature of design activities (Cross 1999).

- The designer has the choice in attending to which interconnections in the design problems. These interconnections are contingent rather than logical. The designer can also arbitrarily move on to work on another part of a problem while keeping 'hold' of existing ones, only to return to attend the latter at a later time. This 'carry over visit' suggests that problem structuring does not only occur at the outset of performing a task but also intermittently returns whenever possible (Cross 2004).

Goel's model of design problem solving appears to corroborate the reasons behind the designer's outwardly 'opportunistic' behaviour. The significant ability to make necessary

shifts or return to a unfinished task along the trajectory of continuous action is a characteristic of design (Goel 1995).

2.6. Strategies in design 'problem-solving' activities

The following issues are various 'psychological' strategies that designers and non-designers resort to in dealing with task problems. From the studies by Goel (1995), we now know that designers benefit considerably from 'personal preferences' and 'biases' in dealing with design problems.

2.6.1 Modifying constraints

What the designer provides in terms of acquired knowledge and some kind of structure to the problem situation has significant bearing on the solutions. This is necessary since the designer has to resolve a large number 'open constraints' before final solutions is obtained. 'Open constraints' are problems with unspecified parameters during a problem solving process (Reitman 1965).

In a study on 'fugue' composition[1], Reitman (1965) discovered that 'ambiguities' brought about by these 'open constraints' actually aid the discovery of solutions for the original problem. They encouraged the composer to modify the parameters of the existing constraints rather than violate them altogether. Such modified constraints further regulate other components in the main problem. This process of gradual 'particularisation' eventually leads to the closure of all open constraints.

The ability to modify the parameters of constraints is an important issue in design expertise. We now acknowledge that experienced designers also tend to restructure the problem space by altering the initial constraints more often than inexperienced designers (Akin 1990). It would also be conceivable for experts to be more successful in selecting parameters for 'closing' these open constraints than non-experts (Voss and Post 1988).

Reitman (1965) also revealed how the introduction of a general constraint at the start of the 'fugue' composition helped reduce the problem space. This came in the form of a condition that requires the 'fugue' composition to be 'pianistic' in its character. Accordingly, the

[1] Although Reitman's study on music composition is not strictly a design activity, we believe that his findings had provided an important catalyst for similar studies within design activities

meaning of the piano in terms of its use and attributes became the benchmark in formulating the problem statement.

2.6.2. Conjecturing

Similarly, Darke's interviews of practising architects showed that designers impose 'primary generators' to work their way into the problem (Darke 1979). These are essentially a small group of valued concepts or objectives by which the architects can formulate fitting conjectures for further testing. By determining the feasibility of these conjectures, the architects are then able to expound the nature of problems they are facing and then to detail further the design requirements.

The reason why designers resort to conjecturing to analyse the feasibility of solutions is likely due to the manageability of cognition. The impossibility of designers to conduct far-reaching searches for solutions coincides with the limitations of the human cognition. This is attributed to the fact that humans can only apprehend about 7 chunks at a time (Miller 1956). Such limitation with the human working memory impedes the application of the 'exhaustive' means-ends strategies as a kind of heuristic tool for problem solving (Green 1987).

2.6.3. 'Framing' design problems

From Reitman's study of the fugue composition, we see a parallel development in Schon's investigation on problem 'framing'. According to Schon (1988), the design world is a *construct* of the designer. However, it is temporal in nature for as long as a designer engages in designing. It also serves as a 'holding environment' for design knowledge and any particular qualities associated with it. The design world is also an 'achievement' for the designer, who experiences interlocking 'processes of perception, cognition and notation' along the way.

To construct such a world, designers need to 'frame' uncertain and problematic situations in a design task in order to select and attend to specific tasks in mind. According to Schon (1988), 'frames' are 'prestructurings' that designers use to construct their design worlds. They bring coherency to problematic situations and contain 'typical' references with which designers validate their conjectures in terms of potential solutions.

Schon (1988) emphasised the utility of 'type' as a scheme that captures the 'fullness' and 'richness' of a particular situation. Imposing a 'type' on a task enables the designer to see if a potential design move fits an attended situation. In doing so, 'type' could instigate a change in a particular situation as well as be affected by it (Schon 1988). In describing the action of one of the architects involved in his library design experiment, Schon observed that:

> Design behavior is shaped by his way of reading the task, which includes his way of framing his role and his relations with researcher or client (Schon, 1988, p.183)

Schon also identified the 'psychological' bias in designers' decision-making process. On this, he noted that:

> a designer's ability to apply a rule correctly depends on familiarity with an underlying type, by reference to which the designer judges whether the rule 'fits the case' and fills the inevitable gap between relatively abstract rule and the concrete context of its application (Schon, 1988, p.183)

2.6.4. Concurrent development of problems and solutions

Design is a knowledge-rich activity. However, the ways through which we acquire and utilise design knowledge appear to be different from other kinds of knowledge. One of these is the way problems and solutions evolve together in structuring and defining the design problem space until acceptable solutions emerge along the way. We are only able to establish the nature and extent of an existing problem space by working towards the solutions for the problems (Reitman 1965; Greeno 1998).

The phenomenon of concurrent development between problems and solutions is now regarded as a fundamental attribute in design thinking (Dorst and Cross 2001). Designers tend to use 'solution conjectures' in order to comprehend the nature of problems and to aid its structuring (Cross 2001). The study by Lawson (1979) on fifth year architectural and science students revealed how the former work with solution-focussed strategies while the latter opted for problem-focussed strategies in problem solving. This meant that, to a certain degree, solutions are already available at the front end of designer's problem solving activities. From this, it appears feasible for the designer to develop some kind of heuristic that initiates the process of synthesis independent of the full completion of problem analysis (Lawson 1979).

The concurrent development of problems and solutions suggests to us that designing involves non-linear reasoning (Goldschmidt and Weil 1998). Thus, moves that transpire during design are not similar to conventional moves. For conventional problems, moves are progressive operations in transforming problem states. In contrast, Goldschmidt and Weir (1998) captured succinctly the nature of design moves by describing that:

> every step is double speared; it moves forward but also makes sure that it is congruous with what has already been achieved, and it validates what has been done thus far with an eye on ways to proceed from that point (Goldschmidt and Weil, 1998, p.100)

The act of dealing with problems and solutions concurrently in dealing with problematic situations is a fundamental characteristic of design activities. What then are the qualities in the designer's perceptual and cognitive abilities that facilitate such concurrent development?

2.7. Recognition

Recognition, which is a key element in a larger context human perception, is fundamental in shaping the strategies of design activities. It denotes the ability to make 'judgements' about 'prior occurrence' of events (Mandler 1980) In particular, recognition relates to the retrieving of meaningful relationships between events or items rather than simply identifying familiar ones (Chase and Simon 1973; Mandler 1980). The ability to configure what is 'meaningful' is strongly related to the 'learning' factor in experience (Sternberg 2006). Learning is especially prevalent in chunking activities, where designers create specific knowledge structures for future retrieval in design activities.

We could relate the designer's ability to recognise meaningful elements within the task environment and the way they decompose design solutions. According to Goel and Pirolli (1992b), designers decompose design solutions into partially or sparsely connected modules based on contingent rather than logical relationships. This supports the findings in study of designers' recall of architectural drawings by Akin (1986), who suggested that the more relevant the networks of chunks are to the drawings, the more hierarchical it becomes in recalling them. We can envisage that the expert designer possesses an elaborate hierarchical system of associative chunks to fit his or her preferences in design (Akin 1986). By developing chunks that represents higher order architectural configurations, expert designers are better than non-expert designers at circumventing memory limitations (Akin 1990).

Therefore, the higher level of abstraction in terms of configuration of chunks, the greater the potential for the designer to recognise meaningful and familiar patterns emerging in design tasks. This also provides greater opportunity for the expert designer to structure design problems at the early stages of designing and reduce the amount of open constraints that hinder progress in moving forward for solutions.

2.7.1. Recognition studies in sketches

The designers' sketches are exemplary tools in supporting recognition. Studying them further reveals the nature of the designer's cognitive abilities. These sketches represent a skill that is unique to the designer, which is the ability to comprehend design problem solving through different levels of abstraction (Cross 1999). Such ability enables the designer to traverse repeatedly within the *context* of a current problem rather than the previous knowledge state (Goel and Pirolli 1992). Unlike non-design activities, this 'carry over visit' increases the processes of learning and development of knowledge. In effect, sketches aid the designer's 'executive' decision-making processes in design.

The study of sketches as 'seeing' tools by Goldschmidt (1991) provides us with a very useful example of how the designer performs effective acts of recognition at the start of design process. Goldschmidt (1991) maintained that:

> Given that an entity to be designed or that is being designed does not yet exist and therefore was never perceived, it cannot, in its entirety or its parts, be recalled or imaged in the normal sense (Goldschmidt, 1991, p.130)

It appears that a variety of stimuli-like features instigate designers into making sketches of 'partial images' in order to 'see' opportunities for moving design forward. Goldschmidt suggested that these images could be triggered by:

> recollections of existing buildings or artefacts which serve as references; they may find their origins in precedents derived from metaphors, analogous cases, or entities belonging to a similar type (Goldschmidt, 1991, p.130)

Recognition is crucial to the development of expertise. It indicates experts' ability in gaining easy access to the huge repository of knowledge in the Long Term Memory through organised retrieval structures called 'cues' (Ericsson and Kintsch 1995). These structures enable experts to organise incoming stimuli into comprehensible patterns of

information. The novice designer, who is deprived of such organising structure, often only 'remembers' piecemeal information.

Lawson (2006) regards the ability in recognising 'cues' as essential in advancing the expertise levels of designers. In particular, they are instrumental in the development of specific design 'precedence' or 'references' and 'gambits'. These are not only problem solving 'devices' but also as tools for making 'novel' discoveries and augmenting the case-based repertoires of knowledge in designers. Lawson (1997) further emphasise the deliberate role of 'recognition' in constructing new ways of perceiving problems:

> If we could understand the *forces and operations* which are responsible for *switching our attention* from one part of a problem to another or *allowing us to reorganise our perceptions in new ways*, we should be well on the way to understanding the design process" (Lawson 1997) p.138

The need for 'conscious' ability in recognition concurs with De Groot's assertion that expertise is the product of deliberately learned 'specific mode of perception' (De Groot 1978). Such ability will be crucial in the acquisition of design expertise (Lawson and Dorst 2005).

2.7.2. Perception and schematic knowledge

A key influence on expert performance is the high-level perceptual mechanisms called 'schemata' (Bartlett 1932; Neisser 1976). These schemata are dynamic and constructive in character. They differ significantly from the passive and symbolic features of perception promoted by Chase and Simon's 'production rule' through the chunking theory. During perception, schemata facilitate the perceiver to recognise or remember familiar features at the sensory level and to reconstruct existing experience in light of a new setting (Bartlett 1932). Integrating new information then causes differentiation and modification to these schemata (Neisser 1976).

We could say that the schemata function as 'building blocks' for organising personal experience. Otherwise, experience would be an overwhelming phenomenon. In contrast, the 'production rule' approach deal only with problem transformations of given tasks. Therefore, the extent of knowledge utilised is constitutive of the task.

According to De Groot (1978), active perception actually involves 'abstractive' or differentiating skills in cognition. Such skills relate to our ability in applying general

heuristics in problem solving activities. These skills are also in line with the gestalt approach that discloses specific elements from the whole object as foreground elements while allowing others to withdraw to the background (De Groot 1978). This would mean making decisions based only on partial knowledge and with a certain degree of subjectivity in order to move forward design propositions. Both accounts would be unthinkable according to the Information processing theory. De Groot further clarifies that:

> decisions are based on necessarily incomplete evidence. Nearly every argumentation is incomplete: it does not generally provide certainties, but at best a high likelihood that the choice is a good one - or the best possible. There is room for 'intuitive completion'; in fact, there is a strong need for this method to enable the subject to build up the subjectivity he requires for actual decisions (De Groot, 1978, p.337)

Neisser (1976) further argued that perception is more about 'differentiating' than being 'enriched' with information from the environment. It involves the development of 'anticipatory' schemata that guide the perceiver to 'pick up' salient and higher-order features in the task environment in a deliberate manner. In the process, these schemata undergo transformation mediated by the information obtained earlier. With the modified schemata, the perceiver then look further for more information in the perceptual field. What then transpires is a continuous cycle of refinement to the processes of schematic transformation and information 'pick up'. Gradually, this would allow the perceiver to modify his or her reasoning schemata to the highest level of abstraction. Correspondingly, experts are able to perceive and represent task problems at a deeper, semantic and more principled level than novices who are syntactically or surface-feature oriented (Chi, Feltovich et al. 1981).

Neisser's cyclic development of the schemata suggests that perception is a complementary and veridical activity. However, there is also a paradoxical dimension to these processes, particularly regarding the 'anticipatory' nature of perception. To this, Neisser (1976) emphasised that:

> We cannot perceive unless we anticipate, but we must not see only what we anticipate (Neisser, 1976, p.43)

2.7.3. Schemata as global control structures in perception

Through the information 'pick up' cycle, experts eventually exercise a certain degree of deliberate control over the construction of 'anticipations' and activity of 'looking' (Neisser

1976). By exercising control over the core processes in perception, it is appropriate to view schematic development as an 'intelligent' skill. This in accordance to Sternberg's (2006) who defined intelligence as:

> the capacity to learn from experience, using metacognitive processes to enhance learning, and the ability to adapt to the surrounding environment (Sternberg, 2006, p.486)

Prolonged experience in domain-specific problem solving activities enhances such schematic development. It inculcates a certain degree of flexibility in the experts' ability in handling problematic situations. We have evidence where experts use more abstract knowledge and strategies acquired from domain-specific experience to solve novel problems in unfamiliar domains of knowledge (Schraagen 1993). Because of the high level of schematic abstraction, experts are able to retain the form of reasoning across domains of knowledge. However, the content or substance of this reasoning would be different (Schraagen 1993).

Through high-level schematic abstractions, experts exert a more global approach to dealing with problems in both familiar and unfamiliar domains of knowledge compared to non-experts (Schraagen 1993). This attribute is also referred to as 'generic' (Goel and Pirolli 1992), 'prototypical' (Rosch 1978), or 'paradigmatic' (Schraagen 1993). Thus, possessing high-level, schematic knowledge is a key feature of expertise (Chi, Feltovich et al. 1981).

2.8. The episodic and experiential nature of design knowledge

In terms of memory and cognition, design processes differ greatly from non-design activities. Much of this distinction is attributed to the leading role of episodic memory, which is a conduit for knowledge acquisition through experience, as well as semantic and perceptual memory systems, three components that interact to make up the human memory system (Tulving 2001). The fact that the designer is selective in perceiving 'contingent' behaviours reflects significantly on the role of episodic memory than that of semantic memory. Episodic memory enables the recollection of specific learning experience of past events (Tulving 1983; Baddeley 2001). Tulving (2001) succinctly puts it that:

> episodic memory has to do with one's 'autonoetic' awareness of one's experiences in the continuity of subjectively apprehended time that extends both backward into the past in the form of 'remembering' and forward into the future, in the form of 'thinking about' or imagining or 'planning for' the future (Tulving, 2001, p.1506)

Episodic memory is 'experiential' in nature. Although it utilises the ability of our senses to apprehend perceptible properties of the stimuli in the past, recollecting it also propels thinking and conjecturing about future events. In contrast, semantic memory is 'knowing the world' without any conscious recollection of events. It uses symbolic forms often found in natural language rather than dealing with sensorial properties as 'episodic' memory does (Tulving 1983).

Episodic memory aids the reconstruction of experience in order to contemplate a current action. Bartlett (1932) suggested that such reconstruction converges around schemas rather than on the specifics of experience. His experiments on remembering revealed how subjects who attempted to reproduce an unfamiliar folk story called 'War of the Ghosts' actually provided an embellished, rationalised, lost important features, account in accordance to their expectations. Bartlett (1932) suggested that:

> Remembering is not the re-excitation of innumerable fixed, lifeless and fragmentary traces. It is an imaginative reconstruction, or construction, built out of the relation of our attitude towards a whole active mass of organised past reactions or experience, and to a little outstanding detail which commonly appears in image or in language form. It is thus hardly ever really exact, even in the most rudimentary cases of rote recapitulation, and it is not at all important that it should be so (Bartlett, 1932, p.213)

Designers rely more on episodic knowledge than semantic knowledge (Lawson 2003). 'Episodic knowledge' is particularly useful in that designers could use it once they recognise features in current design activities as similar to particular experiences or precedent knowledge stored in memory (Visser 1995). Precedent knowledge is essentially a type of 'experiential' knowledge. In the context of architectural design, precedent knowledge is one of the most vital sources for the designer. It points to the fact that designers utilise a kind of knowledge structure that encodes design information as gathering of events instead of as discreet collections of objects, artefacts, images etc. Tulving (1972) also commented that:

> Each experienced event always occur at a particular spatial location and in particular temporal location relation to other events that have already occurred, events occurring simultaneously with it, or events that have not yet occurred. To ask a person about some item in episodic memory means to ask him when did event E happen, or what events happened at time T. Retrieval of information of this kind from episodic memory is successful if the person can describe the perceptible properties of the event in question and more or less accurately specify its temporal relations to other events (Tulving, 1972, p.388)

We could clearly observe the influence of 'episodic knowledge' in an experiment Schon (1988) had conducted with seven architects. These architects were asked to configure a new entrance for an existing library based on six predetermined locations around the library's 'footprint'. They were also required to redesign the internal part of the library to fit in with the proposed entrance and then report their judgement in the form of design guidelines. From these exercises, Schon found that there were designers who utilised the same rules in configuring the building but arrive to different decisions, as there were those who used different rules but were led sometimes to similar decisions and sometimes to different ones. Such findings are a lucid example of the dynamic and temporal nature episodic knowledge.

Episodic memory encodes information with experience (Kolodner 1983). In the case of Schon's library configuration exercise, we could argue that while certain architects might have turned to the same rules or propositions regarding their proposals, the mediating effects of personal and circumstantial experience had resulted in these architects arriving at different judgments.

2.9. Summary

1. In this chapter, we identified some of the core operations in design by examining and comparing previous literature and research in design and non-design activities. The purpose for this is to set down key factors that could serve as evaluative criteria for our current study in design expertise. From the investigation, we were able to establish a link between the inherent nature of design problems and specific perceptual and cognitive features designers possess in dealing with those problems. These features seemed to implicate specialised knowledge and memory structures, the role of experience, and strategies and heuristics that designers have acquired in practice.

2. Design problem solving activities are dissimilar to conventional or traditional problem solving activities in many aspects. The former is often regarded as ill-structured problems and the latter, well-structured problems. Our study suggests that the differences between the types of problems are not only about the nature of tasks involved but more importantly, they relate to how problem solvers perceive and deal with them. For designers, this issue reveals a very interesting finding:

designers' psychological position is profoundly influential in generating the scope of the problem in hand.

3. For design activities, problem structuring does not only occurs at the start of solving problems but is also concurrent with the development of solutions. This issue was the focus many findings in early studies we regard as closely linked to the Information processing theory such as those produced in Chess studies (De Groot 1978) and musical composition (Reitman 1965). Recent studies by Darke (1979), Lawson (1979), Schon (1988), Goel and Pirolli (1992) and Dorst and Cross (2001) showed how such issue is directly related to design practice.

4. One prevailing issue in this chapter is the close association between perception and knowledge use and acquisition. We have identified 'learning' and retrieval structures such as knowledge chunks and schemata as crucial to problem solving activities. Chunking is a mechanism that encodes relevant information within the limitations of human memory; and schemata facilitates relevant actions by matching the organised structure of reaction of previous experience with similar features that exist in the current task environment. We suggested that experts and non-experts could differ substantially on this matter.

5. Designers actively use 'constructive' perception during problem solving activities. Unlike non-designers, designers' constructive perception determines the extent of design problem solving activities. It is the 'perceptual achievement' of the designer. The reason for this behaviour is that the designer's schemata are active mechanisms that could advance problem-solving activities even with partial 'evidence' in hand.

6. We also allude to the role of episodic memory in facilitating design cognition. It is with episodic structure that designers are able to elicit the 'experiential' aspect of information encoded and stored in memory.

CHAPTER 3
Design conversations as situated cognition

3.1. Introduction

Characterising design as a distinct form of human intelligence has led researchers to study specific issues that might define its activities. Many of these issues concern how designers learn, think, act, interact, instruct, and communicate. Basic understanding of these issues then provides valuable support for the study of design expertise. In the previous chapter, we established important factors that shape the parameter for assessing design expertise: design problem solving activities and designer's cognitive abilities that support these activities.

As such, design activities could appropriately be described as psychological and social 'constructions' rather than symptomatic of logical problem 'transformations'. Such description, however, assumes certain challenges in terms of acquiring and examining necessary information about design activities and therefore, the nature of design expertise. We could sum this up in a simple aphorism: design data are ingrained in 'specifics' and 'situations'. Design is 'specific' because its cognitive and perceptual activities hinges on the utilisation of temporal knowledge structures and episodic memory. Design is a 'construct' that is realised in 'action'. Based on these factors, it would be more appropriate to study the situations that give rise to design activities.

Studying design at the point of design interaction then holds the key to understanding the nature of design expertise. This is the aim of the current chapter. Furthermore, we also define this study by referring to the specific context of studio design tutorials. How could 'situations' like design tutorials provide us with the necessary information about design expertise? What are the inherent factors in design tutorials that make them tangible subjects for evaluation in expertise?

3.2. Design conversations as kind of 'performance'

Over the years, many expertise studies had evolved through the framework of 'competency' rather than 'performance'. Adopting the terms used by (Mandler 1985), 'competency' relates to the structure of a system that entails a particular ability, task, skill, or language. In contrast, 'performance' is the realisation of this structure in human cognition and behaviour. The 'competency' approach is evident in memory recall and representation studies in chess skills (Chase and Simon 1973a) and classroom physics (Chi, Feltovich et al. 1981). These studies employed the language of 'production rule' to elicit material differences in learning and perceptual strategies between subjects.

Alternatively, the 'performance' approach is evident in simulated activities like writing specification for machining operations (Visser 1990) and software design for lift control system (Guindon 1990a). An emerging area of 'performance' study is the investigation of design as 'situated' action (Buciarelli 1994; Greeno 1998; Suwa, Gero et al. 2000)

We regard studio design tutorials as a kind of 'performance' that is revealed through tutor-student conversations. In this study, 'conversation' does not reflect the language point of view. Rather, our interest lies in the cognitive and perceptual dimensions of design 'conversation' and how they shape design problem-solving activities. This also concurs with the notion of perception as a 'stream' of cognitive activities (James 1890; Gibson 1986). This provides the opportunity for discovering what expert (tutor) and novice (student) designers are capable of doing when exposed to activities that are 'conversational' in nature.

3.2.1. Design 'conversations' as situations

The logical language of information-processing theory is not sufficient in describing the nature of design 'conversations'. This is because, through its promotion of the 'production rule', the information-processing theory implies a one-to-one correspondence between the designer's symbolic representation of the world and his or her real world actions. Symbolic representations tend to underestimate the mediating effects of experience, and overlook the cognitive and psychological limitations and capabilities of human designers. Dreyfus (1992) succinctly described the relationship between 'rules' and performance:

> although science requires that the skilled performance be described according to rules, the rules need in no way be involved in producing the performance (Dreyfus 1992)

Therefore, it is imperative to view design through the language of 'doing' or 'performing'. It needs to reflect the 'situation' where 'what people perceive, how they conceive their activity, and what they physically do develop together' (Clancey 1997) p.1. Bartlett also alluded to the 'situated' characteristic of human perception, which he likened to playing a skilled game of tennis or cricket:

> It is with remembering as it is with the stroke in a skilled game. We may fancy that we are repeating a series of movements learned a long time before from a text-book or from a teacher. But motion study shows that in fact we build up the stroke of postures and the momentary needs of the game. Everytime we make it, it has its own characteristics (Bartlett 1932)

Design 'conversations' play a significant role in revealing and mediating design problem solving activities. From the previous chapter, we concur that design problem solving is not akin to traditional problem solving. One of the fundamental differences here is that in design, problem-solving activities co-evolve to develop a stable pairing of problems and solutions (Dorst and Cross 2001). Central to this process are dialectical activities that designers gradually carry out in order to arbitrate the conflicting perception of problems and solutions. Three important studies that sustain this line of inquiry are Schon's 'generative metaphor' model for dealing with social problems (1993), Clancey's cognitive studies on situated actions (1997), and Dorst and Cross's formulation of design 'co-evolution' (2001).

3.2.2. Generative metaphor

According to Schon (1993), being aware of the 'generative metaphor' is a key to dealing with conflicting 'frames' in problematic situations. By this, we might already be dealing with tacit and persistent generative metaphors that have brought about conflicting 'framing' of problems in current activities (Scion, 1993, p.139). To remedy such conflicts, Schon suggested that 'frames' could also be restructured and coordinated by generating new metaphors that foster new ways of 'seeing' problematic situations and concurrently provide solutions to them. He substantiated this by citing an example in product research and development where the task was to improve the performance of a new synthetic paintbrush. This triggered the paradigmatic 'restructuring' of problematic situations, by way of 'framing' the paintbrush through the metaphor of the 'pump' (Schon 1993).

It had emerged that such 'framing' occurred while researchers were 'immersed' in the sensory experience of evaluating the various kinds of brushes (p.142). Following this, 'problematic' paintbrush functions were identified, regrouped and reclassified, resulting in spaces between bristles being seen as 'channels'. A critical association became apparent between the perceived channel-like elements and typical pump action. Such recategorisation of functions further led to the development of other cleaning apparatus under the new category of 'pumpoids' (Schon 1993). The whole generative processes of 'framing' and 'recategorisation' here could be described as incremental development within a specific area inquiry (Clancey 1997).

The generation of 'paintbrush as pump' metaphor constitutes a 'dialectical' readjustment between previous and new experiences, a kind of back-and-forth mapping of experience and restructuring of concepts in terms of generic functions and features between related artefacts. On this matter, Schon clearly remarked that:

> New descriptions of problems tend not to spring from the solutions of the problem earlier set, but to evolve independently as new features of situations come into prominence. (Schon 1993)

Schon's concepts of 'naming' and 'framing' serve as a prescription for future transformation (Schon, 1993, p.147). In the example of 'paintbrush as a pump', this transformation relates to the process where the initial recognition, through concrete, sensory experiences, of generic features and relations between two seemingly disparate phenomenon (paintbrush and pump) led to the new 'coordination' in the search for an appropriate solution (p.159).

It must be noted that Schon's notion of transformation or coordination differ significantly from Newell and Simon's (1972) 'production rule' proposition, which was utilised to describe the nature of chess expertise by Chase and Simon (1973) (discussed in previous chapter). The fundamental difference here is that the former emphasised incremental development and 'dialectical' interactions between new 'ways of seeing' both problems and solutions, while in the latter, transformation occurs largely out of well-defined and logical move transformations. Schon's 'framing' activities tap into the information-rich features from the task and experience. This is in contrast to the 'operational' aims of the 'production rule' approach in the Information Processing theory.

3.2.3. Perception and Conceptual 'Coupling'

Clancey (1997), in his intuitive discussion on the situated nature of human cognition, expanded further Schon's ideas of the 'generative metaphor'. In Schon's generation of 'paintbrush as pump' metaphor, Clancey observed the 'dialectical' or 'mutually defining' feature of the following activities:

- New attributes for the paintbrush did not materialise through matching previous descriptions. Instead, they emanated from concrete perceptual experiences that were re-categorised in the process of inventing the pump metaphor.
- New attributes of the 'pump' were visualised only after this metaphor came into being. Subsequently, this led to the re-conceptualisation of the 'pump' in the context of the paintbrush.

Clancey (1997) regarded Schon's 'paintbrush as pump' metaphor as a 'coupled perceptual-conceptual process'. This involves the re-coordination of 'seeing, doing and talking', in order 'that process of painting is like the process of pumping' (p.211). There was mutual transformation in the perception and previous description or conceptualisation of the paintbrush and pump (Clancey 1997). In these circumstances, perception involved concrete, sensory appreciation of current (painting bristles) and previous (pump action) experiences. These experiences subsequently triggered a conceptual re-coordination process between 'instance' (paintbrush) and 'type' (pump) (p.238). Thus, while painting is re-conceived within the context of pump (bristles as channels), the pump was also comprehended differently than previously intended.

The link between perception and concept grows incrementally through the process of 'inquiry' (Dewey 1938). The experiential factors in human perception provide the rationale behind such link. In the acts of perceiving, one is bound to recognise elements of similarity in a particular emerging situation. Almost immediately, it begs a reflection on the following question: similar to what? Evidently, such question alludes to the concept of relationships. Clancey (1997) further described that:

> Knowing that a similarity exists (a paintbrush is like a pump) precedes and forms the basis for describing what that similarity is (the spaces bristles are channels). Seeing-as and knowing that you are seeing-as precede the interactive process of descriptive theorizing. You conceive relationships before you can articulate a model. But the effect goes the other way over time: Describing

> relationships is a coordinated way of creating new conceptions (you cannot speak without conceiving unless you want to mimic one of today's robots). (Clancey, 1997, p.209)

Clancey's (1997) notion of 'coupling' refers to a firm link between perception and conceptualising or describing about relationships (e.g. between paintbrush and pump). It also deals with perception and conceptualisation of relationships as *parallel experiences* rather than *given* facts. These perceptual and conceptual experiences fits nicely into Schon's reflection-in-action (seeing-as) and reflection-on-action (knowing-that) modes respectively (Clancey 1997). Theoretically, conceptual experience could inform us on the state of perceptual experience during the process of an 'inquiry'. In this situation, the coupling process becomes 'dialectical' in character, where 'each aspect is the developmental context for the other' (Clancey 1997).

Schon's 'paintbrush-pump' metaphor development revealed that the research team experienced a state of flux in early phase of design problem solving. It was only after the process of perception (recognition of similarity) and their reflection on the conceptualisation of relationships (acknowledgement of discordance between concepts) achieved congruency, that stability eventually became apparent in the research team's design activities. This sense of stability emerged in the tacit dimension of designing. Using Schon's reflective expressions, this meant that the design team could 'reflect-in-action' *in* what they were perceiving and 'reflect-on-action' *about* what they regard in terms of the relationships between 'instance' (paintbrush) and 'type' (pump), but yet did not possess a descriptive model of them. Clancey (1997) described such situation:

> Indeed the painters' experience indicates that the previously articulated features of these objects are incommensurate at first; all they have is a sense of similarity (in the seeing) and a sense of discord (in the saying). The new way of seeing and the tentative way of talking arose together, but the painters don't yet have a descriptive model to explain this relation. (Clancey, 1997, p.209)

3.2.4. Co-evolution of problems and solutions

Dorst and Cross's (2001) research into the 'co-evolutionary' nature of designing shares a similar line of reasoning as those in Schon's generative metaphor and Clancey's 'perceptual-conceptual coupling' models. In particular, these studies acknowledge the dialectical nature of design in 'mutually defining' the parameters of problem formulation and solution discovery. In the study by Dorst and Cross (2001), the designer's perceptual (discovery and recognition) and cognitive (analysis, synthesis and evaluation) abilities play

a key role in the parallel developments of partially redefined problems and acquired solutions. These interactions involve the search between the problem space and solution space. Maher (2000) described the 'co-evolution' model as:

> the process in nature in which two or more species interact so intimately that their evolutionary fitness depends upon each other. (Maher 2000)

Dorst and Cross (2001) studied the nature of creativity in designing a litter disposal system for a new train carriage in the Netherlands. In particular, their observations described how all nine designers involved in the experiment had worked on the prevalent idea that newpapers should be kept separately. Based on Maher's model of 'co-evolutionary' design (Maher, Poon et al. 1996; Maher 2000; Maher and Tang 2003), Dorst and Cross tracked the progress of a series of 'creative' newspaper disposal systems that held on to this prevalent idea. Each disposal system could be traced from its development from a coherent chunk of information upon which a core solution idea was consequently formulated. This partial but core solution then modified the designer's perception of the problem. The redefined problems were then evaluated against preceding part-solutions. The development and refinement of partial solutions ensued further amid the constant iteration of analysis, sythesis and evaluation. Figure 3-1 below illustrates the Dorst and Cross's (2001) 'co-evolution' model.

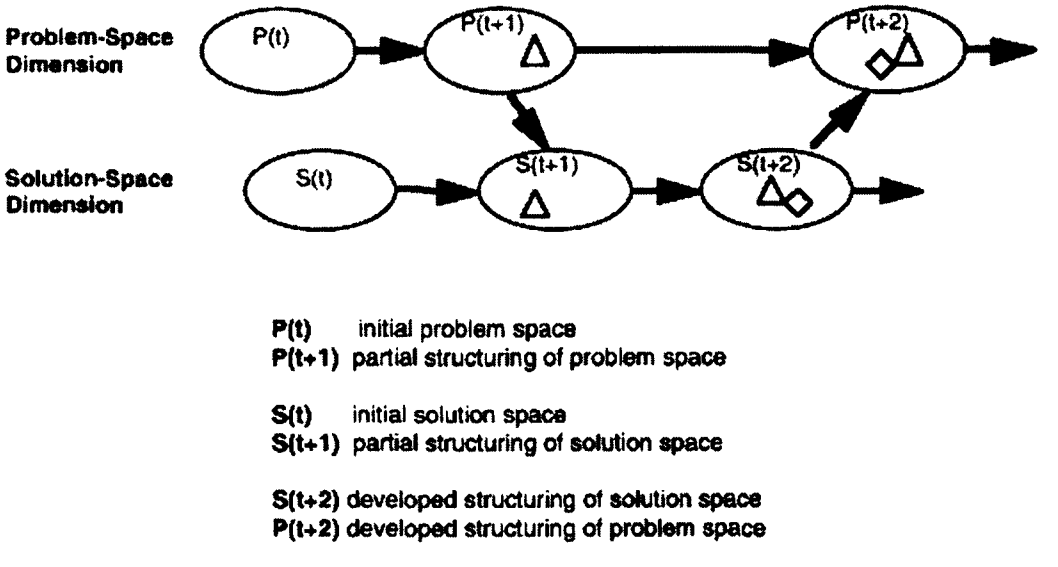

Figure 3-1 Co-Evolution Model of Design (Source: Dorst and Cross, 2001, p.435)

Apparently, a 'default project' was working tacitly in the minds of these expert designers in directing their inquiry on relevant clusters of information within the problem space (Dorst and Cross 2001). By asking specific questions about this information, the designers were then able to compare the answers with their set expectations. In the process, they manage to conjure an overall 'frame' of the problematic task, and detect 'surprises' that emerge along the way. These elements of 'surprise' form a coherent chunk. For the designers, recognition of such chunk reflects the successful comprehension of the core problem. There is now a kind of 'bridge' between problem and solution spaces.

3.2.5. Surprises and breakdowns during design conversation

According to Clancey (1997), the instability that occurs during the early phase of dialectical development between problems and solutions could be due to a 'breakdown in prior coordinations of seeing and doing' (p.211). In other words, while there is recognition of similarities in perceptual terms, there is also discordance in the way concepts are related or coordinated between the 'instance' (e.g. paintbrush) and 'type' (e.g. pump) involved in this perceptual process. To remedy the 'breakdown', the designer undertakes further seeing and coordination until there is an appropriate fit between perceived and anticipated concepts. Thus, 'framing' continuously occurs until there exists a stable phase where seeing and doing corresponds with each other.

Schon (1993) used the term 'frame restructuring' and 'frame coordination' to depict exactly the same phenomena of perceiving (seeing, recognising) and coordinating between conceptualisation of relationships (doing) respectively. Clancey's (1997) idea that there needs to be a recurring process that mediates the discordance between 'instance' and 'type' supports Schon's (1983) idea that designers rely primarily on the repertoire-building process of 'inquiry'. In the latter idea, cases and precedents (Schon 1983) inform the designer's reflective activities.

Generally, 'breakdown' marks an end to routine or automatic actions commonly associated with tacit action, and a shift towards re-coordinating the situation by explicit reference to the course of action often embodied in 'plans' or programmes. These 'plans' or programmes are nothing more than just a type of resource (Suchman 1987) that designers could use for triggering the next cycle of 'frame' related actions. Rather than providing solution to a particular problem, it only serves as a restatement of that problem (Suchman,

1987, p.47). Similarly, Schon (1983) described breakdowns as 'surprises' that could both be the result of and a contribution to reflective practices (p.328).

3.3. Role of Frames in 'Conversations'

Design is a unique process of 'inquiry' that develops, generically, through 'repertoire-building' activities rather than depending on the validation of established theories (Schon 1983). This process involves the designer's frame activities and a repertoire of examples and cases that might inform such activities. Schon (1983) provided the justification for such practice:

> When practice situations do not fit available theories of action, models of phenomena, or techniques of control, they may nevertheless be seen as familiar situations, cases, or precedents. Repertoire-building research serves the function of accumulating and describing such exemplars in ways useful reflection-in-action, and it varies from profession to profession (Schon, 1983, p.315)

The focal point of 'reflective' practices is the 'frame' process. According to Schon (1983), the designer's 'frames' reflect strategies used in identifying and attending to specific 'problematic' situations. These frames facilitate possible move actions in order to remedy such situations. The designer then reflects on the name-frame-move cycle and re-frames the situation in a bid to draw a conclusion to the attended problematic situation. Schon (1988) described that:

> In order to formulate a design problem to be solved, the designer must frame a problematic design situation: set its boundaries, select particular things and relations for attention, and impose on the situation a coherence that guides subsequent moves. Moreover, the work of framing is seldom done in one burst at the beginning of a design process. Designing triggers awareness of a new criteria for design: problem solving triggers problem setting. (Schon, 1988, p.182)

The 'appreciative' system that revolves around these 'frame' activities encourages novel discoveries (Schon 1992) and facilitates the constructive learning in designers (Pereira 2000). Schon explained that:

> In this reflective conversation, the practitioner's effort to solve the reframed problem yields new discoveries which call for new reflection-in-action. The process spirals through stages of appreciation, action, and reappreciation. The unique and uncertain situation comes to be understand through the attempt to change it, and changed through the attempt to understand it (Schon, 1983, p.32)

However, it is not easy to apply Schon's 'frame' ideas in design 'conversations'. Others suggested that this could be because of the lack of clear definition in Schon's concept of 'frame' (Dorst 2003; Valkenburg 2003). Valkenberg (2003) suggested that Schon's 'framing' occurrences in tutorial design 'conversations' actually typifies 'reflection-on-action' rather than the 'reflection-in-action' process. 'Framing' here is more about a reflection on the 'problem structuring' process that occur at the start of design problem solving.

'Frame' activity forms the basis of the designer's appreciative system (Schon 1992). Dorst and Dijkhuis (1995) contended that such system does not require the designer to evaluate concepts as such in the course of designing. Instead, it is more concerned with the designer evaluating his or her problem structuring and solution generation activities (Dorst and Dijkhuis 1995). Following previously discussed issues in Schon (1993) and Clancey (1997), we might add that such appreciative system could also actively mediate the discordance in conceptual relationships between instances and types or exemplars. Furthermore, this inclusion would be more in keeping with Schon's repertoire-building process of 'inquiry'.

Valkenburg and Dorst (1998) undertook a more rigorous formulation of the 'frame' concept and successfully tested its dependability in *describing* the reflective activities of teams of robot designers. Their approach was to concentrate on 'frame' building and development that occurs through 'reflective' team activities. In this context, 'frames' were differentiated on whether they were related to task problem or solutions (Valkenburg and Dorst 1998). The way different teams utilise 'frames' eventually reveal specific formulation of strategies in dealing with the original task. This investigation also identified the need to develop a prescriptive method for analysing 'frames', particularly in providing a general picture of designers' reflective activities.

Schon (1983) had explored at least three situations where designers experience 'reflective-in-action' and undertake 'reflective-on-action' activities. In the first situation, designers with different levels of expertise like tutors and students participate interactively in architectural design tutorial sessions (Schon 1983). In the second situation, independent designers engage in a 'conversation' with materials available in design situations (Schon 1992). In the third situation, a team of designers collaborate to design a specific industrial product (Schon 1993). The current thesis replicates the first type of observation, but with

different aims, context, details, scale and level of complexity than Schon's undertakings. Further details on this are in the following chapter.

3.3.1. 'Frame' as 'formulating' action

In the current chapter, we expound further key issues concerning design core 'operations', a topic previously outlined in Chapter 2, in relation to the *experiential* dimension of design activities. We made two observations in terms of the nature of design. Firstly, design problem solving is essentially a 'dialectical' process that gradually finds a stable correspondence between formulating problems and generating solutions. Secondly, such process only becomes evident as design develops in 'conversation' with specific situations, thus revealing design as a 'situated' activity.

At least two events define design as a kind of situated 'conversation': 'frame' actions and 'breakdowns'. As far as these issues are concerned, studies undertaken by the likes of Schon (1993), Clancey (1997) and Dorst and Cross (2001) provide an initial framework for setting up a 'situated' study of design expertise. Clarity on these issues would be essential before such study could be undertaken.

Defining 'frame' actions', in particular, is not an easy task. In particular, there is still a debate as to what constitutes Schon's 'frame' activity (Valkenburg 2003). Lawson (2006) suggested that it might be useful to regard 'frame' together with 'naming' or 'identifying' as part of the constellation of activities that designers generally undertake when 'formulating' problematic situations. The term 'formulating' then avoids the complexities that accompany any attempt to define and elaborate Schon's archetypal 'frame' activity.

3.3.2. Framing as a function of visual perception and imagery

A critical way in examining Schon's 'frame' action is to corroborate it with relevant studies in visual cognition. The fact that Schon had referred to visual perception as a 'seeing-as' activity (Schon 1993) makes such effort even more important. For a start, there is a need to distinguish human visual processing that occurs between perception and in particular, imagery. This was something that Schon did not clearly express in his description of the 'frame' theory, and indeed the whole idea of 'reflective' practice.

According to Kosslyn (1999), visual perception arises as 'one registers properties of stimuli that are being apprehended at the time'. In contrast, visual imagery occurs 'when one is not

looking at a stimulus, but rather recalls perceptual information from memory or retains previous perceptual input' (Kosslyn 1999). While there is clear definition between visual perception and imagery, the relationship between them is more complex due to the fact that they share certain mechanisms of visual processing (Kosslyn 1994). It would be easier to comprehend the complex nature of vision if we look at the following key design activities in terms of corresponding visual processing activities:

- Design actions emanate from the designer's explicit ability to recognise or 'see' specific elements or opportunities they encounter in design. This action utilises 'local' vision: visual perception

- Designers have to deal with the 'ill-structured' nature of problematic design situations. They confront such situations through a parallel effort of restructuring the problems and generating appropriate solutions. Such concurrent action generally occurs as part of a purposeful framing activity. It exploits heavily on the 'doing' or 'thinking' dimension of vision (visual thinking or cognition) in dealing with imagery rather than basic stimuli. In order to 'see' further possibilities afforded by the framing activity, designers also depend on similar perceptual functions as those used for 'local' action. This kind of visual perception acts 'globally' on mental imagery rather than on real object.

From the above description, it is clear that there is an inextricable link between key design and visual activities. Concerning the latter, both perception and imagery involve low and high levels of visual processing (Kosslyn 1995; Oxman 2002). According to Oxman (2002), low-level visual processing concerns 'what the object is' instead of 'what the object is about'. In contrast, high-level processing involves 'knowing about the object' (p.146). However, this low and high level division does not reflect a 'computational' order in visual processing (Subirana-Vilanova 1993). Therefore, it is non-hierarchical (Kosslyn 1995; Oxman 2002). In fact, high and low level visual processing mechanisms complement each other in both visual perception and imagery.

Visual perception is 'local' vision (Subirana-Vilanova 1993). There can be low-level perception occurring at stimuli level and high-level perception during imagery. In the latter, retained or recalled images are 'seen' as though they possess stimuli-based properties; hence, visual imagery uses perceptual-like processing. During imagery, high-level mechanisms of cognition are primarily responsible for processing stored information.

However, these mechanisms are also crucial for perception (Kosslyn 1994). Therefore, perception and imagery share certain visual processing mechanisms. This then follows our understanding that 'picture and description are so hopelessly intertwined in imagery' (Goldschmidt, 1994, p.166). Kosslyn (1999) outlined four abilities in imagery, some of which implicate the integrative mechanisms between visual imagery and perception-like actions. They are:

Image generation

This occurs by either activating a previous perceptual input or eliciting stored images from long-term memory. The way the brain deals with this is quite complex.

Image inspection

Images undergo inspection and scrutiny like real objects do during perception. 'Looking' in imagery shares same processing mechanism and many brain functions as in actual perception.

Image maintenance

Since images fade quickly, they have to rely on the effort of perceptual-like features like chunking in order to retain patterns and information as sustainable remembered groupings.

Image transformation

This relates to the ability to modify, rotate, expand or reduce the size of patterns of imaged objects. Even though mental images are not physical objects, at least one part of the transformation mechanism in imagery replicates the perception-like process of orientating along a trajectory of change. It is useful in navigating and tracking.

3.4. Emergent situations

The best way in seeing how these shared mechanisms between visual perception and imagery work is to look into the phenomenon of visual 'emergence' that designers often encounter in design activities. The meaning of 'emergence' by Soufi and Edmonds (1996) reflected considerably on the dialectical and situated nature of design activities. In their study on emergent shapes (Soufi and Edmonds 1996), it was considered that:

> Emergent shapes in design are not only the result of perception constructing a model of the world but also a consequence of transforming the world. This view of emergence is necessary if we are to account for certain emergent

> shapes that do not exist in the model of the world as represented by the original stimulus pattern (Soufi and Edmonds, 1996, p.453)

3.4.1. Emergent forms

It follows that defining 'emergence' within the dialectical and situated boundary of design could provide the answer to a paradoxical question: if we are dealing with entities that do not yet exist and are not represented by the world at the point of perception, how could we then conceive 'emergent' forms? The clue to this then lies in the complementary mechanisms of perception and imagery as previously described. Oxman (2002) proposed how these mechanisms might work in leading towards new discoveries in the design process; that is through 'syntactical emergence', 'semantic emergence', and 'cognitive emergence'.

Syntactical emergence

This relates only to the perception of primordial shapes and forms, their properties (e.g. depth, edges and motions), and transformations that occur gradually in the process of emergence. Any sub-shape detected would be a derivative of these basic shapes and forms. We can further regard 'syntactical emergence' as a function of low-level visual processing (Kosslyn 1994).

Semantic emergence

This type of emergence deals with symbolic systems and their interpretation as well as reinterpretations during design. It would be evident in drawings and sketches. Symbols attached to drawings, for example, could signify functions, activities and relationship between shapes or elements. Such symbolic inferences would often lead to the manipulation of meaning behind particular shapes, forms, relationships. Oxman (2002) suggested that the introduction of new semantic content might encourage a new semantic emergence, which could in turn lead to a new syntactic emergence. In short, the appearance of new visual information resulting from a framing or formulating activity could then lead to the discovery new concepts and possibly, novel solutions (Suwa, Gero et al. 2000).

Cognitive emergence

This type of emergence refers to a high-level reasoning supported primarily by domain knowledge, which is often in the form of schematic structures or patterns, and visual memory. It reflects a skilful bridging process in cognition, where a generalised 'perceptual

event' is 'seen' through the perspective of an existing schematic structure of knowledge. According to Oxman (2002), Liu's (1995) study of shape emergence provided a strong evidence for this bridging process. We will discuss Liu's study in later in this chapter.

3.4.2. Sketches as medium of visual thinking

Designers' activities depend almost entirely on their visual abilities in 'seeing' (perception) as well as 'imagining' (imagery) about objects. We see them more clearly in situations where designers use sketches as part of an elaborate visual cognitive tool for design problem solving (Goldschmidt 1991; Schon 1992). Goldschmidt (1991) suggested that designers' sketches represent two modalities involved in the dialectical process of design: 'seeing-as' and 'seeing-that'. The former concerns 'figural' action or argumentation designers produce during design. The latter involves 'non-figural' argumentation or reasoning about the qualities of design subjects that are the focus of the design activity (Goldschmidt 1991).

Design sketches function as a visual medium that facilitates 'dialectical' conversation, to Goldschmidt (1991) referred to as the 'ping-pong argument across modalities', between percepts and mental images. They occur as the designer attempts to structure a problematic situation by acquiring a figural-conceptual 'correspondence' between what is perceived in the current design task and examples to be elicited from the designer's repertoire of knowledge. The process of imagery initiated by sketching facilitates such correspondence (Goldschmidt 1991). Goldschmidt (1991) explained:

> Given that an entity to be designed or that is being designed does not yet exist and therefore was never perceived, it cannot, in its entirety or its parts, be recalled or imaged in the normal sense. How then does a designer start? He or she starts by generating partial images of tentative aspects of the designed entity. Such images may follow recollections of existing buildings or artefacts which serve as references; they may find their origins in precedents derived from metaphors, analogous cases, or entities belonging to a similar type (Goldschmidt, 1991, p.130)

Fish and Scrivener (1990) suggested that sketches allow designers to translate visual representation from abstract and categorical 'descriptions' to concrete and specific 'depictions'. A focal attention directed towards these resultant depictions could then bring about the discovery of novel descriptions. A good fit in this dialectical process between description and depiction could emerge after a few transformation cycles. Therefore, sketching activity here serves as an 'amplifying' mechanism in visual cognition (Fish and

Scrivener 1990). Figure 3-2 illustrates the position of sketches in the visual representation continuum.

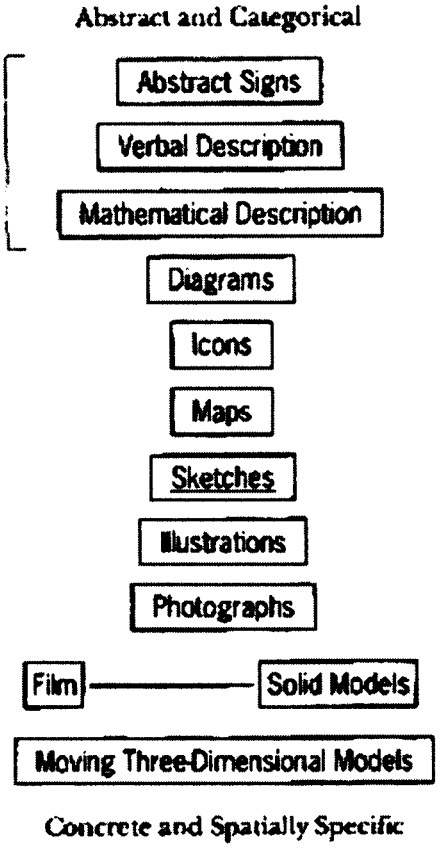

Figure 3-2 A Continuum of visual representation (Source: Fish and Scrivener, 1990, p.117)

3.4.3. The role of 'visual clues'

Goldschmidt (1994) regarded the dialectical reasoning that occurs during sketching to be as systematic and logical as other forms of rational activity. However, the ability to 'dart' between modalities actively during reasoning depends on the level of design expertise. It is likely that expert designers are better at such activity than novice designers (Goldschmidt 1991). 'Images' contain visual 'clues' (Goldschmidt 1994) or 'tokens' (Suwa, Gero et al. 1998) that serve as an 'index' for relevant information gathered in the designer's memory. Prompted only by partial or rudimentary images, expert designers are more capable of exploring more visually than novices could. However, clues are only useful as long as they are the object of a designer's search or preoccupation (Goldschmidt 1994).

These visual 'clues', which often manifest as shapes or figural forms, do not only inform us about specific objects of design but also the concepts that they represent (Oxman 2002). Furthermore, these 'clues' also enable designers to access 'functional issues, relevant past experiences, or problem solving strategies' (Suwa, Gero et al. 1998). Goldschmidt (1994) further pointed out that the interactive use of visual 'clues' could even facilitate the resolution of diagram-based mathematical problems like that of Wertheimer's parallelogram (Wertheimer 1959).

Grounded in the 'figure-concept' structure, expert designers are able to treat sketching as a necessary tool in the process of cognitive inquiry. This concurs with Schon (1983) who described a close association between design activities and the designer's 'frames' and 'repertoire of exemplars' (p.317). By this way, 'visual thinking' is closely associated with 'framing' or formulating activities. As part of this framing activity, designers are also able to utilise sketching as a way of probing, speculating and imagining all the possibilities necessary in progressing a design idea (Mitchell 1992). As such, we envisage that expert designers see more opportunities in sketches than novice designers could.

3.4.4. 'Seeing' implicit and ambiguous emergent visual forms

Sketches are the extension of the designer's processing ability in imagery. They provide visual clues, often in the form of partial or ambiguous images, for designers to work with in order to advance the design process. In a study related to image transformation, Mast and Kosslyn (2002) established that the process of imagery is capable of providing the level of ambiguity necessary for the discovery of unanticipated shapes. The presence of partial visual clues facilitates such discovery. It was also found that the ability to make novel interpretation of images is largely determined by the acquired skill in transforming images like rotation (Kosslyn 1994; Mast and Kosslyn 2002). Image transformation occurs gradually in small increments (Kosslyn 1994). It involves substantial 'effort' and time spent on the part of designer, not least in terms of sketching activities. It would likely be that such a skill like image transformation, which is a key component in imagery, is more prevalent in experienced rather than less-experienced designers.

Liu (1995) undertook a study that found a vivid link between detecting ambiguity in images and design expertise. By experimenting on experienced graduate architectural students and non-experienced non-architecture students, he found that the former generally have lower values in terms of the *threshold of recognising activation* (TRA) for seeing shapes than the

latter. In other words, expert designers are distinctive by their proficiency in not only recognising explicit emergent shapes but also implicit emergent sub-shapes in visual perception and imagery. In contrast, novices often fail to recognise these sub-shapes as their TRA are not low enough to enable such activity to occur (Liu 1995). It was also found that for both expert and novice designers in general, seeing implicit sub-shapes only came after an initial period of identifying and naming primordial shapes like square, triangle and L-shape.

Figure 3-3 illustrates one of Liu's recognition experiments on shapes that were implicit and incomplete. Only an experienced or expert designer would have recognised the emergence of an implicit square in form type 'b'. To do this the designer would have to recognise L-shape first as an incomplete square on top of the other overlapping geometries. This is due to the high TRA values of expert designers.

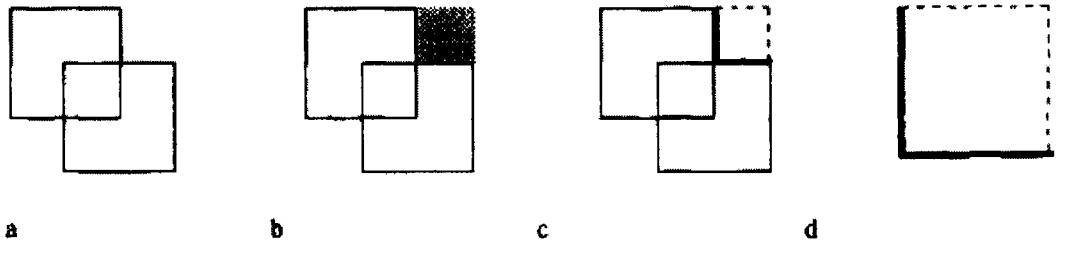

Figure 3-3 Recognising implicit and incomplete square experiment (Source: Liu, 1995, p.382)

Liu's (1995) study has two implications. Firstly, detecting deep structural features in images is critical for design problem solving activities. Secondly, seeing implicit sub-shapes images after detecting structural features are necessary for seeing unintended shapes and forms, which is a key to creative acts. For expert designers, there is a strong link between visual imagery and design problem solving as well as generating new ideas. Although novice designers detect primary shapes as had experts, this only relates to seeing surface features that are insufficient in facilitating creative actions. To some degree, this observation coincides with the earlier study on the differences in categorising and representing Physics problems between experts and novices by Chi, Feltovich et al. (1981).

Unexpected features could be used to 'form and to inform emerging design concepts' (Goldschmidt, 1994, p.164) and generate new design ideas (Suwa, Gero et al. 2000). Visual 'clues' are present in emergent shapes and forms that evolve as part of the process of

imagery during design activities. The way designers perceive them reflect the nature of expertise in design cognition. Designers with different levels of expertise might see different types of visual 'clues' in these emergent forms. As shown by Liu (1995), this would depend on the 'threshold' of visual appearance such 'clues' possess; whether forms perceived are explicit or implicit. Therefore, design expertise increases with the designer's ability to deal with rising level of ambiguity of visual forms throughout the course of his or her education and working experience.

3.4.5. Interacting with rich imagery

In a study comparing advanced and novice levels architectural design students' perception of sketches, Menezes and Lawson (2006) found that the former was more capable of producing a richer interpretation and perceived more ideas from architectural sketches than the latter. This suggests that designers who have significant domain knowledge experience interact more meaningfully with conceptual sketches even if they were not responsible for producing them. It is likely that experienced designers interact more effectively with sketches than novices through formal and symbolic languages that might have been developed during the conceptualisation phase of design (Menezes and Lawson 2006).

Bilda, Gero et al. (2006) suggested that under limited conditions, expert architectural designers are capable of conceptualising only by 'thinking' and without the aid of sketching. Their case study involved three expert designers 'thinking aloud' about design conceptualisation activities in two circumstances: one blindfolded and the other in conjunction with sketching. They found that in the early conceptual phases of design development, the designers' blindfolded and sketching activities did not significantly differ in terms of the design outcomes, total cognitive actions and overall density of ideas.

Experts are capable of simulating the developments of concepts through the use the architectural language they have acquired over time. For expert designers, sketching is necessary to reduce the cognitive load sustained during design, produce better design results and enable the development of coherent ideas and concepts (Bilda, Gero et al. 2006). However, interacting with imagery alone without externalising it in the form of sketches is sufficient as a tool for developing ideas in the early phase of design.

The studies by Menezes and Lawson (2006) and Bilda, Gero et al. (2006) suggest that the designer's ability to interact with imagery is an important indicator of expertise. Sketching

activities aid designers significantly in learning and developing domain-specific 'language' for interacting with visual imagery. This interaction occurs during the early phase of design, where designers deal with the idea conceptualisation process. The 'language' that the designer develops is a result of 'figure-concept' (Goldschmidt 1994) or 'description-depiction' (Fish and Scrivener 1990) dialectics that occur during this conceptualisation process.

Over an extended period of practice, it is possible for expert designers to utilise this acquired 'language' of 'interactive imagery' (following Goldschmidt (1994)) to simulate idea development purely out of verbal reflection rather than sketches (Bilda, Gero et al. 2006). Thus, this 'language' does not only pertain to the visual modality of sketches. In fact, they reveal the richness of a multi-modal account of design 'conversation' acquired through experience. Fish and Scrivener (1990) postulated that imagery and verbal processes complement each other and are difficult to separate. They share a common modality in abstract and categorical representation. According to Kosslyn (1999), the ability of imagery to transcend across different modalities of the senses gives us collective sensations like 'seeing with mind's eye', 'hear with the mind's ear' or 'feel with the mind's hands'.

3.5. Studio tutorial as continuous cognitive activity

The architectural studio tutorial is a very good example of an environment where a rich process of 'interactive imagery' takes place between two or more groups of designers who possess different levels of expertise. In this environment, there is a progressive and mutual exchange, learning, criticism and development of concepts and ideas pertaining to a particular stage in a design activity. Schon (1983, 1987) famously characterised the studio as an environment where the languages of 'doing' and 'reflecting' intersperse, thus providing valuable insight into the intelligent activities of design.

Schon (1983) also viewed the studio as an archetypal setting for educating designers in 'reflective' practices. For him, the studio tutorial is where corresponding tutors and students participate in either designing or performing a range of reflective activities. Schon (1987) suggested that these actions form a 'ladder of reflection' consisting of:

1. Designing (reflection in action)
2. Description of designing (reflection on designing)
3. Reflection on the description of designing

4. Reflection on reflection on description of designing

However, Schon's ideas of reflective practice lack the clarity in terminology, empirical evidence, practical application and reveal a paradox between specific and general attributes (Valkenburg 2003). Coding reflective activities is also difficult (Dorst 1997). Furthermore, those ideas not easily reconciled with established studies in cognition. What would be more elemental is the ability to define design 'conversations' like studio tutorials in terms of the 'cognitive' activities they most likely relate to. Thus, a model of cognitive action is required to study design tutorials, the closest one being visual cognition since for many, design is essentially a visual reasoning process (Tang and Gero 2001). There is also ample support for this in the likes of studies by Goldschmidt (1994), Fish and Scrivener (1990) and Goel (1995)

Schon's reflective theory promotes a study of studio tutorial as discreet reflective actions, not as a continuous and general phenomenon of cognition. Therefore, it is difficult to envisage how Schon's 'ladder of reflection' fits into the idea of design tutorial as a continuum of 'situations' that undergo a perpetual 'stream' of perception (Gibson 1986). Such situations, often experienced as 'table crits' that students and tutors perform, involve different and successive mediums of visual representation like sketches, drawings, diagrams, models, materials, photographs and textiles. From these mediums, tutors and students elicit and process an intermingling array of percepts and images that appear incessantly at the forefront of their attention.

Humans perceive only those features that are at the focal of attention (Neisser 1976), rather than all features that are available in the environment. The existence of percepts and images shows that visually, humans are able to detect permanent and salient features as well as changes that occur in the environment (Gibson 1986). The ability to detect these features as 'affordances' in the environment reveals the discriminatory and economical nature human perception (Gibson 1986). Since perceiving and imagery possess share certain mechanisms at least in the process of visual cognition (Kosslyn 1995), an unbroken 'stream' of perception would also bring about ceaseless activities in cognition. Therefore, percepts and images facilitate the processes of 'knowing' or 'cognition' in designers. In a visual and verbal interaction like the studio tutorial conversation, 'cognition', rather than 'reflection', forms the primary and basic medium for action for tutors and students.

'Breakdown' occurs anywhere along the trajectory of a studio tutorial 'conversation'. However, this actually has positive implications for participating tutors and students. At the point of 'breakdown' during conversation, tacit activity in cognition ceases and the designer becomes more aware of the explicit state of design. This juncture provides the 'space' for revealing what we can describe and say about problematic situations and the nature of 'tools' that we use in activity (Winograd and Flores, 1987, p.165).

According to Winograd and Flores (1987), breakdowns also expose a 'nexus of relations' required in accomplishing certain tasks (p.165). Such phenomena are explicit to the designer and only become relevant from the perspective of design tutorial as a continuum, rather than discreet activities. Therefore, analysing tutors and students' cognitive actions in continuous tutorial conversation might enable us to differentiate the nature of expertise between them.

The 'stream' of perception and cognitive activities associated with the process of imagery could also disclose gaps, problems and inadequacies as well as opportunities and 'affordances' observed at specific stages of designing. Designers respond to these disclosures by adapting their focus of attention along the trajectory of design 'conversation'. Goel (1995) called them 'lateral' and 'vertical' transformations respectively. The former relates to a transformation 'from one idea to a slightly different idea'. The latter describes a movement 'from one idea to a more detailed version of the same idea' (p.119).

Similarly, Suwa and Tversky (1997) suggested that there are two kinds of adaptation: 'focus-shift' or 'continuing' segments (Suwa and Tversky 1997). By examining the occurrences of these segments in designers' verbal protocols, they were then able to elicit differences in the amount, content, duration of information contained in chunks produced between experts (architects) and novices (students). Following this, they found that architects had longer and more continuing segments than students. This suggests that the architects thought more deeply about a particular issue once there is a shift in attention than students, thus indicating a more significant 'read-off' of information from their sketches (Suwa and Tversky 1997). The architects were also more receptive to depictions during focus-shift and were able to relate them with certain kinds of the function more frequently than students. These indicate that experts are more capable of detecting 'cues' of non-visual functional elements from the perception of visual features than novices.

3.6. Transformative roles in conversations

In studio tutorial 'conversations', it is reasonable to assume that tutors and students make either lateral or vertical transformations irrespective of whether there is a 'breakdown' in cognition during design conversation or amid routine activity. Such assumption provides a useful simulation of possible scenarios in transformations.

For example, a designer who makes a lateral transformation following a breakdown in cognition is probably leading on to a problem structure or frame that exists at a different metaphorical level, perhaps to restructure the situation for clarity before another attempt is made to overcome the problem (lateral-breakdown). We see an example of this in Schon's 'paintbrush-as-pump' generative metaphor (Schon 1993) discussed earlier, where a kind of mapping occurs between two different instantiations: the paintbrush and the pump. Another example, a lateral transformation that occurs during routine design conversation might indicate a novel discovery made through observing emergence in the visual features of 'partial' object or image (lateral-routine).

Alternatively, a designer could undertake vertical transformation to develop or augment a current argument in the design conversation (vertical-routine). Inadvertently, one might also persist in developing the same line of inquiry that is problematic (vertical-breakdown), thus leading to a situation of 'fixation'. If a breakdown prevents any kind of transformation, the designer then becomes 'stuck' (Sachs 1999). A corresponding designer (e.g. tutor) in the same tutorial session might help remedy situations of 'fixation' and 'stuckness' experienced by the other (e.g. student) by facilitating the process of transformation in the next conversational 'turn' through 'scaffolding'. 'Scaffolds' provide 'guidance' or 'feedback' in structuring task (Chi, Siler et al. 2001). It could encourage the student either 'to stay on the same track of reasoning' or 'to change direction or goal'. A 'scaffolding episode' also addresses the 'same concept or topic' (p.473).

The human 'dialogue' is essentially a 'robust' phenomenon (Hayes and Reddy 1983; Suchman 1987). By 'robust', it means that its participants – tutors and students – are able to deal with unexpected situations and remedy breakdowns that occur in communication (Hayes and Reddy 1983). However, the studio tutorial 'conversation' is not simply about communication. More crucially, it is a verbal manifestation of cognitive actions corresponding tutors and students make and impart between them during tutorial conversation. These cognitive actions are not about designing. Instead, they relate to the

'intertwining' process of visual perception and imagery. In this process, 'seeing' and reasoning involves depictions and descriptions of specific features attended to in the likes of models, sketches, drawings, diagrams, plans and photographs. From this, tutors and students convey and exchange matters that they perceived and thought of as important.

Verbal and imagery processes complement and are interdependent on each other during cognition (Fish and Scrivener 1990). In theory, we could observe this phenomenon in a studio tutorial conversation but not in the actual situation of designing. In a tutorial conversation, mutual and explicit understanding about the state of design between tutors and students is vital. Learning about and reacting to each other's depictions and descriptions will be important since these are the objects of attention, action and communication between them. In this case, verbalisation provides a reasonable indication of cognitive activities that occur in designers (Lloyd, Lawson et al. 1995). Such approach would be more difficult to apply in actual designing activity, where knowledge in use is tacit in nature.

3.7. 'Conversational' roles in tutorials and determination of expertise in design

Tutorial conversations are not homogeneous verbal expressions. Expert (tutor) and novice (student) designers could take up different cognitive 'roles' to suit the various cognitive 'streams' in a conversation (Lawson and Loke 1997). These roles reflect the point made by Lloyd, Lawson et al. (1995) that design is not a 'unitary' activity. Thus, obtaining a single, universal definition of 'design' is not a practical enterprise. It seems that the way forward is to work on a 'relative' account of design, where we seek a better understanding about the 'hidden' mechanisms of design and their manifestations in the various types of design activity. Lloyd, Lawson et al. (1995) suggested that:

> Clearly the incarnations of design vary considerably and this seems to imply that perhaps better questions to ask are what it is that distinguishes a good designer from a bad one, a novice from an expert, an architect from an engineer. (Lloyd, Lawson et al., 1995, p.259)

Such a suggestion fits well with the study of design studio tutorials, where two disparate groups 'converse' about specific states of designing. In the previous section, we indicated how such interaction could bring about 'multi-turn' transformations in tutors and students' cognitive actions along the trajectory of conversation. This could be indicative of the combination of roles tutors and students carry out during tutorials to fulfil various objectives in learning and cognition.

Lawson and Loke (1997) suggested that 'conversational' roles could form the basis for developing a Computer Aided Design (CAD) framework that facilitates human-computer design interactions. Generally, these 'roles' could typify 'learner', 'informer', 'critic', 'collaborator' or 'initiator' modes of interaction (Lawson and Loke 1997). The learner grasps and learns from the comments of others, while the informer provides answers to queries brought up during conversation. The critic evaluates and comments on the judgements made by other participants. In contrast, the collaborator develops other designers' ideas. The initiator instigates a new approach towards the current topic of conversation.

These 'cognitive' roles are detectable from verbal descriptions designers make during conversation. Reflecting on Fish and Scrivener's (1990) model of a continuum of visual representation, we could envisage verbal descriptions, being more abstract and categorical than sketches, as assessable information in any tutorial 'conversation'. Accordingly, it is possible to identify utterances that signify distinct and measurable categories of cognitive actions tutors and students produce in tutorial interactions. One such grouping of cognitive actions could potentially include problem formulation, evaluative function and solution moves as measurable attributes of conversation. Such suggestion would be consistent with studies related to parallel or 'co-evolving' development of problems and solutions (Lawson 1979; Schon 1993; Clancey 1997; Suwa, Gero et al. 2000; Dorst and Cross 2001; Maher and Tang 2003).

3.8. Summary

1. The dialectical nature of design only becomes apparent in situated environments. In these 'situations', problems and solutions mutually and progressively define each other, thus propelling design activities forward. Such actions involve a continuous cycle of perceptual and cognitive activities, which enable the designer to recognise familiar features, and make association, coordinate and re-coordinate between concepts. These are typical situations where designers 'converse' with the situation.

2. In the chapter, we examined the nature of design problem solving as a kind of 'dialectical' inquiry. Such a framework suggests that we need to consider the inherent 'flow' of human design conversations. Conversations represent a good medium to observe how designers deal cognitively with emerging design

'situations'. From these conversations, we could detect the designer's responses to distinct events like breakdowns and surprises and various types of transformations. These are typical of the 'robust' characteristics of human design conversation.

3. Schon's (1993) 'frame' concept provided a crucial understanding that designers do not solve given problems; instead they restructure problematic situations that they encounter until a certain conceptual realignment is achieved between recognised features of object being designed ('instance') and their archetypical 'schema' or 'type'. The designers would then move to generate solutions. The way that this 'framing' activity move design forward is best captured by the idea of parallel development between problem formulation and solution generation during design (Dorst and Cross 2001; Maher and Tang 2003). Such an idea appears to be one of the most important features in design cognition. It is also markedly different from conventional thinking processes that rely on transformation operations between problem states.

4. Designers rely on framing or formulating as part of the 'appreciative' system that deals with problematic situations. They use this to substantiate the value of their actions as design progresses. This 'appreciative' system also involves designers' perceptual abilities, which are crucial in supporting the process of visual imagery. Both perception and imagery forms the designers' visual cognitive activities. The close relationship between this 'appreciative' system and visual cognition is evident in designers' 'conversations' with drawings, sketches, models etc. Framing or formulating action provides coordination in the activity of 'looking' or 'seeing' during design.

5. We identified studio tutorials as a rich environment where we can observe the situated cognitive actions of designers. In such an environment, designers' 'conversations' occur at conceptual level. This means there is a certain level of congruity between the designer's visual and verbal output. In addition, conversational data also becomes assessable and explicit for observation and analysis. This would allow us to study situated cognitive *transformations* that occur during the designers' interactions with emerging situations during conversations. By determining the nature of these transformations, we would then be able to differentiate the levels of expertise between designers.

CHAPTER 4
Research Methodology

4.1. Introduction

This chapter describes the development of a methodology for the research in the nature of design expertise as revealed in architectural studio tutorial conversations. This follows the identification of core activities of design (Chapter 2) and their realisation in situated environments like studio tutorials (Chapter 3).

Characterising design activities as 'conversations' is a novel way in studying design expertise. Studio tutorials are a fertile environment in establishing the differences in design expertise between corresponding designers who possess different backgrounds and experience. The current study on studio tutorial conversations involves a comparative study between two categories of designers, the tutor and the student. It assumes that tutors are at expert level and second-year students at the novice level. Twelve second-year architectural studio tutorial sessions form the case studies for this purpose. Each tutorial session consists of an interaction between a tutor and a student.

The results of the audio-visual observation of 12 tutorial sessions, each consisting of a continuous sequence of protocol segments and an interactive matrix of cognitive action segments, form the Appendix at the end of the thesis.

4.2. Assumptions and hypothesis

The development of a research methodology for the study of design expertise in this chapter follows closely the assumptions and hypothesis outlined in Chapter 1. Firstly, these assumptions and hypothesis work on the basis that designers' productivity in cognitive activities is a key to differentiating the level of expertise between experts (tutors) and novices (students). Secondly, they enable us to establish whether designers' intuitive and perceptive responses to design situations provide a significant indicator of expertise. Thirdly, we also determine if expert designers more readily differentiate design 'situations'

during design tutorial conversations than novice designer, thus leading to the potential conclusion that the former are better in adapting cognitive roles than the latter.

4.3. Research aims, objectives and methodological considerations

Also previously outlined in Chapter 1 are the aim and objectives of this thesis. To reiterate, the aim of the thesis is to explore and understand the nature of design expertise by analysing and comparing cognitive activities between tutors and students during studio tutorial conversations. The objectives are to define a parameter of cognitive activities that could reveal the nature of design expertise and create a framework that would reflect the dialectical and 'situated' nature of tutorial conversations. In addition, there exists a need to provide a cognitive basis for investigating the substance of tutor-student interactions during tutorials. Clarifying the nature of differences in cognitive actions, skills and strategies that might transpire from design tutorial conversations also forms one of the objectives of the study.

In this chapter, we discuss three important issues relating to the methodology of analysing and differentiating expertise levels through tutorial activities. As a preface, we first highlight the utility of background theories and previous research in informing the direction and methods for analysis of the current study. In particular, this concerns protocol analysis of conversation data. Secondly, there is a discussion on segmenting and coding of tutorial conversations. Thirdly, we discuss aspects related to analysing patterns and behaviour in data collated for the study.

4.4. Background of study: Two Cognitive modes in design

We can at least identify two cognitive modes of design: cognitive actions that occur in 'doing' design, and cognitive actions that transpire as we converse or are in discourse about design (Lloyd, Lawson et al. 1995). Both modes involve situated acts of cognition since humans are ever receptive to perceiving and knowing about their environment. This follows Gibson (1986), who suggested that perception is like a 'stream' (p.240). However, the nature of knowledge, representation and behavioural effects between the two modes cognition are fundamentally different.

Knowledge related to 'doing' design is tacit and difficult to elicit from concurrent verbalisation (Lloyd, Lawson et al. 1995). In contrast, knowledge involved in conversation,

talk or discourse on design is verbally explicit. This will be the focus of the current study on studio tutorials, where tutors and students discuss specific states of design the latter has attained at the point of interaction.

During studio conversations, verbal expression runs parallel to the process imagery in experts (tutors) and novices (students). To a greater or lesser degree, we see both tutors and students at ease in handling both verbal and visual expressions during studio interactions. This is not surprising due to the complementary and interdependent nature of imagery and verbal activities (Fish and Scrivener 1990). These interactions often involve mental 'simulations' based on the descriptions and depictions of design artefacts at the centre of tutorial discussion.

Table 4-1 provides segment examples showing these mental 'simulations', the following obtained from verbal protocols in tutorial session 1 (tutor T1 and student S1).

Table 4-1: Examples of protocol segments in Tutorial session 1 (Tutor T1, Student S1)

Segment	Contributor	Protocol Segments
3	S1	Because what I did was, I did this with the first floor plan because I was really happy with myself. Later I'm was going to see how it looks like 3D. And then I thought, okay it looks fine. So, I've got to think of what's happening at the ground floor now [Reference to image inspection]
4	S1	And then I looked at that (model). And then ok, I think like I could need something else here because it seems like a bit towering over the other one [Reference to image inspection]
15	T1	So if we have a six metre shaft in a space that's say 3 metres wide, that's going to be like *sitting in a bottom of a chimney* [Reference to image generation]

Such mental simulation reflects at least the first two of the processes that we find in imagery, which are image generation, inspection, maintenance and transformation (Kosslyn 1999). It indicates that designers are capable of verbally describing what they are *learning* about their task environment and their *adaptation* to emerging situations during tutorial interactions. This is typical of the early or conceptual phase of design, which we often refer to as the problem structuring or conceptualisation stage.

In the early phase of design, both tutors and students attend to specific issues, restructure problematic situations and seek meaningful patterns as part of the effort to grasp the essence of a particular situation of design. These occur at different levels for corresponding tutors and students. It is at this stage of learning that we find a reasonable correspondence between design cognition and the process of concurrent verbalisation (Lloyd, Lawson et al. 1995). This justifies the use of verbal protocol analysis method in studying and comparing designers' cognitive activities during tutorial conversations.

4.5. Protocol analysis of design conversations

In this thesis, we explore the nature of expertise by using the architectural design studio tutorial environment as a medium to compare cognitive activities between two groups that possess disparate levels of design abilities. Schon (1983) famously carried out a similar observation on studio tutorials in his effort to describe design as 'reflective' practice. This has been discussed extensively in Schon (1983, 1987, 1988, 1992) and Schon and Wiggins (1992).

4.5.1. Concurrent and retrospective protocol analysis

Schon's work on reflective activities provides a critical preface to the methodological issues concerning observing, gathering, encoding and examining verbal data of design activities. In particular, these methodological issues pertain to two of the most common forms of verbal analysis used in examining the substance of design activities: concurrent and retrospective protocol analyses. The way these protocol analyses are used reflects the assumptions we can make about specific aspects of design activity.

Concurrent protocol analysis

The aim of *concurrent* protocol analysis is to elicit process-based features of design by asking participants to talk-aloud, think and sketch simultaneously during designing (Maher and Tang 2003). However, such approach may have limited application in comprehending the nature of design since process features ultimately hinge on the contents of design decisions (Dorst and Dijkhuis 1995). The focus on process means that the effort to tease out the underlying attributes of design problems with the purpose of aiding their solution only fades to the background. Another drawback with this approach is the potential effect talking aloud has on the actual thought process (Lloyd, Lawson et al. 1995).

However, the most critical shortcoming with the concurrent protocol analysis method is its failure to acknowledge the linkage in reasoning behind design activities. On this subject, Dorst and Dijkhuis (1995) pointed out that the break in process-content links between observations attributable to predetermined coding categories causes difficulty in grasping the conceptual basis of encoded protocol data. In essence, we have here an account of design activity that is devoid of the 'emerging sense of the whole' that Schon speaks about (Schon, 1987, p.30). For this reason, the discreet method of concurrent protocol analysis is inappropriate for the study of design conversations like those in tutorials.

Retrospective protocol analysis

Alternatively, Schon's (1983) well-known study of a tutor and student's tutorial conversation demonstrated the typical use of the *retrospective* protocol analysis method. Maher and Tang (2003) regarded this method as appropriate for studying reflection of actions. Unlike the concurrent protocol analysis method, this method preserves the process-content links between observations by encoding each design statement as a unique 'framing' boundary of problem structuring, solution moves and the evaluation of these moves (Dorst and Dijkhuis 1995). Suwa and Tversky (1997) also called this method 'informal analysis', where each designer intuitively 'constructs his or her reality' (p.398).

However, Dorst and Dijkhuis (1995) also noted at least two critical limitations the retrospective protocol analysis method. Firstly, there is poor definition in the process feature due to the focus on the content aspects of design activity. Secondly, the lack of knowledge and taxonomy of design problems deems it difficult to generalise and compare the results of observations between cases. Suwa and Tversky (1997) further revealed a third potential limitation to this method: selectivity in retrospective reporting based on recorded or videotaped design activities like sketching. Such limitation is manifest in Schon's (1983) reporting of reflective activities that occurred in the famous tutorial conversation between 'Quist' and 'Petra'.

For example, Schon's tutorial observations provided a tutor-bias description of design conversation. On equal basis, it is reasonable to suggest that a student could be as prolific as a tutor could in producing framing episodes. However, Schon had not brought this to light. How could this then inform us about the usefulness of frames between tutor and student if not, for example, by differentiating quantitatively between them?

4.5.2. Methodological strategies in retrospective protocol analysis

Recent studies suggest that there are two dimensions to retrospective protocol analysis. These are the 'microscopic' and 'macroscopic' analyses of design. We distinguish these types of analyses: the former relates to examining cognitive interactions at the local level, while the latter involves a global study of cognitive activities covering the whole duration of design activity (Suwa, Purcell et al. 1998). Recent examination of designers' sketching and verbalisation activities reveal unique applications of 'microscopic' and 'macroscopic' analysis of protocols.

Microscopic analysis

Suwa and Tversky (1997) used the 'microscopic' analysis in examining what designers perceive in their sketches. Their study compared design activities undertaken by experts (two architects) and novices (seven students). It revealed differences in expertise between the two groups by analysing the frequency and depth of 'dependency chunks' formed by designers during cognitive action. A dependency chunk is 'a sequence of conceptually interrelated design thoughts' (Suwa and Tversky, 1997, p. 394) and is related to a segment that precedes it or located anywhere else in the past (p.392). A shift from a chunk or an isolated segment to a different topic in the protocol indicates a change in a designer's focus (focus-shift), while 'continuing segments' develop a topic within a chunk (Suwa and Tversky 1997). These chunks represent the ability of designers to interlink different information categories like those of visual (depictions and their spatial arrangements) and non-visual (functions and background knowledge) types. However, the size of these chunks was small since the object of scrutiny here was the direct relationship between subsequent segments; that is whether such relationship involved a shift in focus or continuous segments.

Macroscopic analysis

In contrast to Suwa and Tversky's (1997) local treatment of chunks and segments, Goldschmidt and Weil (1998) elicited a global pattern of design reasoning through 'macroscopic' analysis of verbal protocol of a team of three industrial designers who worked on conceptual design of a bicycle carrier for a backpack. The interesting point here is the use of the 'Linkograph' method in providing an overall interpretation of the design process based on the graphic notation and statistical patterns of relationship identified from links between individual design 'moves'. A link between two moves indicates that they deal with same or closely related issues. High productivity in design activity is associated

with the high ratio of links between moves. This link could either be a historical one, since they go back in time (backlink) or one that contributes to a subsequent move (forelinks). The 'linkograph' method also provides a systematic method to establish design productivity, which is so crucial in determining what make good moves and creativity. However, we will not discuss this, as creativity is not the focus of investigation in the current study.

Both microscopic and macroscopic analyses

Suwa, Purcell et al. (1998) used both microscopic and macroscopic analyses in studying a practising architect's cognitive activities in design. For the former type of analysis, they introduced an elaborate coding scheme that identified each segment in the architect's verbal protocol in terms of a particular set of cognitive action variables. These variables consist of a 'primitive' grouping of four levels of cognitive actions (physical, perceptual, functional and conceptual levels) as well as other accompanying attributes, such as type of 'dependency' (preceding action), content of action and 'index' of action (whether segments are new, continual or revisited). Such 'primitive' grouping is consistent with mainstream cognitive science literature, which described how human cognition first progresses from sensory (physical action) to perceptual (perceptual action) and then to semantic levels (functional and conceptual) (Suwa, Purcell et al. 1998). What this gave the researchers was the ability to track the formation of ideas that occurs within a segment.

To undertake a macroscopic analysis of the same architect's cognitive activities, Suwa, Purcell et al. (1998) correlated between physical, perceptual, and functional actions in terms of their frequencies of occurrences throughout the period of designing. The researchers also compared these actions against six sequences of sketches that the architect produced during the period. The aim here was to detect if there was any changes in correlation during this period and if there was, how did these relate to the corresponding sequence of sketches made. This then forms the basis for interpreting how the architect interacted cognitively with his sketches.

In this macroscopic analysis, Suwa, Purcell et al. (1998) diverted from the use of retrospective protocol analysis by systematically chunking every five segments of protocol on the notion that segment-by-segment study is 'too sharp' to yield some kind of general pattern about the nature of cognitive activities (p.477).

4.5.3. The challenge in analysing protocols in the current study

The current study involves comparing two groups of designers who possess different levels of expertise: experts (tutors) and novices (students). The setting for this study is the studio tutorial session. In order to differentiate the levels of expertise between these designers equitably, we need a global framework for evaluating and comparing their cognitive activities. This justifies a macroscopic approach for the study. However, it is also hard to envisage a macroscopic view of cognitive activities without the build-up of relations within and between segments that we find in microscopic analysis. A rich segmentation scheme, such as one used by Suwa, Purcell et al. (1998), provides a 'bottom-up' perspective of the analysis of designer's cognitive actions that covers both microscopic and macroscopic approaches to studying cognitive activities.

The main challenges for the current study lie in the following:

- Segmenting interactive protocols like tutorial conversations, which contain two sequences of cognitive activities (one from tutor and the other student) that interweave with each other.
- Encoding segments with attributes that would enable us to answer the set assumptions and hypothesis stated earlier.

4.5.4. Outline of tutorial observation

The current study examines 12 verbal protocols taken from direct tutorial interactions between an architectural tutor and a second year architectural student at the School of Architecture, University of Sheffield during the 2003-2004 second year academic studio session. A total of four tutors and 11 second-year students were involved. The former consist of a permanent staff of the school and three practising architects who worked as part time tutors for the department. All tutors have at least 5 years in practice. At the time of audio-visual recording, the second year students were midway through their first and second semester design projects.

Audio-visual recording of these tutorials used Hi-8 and Mini DV camcorders on tripods and microphone. Recording was made under the condition that it should be as inconspicuous as possibly could. As such, the researcher only conducted intermittent checks on these apparatus during recording to ensure that this occurred smoothly.

The initial objective was to select at least 20 direct or one-to-one audio-visual recordings of tutorial sessions. However, this did not materialise due to the unpredictability surrounding the progress of these tutorials. For the purpose of the current study, any tutorial session that involved active engagement by students other than the one whom the tutor of the group is directly addressing were 'discarded'. This was necessary in view of cutting back on the potential influence of external issues a third party might introduce to a tutorial session and the effect this might have on the cognitive activities of the tutor and student involved in the original conversation.

Each of the four tutors represents a unit tutorial. All tutors held their meetings with students on a first-come-first-serve basis. Towards the end, the eleven students who formed the final list of participants emerged randomly due to the tutorial system that the tutors have in place as well as circumstances that dictated the clarity of recording. **Table 4-2** shows the tutorial sessions considered for the study.

Table 4-2 Tutor-student interactions in tutorial conversations

Session	Tutor	Student	Total Duration (min)
1	T1	S1	23.34
2	T2	S2	27.15
3	T3	S3	17.90
4	T4	S4	23.21
5	T4	S5	29.98
6	T1	S6	22.03
7	T1	S4	16.55
8	T3	S7	11.28
9	T2	S8	10.67
10	T2	S9	24.07
11	T4	S10	20.38
12	T4	S11	24.78

4.5.5. Protocol data on the current observation of tutorial conversations

For the current study of 12 tutorial conversations, the effect of conversation was different from the conventional protocol analysis methods used for previous studies of designers' interactions. The main difference here is that the current researcher did not deliberately intervene in order to obtain a desired outcome from tutorial conversations. This differs from other forms of observation that involved deliberate probing or introduction of cues such as those in simulated or focus groups methods.

4.5.6. Profile of recorded conversations

The following items are features surrounding the 12 tutorial sessions recorded for the purpose of the current study:

Tutorial 1 (Tutor T1; Student S1)

Recording was made on 28th November 2003 (First semester) for the duration of 23.34 minutes. The design was for a tall building that houses a series of private accommodations and a public area at the base. Some of the issues of contention were the internal and external public spaces. The design was at sketch planning.

Tutorial 2 (Tutor T2; Student S2)

Recording was made on 28th October 2003 (First semester) for the duration of 27.15 minutes. The design was for a tall building that houses a series of private accommodations and a public area at the base – an artists' accommodation that double up as exhibition space. Issues discussed included permanent and rentable areas of building and programmes that could accommodate these functions. The design was at sketch planning.

Tutorial 3 (Tutor T3; Student S3)

Recording was made on 1st April 2004 (Second semester) for the duration of 17.90 minutes. The design was for a library and gallery. Issues discussed were on the notions of classical order and symmetry, wall enclosure as feature for design, public and private space, a labyrinth etc. The design was at sketch planning.

Tutorial 4 (Tutor T4; Student S4)

Recording was made on 21st April 2004 (Second semester) for the duration of 23.21 minutes. The design was for a 'Theatre of Memory'. Issues discussed were tectonics of space, transport access, town planning scale, serviced walls etc. The design was at sketch planning.

Tutorial 5 (Tutor T4; Student S5)

Recording was made on 1st April 2004 (Second semester) for the duration of 29.98 minutes. The design was for a teaching institute. The dominant issues were roof articulation, café tower, plant room etc. The design was at sketch planning – predominantly models.

Tutorial 6 (Tutor T1; Student S6)

Recording was made on 2nd December 2003 (First semester) for the duration of 22.03 minutes. The design was for a tall building that houses a series of private accommodations, a public area at the base and studio space. The issues discussed included two cube concept, timber shutters, 'kink' in plan etc. The design was at sketch planning.

Tutorial 7 (Tutor T1; Student S4)

Recording was made on 28th November 2003 (First semester) for the duration of 16.55 minutes. The design here was for a tall building that houses a series of private accommodations and a public area at the base. Some of the features discussed were the atrium space and roof garden. The stage of design was at sketch planning.

Tutorial 8 (Tutor T3; Student S7)

Recording was made on 2nd April 2004 (Second semester) for the duration of 11.28 minutes. The design was for theatre and exhibition space. Discussed features were the idea of three-sided theatre, Manchester exchange theatre, sitting arrangement etc. The stage of design was at sketch planning.

Tutorial 9 (Tutor T2; Student S8)

Recording was made on 6th April 2004 (Second semester) for the duration of 10.67 minutes. The design was for a Dance centre. Issues discussed were dance movement that might influence building design, transparency of building, undulating lines, colourful elements to buildings etc. The stage of design was at sketch planning – predominantly model.

Tutorial 10 (Tutor T2; Student S9)

Recording was made on 5th April 2004 (Second semester) for the duration of 24.07 minutes. The design was for a gallery and museum in Bradford. Issues discussed were reconciling building with slope, materiality of building, question of scale, Greek amphitheatre etc. The stage of design was at sketch planning – predominantly model.

Tutorial 11 (Tutor T4; Student S10)

Recording was made on 21st April 2004 (Second semester) for the duration of 20.38 minutes. The design was for a museum, gallery. Issues discussed were about organic building form, abstract shapes, clear glass surface, cage-like etc. The stage of design was at sketch planning.

Tutorial 12 (Tutor T4; Student S11)

Recording was made on 1st April 2004 (Second semester) for the duration of 24.78 minutes. The design was for a 'Theatre of Memory'. Issues discussed were central drum-like structure with rising ramps, circulation in atrium space, building materials etc. The stage of design was at sketch planning.

4.6. Segmenting the protocol

A segment is a basic unit for protocol analysis. Generally, a segment here is akin to Goldschmidt's (1991) 'design move', which is regarded as 'an act of reasoning which presents a coherent proposition pertaining to an entity that is being design' (p.125). Similarly, Suwa and Tversky (1997) defined segment as a 'coherent statement about a single item/space/topic', even if there could be one or many sentences in such statement. Furthermore, it could also be defined as 'a set of thoughts and /or actions that are interpreted as having occurred simultaneously' (Suwa, Tversky et al. 2001). It is also possible to differentiate subsequent segments by observing the 'change in the subject's intention or the contents of their thoughts' (Gero and McNeill 1998). We could also identify a segment through pauses in conversation (Ericsson and Simon 1993) and, particularly in the current study, conversational 'turns' between tutor and student. We find

all these definitions useful in directing the processes of segmentation and coding in the current study.

4.6.1. Indication of Cognitive action segments from 'performative' utterances

One of the most convenient ways in identifying explicit segments in tutorial conversations is by inferring a measure of correspondence between the designer's verbal utterances and cognitive activities. Designers' utterances are productive in a sense that they could bring about certain kind of effect or action during conversations. They reflect designers' intention and are appropriate for advancing cognitive propositions in design activities. In essence, these utterances move design activities forward.

In a seminal study on communicative action, Austin (1976) suggested that we often use words and utterances to perform 'speech acts' rather than simply describe meanings and facts. Calling these verbal activities 'performatives', he suggested that words and utterances could either be 'locutionary', 'illocutionary' or 'perlocutionary' acts (Austin 1976). 'Locutionary' utterances are descriptions or references of things. 'Illocutionary' utterances directly motivate certain kinds of action. For example, these might denote verbal acts of 'informing', 'ordering' and 'warning'. 'Perlocutionary' utterances are 'what we bring about or achieve by saying something' (Austin, 1976, p.109). These could be affective words produced in processes like 'convincing', 'persuading', 'deterring' or even 'misleading'.

Designers' conversations are more than just about communicating intention. They are cognitive responses to a variety of circumstances that emerges from the perception of design situations. In the context of tutorials, these conversations translate into tutors and students experiencing various transformations in cognitive 'roles' in dealing with specific situations and problems of design. Such phenomenon relates to an assumption stipulated earlier, that designers who possess distinct levels of expertise perceive problematic design situations differently. Verifying such assumption requires us to examine tutors and students' cognitive activities in tutorial conversations obtained for the current study.

4.6.2. Parallel visual and verbal actions

Words and utterances provide a useful reflection of cognitive activities that occur in studio tutorial conversations. They serve as memory 'indices' that gather and represent various types of information. Tulving (1983) emphasised the ability of words to function as a 'focal

element' in describing the collective experiences of the likes of things, events and spaces that occur in specific situations. With this characteristic, tutorial conversation serves as an important conduit for imparting descriptive or propositional knowledge. Tulving (1983) described the propositional nature of verbal activities:

> Words can be grouped in a variety of systematically describable ways; conceptual categories, acoustic or orthographic similarity groups, semantically associated associated pair, as well as phrases, sentences, and larger linguistically meaningful units. (Tulving, 1983, p.147)

Like sketches, verbal utterances could represent 'objects, scenes or events' that are not 'physically present' (Fish and Scrivener, 1990, p.117). In the study of emergence of visual forms, Liu's (1995) postulated that designers are capable of encoding images both in visual and verbal memory. For example, it would be easy to for them to attend, firstly, to the 'named' underlying pattern like 'triangle', 'parallelogram', 'diamond' and 'hour-glass', before proceeding to recognise sub-variant patterns (Liu 1995). This suggests that at abstract or conceptual stage, cognitive activities that transpire through the visual dimension (perception and imagery) achieve parallel expression in the verbal dimension. Schon (1983) suggested that 'drawing' and 'talking' form parallel elements in the 'language of designing' (p.80). Tulving (1983) supported this parallel modality of visual-verbal representation:

> Words have useful properties: they have meanings and semantic senses; they can be presented either visually or auditorily, or both; their mode of presentation within a given modality can also be varied, by using different typescripts, speakers' voices, spatial locations, and the like. (Tulving, 1983, p.147)

The notion that there exists a parallel expression of cognitive activities in visual and verbal dimension provides us with a theoretical basis for coding tutorial conversations.

4.7. Encoding Cognitive action segment

Encoding segments enables us to undertake a purposeful analysis, evaluation and management of data on design conversations. The challenge for the current study is that it deals with interactive conversations of studio tutorials rather than individual utterances. The latter were evident from the studies of Suwa and Tversky (1997), Goldschmidt and Weil (1998) and Suwa, Purcell et al. (1998). The former consist of rich cognitive interactions between tutors and students. There is a need to derive a coding framework for protocols that express such interactions. This would allow us to encode segments, which is the process of applying 'a code to a single segment' (Maher and Tang, 2003, p.51).

As in the study of Suwa, Purcell et al. (1998), a segment may also possess several coding categories and subcategories. The current study adopts this approach in order to express information-rich and interactive activities in tutors and students' conversation protocols. Accordingly, we identify a segment based on the following coding categories: *Cognitive action, Cognitive organisation, Knowledge domain* and *Transformation type*. In the following sections, we discuss the basis for such a coding scheme for conversation protocols. This then leads to subsequent section 4.8, which describes and discusses the format for tabulating data of cognitive attributes denoted through the prescribed coding scheme.

4.7.1. Cognitive action

Based on the parallel or 'co-evolving' development of problems and solutions in design cognition (Schon 1993; Clancey 1997; Suwa, Gero et al. 2000; Dorst and Cross 2001; Maher and Tang 2003; Lawson 2006), we derive a category of Cognitive action consisting of (1) problem *formulation*, (2) *evaluative* function and (3) solution *moves*. Through this category, we acknowledge that designers mutually redefine problems and solutions until a firm problem-solution 'coupling' (Clancey 1997) or 'bridge' (Dorst and Cross 2001) emerges as a fitting proposition for specific design tasks. It is reasonable to suggest that an experienced designer would have access to a substantial repository of problem-solution 'indices'. Perceptually, this would allow him or her to make an automatic link between a particular problem formula and a move for a corresponding solution. If there is disparity between tutors and students in terms of *formulate*, *evaluate* and *move* actions, then this would point to different capability in 'bridging' problem-solution between the groups.

We made inferences as to what these Cognitive actions are in the current tutorial protocols. Based on work of Austin (1976), these actions are clearly identifiable by the role they 'intend' to perform (i.e. 'performative') in a coherent segment. We further outline the three types of Cognitive action as follows:

Formulate action

As discussed in the previous chapter, it is useful to designate *framing* activities within a general category of problem *formulation* that also include *ways of understanding* and *identifying* problems (Lawson 2006). This avoids the potential confusion in definition (Valkenburg 2003; Lawson 2006) that might arise through the use of Schon's archetypical 'frame' activity as the overarching category. Nevertheless, the current study also

encompasses framing as a 'selective window' to formulate and structure problems. Some of the examples of Formulate actions are as follows:

Tutor T1 prescribing the feel for space in a design (Tutorial Session 1)

Segment	Contributor	Protocol Segments
47	T1	And I think, you know, *once things start to find a place*, and I think things are really, you know, they're beginning to look as though they've *got some life*, you know, which is exciting

Tutor T2 makes formulating enquiry on configuration of scheme (Tutorial Session 2)

Segment	Contributor	Protocol Segment
45	T2	Is there another *framework that holds the whole building* together then. You know, in terms of where you arrive and where you leave, how does the circulation in a way gives some sense of order to these various programmes that are beginning to come together. Have you begun to develop that?

Tutor T4 asks for relationship between spaces (Tutorial Session 4)

Segment	Contributor	Protocol Segment
23	T4	And how are these spaces *connected?*

Evaluative action

According to Lawson (2006), skilled designers cannot avoid making both objective and subjective evaluations in design. Being evaluative incorporates various abilities in making specific judgements about the value of certain object of attention or subject matter. For the current study, we postulate that the *Evaluative* function groups together iterative activities like analysis, synthesis and evaluation. These activities form an effective 'processing' environment between problem and solution 'spaces' illustrated by the 'co-evolving' model of design (Dorst and Cross 2001). Some examples of Evaluate action are as follows.

Tutor T2 enquires whether building program fits site (Tutorial Session 2)

Segment	Contributor	Protocol Segment
20	T2	I mean, is the site *big enough to do all* that?

Tutor T3 expresses his judgement on a feature of building (Tutorial Session 3)

Segment	Contributor	Protocol Segment
40	T3	That seems *too physical*, really, it's not actually part of the building, is it? *It's just a screen*, really (reference to sketch)

Tutor T4 compares sketches to model (Tutorial Session 4)

Segment	Contributor	Protocol Segment
46	T4	Although interestingly these *sketches don't relate that closely to this model*

Move action

Designers prescribe solutions through a variety of *move* actions. This as parallel to the idea of Goldschmidt (p.195), who equates a design move to a move in chess: 'a design move is a step, an act, an operation, which transforms the design situation relative to the state in which it was prior to that move' (Goldschmidt 1995). In the same light, a segment of utterance from a designer is comparable to the conventional idea of a 'design move'. The following segments reflect this type of action.

Tutor T2 asks student to configure a framework for space planning (Tutorial Session 2)

Segment	Contributor	Protocol Segment
58	T2	Now, what you need to do is to start looking at *organising kind of a framework* that allows the users to move around these various spaces, and also the quality of the spaces, the quality of light that you envisage in these various areas

Tutor T3 prescribes an 'atmospheric' solution to a spatial problem (Tutorial Session 3)

Segment	Contributor	Protocol Segment
52	T3	I just perhaps being a bit more subtle somehow, so you keep the enclosure of the space in the darkness and sombre light and just see (sketch)....

Tutor T4 suggests an intervention in a tower building (Tutor Session 5)

Segment	Contributor	Protocol Segment
91	T4	You know, I wonder whether that tower, if you could open up the top part of it..... to make the café in there (starts sketching)

4.7.2. Cognitive Organisation

Design activities draw considerably from visual cognitive activities. At abstract or conceptual level, there is parallel expression between visual and verbal dimension of cognition (Fish and Scrivener 1990). Since tutorial conversations are discourses on design rather than about designing itself, we consider it appropriate to infer visual activities from verbal expressions as well as explicit physical gestures that transpire during tutorial conversation. We then categorise these inferred visual activities in relation to basic processing functions of human vision. In the current study, basic visual functions pertain to the organisation of 'percepts' and imagery that emerge at the forefront of attention during tutorials. Based mainly on the work of Ullman (1996), the human visual processing addresses the following three kinds of organisational activities and their respective examples in the tutorial conversation protocols:

Low level vision (Componential)

This activity relates to process of extracting primitive physical properties from objects in the visible environment. This includes 'depth', 'three-dimensional (3-D) shape', 'boundaries' and 'surface material properties' (Ullman 1996). This is the 'bottom up' approach that we find in perception. It is also called early or local vision (Subirana-Vilanova 1993). For the current study, we can call it *componential* organisation due to its early identification of components or parts of objects that emerge in the visual field. The following are some examples componentially organised segments.

Student S1 reflecting on the size of her plans (Tutorial session 1):

Segment	Contributor	Protocol Segments
44	S1	I think I might have made the plans a bit small. I think the rooms are a bit small because every time I start doing it I get smaller and smaller

Tutor T1 commenting on the scale of student's plans (Tutorial session 1):

Segment	Contributor	Protocol Segments
46	T1	I think that you're working on a small scale in any case. I mean, what is it, 1:200? It's tiny

Tutor T1 recognising a familiar shape in plan (Tutorial session 6)

Segment	Contributor	Protocol Segment
32	T1	What's that....what's that 'kink' in the plan here? (sketch plan)

Intermediate level vision (Structural)

Unlike 'high level vision', this process does not depend on specific knowledge about objects or domain knowledge (Ullman 1996). It relies on its own 'gestalt' dynamics that work on ambiguous, embedded or occluded visual objects so that the latter become more explicit and amenable for subsequent 'top down' visual processes like symbolic or high level cognition to occur. It is also called *global* vision (Subirana-Vilanova 1993). This level concerns the more organisational aspect of vision like segmenting, grouping, linking, differentiating, combining and restructuring of visual elements. The following segments are good examples of this kind of organisation.

Tutor T1 describes conceptual link between several elements of design (Tutorial session 6):

Segment	Contributor	Protocol Segment
107	T1	And this is a central sort of zone or a pin that's holding the two cubes together. It could be expressed more distinctly. Yeah, I mean, it might push up both the roof at this point (reference to section sketch)

Tutor T3 seeks clarification on the arrangement of building elements (Tutorial session 8):

Segment	Contributor	Protocol Text
17	T3	I mean is that trying to enclose not just the theatre but the proper foyer and the other things around it?

High level vision (Symbolic)

This kind of organisation concerns the interpretation and use of information in the image, rather than direct recovery of physical properties (Ullman 1996). It is also called symbolic or late vision (Subirana-Vilanova 1993). Kosslyn (1999) further described that high level visual processing does not only involve perception but also mental imagery. In addition, it also relates to the faculty of 'reasoning' (Oxman 2002). Two examples of 'Symbolically' organised segments are as follows.

Tutor T1 suggests some ideas on student's space planning (Tutorial session 7):

Segment	Contributor	Protocol Segment
71	T1	You could do what you are proposing here and glaze each floors and say, well okay, this is a kind of a continuation of the space out into something semi-public that can happen here (points to centre of atrium)

Student S5 describes design scheme (Tutorial session 5):

Segment	Contributor	Protocol Segment
64	S5	So that's like the main place for learning and studying, exhibition, and then the more communal, well, the more recreational thing is the word

4.7.3. Domain of Knowledge

This category reflects on the kind of knowledge designers employ in cognitive activities as reflected from their protocol conversations. It concerns the distinction between content-based and process-based taxonomies in the analysis of design activities. According to Dorst and Dijkhuis (1995), reflective practice like design inherently preserves a link between the two types of knowledge. This implies that designers do not only work with knowledge at the stimulus level but also make use of higher order knowledge that will enable them to comprehend the world that they are dealing with. However, the current study is only concerned with obtaining exact differences in tutors and students' production of content-based and process-based segments rather than assessing the extent of preservation in process-content links that exist in tutors and students' segments. We differentiate between process and content domains of knowledge as follows.

Process domain of knowledge

The process domain of knowledge relates to problem solving 'processes' and issues concerning *problem-states*, *operators*, *plans*, *goals* and *strategies* (Suwa, Purcell et al. 1998). Process-based segments in protocols suggest the presence of *executive* function that brings about 'active monitoring and consequent regulation and orchestration' of cognitive activities (Flavell 1976). This implies that a 'different' kind of knowledge is involved, particularly when utterances communicate 'meta-cognitive' notions of *concepts* and *skills*, rather than just *basic information* of the 'world'.

One study that dealt with process-content classification is the experts' and novices' categorisation and representation of physics problems (Chi, Feltovich et al. 1981). The study revealed that experts' descriptions of task problems mainly involved 'underlying principles' while novices simply expressed objects and other 'surface characteristics' to those problems.

In the current study, process-based cognitive action segments alludes to *concepts, precedence, analogies, regulations, scale, model, brief and programme, strategies, frameworks* and *plans*. These examples are indicative of 'what people know about their knowledge' (Vos 2001; Vos and De Graaff 2004). The following are two of the many examples of process-based cognitive action segments in the tutorial session protocols.

Tutor T2 advises student to devise overall strategy in space planning (Tutorial session 2):

Segment	Contributor	Protocol Segment
58	T2	Now, what you need to do is to start looking at *organising kind of a framework* that allows the users to move around these various spaces, and also the quality of the spaces, the quality of light that you envisage in these various areas

Student S3 agrees on the need for planning (Tutorial session 3):

Segment	Contributor	Protocol Segment
69	S3	Yeah, I've definitely got to start *thinking about plans*

Content domain of knowledge

This category of domain knowledge relates to 'what designers see, attend to, think of and retrieve from memory' (Suwa, Purcell et al., 1998, p.457). Often, content-based knowledge refers directly to issues and elements about the actual product of design. They bear supporting information, descriptions, explanations and clarifications (Vos 2001) on products or artefacts at the centre of tutorial design conversations. The following are two examples of content-based cognitive action segments.

Tutor T3 suggest an idea on planning to student (Tutorial session 3):

Segment	Contributor	Protocol Segment
77	T3	Yeah, so maybe, maybe this has the sort of the things like the library and the external galleries in, which has it linked with the cathedral where, you know...

Student S5 enquires on planning aspect of scheme (Tutorial session 5):

Segment	Contributor	Protocol Segment
96	S5	Do you think that that position of the tower should be at this end (lower end of site) or should it be elevated (upper end of site)?

4.7.4. Transformation

We can establish the relationship between successive segments by identifying the type of transformation a current segment makes in relation to a previous one. Goel (1995) used the term 'transformation' in describing the movements of ideas: a 'lateral transformation' indicates a shift from one idea to a different idea, while 'vertical transformation' suggests a detailed development of the same idea. Similarly, Suwa and Tversky (1997) used 'focus-shift' and 'continuing' segments respectively. Using transformation to differentiate between segments enables us to investigate tutors and students' overall strategies as they experience emerging 'situations' in tutorial conversations.

There are many interpretations to these transformations. For example, 'lateral' transformation might indicate that the designer has seen a new 'opportunities' due to purposeful or unintended reorganisation of perception. In contrast, 'vertical' transformation could reflect 'deepening' deliberation on existing ideas. Both types of transformation show that tutors and students experience cognitive 'learning' during studio tutorial. The extent of these experiences is a subject of comparison in the current study. Studying studio tutorial 'conversations' as an environment of contesting 'universes' (Schon 1988) and 'discourses' (Dorst 2006) might reveal a measured level of disparity between experts (tutors) and novices (students) in cognitive actions.

4.8. Tabulated format for segments

This section proposes a unique method for tabulating conversational activities like studio tutorials. It follows earlier suggestion that each complete segment is encoded with relevant attributes (in bracket) under the following four categories: (1) *Cognitive action* (Formulate, Evaluate or Move), (2) *Cognitive organisation* (Structural, Symbolic or Componential), (3) *Domain of Knowledge* (Process or Content), and (4) *Transformation* type (Lateral or Vertical). These attributes then populate a table referred to as the *Matrix of Cognitive Interaction* as shown in example Table 4-4. Each attribute is an interpretation of a corresponding protocol segment illustrated in Table 4-3. The tables were created using Microsoft Excel application. The following sections highlight the basis for the current tabulation format.

4.8.1. Systematic and coherent description of cognitive actions in conversation

The proposed tabulation scheme forms an effort to represent and capture protocol data from a series of live tutorials performed between two groups of designers (i.e. tutor and student) who possess disparate levels of expertise. These tutorials are *interactive* and *dynamic* in nature. Therefore, extracting information from two interacting subjects through a common framework of analysis and evaluation is by no means easy and forthright. This differs substantially from many previous studies on design expertise and cognitive activities, which often analysed and compared protocol data obtained from discrete 'talk-aloud' method applied to individual or team designers (e.g. Goldschmidt (1995), Suwa and Tversky (1997) and Suwa, Purcell et al. (1998)).

Table 4-3: Selected Protocol segments 45-57 of Tutorial session 2 (Tutor T2, Student S2)

Segment	Contributor	Protocol Segment
45	T2	Is there another *framework that holds the whole building* together then. You know, in terms of where you arrive and where you leave, how does the circulation in a way gives some sense of order to these various programmes that are beginning to come together. Have you begun to develop that?
46	S2	Yeah, the main entrance will be here and will kind of allow you to walk almost all the way through. You have a door here door there (model)
47	T2	Have you kind of develop that *idea in terms of plans* anywhere yet?
48	S2	Of course, I've got some ideas. This was just a quick sketch of what I imagined this ground floor to be. You've got most access running up this side of Brown Lane side so from there you'll be able to, I'm trying to find.....anyway, basically this side where most of the circulation (model)
49	T2	So you've got circulation around that edge, which is this one here (models)
50	S2	You can go down, that's going to be a (shoved) close to that wall. There'll be like that cube where you can go along into this....(model)
51	T2	I think that this is a good model, yeah. What I think you need to do is to in a way *develop a large scale model* for this, you know, that explains the whole scheme
52	T2	Because at the moment what we have is lots of information everywhere, but I think in a way symptomatic of how the project is developing as well. I think it's *developing in a piecemeal*, right. I kind of sensed that because you were searching when we're having our discussion. Basically is, you've got lots of ideas but it seems to be, in a rather chaotic manner
53	S2	Yeah, I just *need to organise* it
54	T2	Yeah, and I think in a way *that reflects in the way you present* your architecture across
55	T2	I think that you should do for next week in our next tutorial, *establish a very clear set of drawings* that determine what's happening at what level, what type of spaces that you envisage at the lower ground floor
56	S2	Do you reckon that this is *too much going on* in the building?
57	T2	No, that's irrelevant. It doesn't matter whether how much, I think. That's not the question, *the question is what is your brief right? W*hich is a series of basically three, starting with the studio.....you've got main studio, you've got rentable space and private accommodation on the ground floor as well, with the display gallery space

In the proposed method of tabulation in Table 4-4, *Cognitive actions*, *Cognition organisation* and *Domain of knowledge* are categories that provide *exact* qualities of a segment. The *Transformation* category (i.e. lateral or vertical) reveals the nature of relationship between successive segments. It denotes the *directional* quality of a segment.

Table 4-4: Matrix of Cognitive interaction for Tutorial session 2 (Segments 45 to 57)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
45	T2	T2	F	F	ST	SY	PRO	PRO	L	L	0.333
46	T2	S2	F	F	SY	SY	PRO	CON	L	V	0.167
47	S2	T2	F	F	SY	SY	CON	PRO	V	V	0.100
48	T2	S2	F	F	SY	CO	PRO	CON	V	V	0.983
49	S2	T2	F	F	CO	SY	CON	CON	V	V	0.083
50	T2	S2	F	F	SY	SY	CON	CON	V	V	0.117
51	S2	T2	F	M	SY	SY	CON	PRO	V	V	0.150
52	T2	T2	M	F	SY	SY	PRO	PRO	V	L	0.333
53	T2	S2	F	M	SY	SY	PRO	PRO	L	L	0.017
54	S2	T2	M	F	SY	SY	PRO	PRO	L	V	0.100
55	T2	T2	F	M	SY	SY	PRO	PRO	V	V	0.283
56	T2	S2	M	E	SY	SY	PRO	CON	V	L	0.067
57	S2	T2	E	F	SY	SY	CON	PRO	L	L	0.350

Contributor	T2	Tutor	Cognitive Organisation	CO	Componential
	S2	Student		ST	Structural
Cognitive Action	F	Formulate		SY	Symbolic
	E	Evaluate	Domain of Knowledge	PRO	Process
	M	Move		CON	Content
			Transformation	L	Lateral
				V	Vertical

By indicating *exact* and *directional* qualities in a segment, we have a dynamic and rich depiction of studio interaction. This will be useful in providing a systematic *description* for each cognitive action segment. Such a description would entail the following information: Who acts? Who initiates? What kind of action and organisation is involved? What kind of knowledge is utilised? Is the action a new or continuing action? For example, we can describe segment 45 by tutor T2 in Table 4-4 as the following:

Tutor T2 inquired how movements (Cognitive action-Formulate), i.e. arrival, circulation and departure, integrate into existing building programme (Cognitive organisation-Structural). He spoke this as a kind of framework that structures overall design of building (Domain of knowledge-Process). This 'formulative' inquiry is a shift from a previous segment (Transformation-Lateral) generated also by the same Tutor T2 (segment 44, not shown).

And a description of segment 46 by Student S2 would be as follows:

Student S2 identifies and frames the entrance position (Cognitive action-Formulate), which he recalls from memory (Cognitive organisation-Symbolic) on a working model during tutorial. He articulates on what he knows about a specific product, i.e. doors (Domain of knowledge-Content). This 'formulative' statement is development of a previous segment (Transformation-Vertical) generated by Tutor T2 (segment 45).

4.8.2. Filtering and analysing relevant information in table

In addition to having *exact* (Cognitive action, organisation and domain knowledge) and *directional* (Transformation) qualities, each segment is also *quantifiable* in terms of frequency and duration. This is especially important for the current study; in which comparing design expertise between two different groups of designers (tutors and students) is the primary focus of investigation.

By using a 'drop-down' filtering menu in Microsoft Excel, we are able to extract and calculate overall frequencies and durations of segments that form specific case studies for further analyses and evaluations. This would allow us to have a 'macroscopic' overview of, and therefore, discriminate between, tutors and students' cognitive strategies in tutorial conversations in relation to those specific case studies. In the following parts, we describe some important considerations to the filtering operations in current study.

Dependency links: relationship between current and preceding segments

A studio tutorial is an interactive and dynamic activity. What sets it apart from other environments of observation is the fact that tutor and student's utterances intertwine extensively and unpredictably in a tutorial conversation. Thus, filtering tutorial conversations is by itself a demanding task.

Prior to filtering information in a segment, it is always important to ask the following question: how do we determine the relationship between segments? We highlight *current* and *preceding* information in a segment as a sub-category under the main four categories of Cognitive actions, Cognitive organisation, Domain of knowledge and Transformation type (Table 4-4). This is to denote a link between a current and previous segment. Suwa and Tversky (1997), who defined the relationship between adjacent segments as a 'dependency link', made a similar approach.

Such a link shows the presence of basic 'chunk' formed, at least, by two adjacent segments. Through the concept of 'dependency link', we are able to track the immediate origin of

certain ideas, propositions or issues in a segment and infer their likely role in tutors and students' cognitive actions during tutorials. We could establish the affinity of a succession of segments, as had been done in the studies by Suwa and Tversky (1997) and Goldschmidt and Weil (1998). The critical number of segments involved in a dependency link depends on what we are looking for in a study.

In the investigation by Suwa and Tversky (1997), possessing 'chunks' consisting of either two or more than two segments in 'length' provide the critical threshold in differentiating the abilities of novice (students) and expert (architects) designers. For Goldschmidt and Weil (1998), the threshold for having critical 'chunks' is substantially more, six segments in total. Both studies were about design productivity. Therefore, the involvement of high number of segments for a critical 'chunk' is not surprising.

The size of 'dependency link' between segments in the current study is different from those considered by Suwa and Tversky (1997) and Goldschmidt and Weil (1998). For the current study, we are only concerned with the link between *two consecutive segments*: a *current* and *preceding* one. In a one-to-one tutorial conversation between a tutor and student, a 'dependency link' would be in any of the following configuration:

1. A current tutor segment that follows a tutor-made preceding segment
2. A current tutor segment that follows a student-made preceding segment
3. A current student segment that follows a tutor-made preceding segment
4. A current student segment that follows student-made preceding segment

To illustrate, Links 1 and 2 correspond to segments 45 and 47 respectively under the column marked 'contributor' in Table 4-4. These links belong to Tutor T2. Links 3 and 4 belong to Student S2; the former corresponds to segment 46 while the latter is absent from the same table.

Productive segments

We consider a current segment that forms this 'dependency link' to be *productive* if it follows a preceding segment made by either the tutor or student. For example, we list segment numbers 45, 47, 49, 51, 52, 54, 55 and 57 in Table 4-4 as those that constitute Tutor T2's eight productive segments. Three of these segments had followed tutor-made preceding segments (segments 45, 52 and 55), while five others had followed student-made preceding segments (segments 47, 49, 51, 54 and 57). In the same table, student S2 has five

productive segments (Segments 46, 48, 50, 53 and 56). All five segments had followed tutor-made preceding segments and, due to the range of segments selected in Table 4-4, none had followed student-made preceding segments. Besides having a 'dependency link', a productive segment also possesses attributes in the coding categories of Cognitive actions, Cognitive organisation, Domain of Knowledge and Transformation. A segment is 'complete' once it fulfils all four categories.

Identifying, assessing and comparing cases involving Cognitive action segments

Within the examples shown in Table 4-4, every segment has its own unique configuration. We could then select relevant segments for specific, case-by-case analysis through Excel's 'filtering' tool. This would allow us to gather crucial information on specific cases of Cognitive interactions in terms of segment frequency and mean duration. The following *example* demonstrates how we identify, assess and compare between specific cases of interactions.

- Example 1: Comparing two groups of Tutor T2's formulate actions, where one followed student-made preceding segment and the other followed tutor-made preceding segments

This example refers to the following Tables 4-5 and 4-6. In this example, there is a difference between the two groups of formulate actions. Tutor T2 produced *more* formulate actions that followed student-made preceding segments (n=4) than formulate actions that followed tutor-made preceding segments (n=2). However, Tutor T2 took longer time to produce formulate actions that followed tutor-made preceding segment (mean=0.167min) than those that followed student-made preceding segments (mean=0.158min). We could then deduce the significance of such findings. However, whether these differences are significant is a separate matter. In any case, this exercise is only an example involving a group of samples that ranged only between segments 45 to segments 57 as originally shown in Table 4-4.

Table 4-5: Tutor T2's formulate actions that followed tutor-made preceding segment

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
45	T2	T2	F	F	ST	SY	PRO	PRO	L	L	0.333
52	T2	T2	M	F	SY	SY	PRO	PRO	V	L	0.333

Segment frequency 2 Mean duration 0.167 min

Table 4-6: Tutor T2's formulate actions that followed student-made preceding segment

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
47	S2	T2	F	F	SY	SY	CON	PRO	V	V	0.100
49	S2	T2	F	F	CO	SY	CON	CON	V	V	0.083
54	S2	T2	M	F	SY	SY	PRO	PRO	L	V	0.100
57	S2	T2	E	F	SY	SY	CON	PRO	L	L	0.350

Segment frequency 4 Mean duration 0.158 min

Many other types of analysis are possible through this simple method. For instance, based only on segments contained in Table 4-4, the following Example 2 compares the distribution of Formulate actions between Tutor T2 and Student S2 in cases that involve the distribution of Transformation type (lateral and vertical transformation).

- Example 2: Comparing distribution of Tutor T2 and Student S2 Formulate actions in relation to Transformation type

We have selected the relevant information for analysis in the following Tables 4-7 and 4-8. In comparing the cases in question, we found that Tutor T2 had produced more formulate actions in the lateral transformation (n=3) than Student S2 (n=0) did. In terms of formulate actions that transformed vertically, the number of segments produced by Tutor T2 and Student S2 is the same (n=3). However, the situation is not the same in relation to mean duration. Student S2 clearly took longer time to make such actions (mean=0.422 min) than Tutor T2 did (mean=0.094 min). In a real analysis, such difference in duration would have been further scrutinised. Then again, this is only an example of how we could apply the current tabulation method of analysis to conversational data obtained in the current study. Thus, it is an exercise to explain to rather than to inform.

Table 4-7: Tutor T2's formulate actions and distribution of Transformation type

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
45	T2	T2	F	F	ST	SY	PRO	PRO	L	L	0.333
47	S2	T2	F	F	SY	SY	CON	PRO	V	V	0.100
49	S2	T2	F	F	CO	SY	CON	CON	V	V	0.083
52	T2	T2	M	F	SY	SY	PRO	PRO	V	L	0.333
54	S2	T2	M	F	SY	SY	PRO	PRO	L	V	0.100
57	S2	T2	E	F	SY	SY	CON	PRO	L	L	0.350

Segment frequency Lateral 3 Mean duration Lateral 0.339 min
Vertical 3 Vertical 0.094 min

Table 4-8: Student S2's formulate actions and distribution of Transformation type

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
46	T2	S2	F	F	SY	SY	PRO	CON	L	V	0.167
48	T2	S2	F	F	SY	CO	PRO	CON	V	V	0.983
50	T2	S2	F	F	SY	SY	CON	CON	V	V	0.117

Segment frequency		Mean duration		
	Lateral 0		Lateral	0 min
	Vertical 3		Vertical	0.422 min

There is a need to emphasize that examples 1 and 2 serve only to inform us *how* we could use the tabulation and analytical methods derived in this chapter in order to examine interactions that occur in tutorial conversations. Obviously, they are *not* real findings and the data presented in the original Table 4-4 does not represent the true picture of what generally transpires during Tutorial Session 2. In fact, these examples merely represent *simulations* of actual analyses that we intend to perform on the extensive protocol data elicited from tutorial conversations. Thereafter, we describe the real findings that resulted from these methods of analysis in the following Chapters 5, 6, 7 and 8. What we hope to achieve in these examples and simulations is an appreciation of the nature, scope and complexity of subject matter that we are dealing with in the current study of tutorial conversations.

4.9. Summary

1. We investigated aspects of cognition that would be crucial to the study of tutorial conversations. One of the issues that might influence the direction of the current study is the parallel modes of visual and verbal actions. We could observe these parallel modes of cognition from the protocols that tutors and students made in conversation. These actions become explicit during tutorials due to the nature of conversations as conceptual discourses rather than actual acts of designing. This then facilitates the gathering and analysis of conversational data.

2. We examined two types of protocol analysis used in past studies in design activities. These are the concurrent and retrospective protocol analysis. The chapter provided some examples in the application of these methods, particularly in terms of how various studies used macro and microscopic strategies in studying verbal and sketches. Central to these strategies were ways to link learning and knowledge

structures like 'chunks' to the productivity of design actions (Suwa and Tversky 1997; Goldschmidt and Weil 1998).

3. Also discussed, were methods of segmenting and encoding protocols obtained from tutorial conversations. This lead to the creation of coding categories based on Cognitive actions, Cognitive organisation, Domain of knowledge and Transformation type. By encoding the segments, we achieve a table called the Matrix of Cognitive interaction for data distribution purposes. Through Excel 'filtering' facility, we elicit only relevant data of cognitive interactions for analysis. Regarding this, some examples were given on how we could elicit the necessary data.

4. Due to the intertwining nature of conversational data, it was necessary to clarify the nature of segments and the links they have between them. In particular, are links between two consecutive cognitive action segments. We defined a productive segment as one that forms a kind of 'dependency link' with a preceding segment as well as having attributes in all coding categories as previously mentioned. By introducing the idea of 'dependency link', we embody the 'flow' or trajectory of situated cognition that prevails during tutorial conversation in our analysis.

CHAPTER 5

Cognitive actions: The basic study of expertise in tutorial conversations

5.1. Introduction

In this section, we first establish the nature of expertise by comparing Cognitive actions that tutors and students performed in the twelve tutorial sessions recorded for the purpose of the current study. There are three types of Cognitive actions: Formulate, Evaluate and Move actions. These are measured by the number actions made by tutors and students, and by the length of time these actions take. By examining these actions, it is possible for us to identify and measure underlying factors that differentiate expert and novice designers in tutorial sessions. We regard Cognitive actions as the most explicit output in designer's conversations. These, together with other categories like Cognitive organisation, Domain of knowledge and Transformation, lead a narrative of cognitive activities at work during tutorial sessions.

Following the presence of these actions in tutors and students' tutorial design conversations, we ask a fundamental question: A*re there significant differences in the way tutors and students employ Cognitive actions throughout these tutorial conversations?*

5.2. Outline of analysis

The following sections provide a good start in uncovering and verifying basic assumptions of expertise based on our understanding of Cognitive actions. We envisage a framework of analysis more or less outlined by the following questions:

- Are there significant differences between tutors and students concerning the production of each Formulate, Evaluate and Move action?

- How significant is the association between Cognitive actions (Formulate, Evaluate & Move) and the expertise level of contributors (tutors and students)?
- Is there any meaningful correspondence between these Cognitive actions such that they explicate further the nature of the differences between tutors and students?

5.3. Direct production of Cognitive actions

In this section, we identify basic findings based on the direct distribution of Formulate, Evaluate and Move actions in tutors and students.

5.3.1. Cognitive action distribution

Finding: Tutors produced more Cognitive actions than students

Using two-way Chi-square test on Table 5-1, we establish that Cognitive actions are very significantly associated with the level of expertise in tutors and students (χ^2=89.47, $p<0.001$, df=2). In total, tutors produced more Cognitive actions (n=739) than students (n=506). Formulate actions provided the highest number and proportion of segments in the Cognitive action category for Tutors (n=442, 59.8%) and students (n=385, 76.1%). The lowest number and proportion of segments for tutors (n=57, 7.7%) and students (n=71, 14.0%) comes from Evaluate actions. Even so, there appear to be marginal differences in the number of Formulate and Evaluate actions between tutors and students. In contrast, tutors (n=240) produced nearly *five times* more Move actions than students (n=50). Proportionately, tutors' Cognitive actions (32.5%) contained *three* times more Move actions than those in students' Cognitive actions (9.9%) (Table 5-2). The following analysis substantiates the differences.

Table 5-1 Segment frequency of Cognitive Actions (Total)

		No. of Cognitive action segments			Row total
		Formulate	Evaluate	Move	
Level of Expertise	Tutor	442	57	240	739
	Student	385	71	50	506
Column total		827	128	290	1245

Table 5-2 Percentage of total Cognitive Actions

		% of Cognitive action segments			%
		Formulate	Evaluate	Move	
Level of Expertise	Tutor	59.8	7.7	32.5	100
	Student	76.1	14.0	9.9	100

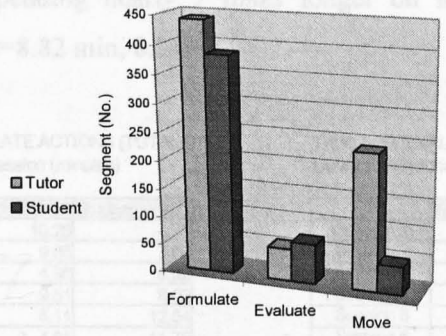

Figure 5-1 Distribution of Cognitive actions (Total)

5.3.2. Differences in Cognitive actions between tutors and students

Finding: Tutors made more Move actions and spent more time in making them than students

The Wilcoxon-Mann-Whitney test was used to determine if there are significant differences in the distribution of duration taken in Formulate, Evaluate and Move actions between tutors and students (Tables 5-3A, 5-3B & 5-3C). Through such comparisons, it is possible to establish if these Cognitive actions derive from the same statistical population. If there is no significant difference in the distribution of duration, we could infer that tutors and students use common strategies in making a particular Cognitive action. However, if the result shows significant difference in the distribution of duration, then we could infer that tutors and students use different cognitive strategies.

In the study, we found that tutors and students did not differ significantly in Formulate ($U=69.000$, $p=0.887$) and Evaluate actions ($U=49.000$, $p=0.193$). However, we found very *significant* difference in the time taken between tutors (mean=4.93) and students (mean=0.74 min) ($U=0.000$, $p<0.001$) in Move actions.

Judging from the time spent in producing verbal protocols of these Cognitive actions, we view that tutors and students probably use similar strategies of cognition in Formulate and Evaluate actions. Tutors and students spent the biggest proportion of their time on Formulate actions (78.77 min, 54.1%; 83.62 min, 79% respectively). Evaluate actions elicited lesser amounts of time for both tutors (7.75 min, 5.3%) and students (13.37 min, 12.6%). The quality of tutors' Move actions appears to be significantly different from

students; with tutors spending nearly *7 times* longer on Move actions (t=59.11 min, 40.59%) than students (t=8.82 min, 8.34%).

Table 5-3A: FORMULATE ACTIONS (TOTAL)
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	10.26	4.73
Session 2	9.65	7.96
Session 3	4.96	6.62
Session 4	9.51	8.02
Session 5	5.11	12.04
Session 6	4.61	11.79
Session 7	6.56	3.88
Session 8	3.51	3.26
Session 9	3.33	3.29
Session 10	9.67	6.84
Session 11	4.88	4.74
Session 12	6.73	10.45
Total	78.77	83.62
Mean	6.56	6.97
Std Deviation	2.57	3.16

U=69.000, p=0.887, two-tailed test

Table 5-3B: EVALUATE ACTIONS (TOTAL)
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	0.92	1.58
Session 2	1.25	0.45
Session 3	0.33	0.72
Session 4	0.37	0.22
Session 5	0.88	4.48
Session 6	0.15	1.47
Session 7	0.15	0.57
Session 8	0.43	0.55
Session 9	0.00	0.08
Session 10	0.38	0.57
Session 11	1.38	1.01
Session 12	1.50	1.67
Total	7.75	13.37
Mean	0.65	1.11
Std Deviation	0.52	1.18

U=49.000, p=0.193, two-tailed test

Table 5-3C: MOVE ACTIONS (TOTAL)
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	4.66	1.20
Session 2	7.71	0.15
Session 3	4.70	0.58
Session 4	5.00	0.10
Session 5	5.60	1.89
Session 6	4.03	0.00
Session 7	5.30	0.10
Session 8	3.18	0.33
Session 9	3.80	0.18
Session 10	5.56	1.05
Session 11	7.13	1.24
Session 12	2.45	2.00
Total	59.11	8.82
Mean	4.93	0.74
Std Deviation	1.51	0.72

U=0.000, p<0.001, two-tailed test

Following this, we propose that mastering Moves is a key factor in gaining expertise here. We find this notion very useful not only as a significant finding in itself, but also in assessing the relationships between Move action and other types of Cognitive actions in this chapter, and segment encoding categories (Cognitive organisation, Domain of knowledge, and Transformation) in subsequent chapters.

Table 5-4A Total Duration of Cognitive Actions

		Total Duration of Cognitive Actions (min)			Total
		Formulate	Evaluate	Move	
Level of Expertise	Tutor	78.77	7.75	59.11	145.62
	Student	83.62	13.37	8.82	105.80

Table 5-4B Percentage total duration of Cognitive Actions

		% of total duration of Cognitive actions			%
		Formulate	Evaluate	Move	
Level of Expertise	Tutor	54.1	5.3	40.6	100
	Student	79.0	12.6	8.3	100

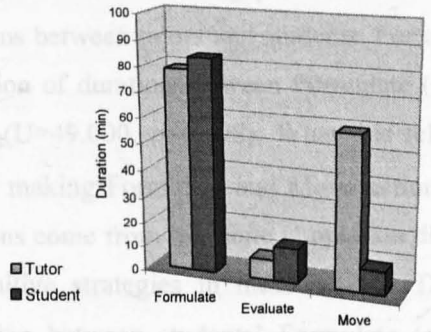

Fig 5-2 Duration in Cognitive Actions

5.4. Similarities and differences in the distribution between types of Cognitive actions

In this section, we determine if there is meaningful correspondence between the types of Cognitive actions made by tutors and students. In particular, we looked at analyses involving Move actions, which were identified previously as key factor in expertise. Two comparisons were made; one concerning Formulate and Move actions, and the other, Evaluate and Move actions. We based these comparisons on the distribution of time tutors and students spent in making those actions.

The first comparison relates to an assumption in terms of productivity in design cognition; that there is a link between problem *formulation* and solution *moves*. We substantiate this by assessing differences in the distribution of duration in Formulate and Move actions between tutors and students in section 5.4.1. The second comparison relates to an assumption in designers' cognitive strategy in design problem solving; novices usually use deductive and backward-reasoning techniques whereas experts apply forward-reasoning approach in problem solving. We substantiate this by comparing differences in the distribution of duration in Evaluate and Move actions between tutors and students in section 5.4.2. We make the two comparisons by using the Wilcoxon-Mann-Whitney test.

The following findings reveal the extent of similarities and differences between the types of Cognitive actions made by tutors and students.

5.4.1. Comparing between Formulate and Move actions

Finding: Tutors used similar cognitive strategies in Formulate and Move actions

In Tables 5-5A and 5-5B, we see contrasting patterns in the distribution of duration of Formulate and Move actions between tutors and students. For tutors, there is no significant difference in the distribution of duration between Formulate (mean=6.56 min) and Move (mean=4.93 min) actions (U=49.000, p=0.198). What this tells us is that tutors commit similar amount of time in making Formulate and Move actions. Since duration of tutors' Formulate and Move actions come from the same population distribution, we can infer that tutors apply similar cognitive strategies in these actions. Due to the very significant difference in mean duration between students' Formulate (mean=6.97 min) and Move (mean=0.74 min) actions (U=0.000, p<0.001), students probably use dissimilar cognitive strategies between these actions.

We expand the issue of cognitive strategies more comprehensively in the following chapters by considering the relationship between Cognitive actions and other influential factors such as Cognitive organisation, Domain of knowledge, Transformation and current-preceding link.

Table 5-5A TUTOR FORMULATE & MOVE ACTIONS
Duration (minutes)

	Formulate	Move
Session 1	10.26	4.66
Session 2	9.65	7.71
Session 3	4.96	4.70
Session 4	9.51	5.00
Session 5	5.11	5.60
Session 6	4.61	4.03
Session 7	6.56	5.30
Session 8	3.51	3.18
Session 9	3.33	3.80
Session 10	9.67	5.56
Session 11	4.88	7.13
Session 12	6.73	2.45
Total	78.77	59.11
Mean	6.56	4.93
Std Deviation	2.57	1.51

U=49.000, p=0.198, two-tailed test

Table 5-5B STUDENT FORMULATE & MOVE ACTIONS
Duration (minutes)

	Formulate	Move
Session 1	4.73	1.20
Session 2	7.96	0.15
Session 3	6.62	0.58
Session 4	8.02	0.10
Session 5	12.04	1.89
Session 6	11.79	0.00
Session 7	3.88	0.10
Session 8	3.26	0.33
Session 9	3.29	0.18
Session 10	6.84	1.05
Session 11	4.74	1.24
Session 12	10.45	2.00
Total	83.62	8.82
Mean	6.97	0.74
Std Deviation	3.16	0.72

U=0.000, p<0.001, two-tailed test

5.4.2. Comparing between Evaluate and Move actions

Finding: Students used similar cognitive strategies in Evaluate and Move actions

We also look at Evaluate and Move actions with interest. There was no significant difference in the duration taken by students in making Evaluate (mean=1.11 min) and Move

actions (mean=0.74 min) (U=58.000, p=0.434). In contrast, the times tutors take to make Evaluate (0.65 min) and Move (4.93 min) actions are very significantly different (U=0.000, p<0.001).

Since the distribution of time taken in students' Evaluate and Move actions derived from the same population, we can infer that cognitive strategies between them are probably similar. In contrast, the large difference in the distribution of time taken between tutors' Evaluate and Move actions points to the possibility that tutors use different strategies in making them.

Table 5-6A Comparing Tutors' Evaluate & Move actions Duration (minutes)

	Evaluate	Move
Session 1	0.92	4.66
Session 2	1.25	7.71
Session 3	0.33	4.70
Session 4	0.37	5.00
Session 5	0.88	5.60
Session 6	0.15	4.03
Session 7	0.15	5.30
Session 8	0.43	3.18
Session 9	0.00	3.80
Session 10	0.38	5.56
Session 11	1.38	7.13
Session 12	1.50	2.45
Total	7.75	59.11
Mean	0.65	4.93
Std Deviation	0.52	1.51

U=0.000, p<0.001, two-tailed test

Table 5-6B Comparing Students' Evaluate & Move actions Duration (minutes)

	Evaluate	Move
Session 1	1.58	1.20
Session 2	0.45	0.15
Session 3	0.72	0.58
Session 4	0.22	0.10
Session 5	4.48	1.89
Session 6	1.47	0.00
Session 7	0.57	0.10
Session 8	0.55	0.33
Session 9	0.08	0.18
Session 10	0.57	1.05
Session 11	1.01	1.24
Session 12	1.67	2.00
Total	13.37	8.82
Mean	1.11	0.74
Std Deviation	1.18	0.72

U=58.000, p=0.434, two-tailed test

5.5. Discussion

In terms of segment frequency or duration, a coherent picture begins to emerge regarding the patterns of Cognitive actions of the tutors and students in tutorial conversations. In particular, this concerns Move actions. We found tutors were more productive in making Move actions and spent longer time in making them than students. We then compared Move actions with Formulate and Evaluate actions in terms of the distribution of duration taken by tutors and students. Tutors' duration of Formulate and Move actions came from the same population distribution since there was no significance difference between these groups of Cognitive action. With this, we infer the possibility that tutors' Formulate and Move actions involve similar cognitive strategies based on a general pattern of behaviour observed from the tutorials. In contrast, significant differences in mean duration between students' Formulate and Move actions might suggest the use of different cognitive strategies during tutorials.

Concerning tutors' Evaluate and Move actions, the differences in the time taken in these actions were very significant. In contrast, the differences in students' time for Evaluate and Move actions were not significant. Such disparities in comparing corresponding categories of Cognitive actions appear to suggest that certain strategies in cognition are mediating the way tutors and students make verbal descriptions and representations across the three types of Cognitive actions during tutorial sessions. In contrast, both tutors & students seem to perform equally to the tasks of Formulate and Evaluate actions given that they did not show significant statistical differences in the distribution of time taken between these actions.

From current analyses, Move actions appear to be a key factor in understanding tutors and students' behaviours during design conversations. However, such analyses do not enable us determine the exact nature of cognitive strategies governing the apparent differences between the two groups in the tutorials, particularly in relation to the comparisons made between Formulate and Move actions and Evaluate and Move actions. It must be stressed that the main focus of observation here are tutors and students' behaviours in tutorial conversation rather than in terms of a predetermined level of expertise. Current methodology did not stipulate means for establishing tutors and students' intentions or objectives in conversation. As such, there could be many interpretations as to why tutors and students behaved the way they did in those tutorials. As it was, we were only able to consider the 'syntactic' attributes of specific cognitive actions performed by the participants, rather than the 'semantic' basis for such actions. Alternatively, we could suggest that a longer duration spent on a particular cognitive action might be an implicit effort by the tutor or student to comprehend 'emerging' situations in tutorials. A tutor might also need longer period to feel their way around such situations than students who could be more familiar with the quality of their own work as well as prevalent circumstances in which these works were made.

5.6. Summary

1. In total, tutors produced more Cognitive action segments than students. Dividing these Cognitive action segments into their respective Formulate, Evaluate and Move action categories, we found very significant association (Chi sq $p<0.001$) between these Cognitive actions and the type of participant in the design tutorial sessions. A sizeable proportion of students' overall Cognitive actions consisted of Formulate actions (76.1%). For tutors, the overall production of Formulate actions was smaller (59.8%)

in proportion. On the contrary, they produced more Move actions (32.5%) than students did (9.9%)

2. Tutors produced more Move actions and spent more time in making them than students had. In terms of segment frequency, tutors produced nearly *five* times greater Move actions than students did. Very significantly, tutors' duration of Move actions was *seven* times longer than the time it took for students to produce them ($U=0.000$, $p<0.001$). Move action is the key to differentiating the cognitive abilities between tutors and students. Potentially, this could also be an important indicator for design expertise. However, further study is required to uncover the nature of these Move actions, particular that pertaining to the objectives or intentions of tutors and students who made such actions. Current analyses only reveal the 'syntactic' nature of cognitive interactions in tutorial conversations rather than semantic one.

3. There is no significant difference in terms of mean duration between tutors' Formulate and Move actions. One possibility might be that tutors invoked similar cognitive strategies in producing these actions. On the other hand, the difference in mean duration between students' Formulate and Move actions was very significant, indicating that different cognitive strategies could be involved in making these actions. However, it must be emphasised that these are only speculative reasons. This is due to the fact that current methodology did not stipulate a direct relationship between data and the intentions or objectives of conversation.

4. For students, there was no significant difference in mean duration between Evaluate and Move actions. This might indicate a link between students' Evaluate and Move actions during conversation. On the other hand, tutors' mean duration showed very significant difference between Evaluate and Move actions. However, current methodology did not stipulate a direct relationship between data and the intentions or objectives of conversation. We could only suggest that different cognitive strategies were involved between these actions. We could also infer that for tutors, there is no relationship between evaluating situations and making moves.

CHAPTER 6

Differentiating Cognitive actions through Preceding segments & Transformation

6.1. Introduction

This section follows the preliminary analyses in Chapter 5, which introduced the basic distribution of Cognitive actions in the twelve tutorial sessions observed for the current study. In this section, we draw on two important features of segment coding outlined previously in Chapter 4 (Research Methodology): dependency between *current* and *preceding* segments and the nature of *transformation* in Cognitive action segments. These features enable us to investigate Cognitive actions within the 'situational' context of tutorial conversation.

The previous chapter provided a comparison between tutors and students' groups in terms of *direct* productivity of Cognitive actions in segments. We found significant association between the segment distribution of each category of Cognitive actions (Formulate, Evaluate and Move actions) and the level of expertise in participants (tutors and students) in the tutorial conversations observed. We extended this investigation in the current chapter by studying the effects of *preceding segments* and *transformation* as differentiating factors in tutors and students' Cognitive actions. These studies aimed to address one of the hypotheses stipulated in Chapter 1: *Do expert designers (tutors) differentiate situations that 'emerge' from design conversations more readily than novice designers (students)?*

The current segment tabulation format in Microsoft Excel, discussed in the earlier chapter, allows us to identify preceding segments that resulted in these Cognitive actions. Chapter 4 (Methodology) serves as an important guide to understanding the current chapter.

6.2. Outline of analysis

This chapter involves two stages of analysis. The first stage of analysis distinguished preceding segments according to the specific cases of Cognitive actions that tutors and students made during tutorial conversation (Tables 6-1A and 6-1B). We then assessed the significance of these preceding segments on tutors and students' Cognitive actions by performing various analyses that from the sections to this chapter. From these analyses, we gathered distinct patterns of distribution in the three types of Cognitive action (Formulate, Evaluate and Move actions). In these patterns, we then determine statistically whether the two groups of expertise (tutors and students) are significantly different in each of the cases that involve preceding segments.

The second stage, we incorporate both the effects of *preceding segments* and *transformation* (lateral and vertical) to study tutors and students' Cognitive actions. This narrows the parameter of inquiry even further compared to the first stage, such that we could make appropriate inferences on the differences in cognitive activities of tutors and students as they deal with the dynamics and 'emerging' situations of tutorial conversations.

6.3. Association between Cognitive actions and Preceding segments

In this section, we aim to produce an *overall* understanding as to whether *preceding segments and direction of transformation significantly differentiate tutors and students' Cognitive actions*. Contingency Tables 6-1A & 6-1B show the respective frequency distributions between tutors and students' Cognitive actions according to the immediate origins of preceding segments.

Firstly, a Pearson Chi-square test conducted on Table 6-1A revealed that there was extremely significant *association* between tutors' Cognitive action segments and the sources of preceding segments, i.e. tutors and students who made the preceding segments (χ^2=35.495, df=2, p<0.0001). As shown in the same table, tutors' Move actions are very much self inspired since 65% of tutors' Move actions (n=156) are tutor initiated. On the other hand, tutors' Formulate and Evaluate actions drew greater inspiration from students' segments than by the tutors' own preceding segments. Students' segments provided 57.9% (n=256) & 61.4% (n=35) of the source of segments that contributed to tutors' segments in Formulate and Evaluate actions respectively.

Relating to students' Cognitive action segments (Table 6-1B), there was no relationship between these and the sources of preceding segments (tutors or students) since the probability value was not beyond .05 (χ^2=2.832, df=2, p=0.243). From the distribution in Table 6-1B, students' Formulate, Evaluate and Move actions depended more on tutors' than students' own preceding segments. These actions amount to a percentage total distribution of 73.2% (n=282), 70.4% (n=50) and 62.0% (n=31) for the Formulate, Evaluate and Move action categories respectively.

Table 6-1A Tutors' Cognitive Actions distribution according to preceding segment

Observed segments	Cognitive Actions			Row total
	Formulate	Evaluate	Move	
Tutor made preceding segments	186	22	156	364
Students made preceding segments	256	35	84	375
Column total	442	57	240	739

Table 6-1B Students' Cognitive Actions distribution according to preceding segment

Observed segments	Cognitive Actions			Row total
	Formulate	Evaluate	Move	
Tutor made preceding segments	282	50	31	363
Students made preceding segments	103	21	19	143
Column total	385	71	50	506

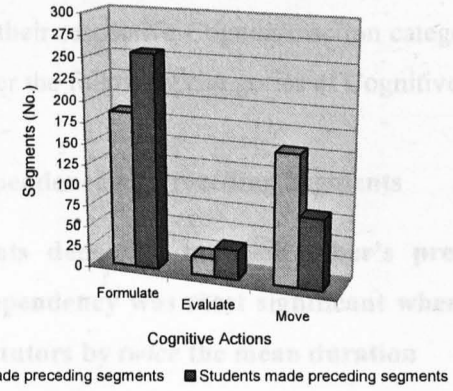

Figure 6-1A Distribution of preceding segment type in Tutors' Cognitive actions

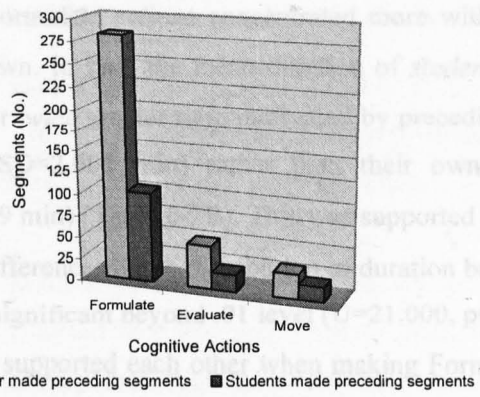

Figure 6-1B Distribution of preceding segment type in Students' Cognitive actions

6.4. Cognitive action: differentiation by preceding segments

Following Chi-square tests for associations, we proceeded to examine how each type of Cognitive action (Formulate, Evaluate and Move actions) is differentiated by the source of preceding segments (tutor-made and student-made preceding segments) between tutors and students.

The Wilcoxon-Mann-Whitney test was applied on the ranked distribution of total durations taken by tutor and students in their respective Cognitive action categories (Tables 6-2, 6-3 and 6-4) and are discussed under the following categories of Cognitive actions.

6.4.1. Formulate Actions: Dependence on Preceding Segments

Finding: Tutors and students depended on each other's preceding segments in *Formulate* actions but the dependency was most significant where students relied on preceding segments made by tutors by *twice* the mean duration

With reference to Formulate actions, the mean duration for *tutors'* segments in the category where preceding segments were made by the students (Mean=3.575 min, SD=1.773 min) was greater than those that originated from tutors (Mean=2.99 min, SD=1.969 min). However, the differences in ranked distribution of total durations between the two sources of preceding segments was not significant beyond the .05 level (U=51.000, p=0.242, two-tailed). This meant that the origin of preceding segments did not significantly differentiate tutors' Formulate actions segments.

By comparison, students' Formulate actions concentrated more with preceding segments made by tutors than their own. In fact, the mean duration of *students'* Formulate actions suggested that students spent *twice* greater time motivated by preceding segments made by tutors (Mean=4.713 min, SD=2.002 min) rather than their own preceding segments (Mean=2.255 min, SD=1.349 min) (Table 6-2B). This was supported by the Mann-Whitney test which proved that the differences in the distribution of duration between the two groups of preceding segments was significant beyond .01 level (U=21.000, p=0.002, two-tailed). In general, tutors and students supported each other when making Formulate actions through their preceding segments (Figures 6-2A & 6-2B), and *nowhere is the support more significant than in the situation when students' Formulate actions depended on preceding segments made by tutors.*

Table 6-2A Tutors' FORMULATE actions
Duration distribution by type of preceding segment

	Tutors made preceding segments	Students made preceding segments
Session 1	7.714	2.544
Session 2	4.725	4.928
Session 3	3.069	1.887
Session 4	2.112	7.395
Session 5	1.116	3.990
Session 6	1.530	3.075
Session 7	4.224	2.340
Session 8	0.852	2.660
Session 9	2.338	0.988
Session 10	4.394	5.278
Session 11	1.881	3.000
Session 12	1.911	4.814
Total Duration	35.866	42.899
Mean	2.989	3.575
Std Deviation	1.969	1.773

U=51.000, p=0.242, two-tailed test

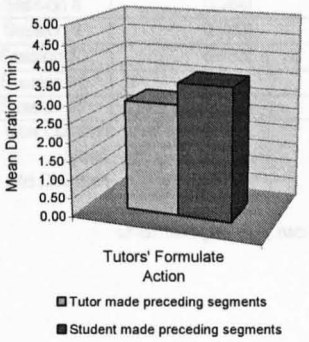

Figure 6-2A Comparing mean duration of Tutors' Formulate actions according to type of preceding segment

Table 6-2B Students' FORMULATE actions
Duration distribution by type of preceding segment

	Tutors made preceding segments	Students made preceding segments
Session 1	3.328	1.400
Session 2	6.630	1.332
Session 3	4.304	2.320
Session 4	5.035	2.980
Session 5	7.749	4.288
Session 6	7.770	4.020
Session 7	3.480	0.400
Session 8	2.160	1.100
Session 9	1.904	1.386
Session 10	4.290	2.552
Session 11	3.640	1.100
Session 12	6.265	4.182
Total Duration	56.555	27.060
Mean	4.713	2.255
Std Deviation	2.002	1.349

U=21.000, p=0.002, two-tailed test

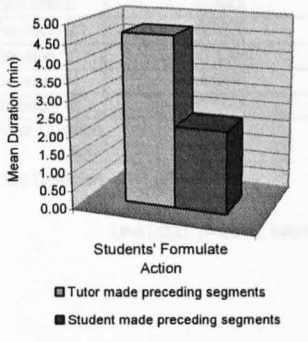

Figure 6-2B Comparing mean duration of students' Formulate actions according to type of preceding segment

6.4.2. Evaluate Actions: Dependence on Preceding Segments

Finding: Tutors and students depended on each other's preceding segments in *Evaluate* actions. Students were more dependent on preceding segments made by tutors than themselves by more than *twice* the mean duration

The overall pattern in the distribution of duration of preceding segments (Tables and Figures 6-3A & 6-3B) also suggests that tutors & students mutually support each other when undertaking this *Evaluate* action through their preceding segments. Tutors' Evaluate segments benefited more from preceding segments made by students (Mean=0.354 min, SD=0.342 min) than those made by tutors (Mean=0.292 min, SD=0.231 min). However, the Mann-Whitney test failed to establish significance beyond the .05 level in the difference of distribution in duration between the two types of preceding segments (U=67.500, p=0.809, two-tailed test) in tutors' Evaluate segments. Students' Evaluate segments were more dependent on preceding segments made by tutors (Mean=0.767 min, SD=0.869 min) than by students (Mean=0.347 min, SD=0.446 min) themselves. The disparity between these preceding segments were also not found to be statistically significant beyond .05 level (U=41.000, p=0.074, two-tailed test).

Table 6-3A Tutors' EVALUATE actions (Overall)
Duration distribution by type of preceding segment

	Tutors made preceding segments	Students made preceding segments
Session 1	0.100	0.815
Session 2	0.632	0.616
Session 3	0.334	0.000
Session 4	0.234	0.133
Session 5	0.434	0.450
Session 6	0.150	0.000
Session 7	0.000	0.150
Session 8	0.284	0.150
Session 9	0.000	0.000
Session 10	0.133	0.248
Session 11	0.567	0.816
Session 12	0.633	0.868
Total Duration	3.501	4.246
Mean	0.292	0.354
Std Deviation	0.231	0.342

U=67.500, p=0.809, two-tailed test

Table 6-3B Students' EVALUATE actions (Overall
Duration distribution by type of preceding segment

	Tutors made preceding segments	Students made preceding segments
Session 1	0.485	1.098
Session 2	0.452	0.000
Session 3	0.716	0.000
Session 4	0.000	0.217
Session 5	3.267	1.215
Session 6	1.284	0.183
Session 7	0.400	0.167
Session 8	0.400	0.150
Session 9	0.083	0.000
Session 10	0.300	0.267
Session 11	1.014	0.000
Session 12	0.800	0.868
Total Duration	9.201	4.165
Mean	0.767	0.347
Std Deviation	0.869	0.446

U=41.000, p=0.074, two-tailed test

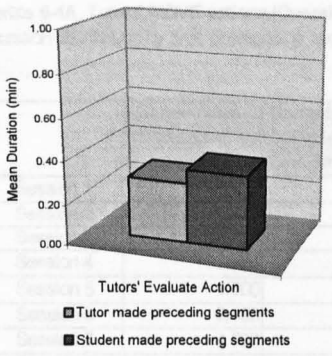

Figure 6-3A Comparing mean duration of tutors' Evaluate actions according to type of preceding segment

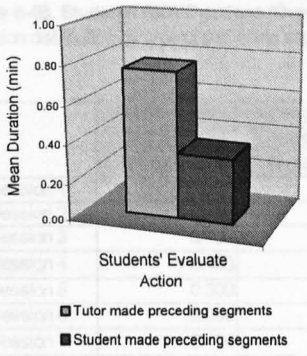

Figure 6-3B Comparing mean duration of Students' Evaluate actions according to type of preceding segment

6.4.3. Move Actions: Dependence on Preceding Segments

Finding: Tutors' *Move* actions relied more significantly on tutor-made preceding segments than student-made preceding segments, whereas preceding segments did not significantly differentiate students' Move actions

For *Move* actions, the general pattern of the results obtained from the application of Mann-Whitney tests on the following Tables 6-4A and 6-4B was substantially more distinct than those of the *Formulate* and *Evaluate* actions previously analysed. The test proved that the statistical difference in the distribution of duration of tutors' Move actions between preceding segments made by tutors and students was significant beyond the .01 level (U=25.000, p=0.006, two-tailed test). Tutors' Move actions also produced twice greater duration from tutor-made preceding segments (Mean=3.246 min, S.D=1.573 min) than from preceding segments made by students (Mean=1.680 min, S.D=1.435 min).

In contrast, unlike tutors, students did not make any distinction between the sources of preceding segments when making Move actions (U=60.000, p=0.449, two-tailed test). In terms of duration spent, there was no significant difference between students' Move actions that follow preceding segments made by tutors (Mean=0.382 min, S.D=0.382) and those that follow preceding segments made the students (Mean=0.353 min, S.D=0.562 min).

Table 6-4A Tutors' MOVE actions (Overall)
Duration distribution by type of preceding segment

	Tutors made preceding segments	Students made preceding segments
Session 1	3.690	0.965
Session 2	7.291	0.417
Session 3	3.348	1.351
Session 4	3.668	1.335
Session 5	1.600	3.996
Session 6	2.430	1.602
Session 7	4.730	0.567
Session 8	2.412	0.765
Session 9	2.730	1.068
Session 10	3.328	2.236
Session 11	2.070	5.058
Session 12	1.650	0.800
Total Duration	38.947	20.160
Mean	3.246	1.680
Std Deviation	1.573	1.435

U=25.000, p=0.006, two-tailed test

Table 6-4B Students' MOVE actions (Overall)
Duration distribution by type of preceding segment

	Tutors made preceding segments	Students made preceding segments
Session 1	0.950	0.250
Session 2	0.150	0.000
Session 3	0.400	0.183
Session 4	0.100	0.000
Session 5	0.300	1.585
Session 6	0.000	0.000
Session 7	0.100	0.000
Session 8	0.134	0.200
Session 9	0.000	0.183
Session 10	1.050	0.000
Session 11	0.868	0.368
Session 12	0.534	1.468
Total Duration	4.586	4.237
Mean	0.382	0.353
Std Deviation	0.382	0.562

U=60.000, p=0.499, two-tailed test

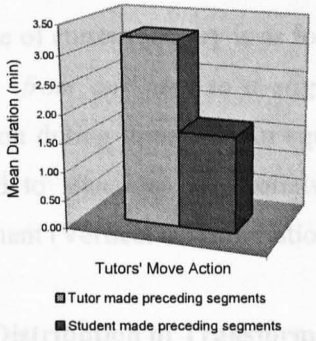

Figure 6-4A Comparing mean duration of Tutors' Move actions according to type of preceding segment

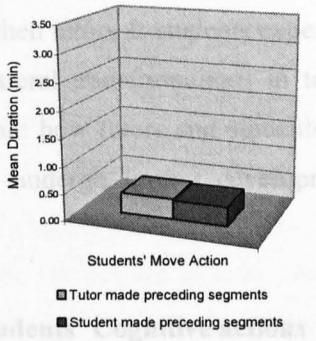

Figure 6-4B Comparing mean duration of Students' Move actions according to type of preceding segment

6.5. The factor of Transformation in Cognitive actions

Having established the impact preceding segments have on tutors and students' Cognitive actions in Section 6.4, we then ask the following question: *could the factor of transformation explain further the extent of differentiation between tutor' and students' Cognitive actions?*

In the context of *successive* segments, *Transformation* is a direct consequence brought about by *preceding* segments on tutors and students' Cognitive actions during tutorial design conversations. A preceding segment that is productive would facilitate either a lateral or a vertical type of Cognitive transformation in a subsequent segment. This gives 'directional' qualities to Cognitive actions and provides reference as to who makes a

preceding segment and who immediately benefits from it. By 'chaining' successive segments in tutorial design conversations, we are able to measure the 'direction' and origin of Cognitive activities of successive segments in terms of frequency & duration of segments.

As such, there is a need to examine the effects of preceding segments and transformation as *joint* features in the current study of Cognitive actions. However, before we can deliberate on this matter it is important to understand the basic configuration of transformation in Cognitive activities. In section 6.5.1, we determine if there is any association in the distributions between Cognitive actions and transformation type. In sections 6.5.2 and 6.5.3, we studied Cognitive actions in light of the two types of transformations that occurred during tutorial conversations: the lateral & vertical transformations. Goel (1995) used these terms to define the nature of transformation.

The line of current inquiry is as follows: what happens when tutors & students experience a change *'from one idea to a slightly different idea'* (lateral transformation) in terms of cognition during tutorials? An equally important question: how tutors and students would respond to situations in tutorials where current ideas undergo further development or refinement (Vertical transformation)?

6.5.1. Distribution of Transformation in tutors and students' Cognitive actions

Finding: There is very significant association between tutors' Cognitive actions and the type of Transformation

We first establish if there is any statistical association between Cognitive actions (Formulate, Evaluate & Move) and transformation types (Lateral or Vertical) by applying the Chi-square test on the following Tables 6-5A (Tutors) and Table 6-5B (Students).

Table 6-5A Distribution of Tutors' Cognitive Actions according to type of transformation

Number of Observed segments		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Transformation type	Lateral	132	19	119	270
	Vertical	310	38	121	469
Column total		442	57	240	739

	% Cognitive Actions		
	Formulate	Evaluate	Move
Transformation type Lateral	29.9	33.3	49.6
Vertical	70.1	66.7	50.4
	100	100	100

Table 6-5B Distribution of Students' Cognitive Actions according to type of transformation

Number of Observed segments		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Transformation type	Lateral	78	13	17	108
	Vertical	307	58	33	398
Column total		385	71	50	506

		% Cognitive Actions		
		Formulate	Evaluate	Move
Transformation type	Lateral	20.3	18.3	34.0
	Vertical	79.7	81.7	66.0
		100	100	100

The results showed that for tutors, there is highly significant association between the three categories of Cognitive actions with the types of transformations that transpired ($p<0.001$, $\chi^2=29.912$, df=2). Tutors' Cognitive actions vary significantly as a function of the types of transformation that occurred. In contrast, there was no significant association between the students' Cognitive actions and the types of Cognitive transformation ($p=0.155$, $\chi^2=3.732$, df=2).

These results suggest that tutors' Cognitive actions were more interactive with the type of transformation experienced during tutorials than students. The main reason for this was that tutors performed equal proportions of Lateral (119 segments, 49.6%) and Vertical transformations (121 segments, 50.4%) in *Move* actions. There were at least *twice* more Vertical than Lateral transformations in tutors' Formulate (70.1% Vertical, 29.9% Lateral) and Evaluate actions (33.3% Vertical, 66.7% Lateral). For students, there were approximately *four* times more Vertical than Lateral transformations in Formulate (79.7% Vertical, 20.3% Lateral) and Evaluate actions (81.7% Vertical, 18.3% Lateral) and twice the difference in Move actions (66% Vertical, 34% Lateral). In the following analyses, we expand the study further by comparing the productivity of tutors and students in Cognitive actions during Lateral (Section 6.5.2) and Vertical (Section 6.5.3) transformations.

6.5.2. Productivity of Cognitive actions in Lateral Transformation

Finding: Tutors were *twice* as productive as students in producing lateral Cognitive actions and in particular, the former produced *seven* times more lateral Move actions than the latter

Table 6-6 & Figure 6-5 illustrates the distribution of tutors and students' Cognitive action segments that underwent Lateral transformation during tutorial conversations. At this stage,

we are only interested with Lateral transformation as a movement *'from one idea to a slightly different idea'*. A Chi-square test on Table 6-6 distribution gives a probability value of $p<0.001$ ($\chi^2=37.89$, $df=2$), indicating that Cognitive actions that underwent Lateral transformation were very significantly associated with the type of participants in the tutorial sessions.

Overall, tutors had produced more than *twice* the number of lateral Cognitive actions (n=270) in comparison to the students (n=108). In terms of the constituents of these Cognitive actions, tutors (n=132) produced more lateral Formulate actions than students (n=78) while the difference in frequency of lateral Evaluate actions between tutors (n=19) and students (n=13) is relatively marginal. On the contrary, tutors (n=119) produce *seven* times more lateral Move actions than students (n=17).

Table 6-6 Distribution of Cognitive actions in Lateral transformation according to participant

Number of Observed segments	Cognitive Actions			Row total
	Formulate	Evaluate	Move	
Tutor	132	19	119	270
Student	78	13	17	108
Column total	210	32	136	378

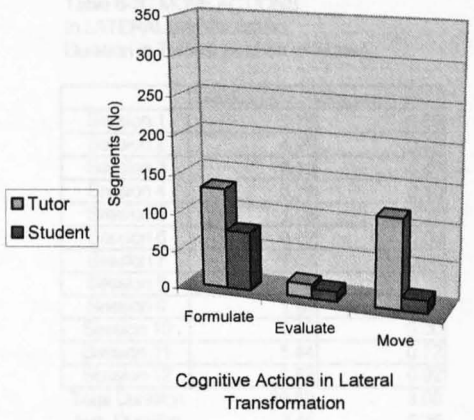

Figure 6-5 Distribution of Cognitive actions in Lateral transformation according to participant

Tables 6-7A, 6-7B and 6-7C show the distribution of duration for each Cognitive action category produced during Lateral transformation between tutors and students. The Wilcoxon-Mann-Whitney test was applied to these tables to establish whether tutors and students possess similar (null hypothesis) or different (alternative hypothesis) statistical distribution in the total duration of segments produced for each cognitive action category during Lateral transformation.

The tests reveal that in relation to Lateral transformation, there is no difference between tutors & students relating to the distribution of duration in the production of Formulate actions (U=59.000, p=0.469, two-tailed) & Evaluate actions (U=66.500, p=0.761, two-tailed). However, there is extremely *significant* difference between tutors & students' Move actions in relation to Lateral transformation (U=1.000, p<0.001, two-tailed).

Table 6-7A FORMULATE ACTIONS
In LATERAL transformation
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	2.79	1.82
Session 2	4.48	0.67
Session 3	1.15	3.45
Session 4	1.45	2.57
Session 5	1.07	2.72
Session 6	0.65	2.87
Session 7	1.44	1.10
Session 8	0.65	0.77
Session 9	1.83	1.38
Session 10	2.08	2.20
Session 11	1.25	0.77
Session 12	1.58	3.28
Total Duration	20.42	23.59
Ave. Duration	1.70	1.97
Std Deviation	1.06	1.02

U=59.000, p=0.469, two-tailed test

Table 6-7B EVALUATE ACTIONS
In LATERAL transformation
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	0.30	0.22
Session 2	0.32	0.12
Session 3	0.10	0.08
Session 4	0.20	0.00
Session 5	0.50	1.48
Session 6	0.05	0.63
Session 7	0.00	0.00
Session 8	0.23	0.00
Session 9	0.00	0.00
Session 10	0.00	0.40
Session 11	0.32	0.72
Session 12	1.28	0.00
Total Duration	3.30	3.65
Ave. Duration	0.27	0.30
Std Deviation	0.35	0.45

U=66.500, p=0.761, two-tailed test

Table 6-7C MOVE ACTIONS
In LATERAL transformation
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	2.78	0.65
Session 2	4.91	0.08
Session 3	3.13	0.40
Session 4	3.78	0.10
Session 5	1.35	0.22
Session 6	0.67	0.00
Session 7	1.88	0.00
Session 8	0.88	0.00
Session 9	1.98	0.00
Session 10	1.40	0.00
Session 11	5.44	0.72
Session 12	1.32	0.92
Total Duration	29.52	3.08
Ave. Duration	2.46	0.26
Std Deviation	1.57	0.33

U=3.000, p<0.001, two-tailed test

Table 6-8 shows the distribution of total duration of Cognitive actions in Lateral transformation between tutors and students. We found that tutors had spent most of the time making lateral Move actions (29.52 minutes) compared to lateral Formulate (20.42 minutes) and lateral Evaluate (3.30 minutes) actions. On the other hand, students spent most of the time producing lateral Formulate actions (23.59 minutes) and the least with

lateral Move actions (3.08 minutes). Tutors had spent nearly *10 times longer* on lateral Move actions than students did.

Table 6-8 Distribution of duration of Cognitive Actions in Lateral transf. according to participant

Total Duration (in minutes)	Cognitive Actions			Total
	Formulate	Evaluate	Move	
Tutor	20.42	3.30	29.52	53.24
Student	23.59	3.65	3.08	30.32

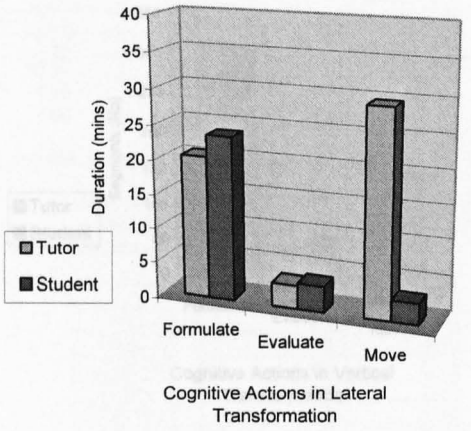

Figure 6-6 Distribution of duration of Cognitive actions in Lateral transformation according to participant

6.5.3. Productivity of Cognitive actions in Vertical Transformation

Finding: Tutors produce almost *four* times more Vertical Move actions than students

Table 6-9 and Figure 6-7 describes the distribution of tutors and students' Cognitive actions that underwent Vertical transformation. In this section, our concern is on Vertical transformation in which *'the current idea undergoes further development or refinement'* (Goel 1995). Chi-square test on Table 6-9 segment distribution gives a probability value of $p<0.001$ ($\chi^2=57.06$, df=2), indicating that groupings of Cognitive actions linked to Vertical transformation varied very significantly between tutors and students in the observed tutorial sessions.

However, such significance in segment distribution does not in anyway substantiate the existence of explicit, differentiated levels of expertise between the two groups in question. In retrospect, what we have here is an analysis of patterns of cognitive behaviour observed from design conversations produced by tutors and students in tutorials rather than a deliberate study based on predetermined levels of expertise. As such, there could be many

interpretations to the objectives of actions that lead to the apparent differences between tutors and students in those vertically transformed cognitive actions.

Table 6-9 Distribution of Cognitive actions in Vertical transformation according to participant

Number of Observed segments	Cognitive Actions			Row total
	Formulate	Evaluate	Move	
Tutor	310	38	121	469
Student	307	58	33	398
Column total	617	96	154	867

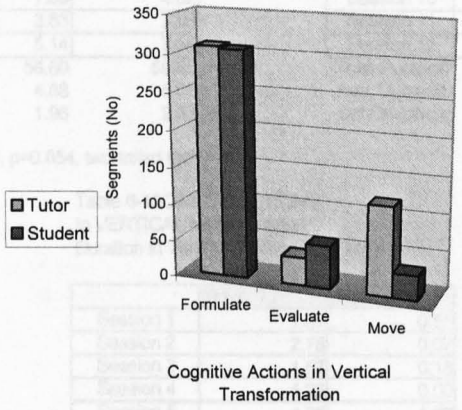

Figure 6-7 Distribution of Cognitive actions in Vertical transformation according to participant

From Table 6-9, we found that tutors (N=469) produced more Vertical Cognitive actions than students (N=398). Evidently, the difference in Vertical Formulate actions between Tutors (n=310) and students (n=307) is small. However, students (n=58) performed more Vertical Evaluate actions than tutors (n=38) during the period, though this distinction could also be described as marginal. The most significant difference was found in the production of Vertical Moves, in which tutors (n=121) generated nearly *four* times more segments than students (n=33).

By applying Wilcoxon-Mann-Whitney test to distribution of durations produced for each type of Cognitive action that underwent Vertical transformation (Tables 6-10A, 6-10B and 6-10C), we found that tutors and students did not differ significantly in terms of the time taken to produce Vertical Formulate actions (U=68.500, p=0.854, two-tailed) & Vertical Evaluate actions (U=46.500, p=0.139, two-tailed).

Table 6-10A FORMULATE ACTIONS
In VERTICAL transformation
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	7.47	2.92
Session 2	5.18	7.28
Session 3	3.81	3.17
Session 4	8.06	5.45
Session 5	4.03	9.32
Session 6	3.96	8.90
Session 7	5.09	2.79
Session 8	2.87	2.50
Session 9	1.78	1.90
Session 10	7.59	4.62
Session 11	3.63	3.96
Session 12	5.14	7.16
Total Duration	58.60	59.95
Ave. Duration	4.88	5.00
Std Deviation	1.96	2.59

U=68.500, p=0.854, two-tailed test

Table 6-10B EVALUATE ACTIONS
In VERTICAL transformation
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	0.62	1.37
Session 2	0.93	0.33
Session 3	0.23	0.63
Session 4	0.17	0.22
Session 5	0.39	3.01
Session 6	0.10	0.83
Session 7	0.15	0.57
Session 8	0.20	0.55
Session 9	0.00	0.08
Session 10	0.38	0.17
Session 11	1.07	0.30
Session 12	0.22	1.67
Total Duration	4.45	9.72
Ave. Duration	0.37	0.81
Std Deviation	0.33	0.84

U=46.000, p=0.139, two-tailed

Table 6-10C MOVE ACTIONS
In VERTICAL transformation
Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	1.87	0.55
Session 2	2.78	0.07
Session 3	1.57	0.18
Session 4	1.22	0.00
Session 5	4.25	1.67
Session 6	3.36	0.00
Session 7	3.42	0.10
Session 8	2.40	0.33
Session 9	1.82	0.18
Session 10	4.16	1.05
Session 11	1.70	0.52
Session 12	1.13	1.08
Total Duration	29.69	5.74
Ave. Duration	2.47	0.48
Std Deviation	1.10	0.53

U=3.000, p<0.001, two-tailed test

However, there was very *significant* difference between tutors & students in terms of the Vertical *Move* actions that were produced (U=3.000, p<0.001, two-tailed). In terms of mean duration, tutors' Vertical Move actions took more than *five* times longer (mean=2.47 min) than those produced by the students' (mean=0.48 min). Since we regard these actions as a function of behaviour observed from natural tutorial conversations rather than being associated with specific and predetermined levels of expertise, we could only speculate the reasons why tutors' Vertical Move actions were significantly longer in duration when compared to those of the students.

For example, it could be that tutors thought deeper on 'emerging' situations and features that captured their attention during conversation prior to prescribing subsequent move actions in comparison to students. Conversely, however, it could also mean that tutors were less familiar with the task at hand and had no other choice but to instigate Vertical Move actions in order to prise open an understanding of a student's work. Thus, we envisage a

multitude of interpretations behind Vertical Move actions, as we do with every other kinds of Cognitive action throughout the current study.

Table 6-11 Distribution of duration of Cognitive Actions in Vertical trans. according to participant

Total Duration (in minutes)		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Level of Expertise	Tutor	58.60	4.45	29.69	92.74
	Student	59.95	9.72	5.74	75.41

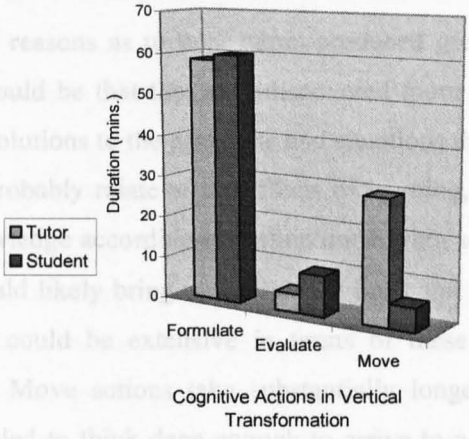

Figure 6-8 Distribution of duration of Cognitive actions in Vertical transformation according to participant

6.5.4. Discussion on the role of Transformation in Cognitive actions

Evidences so far show that tutors were more productive in overall cognitive actions and in particular, Move actions. During Lateral transformations, tutors produced *seven* times more 'Move' actions than students did. However, the relative difference drops to only about *four* times during Vertical transformations when students were more capable in making more purposeful moves than in Lateral transformation. We see here that the advantage tutors have over students in making Moves is far greater for actions made during Lateral transformation than those in Vertical transformation.

Despite of the substantial differences in Lateral and Vertical Move actions between tutors and students, there is a need for us to mitigate critically and carefully the significance of these findings so as to gain a qualified understanding of the nature of such transformations. This is particularly important in relation to the background of the current study, of which the primary focus is to observe tutors and students' cognitive behaviours through design conversations that transpire during tutorials. Moreover, these conversations represent dialectical interactions between tutors and students along the trajectory of studio tutorials. To interpret such interactions appropriately, we need to acknowledge the specific intentions

or objectives behind tutors and students' conversations. However, the current study does not provide for such exercise to take place. For example, prescribing *models of conversation* as part of the effort in marking out intentions or objectives of designers' actions during tutorial interactions would have been very useful. Nonetheless, we view the current study as a crucial springboard in opening up the opportunities for further research into the matter. For the time being, we would have to contend that tutors and students' cognitive actions are reasoned through a myriad of possible interpretations.

For example, one of the reasons as to why tutors produced greater Move actions during Lateral transformation could be that that they discovered more opportunities and possess quicker access to many solutions to the problems and situations that they were familiar with during tutorials. These probably relate to the effects of learning, through which tutors had probably 'chunked' knowledge according to certain underlying schema. When tutors recall a specific schema, it would likely bring to the fore all links and propositions that make up the schema. A 'chunk' could be extensive in terms of these links. This could be an explanation why tutors' Move actions take substantially longer time than those of the students, the former needed to think deep enough to arrive to a solution that matches the problematic situation.

Equally likely, we could also argue that tutors' Move actions in Vertical and Lateral transformations were a reflection of their effort in learning and 'feeling' their way around a situation in a tutorial. In these circumstances, Move actions could be associated with tutors' deep level of unfamiliarity with the scheme or even lack of knowledge in the subject of discussion. On the other hand, students' Move actions in Vertical and Lateral transformations could be outcomes of strong sense of awareness about a particular design work. After all, it is the students' works that often initiate tutorial conversations in the first place.

Other interpretations of Move actions are in abundance. For example, tutors with significant practical experience could also recognise a problem-solution coupling promptly from memory. One of the advantages tutors might have is greater ability in interacting with imagery. Tutors could easily perceive and visually attend to familiar elements acquired from drawings, models, and diagrams throughout a tutorial session. They then make links to substantial repository of precedent knowledge and look for clues that might lead to immediate solutions. Tutors might also elicit deeper connections with long-term memory

such that they could produce 'Moves' actions more comprehensively, productively & effectively than students. It is possible for such phenomenon to concur with the experts' ability to recognize underlying 'deep structures' in design situations. By the same token, we could also reason that there could be circumstances where tutors' Moves are not as elaborate as those described above.

It is also possible that students do not have the effective ability in acquiring memory structures like 'schema' or 'chunks'. One possible outcome from this could help explain why, without the tutors' assistance, novices like students often end up 'stuck' in design. Then again, there could be many other situations where this is not the case for students.

During Vertical transformation, we could stipulate that students are expected to obtain more cognitive 'cues', particularly those coming from preceding discussions & issues in conversation with tutors, thereby assisting them in the more effective recognition of problems & situations and in making appropriate cognitive 'Moves'. This is not surprising since in a Vertical transformation; a current segment is the development of an idea emerging directly from a previous segment. Therefore, we could reason the possibility that students' 'Moves' are propped by cues provided by tutors. We could then say that tutors uniquely treat design conversations as *'cognitive scaffolds'* to facilitate 'Moves' on the part of students during tutorials and that such skill develop over time.

6.6. Effects of Preceding segments and Transformation type on Cognitive actions

In previous sections 6.5, we examined the effects of transformation on Cognitive actions *without* the factor of preceding segments. In the current section, *both* factors of *transformation* and *preceding* segment form key considerations in broadening the analyses of tutors and students' Cognitive actions. This could reveal further distinct characteristics in cognitive activities that transpire between tutors and students in tutorial conversations.

For this purpose, Table 6-1A (Tutors' Cognitive actions and sources of preceding segments) expands as Table 6-12A (Where tutors made the preceding segments) and Table 6-12B (Where students made the preceding segments) for section 6.6.1. We then assign frequencies of Tutors' Cognitive actions that occur either under Lateral or Vertical transformations in the two tables. In parallel, Table 6-1B (Students' Cognitive actions and sources of preceding segments) also extends as Tables 6-16A (Where tutors made the

preceding segments) and Table 6-16B (Where students made the preceding segments) for section 6.6.2. We then assign frequencies of Students' Cognitive actions that occur either under Lateral or Vertical transformations in the two tables.

Chi-square tests on Tables 6-12A and 6-12B and on Tables 6-16A and 6-16B would determine any significant association between Cognitive actions and *transformation* types based on specific cases of preceding segment source. In each specific case of preceding segment source, Wilcoxon-Mann-Whitney test also measures the strength of the differences in the distribution of duration that Cognitive actions produced between Lateral and Vertical transformations. We then discuss the findings and implications of these tests in the following sections. For clarity in comparing tutors and students' Cognitive actions under the current circumstances, it is necessary to comprehend sections 6.6.1 and 6.6.2 together.

6.6.1. Tutors' Cognitive actions: The impact of Preceding segments and Transformation

In the case of *Tutors'* Cognitive actions *where tutors made the preceding segments* (Table 2-1A), chi-square tests concluded that there was *highly* significant association between Cognitive actions and the types of transformation that occurred (χ^2=13.859, df=2, p<0.001). *Where tutors' actions originated from preceding segments made by the students* (Table 2-1B), there was *probably significant* association between Cognitive actions and the type of transformation taking place, beyond the .05 level (χ^2=6.532, df=2, p=0.038). Therefore, we could say that tutors' Cognitive actions were, at least, probably *significantly associated* with the types of transformation regardless of the origins of preceding segments.

Table 6-12A Distribution of Tutors' Cognitive actions according to transformation type Where Tutor made preceding segment

		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Type of Transformation	Lateral	63	9	84	156
	Vertical	123	13	72	208
Column total		186	22	156	364

		% of Cognitive action		
		Formulate	Evaluate	Move
Type of Transformation	Lateral	33.9	40.9	53.8
	Vertical	66.1	59.1	46.2
		100.0	100.0	100.0

Table 6-12B Distribution of Tutors' Cognitive actions according to transformation type Where Student made preceding segment

		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Type of Transformation	Lateral	69	10	35	114
	Vertical	187	25	49	261
Column total		256	35	84	375

		% of Cognitive action		
		Formulate	Evaluate	Move
Type of Transformation	Lateral	27.0	28.6	41.7
	Vertical	73.0	71.4	58.3
		100.0	100.0	100.0

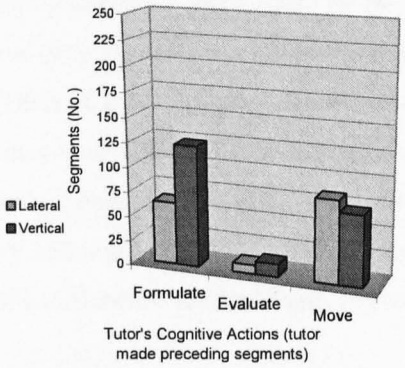

Figure 6-9A Distribution of Tutors' Cognitive Actions according to type of Transformation (Where tutor made preceding segment)

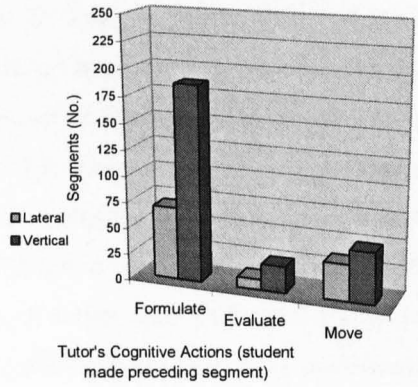

Figure 6-9B Distribution of Tutors' Cognitive Actions according to type of Transformation (Where student made preceding segment)

Figures 6-9A and 6-9B generally show similar patterns of distribution of Tutors' Formulate and Evaluate actions irrespective of the source of preceding segments. Both actions occur more in the Vertical rather than Lateral transformation. The exception here is the Move actions. They seem to occur in almost equal frequencies in Lateral and Vertical transformation. We determine the significance of differences and similarities of various cases of Tutors' Cognitive actions by using the Wilcoxon-Mann-Whitney test. The results of these tests are as follows:

a) Finding: Regardless of the source of preceding segments, tutors' *Formulate* actions develop more significantly in the Vertical rather than Lateral transformation.

In cases *where the preceding segments were made by tutors* themselves, 66.1% of tutors' *Formulate* action segments (n=123) occurred in the Vertical rather than the Lateral (33.9%, n=63) transformation (Table 6-12A). This difference was also reflected in terms of distribution of duration in which tutors' *Formulate* actions spent *more than twice* longer time during the Vertical (Mean=2.143 min, S.D=1.494 min) than in the Lateral (Mean=0.845 min, S.D=0.758 min) transformation (Table 6-13A). The Wilcoxon-Mann-Whitney test confirmed this difference as significant beyond .01 level (U=24.000, p=0.005, two-tailed test).

In cases w*here preceding segments were made by students*, 73.0% of tutors' *Formulate* actions (n=187) occurred in Vertical rather than Lateral (27.0%, n=69) transformation (Table 6-12B). The difference over the two types of transformation was confirmed by the Wilcoxon-Mann-Whitney test as highly significant beyond .001 level (U=8.000, p<0.001, two-tailed test) (Table 6-13B). Here, tutors' *Formulate* actions incurred *three* times greater duration in the Vertical (Mean=2.740 min, S.D=1.626 min) than in the Lateral (Mean=0.857 min, S.D=0.484 min) transformation. Therefore, more tutors' *Formulate* actions occurred in *Vertical* rather than in Lateral transformation *irrespective* of whether preceding segments originated from students or tutors themselves.

TUTORS' FORMULATE ACTIONS

Table 6-13A Direction of Transformation where Tutor made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	1.738	5.967
Session 2	2.563	2.156
Session 3	0.450	2.618
Session 4	0.984	1.134
Session 5	0.000	1.116
Session 6	0.316	1.218
Session 7	1.068	3.152
Session 8	0.083	0.768
Session 9	1.281	1.050
Session 10	0.920	3.474
Session 11	0.616	1.265
Session 12	0.117	1.800
Total Duration	10.136	25.718
Mean	0.845	2.143
Std Deviation	0.758	1.494

U=24.000, p=0.005, two-tailed test

Table 6-13B Direction of Transformation where Student made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	1.050	1.500
Session 2	1.914	3.024
Session 3	0.702	1.188
Session 4	0.468	6.930
Session 5	1.065	2.912
Session 6	0.336	2.737
Session 7	0.369	1.938
Session 8	0.568	2.100
Session 9	0.549	0.730
Session 10	1.164	4.117
Session 11	0.632	2.368
Session 12	1.467	3.340
Total Duration	10.284	32.884
Mean	0.857	2.740
Std Deviation	0.484	1.626

U=8.000, p=0.000, two-tailed test

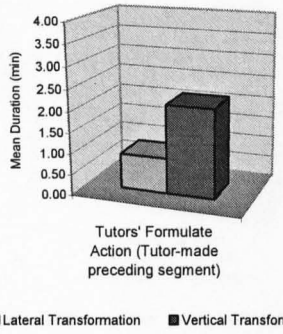

Figure 6-10A Mean Duration of Transformation Type in Tutors' Formulate actions Where Tutor made preceding segment

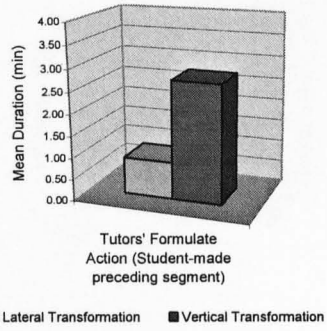

Figure 6-10B Mean Duration of Transformation Type in Tutors' Formulate actions Where Student made preceding segment

b) Finding: Regardless of the type of preceding segment, tutors' *Evaluate* actions did *not* show preference in developing either laterally or vertically

Regarding tutors' *Evaluate* actions, Wilcoxon-Mann-Whitney tests on the distribution of duration in the following Tables 6-14A (Where tutors made the preceding segments) and 6-14B (Where students made the preceding segments) revealed that the differences between Lateral and Vertical transformations for *both* situations were *not* significant beyond the .05 level. This proved that irrespective of the source of preceding segments, tutors' *Evaluate* actions were *not* significantly differentiated by the type of transformation.

TUTORS' EVALUATE ACTION SEGMENTS:

Table 6-14A Direction of Transformation where Tutor made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.000	0.100
Session 2	0.117	0.516
Session 3	0.100	0.233
Session 4	0.067	0.167
Session 5	0.434	0.000
Session 6	0.050	0.100
Session 7	0.000	0.000
Session 8	0.083	0.201
Session 9	0.000	0.000
Session 10	0.000	0.133
Session 11	0.317	0.250
Session 12	0.633	0.000
Total Duration	1.801	1.700
Mean	0.150	0.142
Std Deviation	0.204	0.150

U=65.000, p=0.697, two-tailed test

Table 6-14B Direction of Transformation where Students made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.300	0.516
Session 2	0.200	0.415
Session 3	0.000	0.000
Session 4	0.133	0.000
Session 5	0.067	0.385
Session 6	0.000	0.000
Session 7	0.000	0.150
Session 8	0.150	0.000
Session 9	0.000	0.000
Session 10	0.000	0.248
Session 11	0.000	0.816
Session 12	0.648	0.216
Total Duration	1.498	2.746
Mean	0.125	0.229
Std Deviation	0.192	0.262

U=55.500, p=0.329, two-tailed test

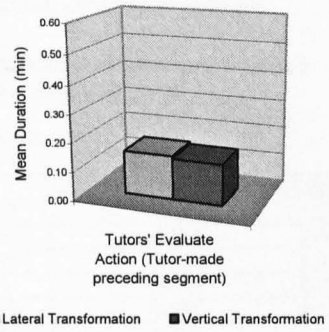

Figure 6-11A Mean Duration of Transformation Type in Tutors' Evaluate actions Where Tutor made preceding segment

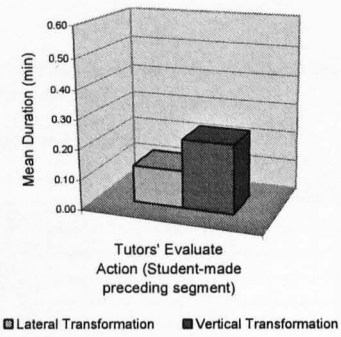

Figure 6-11B Mean Duration of Transformation Type in Tutors' Evaluate actions Where Student made preceding segment

c) Finding: Where students made the preceding segments, tutors' *Move* actions were more Vertically transformed. Where tutors made the preceding segments, tutors' *Move* actions did not differentiate between the types of transformation

On tutors' *Move* actions, the Wilcoxon-Mann-Whitney test on the distribution of duration of Table 6-15A revealed that *where tutors made the preceding segments*, tutors' *Move* actions were *not* significantly differentiated by the type of transformation (U=60.000, p=0.504, two-tailed test). This regardless of the fact that in terms of segment distribution (Table 6-12A), tutors' *Move* actions were more likely to occur in Lateral (53.8%, n=84) rather than Vertical (46.2%, n=72) transformations.

*Where students made the preceding segment*s, tutors produced more Move actions in the Vertical (58.3%, n=49) rather than Lateral transformation (41.7%, n=35). This preference was reflected in the Wilcoxon-Mann-Whitney test on the distribution of duration of Table 6-15B. It confirmed the difference between Vertical (Mean=1.061 min, S.D=0.982 min) and Lateral (Mean=0.627 min, S.D=1.034 min) transformations in tutors' *Move* actions to be probably *significant* beyond the .05 level (U=31.500, p=0.018, two-tailed test). Therefore, where tutors made the preceding segments, their *Move* actions did *not* significantly prefer a particular type of transformation. However, where students made the preceding segments, tutors *Move* actions would more likely be a cognitive movement in the *Vertical* transformation.

TUTOR'S MOVE ACTION SEGMENTS:

Table 6-15A Direction of Transformation where Tutor made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	2.365	1.316
Session 2	4.710	2.568
Session 3	2.035	1.316
Session 4	3.115	0.550
Session 5	1.135	0.468
Session 6	0.200	2.232
Session 7	1.800	2.938
Session 8	0.732	1.686
Session 9	1.981	0.750
Session 10	1.085	2.248
Session 11	1.668	0.400
Session 12	1.168	0.483
Total Duration	21.994	16.955
Mean	1.833	1.413
Std Deviation	1.193	0.909
	U=60.000, p=0.504, two-tailed test	

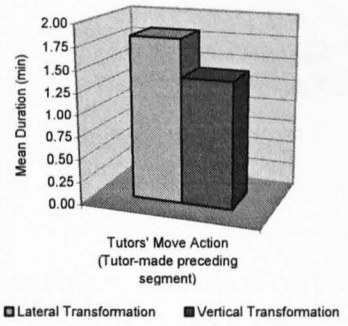

Figure 6-12A Mean Duration of Transformation Type in Tutors' Move Actions Where Tutor made preceding segment

Table 6-15B Direction of Transformation where student made Preceding Segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.416	0.549
Session 2	0.200	0.216
Session 3	1.098	0.250
Session 4	0.666	0.666
Session 5	0.217	3.784
Session 6	0.465	1.132
Session 7	0.083	0.484
Session 8	0.150	0.716
Session 9	0.000	1.068
Session 10	0.316	1.914
Session 11	3.768	1.302
Session 12	0.150	0.651
Total Duration	7.529	12.732
Mean	0.627	1.061
Std Deviation	1.034	0.982
	U=31.500, p=0.018, two-tailed test	

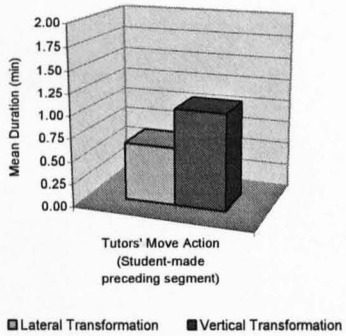

Figure 6-12B Mean Duration of Transformation Type in Tutors' Move Actions Where Student made preceding segment

6.6.2. Students' Cognitive actions: The impact of Preceding segments and Transformation

Further Chi-square tests concluded that *where tutors made the preceding segments* (Table 6-16A), there was *highly* significant association between students' Cognitive actions and the types of transformation that occurred (χ^2=16.965, df=2, p<0.001). Where students made the preceding segments (Table 6-16B), there was *probably significant* association between Students' Cognitive actions and the type of transformation taking place (χ^2=8.109, df=2, p=0.017). Therefore, we could generally conclude that like tutors' Cognitive actions in section 6.6.1, *students'* Cognitive actions were also statistically associated with the occurrences of *transformation* irrespective of who made the preceding segments. To establish if students' Cognitive actions significantly prefer one type of transformation to the other, Wilcoxon-Mann-Whitney test had been included in the following analyses.

Table 6-16A Distribution of Students' Cognitive actions according to Transformation type Where Tutor made preceding segment

		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Type of Transformation	Lateral	38	11	13	62
	Vertical	244	39	18	301
Column total		282	50	31	363

		% of Cognitive action		
		Formulate	Evaluate	Move
Type of Transformation	Lateral	13.5	22.0	41.9
	Vertical	86.5	78.0	58.1
		100.0	100.0	100.0

Table 6-16B Distribution of Students' Cognitive actions according to Transformation type Where Student made preceding segment

		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Type of Transformation	Lateral	40	2	4	46
	Vertical	63	19	15	97
Column total		103	21	19	143

		% of Cognitive action		
		Formulate	Evaluate	Move
Type of Transformation	Lateral	38.8	9.5	21.1
	Vertical	61.2	90.5	78.9
		100.0	100.0	100.0

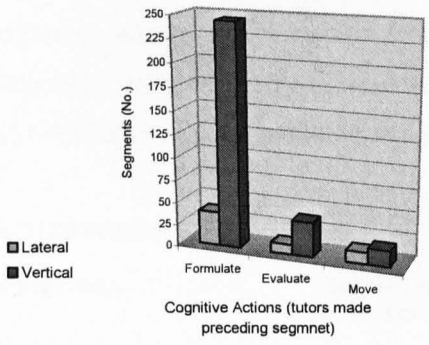

Figure 6-13A Distribution of Students' Cognitive actions according to type of Transformation (Where Tutor made preceding segment)

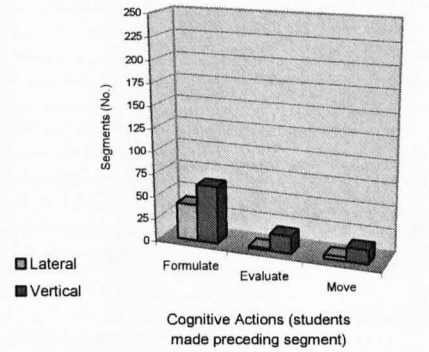

Figure 6-13B Distribution of Students' Cognitive actions according to type of Transformation (Where Student made preceding segment)

a) Finding: Where tutors made the preceding segments, students' *Formulate* actions developed more significantly in the Vertical transformation. Where students made the preceding segments, students' *Formulate* actions did not differentiate between the types of transformation

The distribution of segment frequencies in Table 6-16A suggests that *where tutors made the preceding segments*, students' *Formulate* actions overwhelmingly develop in Vertical (86.5%, n=244) rather than Lateral (13.5%, n=38) transformation. This was supported by the Wilcoxon-Mann-Whitney test (Table 6-17A) that showed the difference in the distribution of durations between Vertical and Lateral transformations for students' Formulate actions to be *highly significant* beyond the .05 level (U=6.000, p<0.001, two-tailed test).

Students' Formulate actions were also *four* times longer in Vertical (Mean=3.779 min, S.D=1.875 min) than in the Lateral (Mean=0.929 min, S.D=0.634 min) transformations. This proved that where tutors made the preceding segments, students *rely more significantly* on tutors' segments during Formulate actions. However, where students made the preceding segments, students' Formulate actions were not significantly differentiated in terms of transformation (U=65.500, p=0.723, two-tailed test)(Table 6-17B).

STUDENTS' FORMULATE ACTION SEGMENTS:

Table 6-17A Direction of Transformation where Tutor made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.684	2.652
Session 2	0.552	6.060
Session 3	2.332	1.968
Session 4	1.600	3.430
Session 5	1.066	6.688
Session 6	1.734	6.021
Session 7	0.699	2.788
Session 8	0.768	1.395
Session 9	0.267	1.638
Session 10	0.549	3.720
Session 11	0.368	3.256
Session 12	0.534	5.728
Total Duration	11.153	45.344
Mean	0.929	3.779
Std Deviation	0.634	1.875

U=6.000, p=0.000, two-tailed test

Table 6-17B Direction of Transformation where student made preceding segments

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	1.134	0.266
Session 2	0.117	1.215
Session 3	1.116	1.200
Session 4	0.966	2.016
Session 5	1.650	2.629
Session 6	1.134	2.880
Session 7	0.400	0.000
Session 8	0.000	1.100
Session 9	1.115	0.266
Session 10	1.650	0.900
Session 11	0.400	0.699
Session 12	2.750	1.434
Total Duration	12.432	14.605
Mean	1.036	1.217
Std Deviation	0.766	0.910

U=65.500, p=0.723, two-tailed test

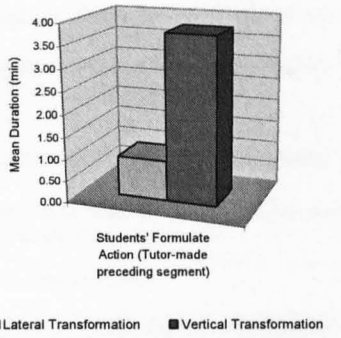

Figure 6-14A Mean Duration of Transformation Type in Students' Formulate actions Where Tutor made preceding segment

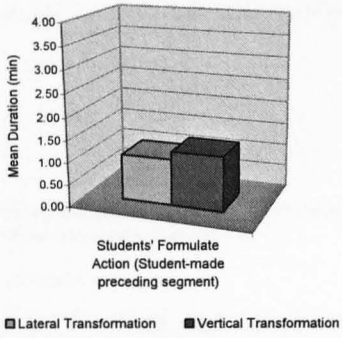

Figure 6-14B Mean Duration of Transformation Type in Students' Formulate actions Where Student made preceding segment

b) Finding: Where students made the preceding segments, students' *Evaluate* actions developed more significantly in the Vertical transformation. Where tutors made the preceding segments, students' *Evaluate* actions did not differentiate between the types of transformation

Where preceding segments were made by tutors, 22.0% (n=11) of students' Evaluate actions were in the Lateral transformation while 78.0% (n=39) in the Vertical transformation (Table 6-16A). However, a Wilcoxon-Mann-Whitney test on the distribution of the duration in students' Evaluate actions (Table 6-18A) revealed that the difference between Lateral and Vertical transformation was not significant beyond the .05 level (U=40.500, p=0.068, two-tailed test).

Where students made the preceding segments, the level of disparity in terms of segment frequency was further increased, with only 9.5% (n=2) of students' Evaluate actions were in the Lateral transformation while 90.5% (n=19) were in the Vertical transformation. The Wilcoxon-Mann-Whitney test proved that in the case where students made the preceding segments, the difference in the distribution of duration between Lateral (Mean=0.036 min, S.D=0.087 min) and Vertical (Mean=0.311 min, S.D=0.430 min) transformations for students' Evaluate actions was probably significant beyond the .05 level (U=40.500, p=0.038, two-tailed test).

In fact, students' Evaluate actions were more than *eight* times longer in Vertical transformation (Mean=0.311 min) than in Lateral transformation (Mean=0.036 min). Therefore, degree of differences in duration between Lateral and Vertical transformations for students' Evaluate actions was greater *where students made the preceding segments.*

This suggests that students were more inclined to weigh up the substance of their own preceding segments rather than those of their tutors.

STUDENTS' EVALUATE ACTION SEGMENTS:

Table 6-18A Direction of Transformation where Tutor made preceding segments

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.216	0.267
Session 2	0.116	0.334
Session 3	0.083	0.633
Session 4	0.000	0.000
Session 5	1.316	1.953
Session 6	0.633	0.651
Session 7	0.000	0.400
Session 8	0.000	0.400
Session 9	0.000	0.083
Session 10	0.133	0.168
Session 11	0.716	0.300
Session 12	0.000	0.800
Total Duration	3.213	5.989
Mean	0.268	0.499
Std Deviation	0.412	0.515

U=40.500, p=0.068, two-tailed test

Table 6-18B Direction of Transformation where Student made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.000	1.098
Session 2	0.000	0.000
Session 3	0.000	0.000
Session 4	0.000	0.217
Session 5	0.167	1.052
Session 6	0.000	0.183
Session 7	0.000	0.167
Session 8	0.000	0.150
Session 9	0.000	0.000
Session 10	0.267	0.000
Session 11	0.000	0.000
Session 12	0.000	0.868
Total Duration	0.434	3.735
Mean	0.036	0.311
Std Deviation	0.087	0.430

U=40.500, p=0.038, two-tailed test

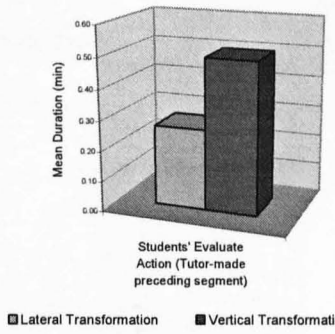

Figure 6-15A Mean Duration of Transformation Type in Students' Evaluate actions Where Tutor made preceding segment

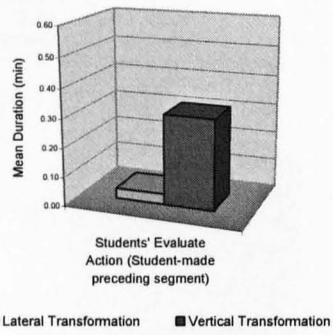

Figure 6-15B Mean Duration of Transformation Type in Students' Evaluate actions Where Student made preceding segment

c) Finding: Regardless of the source of preceding segments, students' *Move* actions did not differentiate between the types of transformation

Where tutors made the preceding segments, 41.9% (n=13) of students' Move actions were in the Lateral transformation while 58.1% (n=18) in the Vertical transformation (Table 6-16A). Where preceding segments had originated from students themselves, only 21.1% (n=4) of students' Move actions followed Lateral transformation as opposed to 78.9% (n=15) for Vertical transformation.

Whether preceding segments were made by tutors or students, the Wilcoxon-Mann-Whitney test proved that the differences in the distribution of duration between Lateral (U=68.000, p=0.825, two-tailed test) and Vertical (U=46.500, p=0.107, two-tailed test) transformations for students' *Move* actions were *not* significant beyond the .05 level (Tables 6-19A). This meant that preceding segments, regardless of whether tutors or students made them, were *not* a factor of transformation in students' Move actions.

STUDENT'S MOVE ACTION SEGMENTS:

Table 6-19A Direction of Transformation where Tutor made preceding segments

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.549	0.400
Session 2	0.084	0.067
Session 3	0.400	0.000
Session 4	0.100	0.000
Session 5	0.000	0.300
Session 6	0.000	0.000
Session 7	0.000	0.100
Session 8	0.000	0.134
Session 9	0.000	0.000
Session 10	0.000	1.050
Session 11	0.716	0.150
Session 12	0.467	0.067
Total Duration	2.316	2.268
Mean	0.193	0.189
Std Deviation	0.263	0.299

U=68.000, p=0.825, two-tailed test

Table 6-19B Direction of Transformation where Student made preceding segment

Total Duration (minutes)

	Lateral Trans.	Vertical Trans.
Session 1	0.100	0.150
Session 2	0.000	0.000
Session 3	0.000	0.183
Session 4	0.000	0.000
Session 5	0.217	1.368
Session 6	0.000	0.000
Session 7	0.000	0.000
Session 8	0.000	0.200
Session 9	0.000	0.183
Session 10	0.000	0.000
Session 11	0.000	0.368
Session 12	0.450	1.016
Total Duration	0.767	3.468
Mean	0.064	0.289
Std Deviation	0.138	0.444

U=46.500, p=0.107, two-tailed test

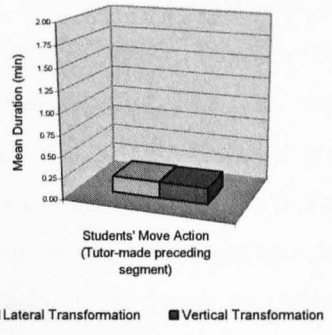

Figure 6-16A Mean Duration of Transformation Type in Students' Move Actions Where Tutor made preceding segment

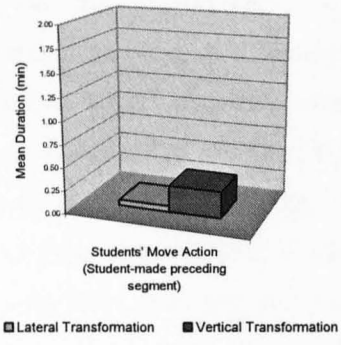

Figure 6-16B Mean Duration of Transformation Type in Students' Move Actions Where Student made preceding segment

6.7. Influence of Preceding segments and Transformation on Cognitive actions

All findings in the foregoing analyses provided us with a comprehensive profile of tutors' and students' Cognitive behaviour from the standpoint of Preceding segments and Transformation. These features enable us to assess the *exact* and *directional* qualities of Cognitive actions as previously mentioned in Chapter 4 of Research Methodology. The following issues are some of the observations of the analyses in this chapter.

6.7.1 Formulate Actions

Formulating consists of a number of activities that included framing (Chapter 4, Research Methodology). In Formulate actions, tutors seemed to consider all preceding segments, irrespective of whether these had originated from themselves or the students, as potential material for further development in the design tutorial conversation. On the contrary, students were more disposed to work with preceding segments made by tutors when formulating problematic situations (Section 6.4.1). For students, Formulate actions transpired largely and more significantly in the Vertical transformation rather than Lateral transformation (Section 6.5).

However, while these patterns of behaviour clearly discern tutors and students' Formulate actions, it is not possible for us to attribute precise motives for such actions. This is due to the fact that current method in protocol analysis did not consider the objectives or intentions behind those actions. Thus, there could be many interpretations behind the production of tutors and students' cognitive actions. On the other hand, we need to remind ourselves that the focus of analysis for the current study is tutor-student cognitive interactions in tutorial conversations rather than outright comparison between predetermined levels of expertise. These depend on the various 'roles' participants perform during tutorial conversations. We could reflect on the characteristics of design conversations based on this line of inquiry without denying the multiplicity of interpretations that could be attributed to tutors and students' cognitive actions. For instance, it would be useful to envisage tutorial conversations as an avenue for tutors to assist students, particularly in the acts of recognising situations and 'seeing' potential solutions and opportunities that could move design activities forward. One of the ways to fulfil this is for tutors to produce conversation *'scaffolds'* that students could take advantage of. This could then explain many of the phenomena observed in students and tutors' actions.

For example, we postulate that students build upon available 'scaffolds' in preceding segments provided by tutors in order to aid design activities. Naturally, this compensates for the students' lack of cognitive 'reach' in undertaking the more complex Cognitive processes required in certain design activities. The following sequence in conversation illustrates an example of a student's development of Formulate action that ensued from the preceding segment made by her tutor, and one that occurred in the Vertical transformation:

Tutor T1 and Student S1 reflecting on circulation (Tutorial session 1):

Segment	Contributor	Protocol Segments
39	T1	So there are some nice things happening here. This seems to be working reasonably well, you've got the *circulation treading everything together,* loos.....(plan)
40	S1	Yeah, the people who live here will probably go in this way and then they can just take a lift going up, so that's like their kind of area, sort of. And that's like the public going to a like kind of foyer

On the other hand, it could be that Tutors' Formulate actions reflect an ability to respond to the varying degrees of task or problem situations coming from different sources of preceding segments. At one end of a spectrum, these Formulate actions might be required as part of the development of ideas or propositions emanating from sources that preceded either from tutors or from the students. At the other end, tutors' formulation of problems might also involve scaffolding structures for instructing knowledge or for students' reflection and learning. Whatever the role tutors' Formulate actions may play, they are distinctly available to cater the needs of different design situations. Their temporal nature alludes to the ability of expert designers like tutors to articulate and utilise episodic knowledge during design conceptualisation or actual designing.

6.7.2. Evaluate Actions

As with Formulate actions, tutors' *Evaluate* actions were not the consequence of a significant preference for any particular type of preceding segments (Section 6.4.2). In fact, whether preceding segments originated from the tutors or students, neither condition was sufficient to affect a significant differentiation between Vertical and Lateral transformation in tutors' *Evaluate* actions (Section 6.6.1 (b)). This reinforces the notion that Evaluate actions were not all influential in tutors' pattern of design cognition. We also found no significant difference in mean duration between students' Evaluate actions that proceed from tutor-made segments and those that derive from student-made segments.

The following dialogue provides an example where the student's *Evaluate* actions was partly an effort to size up to a plant room requirement stipulated in the preceding segment made by the tutor (Tutorial session 5):

Segment	Contributor	Protocol Segment
122	T4	Because plants are, well, generally 5% of the building
123	S5	Is it? So it should be even smaller than that...bigger?...smaller?, bigger?
124	T4	It'd be bigger probably....a plant room (laughs)

6.7.3. Move Actions

Regarding Move actions, there were significant differences between tutors and students in terms of their interactions with preceding segments. For tutors, Move actions were more self-inspired. By this, tutors were more inclined to use preceding segments made by themselves rather than those of the students (Section 6.4.3).

One possible interpretation could be that tutors use their own preceding segments as 'springboards' for further Moves in design conversations. As this happens, tutors' subsequent Move actions also did not provide evidence of a preference in making either Lateral or Vertical transformation (Section 6.6.1 (c)). This says something about the unique attributes of preceding segments made by tutors. These segments were as capable of instigating subsequent Moves that 'leap' between ideas (Lateral transformation) as they were at sustaining developmental Moves (Vertical transformation) on the part of tutors themselves. However, it must be noted that these are some of the possible explanations of the phenomena observed in tutors' Move actions.

In contrast, tutor-made and student-made preceding segments did not differentiate students' Move actions. Again, there could be many interpretations for this phenomenon as we had for tutors' Move actions above. One possibility is that the students did not see tutor-made segments as useful cognitive and knowledge *'scaffolds'* for facilitating subsequent actions. As such, students had not benefited from tutor-made preceding segments as much as the tutors had in making *Move actions.* It could be that the kind of design knowledge involved in the development of tutors' *Move* actions might only be of benefit to tutors but was beyond the cognitive 'reach' of students. Tutors, for example, could rely on their knowledge and cognition of *'deep structures'* (Chi, Feltovich et al. 1981) in design situations. For this to happen, 'deep structures' must also be readily accessible from preceding segments in design conversations. It requires substantial experience in practice and training to 'pick up' such structures. Obviously, this benefits the tutors rather than the students.

From the results in Sections 6.4.1, it is reasonable to suggest that *preceding segments that originated from tutors* were probably richer with 'deep structures' than those that came from students. Predictably, tutors' *Move* actions often come in complete succession to *preceding segments made by tutors* themselves (Sections 6.4.3). The following is an example of a sequence of successive segments made by a tutor as he asked (*Move* action) the student he was conversing with to introduce workable plans in the latter's design scheme (Tutorial Session 2):

Segment	Contributor	Protocol Segment
94	T2	At the moment, I mean, I don't disagree with your points, all I'm saying is that I don't really see how those simply organised underneath the space, how they are *organized in terms of movements* inside that
95	T2	You know, I think what you need to do is begin to establish that in terms of the *working plan*, of how are those areas *organised?* How do you *move* down there?

Tutors' Move actions seemed to be able to accommodate the extreme needs of design situations discussed during tutorial conversations. At critical stages, it might be necessary for tutors to put up a more vigorous approach in advising students. This meant producing Move actions that consist of firm instructions and coherent propositions in order to progress particular design issues.

Although the nature and content of tutor Move actions are entirely different from those of Formulate actions, their roles might overlap in certain cases. This is particularly true in dealing with novice students who experience fixations and inhibitions during design. In such circumstances, corresponding tutor 'Moves' often reflect efforts in prescribing frameworks, concepts and precedents as means to alleviate students' problems in design. The role of such Move actions might be to maintain mutually agreed design agendas throughout the duration of tutorial conversation and to put a check on potential diversions from these agendas. Therefore, part of maintaining a 'robust' regime in design tutorial is to ensure that core Cognitive activities like Move actions function effectively on the part of tutors.

However, it must be emphasised that all interpretations related to the observed cognitive behaviours of tutors and students above are only speculative in nature. Due to the dialectical nature of tutorial conversations and the various cognitive roles participants perform within them, it is only conceivable for us to produce an overview of tutors and

students' cognitive *behaviours* in design conversations rather than to corroborate the groups' interactions based on a predetermined framework of expertise. The latter seemed unlikely since current methodology did not initially stipulate clear differences in the levels of expertise between the two groups of designers. This then prevents us from making comparable assessment between tutors and students' cognitive abilities in tutorials. Current data has not supported a firm link between tutors and students' patterns of behaviours observed and expertise. In spite of this, however, the behavioural study of tutors and students' tutorial conversations has certainly revealed the richness of cognitive interactions. This could pave the way for further research into the different roles of design conversations and their implications for tutors and students. One very good example relates to the significance of cognitive *'scaffold'* as a mediating tool for teaching and learning or even in providing effective synergy in design collaborations.

6.8. Summary

1. Most of tutors' Move actions had derived significantly from preceding segments that were made by tutor themselves rather than those from the students ($U=25.000$, $p<0.01$). It is possible that their ability in using their own preceding segments as building blocks for subsequent Moves contributes to the overall productivity of Cognitive actions during tutorial conversations. However, students' Move actions did not differentiate significantly between the sources of preceding segments. In particular, this could suggest students' poor ability in comprehending important cues and propositions afforded by tutor-made preceding segments in order to trigger the necessary Moves in tutorial conversations. This could be one of the key problems with novices like the second year architectural design students in the current observation.

2. Students' Formulate actions that followed preceding segments made by tutors were *twice* longer in duration than Formulate actions that followed student-made preceding segments. From this, it is clear that students' Formulate actions depended more significantly on tutors segments. One possible reason could be that the tutors provided students with cognitive 'scaffolds' that assist moving forward design activities. This also showed that tutors could operate at different roles during tutorial conversations due to their substantial experience in practice. In contrast, we postulate that students' preceding segments may be less useful as building blocks

for subsequent Formulate actions even for the students themselves. Thus, a tutor's input is helpful for the student to make further Formulate actions.

3. We also suggest the possibility that tutors' superior cognitive abilities are such that they are were able to develop Formulate actions from both students' and their own preceding segments. It could be that prior to making Formulate actions, tutors' are able to scrutinise cognitively both different sources of preceding segments in search for the necessary components that form corresponding Formulate actions. They did not differentiate their cognitive strategies towards these two types of preceding segments. This is in spite of the fact that in nature, the two sources of preceding segments may be highly differentiated in terms of the quality and level of information contained in them.

CHAPTER 7
Cognitive Actions and Organisation of Cognition

7.1. Introduction

In this chapter, we differentiate tutors and students' Cognitive actions by identifying them with particular *organisational* functions in visual cognition. The effort to establish the link between Cognitive actions and visual organisation is appropriate since verbal protocols and physical gestures that tutors and students made during tutorials often contain explicit references to visual modes of representation, reasoning and communication. These visual modes included drawings, diagrams, models, plans, notes, photographs, building materials and montages. Therefore, segments that indicate Cognitive actions would also reflect a certain measure of visual organisation.

In the current study, the visual organisation category consists of *structural*, *symbolic* and *componential* functions of vision. These functions were an adaptation of Ullman's (1996) theory of visual cognition, which suggested three levels of cognitive processing in vision: low, intermediate and high level. Previous discussion in Chapter 4 (Research Methodology) provided detailed characteristics of Ullman's original visual processing levels and their subsequent renaming for use in the current study.

7.2. Outline of analysis

Earlier in Chapter 5, we initiated a basic comparison in productivity of Cognitive actions between tutors and students. In subsequent analysis chapters, we expand this study to incorporate other factors that may further differentiate Cognitive actions between the two groups of subjects. In the current study, we establish whether there are any significant differences in the way tutors and students' Cognitive actions are *organised* according to *structural*, *symbolical* and *componential* functions of vision during tutorial conversations. If differences were significant, what would be the extent of these differences? Data available for analysis are available in segment frequency and duration.

Tables 7.1 and 7.2 illustrate respective frequencies of tutors and students' Cognitive action types (i.e. Formulate, Evaluate and Move actions) according to their distribution in *structural* (e.g. combining objects), *symbolic* (e.g. interpreting from experience) and *componential* (e.g. explicit shapes, forms and surfaces) organisational functions. We determine the significance of these interactions through the Chi-square test.

Tables 7.1A and 7.2A, which are percentage tables for Tables 7.1 and 7.2 respectively, would enable us to make *proportionate* comparison of specific cases of interactions between tutors and students' Cognitive action groups and visual organisation. This is particularly useful where there are noted differences in those interactions. Such comparison provides a general understanding as to how tutors and students organise their visual attention as they carry out specific types of Cognitive action during tutorials. We discuss the analysis of the interactions between Cognitive actions and visual organisational function in following Sections 7.3 and 7.4.

By using Wilcoxon-Mann-Whitney statistical test, we further establish if differences in the *distribution of duration* between tutors and students' Cognitive action in relation to visual organisation are significant. Section 7.5 discusses the findings for this type of analysis.

7.3. The association between Cognitive actions and Organisational function

A Chi-square test on the relevant frequency distribution tables would determine the following question: *Is there any significant association between tutors and students' Cognitive actions and the organisation function of vision?* The test on Table 7-1 revealed *significant* association between tutors' Cognitive actions and the organisation function as beyond the .01 level of probability (χ^2=16.918, df=4, p=0.002). For tutors, the type of Cognitive action undertaken varies significantly with the type of organisation function.

Table 7-1 Segment frequency of Cognitive actions in relation to organisation type (Tutors)

Observed

		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Organisation type	Structural	92	10	69	171
	Symbolic	307	39	167	513
	Componential	43	8	4	55
Column total		442	57	240	739

Table 7-1A Percentage of Cognitive actions in relation to organisation type (Tutors)

		% of Cognitive action		
		Formulate	Evaluate	Move
Organisation type	Structural	20.8	17.5	28.8
	Symbolic	69.5	68.4	69.6
	Componential	9.7	14.0	1.7
Column total		100.0	100.0	100.0

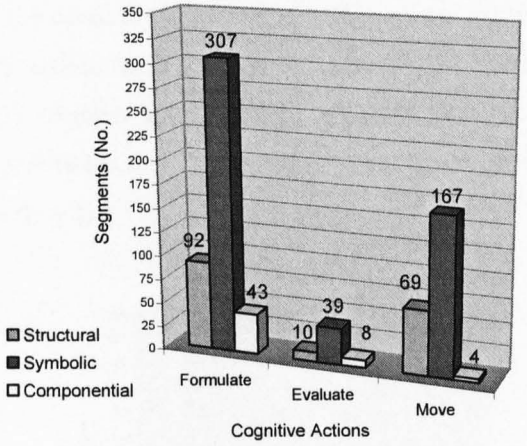

Figure 7-1 Organisation of Cognitive actions (Tutor)

Due to the skewed representation of cell distributions in Table 7-2, we conducted a Chi-square test on the percentage distribution of students' segments in Table 7-2A. The result showed that there was *no* significant association between students' Cognitive actions and the organisation function beyond the .05 level of probability (χ^2=9.153, df=4, p=0.057). For students, Cognitive action did *not* vary significantly with the type of visual organisation.

Table 7-2 Segment frequency of Cognitive actions in relation to organisation type (Students)

Observed		Cognitive Actions			Row total
		Formulate	Evaluate	Move	
Organisation type	Structural	51	13	12	76
	Symbolic	309	55	38	402
	Componential	25	3	0	28
Column total		385	71	50	506

Table 7-2A Percentage of Cognitive actions in relation to organisation type (Students)

		% of Cognitive action		
		Formulate	Evaluate	Move
Organisation type	Structural	13.2	18.3	24.0
	Symbolic	80.3	77.5	76.0
	Componential	6.5	4.2	0.0
Column total		100.0	100.0	100.0

7.4. Observing Patterns in frequency and percentage distributions

Three interesting patterns emerged from the frequency (Tables 7-1 and 7-2) and percentage (Tables 7-1A and 7-2A) distributions in the interactions between tutors and students' Cognitive actions and visual organisational functions. Firstly, it relates to the *structural* organisation of Cognitive actions. There were greater percentage ratio *and* number of segments related to the *structural* organisation in *tutors'* Formulate (20.8%, n=92) and Move (28.8%, n=69) actions than there were in students' Formulate (13.2%, n=51) and Move (24.0%, n=12) actions. Substantially, we also observe here that tutors (n=69) produced more than *five* times the number of *structurally* organised *Move* action segments compared to students (n=12).

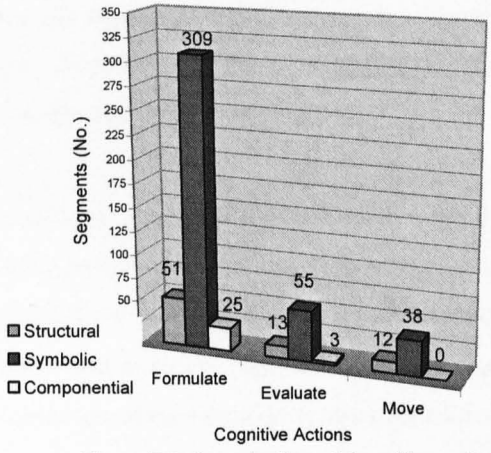

Figure 7-2 Organisation of Cognitive actions (Students)

Secondly, we noted that students relied more on *symbolic* organisation than tutors did for all types of Cognitive action. There were greater percentage of symbolic organisation in students' Formulate (80.3%, 309), Evaluate (77.5%, 55) and Move actions (76.0%, 38) than there were in tutors' Formulate (69.5%, n=307), Evaluate (68.4%, n=39) and Move (69.6%, n=167) actions. Nevertheless, in the case Move actions, the number of tutors' segments (n=167) that were symbolically organised was more than *four* times that of the students (n=38).

Thirdly, there was greater percentage of componential organisation in tutors' Evaluate actions (14.0%, n=8) than there was in students' Evaluate (4.2%, n=3) actions. This was regardless of the fact that overall, students (n=71) actually produced more Evaluate actions overall than tutors (n=57).

7.5. Comparing cases of interaction between Cognitive actions and Organisation functions

The next step was to apply Wilcoxon-Mann-Whitney tests on cases of interactions between tutors and students' Cognitive actions and visual organisational functions as described in preceding section 7.4. The main subject of these tests was the distribution of duration of cases concerned. This was to establish whether frequency and percentage differences observed in those cases are statistically significant. We discuss the findings of these tests in the following sub-sections.

7.5.1. Formulate actions: Comparing cases relating to visual organisational functions

Finding: There were *no* significant differences in distribution of duration between Tutors and students' *Formulate* actions, regardless whether they were organised structurally, symbolically and componentially.

Whether Formulate actions were *structurally* (U=47.000, p=0.160, two-tailed test), *symbolically* (U=52.000, p=0.266, two-tailed test) or *componentially* (U=66.500, p=0.766, two-tailed test) organised, there were *no* significant differences in the ranked distribution of durations between tutors and students (Tables 7-3A, 7-3B and 7-3C). Although there are some differences in mean duration between tutors and students' groups (Figures 7-3A, 7-3B and 7-3C), these were not significantly different.

Table 7-3A Differences in Structurally organised Formulate actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	2.385	0.501
Session 2	1.320	1.302
Session 3	0.665	0.167
Session 4	1.016	1.284
Session 5	1.332	3.834
Session 6	1.166	2.420
Session 7	0.469	0.466
Session 8	1.336	0.050
Session 9	0.768	0.233
Session 10	1.837	1.236
Session 11	1.350	0.117
Session 12	1.132	1.035
Total Duration	14.776	12.645
Mean	1.231	1.054
Std Deviation	0.515	1.118

U=47.000, p=0.160, two-tailed test

Table 7-3B Differences in Symbolically organised Formulate actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	4.224	3.840
Session 2	7.788	5.676
Session 3	4.260	6.336
Session 4	8.244	6.739
Session 5	2.884	8.164
Session 6	2.934	8.787
Session 7	5.610	3.420
Session 8	2.190	2.944
Session 9	2.508	3.040
Session 10	7.686	5.313
Session 11	3.476	4.553
Session 12	4.640	7.770
Total Duration	56.444	66.582
Mean	4.704	5.549
Std Deviation	2.159	2.042

U=52.000, p=0.266, two-tailed test

Table 7-3C Differences in componentially Organised Formulate actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	0.684	0.400
Session 2	0.535	0.983
Session 3	0.017	0.117
Session 4	0.250	0.000
Session 5	0.880	0.034
Session 6	0.264	0.567
Session 7	0.465	0.000
Session 8	0.000	0.284
Session 9	0.034	0.017
Session 10	0.166	0.300
Session 11	0.050	0.050
Session 12	0.948	1.630
Total Duration	4.293	4.382
Mean	0.358	0.365
Std Deviation	0.340	0.495

U=66.5000, p=0.766, two-tailed test

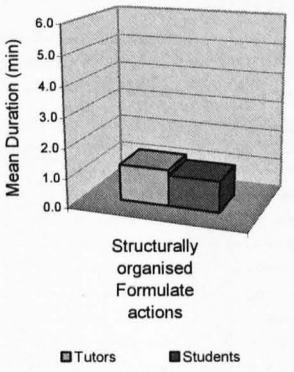

Figure 7-3A Mean Duration of Structurally organised Formulate actions

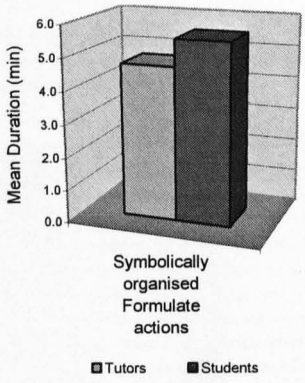

Figure 7-3B Mean Duration of Symbolically organised Formulate actions

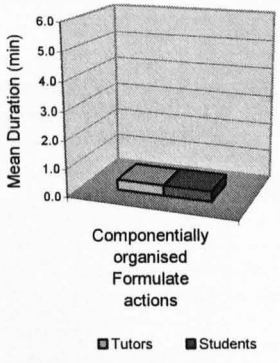

Figure 7-3C Mean Duration Componentially organised Formulate actions

7.5.2. Evaluate actions: Comparing cases relating to visual organisational functions

Finding: There were *no* significant differences in the distribution of duration between Tutors and students' *Evaluate* actions, regardless whether they were organised structurally, symbolically and componentially.

Whether Evaluate actions were *structurally* (U=66.500, p=0.738, two-tailed), *symbolically* (U=48.000, p=0.178, two-tailed test) or *componentially* (U=53.000, p=0.198, two-tailed test) organised, there were *no* significant differences in the ranked distribution of durations between tutors and students (Tables 7-4A, 7-4B and 7-4C). There were some differences in the mean durations between the two groups of cases, but these differences were significant (Figures 7-4A, 7-4B and 7-4C).

Table 7-4A Differences in Structurally organised Evaluate actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	0.000	0.380
Session 2	0.332	0.000
Session 3	0.000	0.000
Session 4	0.067	0.000
Session 5	0.083	1.968
Session 6	0.150	1.050
Session 7	0.150	0.000
Session 8	0.000	0.083
Session 9	0.000	0.000
Session 10	0.000	0.000
Session 11	0.400	0.000
Session 12	0.000	0.000
Total Duration	1.182	3.481
Mean	0.099	0.290
Std Deviation	0.138	0.612

U=66.500, p=0.738, two-tailed test

Table 7-4B Differences in Symbolically organised Evaluate actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	0.516	0.984
Session 2	0.798	0.452
Session 3	0.233	0.716
Session 4	0.300	0.217
Session 5	0.715	2.520
Session 6	0.000	0.416
Session 7	0.000	0.567
Session 8	0.435	0.465
Session 9	0.000	0.083
Session 10	0.385	0.564
Session 11	0.985	1.014
Session 12	1.332	1.603
Total Duration	5.699	9.601
Mean	0.475	0.800
Std Deviation	0.419	0.677

U=48.000, p=0.178, two-tailed test

Table 7-4C Differences in Componentially organised Evaluate actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	0.400	0.216
Session 2	0.117	0.000
Session 3	0.100	0.000
Session 4	0.000	0.000
Session 5	0.084	0.000
Session 6	0.000	0.000
Session 7	0.000	0.000
Session 8	0.000	0.000
Session 9	0.000	0.000
Session 10	0.000	0.000
Session 11	0.000	0.000
Session 12	0.166	0.067
Total Duration	0.867	0.283
Mean	0.072	0.024
Std Deviation	0.119	0.064

U=53.000, p=0.198, two-tailed test

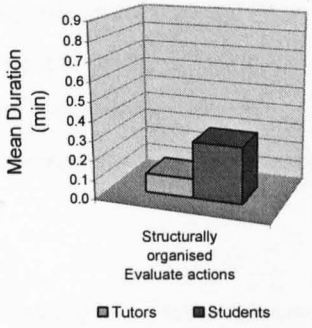

Figure 7-4A Mean Duration of Structurally organised Evaluate actions

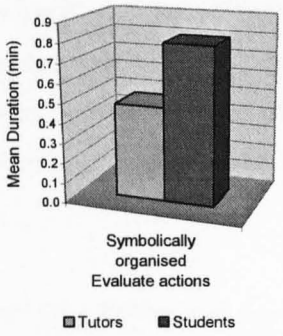

Figure 7-4B Mean Duration of Symbolically organised Evaluate actions

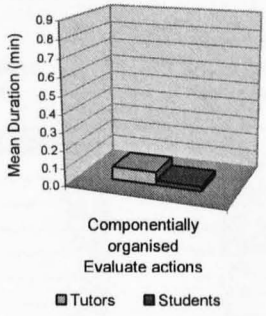

Figure 7-4C Mean Duration Componentially organised Evaluate actions

7.5.3. Move actions: Comparing cases relating to visual organisational functions

Finding: Tutors spent *five* times longer duration in producing Move actions that were *structurally* organised and *eight* times longer on Move actions that were *symbolically* organised than students did.

There were *highly significant* differences in Move actions that were organised *structurally* and *symbolically* between tutors and students groups. In cases involving Move actions that were *structurally* organised, tutors (Mean=1.643 min, S.D=1.034 min) spent *five* times longer duration in producing these actions than students did (Mean=0.322 min, S.D=0.580 min). This was substantiated by the Wilcoxon-Mann-Whitney test, which revealed that the differences in the durations between tutor and student groups were *extremely significant* beyond the .001 level of probability (U=13.000, two-tailed test).

Where Move actions were *symbolically* organised, tutors (Mean=3.250 min, S.D=1.479 min) took approximately *eight* times longer duration in making these actions than students did (Mean=0.412 min, S.D=0.400 min). In such circumstances, the Wilcoxon-Mann-Whitney test revealed that the differences in the durations between tutor and student groups were also *extremely significant* beyond the .001 level of probability (U=0.000, two-tailed test).

For Move actions that were *componentially* organised, the differences in the durations between tutors and students were *not* significant beyond .05 level of probability (U=54.000, p=0.217, two-tailed test). However, we could regard that such case is a rarity in both groups judging from the negligible production of segments.

Table 7-5A Differences in Structurally organised Move actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	2.130	0.100
Session 2	2.718	0.067
Session 3	1.600	0.000
Session 4	1.368	0.000
Session 5	4.020	1.668
Session 6	2.214	0.000
Session 7	1.535	0.000
Session 8	0.651	0.184
Session 9	0.900	0.000
Session 10	1.648	0.317
Session 11	0.466	0.117
Session 12	0.468	1.416
Total Duration	19.718	3.869
Mean	1.643	0.322
Std Deviation	1.034	0.580

U=13.000, p<0.001, two-tailed test

Table 7-5B Differences in Symbolically organised Move actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	2.522	1.098
Session 2	4.980	0.084
Session 3	3.096	0.582
Session 4	3.636	0.100
Session 5	1.332	0.216
Session 6	1.764	0.000
Session 7	3.672	0.100
Session 8	2.534	0.150
Session 9	2.900	0.183
Session 10	3.924	0.732
Session 11	6.656	1.120
Session 12	1.980	0.584
Total Duration	38.996	4.949
Mean	3.250	0.412
Std Deviation	1.479	0.400

U=0.000, p<0.001, two-tailed test

Table 7-5C Differences in Componentially organised Move actions
Total Duration in Session (minutes)

	Tutors	Students
Session 1	0.000	0.000
Session 2	0.000	0.000
Session 3	0.000	0.000
Session 4	0.000	0.000
Session 5	0.250	0.000
Session 6	0.050	0.000
Session 7	0.100	0.000
Session 8	0.000	0.000
Session 9	0.000	0.000
Session 10	0.000	0.000
Session 11	0.000	0.000
Session 12	0.000	0.000
Total Duration	0.400	0.000
Mean	0.033	0.000
Std Deviation	0.075	0.000

U=54.000, p=0.217, two-tailed test

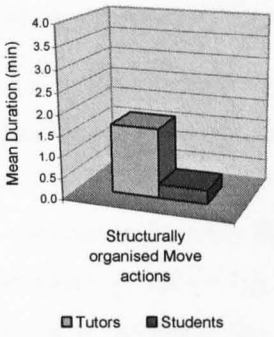

Figure 7-5A Mean Duration of Structurally organised Move actions

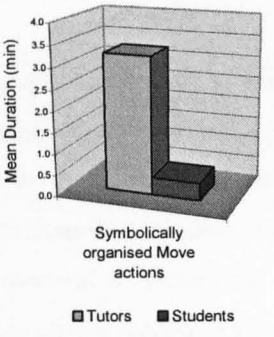

Figure 7-5B Mean Duration of Symbolically organised Move actions

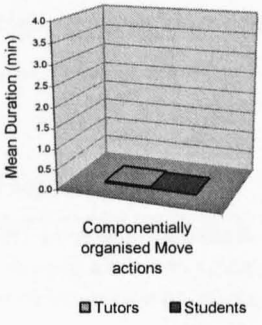

Figure 7-5C Mean Duration Componentially organised Move actions

7.6. Role of visual organisation in differentiating Cognitive actions

In this chapter, we differentiated tutors and students' cognitive behaviours by observing the interactions between their Cognitive actions (Formulate, Evaluate and Move actions) and organisational functions (Componential, Structural and Symbolic) in visual cognition. We found that such interaction was significant only in relation to tutors' Cognitive actions and not in students' Cognitive actions. The key factor in tutors' interaction was Move actions. We know from previous analyses in Chapter 5 (Basic Cognitive action study) that tutors produced greater number and ratio of Move actions and spent more time in producing them than students did. The current analysis revealed two crucial characteristics that further differentiated Tutors' Move actions from students' Move actions: *structural* and *symbolic* organisations. Tutors produced more *segments* and longer *durations* of Move actions that were organised *structurally* and *symbolically* than students.

7.6.1 Structural organisation of Move actions

There are various motives behind the structural organisation of Move actions. One of the motives concerns the notion of *'processing'* in perception and imagery. Following Ullman's (1996) Visual cognition theory, we consider *structural* organisation in visual cognition as a 'processing' ability that deals with activities like segmenting, regrouping, separating, restructuring, combining and linking of features in perception and imagery. Kosslyn (1999) also revealed that imagery also involves certain 'effort' in image *generation*, *inspection*, *maintenance* and *transformation*. Many of the structurally organised Move actions observed in the current study of tutorial conversations reflected a certain degree of 'processing' activities on perception and image as outlined by Ullman (1996) and Kosslyn (1999). In the following segments, we noted a few of Tutor's Move action (structurally organised) examples in Tutorial session 1.

Segment	Contributor	Protocol Segments
16	T1	So I think I would just examine those spaces and see whether they could be brought down to say 2.4 as a single height, floor to ceiling height.And which pushes, well it takes a metre and a half off, doesn't it...4.8?
		[Move action concerning image inspection]
43	T1	Ok, sounds good. And so we go up to the first floor level
45	T1	I think you need to go up a scale
50	T1	Make it a little bit bigger. Work at 1:100 and work at 1:50,
		[Move actions to transform from small to larger scale]
92	T1	So, you know, I think that needs.....it's a tiny little sort of action to draw this line around and just say, well, that's the edge of the site
		[Move action to establish boundary on plan]

Another important motive is that structurally organised Move actions constitute *propositions* for *advancing* or *transforming* a current state of design. This has to do with the way tutors gathers, combines and make links with various design elements that form a temporal 'chunk' of knowledge for dealing with a specific design situation. Tutors are able to access a great deal of information from large repository knowledge and acquired experience. Therefore, it is not surprising that tutors produced more structurally organised Move actions and took longer time to produce them. The following segments show two examples of structurally organised Move action that served as propositions in Tutorial session 2.

Segment	Contributor	Protocol Segment
73	T2	So I think a very *clear and strategic approach* on how you're dealing with certain edges of the site's conditions. *Then from that* the quality of the (banding) of the spaces that you've kind of identified. *And then, also*, then that will give you a very, you know, unambiguous approach to *how you are dealing with the site*. And then *from that*, you can actually *begin to work with the spaces and give more definitive character* to, you know, to the mass of the building, the mass and the form [Move action as instruction to work systematically on key design features]
157	T2	So I think for for Thursday, see if you can clarify this kind of strategy, the *site strategy in terms of movement, circulation and the types of space* [Move action to clarify site strategy]

7.6.2 Symbolic organisation of Move actions

Move actions that are organised symbolically are essentially propositions that often come with various forms of *interpretation*, *reasoning* and *inference*. We could infer this type of Move action from the encoded segments in tutorial conversations. We now know that tutors produced more symbolically organised Move actions and took longer time in producing them than students. This ability shows tutors' effective access to knowledge, experience and resources as well as skills in memory. Particularly in the context of tutorials, such a condition facilitates the production of viable and meaningful actions on the part of tutors, which then sets the stage for subsequent activities to occur. The following segments are some examples of symbolically organised Move actions in Tutorial session 1.

Segment	Contributor	Protocol Segments
14	T1	And it's not simply the height that we have to consider but also have to consider it's volume and it's proportion [Move action prescribing joint analysis of height, volume and proportion]
22	T1	I think you can *afford* to bring that height down [Move action inferring possibility of reducing height of scheme]
102	T1	So we've got the floor to ceiling heights. And I think that's the thing to look at first because that's going to throw everything else into disarray. Do that first [Move action prescribing focus on floor-ceiling height as key determinant]

7.7. Summary

1. *Move* actions categorised as *structurally* organised are propositions that possess certain visual processing abilities like segmenting, regrouping, separating, restructuring, combining and linking of features in perception and imagery. Tutors produced more than *five* times the number of *segments* and *five* times longer *duration* of Move actions that were organised *structurally* than students did.

2. *Move* actions regarded as *symbolically* organised are propositions that relate to interpretation, reasoning and inference. Tutors produced more than *four* times the number of segments and *eight* times longer duration of Move actions that were organised *symbolically* than students did.

CHAPTER 8
Cognitive Actions and Domain Knowledge

8.1. Introduction

In this chapter, we differentiate tutors and students' Cognitive actions by their interactions with a category of coding called *Domain knowledge*. The Domain of Knowledge category stipulates whether Cognitive actions performed during tutorial design conversations relate to *Process* or *Content* knowledge. Previous discussion in Chapter 4 (Research Methodology) provided detailed description of these types of Knowledge. This category is important since it enables us to differentiate tutors and students' cognitive abilities by establishing the nature of knowledge that they access and utilise during tutorial design conversations.

Process-based activities reflect an 'executive' function of cognition (Flavell 1976). Suwa, Purcell et al (1998) suggested that these activities relate to *problem-states*, *operators*, *plans*, *goals* and *strategies*. We could infer many verbal expressions in tutorial conversations as those belonging to this type of knowledge. For example, these might pertain to *concepts, precedence, analogies, regulations, scale, model, brief and programme, frameworks and plans*. On the other hand, *Content* knowledge actions deal with specific aspects of designing. Suwa, Purcell et al. (1998) described that this type of knowledge deals with 'what designers see, attend to, think of and retrieve from memory' (p.457). Generally, we regard this as knowledge about products or artefacts.

8.2. Outline of analysis

In this chapter, we determine whether the factor of Domain of Knowledge significantly differentiates tutors and students Cognitive actions in tutorial conversations. Tables 8.1 and 8.2 show respective frequencies of tutors and students' Cognitive action types (Formulate, Evaluate and Move actions) based on their distribution in *Process* and *Content* Knowledge. We determine the significance of these interactions through the Chi-square test.

Percentage Tables 8.1A and 8.2A facilitates *proportionate* comparison of specific cases of interactions between tutors and students' Cognitive action groups and domain of knowledge. This is particularly useful where we detect marked differences in those interactions. We discuss the analysis of the interactions between Cognitive actions and domain of knowledge factors in following Sections 8.3 and 8.4.

By using the Wilcoxon-Mann-Whitney statistical test, we establish if differences in the *distribution of duration* between tutors and students' Cognitive action in relation to Domain knowledge are significant. This type of analysis forms the discussion on findings in Section 8.5.

8.3. The association between Cognitive actions and Domain of knowledge

The lead analysis in this section refers to the following question: *Is domain of knowledge a significant factor in differentiating between tutors and students' Cognitive actions?* The Chi-square test on the segment distribution in Table 8-1 showed *highly significant* association between tutors' Cognitive actions and the Domain of Knowledge (χ^2=13.574, df=2, p<0.001). On the contrary, the test on Table 8-2 proved that there was *no* significant association between students' Cognitive actions and the Domain of Knowledge (χ^2=0.937, df=2, p=0.626). For tutors, the type of Cognitive action performed varies significantly with the type of Domain knowledge. For students, the similarity in patterns of distribution in illustrated in Figure 8-2 and Chi-square test indicate that there is no significant variation between the type of Cognitive action and type of Domain of knowledge

Table 8-1 Segment frequency of Cognitive actions in relation to Domain knowledge (Tutors)

Observed		Cognitive Actions of current segments			Row total
		Formulate	Evaluate	Move	
Domain of Knowledge	Process	199	28	144	371
	Content	243	29	96	368
Column total		442	57	240	739

Table 8-1A Percentage of Cognitive actions in relation to Domain knowledge (Tutors)

		% of Cognitive Actions		
		Formulate	Evaluate	Move
Domain of Knowledge	Process	45.0	49.1	60.0
	Content	55.0	50.9	40.0
Column total		100.0	100.0	100.0

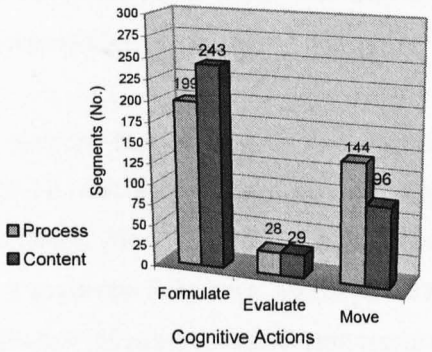

Figure 8-1 Cognitive action and Domain of knowledge (Tutors)

Table 8-2 Segment frequency of Cognitive actions in relation to Domain knowledge (Students)

Observed		Cognitive Actions of current segments			Row total
		Formulate	Evaluate	Move	
Domain of Knowledge	Process	156	25	22	203
	Content	229	46	28	303
Column total		385	71	50	506

Table 8-2A Percentage of Cognitive actions in relation to Domain knowledge (Students)

		% of Cognitive Actions		
		Formulate	Evaluate	Move
Domain of Knowledge	Process	40.5	35.2	44.0
	Content	59.5	64.8	56.0
Column total		100.0	100.0	100.0

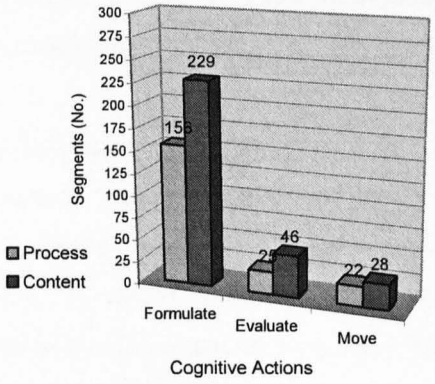

Figure 8-2 Cognitive action and Domain of knowledge (Students)

8.4. Observing patterns in frequency and percentage distributions

It is important to recognise that the basic study in the productivity of Cognitive actions (Chapter 5) had already revealed the highly significant interaction between *Cognitive action* type (Formulate, Evaluate and Move actions) and *expertise level* (tutors and students). The current study further extends this understanding by determining how each type of Cognitive

action differs *proportionately* between tutors and students in terms of its distribution through type of *Domain knowledge*.

We view with interest patterns that emerge by comparing Tables 8-1 and 8-2 (segment frequency) and Tables 8-1A and 8-2A (percentage distribution). There are *three* notable observations from these tables. Firstly, we refer to the process and content distribution of *Move* actions. In terms of segments frequency and percentage, there seems to be substantial differences in the distribution of process-based and content-based *Move* actions between tutors and students. There were greater *percentage* ratio and number of *segments* related to *process* knowledge in *tutors'* Move action (60.0%, n=144) than there were in students' Move action (44.0%, n=22). It is evident here that tutors produced more than *six* times the number of segments associated with *process-based* Move actions compared to those of the students.

In terms of segment frequency, tutors' *content*-based Move actions (n=96) are more than *three* times the number of students' content-based Move actions (n=28). This regardless of the fact that in percentage terms, students (56.0%) produced greater portion of content-based Move actions than tutors did (40.0%). However, we also need to acknowledge that overall tutors (n=240) produced substantially more Move actions than students did (n=50). Therefore, the huge differences in ratio between tutors and students process-based and content-based segments are inevitable.

Secondly, we also found differences in the patterns of distribution of process-based and content-based *Evaluate* actions between tutors and students groups. Tutors produced greater percentage and number of segments of process-based Evaluate actions (49.1%, n=28) than students did (35.2%, n=25). This is in view of the fact that overall, students (n=71) produced more Evaluate action segments than tutors did (n=57).

Thirdly, tutors produced greater percentage and number of segments of process-based *Formulate* actions (45.0%, n=199) than students did (40.5%, n=156). In contrast, students produced greater percentage of content-based Formulate actions (59.5%) than tutors did (55%).

8.5. Comparing cases of interaction between Cognitive actions and Domain of knowledge

To establish whether the differences described in the previous section are statistically significant, we conducted Wilcoxon-Mann-Whitney tests on the distributions of duration of activities involved. The following sub-sections form the discussion on the results of these tests.

8.5.1. Formulate actions: Comparing cases relating to Domain of knowledge

Finding: Tutors and students' Formulate actions did not differ significantly in mean duration regardless whether they occur in Process and Content domains of knowledge

For *Formulate* action, the mean duration for tutors' segments that occurred in the *Process* domain (Mean=3.343 min, S.D=1.692 min) was *greater* than that of the students (Mean=2.526 min, S.D=1.436 min) (Table 8-3A). However, the differences in ranked distribution of durations between tutors and students were *not* significant beyond the .05 level (U=53.000, p=0.291, two-tailed).

The opposite pattern occurred in the *Content* domain where the mean duration of students' segments (Mean=4.442, S.D=2.591) was *greater* than that of the tutors (Mean=3.220, S.D=1.969) (Table 8-3B). The differences in the distribution of durations between tutors and students were also *not* significant beyond the .05 level (U=51.000, p=0.242, two-tailed). Therefore, whether *Formulate* actions were *Process-based* or *Content*-based, there were *no* significant differences in the distribution of duration between tutors and students.

Table 8-3A Formulate actions
In Process domain of knowledge
Total Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	2.868	0.668
Session 2	7.144	3.682
Session 3	2.470	2.250
Session 4	3.650	4.886
Session 5	3.636	4.470
Session 6	2.912	1.650
Session 7	1.582	0.965
Session 8	0.980	1.260
Session 9	2.286	1.620
Session 10	5.325	1.770
Session 11	2.686	3.243
Session 12	4.576	3.850
Total Duration	40.115	30.314
Mean	3.343	2.526
Std Deviation	1.692	1.436

U=53.000, p=0.291, two-tailed test

Table 8-3B Formulate actions
In Content domain of knowledge
Total Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	7.392	4.064
Session 2	2.508	4.264
Session 3	2.480	4.365
Session 4	5.865	3.135
Session 5	1.469	7.568
Session 6	1.680	10.150
Session 7	4.970	2.924
Session 8	2.535	2.002
Session 9	1.035	1.665
Session 10	4.350	5.070
Session 11	2.196	1.504
Session 12	2.160	6.588
Total Duration	38.640	53.299
Mean	3.220	4.442
Std Deviation	1.969	2.591

U=51.000, p=0.242, two-tailed test

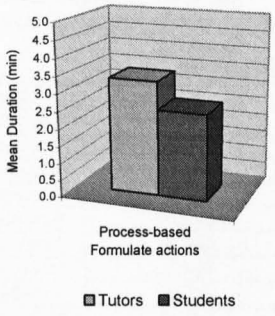

Figure 8-3A Mean Duration Comparison of Process-based Formulate actions

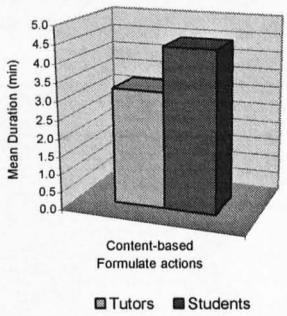

Figure 8-3B Mean Duration Comparison of Content-based Formulate actions

8.5.2. Evaluate actions: Comparing cases relating to Domain of knowledge

Finding: Tutors and students' Evaluate actions did not differ significantly in mean duration regardless whether they occur in Process and Content domains of knowledge

For *Evaluate* actions, the mean duration for students' segments that occurred in the *Process* domain (Mean=0.481 min, S.D=0.508 min) was *greater* than that of the tutors (Mean=0.377 min, S.D=0.344 min) (Table 8-4A). However, the differences in the distribution of durations between students and tutors were *not* significant beyond the .05 level (U=68.500, p=0.854, two-tailed).

For Evaluate actions that occur in *Content* domain, the mean duration of students' segments (Mean=0.634, S.D=0.760) was also *greater* than that of the tutors (Mean=0.301, S.D=0.283) (Table 8-4B). However, the differences in the distribution of durations between tutors and students were also *not* significant beyond the .05 level (U=52.000, p=0.257, two-tailed). Therefore, whether *Evaluate* actions were *Process-based* or *Content*-based, there were *no* significant differences in the distribution of duration between tutors and students.

Table 8-4A Evaluate actions
In Process domain of knowledge
Total Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	0.266	0.584
Session 2	0.548	0.000
Session 3	0.233	0.618
Session 4	0.234	0.217
Session 5	0.434	1.650
Session 6	0.050	0.934
Session 7	0.150	0.000
Session 8	0.348	0.000
Session 9	0.000	0.083
Session 10	0.234	0.399
Session 11	0.816	0.282
Session 12	1.216	1.000
Total Duration	4.529	5.767
Mean	0.377	0.481
Std Deviation	0.344	0.508

U=68.500, p=0.854, two-tailed test

Table 8-4B Evaluate actions
In Content domain of knowledge
Total Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	0.648	1.001
Session 2	0.700	0.452
Session 3	0.100	0.100
Session 4	0.133	0.000
Session 5	0.450	2.834
Session 6	0.100	0.534
Session 7	0.000	0.567
Session 8	0.083	0.552
Session 9	0.000	0.000
Session 10	0.150	0.168
Session 11	0.566	0.732
Session 12	0.684	0.666
Total Duration	3.614	7.606
Mean	0.301	0.634
Std Deviation	0.283	0.760

U=52.000, p=0.257, two-tailed test

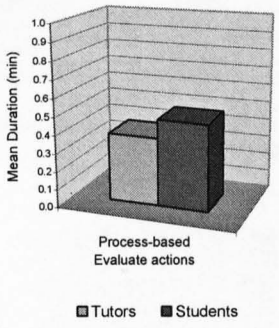

Figure 8-4A Mean Duration Comparison of Process-based Evaluate actions

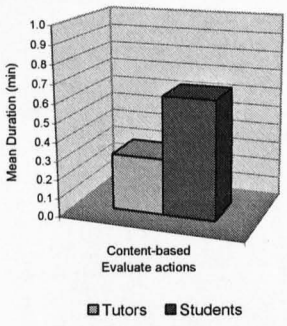

Figure 8-4B Mean Duration Comparison of Content-based Evaluate actions

8.5.3. Move actions: Comparing cases relating to Domain of knowledge

Finding: Tutors significantly spent more time on Process-based and Content-based Move actions than students did

For Move actions, the mean duration for tutors' segments that occurred in the *Process* domain (Mean=2.941 min, S.D=1.722 min) was more than *twelve* times *greater* than that of the students (Mean=0.236 min, S.D=0.306 min) (Table 8-5A). This huge disparity between tutors and students mean durations was further supported by the fact that the differences in distribution of durations between students and tutors were *highly* significant beyond the .001 level (U=1.000, $p<0.001$, two-tailed).

For Move actions that occured in *Content* domain, the mean duration of tutors' segments (Mean=1.984 min, S.D=1.347 min) was nearly *four times greater* than that of the students

(Mean=0.499, S.D=0.506) (Table 8-5B). The differences in the distribution of durations between tutors and students were significant beyond the .01 level (U=17.000, p<0.01, two-tailed). On average, tutors were significantly spending more time in making process-based and content-based Move actions than students did.

Table 8-5A Move actions
In Process domain of knowledge
Total Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	2.270	0.333
Session 2	6.384	0.084
Session 3	1.000	0.133
Session 4	3.950	0.000
Session 5	0.750	0.633
Session 6	3.288	0.000
Session 7	2.119	0.000
Session 8	1.720	0.083
Session 9	2.898	0.000
Session 10	3.165	0.116
Session 11	5.698	0.936
Session 12	2.054	0.516
Total Duration	35.296	2.834
Mean	2.941	0.236
Std Deviation	1.722	0.306

U=1.000, p<0.001, two-tailed test

Table 8-5B Move actions
In Content domain of knowledge
Total Duration in Tutorial Session (minutes)

	Tutor	Student
Session 1	2.379	0.868
Session 2	1.315	0.067
Session 3	3.696	0.450
Session 4	1.050	0.100
Session 5	4.845	1.250
Session 6	0.749	0.000
Session 7	3.180	0.100
Session 8	1.467	0.249
Session 9	0.900	0.183
Session 10	2.398	0.935
Session 11	1.434	0.300
Session 12	0.400	1.482
Total Duration	23.813	5.984
Mean	1.984	0.499
Std Deviation	1.347	0.506

U=17.000, p<0.01, two-tailed test

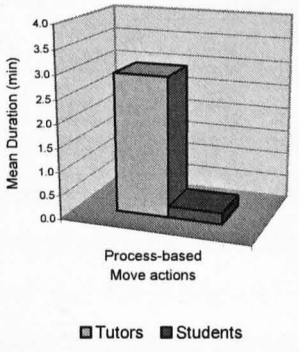

Figure 8-5A Mean Duration Comparison of Process-based Move actions

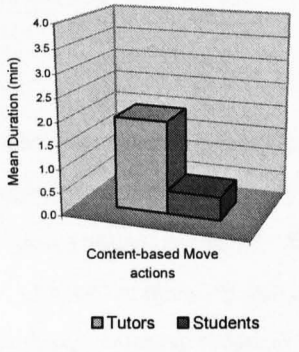

Figure 8-5B Mean Duration Comparison of Content-based Move actions

8.6. Discussion on the effects of Domain knowledge in differentiating Cognitive actions

In particular, the current analysis revealed how domain knowledge differentiated tutors' Move actions from those of the students. In terms of percentage and number of segments, tutors produced relatively more *process*-based *Move* actions and spent more time on these actions than students did. However, it must be emphasised we could only speculate on the possible explanations for the patterns of behaviours associated with the interactions between tutors and students' Cognitive actions and Domain knowledge. For example there is a prospect that, based on the knowledge type, tutors' Move actions might have dealt

primarily with 'overseeing' of design activities. Tutors' ability in the *knowledge of 'processes'* could suggest advanced level of learning and experience compared to the students. At this stage, tutors might have also acquired greater level of necessary skills, heuristics and strategies in dealing with 'emerging' situations of design. Then again, these interpretations could equally apply to students participating in the current observations. For example, we might have obtained results of cognitive activities from certain students who could be at a more advanced level of expertise than other students. Current data does not permit us making specific inferences as to the nature of cognitive behaviours observed in tutors and students' tutorial conversations.

We need to understand that the present methodology holds certain limitation in that it did not differentiate tutors and students' Cognitive actions based on explicit, stipulated levels of expertise. Furthermore, it had not taken into account the objectives or intentions behind actions made by the two groups of designers in question. Nonetheless, what we have acquired are patterns of behaviour that reflect the dynamic and dialectical nature of tutorial conversations rather than the distinction between predetermined levels of expertise. What we have then is a rich overview of cognitive behaviours by tutors and students who interact in tutorials.

In studying the relationship between Cognitive actions and Domain knowledge, Move actions again appear to be a key element in understanding tutors and students' behaviours during design conversations. We found significant association between tutors' Move actions and the Knowledge of *'processes'*. Tutors' Move actions were substantially process-based (60%) than content-based (40%). In contrast, inexperienced designers like students in the tutorial conversations relied more on *content*-based Cognitive actions of all types (Formulate, Evaluate and Move actions) (Percentage Table 8-2A).

However, we also need to acknowledge that overall tutors (n=240) produced substantially more *Move* actions than students did (n=50). Distributing tutors' Move actions according to process-based and content-based knowledge meant that in both types of distributions, tutors were more productive in terms of segment than the students were. The ratios of differences between tutors and students regarding process-based and content-based Move action segments were *six* and *three* times respectively. Therefore, for tutors, knowledge of 'content' is relatively as crucial as knowledge of 'processes' in cognitive activities that

transpire during tutorial conversations. The following are some of the examples of segments that represent process-based Move actions in Tutorial session 6.

Segment	Contributor	Protocol Segment
34	T1	No, I mean, I think you can make some decisions about this. Because you can say, okay, this is about two cubes and there's a coming together of the two cubes which may introduce something else (kink element). You know, if there's a meeting of things, there is a possibility for something to occur [Move action on initiating programme]
59	T1	Well, I don't know, I think, again, this is where we go back to this idea. Well, is this the cube? [Move action on reference to concepts and ideas]
101	T1	I think you need to model that [Move action on modelling]
113	T1	So you've got some things to concentrate on. I think there are some planning matters that needed to be sorted out quite quickly. You've got the bones of that there. But I think really we need to be thinking about materiality, what it looks like in 3-D (Conversation ends at 24:22) [Move action on detail planning]

8.7. Summary

1. Tutors produced more than *six* times the number of *Process*-based Move action segments than students. In addition, tutors also spent more than *twelve* times longer in producing these segments than students. This ratio difference in duration is also very significant. This could suggest that tutors have access to a higher or 'meta' knowledge which Flavell (1976) called the 'executive' function of cognition, which would have enabled them to 'oversee' situations and manage design activities. In the current study of tutorial conversations, this might possibly involve references to the likes of *concepts, precedence, analogies, regulations, scale, model, brief and programme, frameworks and plans*. However, such suggestions are not supported by current analyses. Many other factors could also explain the findings related to the Process-based Move actions. Therefore, further research into these issues might be necessary to establish the nature of such differences.

2. Tutors produced more than *three* times the number of *content*-based Move action segments than students. Very significantly, tutors had also spent almost *four* times the duration in producing these segments than students did. Content-based knowledge pertains to 'what designers see, attend to, think of and retrieve from memory' (Suwa, Purcell et al, 1998, p.457). One possible explanation for this is that tutors might have developed a large repository of domain knowledge about design through substantial practical experience. They are probably more capable of recollecting specific experiences in order to aid current design activities than students could. However, these interpretations were not supported by current analyses. In fact, there could be many other reasons for the differences in the ratio of Content-based Move actions between tutors and students. Thus, further research into these issues might be necessary to expound the precise nature of such differences.

CHAPTER 9
Conclusion

9.1 Introduction

Studio tutorials provide a rich interactive environment in which we could observe and analyse a whole range of issues pertaining to design activities. In the current study, the aim is to compare the differences in expertise through studio tutorial conversations between tutors and students. As part of the scheme in making such comparison, we first discussed core aspects of design activities, particular those concerning the nature of design problems that designers deal with in terms of cognition (Chapter 2). Secondly, we looked into how such activities manifest in interactive design 'situations' like tutorials (Chapter 3). This then, thirdly, gave rise to the formulation of a simple tabulation methodology that would allow us to extract and discriminate two intermingling sets of conversation protocols produced by the tutor and student from each tutorial session observed for the purpose of this study. Such process relied on the segmentation and encoding of segments identified in these protocols based on specific attributes in Cognitive actions (Formulate, Evaluate and Move actions) and other supporting qualities (Cognitive organisation, Domain of knowledge and Transformation) (Chapter 4). Fourthly, we analysed specific arrays of data relevant to the early assumptions and hypotheses about tutors and students' cognitive abilities in design as outlined in Chapter 1. These analyses formed the discussions from Chapter 5 to Chapter 8.

From such analyses, we were able to develop some understanding about tutors and students' cognitive abilities in 'situated' environments like the studio tutorial and provide an account as to what the differences are between the groups as they interact in design conversations.

The following sections provide two important sets of conclusion for the current study. In the first set of conclusion, we consider the direct implications of the current analyses on the

study of design expertise. The second set reveals the general implication of the study, particularly on issues of design education.

9.2 Direct implications of the current study of expertise

In this section, we consider a general account of design expertise based on the juxtaposition of analyses obtained from the case studies involving tutorial conversations. It draws together the implications of findings, issues and viewpoints around three major categories of Cognitive actions (Formulate, Evaluate and Move actions) used in the study. Also surmised are the interactions of each Cognitive action with other categories like the type of Organisation in visual cognition, Domain of knowledge and Transformation. From this, we draw a general understanding of the key factors and circumstances that differentiate the cognitive abilities between tutors and students.

9.2.1. The nature of Formulate actions

Much of our basic understanding about 'frame' activities comes from Schon's (1983) famous study of the design studio, which he regarded as an archetypical setting for educating architects in 'reflective' practice. In such practice, 'framing' activities form the core of the designer's *appreciative* system (Schon 1992). Through 'framing', designers configure problems iteratively and progressively in order to instigate appropriate *means* in achieving solutions that are unique to the perceived problems. In the current study, we regard framing activity as part of the designer's overall *Formulating* action.

Designers' ability to *formulate* problematic situations rely substantially on the perceptual *recognition* of familiarity between problem 'instances' and 'types' (Clancey 1997), which then leads to the *conceptual* realignment of problems in hand and the exploration of the possibilities that this affords in terms of potential solutions. We observed such process in Schon's description of an industrial design process involving the conceptualisation of the 'paintbrush' as a kind of 'pump' (Chapter 3). Through *formulating* ability, designers are capable of acquiring completely innovative ways of seeing the original problem situations and generating appropriate solutions.

Formulate action, which includes framing activity, reflects a great deal about the nature of designing as a reflective practice. On this matter, Schon's influential 'frame' concept provided an excellent description of how humans solve situated, ill-defined problems.

However, it is difficult to verify the significance of Formulate actions from Schon's (1983) selective accounts of studio tutorial interaction. His regular emphasis on tutors' framing activity in the referred study certainly gave the impression that tutors are *more productive* in such activity than students are. However, we have seen how in the current study of cognitive behaviours between tutors and students, such view is not entirely accurate.

In addition, Schon's descriptive accounts also lacked the critical measure of interaction between Formulate actions and other key factors that contribute to the overall productivity of designers' Cognitive actions during tutorials. Therefore, probing the role and significance of Formulate actions in a wider context of Cognitive activities and using such measure to differentiate between two groups of designers is vital in expanding our understanding of Formulate actions and frame activities.

A critical outlook on the nature of Formulate actions would then enable us to derive a series of crucial questions for further examination. For example, is Formulate action a general phenomenon for all designers involved in studio tutorial interactions? Alternatively, does the capacity to make Formulate actions rely on the differentiating factors of experience and cognitive abilities between designers? What then are the indicators that contribute to the differences in Formulating actions between tutors and students? Such questions enable us to differentiate the kind of Formulate actions that tutors and students make. This highlights the importance of the current study in facilitating better understanding about the nature of design expertise. The following are some significant observations concerning Formulate actions.

Similar capacity in Formulating problematic situations

In terms of *overall* segment, we found that tutors (n=739) produced more Cognitive actions than students did (n=506). However, some of the most interesting findings surfaced when we compare tutors and students cognitive activities in terms of the overall distribution of segments and durations of *Formulate* action. In terms of overall number of *segments*, students (76.1%, n=385) produced a greater proportion of Formulate actions than any other type of Cognitive actions in comparison to tutors (59.8%, n=442). In terms of overall *duration*, students also spent more time proportionately in Formulate (79.0%) actions than any other type of Cognitive actions than tutors (54.1%) did. However, there was no significant difference in the mean duration of Formulate actions between the tutors and

students when we test the rank distribution of duration of these actions by means of the Wilcoxon-Mann-Whitney method (Chapter 5).

From those findings, we found that tutors and students experienced *similar* durations in producing Formulate actions despite the apparent differences in the number and proportion of segments made between the two groups of designers. There could be many interpretations for this since current methodology did not stipulate a scheme for verifying the intentions or objectives behind these actions. For example, we could reason that in the context of current study, tutors were more productive at Formulate actions owing to more significant experience in design practice than architectural students who were only at the second year of formal education. Such experience might have facilitated the development of a wide range of skills and strategies for designing. Conversely, we could also argue that tutors were less familiar with the design work compared to the students. Thus, the former needed to produce more Formulate actions as means or as a 'search' activity in comprehending the nature of such work. In this context, Formulate actions could be seen as a process of opening *prospective 'windows'* for identifying, selecting, understanding and framing problematic situations for the designers' cognitive attention (Lawson 2006).

Furthermore, we need to acknowledge that tutors and students perform different roles according to the 'needs' of conversation. Depending on the circumstances of tutorials, tutors and students' Formulate actions did not tantamount to the same kind of activity. Thus, while the durations of tutors and students' Formulate actions were similar in ranked distribution, those actions might not serve the same intentions or objectives between the two groups. For example, certain Formulate actions might have transpired within the context of tutors inculcating new ways of seeing in students. Otherwise, Formulate actions could also have also formed part of tutors' effort in understanding a particular design scheme or that those actions might simply represent tutors' critique of students' work. To a certain extent, these roles could also apply for the reasons behind students' Formulate actions. Therefore, we envisage various motivations for the same Cognitive action category.

However, similarities in the duration of formulating strategy between the two groups could not simply be justified based on productivity of Formulate actions alone. This highlights the notion discussed earlier in the section that the *usefulness* of Schon's *frame* concept, which is a feature in our Formulating action category in the current study, is only *limited* to

describing how designers deal with problematic design situations. Schon's concept does not enable us to establish the role and significance of Formulate actions within the wider context of Cognitive activities experienced by designers. In contrast, the current study aids the overall understanding of Formulate actions by determining their relationship with other factors of cognition in specific cases of analysis. The following findings further expand this view.

Formulate actions were not significantly differentiated by designers' Visual organisation

We examined the distribution of tutors and students' formulate actions in terms of *componential*, *structural* and *symbolic* organisations and found that there were *no* significant differences between tutors and students in terms of mean duration in all cases of related interactions. Following this, there is a possibility that tutors and students invoked *similar* cognitive strategies in organising the three types of visual activities that occurred in *Formulate actions*. However, such assumption would be inconclusive since current methodology did not enable us to infer a direct relationship between tutors and students' behaviour and the intentions or objectives in tutorial conversations. Furthermore, current methodology only reflected a 'syntactic' approach in eliciting and analysing protocols rather than a 'semantic' one. As such, we could only speculate the nature of cognitive behaviour observed during tutorials.

For example, we could suggest that tutors and students were similar in their ability to Formulate *componentially* by way of articulating issues and problems based on basic physical properties of objects of visual attention during tutorial conversations. In Formulating *structurally*, both tutors and students could be seen as equally capable in dealing with ambiguous, superimposed or occluded visual images by subjecting them to various restructuring activities like grouping, linking, combining and segmenting. Similarly, we could also consider that the two groups were also equal to the task of formulating *symbolically*, which concerns the use of prior knowledge in interpreting what was visually perceived and visual imagery.

The possibility of tutors and students working with similar strategies in dealing with the three types of Visual organisation during *Formulate* action could suggest that this type of Cognitive action is a *general* phenomenon for all designers.

Tutors' Formulate and Move actions infer the possibility of similar cognitive strategies in problem-solution development

Recent studies suggest the ability of designers to 'leap' at innovative design decisions once they establish a conceptual 'bridge' between problems and solutions (Schon 1993; Clancey 1997; Dorst and Cross 2001). 'Frame' activities play a crucial role in this phase of design development. This is in contrast to the process of solving conventional, well-structured problems, which involves the application of move 'operators' through a progression of problem states. While it is more straightforward to assess the resolution of conventional problems, framing activities in design is more difficult to measure. The current study suggests that it is possible to determine the significance of relationships between Formulating action, which encompasses framing activity, and other types of Cognitive action and related variables. We postulate that one of the ways of verifying the presence of conceptual 'bridging' between problems and solutions is to establish a measure of relationship between designers' problem Formulation and Move actions.

In the present study, we compared the distributions of duration between Formulate and Move actions produced by tutors and students. The results revealed a major difference between tutors and students. We found that there was *no* significant difference in mean duration between tutors' *Formulate* and *Move* actions. In contrast, the difference in mean duration between Formulate and Move actions for students was *highly significant*. Yet again, we can only draw qualified inference on these findings due to certain limitations of the current methodology. It must be emphasised that the focus of observation and analysis here are patterns of cognitive behaviour elicited from the dynamic interactions in tutorial design conversations. Current methodology, however, did not stipulate in advance an explicit model of expertise with which to discriminate design abilities in conversation. Furthermore, it also did not corroborate participants' intentions or objectives with observed behaviour in tutorial conversations.

One potential implication from these findings is that tutors possess *common* cognitive strategies in dealing concurrently with *Formulate* and *Move* actions. This could be the result of substantial experience and training in design practice. Furthermore, we now know that designing involves a dialectical, iterative and cyclical development between problem and solution spaces (Dorst and Cross 2001; Maher and Tang 2003). Therefore, an expert designer does not separate problem formulation from move solutions during design. This also reaffirms Lawson's (1979) notion that advanced level designers deal with problems

through a 'solution-focussed' approach. We speculate that the second year students' inability to reconcile formulating and move actions could be a reflection of their lack of experience and training in designing.

It is true that Schon's investigation of framing activities in studio tutorials does not offer us ways of making make 'good' frames (Valkenburg 2003). In fact, it is difficult to determine what 'good' or 'bad' frames are from designers' verbal protocols. This is probably due to the inherent nature of framing or, in the current term, formulating action, as a mechanism that deals with the *specific* and *situational* characteristics of design problems. Perhaps, it is more appropriate to consider formulating action as a device that facilitate design decision-making process rather than as means for measuring productivity of designers' actions only. We suggest that what formulate action does well here, as revealed in the current study, is to open up the possibilities for move actions to occur.

The exercise in comparing differences and similarities between tutors and students' Formulate and Move actions is a practical one. Potentially, other crucial questions could arise from this, thereby initiating further research along the same line of inquiry. Examples of such questions could be:

- At what point do designers acquire an integrative ability in formulating problems and Move actions?
- Can the association between formulate and move actions form the general basis for identifying the novice-expert threshold?
- Can the same exercise above apply in distinguishing the thresholds between higher levels of expertise, such as between an expert and a master, and lower levels of expertise, such as between a novice and an advanced beginner?

Tutors' Formulate actions reveal ability in 'juggling' different cognitive roles

We also observed two kinds of Formulate action produced by tutors and students in tutorial conversations: one that developed from tutor-made segments and the other from student-made segments. By comparing the distribution of duration between the two kinds of actions, we learnt that *tutors'* formulating actions did *not* differentiate significantly between the two sources of preceding segments. In contrast, the difference in mean duration between *students'* formulating actions that derived from tutor-made segments and those that came from student-made segments was *significant*. In fact, exact figures provided in the analysis

in Chapter 6 suggest that students' formulating actions were nearly *twice* more dependent on tutor-made segments (mean=4.73 min) than they were on student-made segments (mean=2.26min). However, as with previous remarks on the observed patterns of behaviour in tutorial conversations, we need to mitigate the circumstances and implications of these findings. This is due to certain limitations in the current research methodology, particularly in its inability to corroborate participants' behaviour with their objectives or intentions in the tutorial conversations. As such, we could only speculate on the nature of such behaviours. In spite of this, current methodology has revealed a rich pattern of interaction during tutorial conversation.

One possible interpretation we could make pertaining to current observations is that tutors and students perform different cognitive *roles* during tutorial conversations. In particular, tutors' Formulate actions might have dealt with regular *shifts in cognition* during tutorial conversation. This would have included the development of tutors' own preceding ideas or arguments at one stage and critical responses to students' design propositions at another. Furthermore, we contemplate the prospect of tutors' Formulate actions serving as 'scaffolding' structures for learning, reflecting, and instructing in both tutors and students. Such 'scaffolds' could be very useful in freeing students from being fixated on particular issues or actions and returning them to the original line of inquiry in design. In fact, they might be symptomatic of tutors' ability in *'juggling'* the acts of cognition within the dialectics of design conversation.

Students Formulate actions rely on tutors' 'scaffold' support

In contrast, we could also suggest that students' *formulating* actions rely very much on tutor-made preceding segments during tutorial conversation. This is possible in view of the fact that such at an early stage of education, student designers might have only acquired a minimum level of design knowledge and practical experience. Therefore, they would required tutors' *'scaffold'* support significantly in the form of tutor-made preceding segments, since these are likely to be rich with new and critical information, concepts, examples and precedents. Propped up by the quality in tutors' segments, there is greater likelihood for students' formulating actions to sustain current design ideas (vertical transformation) rather than starting new ones (lateral transformation).

9.2.2. 'Move' phenomenon: A key to understanding the nature of design expertise

In the previous section, we discussed how comparing the distribution of durations between Formulate and Move actions could differentiate tutors and students' cognitive abilities. Our findings suggest that these corresponding durations were similar for tutors but dissimilar for students. However, we could only provide qualified interpretations for such findings due to certain limitations in the current methodology. These included the lack of means to corroborate participants' behaviours with the intentions or objectives of design conversation. In the previous section, the nature and implications of Formulate actions was discussed within the boundary of existing knowledge in design cognition. Likewise, in the current section, we contemplate on how the nature of Move actions might explicate the similarity of the distributions between Formulate and Move actions in tutors as referred to above.

To begin with, it would be helpful for us to acknowledge the potential role of knowledge 'schemata' (Bartlett 1932; Lawson 2004) in influencing tutors and students' cognitive behaviours during tutorial conversations. These knowledge structures contain integrated propositions of problem *formulation* as well as *moves* towards solutions. Recognising familiar features in a new problem situation could evoke part or entire recall of corresponding solutions from previous schemata indexed in memory. This then would enable the reconstruction of experience in the new setting. Concurrently, the original schemata could also undergo differentiation and modification instigated by the assimilation of new information (Neisser 1976). Thus, through significant practical experience and training, we would expect tutors' knowledge schemata to become richer and more differentiated in problem-solution propositions than students' schemata.

More recently, Schon (1993) and Clancey (1997) brought to light the significance of schematic reconstruction in 'reflective' practices like design. This was evident in their idea about the *conceptual* realignment or coordination of knowledge between 'instances' and 'types' during the *framing* or *formulation* of perceived problems (see Chapter 3). Such an activity could prompt designers to identify and make corresponding solution *moves* that are novel to the perceived problems.

Mastering Moves is crucial in the acquisition of design expertise

Tutors' cognitive behaviours in tutorial conversation seemed to be strongly associated with high productivity in Move actions. In the current study, tutors' Move actions constituted

32.5% (n=240) of their overall Cognitive actions. For students, the overall percentage of Move actions was substantially lower at 9.9% (n=50). Evidently, the ratios of difference between tutors and students' Move actions in terms of percentage (*three* times) and segment number (*five* times) are overwhelming. Furthermore, in comparing the rank distribution of duration between tutors and students' Move actions, we also found that tutors (mean=4.93 min) spent *five* times as long as students (mean=0.74 min) in making such actions. This difference was highly significant according to the Wilcoxon-Mann-Whitney test.

However, due to the limitations of the current methodology as mentioned in previous sections, we could only speculate on the likely reasons behind the substantial differences in segment frequency and duration between tutors and students' Move actions. A possible reason for this could be that tutors are more capable of deriving 'meaningful' clues from emerging situations during tutorials than students. The term 'meaningful' here has particular resonance in the study of expert chess players by Chase and Simon (1973), who suggested that a player's ability in recognising 'functional' relationships between chessboard pieces serves as the basis for developing new move propositions during chess play. The study also provided a good example of how the introduction of the concept of a 'fork' in a game could integrate two conventional move sequences into a single move structure. What is 'meaningful' here is that this new move structure is functionally and perceptually 'organized around the concept of a 'fork'' (Chase and Simon 1973). Such a concept could be stored in the Short Term Memory (STM) as a cue for recall once the player recognises a potential for producing a 'fork-like' move in future games. We envisage that as chess players expand their knowledge and experience of related board positions and their corresponding 'functional' relationships, the repository of concepts or cues that represent an amalgamation of move propositions could also increase.

We could apply the notion of 'meaningful' clues from Chase and Simon's (1973) chess study to the current analysis of tutorial conversations. In the latter, tutors substantially produced more Move actions than students did. A possible explanation for this is that tutors possess far richer and more differentiated knowledge schemata compared to students. These schemata could contain the knowledge of 'functional' relationships that Chase and Simon (1973) referred to in their study of expert chess players. However, the difference here is that within the context of tutorial conversation, 'functional' relationships encompasses to a

variety of design features discussed between tutors and students rather than chessboard pieces.

Chunking and differentiated Move actions

Tutors' Move actions not only were more profound in number but also took significantly longer time to produce than students' Move actions. The duration factor is important since it could highlight the potential role of *'chunking'* during Move actions, particularly in terms of learning and memory recall and retrieval. We understand that from current literature, the time taken to generate Move actions could be strongly related to the *size* and *organisation* of 'chunks' that hold 'meaningful' relations between pieces of information within specific knowledge schemata (Gobet, Lane et al. 2001). The term 'meaningful' here extends the previous discussion in relation to the study of expert chess players by Chase and Simon's (1973). This study informs us of how the recall of a concept or cue from the Short Term Memory (STM) might instigate the retrieval of a 'chunk' of associated knowledge from the Long Term Memory (LTM). Presumably, this could explain why tutors took longer time to produce Move actions than the students. From such an understanding, we postulate that tutors' 'chunks' might contain greater amount of information than those of the students, so retrieving them is a deep and extensive process. In the study of the categorisation and representation of physics problems, Chi, Feltovich et al. (1981) suggested that an expert's chunk is different from that of a novice in terms of the former's ability in making deeper connections with the underlying characteristics of particular problems rather than superficial ones.

However, it must be emphasised here that we can only speculate on the nature of Move actions for issues beyond those the current data were intended for. These include the subjects of memory recall and retrieval discussed above. Furthermore, current methodology did not stipulate a scheme for determining the extent of memory recall and retrieval between tutors and students like that devised for chess study in Chase and Simon (1973). This adds further to the limitations of the current methodology. In addition, we need to acknowledge that current study is only limited to observing and differentiating patterns of behaviour between tutors and students in tutorial conversations. Thus, in spite of the potential interpretations offered by existing theories on cognition, theoretical understanding does not substitute the real objectives or intentions of the two groups of designers involved in the tutorial conversations. Again, current methodology did not offer means for corroborating designers' intentions or objectives with the contents of conversations.

Perception and recognition are crucial in tutors' Move actions

We also found an interesting relationship between tutors and students' Evaluate and Move actions. For tutors, the difference in mean durations between Evaluate and Move actions was highly significant. This demonstrates to us the possibility that the two actions were not similar in terms of cognitive activities. In contrast, there was no significant difference in the distribution of durations between students' Evaluate and Move actions. This prompts us to assume the possibility that the two actions could be associated in terms of cognitive activities.

We use such contrasting relationships between Evaluate and Move actions to explicate further the nature of tutors and students' Move actions. Tutors do not depend on analytical and evaluative ability in determining Move actions. On this matter, we allude to the role of tutors' rich and integrated *knowledge schemata* in identifying salient features from a design situation that they perceive as familiar to those they have experienced before.

Possibly, this could then instigate the process of problem formulation or structuring, thereby leading to the conceptual realignment of current experiences of 'instances' with previously experienced 'types'. Thus, within a circumscribed *'world'*, tutors are bound to *'recognise'* Moves that correspond to a current problem as well as to discover novel ones. To a certain degree, the ability to prescribe Moves intuitively during design is an 'economical' feature that reduces the cognitive 'loading' (Sweller 1988) of the more experienced tutors. Yet again, these are mere assumptions not methodically supported by current study. Thus, further research might be necessary.

Students derive Move actions from knowledge-lean, logical heuristics

In contrast, students might not possess the abilities afforded by rich knowledge schemata and trained perception as do tutors. The former could only rely on the backward evaluative strategies, which involve logical heuristics like means-ends analysis, forward search, backward search and generate and test approaches (Newell and Simon 1972; Sweller 1988). These *knowledge-lean* strategies (Chi and Glaser 1985) could cause severe limitations to the students' ability in making intuitive Move actions. What we then have are situations where students' Cognitive actions become entirely self-referential and inward looking. Again, we are merely suggesting some possibilities here that might explain certain nature of students' Move actions.

Some of the students' actions in the current set tutorial conversations revealed certain degree of 'fixation' on certain design issues which, without tutors 'scaffold' input, would have caused 'breakdowns' in the trajectory of design. On this note, we can consider 'breakdowns' and 'fixations' to be *symptomatic* of *cognitive overloading*. The following sequences of protocol segments in Tutorial Session 3 (Tutor T3, Student S3) and Tutorial session 5 (Tutor T4, Student S5) are two examples that show students' fixations with certain building features in their respective design schemes. On both occasions, the tutors' responded by providing 'scaffolds' that lead to specific building precedents.

Tutorial session 3 (Tutor T3, Student S3)

Segment	Contributor	Protocol Segment
49	S3	So it'd be nice to have this kind of contrast between the two and while in the library you can sort of look down and I thought it would be quite a nice feature
50	T3	Yeah. I know, I think it's fine. I mean I've seen something like that, don't know, *maybe Hetrzberger or something*, I can't remember that

Tutorial session 5 (Tutor T4, Student S5)

Segment	Contributor	Protocol Segment
59	S5	I mean, I quite like this to be enclosed in massive copper. You know, the copper stuff you have (reference to tower element)
60	T4	I mean there's a café at the top of the Tate of St. Ives that looks out over the sea. It's wonderful being there

Tutors' Move actions are self-inspired

Since Move action is potentially seen as a key indicator for design expertise, it would be very useful to determine the circumstances that instigate such actions. In Chapter 6, we discriminated two kinds of Move action produced by tutors and students in the tutorial conversations: one that developed from tutor-made segments and the other from student-made segments. When compared in terms of mean duration, we observed that tutors' Move actions that proceeded from a tutor-made segment were *twice* as long as tutors' Move actions that followed a student-made segment. This difference was significant by Wilcoxon-Mann-Whitney test.

In terms of segment frequency, tutors' Move actions that proceeded from a tutor-made segment were also *twice* as many as tutors' Move actions that follow a student-made segment. There is a possibility here that, perceptually, tutors might have utilised tutor-made preceding segments as 'springboards' for Move actions. This again alludes to the crucial role of knowledge schemata in supporting tutors' Move actions. Through such structure, tutors are able to recognise that certain problems or situations lead to a repertoire of potential moves.

In contrast, the students' Move actions did not differentiate between tutor-made and student-made preceding segments. Potentially, it could be that the students had yet to appreciate fully the value of cognitive and knowledge '*scaffolds*' that often accompany tutor-made segments. Such an assertion is significant in terms of what it holds for the future of research on expertise in design education. Among the potential questions that might arise from this issue are:

- Are advanced level design students more receptive to cognitive and knowledge 'scaffolds' than design students at beginner's level?
- At what stage do the awareness of cognitive and knowledge 'scaffolds' become deliberate?
- What then makes a good educational and training programme in facilitating deliberate awareness of cognitive and knowledge 'scaffolds'?
- How could tutors improve on their delivery of cognitive and knowledge 'scaffolds' in studio and in formal teaching?

Skills in Knowledge Domain and Organisation of Move actions

As with other Cognitive actions, tutors and students' Move actions draw from two kinds of *knowledge*: Process and Content based knowledge. In terms of segment frequency, a greater portion of tutors' Move actions involved Process knowledge (60%, n=144) in comparison to Content knowledge (40%, n=96). In contrast, process and content knowledge constituted 44% (n=22) and 56% (n=28) of students Move actions respectively. Tutors significantly took longer time in producing Process-based and Content-based Move action than students did. The two types of knowledge support tutors' Move actions considerably in terms of managing the acts of design cognition (Process knowledge) and applying immediate knowledge about products or artefacts (Content knowledge). These skills could only increase with experience, something that students clearly lack.

Tutors and students' Move actions also differ significantly in terms of *visual organisation* involved during cognition. Tutors' Move actions were organised more *structurally* and *symbolically* than students Move actions were. These are crucial skills in cognitive processing. Structurally organised Moves relate to activities such as *segmenting, regrouping, separating, restructuring* and *linking*, whereas symbolically organised Moves pertain to the ability to make *interpretation, reasoning* and *inference* during design.

9.3 General implications of the current study of expertise

This study reflects a very basic effort in comprehending the nature of design expertise through the natural learning environment of the design studio tutorial. We found this very challenging in view of the inherent complexities and the dynamic nature of interactive activities that occur within it. In particular is our dealing with tutorial conversations, which are the centre of interactive activities in the design studio. The following sections are some reflections on a few key issues to conclude the current study, with the hope that these could be of benefit to future research in design.

9.3.1. Tutorial conversations as the focus of observation in expertise study

In the current study, we captured a synopsis of cognitive behaviours from tutorial conversations between tutors and students. By generating a series of protocol-based Matrices of Cognitive Interactions (see Appendix), we then acquired an overall 'syntactic' or structural profile of tutorial conversations between the two groups of designers. This led to various statistical analyses for gaining evidence on possible differences or similarities of specific cognitive activities between these groups of designers. However, these matrices could only reveal general patterns of behaviour of how designers, with varying degrees of experience and skills, perceive and deal with situations that emerge during conversation. It must be noted that these are not a catalogue of the differences or similarities in cognitive activities based on predetermined levels of expertise in conversation.

We could say here that there is a difference between an expertise study that observes situated phenomenon like studio tutorial conversations, and one based on discrete research like Chase and Simon's (1973) memory recall studies in chess play. The current study on tutorials offers a rich overview of cognitive interactions between tutors and students. Its findings, when considered jointly, could lead us to an overall pattern of behaviour peculiar

to tutorial design conversations, such that might not be obtained through other modes of research. This brings us to the notion of design 'scaffolds' as a novel way in dealing with data elicited from tutors and students' conversational interactions.

Design 'Scaffolds' in conversations

In hindsight, there are certain patterns of cognitive behaviour in tutorial design conversations that was not easy for us to deduce. In fact, there is a need for us to step back and scrutinize such patterns from an overall perspective of a particular tutorial session. This is why introducing the idea of design 'scaffold' here becomes an interesting prospect; it may enable us to deal with the 'worlds' of interaction as suggested by Schon (1988) rather than 'instances' of action. To emphasise on this point, the object of current research is tutorial design conversation rather than discrete data acquired through a predetermined framework of expertise. The design 'scaffold' could serve as a cognitive 'support' for tutors and students to build and act on throughout a tutorial session. It could be that such mechanism is located at a higher level of granularity than, say, our current stipulation of a Formulate action. Notionally, a design 'scaffold' could form a basic unit of cognitive interaction between designers like tutors and students. It would also be interesting to compare the constructive features of design 'scaffolds' with the problem solving 'scaffolds' described by Chi, Siler et al. (2001). Essentially, the latter is a tutor's affirmative 'feedback' system that monitors the student's problem solving activities.

Design 'scaffold' appears to be a realistic proposition for merging the key findings of current study into an overall understanding about tutor-student interactions during conversations. Above all, our main interest resides with circumstances surrounding tutors and students' production of Formulate and Move actions. For example, we found that tutors' Formulate and Move actions are associated by virtue of having similar distribution of durations. Furthermore, we also found tutors' Move action were more significantly inspired by their own preceding segments than in the case of students' Move actions. On the other hand, students' Formulate actions were more receptive towards tutors' preceding segments than the students' own preceding segments. Taken together, what would be the possible implications of these behaviours in terms of defining what a design 'scaffold' is in such circumstances? Obviously, there could be many interpretations here. Reflecting on those findings, could we then suggest that the tutor's design 'scaffold' is essentially a co-evolved Formulate-Move proposition that a student will find useful in developing Formulate actions but not in creating Move actions? Again, we are merely speculating here.

It must be emphasised that it is not the intention of the current study to examine the nature of these issues. Suffice for us to say that, perhaps, grasping the essence of design 'scaffold' could be the subject of future research in design expertise. Note that while these issues are by no means a confirmation that a tutor is more 'expert' than a student, they could provide a more useful direction for research in design expertise than simply measuring and reasoning outright differences between designers.

9.3.2. Studio as conceptual study of situated design cognition

Tutorial conversations are a potent manifestation of many things about design activities. From these conversations, we gain a crucial insight into what differentiates design skills from other skills pertaining to conventional human activities. This is possible in part due to the nature of tutorial conversations, which are conceptual *discourses* on design rather than about real designing activities. The study of situated actions *in designing* has long been the aspiration of many earlier studies. Most notably, it became the backdrop for Schon's (1983) remarkable study in 'reflective practice'.

However, a study in situated 'design' is never easy. It involves tacit or hidden knowledge and processes in designers' cognitive activities that are too intricate to elicit and assess. Schon's study in the studio tutorial was also partly embroiled in this predicament (Valkenburg 2003). Paradoxically, the tutorial conversation Schon had observed in the study was essentially a *conceptual* discourse on design *par excellence*. At conceptual level, we are able to comprehend designers' cognitive actions through explicit verbal and visual modes of expressions. As such, studio tutorials represent an ideal environment for observing *situated cognitive actions* in design rather than situated design. This is the assertion and premise of the current study.

Following the analyses and findings in the current study, we are convinced that eliciting, assessing and differentiating design abilities of designers who interact in design conversations are a real and stimulating prospect for the future of design research. Equally promising is the fact that through effective analytical methods, we achieved such processes in a seemingly elaborate, volatile and protracted environment that is the design studio tutorial.

The findings obtained from the study were also equally realistic in the sense that they provided a fair representation of what actually transpires during design tutorials. At the

same time, these findings provided us with the desired results, particularly on tutor-student differences in situated cognition. It appeared from the study that tutors differentiated and interacted with emerging 'situations' more than the students did. Thus, it is possible that tutors undertake more 'situated' thinking than students do. The former might have adapted to these situations by fulfilling three tasks simultaneously during tutorials: moving design forward, assisting students in design cognition and behaviour and teach generic principles of design.

9.3.3. Coding process: Difficulties and Limitations

One of the main challenges in undertaking protocol studies is to deal with their encoding process. Verbal protocols provide a useful reflection of cognitive activities that occur in studio tutorial conversations. How we encode and segment basic verbal protocols depends entirely on what we are looking for in the cognitive activities of designers. However, the process of encoding segments can encounter certain situations where characterising the nature of protocol segments is fraught with uncertainty or ambiguity. In order to remedy the situation, the encoding process was repeated for all tutorial sessions after a break of at least a week from the date of the first attempt at encoding by the same coder. For tutorial sessions that were more problematic than others this repeat process at encoding occurred more twice within a period of one month. The process of repeated encoding was made for the purpose of producing a stable interpretation for the concerned segments, in particular, and whole tutorial sessions, in general. In the intervening period between these repeated encoding activities, the coder also performed fresh encoding process on other tutorial sessions. Repeated encoding would then result in arbitrated protocols in preparation for the ensuing stages of analysis.

In the current study, these arbitrated protocols were not derived statistically in terms of tabulated value of coding consistency, which is a method to determine coding agreement. Instead, they were *qualitative* outcomes of what the current coder deemed as 'reasonable' coding attribution. Thus, it is possible that if the same protocols were presented to other coders, they might provide different patterns of encoding. On this matter, we rather reflect on Goldschmidt and Weil's (1998) position on the issue of reliability of coding and encoding process. They had suggested that 'no research methodology is 'universal' in the sense that it is suitable for every purpose and under all circumstances'. Clearly, protocol analysis has many limitations. Among its other limitations are differences in rater perception and category scheme (Goldschmidt and Weil 1998).

To aid the process of encoding, the coder had to rely on a multimodal activities observed from audio-visual recordings made of the 12 tutorial sessions. This is to ensure that there is corroboration between a particular coding attribute and the physical actions or gestures observed from those recordings. In effect, this also reduces the level of ambiguity during the encoding process. Our current understanding on behaviour during conversations had derived much from the assessment of designers' visual output (e.g. sketches, drawings, models and plans) as well as corresponding verbal protocols.

In addition, the encoding process involves attributing protocol segments with *all* four coding categories (refer to Matrices of Cognitive Interactions in Appendix). The primary category here is the Cognitive action, while others are Cognitive organisation, Domain of knowledge and Transformation. For the current study, encoding is an exacting process in that a productive segment has to possess all four qualities provided by the coding categories. We regard a segment to be 'complete' once it complies with all four coding categories. Two successive and productive segments are also unique if they differ even in only one of these coding categories. On the other hand, a non-productive segment in the current protocols is usually a conversational *'turn'* that contains ambiguous or meaningless verbal exclamations like 'I know what you mean', 'yeah' or 'um'. These segments are obvious by the absence of any coding attributes from their cells in the Matrices of Cognitive Interactions.

9.3.4. Implications on research in design education

Schon (1983) regarded the studio as an archetypical environment for training reflective practitioners like architects. Findings from the current study of expertise, which is set within the environment of the studio, should then be of interest to us in providing significant direction to the research in design education. In the context of current study, we consider the studio as a situation that facilitates the *generation*, *transaction*, *transformation* and *inculcation* of knowledge and understanding about design. Principally, these activities transpire through the medium of *cognitive* actions and occur at the *conceptual* level. Following these descriptions, how might our understanding on design expertise contribute towards the advancement of design education? Some of the issues that might assist in developing better approaches to learning and teaching of design are as follows.

Investigating ways of improving perceptual and cognitive abilities and skills in designers

Designers construct the 'world' through perceptual activities at stimulus level and cognitive activities that work with higher order information. From the current study in expertise, we acknowledge that the observed students lack in certain abilities in perception and cognition. Our study also suggests that tutors support students in dealing with design problems by encouraging the reorganisation of perception, facilitating cognitive processes and developing specific knowledge structures. How could we acquire methods and programme that could enhance and support these abilities?

Looking into the ways of integrating studio tutorials with class-based teaching and site-based practice in terms of conceptual understanding, development and application

Conceptual development appears to be the generic way forward in integrating studio education with classroom teaching and practice. Through such correspondence, design education becomes a more cohesive entity. In the current study, we regard studio tutorials as conceptual discourses. Such an assertion provides an appropriate preface for such integration. What then constitutes a programme of conceptual development in design education? Evidently, further research is needed on this matter.

Exploring and expanding the idea of design 'scaffolding' as support system for students

For non-design tutorials, the use of 'scaffolding' by tutors provides 'guidance' or 'feedback' (Chi, Siler et al. 2001) for students. It encourages the latter to either 'stay on the same track of reasoning' or 'change direction or goal' (p.473). 'Scaffolding' also supports cognitive learning and performance for both students and tutors (Chi, Siler et al. 2001). Design 'scaffolds' that transpire during design tutorials could have the same, if not greater, effect on the studio learning and performance in comparison to those produced in non-design tutorials. This issue requires further research.

Developing computer-based applications that assist studio education

The development of computer applications for studio education needs to reflect a deep understanding of cognitive activities that transpire in tutorial conversations. On this matter, the current study on design tutorials provides the necessary ingredient in programming such applications. In the study, we acknowledge that tutorial conversations are the results of the different cognitive roles performed by tutors and students. How do we then accommodate

such differences within computer applications? What triggers the transformation from one cognitive role to another? These are among many questions that provide justification for further research in this area.

Expanding the conversation-based expertise study to include team interactions and larger interactive tutorial groups

We require more effort in comparing the many different 'thresholds' of expertise based on the conversation method. Designing within the team environment provides the social dimension to the 'reflective conversation'. In such situation, cognitive activities transpire through collaboration between team members and mitigation by available design materials during designing.

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APPENDIX 1

PROTOCOL TEXT
Tutorial Session 1 (Tutor T1, Student S1)

Segment	Contributor	Protocol Segments
1	S1	This is the old model? This is like the new one but without openings like the new model
2	S1	I've got some of the plans that might (.....) what I'm really happy with. Having....this is the ground floor and it having a bit of landscaping here keeps some greenery on the site. And then having some practice rooms that look out. And so perhaps during the night, it will be quite nice to let people pass and see things going on inside. That's the only, sort of, this is really the only floor that's really public, I think. The rest are all private and no one else accesses it. And then, like, maybe a workshop room cum a small auditorium-like thing. Oh! it's not in this model (tutor views model). That one's the first, second and third (model)
3	S1	Because what I did was, I did this with the first floor plan because I was really happy with myself. Later I'm was going to see how it looks like 3D. And then I thought, okay it looks fine. So, I've got to think of what's happening at the ground floor now
4	S1	And then I looked at that (model). And then ok, I think like I could need something else here because it seems like a bit towering over the other one
5	S1	Yes, so I'm going to have a little common area here maybe a launderette kind of thing or, and then, like a bit of garden space here for them, it's like....(plans and model)
6	T1	What's happening in the towers, where have they come from? (model)
7	S1	That's the unit, first, second and third. And then that's like double height ones. Two double height ones, so that that could be quite a crucial.....(model)
8	T1	What's the floor to floor, floor to ceiling height in these?
9	S1	3.3 metres
10	T1	So they are quite high, aren't they? As a double height space that might be too, too high
11	T1	Are there any intermediate floors in that space?
12	S1	No, it's just like 3m and 3m
13	T1	It's just three to three. That's pretty tall for domestic space. Particularly when you're doubling it up because in this case is what, nearly seven or six a half metres. How much have we got in here? Probably around about, there might be 3 metres, just nudging 3 metres in here. Ok, so if we double this, that's tall
14	T1	And it's not simply the height that we have to consider but also have to consider it's volume and it's proportion
15	T1	So if we have a six metre shaft in a space that's say 3 metres wide, that's going to be like *sitting in a bottom of a chimney*
16	T1	So I think I would just examine those spaces and see whether they could be brought down to say 2.4 as a single height, floor to ceiling height.And which pushes, well it takes a metre and a half off, doesn't it...4.8?
17	T1	And that might just help to bring this down. And simply doing that will have an impact. So, remodelling this bit (the floor in the tower) might push things to a different kind of perspective
18	S1	Do you think that the single floor one, 3.3, is too much?
19	T1	I think when it's only one floor and, I don't know what's happening in plan here. This....(plans)

20	S1	That's the first floor. This is the accommodation already. And then that's the second and third floor....that's like double, two bedroom, and then that's one bedroom. And then on the sixth floor, seventh, oh sorry, fourth and sixth. This one's seventh floor (plans)
21	T1	So it's fairly small scale accommodation, isn't it? (plans)
22	T1	I think you can afford to bring that height down
23	T1	So I think the whole thing might shrink (model)
24	T1	Oh! having said that I would look at the public spaces at ground level because you've got much larger volumes (model & plans)
25	T1	These large kind of, almost an auditorium-type space. But it could be used as an auditorium. You could have conferences, meetings, all kinds of things happening here. And these are larger spaces, practice rooms (plans)
26	T1	And I think you can afford to push that floor to ceiling height up in at ground floor level
27	T1	So you have some variety in the section of spaces, you've got that here but it just seems that these are.....(tower section)
28	S1	Yeah, I can't see them in sections, the double height ones because I didn't cut it there (section)
29	S1	Yeah, maybe If I'd make that a bit bigger because I kind of like this performance-room kind of thing, it might be a nice space (section)
30	T1	Is this all on one level? (auditorium in plan)
31	S1	I was thinking, I don't know whether I might....I wrote 'slope' over there, because I am not sure if I could have it, I don't know
32	T1	But I mean, this might be seating that rakes down. So that you've got, there is a slope here (plan)
33	T1	So maybe you use that slope and bring people in at this point and in this performance happening here, you know and to the two opposite sides of the building, you know, that they're kind of, there's practice going on here that's backstage and there is performance happening here as front stage (plan)
34	T1	And you know, this wall then becomes very important. What does that mean? (plan)
35	T1	Now, I think you've have kind of shown something here that has real potential as an auditorium and it maybe that these are all temporary seating. That you might actually have a platform here, a drop and some steps down and a flat level here and pull out the seats to allow performance to take place. So it doesn't all have to be set sort of built in so that it's fixed. It could, you know, be rack seating that pulls out from underneath there (plan)
36	S1	I was thinking if you could have workshops or exhibitions for the public, then you could double as that so that it could be like one space without chairs or anything and then when there's like a performance going on then like it turns into an auditorium kind of thing
37	T1	And this (the wall) could change as well in response to that. You know, if this is let's say an exhibition, then this wall could open up. If it's a performance then this might shut down, you know, or to form the back of something (plan)
38	T1	And so the building has a sort of life of its own, a movement that's responding to the things that are happening inside. But I think this space, even in plan it's saying this is what I am, go with it, yeah (plan)
39	T1	So there are some nice things happening here. This seems to be working reasonably well, you've got the *circulation treading everything together,* loos.....(plan)
40	S1	Yeah, the people who live here will probably go in this way and then they can just take a lift going up, so that's like their kind of area, sort of. And that's like the public going to a like kind of foyer
41	T1	So this is a lobby, it's an intermediate
42	S1	Or hot spots or whatever

43	T1	Ok, sounds good. And so we go up to the first floor level
44	S1	I think I might have made the plans a bit small. I think the rooms are a bit small because every time I start doing it I get smaller and smaller
45	T1	I think you need to go up a scale
46	T1	I think that you're working on a small scale in any case. I mean, what is it, 1:200? It's tiny
47	T1	And I think, you know, *once things start to find a place* , and I think things are really, you know, they're beginning to look as though they've *got some life* , you know, which is exciting
48	S1	That looked quite 'dead' (reference to previous model)
49	T1	That's 'buried' by that one! This is starting to look lively. And I think once it's got that sense of it, it's been born
50	T1	Make it a little bit bigger. Work at 1:100 and work at 1:50,
51	T1	Key spaces to check out whether they'll work, you know
52	T1	If you draw this at 1:100....I think that you would probably be *able to make some of the key decisions* at 1:100
53	T1	But it maybe that looking at *the way these are lit* needs to be explored at a bigger scale
54	T1	Taking on board the thickness of the materials that you're using, the reveals that you're creating, the..... (models)
55	S1	That's why those walls, you know, where does it.....? It could go on and all that (plan)
56	S1	So I thought if these plans are all right, I might start to make a 1:100 model
57	S1	And then from the model and then I could sort of like cut things out or put things in and then,
58	S1	Because this (model) is like really hard to model, like, it's quite small, that's why
59	T1	Yes but it *tells* us about the massing, doesn't it? It gives us that information quite quickly without going in into too much detail
60	T1	Having said that, we're still missing the site on this model (current model) even at 1:200 it will useful just to put the site back in....in plasticine, sit it in there. And engage with that as part of the, as part of the composition because at the moment it's missing. I mean, this could occur anywhere. It could occur on flat ground. It could rotate. All kinds of things happens. But that's not real. That's not what we're dealing with So slot it into the site and then make some decisions about what do you do with these, and before working with 1:100. You're doing it in section so it should occur on the model as well
61	T1	I mean this (base of building), what's happening here? What are you building this up? (section)
62	S1	That's what's already there, that's like the slope that goes down, and then at the top St James house's here, so that's already there, I'm just building on it
63	T1	What are you *doing with it* ?
64	S1	Don't know, I thought that I could.....I like the level like that because that means that all these are sort of elevated above the public level. So I quite like that
65	S1	I don't know about what you mean like, to, like, not the level but like what's in it?
66	T1	It gives you some opportunities, doesn't it? Because it's *pushing this forward and pushing this up. And it's almost like sailing out there*
67	T1	And this becomes the part of the elevation at street level. Now this is actually not a building sitting on top of something that's whatever. This is part of the building.
68	T1	What does that mean? Is it really a sort of solid plinth that this one sits on? Is it dressed in stone so that it's forming a kind of large step and then this is much lighter weight above it? Or is this, I don't know, becomes something gentle and landscaped? (section)

69	S1	I think that the height is, like, about three metres right. I think that sort of like if I was walking here and I saw that, then I would think it's all like a boundary for the building. It's like a....this is my space, you know. If you are looking in, you may be looking into somebody else's room or something. It's that kind of the feeling that it gives....
70	T1	Separation?
71	S1	Yeah, feel a bit higher up, sort of....
72	T1	But it's a *wall* people are going to pass everyday, isn't it? It's something that people are going to notice, or not notice, because it's part of this idea of going past. Does it....is it anonymous? Is it something you know you don't acknowledge until you get around here? Or is it something that actually has a connection with the street? Does it have something happening within it? Could it have say some seating as part of it? Could be some sort of stepping down that becomes part of public space perhaps
73	T1	And..... I think, I mean I think you should think about it and think what does it mean? It's part of the building. It's not the thing that the building is built on. It's there to be changed and there to be integrated. How am I going to do that?
74	T1	And you know, you're looking at landscape and you're looking at the edges of the building and thinking about what might happen in these spaces. I think it's an edge that's quite an important one
75	T1	It's sort of like main edge. What does it mean?
76	S1	Ok, once I put the model and I put the site in, then I will sort of see how it feels to walk past and how it looks like, yeah
77	T1	But where does...what happens where we've got the auditorium? So we've got that change in level happening where are we? Campor lane is north. It's along here, isn't it?
78	T1	So we've got that dramatic change in level might occur there, and it will also it will kind of push all of these out (reference to plan). This is all out on a kind of platform. Or else it's a big step happening here. So, you know, you're keeping this elevated. It's on the same level as this but it's happening on something that pushes it both at street level
79	T1	So this is a kind of *negative space* that's happening around that
80	T1	Does this all project? Is this all at a higher level? Or is there something...what's the interface? (plan)
81	S1	I never really thought about that actually, like what's around it. Just thought of, like, that's where my building is, and then look what's inside there. I mean, I thought about that but not really what's out.....but even that tree I think it was there. I am *not very sure*
82	T1	There is a tree here. There's the signage, isn't there? That runs along there. I mean that's something that you *could propose*
83	T1	But it means that this space....If this is happening at a higher level, which you just said, which I agree I think, you know, you were talking about separation and that things that can happen on a stage. That's one thing. But that means we still have space around that doesn't belong to this realm or this realm
84	T1	It's kind of undefined. And I mean it would be easy for this to become quite neglected
85	T1	So I think, you know, you've thought about landscaping in the heart of building, what happens around its edges? (plan)
86	S1	I wanted to keep a lot of the green on the site there because they look quite nice when somebody like had planned view of the site, like pictures all in a collage thing. And then the green bit inside looked really nice. So I thought I'd try and keep that in because like that's quite (green). Maybe sort of make that a bit better, that second half of the site

87	S1	And I don't know, maybe sort of like make that blend into this a little bit, not have this sharp boundary line kind of thing like that's all part of what's around it. Something like that. Could be on the same level as that I suppose, or, I don't know (plan)
88	T1	I think a section through here would just sort of reveal this, extending beyond this point and really understanding what's happening from zone to zone, from private to semi public to, well, I don't know what this is (building edge in plan)
89	T1	But I think that's the question, what is this? What does this mean? Does it blend? Does it bring the street?
90	T1	You could sort of say that actually this line no longer exist. This is a street edge. This is the street line
91	T1	And then this becomes something else. (There) might be seats in here. Like more where people can come and sit. And then possibly a connection through there
92	T1	So, you know, I think that needs.....it's a tiny little sort of action to draw this line around and just say, well, that's the edge of the site
93	T1	But in fact that has impact and the meaning (plan)
94	S1	The think that in the section, I know that it's really important to use the section and last year Ruth said that it was one of the first few things that you should do which helps in the design and the planning and all that
95	S1	I just don't really know how really it helps to decide seeing heights and proportions and like, like I wanted sort of see everything inside but then I sort of cut in the wrong way that that comes in (section)
96	T1	Well, you can make sections work for you. So that they're not all, you know, it's not just one simple cut line through the building. You can actually manipulate the section so that it's revealing.....
97	S1	You'll go like that and..... (gestures imaginary line along plan)
98	T1	Yeah, you usually step in parallel. So if you're taking a section through, say, the building here and you get to that point and you want to show the staircase, you can bring the section back show it through the lift and step it back again and bring it through this space so that you have a series of sections
99	T1	And I think with the section is it shows, it is this thing. That if you have a 6m floor to ceiling height and you have a 3m wide room, it is very difficult to understand that until you draw it in section. And, you know, that's one reason for working with the section
100	T1	The other is, we can see the *effect of openings* and the *effect of the volume* on the quality of the space. I mean this section doesn't show any windows at all (reference to section). It's *indicating* that this is a solid wall. But if this wall did have openings we could then start to *understand the space in relation to the light that is coming in* . And the way that that light might only penetrate to that point, which makes this space a very different kind of feeling. And that that might be something that we could top light or borrow light from this stairwell actually, if you make it to this point
101	T1	You can only see that from the section. That's just not available on plan. So, yeah, it's one of the.....it's a hard drawing to think about because it doesn't come naturally. You've got to kind of practice. But I think Ruth is absolutely right, they are the most revealing drawings that you can draw. And, you know, as I was saying on Monday, *plans are plans, they are a kind of a strategic exploration but the sections are really the ones that give life and architecture to the proposal* . Ok. I mean I think, the way that you are working is fine. So, it just needs those key issues exploring
102	T1	So we've got the floor to ceiling heights. And I think that's the thing to look at first because that's going to throw everything else into disarray. Do that first

103	T1	Then work, start working with the plans at a larger scale, and at larger scale in both plan and section
104	T1	And addressing the edges. What happens around in this space around Campor lane
105	T1	And this auditorium space. What does that mean? (plans and section)
106	S1	Yeah, I think, that could really be something that's not what it is now because that, at moment I just have like the basic function of it but not really like what effects it would give with the different functions that I would use it for
107	T1	And It's actually a big block
108	T1	A big building block in terms of these (plans). You know, something that everything else sits on top of
109	T1	So it has *presence* but that, it's impact maybe entirely internal, but maybe something you go into and think wow this is fantastic, but you don't really read from the outside (plans)
110	S1	I was going for like having sort of like heavier kind of compact ground floor and then like working upwards and getting not to say just smaller but lighter and like breaking it a little bit. Like now it's kind of like in one piece, then you sort of break it as you go up. That kind of a thing
111	S1	I don't know. I'm kind of worried that my concept will get weaker and weaker as I go on
112	T1	I don't think it is. I mean I think, the key decisions that you've made hold the concept in this scheme
113	T1	And I think this idea of breaking the building down, I think it's less evident here (reference to section)
114	T1	I mean again that's why the section is useful. That it doesn't look like as though it's breaking down particularly in the section
115	T1	So maybe you make some decisions about the way that these are treated and the materials that you use at different levels
116	T1	And this feels very static (shorter tower) and very flat and this doesn't (rising tower), this has got this sense of *soaring*
117	T1	But perhaps that's something that could happen in this top volume. Something that this (shorter tower) *could be released* at this point (section)
118	S1	I also have to think of the roof as well which I haven't done?
119	T1	Yeah
120	S1	It's quite hard really
121	T1	I think it is, but I think.... I think it's hard to think of the roof as an isolated object that's just, you know....
122	T1	It's like going to choose for a hat, which one shall I have
123	S1	You just know that it's suppose to like, sort of, when it rains you've got one thing to collect in the middle (laughs)
124	T1	Well, think of the roof as a kind of this *culmination of this idea* . This *explosion* . And that the roof is the, as a kind of icing on the cake. It's the final moment. And it should leave us with the sense that you're trying to represent in the *concept.* You know that it's this thing where the whole starts to *fly* off. And so it isn't a question of just choosing a roof because it fits. It's a question of choosing a roof because it fits and it suits the occasion. It's the 'hat' thing again
125	T1	And maybe the roof is expressive in its own right and has *more than just a kind of protective function* . Yeah, the *same with the balconies* . You know, *they can do things for you*
126	S1	Yeah...ok
127	T1	So you've got lots to concentrate on but getting it to bigger scale to start with will help (Conversation ends at 51:48)

Matrix of Cognitive Interaction

Tutorial Session 1 (Tutor T1, Student S1)

Seg. no	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S1		F		SY		PRO		L	0.150
2	S1	S1	F	F	SY	SY	PRO	CON	L	L	0.867
3	S1	S1	F	F	SY	CO	CON	PRO	L	L	0.267
4	S1	S1	F	E	CO	SY	PRO	CON	L	V	0.167
5	S1	S1	E	F	SY	SY	CON	CON	V	V	0.200
6	S1	T1	F	F	SY	ST	CON	CON	V	L	0.050
7	T1	S1	F	F	ST	SY	CON	CON	L	V	0.183
8	S1	T1	F	F	SY	ST	CON	CON	V	V	0.083
9	T1	S1	F	F	ST	SY	CON	CON	V	V	0.017
10	S1	T1	F	E	SY	SY	CON	CON	V	V	0.117
11	T1	T1	E	F	SY	CO	CON	CON	V	V	0.033
12	T1	S1	F	F	CO	SY	CON	CON	V	V	0.067
13	S1	T1	F	F	SY	SY	CON	CON	V	V	0.417
14	T1	T1	F	M	SY	SY	CON	CON	V	V	0.133
15	T1	T1	M	F	SY	SY	CON	PRO	V	V	0.133
16	T1	T1	F	M	SY	ST	PRO	CON	V	V	0.250
17	T1	T1	M	F	ST	SY	CON	PRO	V	V	0.217
18	T1	S1	F	E	SY	SY	PRO	CON	V	V	0.067
19	S1	T1	E	F	SY	SY	CON	CON	V	V	0.117
20	T1	S1	F	F	SY	SY	CON	CON	V	V	0.500
21	S1	T1	F	E	SY	SY	CON	CON	V	V	0.050
22	T1	T1	E	M	SY	SY	CON	CON	V	L	0.083
23	T1	T1	M	F	SY	ST	CON	PRO	L	V	0.050
24	T1	T1	F	M	ST	SY	PRO	CON	V	L	0.117
25	T1	T1	M	F	SY	SY	CON	CON	L	V	0.217
26	T1	T1	F	M	SY	ST	CON	CON	V	L	0.100
27	T1	T1	M	F	ST	CO	CON	CON	L	L	0.117
28	T1	S1	F	F	CO	CO	CON	PRO	L	L	0.133
29	S1	S1	F	M	CO	SY	PRO	CON	L	V	0.150
30	S1	T1	M	F	SY	ST	CON	CON	V	L	0.017
31	T1	S1	F	E	ST	SY	CON	CON	L	V	0.167
32	S1	T1	E	F	SY	SY	CON	CON	V	V	0.117
33	T1	T1	F	M	SY	SY	CON	CON	V	V	0.333
34	T1	T1	M	F	SY	SY	CON	CON	V	L	0.133
35	T1	T1	F	M	SY	SY	CON	CON	L	L	0.450
36	T1	S1	M	M	SY	SY	CON	CON	L	L	0.250
37	S1	T1	M	M	SY	SY	CON	PRO	L	V	0.217
38	T1	T1	M	F	SY	SY	CON	CON	V	L	0.300
39	T1	T1	F	F	SY	ST	CON	CON	L	L	0.133
40	T1	S1	F	F	ST	SY	CON	CON	L	V	0.183
41	S1	T1	F	F	SY	CO	CON	CON	V	V	0.033
42	T1	S1	F	F	CO	SY	CON	CON	V	V	0.033
43	S1	T1	F	M	SY	ST	CON	PRO	V	L	0.150
44	T1	S1	M	E	ST	CO	PRO	PRO	L	L	0.133
45	S1	T1	E	M	CO	ST	PRO	PRO	L	V	0.033
46	T1	T1	M	E	ST	CO	PRO	PRO	V	V	0.100
47	T1	T1	E	F	CO	SY	PRO	CON	V	L	0.183
48	T1	S1	F	E	SY	SY	CON	CON	L	V	0.033
49	S1	T1	E	E	SY	SY	CON	CON	V	V	0.183
50	T1	T1	E	M	SY	ST	CON	PRO	V	L	0.067
51	T1	T1	M	F	ST	SY	PRO	CON	L	V	0.067
52	T1	T1	F	F	SY	SY	CON	PRO	V	V	0.100
53	T1	T1	F	M	SY	SY	PRO	PRO	V	L	0.117
54	T1	T1	M	M	SY	SY	PRO	CON	L	V	0.133
55	T1	S1	M	E	SY	CO	CON	CON	V	L	0.083

56	S1	S1	E	M	CO	ST	CON	PRO	L	L	0.100
57	S1	S1	M	F	ST	ST	PRO	PRO	L	V	0.067
58	S1	S1	F	E	ST	SY	PRO	PRO	V	V	0.133
59	S1	T1	E	F	SY	SY	PRO	PRO	V	V	0.150
60	T1	T1	F	M	SY	ST	PRO	PRO	V	L	0.817
61	T1	T1	M	F	ST	ST	PRO	CON	L	L	0.083
62	T1	S1	F	F	ST	SY	CON	CON	L	V	0.200
63	S1	T1	F	F	SY	SY	CON	CON	V	V	0.050
64	T1	S1	F	F	SY	SY	CON	CON	V	V	0.250
65	S1	S1	F	E	SY	SY	CON	CON	V	V	0.100
66	S1	T1	E	F	SY	SY	CON	CON	V	L	0.183
67	T1	T1	F	F	SY	ST	CON	CON	L	L	0.233
68	T1	T1	F	F	ST	SY	CON	CON	L	V	0.400
69	T1	S1	F	F	SY	SY	CON	CON	V	L	0.350
70	S1	T1	F	F	SY	ST	CON	CON	L	V	0.017
71	T1	S1	F	F	ST	ST	CON	CON	V	V	0.083
72	S1	T1	F	F	ST	SY	CON	CON	V	V	0.317
73	T1	T1	F	F	SY	ST	CON	CON	V	V	0.600
74	T1	T1	F	F	ST	ST	CON	CON	V	V	0.167
75	T1	T1	F	F	ST	SY	CON	CON	V	V	0.117
76	T1	S1	F	M	SY	SY	CON	PRO	V	L	0.217
77	S1	T1	M	E	SY	CO	PRO	CON	L	L	0.300
78	T1	T1	E	F	CO	ST	CON	CON	L	V	0.383
79	T1	T1	F	F	ST	SY	CON	CON	V	V	0.083
80	T1	T1	F	F	SY	ST	CON	CON	V	V	0.100
81	T1	S1	F	F	ST	SY	CON	CON	V	V	0.317
82	S1	T1	F	F	SY	CO	CON	CON	V	L	0.133
83	T1	T1	F	F	CO	ST	CON	CON	L	L	0.283
84	T1	T1	F	F	ST	SY	CON	CON	L	V	0.183
85	T1	T1	F	F	SY	ST	CON	CON	V	V	0.100
86	T1	S1	F	M	ST	SY	CON	CON	V	V	0.383
87	S1	S1	M	E	SY	ST	CON	CON	V	V	0.383
88	S1	T1	E	M	ST	SY	CON	PRO	V	L	0.267
89	T1	T1	M	F	SY	SY	PRO	CON	L	V	0.100
90	T1	T1	F	M	SY	ST	CON	CON	V	V	0.117
91	T1	T1	M	M	ST	SY	CON	CON	V	V	0.200
92	T1	T1	M	M	SY	ST	CON	PRO	V	V	0.150
93	T1	T1	M	F	ST	SY	PRO	PRO	V	V	0.100
94	T1	S1	F	F	SY	SY	PRO	PRO	V	L	0.200
95	S1	S1	F	E	SY	SY	PRO	PRO	L	V	0.233
96	S1	T1	E	F	SY	SY	PRO	PRO	V	V	0.200
97	T1	S1	F	M	SY	SY	PRO	PRO	V	V	0.017
98	S1	T1	M	M	SY	ST	PRO	PRO	V	V	0.300
99	T1	T1	M	F	ST	CO	PRO	PRO	V	V	0.283
100	T1	T1	F	F	CO	SY	PRO	CON	V	V	0.750
101	T1	T1	F	F	SY	SY	CON	PRO	V	V	0.850
102	T1	T1	F	M	SY	SY	PRO	CON	V	L	0.183
103	T1	T1	M	M	SY	ST	CON	PRO	L	L	0.150
104	T1	T1	M	M	ST	SY	PRO	CON	L	L	0.117
105	T1	T1	M	F	SY	SY	CON	CON	L	L	0.050
106	T1	S1	F	F	SY	SY	CON	CON	L	V	0.317
107	S1	T1	F	F	SY	SY	CON	CON	V	L	0.050
108	T1	T1	F	F	SY	ST	CON	CON	L	V	0.083
109	T1	T1	F	F	ST	SY	CON	CON	V	V	0.233
110	T1	S1	F	F	SY	ST	CON	CON	V	V	0.350
111	S1	S1	F	E	ST	SY	CON	PRO	V	V	0.083
112	S1	T1	E	E	SY	SY	PRO	PRO	V	V	0.167
113	T1	T1	E	F	SY	CO	PRO	CON	V	L	0.083
114	T1	T1	F	F	CO	SY	CON	PRO	L	V	0.100
115	T1	T1	F	M	SY	SY	PRO	CON	V	L	0.167
116	T1	T1	M	F	SY	SY	CON	CON	L	L	0.133
117	T1	T1	F	F	SY	SY	CON	CON	L	V	0.150

118	T1	S1	F	M	SY	SY	CON	CON	V	L	0.083
119	S1	T1	M		SY		CON		L		0.050
120	T1	S1									0.067
121	S1	T1		F		SY		CON		V	0.133
122	T1	T1	F	F	SY	SY	CON	PRO	V	V	0.067
123	T1	S1	F	F	SY	SY	PRO	CON	V	V	0.150
124	S1	T1	F	F	SY	SY	CON	PRO	V	L	0.617
125	T1	T1	F	F	SY	SY	PRO	CON	L	V	0.300
126	T1	S1	F		SY		CON		V		0.067
127	S1	T1		M		SY		PRO		L	0.067

APPENDIX 2

PROTOCOL TEXT
Tutorial Session 2 (Tutor T2, Student S2)

Segment	Contributor	Protocol Segment
1	S2	That level there is the same as the level there (reference on model)
2	T2	This is below ground then (model)
3	S2	No, no that's the only one below ground. That's ground level, that's the second floor, the section that's on permanent accommodation (model)
4	S2	And this is studio which tries to sit on top like that and that will go around on that side. Those stairs coming out there (model)
5	T2	Oh I see, yes. So that doesn't exist really. That's at that level (model)
6	S2	So I've duplicated the floor
7	T2	And so how are you developing your scheme, what's the *kind of big idea* on this
8	S2	Looking at some of the sketches that I did...I didn't really realised at the time but in the review, I've used this *cut and paste.* It's....I need to sort this out and I had put it on a big sheet so they are all out. Basically, this is kind of thing, where I was doing sketches of just the like basic building (sketch)
9	T2	Yeah, organisation of the spaces
10	S2	Yeah. And then, like, *I wanted to cut out* the bottom corner so that people can go through because at the moment people are walking the corner of the car park. I don't want to block that off so I thought, like, cutting that out
11	S2	And then there was just *this idea of cutting, like, and folding* bit's down, cutting blocks out of them and then seemingly putting them on top of the building. And the...that was just doing the plan with the same kind of idea of copy and paste (showing to another sketch), if I can find these scraps of paper
12	S2	And then there would , I was trying to work out how, *I wanted* like light to come in through the top of the studio here...I wanted to cut out that so, this idea there where I want to cut out the bottom there and the shape would be like inverted around there
13	T2	Why was that? *What's determining* that kind of, you know, *where you cut out and replace* over there
14	S2	The *way I was sketching*, like doing this, I like doing these motifs for myself (showing same sketch), like so to remind me that I was going to cut it out and stuff. And then we talked in the review about how we could take it *quite literally like cutting out something and stick it somewhere* else and then like *folding* the walls down as if it was like a hard object
15	T2	But what's determining that? Is there *a kind of framework or decision-making process* or is it a purely arbitrary one?
16	T2	You know, I mean that's one approach, you cut it and place it somewhere else. How does that fit in within the broader concept or philosophy of what you are trying to do?
17	S2	It was just something that we got *from the sketches*. So in that sense it doesn't really come from... It was just an idea *to get the spaces*
18	T2	And the accommodations, you're applying for the students, isn't that?
19	S2	No, in here there were going to be five flats for the artists currently living there and in the basement there was going to be kind of hotel rooms that you could rent out with some studio space
20	T2	I mean, is the site *big enough to do all* that?
21	S2	No, it's not that, it was something else. I'll talk about it, I was try to *see how many flats that could fit* into that kind of area. I can just about fit three

22	T2	Yeah it's not a very big site at all. So I think perhaps you're being perhaps a little bit too ambitious in terms of trying to get *too many programmes* in
23	T2	Right, I'd just kind try to *simplify your briefing* a little bit and *say it's basically habitable accommodations* on sort of three floors at the top or, you know, whatever's on the floor
24	T2	And the ground floor is where....what are the facilities you're going to have? What you're thinking of putting on this floor?
25	S2	On the ground floor? Yeah, it was because it's kind of *rentable rooms* below, there is kind of a reception like in a hotel
26	T2	You see *I am not very clear what your brief* is. Listen, what's your brief on this?
27	S2	It's artist accommodation, so that all the galleries around they tend to have kind of artists that come for a couple of months to do an exhibition and they'll do some work in situ. There's not accommodation for them to....or not enough of it, for the artist they want to come in. So this will be kind of, there'll be *this kind of 'art hotel'* which is, where you...
28	T2	I mean, you're *confusing the language,* is it a hotel? It's not a hotel, is it? So it's really....
29	S2	But why not? I think it is. Because you'll come to rent a room for say a week or a day or something and with that you'll get some studio space. In here, (top floors) there is going to be some people actually live in. They have apartments, say three or four, I mean they'll have like permanent studio spaces. But you can also come in and rent some (ground floor). These won't always be inhabited (model)
30	T2	So, yeah, it's a *rentable accommodation* , but hotel has a very different implication.. Hotel is where you rent rooms, you get all the different services, you know, they are all catered for you, whatever you need you will go to the reception
31	S2	There won't be things, like, you won't have a lounge or kitchen, so in that respect you've got like the bedroom, maybe a desk in the room
32	T2	Does that happen on the other ground floor then, at this lower level? (models)
33	S2	Yeah. Because this one will be a proper of flat where you're going to have ...There will be a lot fewer....maybe that you can fit six rooms down there, but say there are only three flats up there (model)
34	T2	And where is the studio for that one, is it within that as well? (model)
35	S2	The studios are all on the top floor so you get the most light. And that's why this idea (stairs shaft) came from because they have to get from their rooms up to the studio without....(models)
36	T2	Now, if you just *explain that idea in terms of this one* . So are we saying that's the studio up there, that's the.....(model & site model)
37	S2	That's the *permanent* accommodation. This is a kind of reception where they could....that's more *public* where they can show work and stuff and then on the basement, which is not obviously shown, there'll be those *rentable* hotel, whatever, role. And they'll come up at the side here. So they don't interfere with this permanent accommodation (model & site model)
38	T2	So, we've got two types of *programme,* one is a kind of *permanency,* one is people *renting* the space at the basement level. And then you've got this as a display, retail sort of space at that level, is that right?(site model)
39	T2	So it's like a gallery space (site model)
40	S2	And also got the public to come in and use the studio
41	T2	And then, that's the studio
42	T2	Once the public come in, do they come in to use to watch-out gallery or do they come in to use as rental space?
43	S2	They can come in to rent a space or they can come in just to sit in there and look at the art work that will be down there

44	T2	OK, well, I think that kind of, yeah, it begins to clarify you know your kind of *'stratas' and how you're organising* that
45	T2	Is there another *framework that holds the whole building* together then. You know, in terms of where you arrive and where you leave, how does the circulation in a way gives some sense of order to these various programmes that are beginning to come together. Have you begun to develop that?
46	S2	Yeah, the main entrance will be here and will kind of allow you to walk almost all the way through. You have a door here door there (model)
47	T2	Have you kind of develop that *idea in terms of plans* anywhere yet?
48	S2	Of course, I've got some ideas. This was just a quick sketch of what I imagined this ground floor to be. You've got most access running up this side of Brown Lane side so from there you'll be able to, I'm trying to find.....anyway, basically this side where most of the circulation (model)
49	T2	So you've got circulation around that edge, which is this one here (models)
50	S2	You can go down, that's going to be a (shoved) close to that wall. There'll be like that cube where you can go along into this....(model)
51	T2	I think that this is a good model, yeah. What I think you need to do is to in a way *develop a large scale model* for this, you know, that explains the whole scheme
52	T2	Because at the moment what we have is lots of information everywhere, but I think in a way symptomatic of how the project is developing as well. I think it's *developing in a piecemeal*, right. I kind of sensed that because you were searching when we're having our discussion. Basically is, you've got lots of ideas but it seems to be, in a rather chaotic manner
53	S2	Yeah, I just *need to organise* it
54	T2	Yeah, and I think in a way *that reflects* in *the way you present* your architecture across
55	T2	I think that you should do for next week in our next tutorial, *establish a very clear set of drawings* that determine what's happening at what level, what type of spaces that you envisage at the lower ground floor
56	S2	Do you reckon that this is *too much going on* in the building?
57	T2	No, that's irrelevant. It doesn't matter whether how much, I think. That's not the question, *the question is what is your brief right? W* hich is a series of basically three, starting with the studio.....you've got main studio, you've got rentable space and private accommodation on the ground floor as well, with the display gallery space
58	T2	Now, what you need to do is to start looking at *organising kind of a framework* that allows the users to move around these various spaces, and also the quality of the spaces, the quality of light that you envisage in these various areas
59	T2	And that will actually begin to then determine specific character of architecture. Because at the moment when we're doing this, we're *talking about spaces in a way without understanding how that volume is defined*, you don't know whether that edge is solid or just transparent whether it allows the light in or you know, I think that comes from understanding the quality of space that is required for that particular event
60	T2	I know you've got a lot of ideas but I think those ideas need to be, in a way, developed through similar exercises that you are beginning to do here (reference to models)
61	T2	But there isn't one model that is complete, is there, at the moment?
62	S2	No
63	T2	No? I think that's what I mean, you know. So, apart from that one (the site model), but that *doesn't look anything like in a way the kind of qualities these models* are beginning to look (reference to spatial model)
64	S2	In the review I had on Monday, Suzi was saying that I've gone far too far with that (an early model), that I've got the form without understanding the interior spaces

65	T2	Yeah I agree. Where as *these are beginning to suggest the quality of spaces* inside, right
66	T2	And I think what you can do is maybe to work with these ideas you've got and then actually *come out with the kind of a broad idea*
67	T2	Saying that now that's my edge, that translucent thing, like you're beginning to suggest. And my circulation occurs in here
68	T2	And that is maybe that studio space, again, had a different kind of *quality* of light into that and you can *reflect* that through the different types of materials that you use
69	T2	And then again that's not going to be *solid* is it, that site level (ground floor)?
70	S2	No. It must be 'inviting' somehow
71	T2	So, but you've shown it as solid, you see
72	T2	So, what you've got to do is use *materials in a way to explore or represent your ideas* . At the moment, they are good ideas but you are not making the best of them, in a way
73	T2	So I think a very *clear and strategic approach* on how you're dealing with certain edges of the site's conditions. *Then from that* the quality of the (banding) of the spaces that you've kind of identified. *And then, also* , then that will give you a very, you know, unambiguous approach to *how you are dealing with the site* . And then *from that* , you can actually *begin to work with the spaces and give more definitive character* to, you know, to the mass of the building, the mass and the form
74	T2	At the moment, I think it's beginning to suggest that that's a different *zone* , you know, at the top level there. And even the quality of your white model is very different from the way you kind of a.....but, *I think I'm reading that into it*
75	T2	It's not actually coming across in the perhaps most poetic manner *as that is might suggested by the use of this material* (the use of perspex on stair shaft in latest model) which you are beginning to imply. Now, this is a much more *controlled intervention* whereas that one (site model) is, you know, a very, *very rough idea* . It's fine, it's fine, that's not a problem
76	T2	Incidentally, have a *look at a gallery* that has been done by Herzog de Meuron. A small art gallery in which he talks about he *uses two materials to create different kinds of languages* , the different *relations between the materials and the events* that take place inside of it. It gives it different characters, so have a look at the gallery, do you know Herzog de Meuron's work?
77	S2	Yeah, I know what you mean
78	T2	Right, that's a gallery right. See if you can dig that out, read about it a little bit so that you can understand how the *concept and narrative that he gets translated into architecture and built form* , forms especially, give you direct reference *how you translate ideas into forms*
79	T2	So if you read that and do a bit of research, you will find you should be able to, in a way, at least to establish a clarity of approach *to use that building* as an example demonstrates, which is about *movement* in space and then the *relationship* of various spaces and how those spaces are then *expressed* as a kind of language
80	S2	Just something about the basement, *having no natural light I have to decide if things like the translucent ceiling* so that you see people walking above but then....
81	T2	Yeah, I don't understand *what the spaces are underneath for* that, you know. So, do you need the transparent light? And if they aren't working spaces underneath that, is the light going to be interfered with?
82	S2	It's not working, underneath is just the rented rooms, so you've got corridors and basically bedrooms
83	T2	You're *not going to get the most pleasant of spaces* are you there to live in? Even though they are rented in the basement

84	S2	Yeah, I know, that's why it's just...
85	T2	So, one can actually *begin to question* then, you know, do you actually put on your *accommodation* there *or* do you just make that into a series of *workshop* spaces?
86	S2	If there's enough accommodation, then there will be no need for basement really because I've worked in workshops and everything in the top floor is by a studio, so I could just do it
87	T2	Well the question is that of a concern to you?
88	S2	I thought it could be quite good, like interesting way of *lighting* and it would just make a unique characteristic *that draws people in,* then maybe they may want to go into this hotel thing to like, you know...
89	T2	I think it's an idea whether it's appropriate to a kind of creating a space that's *habitable* and a space that is actually a *creative* space for a kind of function that you are trying to put in it. If it's a studio, yes it can work because you're very much involved with your programme. What you are doing, you're involved with your activities. Then really all you need a space for lying. Whereas if it's just a room that you need like some kind of interaction with the outside, do you see that as an appropriate space?
90	S2	It's just a *bedroom*
91	T2	Yeah. But, you see, a bedroom, what do you do? Well *you do need a quality of life, it's like being in a prison cell* doesn't it, at one level?
92	S2	Yeah, but you don't get these translucent ceilings in prisons
93	S2	I don't know, because they will be working to get the inspiration will be happening a lot here, for natural light to coming, that's where they get their ideas
94	T2	At the moment, I mean, I don't disagree with your points, all I'm saying is that I don't really see how those simply organised underneath the space, how they are *organized in terms of movements* inside that
95	T2	You know, I think what you need to do is begin to establish that in terms of the *working plan* , of how are those areas *organised?* How do you *move* down there?
96	T2	What kind of quality light goes into there? Do you have views out and are the views out important in terms of making it a sense of place?
97	S2	Yeah. I mean, this was the start of doing the plans for it. I was just thinking, there won't be any views out
98	T2	Are these to scale?
99	S2	Er...1:200-ish, yeah
100	T2	I think you also need to start *working them up* so that they are *credible* plans
101	T2	At the moment, you know, I mean that's sort of *an indication of a staircase* (reference to sketch plan), is that right?
102	S2	Yeah
103	T2	Yeah, you probably can't get that many treads in
104	T2	I just think that these plans need actually now to be developed maybe at least *1:100 plans* , that begin to demonstrate how the *circulation,* how that relates to on the *ground floor where you're coming in* , how does the whole building works in terms of plans. It's an *organizational approach to spaces. A* nd then, I think there are two or three things, one is to establish a sense of hierarchy of spaces, a *spatial hierarchy. T* wo, is to establish clear *points of arrival* into the building and the main *vertical circulation. T* hat will provide you a platform for an *access* to the first, second, third, whatever floors you have
105	T2	And then you begin the need to explore the characters of your spaces so that we actually *understand that the formal strategy* suggests the *relationship,* a *dialogue* between the *nature* of spaces and how the forms *evolve*

106	T2	Because clearly now that's going to have a different character to come from that character (comparing different floors on the initial model). That's sort of coming across but it's very sketchy at the moment, you know, as that model suggest. It's a very loose idea
107	T2	And I think that that *idea* needs to be further evolved and rationalised in terms, you know, of *functional requirements* of spaces
108	T2	So, I think that model acts fine as basis of suggesting ideas. This model is sort of beginning to talk about the quality of space inside
109	T2	Now, I think what you need to do is to create another development of the site strategy model which is perhaps a little bit more refined than that one is (the initial model). And perhaps deal with slightly more precise *making* process like what you've done here (the later model)
110	T2	And then, don't simply go around for.....Be careful that we're *not just making shapes, you know, for the sake of making shapes*
111	S2	I just need to *work out the interiors* so that the shapes....
112	T2	Yeah, it's not so much working the interior but *working with the spaces required*, you can't work, you know, with the shapes
113	T2	You've got to work from a kind of *programme* that are to be in the building
114	T2	If that is the gallery space, right, what kind of....is it a shared gallery space? Is there sort of a small area within the gallery that has a specific function (as opposed to let it open for that)
115	T2	If that is, why have you twisted it around? You know, what's that doing to it, or is it just for the sake of twisting?
116	S2	Well, the main point twisting is *to get the north light*, so you that like (model) have the main band of windows to be facing north which is the light I want to get, otherwise...
117	T2	That's fine but then all these *looked like* the same kind of materials. It looks all translucent materials all the way around, is that what it is? (model)
118	S2	No
119	T2	No? Well, you see that's what I mean, at the moment there's different messages are coming out
120	S2	That's why I think this works better, more obvious of the the translucent side (current model)
121	T2	Yeah, they do. But then I don't know how that sits in context at the moment
122	T2	I think a lot of your ideas are there, they just need kind of clarifying in terms of how the *orientation is determining the material aspects* of the building.
123	T2	And also the kind of operational strategy for building. It's slightly, you know, ambiguous at the moment. In terms of....we're not so sure why or certainly I am not so sure, you might be. But I think that needs clearly stating. And I think you've got to kind of get out of these folded sketches and start to produce proper working drawings, a kind of more considered, scaled approach. And again, I think the ideas are generally there, that's how it all works. But here comes a point where you have to say right I've got to work through a final strategy and you've got sort of two weeks to get these up to a level where these become formalised series of plans and these models are completed
124	T2	I know these are two models of the same version really and decide which is your working strategy and then, perhaps make another site model that actually embodies these with that quality of material and distinction between them into that (reference to models)
125	S2	I might go *1:50* with a combination of these ones (models)
126	T2	Yeah. I think that (will be fine). Or see if you can by Thursday when we have the next discussion, right, to get out of your sketchbook and on to proper working platform, you know...the drawings

127	T2	And also clearly so that we are able to understand clearly what's happening at different levels, where the key circulations points are in the building, you which are the commonly shared circulation spaces and what are operational spaces
128	T2	Because at the moment, it's very difficult to read from these models, you know....to get an understanding of the whole operation
129	S2	Do you think I should keep going with this down at the *basement* area?
130	T2	Well, I'm not fully convinced whether, you know, the basement area, you know, whether you kind of *get lost with a nice idea rather than whether the idea might work*
131	T2	I don't mind. I think it can work, you know, they *could be shops. T* hey could be..... you could see those working *if* they were in a kind of *proper public spaces* like in corridors to get ( ) lighting. Yeah, I think I can see them working in those areas but I can't see, you know, them necessarily *working in personal, private spaces* like in the bedroom. But I found that you've got some rooms down there, right
132	T2	And they are not going to produce.....they are really going *like prison* cell lights basically inside, you know. And totally artificially and environmentally, you know, it's not the most pleasant spaces
133	S2	These aren't light in themselves, you'd get the *light from here and it will go down* (model)
134	T2	But are they in the bedrooms *or* are they in the corridor spaces, where are they?
135	S2	My original idea was just having it *following the routes*.... the corridor routes
136	T2	But what about the spaces where the people are going to be staying?
137	S2	Yeah...they'd have purely artificial
138	T2	Which that is not a good environment really. You know, you're paying for it, one. Two, you know.....but *if there is a specific quality about a space, say you need or it has to be, or you're trying to extend an experience, that kind of lifestyle* .....That's a different story
139	T2	Because at the moment, I think, they're happen to be there because you can't get light down to it
140	S2	Yes, there's got to be a reason why the....
141	T2	It's not so much about reason but it's actually trying to *understand the character of space. A* nd that should say whether appropriate or not. It's *not an arbitrary decision-making* process, it's not a wallpaper exercise. You know, it's actually understanding the current nature of that space and *how that space needs to be evolved*
142	T2	*If the space requires light, it's not an appropriate place* , or you need to find a way of *getting light* into it, are there *views* in there. So those are the sort of issues you need to address?
143	T2	You know sometimes what you might be finding is that you're making, you know, they were *nice ideas* , and then you've got to *start editing them out* or maybe start *relocating* them elsewhere
144	S2	The main *reason* why I put it down there (in the basement) is because I don't want it to be towering above
145	T2	Well, I mean, but why not...I think it's quite a *strong site* and you've got quite a powerful building here
146	T2	And this could very well easy *accommodating another 2,3,4 floors* even
147	S2	If you did that, it will be *more likely* to this (site model)
148	T2	More what?
149	S2	More like into the studio if it was higher up. So in some ways it would be better forward
150	S2	The reason I started to think about having that basement was because, you know in our first tutorial, I've heard you talked about *how scale doesn't mean big*
151	S2	And I didn't want it to kind of overshadow the ones around it

152	T2	Yeah.....I don't think these are really an issue, because I think in a way in terms of the *urban strategy*, that *corner* could at least be developed, as you have done, to that line. But then it could certainly support this *taller building* because the whole area has a history of quite strong, tall buildings. So, it's not out of character
153	T2	But I just think the appropriating of that *space* for what you were defining is perhaps needs to be requestioned
154	T2	And then it may well be that that's suggest, you know, that you don't eliminate that programme. That programme is embodied elsewhere, you know, in your building
155	T2	And maybe there are some *shared qualities* about the kind of studio *there* and studio working space *here*. You know, so you could have shared space between different areas
156	T2	You know, that could become a double height space with kind of link stairs or something that you get down from one space to the other
157	T2	So I think for for Thursday, see if you can clarify this kind of strategy, the *site strategy in terms of movement, circulation and the types of space*
158	T2	And then try to address in your model of that sort of scale but with perhaps a more considered approach to materials (Conversation ends at 29:18)

Matrix of Cognitive Interaction

Tutorial Session 2 (Tutor T2, Student S2)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S2		F		SY		CON		L	0.117
2	S2	T2	F	F	SY	SY	CON	CON	L	V	0.017
3	T2	S2	F	F	SY	SY	CON	CON	V	V	0.117
4	S2	S2	F	F	SY	ST	CON	CON	V	V	0.217
5	S2	T2	F	F	ST	SY	CON	CON	V	V	0.100
6	T2	S2	F	F	SY	ST	CON	CON	V	V	0.067
7	S2	T2	F	F	ST	SY	CON	PRO	V	L	0.117
8	T2	S2	F	F	SY	SY	PRO	PRO	L	V	0.650
9	S2	T2	F	F	SY	SY	PRO	PRO	V	V	0.050
10	T2	S2	F	F	SY	SY	PRO	CON	V	V	0.200
11	S2	S2	F	F	SY	ST	CON	PRO	V	V	0.450
12	S2	S2	F	F	ST	ST	PRO	CON	V	V	0.300
13	S2	T2	F	F	ST	SY	CON	PRO	V	V	0.083
14	T2	S2	F	F	SY	SY	PRO	PRO	V	V	0.367
15	S2	T2	F	F	SY	SY	PRO	PRO	V	V	0.133
16	T2	T2	F	F	SY	SY	PRO	PRO	V	V	0.150
17	T2	S2	F	F	SY	SY	PRO	PRO	V	V	0.167
18	S2	T2	F	F	SY	SY	PRO	PRO	V	L	0.050
19	T2	S2	F	F	SY	SY	PRO	PRO	L	V	0.250
20	S2	T2	F	E	SY	ST	PRO	PRO	V	V	0.033
21	T2	S2	E	F	ST	ST	PRO	PRO	V	V	0.183
22	S2	T2	F	E	ST	SY	PRO	PRO	V	V	0.150
23	T2	T2	E	M	SY	SY	PRO	PRO	V	V	0.167
24	T2	T2	M	E	SY	CO	PRO	CON	V	L	0.117
25	T2	S2	E	F	CO	SY	CON	PRO	L	V	0.133
26	S2	T2	F	F	SY	SY	PRO	PRO	V	V	0.067
27	T2	S2	F	F	SY	SY	PRO	PRO	V	V	0.450
28	S2	T2	F	F	SY	SY	PRO	PRO	V	V	0.100
29	T2	S2	F	F	SY	SY	PRO	PRO	V	V	0.400
30	S2	T2	F	F	SY	SY	PRO	PRO	V	V	0.200
31	T2	S2	F	F	SY	SY	PRO	CON	V	V	0.167
32	S2	T2	F	E	SY	SY	CON	CON	V	V	0.050
33	T2	S2	E	F	SY	SY	CON	CON	V	V	0.167
34	S2	T2	F	E	SY	ST	CON	CON	V	L	0.050
35	T2	S2	E	F	ST	SY	CON	CON	L	V	0.150
36	S2	T2	F	F	SY	SY	CON	PRO	V	V	0.133
37	T2	S2	F	F	SY	SY	PRO	PRO	V	V	0.283
38	S2	T2	F	F	SY	SY	PRO	PRO	V	L	0.233
39	T2	T2	F	F	SY	SY	PRO	CON	L	V	0.017
40	T2	S2	F	F	SY	SY	CON	CON	V	V	0.067
41	S2	T2	F	F	SY	SY	CON	CON	V	V	0.017
42	T2	T2	F	F	SY	SY	CON	CON	V	L	0.100
43	T2	S2	F	F	SY	SY	CON	CON	L	V	0.117
44	S2	T2	F	F	SY	ST	CON	PRO	V	L	0.167
45	T2	T2	F	F	ST	SY	PRO	PRO	L	L	0.333
46	T2	S2	F	F	SY	SY	PRO	CON	L	V	0.167
47	S2	T2	F	F	SY	SY	CON	PRO	V	V	0.100
48	T2	S2	F	F	SY	CO	PRO	CON	V	V	0.983
49	S2	T2	F	F	CO	SY	CON	CON	V	V	0.083
50	T2	S2	F	F	SY	SY	CON	CON	V	V	0.117
51	S2	T2	F	M	SY	SY	CON	PRO	V	V	0.150
52	T2	T2	M	F	SY	SY	PRO	PRO	V	L	0.333
53	T2	S2	F	M	SY	SY	PRO	PRO	L	L	0.017
54	S2	T2	M	F	SY	SY	PRO	PRO	L	V	0.100
55	T2	T2	F	M	SY	SY	PRO	PRO	V	V	0.283

56	T2	S2	M	E	SY	SY	PRO	CON	V	L	0.067
57	S2	T2	E	F	SY	SY	CON	PRO	L	L	0.350
58	T2	T2	F	M	SY	SY	PRO	PRO	L	L	0.317
59	T2	T2	M	M	SY	SY	PRO	CON	L	L	0.500
60	T2	T2	M	M	SY	SY	CON	PRO	L	L	0.133
61	T2	T2	M	F	SY	CO	PRO	PRO	L	V	0.067
62	T2	S2	F		CO		PRO		V		0.017
63	S2	T2		E		SY		PRO		V	0.150
64	T2	S2	E	F	SY	SY	PRO	CON	V	L	0.100
65	S2	T2	F	E	SY	SY	CON	PRO	L	V	0.100
66	T2	T2	E	M	SY	SY	PRO	PRO	V	V	0.200
67	T2	T2	M	F	SY	ST	PRO	PRO	V	V	0.117
68	T2	T2	F	M	ST	SY	PRO	CON	V	L	0.150
69	T2	T2	M	F	SY	CO	CON	CON	L	V	0.100
70	T2	S2	F	F	CO	SY	CON	CON	V	V	0.033
71	S2	T2	F	F	SY	CO	CON	CON	V	V	0.050
72	T2	T2	F	M	CO	SY	CON	CON	V	L	0.233
73	T2	T2	M	M	SY	ST	CON	PRO	L	L	0.600
74	T2	T2	M	F	ST	CO	PRO	PRO	L	L	0.217
75	T2	T2	F	F	CO	SY	PRO	PRO	L	L	0.417
76	T2	T2	F	M	SY	SY	PRO	PRO	L	L	0.450
77	T2	S2	M		SY		PRO		L		0.017
78	S2	T2		M		SY		PRO		V	0.383
79	T2	T2	M	M	SY	ST	PRO	PRO	V	V	0.550
80	T2	S2	M	F	ST	SY	PRO	CON	V	L	0.267
81	S2	T2	F	F	SY	SY	CON	CON	L	V	0.233
82	T2	S2	F	F	SY	SY	CON	CON	V	V	0.150
83	S2	T2	F	E	SY	SY	CON	CON	V	V	0.083
84	T2	S2	E		SY		CON		V		0.033
85	S2	T2		F		ST		PRO		V	0.167
86	T2	S2	F	E	ST	SY	PRO	CON	V	V	0.200
87	S2	T2	E		SY		CON		V		0.067
88	T2	S2		F		SY		PRO		V	0.317
89	S2	T2	F	F	SY	SY	PRO	PRO	V	V	0.650
90	T2	S2	F	F	SY	SY	PRO	CON	V	V	0.050
91	S2	T2	F	F	SY	SY	CON	PRO	V	V	0.133
92	T2	S2	F	F	SY	SY	PRO	PRO	V	V	0.033
93	S2	S2	F	F	SY	SY	PRO	CON	V	V	0.167
94	S2	T2	F	F	SY	ST	CON	PRO	V	L	0.183
95	T2	T2	F	M	ST	SY	PRO	PRO	L	V	0.000
96	T2	T2	M	F	SY	SY	PRO	CON	V	L	0.300
97	T2	S2	F	E	SY	SY	CON	CON	L	V	0.133
98	S2	T2	E	F	SY	SY	CON	PRO	V	L	0.050
99	T2	S2	F	F	SY	SY	PRO	PRO	L	V	0.067
100	S2	T2	F	M	SY	ST	PRO	PRO	V	V	0.067
101	T2	T2	M	F	ST	CO	PRO	CON	V	V	0.100
102	T2	S2	F		CO		CON		V		0.017
103	S2	T2		E		CO		CON		V	0.083
104	T2	T2	E	M	CO	ST	CON	PRO	V	V	0.933
105	T2	T2	M	M	ST	SY	PRO	PRO	V	L	0.333
106	T2	T2	M	E	SY	SY	PRO	PRO	L	V	0.267
107	T2	T2	E	M	SY	SY	PRO	PRO	V	V	0.200
108	T2	T2	M	F	SY	SY	PRO	PRO	V	V	0.183
109	T2	T2	F	M	SY	SY	PRO	PRO	V	L	0.267
110	T2	T2	M	F	SY	SY	PRO	CON	L	L	0.133
111	T2	S2	F	M	SY	SY	CON	CON	L	L	0.067
112	S2	T2	M	F	SY	ST	CON	PRO	L	L	0.133
113	T2	T2	F	F	ST	SY	PRO	PRO	L	L	0.083
114	T2	T2	F	F	SY	ST	PRO	CON	L	L	0.217
115	T2	T2	F	E	ST	ST	CON	CON	L	V	0.150
116	T2	S2	E	F	ST	SY	CON	CON	V	V	0.217
117	S2	T2	F	E	SY	SY	CON	CON	V	L	0.150

118	T2	S2	E		SY		CON		L		0.017
119	S2	T2		F		SY		CON		V	0.067
120	T2	S2	F	F	SY	SY	CON	PRO	V	L	0.133
121	S2	T2	F	F	SY	ST	PRO	PRO	L	L	0.067
122	T2	T2	F	M	ST	SY	PRO	CON	L	L	0.200
123	T2	T2	M	M	SY	SY	CON	PRO	L	L	0.867
124	T2	T2	M	M	SY	ST	PRO	PRO	L	L	0.367
125	T2	S2	M	M	ST	ST	PRO	PRO	L	V	0.067
126	S2	T2	M	M	ST	SY	PRO	PRO	V	L	0.200
127	T2	T2	M	F	SY	ST	PRO	PRO	L	L	0.283
128	T2	T2	F	F	ST	SY	PRO	PRO	L	V	0.150
129	T2	S2	F	E	SY	SY	PRO	CON	V	L	0.050
130	S2	T2	E	F	SY	SY	CON	PRO	L	V	0.267
131	T2	T2	F	F	SY	SY	PRO	CON	V	V	0.400
132	T2	T2	F	F	SY	SY	CON	PRO	V	V	0.183
133	T2	S2	F	F	SY	SY	PRO	CON	V	V	0.100
134	S2	T2	F	F	SY	SY	CON	CON	V	V	0.083
135	T2	S2	F	F	SY	SY	CON	CON	V	V	0.100
136	S2	T2	F	F	SY	SY	CON	CON	V	V	0.050
137	T2	S2	F	F	SY	SY	CON	CON	V	V	0.033
138	S2	T2	F	F	SY	SY	CON	PRO	V	V	0.367
139	T2	T2	F	F	SY	SY	PRO	CON	V	V	0.067
140	T2	S2	F		SY		CON		V		0.050
141	S2	T2		F		SY		PRO		V	0.333
142	T2	T2	F	M	SY	SY	PRO	CON	V	V	0.233
143	T2	T2	M	F	SY	SY	CON	PRO	V	V	0.150
144	T2	S2	F	F	SY	SY	PRO	CON	V	V	0.083
145	S2	T2	F	F	SY	SY	CON	CON	V	L	0.133
146	T2	T2	F	E	SY	ST	CON	CON	L	V	0.100
147	T2	S2	E	F	ST	SY	CON	CON	V	L	0.050
148	S2	T2	F		SY		CON		L		0.017
149	T2	S2		E		SY		CON		L	0.133
150	S2	S2	E	F	SY	SY	CON	PRO	L	L	0.117
151	S2	S2	F	F	SY	ST	PRO	CON	L	V	0.083
152	S2	T2	F	F	ST	SY	CON	PRO	V	L	0.433
153	T2	T2	F	M	SY	SY	PRO	PRO	L	L	0.100
154	T2	T2	M	F	SY	SY	PRO	PRO	L	V	0.150
155	T2	T2	F	F	SY	ST	PRO	PRO	V	L	0.150
156	T2	T2	F	F	ST	SY	PRO	CON	L	V	0.317
157	T2	T2	F	M	SY	ST	CON	PRO	V	L	0.200
158	T2	T2	M	M	ST	SY	PRO	PRO	L	L	0.150

APPENDIX 3

PROTOCOL TEXT
Tutorial Session 3 (Tutor T3, Student S3)

Segment	Contributor	Protocol Segment
1	S3	Last I time I saw you, I showed you how I had the idea. How I want it to be sort of *a pathway* in which it wasn't so intimidating a public building and I did a model which kind of describe what I was doing. Sort of like a *series of barriers*
2	S3	And you sort of have to wind your way through and also the fact that I want it to have like the pillars kind of showing that it is a classical style building but it's different to what you'd expect
3	T3	Classical but modern library
4	S3	Exactly. So I sort of came up with the, do you remember where we were talking about, like the relationship between new and old one and the space that I want to have between the two of them. So I came up with the idea of this kind of a shape building so from the outside it's quite sympathetic to what's going on. I mean it's going to have the same kind of levels and things like that. But then internally it's going to be a completely different space, and they will be this area outside where it can be used for cafes, base, or just sculptures or anything like that
5	S3	I also thought of the idea of having like that (sketch), having sort of like having some kind of maybe glass sheet or something like so it encourages people to look at that wall as if it is a piece of art and it also has sort of a lot of other effects like there's going to be all kinds of reflections of light and things that this space is going to be quite exciting
6	S3	Also like as you walk around and here, it's not a case of you don't see anything like you start to see reflections of what's here as you kind of wind your way around here. Things like that so it becomes, quite an exciting sort of active enough, it will feel like there's a lot of movement in (light) (reference through sketchbook)
7	T3	So, I can walk into this space here from the outside, is that the idea?
8	S3	Yeah. In plan it's just like (sketches), there's the wall at the moment, and then there will be this *kind of barriers* or something like that as you sort of wind your way around. And so its *sort of a journey into* .....
9	T3	It's closed at the end, so I can't use it as a route through then? (But) through here (points to external area of the sketch)?
10	S3	Well....I had considered the idea that you'd be able to walk all the way around, but I wanted to sort of *create the kind of enclosed space in the middle* which is like, it's a *private space* but it's also outside and *sort of fresh*
11	T3	Yes. So we have perhaps another two alternatives here, haven't we? We have the wall and we have the possibility of closing it off at the end and giving access only through the building at some point
12	S3	But I didn't really want to do that because part of the main thing about my ideas is that I want it to be, I want it to be *as accessible as possible* and if you go *straight from a public space, your private space is quite intimidating*
13	T3	So, I could make it as close as I can walk into and walk through as a short cut
14	S3	I want it to have a lot of kind of like public/ private space which sort of *merges between the two*. It makes it easier to walk into it, it's not quite.....
15	T3	I mean could this be a space that you *could close of at night* really

16	T3	Because, I mean one thing I do see is if we have *this kind of labyrinth thing* , people could come in here at night doing the thing they want to, couldn't they? (reference to sketch)
17	S3	That's true, yeah
18	T3	But I think if it was something that you could easily open up for the day or daylight hours, say, because people probably wouldn't want to be in it at night unless if they have any ulterior motives, would they? I think that could work
19	T3	There is a quite *nice vista* probably, isn't it? Through here, to sort of a bit of the cathedral isn't there that could be exploited, I think? (sketch)
20	S3	Yeah, and I do sort of, I do want to keep the idea because I was looking at, I don't know if you remember but early on, sort of, trying to kind of *integrate sort of a classical style with a more modern style*
21	S3	And I was looking at sort of big kind of round sort of (quite overbearing) shape maybe
22	S3	But I think it would really nice to have, from the outside, what seems like a really sort of sympathetic building with Little Germany and it's quite kind of cautious in not sort of destroying the atmosphere of Little Germany but then completely different atmosphere as soon as you get into that kind of central space for the building
23	T3	Do you know Stirling's Staatsgalerie?
24	S3	No
25	T3	In a Stuttgart
26	S3	Oh yes, you were saying about that the last time *about the central* . Yeah, I had a look at that
27	T3	The central, he did, yes. He kind of put in a ramp and went around this and down the other side (sketch outline of central ramp of Staatsgalerie)
28	S3	It was nicer in a way. It looked like a really sort of, almost quite an ordinary sort of shape and then inside everything was so fluid. It's the kind that I want to....
29	T3	Yes, I mean that'll allow me to walk through ( ), it'll allow you to walk through. But, you know, you kept the sort of the intimacy of that space really
30	T3	Um, I think it might be a bit of an *overkill on the scheme of this size* , somehow, I don't know. You obviously must have thought of that really. You liked to admit that you couldn't see how they're relevant to those?
31	S3	I don't know really, I liked certain aspects of it like the fact that internally there was such a kind of sense of sort of fluidity and you can sort of move around. Which in a way, if I did have a passage that ran all the way through that might be a bit, that *might be similar*
32	T3	Yeah, well, it's something you could hold in your mind isn't it anyway?
33	T3	I mean the other thing about it is about this wall here. You see, it's that piece of (wall) (points to own sketch) you're dealing with really, I suspect, you know. Because if it's closed up....I sort of have a thing about mirrors I must admit because if it's an outdoor mirror, does it (stand) as a mirror? Does it get dirty and damaged and that sort of thing?
34	S3	Yeah...yeah, I've always kind of thinking that maybe it is a bit 'gimmicky' or something
35	T3	I mean I'm actually thinking of two things when I'm talking to which I saw in New York

36	T3	One I saw in New York where one off one of the big squares, for some reason (sketches). I don't know what's happened but a building has been removed or sometime collapsed from an organised façade, and so that's sort of the street edge (sketches). And what somebody's done is to take that space which is probably, I think, it would be no more than the width of this room, possibly slightly less. And it's about sort of that height (continues sketch), probably three stories high, and they've just put probably a little kiosk in there. And the wall itself is just a granulated concrete. And in section it's actually like that (sketches a wall face). So, water trickles into the top and runs down the face of that. And because it's granulated, it makes sort of (white) water surface and disappears at the bottom and make a spout in the ground and it just recycles constantly. So it's a moving wall of water, so I mean that....
37	S3	I suppose that would give you the *dynamic* effect?
38	T3	It might, yeah. It would just give you the *dynamic effect* you want or, I mean, I suppose you could put some sort of that kind of climbing plants arises or something up the wall or something which is less dynamic
39	T3	But I think it's got to be *a landscape effect*
40	T3	That seems *too physical*, really, it's not actually part of the building, is it? *It's just a screen*, really (reference to sketch)
41	S3	Yeah, I did some, like, I wanted to do some kind of concept drawings and paintings (shows sketches)
42	T3	Or it could a place to hang some banners down or something
43	S3	Yeah, but at the same time I want to keep as much of what's there there because of the fact that I think it's the best thing about it is the way it's *so kind of gritty and textured*
44	T3	But it is certainly But at least I'll keep part of it, you know, just feature a segment of it. The majority of the wall is still there, I can touch
45	S3	I was also looking at in plan. I wanted to have a sort of double height space with a gallery. I quite like the gallery to be sort of main feature. So say, that's it in plan (sketches). If the gallery sort of took up that gallery space and then one on the second floor, it would be double height. That means, say here also, well, next to it anyway, I thought it would be really nice, in the library, you could look over on to the gallery. Because, I mean, looking into a gallery is an element that's too distracting. But at the same time it's going to have.....It's going to be quite light and it's going to sort of make the room all fresh. I wanted to use really like quite rich materials in the library
46	T3	So that's where I could walk into glass or something and see over
47	S3	Yeah. And I think it'd be a real contrast between, because I want the gallery to be quite light and fresh open space
48	S3	Whereas after going to Cheetham's in Manchester, I thought a really sort of rich library is really a nice place to work
49	S3	So it'd be nice to have this kind of contrast between the two and while in the library you can sort of look down and I thought it would be quite a nice feature
50	T3	Yeah. I know, I think it's fine. I mean I've seen something like that, don't know, *maybe Hetrzberger or something*, I can't remember that
51	T3	Where if that is your library and these books (sketches), and presumably, I don't know, you maybe have some sort of *tables down the centre or something*. That instead of having the whole walls as an experiencing thing,you could sort of have it come out into a sort of a little balconnette I suppose, you know, with just a bench in it. So two or three people could just sit there and kind of look over the edge
52	T3	I just perhaps being a bit more subtle somehow, so you keep the enclosure of the space in the darkness and sombre light and just see (sketch)....
53	S3	I suppose it would also *wouldn't be so kind of distracting* as well

54	T3	Yes, it's only *like a railway carriage door width to get through* and then two people could sit there and a …..
55	S3	That will be really nice. Another thing I wanted was the bar to be quite….because of the fact the people using the bar are going to be people just from theatre. So if there's *a circulation that would sort of encourage you to move upwards* and the *bar to be almost like a roof garden* but obviously enclosed, and then it would sort of.....It would throw light out and it would have an effect on the kind of the whole surrounding
56	T3	So that's like a cube of light on top of the building?
57	S3	Exactly, yeah
58	T3	Yeah, so, you see, one other thing you showed me on your diagram minutes ago was putting the galleries here, on this corner (sketch). But you know, you've also shown that that's your kind of entrance to the building, or have you, or maybe some mistake here(sketch) ?
59	S3	The entrance would be, because I'd want them to move into this space before they enter the building so that the entrance would be more around there (sketch)
60	T3	Ah, in the courtyard?
61	S3	Yeah
62	T3	Right, I see (sketch)
63	S3	And that would kind of…..that would mean that you'd *get a sense of the layer of the building* before you enter as well
64	T3	Yeah, so *I could have say a circulation system* that operated in some way up the building, across the street side, which is probably be a bit gloomy and dark anyway (points to sketch). Em, so you could actually come to here, to this point here and you could say have your corner café box or something, couldn't you, look across to the cathedral, which would be nice
65	T3	And be like (box of minds?) Which a bit like those things at the *on the Tate Modern*, isn't it? Solid buildings with this light box's high up. Yeah, I think that will be good
66	T3	Where would your library come in this? Partly, somehow looking into this gallery (would you say really)?
67	S3	Yeah. I was kind of thinking it (tutor's sketch of plan) to be over this side of the building *so that* then it would have sort of the view on the other side of the building, and….
68	T3	That's where your entrance is as well?
69	S3	Yeah, I've definitely got to start *thinking about plans*
70	S3	And I think that's the main problem is I've left the circulation like the stairs and the lifts and I don't think about them first, which I didn't think I need to do. So I've sort of had the idea where everything is to be laid out and then it was just suddenly 'oh God, where am I going to put the circulation'? Whereas, I think, if I were think about that first, it's going to all fall into place
71	T3	I mean, might it be that this diagram becomes a little *less kind of classically ordered and symmetrical*
72	T3	And then maybe say, start to look at something which allows you to, say, have the library space and the double height gallery and maybe in *some format,* the light box at the top, which is your café
73	T3	And so you come into the courtyard, either end, and maybe the entrance starts to be sort of here, with the sort of circulation elements could be sort of anywhere really because you'd cross that sort of void for ( ) as you want. And maybe you'd get a sort of thinner extrusion along the street edge here. So you come in more to a square here
74	T3	Yeah, which would still sort of have the potential for doing something about the wall, the route through, and, and the entrance. You know, the entrance would be sort of somehow part of this. You know, it might even take on a more dynamic form, I don't know (sketches)

75	S3	Yeah, I don't know, I do definitely think that I need to *feel less rigid about where everything is*
76	S3	But I would like, I'd like the idea that there being sort of *contrast* between the sort of *modern* sort of smooth curve wall and *old* rigid-like wall
77	T3	Yeah, so maybe, maybe this has the sort of the things like the library and the external galleries in, which has it linked with the cathedral where, you know...
78	T3	Yes, it's where people sit in café, and then perhaps the element, which is the more closed box, you know, might like the theatre, might actually be, I don't know. Maybe that can become the more sinuous elements, say, with the theatre being the sort of making the corner in some way and this (sketches) being the foyer and movement space, I don't know (sketch plan)
79	T3	But it does rely on you *breaking down that initial diagram* a little bit, doesn't it?
80	S3	Definitely yeah
81	T3	Yes, so this (sketch) becomes very much an *interactive space I think with the entrance*, it can always be the sort of secondary door, can't we, *from the street*?
82	T3	It allows you to *enter more the middle of things*, doesn't it? Things on either side
83	S3	And I suppose it'll give the users an awareness of the layout of the building before they enter as well
84	T3	That's right, that's right. So, I mean, I think, the *first thing you've got to find is the position for your theatre* and a, you know, I don't know how that's going to work
85	T3	And it might be that you have very things like your dressing rooms and things like that more overlooking the streets, which would be quite nice that you're actually relating some of the more ordinary windows with streets or buildings opposite ( )
86	S3	Yeah definitely
87	T3	And this thing more of sort a *curve walling experience and related to that sort of façade* and the, yeah, I think that's the direction for it to go in, doesn't it?
88	S3	Yeah, definitely, I do feel quite positive about it. The fact that I'll have a few days of it sort of...
89	T3	Make you think a bit, yeah. Well, I mean, I think we *don't want to lose the principles that were embodied in the first scheme*. I'm very keen on the *ideas that develop, not just sort of like go off at a tangent and do something else altogether*. Would that be positive?
90	T3	I say that do you think that you could really sort of try make a stand and try to *draw some plans for Friday so that we could look at something and agree about it* at the end of the day. You know you've got *something to go away with,* holiday is going to a misnomer, I think, isn't it?For that break, you know, you've actually got something you can work with confidence because I won't see you in well, till end of April I suppose
91	T3	And because when we get back, we've also got to *start into the structures,* and *services* and the *materiality* of the building far more closely, buildability. So it's certainly good if you could get this part (over) for this week
92	S3	I would do, definitely
93	T3	Yeah, but you'll still keep your freedom, can't you? But the curve have to start to become a little more subtle (Conversation ends at 20:13)

Matrix of Cognitive Interaction

Tutorial Session 3 (Tutor T3, Student S3)

Seg. no	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S3		F		SY		CON		L	0.367
2	S3	S3	F	F	SY	SY	CON	PRO	L	V	0.333
3	S3	T3	F	F	SY	SY	PRO	PRO	V	V	0.017
4	T3	S3	F	F	SY	SY	PRO	PRO	V	L	0.750
5	S3	S3	F	F	SY	SY	PRO	CON	L	L	0.433
6	S3	S3	F	F	SY	SY	CON	CON	L	V	0.333
7	S3	T3	F	F	SY	SY	CON	CON	V	V	0.100
8	T3	S3	F	F	SY	SY	CON	CON	V	V	0.333
9	S3	T3	F	F	SY	SY	CON	CON	V	V	0.100
10	T3	S3	F	F	SY	SY	CON	CON	V	V	0.267
11	S3	T3	F	F	SY	ST	CON	CON	V	V	0.333
12	T3	S3	F	F	ST	SY	CON	CON	V	V	0.217
13	S3	T3	F	F	SY	SY	CON	CON	V	V	0.117
14	T3	S3	F	F	SY	SY	CON	CON	V	V	0.183
15	S3	T3	F	F	SY	SY	CON	CON	V	V	0.033
16	T3	T3	F	F	SY	SY	CON	PRO	V	V	0.150
17	T3	S3	F		SY		PRO		V		0.017
18	S3	T3		F		SY		CON		V	0.317
19	T3	T3	F	M	SY	SY	CON	CON	V	L	0.133
20	T3	S3	M	F	SY	SY	CON	PRO	L	V	0.267
21	S3	S3	F	F	SY	SY	PRO	PRO	V	L	0.133
22	S3	S3	F	F	SY	SY	PRO	CON	L	L	0.350
23	S3	T3	F	F	SY	SY	CON	PRO	L	L	0.050
24	T3	S3	F		SY		PRO		L		0.033
25	S3	T3		F		SY		PRO		V	0.033
26	T3	S3	F	F	SY	SY	PRO	PRO	V	V	0.083
27	S3	T3	F	F	SY	ST	PRO	PRO	V	V	0.100
28	T3	S3	F	E	ST	SY	PRO	PRO	V	V	0.217
29	S3	T3	E	F	SY	SY	PRO	PRO	V	L	0.267
30	T3	T3	F	E	SY	SY	PRO	PRO	L	V	0.233
31	T3	S3	E	E	SY	SY	PRO	PRO	V	V	0.317
32	S3	T3	E	M	SY	SY	PRO	PRO	V	L	0.067
33	T3	T3	M	F	SY	SY	PRO	CON	L	L	0.383
34	T3	S3	F	E	SY	SY	CON	CON	L	V	0.100
35	S3	T3	E	F	SY	SY	CON	PRO	V	L	0.100
36	T3	T3	F	F	SY	SY	PRO	PRO	L	V	1.300
37	T3	S3	F	F	SY	SY	PRO	PRO	V	V	0.033
38	S3	T3	F	F	SY	SY	PRO	CON	V	V	0.283
39	T3	T3	F	M	SY	SY	CON	CON	V	L	0.033
40	T3	T3	M	E	SY	CO	CON	CON	L	L	0.100
41	T3	S3	E	F	CO	CO	CON	PRO	L	V	0.117
42	S3	T3	F	M	CO	SY	PRO	CON	V	L	0.050
43	T3	S3	M	M	SY	SY	CON	CON	L	L	0.267
44	S3	T3	M	M	SY	SY	CON	CON	L	V	0.250
45	T3	S3	M	F	SY	SY	CON	CON	V	L	0.917
46	S3	T3	F	F	SY	SY	CON	CON	L	V	0.050
47	T3	S3	F	F	SY	SY	CON	CON	V	V	0.133
48	S3	S3	F	F	SY	SY	CON	PRO	V	V	0.167
49	S3	S3	F	M	SY	SY	PRO	CON	V	V	0.183
50	S3	T3	M	F	SY	SY	CON	PRO	V	L	0.133
51	T3	T3	F	M	SY	SY	PRO	CON	L	L	0.650
52	T3	T3	M	M	SY	SY	CON	CON	L	V	0.150
53	T3	S3	M	F	SY	SY	CON	CON	V	V	0.050
54	S3	T3	F	F	SY	SY	CON	CON	V	L	0.117
55	T3	S3	F	F	SY	SY	CON	CON	L	L	0.567

56	S3	T3	F	F	SY	SY	CON	CON	L	V	0.033
57	T3	S3	F		SY		CON		V		0.017
58	S3	T3		F		CO		CON		L	0.317
59	T3	S3	F	F	CO	SY	CON	CON	L	V	0.117
60	S3	T3	F	F	SY	CO	CON	CON	V	V	0.017
61	T3	S3	F		CO		CON		V		0.017
62	S3	T3									0.050
63	T3	S3		F		SY		CON		V	0.117
64	S3	T3	F	M	SY	ST	CON	CON	V	L	0.433
65	T3	T3	M	F	ST	SY	CON	PRO	L	V	0.283
66	T3	T3	F	F	SY	SY	PRO	CON	V	L	0.067
67	T3	S3	F	F	SY	ST	CON	CON	L	V	0.167
68	S3	T3	F	F	ST	ST	CON	CON	V	L	0.033
69	T3	S3	F	M	ST	SY	CON	PRO	L	L	0.133
70	S3	S3	M	F	SY	SY	PRO	PRO	L	V	0.367
71	S3	T3	F	M	SY	SY	PRO	PRO	V	L	0.100
72	T3	T3	M	M	SY	ST	PRO	PRO	L	V	0.483
73	T3	T3	M	M	ST	ST	PRO	CON	V	V	0.467
74	T3	T3	M	F	ST	SY	CON	CON	V	V	0.283
75	T3	S3	F	E	SY	SY	CON	PRO	V	L	0.083
76	S3	S3	E	F	SY	SY	PRO	CON	L	L	0.200
77	S3	T3	F	M	SY	ST	CON	CON	L	L	0.217
78	T3	T3	M	F	ST	SY	CON	CON	L	V	0.400
79	T3	T3	F	F	SY	ST	CON	PRO	V	V	0.067
80	T3	S3	F		ST		PRO		V		0.033
81	S3	T3		M		SY		CON		L	0.217
82	T3	T3	M	F	SY	ST	CON	CON	L	V	0.133
83	T3	S3	F	F	ST	SY	CON	CON	V	L	0.100
84	S3	T3	F	M	SY	SY	CON	CON	L	L	0.233
85	T3	T3	M	M	SY	SY	CON	CON	L	V	0.217
86	T3	S3	M		SY		CON		V		0.033
87	S3	T3		F		SY		CON		L	0.233
88	T3	S3	F		SY		CON		L		0.100
89	S3	T3		M		ST		PRO		L	0.000
90	T3	T3	M	M	ST	SY	PRO	PRO	L	L	0.350
91	T3	T3	M	M	SY	SY	PRO	CON	L	L	0.867
92	T3	S3	M		SY		CON		L		0.067
93	S3	T3		M		SY		CON		L	0.200

APPENDIX 4

PROTOCOL TEXT
Tutorial Session 4 (Tutor T4, Student S4)

Seg. No	Contributor	Protocol Segment
1	S4	I had *broken* all my ideas into urban scale and architectural scale and then my agendas. Things specific to Bradford like in the hills and then my.....That was the architectural scale, and then.....
2	T4	Do you think you find these helpful?
3	S4	Yes, I think so. That's for the museum one, I was obviously culminating these and that's where I got into overall (image) (reference to presentation sheet)
4	T4	That one I remember, we did talk about *it* didn't we? (reference to section presentation sheet)
5	S4	Yeah. And they basically told me to try 3-Dimensionalise it because some of the ideas in here weren't really realised like what made me changed the site was this (threshold) here and the difference you've got like on both sites like Modernist buildings, (retired) buildings governed by roads and pedestrian whatever, so, *how would I address* that 3-Dimensionally in the building and I suppose I'll show you it gets harder to softer as it goes from card to ( ) (shift reference from drawing to model)
6	T4	Yes. Of course, you started exploring the bigger model, didn't you, the gallery space, right
7	S4	And this is basically, the 3-Dimensional thing is basically *like massing which, and also trying to convey some ideas like how these spaces would be like*
8	T4	So talk me through this. Is that....you're on the wall side, are you? No? Which site are you? (reference to model)
9	S4	No, I'm on 5 at the top. This was *representative* of services (reference to wall of model) and the elevators and stuff like through how that, what makes the building function are the pipes (things) on the (indicative) side, one you'd into each want like a hard side all need addressing to as openly as this site
10	S4	See a side of me find this to be *like a cavernous thing* because looking at the textile works, it's all this kind of a *paradoxical element.* It's a like really heavy massed building with a lot of light, so if I break those into the separate elements and you can really force the mass down here and the light somewhere else and it would be better than just put them all together and getting a weaker overall effect
11	T4	So it's layering this way but it's also layering (gestures with model)
12	S4	Upwards (gestures with model)
13	T4	Upwards....kind of....
14	S4	Kind of doing that way as well (gestures with model)
15	T4	Yes, and that way, right (gestures with model)
16	S4	Um...and with like the admin and stuff on this with grey wooden boxes cladding the materials and galleries
17	S4	On the galleries, I've broken down into a lot of spaces
18	S4	Because I kind of decided as part of my review that I wanted to try and convey an idea of complexity of textiles that these historical things, political things involved. So each one conveys a single idea. Like I don't want to, I think the strongest way to convey an experience is just by *focussing on one thing rather than lots of things* all at once
19	S4	So I just break down into individual boxes and create a real wide range of different spaces
20	T4	So each space you're going to is about one specific thing, ok?
21	S4	Yeah....but it's about....go on...yeah

22	T4	It's *about* one element, whether it's political upheaval ( ) and waves or whether it's about textile (manufactural-ship) so you're going to cover a lot of ground aren't you, basically? Which is quite interesting again
23	T4	And how are these spaces *connected?*
24	S4	Right, well that's a.... kind of, I mean that's what I think about in a minute.....there's going to be a public space here which is be totally free where they could occupy, probably have some coffee as well. Hence, they choose if they want to go on into the galleries. And then what I would.....my circulation was going to be in a void that the gallery's left around to use the space down the middle (reference to model)
25	S4	What I decided to do instead is *change this into a vertical space,* like this. And then place the galleries at the side, only I need to get some help on how to deal with this, but so that these all become one thing and the galleries lead off it like that (reference to model)
26	T4	Using the servicing, the service walls, the circulation unit and then somehow connected boxes (gestures)
27	S4	I've got....very sketchy ideas of how they're going to start fit it together
28	T4	In a way, I have to admit, I think that might help because...(reference to model)
29	S4	This (model) would make much *more sense rather than scribbling*
30	S4	These are rather kinds of massing diagrams or plans (reference to sketches). This is the basement ( ). I've been looking at brick tiles and things, trying to make how (to make it more) cavernous and stuff. But this is where I kind of deal with parking and pedestrian (reference to sketches)
31	S4	The thing that I've got, I'm quite interested in how like traffic and pedestrians on a *different scale than like a town planning scale and little over on a smaller scale* but it's such a complex issue I can't come down on one side and say this should be separated or it should ignore cars or whatever it is. I kind of have to make the decisions I think for the sake of doing it. Yeah, this was kind of....
32	T4	Don't you think, I mean, part of this could be in fact, even you could have, if you probably did want to *employ car parking* somehow, the potential is on the (croft) to do that, even if this is raised above ground level and making it sort of appear solid like an underground space but it isn't, it should be quite interesting
33	T4	It's a *kind of underground space but not* . You could dedicate part of that to some (gestures) or drop-off point or...
34	S4	Yeah, I think, it would be like, practically sensible *but maybe go against some of the ideas* I've got about keeping it and I wanted to keep all of the pedestrians and the cars are in this level here. So there's an idea of movement from the city into the building that they were going to be combined but I mean I'd be willing to let that go for the practicality in my part really
35	T4	Yeah, if you decide that they couldn't park in here, that would be very nice and well and say actually I don't believe that should be encouraged. It's *part of the (later) transport policy* anyway is to discourage vehicles to come into Little Germany
36	S4	I thought I'd like to put a bus route but make part of them go to a bus stop
37	T4	But that might be more interesting, I think actually, but that could be sort of (gestures), I don't know, I don't know if this is underground
38	S4	This is underground
39	T4	It is underground, ok. I mean, can the bus drive along it, and circulate (gesture)?
40	S4	Could well be, yeah
41	T4	It could pull in, and stops actually (at) *something internal (gestures)*
42	T4	So you'd have the entrance perhaps more internalised than on the street front

43	S4	I did think about making a bus (stop) on this side, right, to actually taking a path across, create the length of the bus to pull in so as you come cross through the ring road here, pull in and down into the city centre as part of a mini bus route I suppose (reference to an orientation on model and in site plan).
44	S4	And it will quite an interesting like a 'gesture' from the building to reflect that
45	T4	Well, I think, you're at a perfect stage now to do a lot of things being asked for for Friday. Have you seen the back of the board? You seem to have gone forward. *I'd start planning it and draw a section through* . I mean you started doing it anyway
46	T4	Although interestingly these *sketches don't relate that closely to this model*
47	T4	This seems more resolved than the drawings do although I think you're working elsewhere (on the) circulation that but there's some strong ideas in there
48	S4	In my review they told me I'm going to kind of work my way through at same time, but in my review they told me to leave, *get in the building together to the last minute and develop these spaces as experiences and textures and then hopefully, they'll fall into place but I'm obviously....*
49	T4	But you're...the way you've approach that, I agree with that in a way. I think what you need is a *scaled plan* only where to sort of, you know, help yourself sort of *circulate around this building* and thus, to (account) if the circulation's working (and how it) connect back into spaces
50	T4	But for Friday, in addition to this stuff, which I think it won't take you too long to work on in each of the levels, you need to highlight what's happening in each of these spaces in these floor levels, maybe start bringing in those in 3D sketches or you actually make 1 or 2 of even more detail model of a larger scale you could develop over easter. But, I think the final thing is that you actually come back to me with a series of plans and well then say, actually that one is going to represent that, you know, have some sort of idea which shows what belongs to what and what's it going to do
51	T4	And then I think the excitement (is going to be in) more detail in terms of the contrast of what they're over and how you are going to deal with each subject matter in each sort the block. Now *how do they feel through their spaces* dealing with people who in fact had to deal with crudely long hours, who could deal with the long hours in real situations, in sweat, repetition of the machinery sort of pounding away. And other space could deal about dyeing fabrics, colours. There's a lot of that sort of thing but I think you could actually know what you're dealing with. I think it'll be good to put it down on paper even if you haven't got to in terms of treating each space just yet
52	T4	But it'll be good to see how it's *orientated* because you might find on this space, you want to deal with more positive issues. And on this side it's much more sort of, I mean, I don't feel that it's a particularly beautiful side but, you know, about the productive aspects, or in order to deal about construction and process of textile production on this side. This could be much more of an emotional area. I don't know, if that's along the right line of it, I think the way you orientate this in terms of different spaces of emotions and different experiences is quite key to this.
53	T4	And then your choice of materials and you're suggesting that all of these are clad in something different, which is interesting. Does that represent something that's physically (malleable)? (reference to model)
54	S4	I think I wanted everything to be, I think, the *experience should be created like, should be like structurally integral* . I don't want it to be like interior design. I don't like the idea on creating something which I think is separated from. It's like painting a layer on top of what seems to be there
55	S4	So, I think why Peter ( ) is so successful is his house is like integral, the services integrity to the structural, at least, kind of more I think....
56	T4	Part of the opening of the slot are in the.....they're slicing wide through the structure, aren't they?.....And fabric at the same time

57	T4	Ok, well, I think for Friday I would start *mapping it out so that you know how it's sort of piecing together really*
58	T4	And you can start, not naming these exactly, but making some sense of what they're representing and at what point on the building they'll come across
59	T4	And how you're going to make this, *integrally, about a place, or a substance or an issue or an atmosphere* . (How are going to deal with that? Have you any *sort of idea* ?)
60	T4	Their *thicknesses* might all vary, couldn't they?
61	T4	It depends what noise or, you know, one of these might be about the water that's required for the manufacturing process
62	T4	So, the space might be rather like, oh my god, what's the artist who *did this big oil slick* in ( )?
63	S4	Yeah I know, I've got to that already
64	T4	And it could be something like that where you walk out into, sort of somehow getting into the (middle) of water and was *subject in the way the turbine or something in the room has that makes the water sort of ripple* . I don't know, it's that kind of a thing. It could be really exciting
65	S4	The problem is going to be, like, because it's such a wide range of things and it's a finite amount of space and if I'm making things structural integral then it means they can't be changed
66	S4	So, the point is that, how do you choose what are most important things to show?
67	T4	How do you mean?
68	S4	Or can't I address every, say, each one of these is relevant to an idea about politics or science or whatever, so *how do you justify just showing* , say, the six galleries just six ideas about it because *they'll be fixed, their meaning won't change* if it's.....
69	T4	You know, your building is *not a conventional museum* . I don't think you're displaying anything particular in mind. It's almost more like, you know, Suzi's project which is the *theatre of memory* . Your building's actually dealing with memory running off a manufacturing process and processes that was particular to Bradford. It's all about Bradford. It's about textile production, the whole building's in fact a museum rather than.....which I'm absolutely happy about... . I don't think your building will include showcases or displays as such. The building itself is there to....for memories or insights or moments, you know, for people finding their way around it. There might be elements of displays within each of the spaces but I think it's going to be integral as you say. But it doesn't matter because that is then recording the history of the textile industry of Bradford and so the spaces, they're actually the exhibits aren't they, the rooms are the exhibits if you like.....is that right?
70	S4	Yeah, right, in a sense. I suppose it's like I'm having a *temporary gallery* as well. Then it's like a, there's just like a very, *like a blank canvas to put in like our little (work) thing* . I suppose we can install something ourselves, constantly changing
71	T4	Well that might mean very different in the way it's meant to have made up, I mean, constructed. It doesn't have (any order). It doesn't have.....
72	T4	Perhaps (it's spread to all) floors that you pass through in these, *I don't know* , could be part of this level couldn't it? Or if you want, it could even be the top of that level?
73	S4	I think it....because I was thinking instead of like.....you know, the, constant ramp before (I did) the U-shape thing that's supposed to go in. If this probably can circulate things or something like that, just to hang things along them some..... ...because I want it to be like, I don't know what the word is
74	S4	So it is *an idea of like taking possession* so there's flat spaces and ramped stuff that some of these spaces that you suggest you could sit in, just to hang them. Because, I imagine that to transform demand quite a lot with the time and different people and stuff and having to just make that into a gallery at all

75	T4	There's a book, I think you probably heard of it, it's called Installation Art
76	S4	I've got it
77	T4	So it was you was it! It's quite good. There's some work in there by a man called (Silva). He's a (Surinam), I think. I'll mention something else actually, I can't remember what book, but it's a *series of cube* spaces that you walk into, each one has a peculiarity to its installation. It's all glazed space, in the late 80s. One of these spaces is covered in....this is filled with the school chalk, you walk in and when you come out, you'd actually walk the chalk dust out into the galleries. The walls were lined with (graphic) paper. And he actually draws on the wall as well, and one of the spaces had *one penny pieces on the floor* (to walk on). They're all brand new because they're all shiny. One almost expects extraordinarily like pennies coming down, more like raining in space and the other ones like ( ). But they were cubes where you walk into rooms where each one is completely different than the other. I think they're in that book. They are not particularly ( )
78	T4	I'm not sure if that's what you're doing because *they're installations* . Where as what I think you're doing is something much more.....
79	S4	Architectural?
80	T4	.....Architectural. But they are sort of seem quite inspired by rooms that are like that because they are *linked to allowing your own sort of perception to design space like that* and ( ) *with your feeling* . But they are quite relevant.
81	T4	Yeah, I would.....this more boring stuff, at the end of the day, which will help you I think decide how the building could be sort of like, *how does it work really* ? And then we can get into your *specifics of the gallery spaces* and about, you know, *how they're working with each other and connected* . Whether they're connected or connected back into the ( ) space
82	T4	And what is it about (this) that's going to offer us another experience?
83	T4	It's almost like ( ) big, solid, un-orthogonal forms, that's just pieced together
84	S4	Is.....what that guy's called? Eduarde Chile De La....something. They're like.....it looks like big boxes with everything's carved out, *it's kind of how I imagine this*
85	T4	Well, his works are quite relevant, I think. There are nice books on him. At least (some of the things which I would recommend) is would to you is the (alabaster) as the actual the daylight shines through it. I mean, you could do welcome a bit of that (in this) actually. They're beautifully work, 20-30 inches long, in stone
86	T4	You could very much use some of that language here. I think that's an amusing, post modernist.....beautiful work ( )
87	S4	I went to textile exhibition at the weekend in a quite (stately) home (it's just white box) but in Hull. And there were long thin bits of panels. They were acid etched and dyed and they were hung like from the ceiling to the floor. So it *create this quite like architectural spaces* . It's quite like over empowering to stand in the middle of it. It's quite interesting, the way you hang them. So I mean, that could be a way in which I display something because that's more of like the experience and they are not like put on pedestal or anything like that
88	T4	Certain displays.....well, the *actual display objects become the wall* and whatever it is you're passing by as it orientates you through the space. ( ) That sort of very powerful effect in the way effect in a way display might so much so, you know, allows you to (dwell) into so many things. ( ) could be helpful to you ( ) in alabaster, nickel, (gold) and stone, items like glass as well like....fake glass, recycled glass, cast glass. All these you could get into in quite a detail in a way *sort of a bridge (to) the spaces by materials, the key to what you're trying to express* (conversation ends at 27:04)

Matrix of Cognitive Interaction

Tutorial Session 4 (Tutor T4, Student S4)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S4		F		SY		PRO		L	0.350
2	S4	T4	F		SY		PRO		L		0.033
3	T4	S4		F		SY		PRO		L	0.167
4	S4	T4	F	F	SY	SY	PRO	PRO	L	V	0.017
5	T4	S4	F	F	SY	SY	PRO	PRO	V	V	0.517
6	S4	T4	F	F	SY	SY	PRO	PRO	V	L	0.117
7	T4	S4	F	F	SY	SY	PRO	PRO	L	V	0.267
8	S4	T4	F	F	SY	SY	PRO	CON	V	V	0.150
9	T4	S4	F	F	SY	SY	CON	CON	V	V	0.383
10	S4	S4	F	F	SY	SY	CON	PRO	V	V	0.483
11	S4	T4	F	F	SY	ST	PRO	CON	V	L	0.050
12	T4	S4	F	F	ST	ST	CON	CON	L	V	0.017
13	S4	T4	F	F	ST	ST	CON	CON	V	V	0.033
14	T4	S4	F	F	ST	ST	CON	CON	V	V	0.017
15	S4	T4	F	F	ST	ST	CON	CON	V	V	0.017
16	T4	S4	F	F	ST	SY	CON	CON	V	L	0.117
17	S4	S4	F	F	SY	ST	CON	CON	L	V	0.267
18	S4	S4	F	F	ST	SY	CON	PRO	V	V	0.183
19	S4	S4	F	F	SY	SY	PRO	CON	V	V	0.117
20	S4	T4	F	F	SY	SY	CON	PRO	V	L	0.133
21	T4	S4	F		SY		PRO		L		0.050
22	S4	T4		F		SY		PRO		V	0.300
23	T4	T4	F	F	SY	ST	PRO	CON	V	L	0.033
24	T4	S4	F	F	ST	SY	CON	CON	L	V	0.400
25	S4	S4	F	F	SY	ST	CON	CON	V	V	0.350
26	S4	T4	F	F	ST	ST	CON	CON	V	V	0.117
27	T4	S4	F	F	ST	SY	CON	CON	V	V	0.100
28	S4	T4	F		SY		CON		V		0.050
29	T4	S4		E		SY		PRO		L	0.183
30	S4	S4	E	F	SY	SY	PRO	CON	L	L	0.367
31	S4	S4	F	F	SY	SY	CON	PRO	L	L	0.483
32	S4	T4	F	M	SY	SY	PRO	CON	L	V	0.350
33	T4	T4	M	F	SY	SY	CON	CON	V	V	0.150
34	T4	S4	F	F	SY	SY	CON	PRO	V	V	0.467
35	S4	T4	F	M	SY	SY	PRO	PRO	V	V	0.317
36	T4	S4	M	M	SY	SY	PRO	CON	V	L	0.100
37	S4	T4	M	E	SY	SY	CON	CON	L	L	0.133
38	T4	S4	E	F	SY	SY	CON	CON	L	V	0.017
39	S4	T4	F	F	SY	ST	CON	CON	V	L	0.167
40	T4	S4	F		ST		CON		L		0.017
41	S4	T4		F		ST		CON		V	0.100
42	T4	T4	F	F	ST	SY	CON	CON	V	V	0.067
43	T4	S4	F	F	SY	ST	CON	CON	V	V	0.317
44	S4	S4	F	F	ST	SY	CON	CON	V	L	0.117
45	S4	T4	F	M	SY	SY	CON	PRO	L	L	0.233
46	T4	T4	M	E	SY	ST	PRO	PRO	L	L	0.067
47	T4	T4	E	E	ST	SY	PRO	PRO	L	V	0.167
48	T4	S4	E	F	SY	SY	PRO	PRO	V	V	0.350
49	S4	T4	F	M	SY	SY	PRO	PRO	V	L	0.367
50	T4	T4	M	M	SY	ST	PRO	PRO	L	L	0.650
51	T4	T4	M	M	ST	SY	PRO	PRO	L	L	1.050
52	T4	T4	M	M	SY	SY	PRO	CON	L	L	0.700
53	T4	T4	M	F	SY	SY	CON	CON	L	L	0.267
54	T4	S4	F	F	SY	ST	CON	PRO	L	L	0.317
55	S4	S4	F	E	ST	SY	PRO	PRO	L	V	0.217

56	S4	T4	E	F	SY	SY	PRO	PRO	V	V	0.250
57	T4	T4	F	M	SY	ST	PRO	PRO	V	L	0.183
58	T4	T4	M	M	ST	SY	PRO	PRO	L	V	0.250
59	T4	T4	M	M	SY	SY	PRO	PRO	V	V	0.300
60	T4	T4	M	F	SY	SY	PRO	CON	V	L	0.083
61	T4	T4	F	F	SY	SY	CON	CON	L	V	0.200
62	T4	T4	F	F	SY	SY	CON	PRO	V	L	0.133
63	T4	S4	F		SY		PRO		L		0.050
64	S4	T4		F		SY		CON		V	0.333
65	T4	S4	F	F	SY	SY	CON	CON	V	L	0.250
66	S4	S4	F	F	SY	SY	CON	PRO	L	V	0.167
67	S4	T4	F		SY		PRO		V		0.017
68	T4	S4		F		SY		PRO		V	0.400
69	S4	T4	F	F	SY	SY	PRO	PRO	V	V	1.583
70	T4	S4	F	F	SY	SY	PRO	PRO	V	V	0.250
71	S4	T4	F	F	SY	SY	PRO	CON	V	V	0.350
72	T4	T4	F	F	SY	ST	CON	CON	V	V	0.217
73	T4	S4	F	F	ST	SY	CON	CON	V	V	0.300
74	S4	S4	F	F	SY	SY	CON	PRO	V	V	0.450
75	S4	T4	F	M	SY	SY	PRO	PRO	V	L	0.067
76	T4	S4	M		SY		PRO		L		0.017
77	S4	T4		F		ST		PRO		V	1.333
78	T4	T4	F	F	ST	SY	PRO	PRO	V	V	0.117
79	T4	S4	F	F	SY	SY	PRO	PRO	V	V	0.033
80	S4	T4	F	F	SY	SY	PRO	PRO	V	V	0.483
81	T4	T4	F	M	SY	ST	PRO	PRO	V	L	0.533
82	T4	T4	M	F	ST	SY	PRO	CON	L	L	0.217
83	T4	T4	F	F	SY	CO	CON	CON	L	L	0.250
84	T4	S4	F	F	CO	SY	CON	PRO	L	L	0.167
85	S4	T4	F	F	SY	SY	PRO	PRO	L	V	0.433
86	T4	T4	F	F	SY	ST	PRO	PRO	V	V	0.383
87	T4	S4	F	F	ST	SY	PRO	PRO	V	L	0.750
88	S4	T4	F	F	SY	SY	PRO	CON	L	V	3.500

APPENDIX 5

PROTOCOL TEXT
Tutorial Session 5 (Tutor T4, Student S5)

Segment	Contributor	Protocol Segment
1	S5	I think I've changed it quite a lot actually.....right this is the first thing....(laying out models)
2	T4	That's the one I saw
3	S5	You saw this one?
4	T4	Yes...yes....that one (referring to a particular model)
5	S5	You saw that thing?
6	T4	Yeah
7	S5	Right, and you said just to, whatever, with the same kind of thing
8	T4	Yes
9	S5	And then I did this and I thought about what you said about the three different things, the teaching institute, the sleeping pods and labs and things like that and then the main space and exhibition space, library space, outside coffee shop and lecturing theatre
10	S5	And I spoke to David about what to do now with regards to the entrance. I was going to have from here all the way down but he said actually I'd need to make it there (centre of building elevation) and so you've got a kind of....(gestures)
11	T4	.....choice
12	S5	This choice. So then I did this, which is a much more detailed model. He also said things like instead of having a route through the middle you can have the route to, kind of, on the outside, like glass thing and then it goes into the building and then it comes out of the building, so you can get these brief glimpses of people walking past as well as these entrance thing where people can go in (hand gesture indicating dispersion) and I've carried it on there actually
13	S5	So this central thing with a ramp. I thought of this idea of ramps
14	S5	And then I settled with this idea because with this idea I kind of thought, if we carry on, you're not going to have enough clearance space there
15	S5	So then, I kind of did this thing and thought of that thing and the kind of ramps going outwards (working model) and so I built this much more detailed and to scale model and I thought I really needed to do this. This (larger model) is 1:50 scale, I needed to do this at scale to work out this 1 in 12 minimum slope. And I thought, right, I'd better do it to scale just to see if it works and if it works, then I can carry on. I didn't want to say oh I want this one and then carry on with the scheme
16	T4	.....And then it goes 'a-hah' (laughs), can't we just want them there!
17	S5	So I need to come away from that kind of loose model thinking, build this really accurate thing and then go back into it and say, oh I can do that now. And I did this, I think, so this model.....
18	T4	What was said at the review? Just generally
19	S5	Basically, well, David really liked it. David's very kind of, he's my tutor, Keith and Suzi at the review on Friday said that this area seemed a bit *fussy,* it maybe needed a bit of calming down (referring to portion of the elevation). And I actually wrote down what they said
20	T4	I mean that could be to do with the pitches of the roof. I mean they could.....

21	S5	Yeah, the idea of into this was this. it starts of very shallow. Then it gets steeper and steeper. So it's kind of builds up to this state and, yes, and they said things like an approach could be like, just to have it flat all the way down with the tower at the very end. So it's like a pinnacle thing. And the very nature of the fact that you've got this building acts as a kind of protrude out to get this view. That could explain the nature of this shape. So this could be like at the end, so you've got flat, and then its almost pinning it down. Underneath you'd probably got car parking spaces and things. Em.....so I'm not sure about that
22	S5	Vijay, this is something Vijay said, he said it would be nice to have something where you can go in, go through this thing and then, you know, get your treatment, go for a coffee, maybe learn about it as well and then come out. So this kind of process. But yeah, maybe make this less.....you know.....(gestures towards elevation of model)
23	T4	...jagged?
24	S5	.....it needs calming down a bit and....
25	T4	I quite like the idea of the roof coming out from the building
26	T4	I don't know....I mean, how do you calm something down kind ( ) sort of having the roofs out there?
27	S5	Suzi kept making this point about the car park space, which I did at the end. I was very keen not to fill this whole space. Not to say, oh this is a rectangle design that I've got to fill in. I've stopped it there partly because of this view, I've got a building here but partly because I used, you know, I've allocated all the spaces to everything and I have this space left over, so either landscaping or car parking, but I didn't fill the entire thing. She did make a constant point, why didn't you do this, which I was bit ( ) didn't know what to say to her really. Just said I didn't want to fill the space. I like this idea of not, yeah, filling the space, just having it (gestures)
28	T4	I suppose if you did bring this tower to this end, you'd get around that because you decide, okay, this is where the site ends, that's why ( ).....
29	S5	I think, yeah, ( ). This point of, and then after that I went
30	T4	What did you say is here again?
31	S5	This is the lecturing theatre and this is the coffee shop
32	S5	And I did....this being the last thing I was going to show you honestly (unroll sheets). These are the plans I did. These are the things I drew after that review, the kind of ideas that I had about what they said, making parts more ordered, less kind of random along the roof pitch and things
33	T4	I'll show you my sketches in here somewhere, maybe its somewhere else (tutor looks through own sketchbook for previous sketches)
34	S5	But, this is the plan, starting at ground floor. Start with the ground floor. So, you come in here (points to central entrance of model), then you've got this kind of, this open spaces, reception area, and treatment room's here. So, in this first block, that's that, so you've got treatment rooms, toilets, and then its opened here. Where you walk down here, you get to the labs and offices and further on, much more private as you go further down, and this.....
35	T4	Why is it sort of meander?
36	T4	Could it not be more of a street, which everything comes?
37	S5	Yeah, I think one of the sketches..... David kind of suggested something like that. Where you come out of the building, going out where its much more linear. But I quite like, but I don't know what you think, I quite like the whole idea of kind of comes up the edge of the building and goes in. So you reckon making it more.....(gestures longitudinally)

38	T4	I think Dave's diagram's interesting and kind of, you're doing that aren't you (sketching staggered forms with line through)? And there's still a route coming through here, coming through these spaces. That's obviously a communal kind of space because you can come in and out of it, I don't know what you're landscape at the back
39	T4	If there are treatment rooms, quite often.....I don't know if this is getting too far down the line ( ). Doctors like little routes, private routes here to the rear. But this is slightly different isn't it because, you know, it's specialised. It's not really for GP such is it?
40	T4	It's difficult because, you know, you're working through. You've done a lot of work. It's difficult to know which direction and I don't want to sort of confuse you too much. You've got David saying this is fine, this works and then you've had commentaries of this as well. I don't want to confuse you too much because you've got.....
41	S5	The main problem I think, is the planning of it. It's just working at ( ) this kind of (part). When you get up here (shifts points from a small area of plan to model), I mean, this really forces you wherever you are, you've got to go through this thing (showing large scale tower model)
42	T4	And what happens in that central?
43	S5	Central part? It's just exhibition. So you've got at various points little gangways going into this room. It's glass and then it goes up. And into the library, it's all wood in it, it becomes study carrels. And you still got these sky lights bouncing light with these mirrors inside. And I'd like....I was thinking of openings in these wooden thing with this glass to let this light out. So while you're working you've got this light bouncing out and casting it's way down on to your desk. But it carries on down and it becomes the focal point of this thing and like I said you have to force in, you have to go through this space but it's designed so that it's not like, oh, if I want a coffee I have to go all the way a bit (holds the big model of Tower?)
44	S5	There are routes, you know, it goes off at different levels, so the most you have to do is like 12 metres, 6 metres x 6 metres, so its not an enormous space. I was very conscious about that when I did that
45	T4	I mean that's your main kind of space and it's where your real interest is in and you've invested a lot of thought into that. And I kind of agree with the others that maybe these things, and I don't know how you resolve that in planning (sketches). I mean you formally need to resolve certain things, I think
46	T4	I wonder if they are sort of, even in elevation there (sketching), something more of little flat roof rather than these jagged...(gestures) And they go up, they bop up and down a little bit, possibly
47	T4	And there's little connection and then you do have this wonderful thing, this thing that you've got at the end
48	S5	But then there's the.....hmm.....I sketched these afterwards (shows new sheet of sketches)
49	T4	And the same thing afterwards happen in plan you see, the play is kind of (verbal gesture)
50	S5	I still, I tell you what, I still would like a pitched roof because I'm not really a big fan of flat roofs. no matter what you say about flat roofs they leak, I'm really not, kind of, go down on that route
51	S5	But, with these things (the roofs of model) I thought, well to make it less fussy, I could make just the pitches much more
52	T4	...gentler
53	S5	...similar, and instead of having 4, just have 3
54	S5	So then I sketched this thing (points to sketch sheet) and I thought, well, I can have the lecturing theatre coffee shop, and then have the tower at the end, possibly...

55	S5	and still kind of gradually, the language is gradually changing from that to that
56	T4	What about the coffee shop in right the top of that thing? You can't bring the light down into it then, can you? That's the trouble……hmm
57	S5	Well you can, but the…Yeah, I suppose, I mean, if you had that shaft going all the way
58	S5	But it would be very big coffee shop, wouldn't it? And there wouldn't be any views
59	S5	I mean, I quite like this to be enclosed in massive copper. You know, the copper stuff you have (reference to tower element)
60	T4	I mean there's a café at the top of the Tate of St. Ives that looks out over the sea. It's wonderful being there
61	S5	That was my thinking of for this. It's all angled towards this. This is south facing (reference to model), this is the valley of view. So this coffee shop here is really kind of looking down on to that. And I didn't mean to make the coffee shop…..
62	S5	That is probably about a storey half up, two storeys up. So it is quite high up
63	S5	But this whole idea of the library being a place to learn and a kind of the 'brain' and then everything like a spinal cord linking all these elements, spooling out
64	S5	So that's like the main place for learning and studying, exhibition, and then the more communal, well, the more recreational thing is the word
65	T4	But think about, think about the human body and the brain. The brain's there, isn't it? The spinal cord……(sketches)
66	T4	But the coffee shop.....I'm totally sort of, I know you're happy with this I just wonder whether it could be in this thing (reference to tower element), maybe it is in this wall, this thing as it leans out. So its library on three sides and a coffee shop, you've got this core in the middle (Sketching)
67	S5	And that would have to make the tower even taller, doesn't it? I mean bigger, tall
68	T4	Maybe……see, I'd take that element away, I think, don't you think it's stronger? (reference to model)
69	S5	Possibly……emm
70	T4	I just, you know, you've got so many different geometries going on there, em…..
71	T4	Essentially, the plan of it makes sense. You've got things generally in the right places, I think, the forms in particular
72	T4	I do think these fully need to be calmed down (reference to model)
73	S5	Yeah, this is what I find. I drew three things. I've incorporated these into one single pitch thing there. And then going up, we've got (transpose plans)....so you're with me there at the balcony thing, and then you come over. There's a slight void below. So you've got these treatment rooms going all the way up to the ceiling and then you've got these two exam rooms and the balconies and you've got a little void here looking down onto the reception. So that's a bit of open space, a bit of interest….it's not all…and I had it finally all the way down in here, to these pods
74	S5	Now I didn't really give it much thought at the time and then I went away and I thought, If you're going to incorporate it all into one thing, just have it as one straight thing and then it would be nice following the labs below
75	S5	You know, scientists don't want to go from the labs all the way to this thing to get to their rooms. They want very quick access up to there, the people that are researching, and then back down to the labs (reference to tower)

76	S5	So I thought maybe at the end of this, to have a kind of glass box thing, again carrying this thing up, so it's there, there and there. And then it comes around and wraps itself over and into the pods. So I thought on the side, having this (pointing to drawing) staircase in this glass thing and like this. So this thing's really weaving in and out into the building and up (gestures) and over, so it's really this kind of this...central...
77	S5	Well, I know it's not central but this kind of linking spinal-type thing and....
78	T4	But in terms of plan, I mean, why, for example, if you've got a route and.....(sketching) pods.....Why on the next level, the labs down, could they not be the same?
79	S5	So you mean.....like that below.....with the glass thing going up? (student sketches)
80	T4	Yes.....and then on the next level, it's that. That's quite nice isn't it with a circulation box at the end (reference to student's sketch)
81	S5	So that brings that. But the problem with this is if you had that central corridor separating the two labs then that brings that even more of the meander
82	S5	It's kind of, because I do want to go with the idea of in and out of the building. I don't really want to sound like I'm trying to force that thing to it. Well, maybe I am. That's the only problem with doing that is that you're going to loose, because you can't have two corridors, can you? It's not going to make
83	S5	I suppose the only other thing is if you had, you know, you kept this at ground level and in on the first floor you shift that that down.....maybe
84	S5	I take your point about the lecture theatre, coffee shop, and the coffee shop could be there and the lecture theatre, because it's only 50 seater. It could be incorporated into this main thing
85	S5	So you go and got reception, toilets, rooms, lecture theatre. And then, more privately you got the offices and labs and sleeping pods. And then on the other side, you got the tower at the end which would say exhibition and then you go up into the library and coffee shop
86	T4	I just think that it might be a stronger scheme if you've got this pod, however, you end up sort of orientating them, you know this, (verbal gesture) link tower
87	T4	And you can either leave it there or shove it further down. But if you left it there and everything else manage to fit in even if it might be tight, you might have to move it down.....
88	T4	And this space you can let the lot have car parking. Have a lovely little garden that this café and library.....so, this balcony actually looks out over (points to model)
89	S5	Ah, but it won't be this, this would be taken out...it would be taken out there
90	T4	Whatever's in this (points to area around tower), ...you've got this thing (annexe space to tower), it wouldn't be needed then would it?
91	T4	You know, I wonder whether that tower, if you could open up the top part of it..... to make the café in there (starts sketching)
92	S5	Hmm...oh yeah...a kind of glass box within that
93	T4	Cut away this tower, fantastic views still, a little garden or landscape. And the site, could be just water actually
94	S5	Just like that (student sketches)
95	T4	Yes
96	S5	Do you think that that position of the tower should be at this end (lower end of site) or should it be elevated (upper end of site)?
97	T4	No, I think that it's right there
98	S5	I think what they were saying about having a sloping....having it level and having this effectively as 'pinned' down

99	S5	I think you could still achieve that just, just stepping it down. But not having it level, you could just……em……I don't know. The pitch of the roofs, overall, you know, the buildings get slightly higher as you come down with varying pitches but overall it's level and then you got this ….. kind of link on to that (sketches)
100	T4	So the link, maybe that perhaps is going to reduce….make the scale of this thing at the end of the tower much bigger. And then all these things happen in there, the 'link'. And a raised pool or something (sketching)
101	S5	It's just resolving this because I really do agree with you, strongly that…it would be much stronger as a scheme in plan if what was on the ground floor mirrors what was above. It's not really going to….
102	T4	Well if we use that (hand gestures to previous sketch of staggered plan forms), and then the level below could just be two rectangles and you still have this route here
103	T4	Because you've got really a kind of….I mean the elevation on this side is quite interesting. It does different things at each level
104	S5	Could it....I don't know.... would it would possible to have your ( )…. I think it'll be possible to have your labs like that (sketches) with this thing and still have this kind of……where it would be one thing……em…..yeah, it would be alright because it's one.....
105	T4	What else is up this end?
106	S5	You'll be fine Jane, look because if that's just one thing, so half of that would be glass and that has to be at least a metre and a half? (sketches)
107	T4	Passing for disabled…
108	S5	Call it a metre and a half. I mean overall this site is not enormously wide. It's about eleven, eleven and a half or call it twelve if you go over to the grass. So you've got ten and a half. So each one would be about five or six metres
109	T4	It's huge
110	S5	Is it quite big? It's adequate isn't it? The labs would have to be sixty square metres each. So that would make that ten. So that would be……that's half glass half opened, passing (sketching) And goes into the…..this is the reception….. I suppose that would be glass, yeah that would be that thing there (sketching and referring to model façade). So that's glass. So that in….out…in….out (gestures with drawing). Yeah this is the sort of thing isn't it that we're talking about? (sketching)……em…….right, okay
111	S5	I suppose in here (plan), I'd just make that somehow wider because I've got to incorporate the fifty seater lecture theatre into this block
112	S5	I suppose that will be good because it calms things that effectively by widening or merging that one
113	T4	Do you need to ( ) with these three offices?
114	S5	Three offices
115	S5	I suppose it would be nice having all these offices and labs off the street that you say, that you talk about this thing (sketching) and then it kind of…….
116	T4	Well, It's just simple isn't it? (shows sketch)
117	S5	(sketching)……..staircase…..Do you reckon that these should all be together? (points to staggered elevations of model) or should it… I mean that could be another link like that (points to original tower-buildings link). This glass tower that you walk through to get to your offices
118	T4	Hmm
119	S5	I'm not quite sure how it'll work…….but somehow you carry the street, this line, this long long line (sketching). And you've got two offices there, one office there and that room could be half storage half boiler …that could be…..oh, toilets as well
120	T4	Are you thinking of that space for the boiler room here? (points to student's sketch)

121	S5	Em, no, no.....why?
122	T4	Because plants are, well, generally 5% of the building
123	S5	Is it? So it should be even smaller than that...bigger?...smaller?, bigger?
124	T4	It'd be bigger probably....a plant room (laughs)
125	S5	How big is that?.....5%, 5% of a thousand, it is about 20....
126	T4	I'll show you (looking through journals, books). I mean double check on this but I'm pretty sure. Look, see this (points to building plant room plan example from a book)
127	S5	55.....So it should be 55 square metres
128	T4	A building of this size, for example, that's about (it) which is on one, two, three, four, five, six levels (points to examples in a book)
129	S5	(Sigh) That could just carry on there, look. I mean instead having this complete gap, it could just be a gap there, and that could exist like that (sketching)
130	T4	I mean you could, if you are going to have a plant (room) deep down the centre there. (sketching)You got lab, continue through, connecting space, four offices and through again (laughs), no you can't do that. But you could....going to be intermediate corridor there. This is one route. that's a tower isn't it? That's a stair, could be a stair and that could be a plant
131	T4	I don't know, you might have to have (verbal gesture) ( ).....
132	S5	Because if that's a corridor, (points to tutor's sketch) ( ) all the way through. You can call that a plant room. No one will notice that
133	T4	( )....It's not great but ....one , two, three. I mean you can't see that glass thing that you're talking about. So, but you could put WCs up this end, plant could all be here or something (points and sketches a large annexe to original sketch)
134	T4	I don't know. It could do with a street through
135	S5	How about this thing as well, running along (points to strip along elevation)
136	T4	And here you would really need to think about.....(points to annexe in sketch) Just double check on the plant room...yeah, you need a bigger plant (conversation is stopped at 34:43)

Matrix of Cognitive Interaction

Tutorial Session 5 (Tutor T4, Student S5)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S5		E		ST		PRO		L	0.100
2	S5	T4	E	F	ST	CO	PRO	PRO	L	V	0.017
3	T4	S5	F	F	CO	CO	PRO	PRO	V	V	0.017
4	S5	T4	F	F	CO	CO	PRO	PRO	V	V	0.017
5	T4	S5	F	F	CO	CO	PRO	PRO	V	V	0.017
6	S5	T4	F		CO		PRO		V		0.017
7	T4	S5		F		SY		CON		V	0.083
8	S5	T4	F		SY		CON		V		0.017
9	T4	S5		F		SY		CON		L	0.317
10	S5	S5	F	F	SY	SY	CON	PRO	L	L	0.267
11	S5	T4	F	F	SY	SY	PRO	CON	L	V	0.017
12	T4	S5	F	F	SY	SY	CON	PRO	V	V	0.450
13	S5	S5	F	F	SY	SY	PRO	PRO	V	L	0.133
14	S5	S5	F	E	SY	SY	PRO	CON	L	V	0.183
15	S5	S5	E	F	SY	SY	CON	PRO	V	V	0.633
16	S5	T4	F		SY		PRO		V		0.067
17	T4	S5		F		SY		PRO		V	0.167
18	S5	T4	F	F	SY	SY	PRO	PRO	V	L	0.083
19	T4	S5	F	E	SY	SY	PRO	PRO	L	V	0.500
20	S5	T4	E	F	SY	CO	PRO	CON	V	V	0.067
21	T4	S5	F	F	CO	SY	CON	CON	V	V	0.983
22	S5	S5	F	F	SY	SY	CON	PRO	V	L	0.383
23	S5	T4	F	E	SY	CO	PRO	CON	L	V	0.017
24	T4	S5	E	F	CO	SY	CON	CON	V	V	0.100
25	S5	T4	F	E	SY	CO	CON	CON	V	L	0.067
26	T4	T4	E	F	CO	SY	CON	CON	L	V	0.150
27	T4	S5	F	F	SY	SY	CON	PRO	V	L	0.800
28	S5	T4	F	F	SY	ST	PRO	CON	L	V	0.183
29	T4	S5	F		ST		CON		V		0.117
30	S5	T4		F		CO		CON		L	0.017
31	T4	S5	F	F	CO	SY	CON	CON	L	V	0.083
32	S5	S5	F	F	SY	SY	CON	CON	V	L	0.667
33	S5	T4	F		SY		CON		L		0.350
34	T4	S5		F		SY		CON		V	0.500
35	S5	T4	F	F	SY	CO	CON	CON	V	L	0.033
36	T4	T4	F	F	CO	SY	CON	CON	L	V	0.183
37	T4	S5	F	F	SY	ST	CON	PRO	V	V	0.483
38	S5	T4	F	F	ST	ST	PRO	PRO	V	V	0.450
39	T4	T4	F	F	ST	SY	PRO	PRO	V	V	0.533
40	T4	T4	F	E	SY	SY	PRO	PRO	V	L	0.317
41	T4	S5	E	F	SY	SY	PRO	PRO	L	L	0.267
42	S5	T4	F	F	SY	CO	PRO	CON	L	V	0.033
43	T4	S5	F	F	CO	ST	CON	CON	V	V	0.767
44	S5	S5	F	F	ST	SY	CON	CON	V	V	0.233
45	S5	T4	F	M	SY	SY	CON	CON	V	V	0.350
46	T4	T4	M	M	SY	SY	CON	CON	V	L	0.267
47	T4	T4	M	M	SY	ST	CON	CON	L	L	0.200
48	T4	S5	M		ST		CON		L		0.117
49	S5	T4		M		ST		CON		V	0.067
50	T4	S5	M	E	ST	SY	CON	CON	V	V	0.250
51	S5	S5	E	M	SY	SY	CON	CON	V	V	0.100
52	S5	T4	M	E	SY	SY	CON	CON	V	V	0.017
53	T4	S5	E	F	SY	SY	CON	CON	V	V	0.050
54	S5	S5	F	F	SY	ST	CON	CON	V	V	0.167
55	S5	S5	F	F	ST	SY	CON	CON	V	V	0.100

56	S5	T4	F	F	SY	SY	CON	CON	V	L	0.200
57	T4	S5	F	E	SY	ST	CON	CON	L	V	0.183
58	S5	S5	E	E	ST	SY	CON	CON	V	V	0.150
59	S5	S5	E	M	SY	SY	CON	CON	V	V	0.117
60	S5	T4	M	F	SY	SY	CON	PRO	V	V	0.133
61	T4	S5	F	F	SY	SY	PRO	CON	V	V	0.333
62	S5	S5	F	E	SY	SY	CON	CON	V	L	0.167
63	S5	S5	E	F	SY	SY	CON	PRO	L	V	0.167
64	S5	S5	F	F	SY	SY	PRO	CON	V	V	0.167
65	S5	T4	F	F	SY	SY	CON	PRO	V	V	0.317
66	T4	T4	F	M	SY	ST	PRO	CON	V	L	0.383
67	T4	S5	M	E	ST	SY	CON	CON	L	V	0.117
68	S5	T4	E	M	SY	CO	CON	CON	V	V	0.250
69	T4	S5	M		CO		CON		V		0.100
70	S5	T4		E		CO		CON		L	0.100
71	T4	T4	E	E	CO	SY	CON	PRO	L	L	0.117
72	T4	T4	E	M	SY	SY	PRO	CON	L	L	0.033
73	T4	S5	M	F	SY	SY	CON	CON	L	V	0.883
74	S5	S5	F	E	SY	ST	CON	CON	V	V	0.250
75	S5	S5	E	F	ST	SY	CON	CON	V	V	0.200
76	S5	S5	F	M	SY	ST	CON	CON	V	V	0.517
77	S5	S5	M	F	ST	SY	CON	PRO	V	V	0.083
78	S5	T4	F	F	SY	ST	PRO	PRO	V	L	0.700
79	T4	S5	F	F	ST	ST	PRO	PRO	L	V	0.150
80	S5	T4	F	F	ST	CO	PRO	PRO	V	V	0.317
81	T4	S5	F	E	CO	SY	PRO	PRO	V	V	0.333
82	S5	S5	E	F	SY	SY	PRO	PRO	V	V	0.483
83	S5	S5	F	M	SY	ST	PRO	PRO	V	V	0.633
84	S5	S5	M	F	ST	ST	PRO	CON	V	L	0.200
85	S5	S5	F	F	ST	SY	CON	CON	L	V	0.333
86	S5	T4	F	M	SY	SY	CON	CON	V	V	0.317
87	T4	T4	M	M	SY	ST	CON	CON	V	V	0.167
88	T4	T4	M	M	ST	ST	CON	CON	V	L	0.250
89	T4	S5	M	F	ST	ST	CON	CON	L	V	0.083
90	S5	T4	F	F	ST	SY	CON	CON	V	V	0.150
91	T4	T4	F	M	SY	ST	CON	CON	V	V	0.183
92	T4	S5	M	F	ST	ST	CON	CON	V	V	0.083
93	S5	T4	F	M	ST	ST	CON	CON	V	V	0.567
94	T4	S5	M	F	ST	SY	CON	CON	V	V	0.033
95	S5	T4	F		SY		CON		V		0.067
96	T4	S5		E		ST		CON		L	0.000
97	S5	T4	E	E	ST	SY	CON	CON	L	V	0.233
98	T4	S5	E	F	SY	SY	CON	PRO	V	V	0.133
99	S5	S5	F	E	SY	ST	PRO	CON	V	V	0.467
100	S5	T4	E	M	ST	ST	CON	PRO	V	V	0.533
101	T4	S5	M	E	ST	SY	PRO	PRO	V	L	0.817
102	S5	T4	E	M	SY	ST	PRO	PRO	L	L	0.217
103	T4	T4	M	F	ST	SY	PRO	CON	L	V	0.250
104	T4	S5	F	E	SY	ST	CON	CON	V	L	0.500
105	S5	T4	E	F	ST	CO	CON	CON	L	V	0.083
106	T4	S5	F	E	CO	ST	CON	CON	V	V	0.283
107	S5	T4	E	F	ST	SY	CON	PRO	V	V	0.083
108	T4	S5	F	F	SY	ST	PRO	CON	V	V	0.517
109	S5	T4	F	E	ST	SY	CON	CON	V	V	0.033
110	T4	S5	E	F	SY	ST	CON	CON	V	V	1.383
111	S5	S5	F	M	ST	ST	CON	CON	V	L	0.217
112	S5	S5	M	F	ST	SY	CON	CON	L	V	0.067
113	S5	T4	F	F	SY	SY	CON	CON	V	L	0.050
114	T4	S5	F		SY		CON		L		0.100
115	S5	S5		E		SY		CON		V	0.200
116	S5	T4	E		SY		CON		V		0.167
117	T4	S5		E		ST		CON		L	0.433

118	S5	T4	E		ST		CON		L		0.067
119	T4	S5		F		ST		CON		V	0.533
120	S5	T4	F	F	ST	SY	CON	CON	V	V	0.067
121	T4	S5	F		SY		CON		V		0.067
122	S5	T4		F		SY		PRO		V	0.083
123	T4	S5	F	E	SY	ST	PRO	CON	V	V	0.083
124	S5	T4	E	E	ST	ST	CON	CON	V	V	0.083
125	T4	S5	E	E	ST	ST	CON	CON	V	V	0.150
126	S5	T4	E	F	ST	SY	CON	PRO	V	V	0.667
127	T4	S5	F	F	SY	SY	PRO	CON	V	V	0.133
128	S5	T4	F	F	SY	CO	CON	PRO	V	V	0.317
129	T4	S5	F	M	CO	ST	PRO	CON	V	V	0.300
130	S5	T4	M	M	ST	ST	CON	CON	V	V	1.233
131	T4	T4	M		ST		CON		V		0.450
132	T4	S5		M		SY		CON		V	0.200
133	S5	T4	M	M	SY	ST	CON	CON	V	V	0.283
134	T4	T4	M	M	ST	SY	CON	CON	V	V	0.117
135	T4	S5	M	E	SY	ST	CON	CON	V	V	0.050
136	S5	T4	E	M	ST	SY	CON	CON	V	V	0.250

APPENDIX 6

PROTOCOL TEXT
Tutorial Session 6 (Tutor T1, Student S6)

Segment	Contributor	Protocol Segment
1	S6	Basically, after Monday, I did loads of plans. I'm trying to...like you said like blow up the site and obviously some plans and.....This one's the bottom floor and its kind of, like I tried to do this so that I can almost relate them. That's like this site (organising plans), got the roads and then St James's building & stuff. Kind of goes on to here (superimpose plans)
2	S6	Basically, do you remember my cube back then? It's kind of like now, because of the way the site is, I thought I should like react to the site more. It's almost like two cubes, and its like one there and then one here like at a slight angle. And like it helps separate like the two kind of parts of the things I want. But then from here, it's like this half, like this line here (first cube in section sketch), almost like this cube (the first cube in plan) and the rest is this cube (the second cube in plan)
3	S6	But, I've almost like.....the bottom floor is almost like public area and then you got like a kind of work environment, like a studio area, and then you've got dwellings on the two top floors
4	T1	And that runs right away across both cubes?
5	S6	Yeah both of them. So, like initially, I was just trying to separate them but it got kind of, when I started doing it. But when I put one on top of the other, I just found that you can't, it's easier just to kind of go across both cubes
6	S6	And the 'cube's idea kind of got lost ( ) so it's just given me almost a shape kind of thing
7	S6	But basically you've got the kind of a bar area type café around the bottom, the bottom floors are a kind of, it looks out onto right there and, it's kind of, it's got a good view like down the corner, which I thought would be good for that, and it kind of runs all the way along, almost along here but then there's the hill that comes up, there's like not windows out but there's windows along this side and this side to give good views. I've got like an actual bar there and you've got like behind the scenes like preparations and stuff
8	T1	So that forming the kind of the footprint of one cube and this is.....(reference to student's sketch plan)
9	S6	And this is, like, the other cube. Basically this is like a delivery area round here and it's quite....I find it quite hard because this is then underneath all the other buildings
10	S6	So for me to, like, get deliveries down there, I kind of.....I change or extended this. So that you wouldn't have to, like, get a van to drive all the way, like, underneath the whole building and basically they kind of come to here and then you connect it around (the ramp area at the back) (reference to sketch plan)
11	T1	So this is all at upper level? (reference to boundary area of plan)
12	S6	This is all open....Yes, this bit here, this green kind of 'V' here is sloped, basically. So it slopes from there to there
13	T1	So it's ramping?
14	S6	From the bottom level to the top and everything else is flat on this bottom level, so this is....(reference to sketch plan)
15	T1	This is along the lower level as well? (reference to student's sketch plan)
16	S6	Yeah. So this is all kind of underground still, the same level as this

17	S6	So its like you've got toilets for the restaurants and you've got, basically, one of my ideas is there is a lift and stairs next to it running like through the main, like, through the centre of the building straight down there. And there, like, the lifts. They're kind of for access for like the restaurants so people can just go straight down like if they're working. The stairs are more for getting outside because you've got this area here (cube area of plan) which I kind of want to use as a bike rack place. So then they can just get at the back and go out and they don't have to.....it's almost like the front kind of the building isn't kind of distorted by having the bike racks that's kind of hidden away here
18	T1	This (the lift core) is connecting everything vertically (plan)
19	T1	And this belongs to the external space (plan)
20	S6	Yeah, this is almost allowing everyone to get in every other way apart from walking because they are living there, and almost like this is you can come in through here and come in through here so everybody can, like, everyone that lives here they can come in from this side obviously they can come in through the restaurant but it will probably inappropriate, like the public can come from this side (reference to sketch plan)
21	T1	So what's happening the next level up?
22	S6	The next level, basically, then you've got this is leveled with this. Yeah, so you've an entrance there, so....And that green bit is the ramp from before because it has come up to this level. And these two bits here, these are raised up because of the ramp is imposing on, like, the upper levels. And so that's like you can see it here. I've cut through like just before the ramp gets to the road. So these bits are raised up, these bits here. And, you just basically, the whole of this level you still got the same kind of things like the lifts and stairs. Also like I try put the toilets all in the same kind of 'core' thing (reference to sketch plan)
23	T1	Right, this is one apartment? (reference to sketch plan)
24	S6	No, it's not an apartment....
25	T1	It's a one living area?
26	S6	It's a living area, kitchen, kind of a really small one just for the studio
27	T1	Okay, and the studio space?
28	S6	The whole of this is, this is a kind of studio space for everyone
29	S6	And I'm not sure if it's too much or not enough. But I've almost use it like a sound insulator from like the restaurant because then all, like the bedrooms are all above this, this kind of square here. So it's kind of like a sound insulator. And almost, I try to make it on this level, so that, I'm not sure what building it was, but the building with metal kind of curtains, is it not curtains, but kind of on the façade like in Paris (reference to sketch plan)
30	T1	Yeah, it was the Herzog and Meuron building with the shutters? They are actually timber and then they're grey-painted but they are timber shutters. Oh! The roll....
31	S6	Yeah. Oh, there's like the wooden ones that go up and down. And I was almost thinking about having something like that, kind of round like for opened sides so that because it's the closest level that they get to the public and like this side, people will be walking slowly and descent below it. So, I was almost like....
32	T1	What's that....what's that 'kink' in the plan here? (sketch plan)
33	S6	That's right, it's been really annoying me. Just like the way the cube is like. Because like this cube and then, because this one was trying to kind of like to edge out to follow the site around. It's really...I don't like it because it's just (annoyed my core) for the rest of my ideas, so I'm going to kind of scrap it! It kind of helps with the shape but it...

34	T1	No, I mean, I think you can make some decisions about this. Because you can say, okay, this is about two cubes and there's a coming together of the two cubes which may introduce something else (kink element). You know, if there's a meeting of things, there is a possibility for something to occur
35	T1	Or you can say well this isn't about two cubes and it was the starting point for me to get going and it's about having these block which has this circulation dropping down through the middle of it
36	T1	So I think if the former is the case and this is clearly about articulating two cubes, then that (kink element) becomes quite key
37	T1	And I wouldn't ignore it. I would think about how it's treated and how it perhaps could be expressed as the point which they come together. Or you can sort of say I don't really want that and I'm just going to follow the building line which is entirely legitimate, you know, and the idea of articulating with the shutters is it may mean that that isn't important, and, you know, the rhythm of this shutter pan is. So, you know, think about why you like it and why you don't like it and what it's actually giving to this, and whether the idea of the cubes has really gone. Or, you know, whether it's something you want to clarify, because at the moment its not very clear and...(reference to sketch plan)
38	S6	Yeah, I am very...., if someone, like, given just a small idea, a small idea in my mind, I can, kind of, ...do you really like it or really not like it? I can probably justify both quite well, but....
39	T1	Yeah, well that can often end in a kind of 'greyness', you know. So I think you have to think actually what do I really want with this. Is it worth fighting for?
40	S6	I do want it because I'll show you in my other drawings
41	T1	OK, right. Well that means that this (boundary along 'kink' area) becomes important, doesn't it? This line that you're showing here starts to mean something
42	T1	And I think I'd look at how much toilet accommodations you actually need, it maybe that...(looking at toilets)
43	S6	You know, that was....it's either that one or that one. It's not both
44	T1	Right, well. I think if that line is important then maybe that's something expressed in structure
45	T1	And this is as a separation of this from this becomes clearer
46	T1	It might be something that lights into this space. It might be a slot that runs through
47	T1	But yeah, I think bringing it (toilet) around to this point particularly because it's over the ones below makes sense
48	S6	Yeah, that's what I did. I kind of put it there and then thought, because then it kind of stay with this one and I thought, look down...I thought, the toilets are there
49	T1	But it also means you can bring stuff out of the lift and directly into the studio
50	S6	Exactly. The whole point of my lift is so that even like from my studio, and from like this, this is like the passage to outside, and then like below, it's like you can come in from the prep area, you can go to the bike rack and you can come out almost this kind of half-space which is inside and it's just a covered outside, but basically....but, yeah
51	T1	So, if that's outside (ramp).....
52	S6	It's not out, it's just....
53	T1	It's part of the ramp, isn't it? It's part of the kind of delivery?
54	S6	Yeah, it's the ramp and it's covered. But it's just going to be, like, concreted over or something you know
55	T1	Could it be opened? I mean, could that be...because you could actually get into this, into there, you can get into here. Just hold it there and think, well, could I get light into this plan at that point by opening that up

56	T1	Let's go up to the next level, because this is looking like we are doing something here (reference to sketch plans)
57	S6	Yeah, again, those are like the two stairs and lift. And then, this bit here, somehow, it's like a bathroom. So it's kind of run with the bathrooms, toilet, and basically there's two levels exactly the same, one above the other. And they have got on this side, kind of near enough, the same plans with four separate bedrooms, quite large bedrooms. So they can have their own private spaces. If they want to watch their own TV channels or listen to their own music, they can do it in their rooms
58	S6	This corridor that runs through on both levels, which I kind to want to make more use of as a kind of ...I don't know. I don't like...I don't know.....it has to be there
59	T1	Well, I don't know, I think, again, this is where we go back to this idea. Well, is this the cube?
60	T1	And that perhaps this becomes somewhere you stand there and look down the street and this becomes public space. You still have four reasonable sized room. There might be some tweeking
61	T1	But I think when we start to do this, this sort of like dog-legged of circulation, the clarity's lost
62	T1	So I think I'd go back to this idea of this being a zone that runs all the way through
63	T1	And then this again, what's happening here?
64	S6	These areas here, they were really quite, undefined. I wanted like a living room and kitchen for like both sets of like the people, these four here and these four here. But then, I didn't want them. It sounds funny, but I didn't want both floors to be exactly the same, because.....
65	T1	Why not?
66	S6	Um, you're loosing out on the chance of having different things on different floors kind of thing
67	S6	So like on the bottom floors. It's like I wanted it to become more enclosed
68	S6	And basically, because of the ramp. It's imposed on the studio space and made that smaller. And I was trying to make this is a bit smaller as well. So it kind of makes it, more like a darker environment. And basically in this corner here, I was trying to think of having, its not shown on this because I've cut to far into the building, but like stairs that are really open and almost let light through from the top here through down through this one into like ( ) area (reference to sketch plans, sections)
69	T1	But you don't need it there do you? Because that's actually opened in any case?
70	S6	Yeah, but ok but not there. I was trying to kind of let the sunlight through but, like there (section),I was almost thinking about having some kind of translucent floor or something. But basically having two different spaces, not just a kitchen and living room there somewhere, kitchen and living room there (reference to sketch plans, sections)
71	T1	What would happen, I'm just thinking a bit. If this space is opened so we've got some light going into the building. Bring light into here (area around ramp), which is locked at the moment, isn't it? We could bring the bathroom over to this. We can bring the bathroom over here so we've got daylight and ventilation and some privacy. Then all of this space becomes public space. And the kitchen, this staircase idea connecting this volume. And this can be more kind of relaxed in the way that it works. At the moment the bathroom's on this prime elevation and it's a (numb) wall and you've got toilet going down here
72	T1	But if we brought it down to there, then this actually connects to the bedrooms much more and, you know, it feels like a living area that has relationship with these rather than somewhere that's tucked around the back (reference to sketch plans)

73	S6	Yeah, that's what I felt. I felt that like someone living here, they've got their bedroom then they've got to walk all the way around, like say there's food like there, like this is going to be a kind of like the kitchen which was going to be on this side here. I mean they're going to walk all the way around. Then it feels somewhat quite disconnected because they're going to walk all the way around this way (reference to sketch plan, section)
74	T1	So you could, you know, I think that's a potential light well happening here
75	T1	And how does that work if we work down?
76	T1	Because it is nice to be able stack things up and to correlate them from floor to floor? So if we brought this down to the studio floor and kept this light well idea in, so that's there and the loos' here, that gives us again the same kind of space here about the kitchen and living that connects into the studio (reference to sketch plan)
77	S6	It's just for this, it's kind of like an artist space so they don't have to go up a couple of floors to go and get food and stuff. They can go and relax there for twenty minutes and then come back and carry on what ever
78	T1	And again we start to get that clarity back, don't we?. That we may have got that 'slot' running across
79	T1	What about the ground floor, because the upper floor we can relate to this third floor. This is where it's different (ground floor plan), isn't it because of the ramp?
80	S6	Because these....it's like you don't need light. You don't need, it's like, I was only thinking about ventilation and it just kind of, that's what them kind of the two little dashes are to light the bike rack area (reference to sketch plan)
81	T1	Well, we've got the opportunity to open this up to get some 'through ventilation' (reference to sketch plan)
82	S6	Well this kind of path here. It was almost like, I was kind of, actually have the wall quite.....almost like a.....so it'll be like a corridor running like down alongside the path. And then like, I want it to like, it was going to be like this bit here and almost along here was going to be the place where they show some of their work
83	S6	So if we change that, maybe, I don't know, could show some of them wall on there. But I'm not, like, just saying that if these come over here somewhere (reference to sketch plan)
84	T1	I was just wondering because, again, it's a predominant position, isn't it (ramp area)?
85	T1	And I mean, maybe whether that could be re-configured so that they're brought into this. Maybe, into this location. So, they're actually tucked behind the lift at this point and you can only access it one way....that's fine, they don't need to
86	T1	What if we're bringing materials in? What if we were bringing some big pieces of canvassing for the studio or materials for the sculptor, we'd need to access the lift and it would be ideal if we could get in from either end (reference to sketch plan)
87	S6	I want to, you see, initially, I don't know if you can do this. But like a lift that you can get in from every side. You can actually do that. So it has doors on like.....
88	T1	Well you can, but I think it's more kind of symptomatic of bad planning rather than being a kind of clever idea and I mean you sometimes have lifts that work at opposite
89	S6	I mean I don't mean on every level but like, almost, you can get in on this side and on this side. And then when you come up here, you just want to get them on this side kind of thing (plan)
90	T1	Um, I think that's a planning matter rather than a lift issue now
91	T1	And that might mean sort of swapping things around so that the lift and stairs are...I don't know. But I think this ground floor needs rethinking because it's slightly sort of.... (plan)

92	S6	I mean really, this. I was really getting quite annoyed because initially I was just going to have delivery her, main road and you just come up the side and it's quite easy there. And then I didn't kind of want that space as like....it's like you say that's kind of a good space. Like you don't want to stick toilets there and I don't....Do you really want to stick a delivery thing there? So I kind of trying to hide it around the back and it just kind of.....It didn't cause problems but I ended up thinking a lot about that little kind of bit there. And then try to (bring this) around here and fit in stuff in the gaps. So, maybe it comes up this way (plan)
93	T1	Well have a look at it and sort of think about, perhaps, rationalising this. What about the way that it's built? What about materials and form? (plan)
94	S6	Yeah, um, like this maybe kind of emphasise like ok. I was thinking like very kind of colourful, like my things are quite colourful. And this, I just do like colours and stuff. So, probably just, it was going to be like kind of cold kind of metal and stuff. And then I could kind of paint it quite sharp, brightly colours and things. But then....um...it's like I don't really want to do that. It's just that's the way I see that I can get these colours, so....(reference to sketches in book and section)
95	T1	So, the colours are important?
96	S6	It....I don't know. They feel like important to me. Because like at the studio spaces, I just feel that it's red kind of thing, I don't know why. It's just, and I kind of draw it in red every single time I do it and it's....
97	T1	Well, I think you have to kind of think, well, if this is something like a graphic device for me to help me identify this space or is it meaningful in terms of this building and you know, I think that's the question you have to dig inside yourself for, you know. But I think to think about the materiality of this means that you have to address the qualities in each of the spaces, you know, what kind of studios are you trying to create? If this is a red space, if this is about a kind of really active creativity because red suggest energy rather than kind of cool contemplation. What does that mean? What generates that kind of activity? It doesn't sound, it sounds like the kind of the opposite of the Zen garden, you know, somewhere where there's lots going on, people are meeting people. They're talking about ideas. There maybe paint being thrown around. You know that it doesn't suggest the kind of cool organisation that, say, white-rendered walls would
98	S6	Kind of relaxed.....
99	T1	So, maybe the red isn't necessarily the colour but it's a quality that you're trying to achieve. And whether that hectic-ness is expressed externally is something to think about and perhaps this idea of the two cubes allows you to root that kind of hectic, moving part of the building in something that's more solid that ties it down. So, there might be two things contrasting here
100	S6	And then, just quickly. On this side it's kind of like roof garden, but not a garden just an area. So it's almost like an open area, communal area. I like to think of that, I think. And then this side, because you've got the two (new) spaces underneath, possibly, I was just going to have it kind of very open. And then, form almost like some kind of shutter thing as well on that. And then, yeah, basically the stairs here, they come and just branch off on to here. And that's about it. I just wondered about whether ( ) (section sketch)
101	T1	I think you need to model that
102	T1	Because you, again, it's what happens when you do that with this idea of two cubes coming together and is the cube...
103	S6	That's because this (kind of then branches) about there? (sketches)
104	T1	And also we're not seeing cubic volumes here. We're seeing things at a much at a taller.....Are they double cubes, you know? (reference to sketches in book)

105	S6	Yeah, probably.....I tried to drawing them, it just ends up being cuboids (at the end) (sketches)
106	T1	So I think, this needs modelling to really understand how that might work
107	T1	And this is a central sort of zone or a pin that's holding the two cubes together. It could be expressed more distinctly. Yeah, I mean, it might push up both the roof at this point (reference to section sketch)
108	S6	Yeah, and then, just to go back to my original one. At night, I want it to almost like you say express the cubes really quite badly then, it was almost like I (was going to the) very edges of cubes....almost like a (mark). So, at night, if everything was dark, all you'd see are these two outlines of cubes
109	T1	So, well see down there, next to the ( ) house
110	S6	Yeah, next to the blue house
111	T1	What's....we need some drawings to show that, to explore it. And that goes back to your concept level, doesn't it?
112	S6	I'm just changing with (light) at night
113	T1	So you've got some things to concentrate on. I think there are some planning matters that needed to be sorted out quite quickly. You've got the bones of that there. But I think really we need to be thinking about materiality, what it looks like in 3-D (Conversation ends at 24:22)

Matrix of Cognitive Interaction

Tutorial Session 6 (Tutor T1, Student S6)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		Duration
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S6		F		CO		CON		L	0.767
2	S6	S6	F	F	CO	CO	CON	PRO	L	L	0.567
3	S6	S6	F	F	CO	SY	PRO	CON	L	V	0.233
4	S6	T1	F	F	SY	ST	CON	CON	V	V	0.033
5	T1	S6	F	F	ST	ST	CON	PRO	V	V	0.300
6	S6	S6	F	F	ST	SY	PRO	PRO	V	V	0.117
7	S6	S6	F	F	SY	SY	PRO	CON	V	V	0.567
8	S6	T1	F	F	SY	CO	CON	PRO	V	V	0.067
9	T1	S6	F	F	CO	SY	PRO	CON	V	V	0.217
10	S6	S6	F	F	SY	ST	CON	CON	V	V	0.283
11	S6	T1	F	F	ST	ST	CON	CON	V	L	0.050
12	T1	S6	F	F	ST	ST	CON	CON	L	V	0.150
13	S6	T1	F	F	ST	SY	CON	CON	V	V	0.017
14	T1	S6	F	F	SY	ST	CON	CON	V	V	0.100
15	S6	T1	F	F	ST	ST	CON	CON	V	V	0.017
16	T1	S6	F	F	ST	ST	CON	CON	V	V	0.083
17	S6	S6	F	F	ST	SY	CON	CON	V	V	0.867
18	S6	T1	F	F	SY	ST	CON	PRO	V	L	0.050
19	T1	T1	F	F	ST	SY	PRO	CON	L	L	0.033
20	T1	S6	F	F	SY	ST	CON	CON	L	V	0.350
21	S6	T1	F	M	ST	CO	CON	PRO	V	L	0.050
22	T1	S6	M	F	CO	SY	PRO	CON	L	V	0.733
23	S6	T1	F	F	SY	CO	CON	CON	V	L	0.033
24	T1	S6	F	F	CO	SY	CON	CON	L	V	0.017
25	S6	T1	F	F	SY	SY	CON	CON	V	L	0.017
26	T1	S6	F	F	SY	SY	CON	CON	L	V	0.083
27	S6	T1	F	F	SY	CO	CON	CON	V	L	0.033
28	T1	S6	F	F	CO	SY	CON	CON	L	V	0.067
29	S6	S6	F	F	SY	SY	CON	PRO	V	L	0.567
30	S6	T1	F	F	SY	SY	PRO	PRO	L	V	0.217
31	T1	S6	F	F	SY	SY	PRO	CON	V	V	0.317
32	S6	T1	F	F	SY	CO	CON	PRO	V	L	0.050
33	T1	S6	F	E	CO	ST	PRO	PRO	L	V	0.300
34	S6	T1	E	M	ST	ST	PRO	PRO	V	V	0.317
35	T1	T1	M	M	ST	SY	PRO	PRO	V	V	0.200
36	T1	T1	M	F	SY	SY	PRO	PRO	V	V	0.133
37	T1	T1	F	M	SY	SY	PRO	PRO	V	V	0.717
38	T1	S6	M		SY		PRO		V		0.217
39	S6	T1		F		SY		PRO		V	0.100
40	T1	S6	F		SY		PRO		V		0.067
41	S6	T1		F		SY		PRO		V	0.133
42	T1	T1	F	M	SY	ST	PRO	CON	V	L	0.117
43	T1	S6	M	F	ST	ST	CON	CON	L	V	0.033
44	S6	T1	F	M	ST	SY	CON	CON	V	L	0.117
45	T1	T1	M	E	SY	ST	CON	CON	L	V	0.100
46	T1	T1	E	M	ST	SY	CON	CON	V	V	0.100
47	T1	T1	M	F	SY	ST	CON	CON	V	L	0.100
48	T1	S6	F	E	ST	ST	CON	CON	L	V	0.117
49	S6	T1	E	F	ST	SY	CON	CON	V	L	0.067
50	T1	S6	F	F	SY	ST	CON	CON	L	V	0.383
51	S6	T1	F	F	ST	CO	CON	CON	V	L	0.033
52	T1	S6	F	F	CO	SY	CON	CON	L	V	0.033
53	S6	T1	F	F	SY	SY	CON	CON	V	V	0.033
54	T1	S6	F	F	SY	SY	CON	CON	V	V	0.150
55	S6	T1	F	F	SY	ST	CON	CON	V	V	0.233

56	T1	T1	F	M	ST	ST	CON	PRO	V	L	0.083
57	T1	S6	M	F	ST	SY	PRO	CON	L	V	0.583
58	S6	S6	F	E	SY	SY	CON	CON	V	V	0.183
59	S6	T1	E	M	SY	SY	CON	PRO	V	L	0.083
60	T1	T1	M	M	SY	SY	PRO	PRO	L	V	0.267
61	T1	T1	M	F	SY	SY	PRO	PRO	V	V	0.150
62	T1	T1	F	M	SY	ST	PRO	CON	V	V	0.083
63	T1	T1	M	F	ST	CO	CON	CON	V	L	0.050
64	T1	S6	F	F	CO	SY	CON	CON	L	V	0.333
65	S6	T1	F	F	SY	SY	CON	CON	V	V	0.017
66	T1	S6	F	F	SY	SY	CON	PRO	V	V	0.100
67	S6	S6	F	F	SY	SY	PRO	CON	V	V	0.083
68	S6	S6	F	F	SY	ST	CON	CON	V	V	0.533
69	S6	T1	F	F	ST	SY	CON	CON	V	V	0.050
70	T1	S6	F	F	SY	SY	CON	CON	V	V	0.333
71	S6	T1	F	M	SY	ST	CON	PRO	V	V	0.667
72	T1	T1	M	F	ST	SY	PRO	CON	V	V	0.283
73	T1	S6	F	F	SY	SY	CON	CON	V	V	0.317
74	S6	T1	F	M	SY	SY	CON	CON	V	V	0.067
75	T1	T1	M	E	SY	ST	CON	PRO	V	L	0.050
76	T1	T1	E	M	ST	ST	PRO	PRO	L	V	0.383
77	T1	S6	M	F	ST	SY	PRO	CON	V	V	0.200
78	S6	T1	F	F	SY	SY	CON	PRO	V	V	0.133
79	T1	T1	F	F	SY	ST	PRO	PRO	V	L	0.133
80	T1	S6	F	F	ST	SY	PRO	CON	L	V	0.167
81	S6	T1	F	M	SY	ST	CON	CON	V	V	0.083
82	T1	S6	M	F	ST	SY	CON	CON	V	V	0.433
83	S6	S6	F	F	SY	ST	CON	CON	V	V	0.200
84	S6	T1	F	F	ST	SY	CON	CON	V	V	0.083
85	T1	T1	F	M	SY	ST	CON	PRO	V	V	0.267
86	T1	T1	M	F	ST	ST	PRO	CON	V	V	0.300
87	T1	S6	F	F	ST	SY	CON	CON	V	V	0.150
88	S6	T1	F	F	SY	SY	CON	CON	V	V	0.167
89	T1	S6	F	F	SY	SY	CON	CON	V	V	0.167
90	S6	T1	F	F	SY	SY	CON	PRO	V	V	0.100
91	T1	T1	F	M	SY	ST	PRO	PRO	V	V	0.217
92	T1	S6	M	E	ST	ST	PRO	PRO	V	L	0.633
93	S6	T1	E	M	ST	SY	PRO	CON	L	L	0.183
94	T1	S6	M	F	SY	SY	CON	CON	L	L	0.817
95	S6	T1	F	F	SY	SY	CON	CON	L	V	0.033
96	T1	S6	F	E	SY	SY	CON	CON	V	V	0.233
97	S6	T1	E	F	SY	SY	CON	PRO	V	V	0.767
98	T1	S6	F	F	SY	SY	PRO	CON	V	V	0.183
99	S6	T1	F	F	SY	SY	CON	PRO	V	V	0.633
100	T1	S6	F	F	SY	SY	PRO	CON	V	L	0.600
101	S6	T1	F	M	SY	SY	CON	PRO	L	L	0.033
102	T1	T1	M	F	SY	ST	PRO	PRO	L	V	0.117
103	T1	S6	F	F	ST	SY	PRO	CON	V	V	0.050
104	S6	T1	F	F	SY	ST	CON	PRO	V	V	0.133
105	T1	S6	F		ST		PRO		V		0.100
106	S6	T1		M		SY		PRO		V	0.117
107	T1	T1	M	F	SY	ST	PRO	PRO	V	V	0.233
108	T1	S6	F	F	ST	SY	PRO	CON	V	L	0.317
109	S6	T1	F		SY		CON		L		0.033
110	T1	S6									0.033
111	S6	T1		M		SY		PRO		V	0.117
112	T1	S6	M		SY		PRO		V		0.050
113	S6	T1		M		SY		PRO		L	0.233

APPENDIX 7

PROTOCOL TEXT
Tutorial Session 7 (Tutor T1, Student S4)

Segment	Contributor	Protocol Segment
1	S4	I can show you. This is part of the bottom plan that I was having trouble with. I've rearranged that ramp to keep this central atrium space. This is my rest sort of area. And then, I've figured out the layout for my roof as well. It's going to be some sort of a roof garden
2	S4	Although I am not very sure what to do with it unless I wanted to like cover it with grass for the sake of it. It wasn't a bit of my style
3	S4	This is a 1:100 scale model
4	T1	That's already feeling as if it's coming together more (gesture)
5	S4	I've been looking at the structure. On how I would like to do it. I am fairly certain about the wood ones but I am trying to look at other joints
6	S4	I'm starting to do this (showing a section). I'm starting to do other sections for the things. It's quite important how this deals with the slope
7	T1	So this is a different. This is a different material for a different form. And these are deliberate slices or cuts in the roof right all the way down
8	T1	And how does that difference, how does it feel? This is lighter weight than this or....? (model)
9	S4	Yeah. This is wood and this is concrete and metal based steel, glass right around the atrium here
10	T1	Cut at the roof off, because I think its quite...that's better. It feels like its been kind of capped
11	S4	And then this is going to be masonry for this. This is kitchen and bathroom at the top. This is sort of a semi communal bath. It might be somewhere in between glass and concrete, say brick. It's solid but it's small scale
12	T1	So we've got a brick tower here. And then these concrete key point, key buildings. This is glazed in the middle
13	S4	Yeah
14	T1	I have to say than since I saw this on Monday, it feels much more confident than it did. And making the decisions about the way materials work have really helped that
15	T1	And what are the thoughts about the roof garden at this stage. That's obviously going to be quite important
16	T1	And if this is a glazed atrium space, that means the roof garden is, perhaps more than one garden
17	S4	Yeah, that's right. But I think that this central part will probably be glass. And then maybe use (the roof spaces) these for different things. Because these are going to be the tops of these (spaces)
18	T1	So are these all at the same heights?
19	S4	Yeah
20	T1	And they're all separate from each other. Each one would be reach through the building rather than through interconnection or off this one central circulation?
21	T1	Ok, I think that's something to look at
22	T1	I mean, where does the slope sit in relation to this?
23	S4	About a metre, or it's about seven centimetres up on this model. About there (points through model), which I have kind of, designed sort of above the glazing cill so that it's above the heating system off the ground. And the back of the wooden thing. I kind of go at that (shows detail section to tutor). As you can see, the ground comes up...
24	T1	So what have we got there? (points to detail section by student)

25	S4	That's the glazing
26	T1	It's glazed, right
27	T1	I think, thinking about these as separate volumes if they are all independent, then they all can be reached internally. I think it's certainly a way forward
28	T1	But I do think perhaps there isn't really a necessity for them all to be the same height. And that maybe some of these are pushed above others, you know, that you have a kind of sense of terracing
29	T1	Because if you actually read this from the street it will read as being very flat. And you won't actually understand it that there's a roof garden there. If you read it from up here you will probably will
30	T1	But it would be...I think it will be interesting to explore how that kind of shifting and pushing up
31	T1	I mean it could be just the change in floor to ceiling heights in these spaces. A top space or studio space or a loft space could really have an impact on the way that this is read from the outside
32	T1	So I'd have a look at that and explore that. I think it just helps to articulate the roof
33	T1	Lets go back to the plans again
34	T1	Because this (model) seems fairly confident and fairly well resolved
35	T1	So that's....let's keep the orientation same (viewing the plan). Ok, so you've got the restaurant spaces is in this timber building here
36	T1	What are all these spaces within this (ground floor plan)?
37	S4	These are, it's an odd one, I don't know if you could see inside (referring to model)? They go from different levels to follow the topography of the site. And I haven't got them today ( ), so you see kind of, you know, surrounded I suppose
38	T1	So you've got these like tectonic plates that move through here
39	T1	How are they connected then, if you, say you're on a wheelchair ?
40	S4	No, these are ramps
41	T1	Right, ok, and what's the level difference from plate to plate
42	S4	500 centimetres
43	T1	Ok, it's a couple of steps. Right ok, and then these spaces are ramps again
44	T1	Ok, I think now you need to move these, I don't know what to call them really, these kind of 'maps' because I think they have been very helpful, into some real drawings
45	T1	And you know, I think we need to see doors, windows, wall thicknesses and a clearer sense of which is internal space and which is atrium space
46	T1	And this space (Atrium) is a key space. It's almost, I mean you've done very well to clear this and to give it a sense of being you know the major space within the building. But I think that now you've cleared it, what are going to do with it? What quality does it contribute to these collection of buildings.
47	T1	It's obviously the thing that pulls them all together and how does it do that?
48	T1	What does that mean? And I think it's worth looking at the relationship of the atrium space and the roof gardens because that is where it's going to blossom isn't it? At this point (between atrium and individual buildings). So, it will be part of these whole roof-scape
49	T1	What's the purpose of glazing this (the atrium), apart from keeping the weather out?
50	S4	You mean as opposed to just leaving all opened?
51	T1	Yeah
52	S4	Well, I don't know. Yeah it was just keep weather out basically
53	T1	But if you say....what have we got in here (ground floor)....bins, what's that?
54	S4	Utility rooms....

55	T1	Utility rooms, storage, kitchens which connect to this. Ok this is separate, self contained. And this is self contained (ground floor plan)
56	T1	I think I would think about this (atrium), whether it needs to be glazed because....
57	S4	You mean the whole way through?
58	T1	This central well
59	S4	You mean on every floor of it or just the top floor?
60	T1	Just the top floor. Because this is providing.....yeah. And actually whether it needs to be solid on every floor. I mean, is there a chance for you to cut a way into this and let some light down into the spaces below?
61	S4	Yeah I was going to glaze this far end and this one as well. At least to let the light go down
62	T1	So they've got a glazed 'hole'
63	S4	Yeah. But it's not ( ) easily seen (material) but basically everything in between are these floor spaces here...
64	T1	.....Is all glass
65	S4	Yeah
66	T1	And I think this need looking at, because this is deep, isn't it? And to glaze this as a floor will give you some translucency but it won't give you transparency. It can't, you know. You wouldn't want to be standing at the bottom because you wouldn't want to see everything when you look up
67	T1	And if this is glazed a floor plate, that means that it's.....that anything that you do is kind of happening in the space below as well. It's not just something that's occurring here (centre of atrium), it's having an impact on this space (pointing to space below in the model)
68	T1	And I think that needs to be explored in more detail. I think a section through there is kind of critical just to show what that means
69	S4	I felt that it might be a positive thing because it's suppose to be communal and bring everyone together. As you can see, not just what's happening in the other five (floor) but the whole of the ( ) above it
70	T1	Well, have a look at some alternatives to see what that also means in terms of, you know.....If that's what you're trying to address here. This idea being the communal space, then maybe it's part of the options that are available to you
71	T1	You could do what you are proposing here and glaze each floors and say, well okay, this is a kind of a continuation of the space out into something semi-public that can happen here (points to centre of atrium)
72	T1	Or you can say well I'm going to take this away (the central solid core area) in totality and glaze over, so that we've got a big glazed atrium space that runs down through here where everything is happening at ground floor level but it is very well lit, which may generate activity on the ground floor that connects this in (between one tower and the restaurant). Because at the moment this is going to be the least naturally well lit space because it's just filtering through all of these layers. So that's another option, trying taking this out completely and letting everything to be self contained apart from the ground level
73	T1	Or this could be galleries that run all the way around so there can be a kind of possibility for action or event to occur at each level but there is also a connection with the ground floor as well. And I think they all give you slightly different experiences in this space
74	T1	But I think it's worth having a look at all those opportunities and see well, which would make the biggest contribution and which would achieve what I am trying to achieve here
75	T1	I have a sense that these floor plates might actually not be read as transparent. Because glass actually doesn't...you know, it's a very....It imposes itself and it does define planes. And it may define a plane that just becomes ignored after a while, you know

76	T1	You know it's like when you go down to basements of department stores and they've got sort of this strip of glazed blocks running along at street level and you see people's feet and then, that sort of 'oh look' you can see people's feet. And then you ignore it. And then you get on what's happening in the space because that's where your eyes take in and where the interest lies. So it maybe something that is an idea, but it perhaps wouldn't really add much to the scheme
77	T1	So I think I'd have a look at this space (the central core area) and I think that's your key to this. Ok, so that's clearly explained
78	T1	And this (points to ground floor restaurant) is happening in a double height volume?
79	S4	It's sort of one and a half
80	T1	And this is one big room, and what's happening in here (ground floor restaurant area). How does this breakdown?
81	S4	Em...That's kind of half-developed
82	T1	What do you think might happen here, what qualities do you want to achieve in that?
83	S4	I wanted somewhere kind of quiet. Because like within this space, I expect people to paint, do creative things and do some other things a bit more private. Then this would the place to do it really
84	T1	How does this space break down, is it one big space is it?
85	S4	I don't know, looks like I'm really still thinking about it, some might be quite good to, like put bookcases and separate it, you can change it with what books ( )
86	T1	So in terms of dwelling this is quite flexible?
87	S4	Yeah
88	T1	What about the fixed spaces like bathrooms and kitchens and so on, where do they occur?
89	S4	Here (referring to top plans), kitchen there which would be on top two floors, and bathroom again on top two floors. And the bottom goes the kitchen goes over there, and get these bathrooms at the bottom
90	T1	I mean the bedrooms are over on the other side of the building
91	T1	So, what happens if you're over here and in the middle of the night and you need to go the loo?
92	S4	You've got to get over for it feels like it...
93	T1	Is there any potential for being a little more flexible at the upper levels. And perhaps mixing bedroom and bathrooms, you know, so they have got some on-suite facilities
94	T1	So that this, you know, this is kind of...it's not really not acceptable but its so uncomfortable isn't it? You know, because it's quite a big building and you've got to walk in the middle of the night in your dressing gown. But I think, think through those sort of scenarios. Well, what if I'm ill and I want to get a cup of tea and I've got to go out there with flu to the kitchen
95	T1	It's not ideal and it maybe that this (potential kitchen area) becomes slightly larger and have a little bit more going on in them. And you've got the opportunity to do that. There might be a wash basin, a small kettle or a ( ) we can put in here. There are also communal facilities as well, which may consist of bathrooms where you can have a bit more.....it's a different kind of thing. So I think, perhaps these need more exploration as well, so you've got a kind a list of things to do, haven't you?
96	T1	Internally, these spaces need some description of what they are, and what it feels like to be in this restaurant space which is looking quite as if it's going to be quite nicely
97	T1	And the atrium space or the centre space needs exploration again and I think some sections through here (points to atrium space in the model) will throw open that for you

98	T1	And these (plans) need planning and planning people in mind. Just keep walking around them and hit all the problems and see how they might be tackled. Real people with real needs. So those are sort of about accommodations and program and I think that the way things are going, I think you'll be able to hit those quite quickly
99	T1	In terms of the building form, then, how do these blocks express themselves and what happens when they reach this level (top level) and how does that connect into the site and what does that mean when we walk pass. But I think you've moved this on by huge leaps since I saw it in the beginning of the week and it's all starting to make real sense
100	T1	And having said that, go back to the concept work that you did at the beginning
101	T1	And some of that are starting to happen in the way the materials are working. But keep it there, don't go loose it, in the sensible bits of (plugging) the project. Okay, good, do you feel you know what you're doing with this now? Great
102	S4	Yeah, just, you know for the concrete ( ) How is concrete wall constructed? Do they have two leaves?
103	T1	In plan you wouldn't need to show that because you're not working at a scale that would really, well that's really meaningful. I mean if you're showing this probably at 1:100, you would draw that as a thick wall sort of 300 thick, 250 thick
104	T1	In detail it would have concrete, and insulation and lining and unless if you want to expose the concrete internally. I mean, that's something to think about. Well you know, if you're using this as a skin, what does that mean? Where there are reveals, where there are openings, and as internal finish, if its.....
105	T1	But I actually think at this stage you kind of need to get this (plans) sorted out first before you make decisions about that. Okay, good, thank you (ended 25:43)

Matrix of Cognitive Interaction

Tutorial Session 7 (Tutor T1, Student S4)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S4		F		SY		PRO		L	0.367
2	S4	S4	F	E	SY	SY	PRO	CON	L	V	0.167
3	S4	S4	E	F	SY	SY	CON	PRO	V	L	0.250
4	S4	T1	F	E	SY	ST	PRO	PRO	L	V	0.150
5	T1	S4	F	F	ST	SY	PRO	CON	V	V	0.183
6	S4	S4	F	F	SY	SY	CON	PRO	V	L	0.150
7	S4	T1	F	F	SY	CO	PRO	CON	L	L	0.167
8	T1	T1	F	F	CO	SY	CON	CON	L	V	0.117
9	T1	S4	E	F	SY	SY	CON	CON	V	V	0.317
10	S4	T1	F	M	SY	CO	CON	PRO	V	L	0.083
11	T1	S4	M	F	CO	SY	PRO	CON	L	L	0.300
12	S4	T1	F	F	SY	SY	CON	CON	L	V	0.117
13	T1	S4	F		SY		CON		V		0.067
14	S4	T1		F		SY		PRO		L	0.250
15	T1	T1	F	F	SY	SY	PRO	CON	L	L	0.083
16	T1	T1	F	F	SY	SY	CON	CON	L	V	0.100
17	T1	S4	F	F	SY	SY	CON	CON	V	V	0.233
18	S4	T1	F	F	SY	ST	CON	CON	V	V	0.033
19	T1	S4	F		ST		CON		V		0.017
20	S4	T1		F		SY		PRO		V	0.217
21	T1	T1	F	M	SY	SY	PRO	PRO	V	V	0.083
22	T1	T1	M	F	SY	ST	PRO	CON	V	L	0.133
23	T1	S4	F	F	ST	ST	CON	CON	L	V	0.400
24	S4	T1	F	F	ST	CO	CON	CON	V	V	0.033
25	T1	S4	E	F	CO	SY	CON	CON	V	V	0.017
26	S4	T1	F	F	SY	SY	CON	CON	V	V	0.117
27	T1	T1	F	M	SY	ST	CON	PRO	V	L	0.217
28	T1	T1	M	M	ST	ST	PRO	CON	L	L	0.283
29	T1	T1	M	F	ST	SY	CON	CON	L	V	0.167
30	T1	T1	F	M	SY	ST	CON	CON	V	V	0.100
31	T1	T1	M	F	ST	SY	CON	CON	V	V	0.267
32	T1	T1	F	M	SY	SY	CON	CON	V	V	0.067
33	T1	T1	M	M	SY	CO	CON	PRO	V	L	0.017
34	T1	T1	M	F	CO	SY	PRO	PRO	L	V	0.167
35	T1	T1	F	F	SY	SY	PRO	CON	V	V	0.133
36	T1	T1	F	F	SY	CO	CON	CON	V	L	0.017
37	T1	S4	F	F	CO	SY	CON	CON	L	V	0.333
38	S4	T1	F	F	SY	SY	CON	PRO	V	V	0.050
39	T1	T1	F	F	SY	ST	PRO	CON	V	V	0.067
40	T1	S4	F	F	ST	SY	CON	CON	V	V	0.033
41	S4	T1	F	F	SY	ST	CON	CON	V	V	0.050
42	T1	S4	F	F	ST	SY	CON	CON	V	V	0.033
43	S4	T1	F	F	SY	SY	CON	CON	V	V	0.133
44	T1	T1	F	M	SY	SY	CON	PRO	V	L	0.250
45	T1	T1	M	M	SY	SY	PRO	CON	L	V	0.183
46	T1	T1	M	F	SY	SY	CON	CON	V	V	0.350
47	T1	T1	F	F	SY	ST	CON	CON	V	V	0.083
48	T1	T1	F	M	ST	ST	CON	CON	V	V	0.350
49	T1	T1	M	F	ST	SY	CON	CON	V	V	0.083
50	T1	S4	F	F	SY	SY	CON	CON	V	V	0.083
51	S4	T1	F		SY		CON		V		0.033
52	T1	S4		E		SY		CON		V	0.133
53	S4	T1	F	F	SY	CO	CON	CON	V	L	0.100
54	T1	S4	E	F	CO	SY	CON	CON	L	V	0.017
55	S4	T1	F	F	SY	SY	CON	CON	V	V	0.217

56	T1	T1	F	M	SY	SY	CON	CON	V	L	0.067
57	T1	S4	M	F	SY	SY	CON	CON	L	V	0.050
58	S4	T1	E	F	SY	SY	CON	CON	V	V	0.050
59	T1	S4	F	F	SY	SY	CON	CON	V	V	0.083
60	S4	T1	E	F	SY	SY	CON	CON	V	V	0.383
61	T1	S4	E	M	SY	SY	CON	CON	V	V	0.100
62	S4	T1	M	F	SY	SY	CON	CON	V	V	0.050
63	T1	S4	F	F	SY	SY	CON	CON	V	V	0.167
64	S4	T1	F	F	SY	SY	CON	CON	V	V	0.017
65	T1	S4	F		SY		CON		V		0.017
66	S4	T1		M		SY		CON		V	0.383
67	T1	T1	M	F	SY	SY	CON	CON	V	V	0.333
68	T1	T1	F	M	SY	SY	CON	PRO	V	L	0.133
69	T1	S4	M	F	SY	SY	PRO	PRO	L	L	0.167
70	S4	T1	F	M	SY	SY	PRO	PRO	L	V	0.233
71	T1	T1	M	M	SY	SY	PRO	CON	V	V	0.217
72	T1	T1	M	M	SY	ST	CON	CON	V	V	0.583
73	T1	T1	M	M	ST	SY	CON	CON	V	V	0.350
74	T1	T1	M	M	SY	SY	CON	PRO	V	V	0.183
75	T1	T1	M	F	SY	SY	PRO	CON	V	L	0.350
76	T1	T1	F	F	SY	SY	CON	PRO	L	V	0.450
77	T1	T1	F	M	SY	SY	PRO	CON	V	V	0.183
78	T1	T1	M	F	SY	ST	CON	CON	V	L	0.050
79	T1	S4	F	F	ST	ST	CON	CON	L	V	0.067
80	S4	T1	F	F	ST	SY	CON	CON	V	L	0.133
81	T1	S4	F	E	SY	SY	CON	CON	L	V	0.083
82	S4	T1	F	F	SY	SY	CON	CON	V	V	0.083
83	T1	S4	F	F	SY	SY	CON	PRO	V	V	0.317
84	S4	T1	F	F	SY	ST	PRO	CON	V	V	0.050
85	T1	S4	F	E	ST	SY	CON	CON	V	V	0.317
86	S4	T1	E	F	SY	SY	CON	PRO	V	V	0.083
87	T1	S4	F		SY		PRO		V		0.017
88	S4	T1		F		SY		CON		L	0.100
89	T1	S4	F	F	SY	SY	CON	CON	L	V	0.367
90	S4	T1	F	F	SY	CO	CON	CON	V	V	0.150
91	T1	T1	F	F	CO	SY	CON	PRO	V	V	0.050
92	T1	S4	F	F	SY	SY	PRO	PRO	V	V	0.083
93	S4	T1	F	M	SY	SY	PRO	PRO	V	V	0.250
94	T1	T1	M	F	SY	SY	PRO	PRO	V	V	0.467
95	T1	T1	F	M	SY	SY	PRO	CON	V	V	0.567
96	T1	T1	M	M	SY	SY	CON	CON	V	L	0.233
97	T1	T1	M	M	SY	SY	CON	PRO	L	L	0.167
98	T1	T1	M	M	SY	SY	PRO	PRO	L	L	0.433
99	T1	T1	M	F	SY	SY	PRO	CON	L	L	0.433
100	T1	T1	F	M	SY	SY	CON	PRO	L	V	0.067
101	T1	T1	M	F	SY	SY	PRO	CON	V	V	0.317
102	T1	S4	F	F	SY	SY	CON	CON	V	L	0.233
103	S4	T1	F	F	SY	SY	CON	PRO	L	V	0.317
104	T1	T1	F	F	SY	SY	PRO	CON	V	V	0.450
105	T1	T1	F	M	SY	SY	CON	PRO	V	V	0.183

APPENDIX 8

PROTOCOL TEXT
Tutorial Session 8 (Tutor T3, Student S7)

Segment	Contributor	Protocol Text
1	S7	Since the review sort of thing, I've been working on basically at what goes on above this ground floor level (shows current model). And as opposed to this (refers to previous model)
2	S7	Which I kind just divided into three separate spaces, I mean sort of like the theatre, the exhibition and the ground floor
3	S7	I sort of looking at how these spaces above might come out of these, these ones (current model)
4	S7	So this is just one example of it, there's a theatre in the middle, perhaps more of an open free space for the temporary exhibition, and the more like intimate-like corridors for JB Priestley's exhibition
5	T3	And the library and the exhibition
6	S7	Yeah, and the archives, something like that. With this, it's still kind of, what I had got from the review, it's still...even though I've separated that...it's still quite separated each individual bit. There's not much interaction between floors. So I'm....
7	T3	How realistic is this site area then, and is that the site or.....(current model)?
8	S7	It is. Well, the site....it's this bit's the site, filling that site (current model)
9	T3	That fills the whole of that site (points to footprint of model)
10	S7	Yeah, I mean I haven't really thought about ...that ground floor
11	S7	Would have to start model that I suppose?...rough one
12	T3	Well, I think it's useful to know that there is a big wall there and where your building sits relative to the edges of the site as well as, where you have the pavements that sort of thing
13	S7	Yeah, I mean I have that in mind. It's just that I haven't shown it here. So...
14	T3	I mean how realistic is this volume for theatre for instance?
15	S7	I don't know but perhaps it isn't as real
16	S7	I didn't really mean to get this volume It was just basically trying to get the block, it was for just the shapes
17	T3	I mean is that trying to enclose not just the theatre but the proper foyer and the other things around it?
18	S7	No, when I moved on to sort of more, like I thought I could do this sort of section (refers to a sectional sketch page). Like this is looking this way (model). As opposed to having this closed up, because this would probably enclose everything, if it was like this
19	S7	But this (shows sketch section), you'd walk from the bottom and walk around it into like, into the theatre. And these bits will be more opened on one side
20	S7	So sort of like an interior courtyard like some of (Simon Preston's) I was looking at
21	T3	Right. And when you said interior courtyard, you mean the theatre stands free with spaces built around it
22	S7	Yeah, I mean, this one here like.....(shows images in book)
23	T3	Like a kind of arcade, isn't it?
24	S7	Yeah, that, I mean that's a bit literal, but I mean that sort of thing. Theatre in the middle with a walkway which might be (ideal) for this
25	T3	Yeah, that's nice

26	S7	And then space in between. For the outside look (shows images in book), like something like that would be, was what I was trying to get at sort of thing
27	S7	Whereas all these (model) would be quite separate
28	S7	Then say they wouldn't be just opened, all opened. It will sort of be maybe like in between, it would be glass. You can still see out but it's like a courtyard
29	T3	So, in a way this is slightly misleading thing then because really it's a volume separate. In other words, the sort of, the armature of movement is another element in these blocks
30	S7	Well, when I first built it, it wasn't really that. Initially, I was looking at once you've walked up from the ground floor you're in a separate space. Then, the whole of my intention was kind of lost, so I sort of thinking of working this (another sketch)
31	T3	I think looking at sections is important really
32	T3	Because in a way, you can almost lift the theatre out of that, as a 'plug' and the rest of it still have a lot of integrity (to dictate). And then you have got the courtyard, haven't you? Or you could sort of lift up the 'arms' of movements really, the other blocks would stand intact, wouldn't they?
33	T3	I think you've got to get to the plans of these as well in some detail now really
34	T3	I mean, we were talking about the size of the theatre. Haven't you got a fix on that now really?
35	S7	I mean, yeah, I had started to bring in, that's what I'm starting to bring in a minute. Sort of like the reality that's suppose to....
36	T3	Do you know the height of this (volume)?
37	S7	Well I was looking at how I'll do the seating arrangement
38	S7	And although it's only small, I'll probably do like a small balcony level...two levels
39	S7	Say if it's an educational space they can all sit around the bottom without sort of like creeping to the back and not getting involved sort of thing. Sort of like a small row at the bottom and then there's another row at the top
40	S7	So I mean how would you recommend the height be?
41	S7	Is there a set rule?
42	T3	Well, we were looking at that this morning actually, and we said this is three metres high (referring to current tutorial room). And we said, well, we started off actually there (stood up and points to ceiling of room). Wherever that is, you know whether it's to the centre or to one side
43	T3	We said that, feasibly, for a set of three or four in a Hamlet play, studio play maybe, it's, you know, maybe six metres might be a sort of useful sort of size
44	S7	Yeah.....from here to include the dressing room or no?
45	T3	No, no. I'm talking about the acting area. Might be, say, roughly six metres square
46	T3	And then we said, you know, about, I'd say, two or three rows of seats
47	T3	So that's going to extend that to a perimeter say, about 2 metres all the way around. Which would make, about 8, 9 (metres) perhaps. So you have a basic box of about 9 metres square
48	T3	You saw it in Manchester. From memory it was about that, wasn't it?
49	T3	The height of it, you know, it (relies) on grid, doesn't it? A structural grid on which you could put lights, speakers and things like that at certain points
50	T3	Three metres high would seem a bit (lower) than it, really?
51	S7	Yeah, I mean if I was having two seating levels, then you'd could get the extra height for the....
52	T3	So it could go to at least 4 and half metres say to the grid, at least 4 and a half
53	S7	At least, yeah?

54	T3	And then the grid itself has depth because people got to get walk and crawl around the building haven't they? So I think, you're talking about something like a box of about 9 by 9 minimum, 6 metres high minimum
55	S7	Yeah, okay
56	T3	You know, that's probably biggest single volume in the building
57	T3	So I think if you get something fixed on that, you can start to see the response of other spaces to that, I think
58	S7	Yeah, okay, well yeah. So I've got the starting dimensions, so I suppose the theatre would dictate where the others can go. That will be useful to start thinking about
59	T3	Because these have got to be, as you say, the supporting things like some dressing rooms, which wouldn't be big but they exist nevertheless
60	S7	Yeah, I mean, these could be like under the stairways here, like walkways
61	T3	Well, possibly, yes....yes...yes. And you've just got to have movement where I mean, I think, you know, one has to think of when the bell rings at the end of the interval, those people all move into the theatre together. And so, they congregate around the door entrance
62	T3	So there's got to be space, breathing space, hasn't it, about how you get into the theatre?
63	S7	So if I had two levels of perhaps two entries to....
64	S7	So it's less...not so congesting getting back in
65	T3	At least two, yeah... I mean, might even be that you have the theatre as a sort of three sided perimeter (starts sketching) that people can penetrate from any side or corners even. Because you know, you're going to have your banks of seating in certain arrangements, aren't you?
66	T3	So, you know, maybe the corner entrance is quite kind of flexible. Or if it's just a battery of seating facing the front like that (sketches), well although it's still probably were, you'd probably just use those two and close off the two and keep them for the actors maybe. Well that's the flexibility of the thing, isn't it?
67	T3	I mean I thought that was one of the weakness of the Manchester one, because it only had one walk-in or entrance into it
68	S7	Which one was that?
69	T3	In the Exchange Theatre, studio theatre one on the Exchange
70	S7	Oh, studio theatre yeah
71	T3	The main theatre, you couldn't filter all the way around. Why it wouldn't, I wonder
72	S7	Because the seating went all the way around in that one, didn't it?
73	T3	Yes...yes, yes. So I think you've got to seriously start to advance these things until you could ( )
74	T3	But I think you've got to see and look at other elements like the exhibition, galleries
75	T3	And I think they're less deterministic in their spaces
76	T3	But nevertheless, I think, you know, one can sort of see a space like this as varied exhibits on the wall. You know, big photographs. Things like what sort of distance? What sort of movement that, so you know, a minimum might realistically deal with that space, mightn't it? And then yours, where you've got this long-'ish' galleries and things. That might work quite well. So, you know, you can start. If you've more intimate things like the Priestly collection itself where you could perhaps have books, manuscripts and things. You might even get to sort of ( ) these things. So even that sort space could perhaps be slightly different
77	S7	Yeah, so what, to make, physically, the two, the temporary one and the JB one, quite different?

78	T3	I think you could do it, yes, absolutely. And the (Priestly) one might be because, you know, perhaps, illuminating with lower levels of artificial lighting for original documents and....original documents that sort of thing that, you know, you are dealing with a very enclosed and an intimate space. Whereas the temporary thing, that might be models, it might be sculpture...it might...we don't know what it's going be
79	S7	Yeah, I know, it could be anything
80	T3	Much more open and clear contrasting character
81	T3	And I think if you can start to elaborate these spaces in terms of what they are
82	S7	Yeah, I mean this is the one I had for the ( ). They also said that with the glass box, it won't be feasible. This is sort of.... I mean I was looking to try and make it exist sort of not to do with the ( ) tradition. I shouldn't make it to box that sort of take you away from where you are in Little Germany. So the spaces like, if it was sitting here (simulate with attach model) looking down the street. This window here. You can look out of it but then you couldn't actually see any of little Germany. You just see the views beyond. Or this one you can see the sky there (referring to attached working model)
83	T3	Where is the cathedral relative to.....
84	S7	The Cathedral....here (gestures with hand)
85	T3	It's on that side
86	S7	Yeah. So these bits (points to attached working model) looked through where there are gaps in the building. Perhaps just an idea, well this looks into the courtyard, so it's kind of separate from Little Germany. You can't actually see it yourself. It sort of take you away at that
87	T3	Yeah. Well, I mean, you've got your *image* that you have shown me what you're trying to achieve with a building inside and out and they are quite strongly structured buildings, aren't they?
88	T3	So I think by sorting these big *volumes* out, you can start to see where the vertical elements of the structure go (gestures) and you can start to build this up where you start expressing the block masses out, which was what you're trying to do really
89	T3	I think there is an orderly process to this, *plans and section* together, really
90	T3	I think you've got to move beyond this sort of kind of conceptual model though
91	S7	Yeah, sure
92	T3	Yeah....I mean, can you try and do that by Friday, because if you can get it well on, that is the last time I shall see you really, after the holidays we can then perhaps talk a bit about materiality and things
93	S7	Okay, yeah, that'll be useful (ends at 12:34)

Matrix of Cognitive Interaction

Tutorial Session 8 (Tutor T3, Student S7)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S7		F		SY		PRO		L	0.150
2	S7	S7	F	F	SY	SY	PRO	CON	L	V	0.133
3	S7	S7	F	F	SY	SY	CON	PRO	V	V	0.100
4	S7	S7	F	F	SY	SY	PRO	CON	V	V	0.183
5	S7	T3	F	F	SY	SY	CON	CON	V	V	0.033
6	T3	S7	F	E	SY	SY	CON	CON	V	V	0.250
7	S7	T3	E	F	SY	SY	CON	PRO	V	L	0.083
8	T3	S7	F	F	SY	CO	PRO	PRO	L	V	0.067
9	S7	T3	F	F	CO	SY	PRO	PRO	V	V	0.017
10	T3	S7	F	E	SY	SY	PRO	CON	V	V	0.083
11	S7	S7	E	M	SY	SY	CON	PRO	V	V	0.083
12	S7	T3	M	F	SY	SY	PRO	PRO	V	V	0.150
13	T3	S7	F	F	SY	CO	PRO	PRO	V	V	0.033
14	S7	T3	F	F	CO	SY	PRO	CON	V	L	0.083
15	T3	S7	F	E	SY	SY	CON	CON	L	V	0.033
16	S7	S7	E	F	SY	SY	CON	PRO	V	V	0.083
17	S7	T3	F	F	SY	ST	PRO	CON	V	V	0.083
18	T3	S7	F	F	ST	SY	CON	PRO	V	V	0.333
19	S7	S7	F	F	SY	SY	PRO	CON	V	V	0.167
20	S7	S7	F	F	SY	SY	CON	PRO	V	V	0.050
21	S7	T3	F	F	SY	SY	PRO	CON	V	V	0.133
22	T3	S7	F	F	SY	CO	CON	PRO	V	V	0.067
23	S7	T3	F	F	CO	SY	PRO	PRO	V	V	0.017
24	T3	S7	F	F	SY	CO	PRO	PRO	V	V	0.117
25	S7	T3	F		CO		PRO		V		0.033
26	T3	S7		F		CO		PRO		V	0.150
27	S7	S7	F	E	CO	ST	PRO	CON	V	V	0.083
28	S7	S7	E	F	ST	SY	CON	CON	V	V	0.133
29	S7	T3	F	F	SY	ST	CON	CON	V	V	0.217
30	T3	S7	F	F	ST	SY	CON	CON	V	V	0.217
31	S7	T3	F	M	SY	SY	CON	PRO	V	L	0.050
32	T3	T3	M	F	SY	ST	PRO	CON	L	V	0.367
33	T3	T3	F	M	ST	SY	CON	PRO	V	L	0.083
34	T3	T3	M	F	SY	SY	PRO	CON	L	L	0.083
35	T3	S7	F		SY		CON		L		0.117
36	S7	T3		F		SY		CON		L	0.033
37	T3	S7	F	F	SY	SY	CON	CON	L	L	0.067
38	S7	S7	F	M	SY	ST	CON	CON	L	V	0.117
39	S7	S7	M	F	ST	SY	CON	PRO	V	V	0.183
40	S7	S7	F	F	SY	SY	PRO	CON	V	V	0.050
41	S7	S7	F	F	SY	SY	CON	PRO	V	V	0.017
42	S7	T3	F	F	SY	ST	PRO	PRO	V	V	0.283
43	T3	T3	F	M	ST	SY	PRO	PRO	V	V	0.200
44	T3	S7	M	F	SY	ST	PRO	CON	V	V	0.050
45	S7	T3	F	F	ST	ST	CON	CON	V	V	0.117
46	T3	T3	F	M	ST	SY	CON	CON	V	V	0.100
47	T3	T3	M	F	SY	ST	CON	CON	V	V	0.217
48	T3	T3	F	E	ST	SY	CON	PRO	V	V	0.067
49	T3	T3	E	F	SY	SY	PRO	CON	V	V	0.183
50	T3	T3	F	E	SY	SY	CON	PRO	V	V	0.050
51	T3	S7	E	F	SY	SY	PRO	PRO	V	V	0.083
52	S7	T3	F	M	SY	SY	PRO	CON	V	V	0.083
53	T3	S7	M	E	SY	SY	CON	CON	V	V	0.033
54	S7	T3	E	F	SY	SY	CON	PRO	V	V	0.233
55	T3	S7	F		SY		PRO		V		0.067

56	S7	T3		E		SY		CON		V	0.083
57	T3	T3	E	M	SY	SY	CON	CON	V	L	0.150
58	T3	S7	M	F	SY	SY	CON	CON	L	V	0.183
59	S7	T3	F	M	SY	SY	CON	CON	V	V	0.133
60	T3	S7	M	M	SY	SY	CON	CON	V	V	0.067
61	S7	T3	M	F	SY	SY	CON	CON	V	L	0.367
62	T3	T3	F	M	SY	SY	CON	CON	L	V	0.100
63	T3	S7	M	M	SY	ST	CON	CON	V	V	0.067
64	S7	S7	M	E	ST	SY	CON	CON	V	V	0.067
65	S7	T3	E	M	SY	ST	CON	CON	V	V	0.300
66	T3	T3	M	M	ST	SY	CON	CON	V	V	0.333
67	T3	T3	M	E	SY	SY	CON	PRO	V	L	0.083
68	T3	S7	E	F	SY	SY	PRO	PRO	L	V	0.033
69	S7	T3	F	F	SY	SY	PRO	PRO	V	V	0.050
70	T3	S7	F	F	SY	SY	PRO	PRO	V	V	0.067
71	S7	T3	F	F	SY	SY	PRO	PRO	V	V	0.100
72	T3	S7	F	F	SY	SY	PRO	PRO	V	V	0.017
73	S7	T3	F	M	SY	SY	PRO	CON	V	V	0.200
74	T3	T3	M	M	SY	SY	CON	CON	V	L	0.067
75	T3	T3	M	E	SY	SY	CON	CON	L	V	0.083
76	T3	T3	E	M	SY	SY	CON	PRO	V	V	0.850
77	T3	S7	M	F	SY	SY	PRO	CON	V	V	0.100
78	S7	T3	F	F	SY	SY	CON	CON	V	V	0.500
79	T3	S7	F	F	SY	SY	CON	CON	V	V	0.017
80	S7	T3	F	F	SY	SY	CON	CON	V	V	0.150
81	T3	T3	F	M	SY	SY	CON	PRO	V	V	0.100
82	T3	S7	M	F	SY	SY	PRO	CON	V	L	0.500
83	S7	T3	F	F	SY	ST	CON	PRO	L	L	0.033
84	T3	S7	F	F	ST	SY	PRO	PRO	L	V	0.017
85	S7	T3	F	F	SY	ST	PRO	PRO	V	V	0.017
86	T3	S7	F	F	ST	SY	PRO	CON	V	L	0.200
87	S7	T3	F	E	SY	SY	CON	PRO	L	L	0.150
88	T3	T3	E	M	SY	ST	PRO	PRO	L	L	0.250
89	T3	T3	M	M	ST	ST	PRO	PRO	L	L	0.100
90	T3	T3	M	M	ST	SY	PRO	PRO	L	L	0.083
91	T3	S7	M		SY		PRO		L		0.017
92	S7	T3		M		SY		CON		L	0.217
93	T3	S7	M		SY		CON		L		0.033

APPENDIX 9

PROTOCOL TEXT
Tutorial Session 9 (Tutor T2, Student S8)

Seg. No	Contributor	Protocol Segment
1	S8	Ok, I haven't got my drawings or anything but do you remember the stuff from Tuesday, like the....its like the drawing of the cube. Like the, all the dances superimposed on top. So it poses like kind of a.....All right (laughs). But it's the Dance centre anyway!
2	T2	What's your name?
3	S8	Peter McMahon..yeah
4	T2	Peter McMahon....(writes)
5	S8	Yeah. All I had before was really kind of drawings. Those kinds of like drawing sections and things like that. Like, trying to find out what the interior spaces will be like
6	S8	But I haven't really, like everyone said, like David and you said, try and like get a 3-D sort of visualisation of it. But I haven't made any models of it
7	S8	So I tried to make this in a trial sort of experiment and like understand the way maybe
8	S8	I've got the two ideas for the dance ( ) So you got, by the way I interpreted the cultures. Like the dances got two main features. You got like the posing because but it's kind of like not quite as affluent as a western dance. But it's got it's own character so you got like the poses and the kind of stops imposed and then you move as another pose
9	S8	So I've got this main body and where you've got these colourful cubic kind of boxes which are like going to be internal spaces but you can see on the outside things like that. So, you've got these coming out from various areas and places (elements in model)
10	T2	What are those things? (articulated elements in model)
11	S8	These (points to colourful projecting elements on model)
12	T2	No, these things (points to face feature on model)
13	S8	Oh right, this. This is a, well, you've got like two things. You've got like this very fluid kind a.....fluid form which kind of like interweave between the outside and the inside. So you got like one relationship. And then you've got these sort of rectilinear couple of things that's set in the main body
14	S8	Which is like the body of the dancer. Like all these bits coming out, like the hand movement, feet. And they (sort of like the hands) on the outside
15	T2	Yeah, I remember now. Because you had that character 'thing' with you? (sketches)
16	S8	Yeah it's kind of *wear* black like all the...yeah
17	T2	You had bits sticking out, yeah, but anyway
18	T2	So you've kind of created another abstract from the abstract
19	S8	Yeah, well, yeah (laughs)
20	T2	Well, a 3-Dimensional abstract
21	S8	Yeah, the thing was, I like I had the idea of the *yellow lines* creeping off from the ground and like creating a pedestrian interaction here (points to wall element on model) to make it wrap around like. But that was kind of a...it didn't really sit within the building. It was just, kind of like (on the site) it's kind of like gimmick
22	S8	So I try to like bring that in into the building and like make it form some space and define circulation in someway which it doesn't really do with this kind of image (current model). It's still very abstract

23	S8	Em....like you know, the *entrance,* like, you bring people up, and then like you got these kind of forms which are very....so you got two very different kinds. Like you got the hard edges and then you've got these (points to wall element). In someway they interweave
24	S8	Like the dance. Because like the dance, it's not purely poses. It's not purely fluid. It's got like both actions going on at the same time. So I'm trying to do that
25	T2	Ok
26	S8	The problem I've got now is I don't know what to....I don't know how to, like, to *'concrete'* that into a building
27	T2	Ok, that's the difficulty, (holds the model) that's the challenge with you being the architect. Actually it's very easy to talk about, well, sometimes its not that easy. It's easier to talk about in the abstract term
28	T2	But to actually make it physical, you have to actually address, begin to address the agenda for the... agenda what the programme is
29	S8	Yeah
30	T2	And I think what you kind of, you know, if I was to say, you've identified two main areas. One is the kind of *static* nature, right, of this kind of box (sketches) right...the kind of static nature of the box. And then you've got the other thing, is what you've got, at the moment it's kind of an *intention* rather than any real kind of concrete output
31	T2	And I think what you need to do is to relate that to a specific *programme.* You know, what actually is that, you know, these kind of movements (elements in the model)
32	S8	Yeah, yeah...what *parts* of the building.....
33	T2	Yeah, how is that going to come in? You know, does it...because it's not something we're trying to decorate. But I understand, I think at the same time, you know, it's useful to begin with an idea that is a contrast between a static form and a very dynamic form. And that might be in the form of which you see as a kind of graphics coming up. You know, the graphics become part of the building or these some of the external qualities are actually fed in. Or maybe even the way the building goes from transparent to solid, which actually talks about this down ( ) area, you know this ( ) area. From being fairly opened to very solid
34	T2	So, the thing is, it's about *duality* rather than, you know, literally, this kind of idea of the wavy lines
35	T2	I mean, have you looked...do you understand the program in detail, If I said to you know what the brief is?
36	S8	Yeah, where you've got like the auditorium and then you've got foyer and public, bar, cafes and then you've got these studio workspace which is like dance studio, music studio, craft studio and then like, maybe some kind of communal area. And then changing rooms and stuff like that
37	T2	Yeah, so in a way, with that there's a very clear kind of process, right
38	T2	What you need to now take on board.....I mean the first thing is, I think is put this first model in, I mean...its site context. How does it actually sit in relation to the site
39	T2	I know this (points to student's model) kind of broadly represents the site
40	S8	You've got the road there (points to side of model)
41	T2	Yeah, so you really need to begin to explore that in terms of how it actually relates to the site
42	T2	And also, you know, what are you trying to suggest by this materiality (element in model). Is it just kind of nice box, nice plastic. Or is it about transparency? And if it is about transparency, is it about.....you know....exactly what is the character of this? Is it all transparent? Do you see through it? Is it partly blocked? Is there sort of space behind it like you begin to suggest here? And I think that's.....

43	T2	At the broadest level, it kind of deals with the agenda, right, and from the 2D drawing, you made the next leap which is to create the 3-Dimensional of, you know, the similar discussion. And you've gone towards somewhere of addressing the site
44	T2	Now, I think what you need to do is to take the programme specifically, right. Identify the site context
45	T2	No.2, I would say you need to begin to address the idea of the operational aspects of site, off the programme, the brief. And then also think about how you move around the spaces, you know, circulation aspects of a...which create spaces....spaces
46	T2	And then this becomes a kind of a boundary that defines those spaces
47	T2	And it may well be that....you know, but you've always got bear in mind your kind of broad concept, which is about this kind of duality between the static space and the dynamic space, ( ).....
48	T2	Of how those two things are coming, you know, with their adjacencies
49	T2	But the main thing is, I think is to address to the programme because here (model), there's no.....
50	S8	Yeah, well, I've kind of like gone back a step because like I was doing too much, like I've gone to plans and things like that, so...
51	T2	But did you do any plans?
52	S8	I've done like, yeah, rough sketch that's sort of scaled plans
53	T2	Were you the one who that did that and then you went in and then there was an auditorium? (sketch)
54	S8	Yeah, there was an auditorium & then the car park (sketch)
55	T2	All right, and you came in and you had sort of a series of rooms like that (sketches)
56	S8	Yeah, yeah
57	T2	Well, I think the same, you know, it's maybe that this kind of line you have is a kind of circulation path, you know
58	T2	Or it cuts through the building and create a series of spaces that had....you know (sketches)
59	T2	So, you can actually maybe begin to bring some of these aspects into that (gestures)
60	T2	But really you do need, I think, you do need to bring this idea now about this kind of two things, about the duality into a specific programme
61	T2	And maybe look and see if the programme can be divided itself up into two sections
62	T2	One is the kind of operational public (site) facilities, you know, where you, where there's a kind of different types of aspects, different aspects relating to the dance and then these aspects about preparation. So it's kind of performance and preparation
63	T2	So this edge between the two kinds of main events, is a strong.....you know, is the strongest element
64	T2	And maybe the whole form kind of splits itself up into that, right
65	T2	And then the path, the link between the dynamics, is a bit, that kind of unites, you know, the two major events kind of together. That's all, you know.....I think could look at it
66	T2	Have you got any kind of precedent examples, have you looked at the ones that might be relevant?
67	S8	Em....I was looking at the dances (issues)
68	T2	Which one?
69	S8	I looked at (Laben) and there's one in America by, I can't remember. It's quite new. It was in the AR last month and then, there's the Scottish dance-based and.....
70	T2	I mean, have you looked at them in depth at all as to what defines their characters in the way they are?

71	S8	Yeah, well each of them got their own kind of key, about their sort of façade or maybe like a key sort of idea like the dance space is all about relation to site, lighting and things like that
72	T2	Right
73	S8	And then you've got, (Laben) is all about sort of the transparency and the material, skin
74	T2	Right, so what's yours about, like you've identified that as very clearly. If I said to you what's yours about, what's your project about?
75	S8	I suppose it's about the colour and the two dynamics of the dance. Maybe the contrast like the (proposed) static and the……..
76	T2	And the dynamic?
77	S8	The fluid
78	T2	Right. Well maybe that...I think, that's what you need to do. You need to explore those two ideas. So there's nature of the static spaces and the nature of the dynamic spaces
79	T2	And maybe there are two kinds of formal expressions that you generate. Or maybe they are within a kind of a unified envelope where they exist within that space as two entities, you know
80	T2	But I think that…I think what you (need to identify) is a very clear direction, right. Now you need to find ways for expressing that but that has to be fed back in with how the things is going to operate, you know, where the entrances are, how they relate to the site, how does it relate to the cathedral, if it relates at all, you know. What are the kind of qualities of the spaces you want. What are the dance studios like? You know, what kind of quality of light do you want?
81	T2	What scale they need to be, so, you can draw out of now, out of the brief, some of the specific characters to build…..build up a place, ok (conversation ends at 12:39)

Matrix of Cognitive Interaction

Tutorial Session 9 (Tutor T2, Student S8)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S8		F		SY		PRO		L	0.300
2	S8	T2	F		SY		PRO		L		0.017
3	T2	S8									0.033
4	S8	T2									0.217
5	T2	S8		F		SY		PRO		V	0.150
6	S8	S8	F	F	SY	SY	PRO	PRO	V	L	0.133
7	S8	S8	F	F	SY	SY	PRO	PRO	L	V	0.117
8	S8	S8	F	F	SY	SY	PRO	PRO	V	L	0.367
9	S8	S8	F	F	SY	SY	PRO	CON	L	L	0.250
10	S8	T2	F	F	SY	CO	CON	CON	L	V	0.017
11	T2	S8	F	F	CO	CO	CON	CON	V	V	0.017
12	S8	T2	F	F	CO	CO	CON	CON	V	V	0.017
13	T2	S8	F	F	CO	SY	CON	CON	V	V	0.400
14	S8	S8	F	F	SY	SY	CON	PRO	V	L	0.133
15	S8	T2	F	F	SY	SY	PRO	PRO	L	V	0.067
16	T2	S8	F	F	SY	SY	PRO	PRO	V	V	0.050
17	S8	T2	F	F	SY	SY	PRO	PRO	V	V	0.067
18	T2	T2	F	F	SY	SY	PRO	PRO	V	L	0.050
19	T2	S8	F		SY		PRO		L		0.017
20	S8	T2		F		SY		PRO		L	0.033
21	T2	S8	F	F	SY	SY	PRO	CON	L	L	0.267
22	S8	S8	F	M	SY	SY	CON	CON	L	V	0.183
23	S8	S8	M	F	SY	ST	CON	CON	V	L	0.233
24	S8	S8	F	F	ST	SY	CON	PRO	L	V	0.150
25	S8	T2	F		SY		PRO		V		0.017
26	T2	S8		F		SY		PRO		V	0.100
27	S8	T2	F	F	SY	SY	PRO	PRO	V	V	0.267
28	T2	T2	F	M	SY	SY	PRO	PRO	V	V	0.117
29	T2	S8	M		SY		PRO		V		0.017
30	S8	T2		F		SY		PRO		L	0.633
31	T2	T2	F	M	SY	SY	PRO	PRO	L	L	0.150
32	T2	S8	M	F	SY	SY	PRO	CON	L	V	0.033
33	S8	T2	F	M	SY	SY	CON	CON	V	V	0.783
34	T2	T2	M	F	SY	SY	CON	PRO	V	L	0.200
35	T2	T2	F	F	SY	SY	PRO	PRO	L	L	0.017
36	T2	S8	F	F	SY	SY	PRO	CON	L	V	0.383
37	S8	T2	F	F	SY	SY	CON	PRO	V	V	0.117
38	T2	T2	F	M	SY	ST	PRO	PRO	V	L	0.233
39	T2	T2	M	F	ST	SY	PRO	CON	L	V	0.050
40	T2	S8	F	F	SY	SY	CON	CON	V	V	0.033
41	S8	T2	F	M	SY	ST	CON	PRO	V	V	0.117
42	T2	T2	M	F	ST	SY	PRO	CON	V	L	0.450
43	T2	T2	F	F	SY	SY	CON	PRO	L	L	0.283
44	T2	T2	F	M	SY	SY	PRO	PRO	L	L	0.167
45	T2	T2	M	M	SY	SY	PRO	PRO	L	L	0.450
46	T2	T2	M	M	SY	ST	PRO	CON	L	V	0.117
47	T2	T2	M	F	ST	SY	CON	PRO	V	V	0.350
48	T2	T2	F	F	SY	ST	PRO	PRO	V	V	0.083
49	T2	T2	F	M	ST	SY	PRO	PRO	V	V	0.083
50	T2	S8	M	E	SY	SY	PRO	PRO	V	V	0.083
51	S8	T2	E	F	SY	SY	PRO	PRO	V	L	0.033
52	T2	S8	F	F	SY	SY	PRO	PRO	L	V	0.033
53	S8	T2	F	F	SY	SY	PRO	CON	V	L	0.083
54	T2	S8	F	F	SY	SY	CON	CON	L	V	0.050
55	S8	T2	F	F	SY	SY	CON	CON	V	V	0.050

56	T2	S8	F		SY		CON		V		0.017
57	S8	T2		F		SY		CON		V	0.117
58	T2	T2	F	F	SY	ST	CON	CON	V	V	0.083
59	T2	T2	F	M	ST	ST	CON	PRO	V	V	0.133
60	T2	T2	M	M	ST	SY	PRO	PRO	V	L	0.233
61	T2	T2	M	M	SY	ST	PRO	PRO	L	V	0.067
62	T2	T2	M	F	ST	ST	PRO	PRO	V	V	0.300
63	T2	T2	F	F	ST	SY	PRO	PRO	V	V	0.100
64	T2	T2	F	F	SY	ST	PRO	CON	V	V	0.083
65	T2	T2	F	M	ST	ST	CON	PRO	V	V	0.233
66	T2	T2	M	F	ST	SY	PRO	PRO	V	L	0.083
67	T2	S8	F	F	SY	SY	PRO	PRO	L	V	0.067
68	S8	T2	F	F	SY	ST	PRO	PRO	V	V	0.017
69	T2	S8	F	F	ST	SY	PRO	PRO	V	V	0.217
70	S8	T2	F	F	SY	SY	PRO	PRO	V	V	0.100
71	T2	S8	F	F	SY	SY	PRO	PRO	V	V	0.183
72	S8	T2	F		SY		PRO		V		0.017
73	T2	S8		F		SY		PRO		V	0.083
74	S8	T2	F	F	SY	SY	PRO	PRO	V	L	0.133
75	T2	S8	F	F	SY	SY	PRO	PRO	L	V	0.150
76	S8	T2	F	F	SY	SY	PRO	PRO	V	V	0.017
77	T2	S8	F	F	SY	SY	PRO	PRO	V	V	0.017
78	S8	T2	F	M	SY	SY	PRO	PRO	V	V	0.167
79	T2	T2	M	F	SY	ST	PRO	CON	V	L	0.200
80	T2	T2	F	M	ST	SY	CON	PRO	L	L	0.117
81	T2	T2	M	M	SY	SY	PRO	PRO	L	L	0.633

APPENDIX 10

PROTOCOL TEXT
Tutorial Session 10 (Tutor T2, Student S9)

Seg. No	Contributor	Protocol Segment
1	S9	I was going to make a little model of 1:5000 scale. That's the scale right now of the building in relations to all the other monuments at the city hall, you know, these.....(reference to sketch)
2	S9	And I noticed that everything here is basically orientated in that direction. And I thought that once you've got exits of building down the stairs, that they have a nice view of Bradford. And like there's a Broadway proposal, a building that will be built quite pretty close. It will be nice to see the city hall which definitely sticks out and like large buildings like a shopping centre and 'Alhambra' theatre and national museum
3	S9	So that's the reason why I would, oh...I need that...(awaits model)
4	S9	So that's the reason why I've decided to orientate the building this way (puts models together on large site model). So that, when you exit you have the view of the whole of Bradford. It should be quite high up at this point here in which you will exit and you have a nice view. And if you can actually climb up higher for a grander experience. And so I was trying to investigate this (model). This are just different angles. This is 25 degree angle and just looking at what height you can actually get (models) and the courtyard space you could keep. So, the larger the gradient the more courtyard space you can get because it rises up higher. These, like, last five meters will be determined by the programme, like, you just deal with it inside out, rather than outside in right now
5	S9	But, yeah, that's 25 degree angle and this is a 30 degree angle (swaps models)
6	T2	Are we talking about the angle of this slope? (reference to model elements)
7	S9	The angle of the slope, yeah. And that there is the 30 degree angle (model). And then I felt that this shape here, as I've told you before, it could taper in slightly
8	S9	It gives it more of a stronger meaning, I think, of the kind of a Greek amphitheatre as well. Of more like steps. More monumental so increases it as a stronger axis, I think, than just having it staying the same dimension on the site
9	S9	And plus by doing this, just by opening up a window here, like some slots like in here, it will be quite easy to get sunlight in to the spaces here where the workshops I'm planning (to put) in that area there
10	S9	And also looking at the materials, I came across this Boston museum, or library. And looking at this material here which (photo) is really rough plywood and different sorts of oaks and many different kinds of wood. I thought that it will be quite interesting composition on this building here in contrast to this.....So far looking kind of a concrete building with different, here on his side here (reference to adjacent building element on site model). I was thinking of having not so much of glass as this building here (photo) but actually material so that glass behind the material front, like the mall I showed you, so that this can actually, you know kind of.....
11	T2	So, this you're looking at this one from the square there? (photo & model)
12	S9	For the front row for the main road façade
13	T2	Right. I mean, at the moment, it seems like, you've trouble trying to decorate the project slightly rather than try working from inside out
14	T2	I think the strategy was well commended at the level of the review time although....
15	S9	I haven't had enough time to....

16	T2	Yeah, although I was kind of critical of the quality of the model but I think that's....I'm still feel slightly concerned that you're not really addressing the question of scale adequately to really move you forward in a more meaningful way
17	T2	You know, when you talk about the angle 25 or 30 degrees. It's a little stylising, you know
18	T2	What you really now need to do is...the principle is there; the courtyard, the tower, and the theatre side
19	T2	And I assume....What's the square block? What's largely the programme for that dwelling?
20	S9	Yeah, ground floor was the basically....
21	T2	Well, not.....I mean overall.....what would you say?
22	S9	Overall, yeah top floor is the forum space...the forum lobby space. And there you have the bridges that enter into the amphitheatre and the performance space
23	T2	Right, is one administration and the other one is a kind of performance spaces, is that how (the two blocks are ordered)?
24	S9	Yeah, yeah, these floors will probably administration. And this is only for performance and workshop. So the other is like the Arts building...and more of like administration building (gestures)
25	T2	That's fine. I think that's what the programme is beginning to suggest. Two blocks, two very clear identities. Two different approaches. Two different material assembly, you know. So two very different characters
26	T2	And the court yard is a kind of a mediating space between the two.
27	S9	And the courtyard...I was thinking at the review...I had it was about ten metres, nine to ten metres. I'm thinking now of reducing it to about four metres to get more space here and make that slope less steep (reference to model)
28	T2	Yeah (sketches). I mean, it strikes me that, you know, there is....that you've kind of got....you've got an idea which you are trying to force to work at one level, right
29	T2	And I think what you need to do is to be flexible a little bit more to accepting the principles of what you're doing as a kind of a programme that's, you know...one...two (sketches)...identifies two different issues
30	T2	But I think about the courtyard space that you're creating was really a fundamental space
31	S9	Yeah, right. Right now I'm thinking that by having that (reference to models), two buildings soaring up like that, I don't think you really need to do anything with that courtyard space because at night time, with the lights that will light up here on a different....Well, actually, project the lights on to this building here, which will be plain, and on to that courtyard will all be coloured just by the lighting
32	T2	Yeah, now, I think again the principle is fine. But to me that's the space you enter. Is that your point of entrance?
33	S9	You can enter anywhere. There's no main entrance
34	T2	Well how....I mean, don't you have a main entrance to your house?
35	S9	That was the concept as well
36	T2	Yeah, but the concept is only in a way....a concept has to be questioned as to the value it serves or what the purpose of that is going to be. Now, if you say there isn't an entrance, how do people arrive to this national gallery, peace museum, you know. *How do they go into this* ? There's a kind of a *logical process that we move through* buildings you know. You arrive at the university here, everybody knows where the main entrance is, through a hierarchical organisation of spaces
37	S9	But I want...the feeling which I want to create in everyone one is basically make them feel lost because that's the whole feeling. I want the architecture to speak, not knowing...
38	S9	You have four entrances that are lit, barely are lit up

39	T2	Right, so they are entrances?
40	S9	They are entrances. It's just that you enter into a space, and here I was thinking of box office space. So, people know where to get the tickets and there's two different elevators, three different staircases leading you up through the journey through the building. Sort of group of people (sketch plan)
41	T2	But I thought that....I remember looking at, you know, your very early sketches you produced as the courtyard in this kind of cultural context. The courtyard was a space which kind of united many events and yet at the same time you offered a clear diagram for separation
42	T2	And I really thought that what you were pushing was that the courtyard actually was the mediating space
43	T2	And what you would do is use that space to enter into it (sketches). So, that becomes the main point of focus. And then from there, you can move whichever way you wanted. But you enter that way and then you like, you know, it's like arriving in and you've got a choice to make. Whether you're going to go to the performance side or whether you're going to administration side (sketches)
44	T2	And here I guess what you're doing is taking everybody in, taking them up and then push them back into that (reference to student's latest sketch entrance plan). That's also fine
45	T2	But my only question really is, is to say, you know, you've got the box right on the edge on this side. It, it basically occupies, you know, whole of your site there right (sketches). You've got the road here. The traffic's moving all the way around (sketches), you know
46	T2	If I was arriving into this you might say well, I'm going to push people through that way. And that way, you can actually have a grand entrance from that point and over that way, right (sketches). So that becomes the main space
47	T2	How do you actually address the street edge to that? If that's....you know, if you want to create an entrance all the way around
48	T2	I don't think, I'm not saying there's any problem with that, just saying if that's the central thrust off the concept, then you've got to address it in terms of how it relates to the street
49	S9	Yeah, another thing which, about that question there, is if you look at this building here (reference to model).....the level, I don't know if you can see here.....the levels.....because of the site, slope with the site, it's going to have a different level there. It's two meters higher in this side that it is on that side
50	T2	Yeah, but I mean that's a.... with a project of this scale, you can adjust that to suit
51	S9	I know, but I'm thinking not adjusting it and letting the site adjust to the programme
52	T2	Fine but again if it becomes....if it's actually presenting difficulties then adjust it. If it's actually contributing towards the process.....
53	S9	And by doing that you actually have....bring the third block further in...and to have little staircase on the road which is suggesting a nice entrance in relation to the road...if that's going to be higher up (reference to model)
54	T2	I don't fully understand it. I think....I think what you need to do is to make a model to explore that
55	T2	I suppose what you're suggesting is if your landscape is like that, what you're doing is you want to create a building that sits there. And you potentially got a space from which you can move underneath, so that.....(sketches)
56	S9	No, no, I'm not suggesting that
57	T2	That's not what you're suggesting?

58	S9	No, no...I'm saying it was. This actually goes all the way down, creating the base and space as well. Say the entrance is here, right, on this side here (reference to model) and you have another entrance on this side. It's just that the floor....would be basically if you enter this side, the floor will be two meters lower on the other side. So you have to go downstairs
59	T2	Well I think that just demonstrates what you need to do. Yeah, you need to make a model to explore that because I'm not entirely convinced that, you know, how it's going to work
60	T2	And I think through making of it, you'll actually begin to discover, right, whether it's the right or the wrong decision, right
61	T2	But don't, again, this is a question, you know, for all of you really. Don't don't be constrained by, you know, the site ( ) I've got to work. It's a major project. A major project of this order, the sites are there as the base to work on. And you take and use it positively, right. If it means changing it, cutting it, filling it, that's fine
62	S9	I think it actually helps the idea of having four different entrances, i.e. around four different levels, four different platforms that take you down. It could work I think
63	T2	I think, think about the emphasis, you know. That's a little street there really, (reference to model) whether you actually will approach it from there. Where is the public going to be coming from? Where are they going to be approaching it from?
64	S9	And that is the question I want to ask you about because the brief say that about 30 parking spaces, I don't know if we should keep at that or not
65	T2	Well, if you can, and it would be useful because.....
66	S9	Because I could use say a parking space over here (reference to model)
67	T2	Yes, but you could also use a basement, parking in basements...
68	S9	I could do that
69	T2	Because the way the site slopes.....(sketches)
70	S9	Yeah, yeah, you could enter like that (refers to tutor's sketch)
71	T2	But you could enter at low level and you could actually create your basement, right. So, you're actually working, you know, working with the site. You could go down into the basement and create a car park there (sketches)
72	S9	So you would have to enter through this side? (reference to tutor's sketch)
73	T2	That's right, you then try the lowest point
74	S9	The lowest point, yeah. And you're going to like an entrance here, exit here, yeah (tutor's sketch)
75	T2	Well, I think, we're kind of going into the detail process without actually getting the strategy right
76	T2	Again, some of the questions I said to Laura here that I think the project's kind of dance around long enough now as a two blocks strategy. I think what it needs now is investigating a little bit in depth just to how the organisation of spaces are, a little bit like you've attempted to do (refer to former student in tutorial)
77	T2	And I think, because I'm still thinking the same sort of diagrams and I think that's the danger
78	T2	We need to now shift to a different scale and different level of details of understanding the project
79	T2	And also, are these are done....if that's to scale or not? (student's sketch plans)
80	S9	It is
81	T2	It is to scale? You know, it is important to get the grasp of the type of spaces you require. How big they need to be, how little they need to be, you know
82	T2	That kind of staircase doesn't really work in the public building. You know, that's like the staircase you've got in the studio

83	S9	That's exactly the kind of ...because this part here...I'm definitely taking the decision that there is going to be a light well coming down to the building
84	S9	So that we offer light to the bar and (second room). First and second floor offices, because of the skin of the building of trying to express different cultures and that different...allowing different openings. I wanted to get more of a.....it also works in environmental issues of like the heat of the glazing on that façade letting it rise up
85	S9	Like working out as a chimney. So almost like cooling system as well
86	T2	Well that would determine the characters of the materials again. Whether you're trying to get the sun in, keep the sun out. So the box may not be...
87	S9	Right now I'm thinking of having, on the...this is...north is sort of this way, I don't know....(gestures orientation)
88	T2	I understand that the north was this way (refers to orientation of model) according to the.....
89	S9	North is this way....sorry...is there a north point (refers to model)
90	T2	According to the last one, the north was...
91	S9	Great, see that's north there and that these are the facades that won't get any sun. So I thought they could be massed up and have very small openings. And then this side here could be glazing and to deal with that overheating, to have this light well, chimney stack (model)
92	T2	I think the principles, again, are honourable. They do need investigating. I think what you've got, you've got some nice sample precedent studies that you began to look at
93	T2	I'm still not convinced about your 'wedge' 100%. Because I think at one level, it's a kind of a shape and you're trying to force things into it. You're not allowing it...
94	S9	Yeah, right now. The next step is to go inside
95	T2	Because what you might find is the wedge isn't .....You know, you've kind of assumed there's a datum and the wedge is like that, it hits the point there (sketches)
96	S9	Yeah, that's another issue. But the building here it's going to hit, I don't want them block the pathway. And also the view on to there has to be something more than just a block. That you could create a kind of a performance space (sketch)
97	T2	Yeah. First of all you've got to see the value of that building if it is relevant. If it relevant then work with it (points to model)
98	T2	But what I would also do is to think about....I think this is something we discussed last time. Think about if you have a series of steps, right. How many would you have on that to get to the top? What happens when you get to the top? You know, is there a kind of an event space at the top? So, it's not just you go up there, nothing happens? (sketches)
99	S9	The views are on the courtyard, which will be interesting
100	T2	Yeah, does this links across to the other side? Is there a café, a place at the top of the tower?
101	T2	So that provides a meaningful purpose to go up there. It could be something, you know, even if it's not using the...using that. And then at night time, the museum is closed, right. It could be that.....(sketches)
102	S9	It would be really nice as restaurant.....
103	T2	Yeah. So it can actually move out and then go up into the...So it becomes a public building all the times, right. So that surface becomes a much more active surface. But the gradient of that, you know....So the nature of that surface and the slope of that will be determined by that event. If it's very steep, it's not going to work
104	T2	And also think about the space that underneath it it's enclosing. How are they going to....you know....
105	T2	What sort of scale and space do you need?

106	T2	You might find you can't actually use this in the way you want to use it. Because it becomes far too steep. Because (it grab) spaces you might need. If that....(references to model and sketches)
107	S9	Does (that mean they get) into the ground?
108	T2	Yeah, that was my next....The point is, you know, how does that change the character of that, you know. How do you get into that, you know? So there is a whole number of issues that you need to begin to plan & consider (sketches)
109	T2	But first of all, to me, the big idea would be to consider, you know, say, that's the area we're going to use for café. So, that's my wedge (sketches). I want to link up with that, and then from there people would move across that surface
110	T2	If it steps, what about people moving with.....?
111	S9	...disability...?
112	T2	Yeah, you can't deal with the steps
113	T2	Or actually in a way, it needs to become a surface that's part of kind of an urban landscape rather than.....I don't want to say it's for disabled people or anything like that. It's just, I think with a.....when you're talking about a surface like that which in the domain of the public, it needs to belong to all, right. You can have steps, you can have ramps on it. But it needs to operate at a level of an urban park rather than a roof top. Because that's what you're setting out?
114	S9	Yeah, just like a Greek amphitheatre theatre
115	S9	I had steps on one side and then there were seating area. And then steps, seating area and here you can, basically, you can play with planes with maybe gallery on top with sculptures or something like that (sketches)
116	T2	Well, this is why I was a bit surprised that you've done it the way you've done it because you're actually making it difficult at one level
117	T2	You know, you could...if the slope is like that. Right. If you go with the slope, what you're doing is that right....the space in between there and there is very little, right
118	T2	Now turn it around the other way...like that.... (sketches)
119	S9	Yeah, I agree but it's also putting the building in a meaningful position as well, like with the view on to Bradford rather than just....
120	T2	Well, yes, but I think you can achieve that. But the point I'm making is that if you actually did that, right, and.....(sketches)
121	S9	...you're working with the slope, right...
122	T2	...working with the slope, absolutely. You're actually creating spaces that then can be used rather than just forcing the style and bring in, you know, a very fixed view and then saying I'm going to force my architecture into that
123	T2	I'll let you, kind of, address a little bit more but just a thought, consider it, right. Because this way, if you have your courtyard here, your tower is here right. Then, certainly, you can actually....then, that gradient can certainly become a lot gentler (sketches)
124	S9	And then you could say that the event is to view Bradford at the top
125	T2	Yeah, it can happen that way and it could be that there's an isolated piece that sits on the top, you know, which offers a kind of a platform for restaurants or, you know, which is a completely....operates in the same way, but then ....(sketches)
126	S9	But you'll loose the bridges as well?
127	T2	No, well, the bridges can actually come over, be linked like that yeah (sketches)
128	T2	So what you're doing is then actually creating that cityscape or landscape much more as a continuous... I know it totally turns the whole thing upside down but what I would do is.....
129	S9	Work with that as well and see what happens

130	T2	Work with programme and see which of the two options give, you know,...delivers what you what
131	T2	And I mean, something like that, you could have that and you could have, you know, the point of entry down into it. So, these almost become sculptural objects in kind of landscape. But, you know, I think that's just the same thing, but just slightly working with the site itself. I mean, there's something nice about, you know, what you've done there in terms of the tower, and you're creating this very dynamic space in the middle. But then what you might find is, you know, that edge has to be, you know....that building has deal with the programme in a slightly different way, you know
132	T2	What kind...what's the nature of those spaces at the bottom? (sketches)
133	S9	Could just stick up here over the spaces (refers to tutor's sketches)
134	T2	Yeah, yeah, but then, you know, how do you move on to that surface? (refers to sketches)
135	S9	I mean, this could be, say, stone or whatever, and then this could be glass sticking out, which I still want to keep that one and only....right, right.... (refers to tutor's sketches)
136	T2	Ok. Next stage is investigating these ideas on site a little bit, you know. Maybe the model needs to now get a little bit bigger. Work on the scale
137	T2	You know, see how they relate to the edge, you know, when you talk about the entrance point
138	S9	Is 1:200 (worth it)?
139	T2	That's 1:200! (refers to model)
140	S9	Um.....1:100, I mean!
141	T2	Yeah, but you might want to make spaces of little areas, you know, in perhaps in a bigger scale like 1:50. But they may be about the tower itself and how it relates to the street
142	T2	But I think the next thing, first of all, is to get a grasp with a scale of your...the programme
143	T2	You know, how big are the galleries? How big are the dance studios? How many of them do you need? What are the workshop areas, you know? What are the classrooms, administration? Because if you've got the huge tower for administration.....you know, you might find you only need 100 sq metres and you've got 1000 sq metres there!
144	S9	Just, just maybe you need a lot of space
145	T2	Yeah, but you can't.....it's not good justifying a lot of it just because you wanted a tower, in a way, you know. That's kind of cheating a little bit. I'll create a 1000 sq metres lobby to create a tower! I think if the tower is important, that space's important, maybe some of the other programmes can come into that. So, I think you've got to.....that's why it's important, now, for all of you to ensure you understand the scale of the building. If you imagine you have to pay for every cubic metre of space you create, right. How do you actually begin to deal with that issue? Not that the issue become a constraint. But it is an issue you need to...you know...It adds a sense of a control or sense of focus to how you deal with, you know, with the nature of these spaces. Otherwise, there are no defining edges, no defining boundaries which are important to somehow give it scale, proportion, sense of realism in the context, ok (conversation ends at 26:24)

Matrix of Cognitive Interaction

Tutorial Session 10 (Tutor T2, Student S9)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S9		F		ST		PRO		L	0.267
2	S9	S9	F	F	ST	SY	PRO	CON	L	L	0.550
3	S9	S9	F		SY		CON		L		0.333
4	S9	S9		F		SY		CON		V	1.117
5	S9	S9	F	F	SY	ST	CON	PRO	V	V	0.083
6	S9	T2	F	F	ST	SY	PRO	CON	V	V	0.033
7	T2	S9	F	F	SY	CO	CON	CON	V	V	0.267
8	S9	S9	F	E	CO	SY	CON	PRO	V	L	0.267
9	S9	S9	E	F	SY	SY	PRO	CON	L	L	0.283
10	S9	S9	F	F	SY	SY	CON	PRO	L	L	0.817
11	S9	T2	F	F	SY	SY	PRO	CON	L	V	0.050
12	T2	S9	F	F	SY	SY	CON	CON	V	V	0.100
13	S9	T2	F	F	SY	SY	CON	PRO	V	L	0.267
14	T2	T2	F	E	SY	SY	PRO	PRO	L	V	0.133
15	T2	S9	E		SY		PRO		V		0.033
16	S9	T2		F		SY		PRO		L	0.317
17	T2	T2	F	F	SY	SY	PRO	PRO	L	L	0.167
18	T2	T2	F	F	SY	SY	PRO	PRO	L	L	0.117
19	T2	T2	F	F	SY	SY	PRO	PRO	L	L	0.083
20	T2	S9	F	F	SY	SY	PRO	CON	L	V	0.033
21	S9	T2	F	F	SY	SY	CON	PRO	V	V	0.067
22	T2	S9	F	F	SY	SY	PRO	CON	V	V	0.150
23	S9	T2	F	F	SY	ST	CON	PRO	V	V	0.067
24	T2	S9	F	F	ST	SY	PRO	PRO	V	V	0.217
25	S9	T2	F	F	SY	ST	PRO	PRO	V	V	0.283
26	T2	T2	F	F	ST	SY	PRO	CON	V	L	0.050
27	T2	S9	F	M	SY	ST	CON	CON	L	V	0.317
28	S9	T2	M	F	ST	SY	CON	PRO	V	L	0.200
29	T2	T2	F	M	SY	ST	PRO	PRO	L	V	0.233
30	T2	T2	M	F	ST	SY	PRO	CON	V	L	0.083
31	T2	S9	F	F	SY	SY	CON	CON	L	V	0.400
32	S9	T2	F	F	SY	SY	CON	CON	V	L	0.100
33	T2	S9	F	F	SY	SY	CON	CON	L	V	0.100
34	S9	T2	F	F	SY	SY	CON	CON	V	V	0.067
35	T2	S9	F	F	SY	SY	CON	PRO	V	V	0.067
36	S9	T2	F	F	SY	SY	PRO	PRO	V	V	0.533
37	T2	S9	F	F	SY	SY	PRO	PRO	V	V	0.183
38	S9	S9	F	F	SY	SY	PRO	CON	V	V	0.050
39	S9	T2	F	F	SY	SY	CON	CON	V	V	0.067
40	T2	S9	F	F	SY	SY	CON	CON	V	V	0.267
41	S9	T2	F	F	SY	SY	CON	PRO	V	L	0.283
42	T2	T2	F	F	SY	SY	PRO	CON	L	V	0.083
43	T2	T2	F	M	SY	ST	CON	PRO	V	V	0.367
44	T2	T2	M	F	ST	ST	PRO	PRO	V	L	0.150
45	T2	T2	F	F	ST	SY	PRO	CON	L	V	0.300
46	T2	T2	F	F	SY	ST	CON	PRO	V	V	0.250
47	T2	T2	F	F	ST	CO	PRO	CON	V	V	0.133
48	T2	T2	F	F	CO	SY	CON	CON	V	V	0.217
49	T2	S9	F	F	SY	ST	CON	CON	V	L	0.317
50	S9	T2	F	E	ST	SY	CON	PRO	L	V	0.067
51	T2	S9	E	F	SY	SY	PRO	CON	V	V	0.117
52	S9	T2	F	M	SY	SY	CON	CON	V	V	0.150
53	T2	S9	M	F	SY	SY	CON	CON	V	V	0.233
54	S9	T2	F	M	SY	SY	CON	PRO	V	V	0.100
55	T2	T2	M	F	SY	ST	PRO	CON	V	V	0.233

56	T2	S9	F	E	ST	SY	CON	CON	V	V	0.017
57	S9	T2	E	F	SY	SY	CON	CON	V	V	0.017
58	T2	S9	F	F	SY	ST	CON	CON	V	V	0.533
59	S9	T2	F	M	ST	SY	CON	PRO	V	V	0.183
60	T2	T2	M	F	SY	SY	PRO	PRO	V	V	0.150
61	T2	T2	F	M	SY	SY	PRO	CON	V	V	0.383
62	T2	S9	M	F	SY	ST	CON	CON	V	L	0.200
63	S9	T2	F	F	ST	ST	CON	CON	L	V	0.167
64	T2	S9	F	E	ST	SY	CON	CON	V	L	0.133
65	S9	T2	E	E	SY	SY	CON	CON	L	V	0.033
66	T2	S9	E	M	SY	SY	CON	PRO	V	V	0.083
67	S9	T2	M	M	SY	SY	PRO	PRO	V	V	0.050
68	T2	S9	M	E	SY	SY	PRO	PRO	V	V	0.017
69	S9	T2	E	F	SY	CO	PRO	CON	V	V	0.033
70	T2	S9	F	F	CO	ST	CON	PRO	V	V	0.067
71	S9	T2	F	M	ST	ST	PRO	PRO	V	V	0.200
72	T2	S9	M	F	ST	ST	PRO	PRO	V	V	0.033
73	S9	T2	F	F	ST	ST	PRO	PRO	V	V	0.033
74	T2	S9	F	F	ST	SY	PRO	PRO	V	V	0.067
75	S9	T2	F	F	SY	SY	PRO	PRO	V	L	0.150
76	T2	T2	F	M	SY	SY	PRO	PRO	L	L	0.367
77	T2	T2	M	F	SY	SY	PRO	PRO	L	V	0.117
78	T2	T2	F	M	SY	SY	PRO	PRO	V	L	0.133
79	T2	T2	M	F	SY	SY	PRO	PRO	L	V	0.100
80	T2	S9	F	F	SY	SY	PRO	PRO	V	V	0.017
81	S9	T2	F	F	SY	SY	PRO	PRO	V	V	0.183
82	T2	T2	F	F	SY	SY	PRO	CON	V	L	0.117
83	T2	S9	F	M	SY	SY	CON	CON	L	V	0.183
84	S9	S9	M	F	SY	SY	CON	CON	V	V	0.483
85	S9	S9	F	F	SY	SY	CON	PRO	V	V	0.067
86	S9	T2	F	F	SY	SY	PRO	CON	V	L	0.167
87	T2	S9	F	E	SY	SY	CON	PRO	L	V	0.117
88	S9	T2	E	F	SY	SY	PRO	PRO	V	V	0.050
89	T2	S9	F	F	SY	SY	PRO	PRO	V	V	0.050
90	S9	T2	F	F	SY	SY	PRO	PRO	V	V	0.067
91	T2	S9	F	M	SY	SY	PRO	CON	V	V	0.333
92	S9	T2	M	M	SY	SY	CON	PRO	V	V	0.233
93	T2	T2	M	F	SY	SY	PRO	CON	V	L	0.150
94	T2	S9	F	M	SY	SY	CON	CON	L	V	0.050
95	S9	T2	M	F	SY	ST	CON	CON	V	V	0.150
96	T2	S9	F	F	ST	SY	CON	CON	V	V	0.300
97	S9	T2	F	M	SY	SY	CON	PRO	V	V	0.133
98	T2	T2	M	M	SY	SY	PRO	CON	V	V	0.350
99	T2	S9	M	F	SY	SY	CON	CON	V	V	0.033
100	S9	T2	F	F	SY	ST	CON	CON	V	V	0.100
101	T2	T2	F	F	ST	SY	CON	CON	V	V	0.183
102	T2	S9	F	F	SY	SY	CON	CON	V	V	0.017
103	S9	T2	F	F	SY	SY	CON	CON	V	V	0.400
104	T2	T2	F	M	SY	ST	CON	CON	V	L	0.133
105	T2	T2	M	F	ST	SY	CON	PRO	L	V	0.033
106	T2	T2	F	F	SY	SY	PRO	CON	V	V	0.150
107	T2	S9	F	F	SY	SY	CON	CON	V	V	0.017
108	S9	T2	F	M	SY	SY	CON	CON	V	V	0.300
109	T2	T2	M	M	SY	ST	CON	CON	V	L	0.283
110	T2	T2	M	F	ST	SY	CON	PRO	L	V	0.067
111	T2	S9	F	F	SY	SY	PRO	PRO	V	V	0.017
112	S9	T2	F	F	SY	SY	PRO	PRO	V	V	0.050
113	T2	T2	F	M	SY	SY	PRO	PRO	V	V	0.500
114	T2	S9	M	F	SY	SY	PRO	PRO	V	V	0.033
115	S9	S9	F	F	SY	SY	PRO	CON	V	V	0.217
116	S9	T2	F	E	SY	SY	CON	CON	V	V	0.117
117	T2	T2	E	F	SY	ST	CON	CON	V	V	0.250

118	T2	T2	F	M	ST	ST	CON	CON	V	V	0.067
119	T2	S9	M	F	ST	SY	CON	CON	V	V	0.150
120	S9	T2	F	F	SY	ST	CON	CON	V	V	0.150
121	T2	S9	F	F	ST	CO	CON	CON	V	V	0.033
122	S9	T2	F	F	CO	SY	CON	CON	V	V	0.283
123	T2	T2	F	M	SY	ST	CON	CON	V	V	0.267
124	T2	S9	M	M	ST	SY	CON	PRO	V	V	0.033
125	S9	T2	M	M	SY	SY	PRO	CON	V	V	0.283
126	T2	S9	M	E	SY	SY	CON	CON	V	V	0.017
127	S9	T2	E	M	SY	ST	CON	CON	V	V	0.100
128	T2	T2	M	F	ST	SY	CON	CON	V	V	0.217
129	T2	S9	F	M	SY	SY	CON	CON	V	V	0.050
130	S9	T2	M	M	SY	SY	CON	PRO	V	L	0.150
131	T2	T2	M	F	SY	SY	PRO	PRO	L	V	0.683
132	T2	T2	F	F	SY	SY	PRO	CON	V	V	0.050
133	T2	S9	F	F	SY	SY	CON	CON	V	V	0.033
134	S9	T2	F	F	SY	SY	CON	CON	V	V	0.100
135	T2	S9	F	F	SY	SY	CON	CON	V	V	0.133
136	S9	T2	F	M	SY	SY	CON	PRO	V	L	0.167
137	T2	T2	M	M	SY	SY	PRO	CON	L	V	0.083
138	T2	S9	M	F	SY	SY	CON	PRO	V	L	0.033
139	S9	T2	F	E	SY	SY	PRO	PRO	L	V	0.033
140	T2	S9	E	F	SY	SY	PRO	PRO	V	V	0.017
141	S9	T2	F	M	SY	SY	PRO	PRO	V	V	0.183
142	T2	T2	M	M	SY	SY	PRO	PRO	V	L	0.167
143	T2	T2	M	F	SY	SY	PRO	CON	L	V	0.250
144	T2	S9	F	F	SY	SY	CON	CON	V	V	0.050
145	S9	T2	F	F	SY	SY	CON	PRO	V	V	1.167

APPENDIX 11

PROTOCOL TEXT
Tutorial Session 11 (Tutor T4, Student S10)

Seg. No	Contributor	Protocol Segment
1	S10	I haven't done much since the tutorials. Just kind of wanted to chat to you after that. I've got like some general ideas and directions that I'm going to go and started to focus. After drawing into these I quite like them but I just get the feeling that VJ and everyone didn't kind of like or appreciate my thoughts that were in my head because I was talking about it as an actual building but I don't think it was really kind of foreseeable from what I've done. So, I've taken more photos, putting it more in context with it on the map showing, like, the directions and the point or the shapes
2	T4	I think that ( ) but I thought it's a fantastic real potential this but you've got to realise what you've taken on, I think, it's not as straight forward.....
3	S10	I think that's the point that in some ways I don't want to do something straight forward because all my bit like the last project of the first year and first project of the second year, they're quite similar in their outcomes. I was pleased.....I wasn't very pleased with P1 just because I don't think it's a very interesting building. I was quite pleased with the last project but they were both kind of buildings that, you know, very straight walls and windows and like two very different materials, like, one reflecting one use at one side of the building and one reflecting a different use or different uses of another type but they're both quite similar
4	S10	And so I just wanted to kind of branch out of that and make sure that all my projects don't become like two different bits of a building that are different materials like say I'm going to do that
5	S10	So I just literally started playing with this plasticine and I just trying to think of the inside space and trying to think where I wanted light and stuff. And that kind of drew it around. But I was doing what you said you know, like how you kind of said something about that the site would cause the form of the building to be as it was because of (gestures) .....
6	S10	Well, and then I printed that one which you quite like (drawing)
7	T4	I like that one more from the other one, I realise that....(drawing)
8	S10	It wasn't really like, you see, that was more form of the building. That one was kind of me in 3D trying to pick out where I want it and what view points I was trying to keep. And what bits I thought, what bits of area and site should be shaded and blocked out, you know (drawing)
9	T4	I think I like this one, for obvious reasons, is you've actually got routes through these. I reckon these to be routes
10	S10	I think they're just views that....I don't know....
11	T4	If you think about this now, you can have lots of public routes with things coming off feeding into this fantastic space here and through these punched little holes, through this big, big, strong route. One of these could be, you know, sort of a private route and another could be something else, maybe it's a route out. I mean just literally, from reading your model
12	T4	What I like about this too is that you've got contrast of spaces. I mean, there are other things happening in this one as well
13	T4	But I like the fact that you've made decisions and it wasn't a completely arbitrary level (gestures on drawing)

14	T4	Now, there's this great grand space here. Can you imagine being underneath these things, these great big scenes coming up over you, some of which turn into routes. And I like the idea that some of these peel back and you get light through
15	T4	I think what I didn't like about these is it just end up being ugly. It was a bit sort of like chocolate ( ). Look like you've turned these lovely sort of sinuous structures into some of which looks like a series of caves, I don't know. It was also a bit literal because you....
16	S10	I quite like it from that side though. Like that's one viewed from the road. I like that. Because you don't really know what's going on from looking it from the outside but then you've got these glimpses (reference to sketch)
17	T4	But you know what, I mean (I'm not going to see you until Friday) and I think I would start drawing plans based on this
18	S10	I wanted to do another one that I'm working off from that one (3D image). Because I do like this one but it was never meant to be the final thing, it was meant to be like a beginning thing to help me start. So I want to what I want to do is go back and think about what I want actually to achieve in the individual spaces like and flow through the building everything and the hope that will in turn help me kind of do another one of these as a bit of something more that I like
19	S10	Then maybe try and incorporate stuff from this one like the routes that you were saying as well and maybe try and do something about it (3D image)
20	T4	Maybe it's just the (thing) where it just ends up looking like a sort of cage
21	T4	If that was just clear glass or frameless glass, it's a bit more (hand gesture) (3D image)
22	S10	Yeah, I mean it could that's just to illustrate the kind of difference between the walls and the windows there. I mean that one's just like a really big skylight that just kind of goes into the main gallery space and it's north facing. So you got this like in the daytime and it'll be like, hopefully quite light and going down the catwalk which had come down like the middle of that space going back into the room and then....
23	T4	Well you obviously got, I think (that's the other one). Towards the end of Friday everyone's was (feeling) tired, people weren't presenting themselves as well as they could and I think if you had much more...if you then take this a stage further start to do some (variants). Because in your head you know what this is doing inside but then to present something as that. I mean it's exciting to do, you can model in ( )
24	S10	It doesn't really fit with of the fact that we had to model it in CAD then. But I don't really care at that at the moment but other wise if I had to I'm really bad at it so I just end up with this square box
25	T4	But...if you start....I don't know if this is of use if I can find it. I had mentioned the work by, I don't know much about ( ) it's Katherine Findley Uschida something. And I think she is the wife. She's actually not working with him any more but they do a house....it's Uschida something, I can't remember the second name, which is isn't very helpful to you. There is a house they designed in Japan which is kind of doing these sort of things. It's really worth looking at because some of the language inside the building is very.....they carried right through to the design of seatings and opening of the (services bare)
26	S10	Oh! It's that just a blob isn't it? I'm sure we saw that, you know, (in the lecture theatre) It's like...I think I know what you mean, where is it?
27	T4	It's not really a....it's (more like a) sculptural blob, it's not really a ( )
28	S10	Yeah, it's all like ('tube'y) bits and just.....it looks like clay.....like a white clay
29	T4	It looks like clay....yes
30	S10	I can't remember where we saw that in

31	T4	I know one who had a piece on it. Do you know ( )? She had some stuff on it in her P1 project
32	S10	Oh was it...yeah....it was the last year like P3 thing. Someone did it as like a research project, last year
33	T4	I think that scene in architecture really works well because they've got composition in epoxy bases as well
34	S10	That will be a really good one to look at, wouldn't it?
35	T4	I think so because it's really what you're trying to do here. I can imagine this, you know, these things sort of fold over. Actually at one point you start looking in towards all these shapes and the stairs actually climb up one and become a platform and then suddenly something else comes over your head. And then, it's all peeled over to this glazing that you can see out, and then you go over another gallery space.....
36	S10	So you're saying ( ) had a book?
37	T4	He had an article on it from a magazine I think it was. But you could plug in.....I'm sure it's Ushida. I just can't remember the surname ( ) the last thing that you can remember, but it was Katherine Findley as well whose married to this guy and did this thing together. It's called something like....ice house, something like that. It's not actually (ice)
38	T4	But it's interesting because there're also some details on how they built it I think you sort of need to think about you might want to....
39	S10	Wasn't it almost, all mesh like?
40	T4	It's all reinforced, but it's got the mesh inside
41	S10	Yeah, a mesh and then like plaster over the mesh or something like that
42	T4	Yeah, it was concrete faced. So it's an interesting language and very much appeal to your sort of (frame) although yours is like more like (woven?) fabric (support)
43	S10	Do you know the name of the building that you don't like in Graz?
44	T4	( ) Peter (Wilkinson).....it's just it's strange
45	S10	Almost like these individual strips (reference to 3D image), I can almost like see them almost as the strips of that material in some ways, some times. Like, I can't sometimes envisage things but...
46	T4	But some might.....some of these ribbons, they're like ribbons aren't they ( )?
47	S10	Do you know what I mean, but like ribbons of that (gestures) and then just kind of stuck like with ( ) bits to the next ribbon of that, do you know what I mean?
48	T4	Well that's what this drawing (tells you). Now, you could have some that are meshed and some are solid and some are glass. Can you imagine the glass one at two (full) skin of glass and they could be different materials, couldn't they? (gestures)
49	S10	Well, they would look a bit like a 'mis-mash' then
50	T4	No, I don't think so
51	S10	I suppose there's no harm in it looking like a 'mis-mash' (laughs)
52	T4	I would look at that product we've just been talking about. And also the plans of Bilbao because they're extremely complex plans and I think your plans are going to end up quite looking like it. There's a book complete on Bilbao. Somebody had a look at it. Sarah, I think she had it.
53	S10	It is real hard getting all these books
54	T4	Yeah, I know ( ) Have a look at the plans of the Bilbao (Museum by) Gehry
55	S10	I don't think I'm going to have time to think much before by Friday. Now, that's the problem
56	T4	Well, I'm really keen if you could have a go at planning the building out
57	T4	And get absolutely to grips through this relationship of footprint to the site and how much.....( ) Well, you started sort to do that. That was one of the criticisms of these...

58	S10	Yeah, if they had seen that (3D image), they might have seen what was in my head
59	T4	Yeah, and even had the model actually include it... I mean I know (the site that linked included something here) but showing the road around it. How this thing engages because you always talk about making a signature building, a big statement on the corner. So it's really important to include that
60	T4	Because the view, you know, when I came back that time from (Salford) and it's a fantastic point
61	S10	Exactly, like driving past it and then see this weird thing emerging and think....
62	T4	It's fine that to see this as a stand-alone structure. It has, you know (gestures)..... But I think it's also important to think about orientation which you have started to do, you didn't really present that particularly well. If you had, because it's all.....
63	S10	Because that's the point about, I don't think Vj...he was like, he hadn't thought about on site and it's not on site and I wasn't like... but that's the point of why it's this shape. It's not just the shape because...It's this shape because of the differences in orientation there
64	T4	But you could sort of think about in terms of, you know, maybe some of these are more....because it's north facing....some of these more open and glazed, and glassy and mesh-y. And these ones are really solid because they're keeping the sunshine out (reference to 3D image)
65	S10	I was talking to, like, the heating and cooling guys and they were like, well if you're having glazing.....it's more, if you have south facing glazing, it's more easily controllable because you're going to get direct sunlight whereas if you have it (this is why I've got it in this one) if you've got either west or east. Because of our site like it's so exposed to the sun that you get really low, one's that's just streaming through and you can't control it. So I guess you either have glazing north or south (faced)....because if you've got glazing outside...(reference to 3D images)
66	T4	What that's going to do is to make your building really interesting, I think. If you thought about all these elements and the different orientations. And keep the sun out from certain areas and sort of like celebrate it on another area. So one might to ( ) is, oh my God! It's a really abstract building. But behind all of that, you've thought about every single thing
67	S10	I just need to show (the) way of presenting that, don't we? Show how I....
68	T4	Well I would think of how I would ( ) really need to sit down and look at all these things. Consider the public and private space, circulation strategy, entrances and exits. I've got..... (reference to checklist)
69	S10	But I haven't got these to that stage yet that I want to go and show
70	S10	So I need start thinking about what I actually want
71	T4	Don't worry, even if it doesn't end up being ( ) you can go way in easter and you've got something to work on and you can also make another model to which it does it in much more detail
72	S10	Do you think I can do this project by easter because I've got to try and do ( ) as it is
73	T4	Well, you're going to have to do something. We're going to have a review in two weeks (in when we come back)
74	S10	I'm hoping if I can get as many of the assignments just out of the way out over easter then I won't have them hanging over and if I want to just come back and go full over this project and not have to do the other ones. That's my (theory) any way

75	T4	Think about sketching some at level one, you know. Just start kind of mapping it out as that. Then at level two, to overlay it. Do a series of overlay, it might end up looking like that. And three might be much more solid. It's more like that (sketches)(verbal gesture) You know, it's more...it's like that. Four, it's like that with a look-out tower on level five, and then.....(gesture)
76	S10	Not that much room space, floor space to deal with there ( )
77	T4	It's not so (great). I mean I did my own calculations here
78	S10	How much did you get...was that what you get (the site included in)?
79	T4	I mean, I just look through.....in fact.....did you see (Thomas) yesterday?
80	S10	Yeah, I see ( ) at least
81	T4	It's only this same thing again (brief handout). It's....just that I put the area here as well. Oh no!...Oh! I've just included the storage in the gallery space and I put plantroom right here as well
82	S10	I started, I mean ( ) I really didn't expect get very far with this but kind of I thought of this as a 1000 square metres (sketches). So I started like ( ) canvas filled up with different colours for different parts of it. So you know that's the plant room, I've thought of that. This has got 25% of (like) which was about discounted a bit (sort of) And then....
83	T4	Which works out to about 40 square metres. Funnily enough, I've put here 14 and it's not right. It's slightly more now
84	S10	But it depends how much also you're like trying to naturally control, doesn't it? Because it can be a little bit smaller
85	S10	So I'm going to try and do that as well
86	T4	Well I would just really start planning it
87	S10	I might do another one of these I suppose (3D image)
88	T4	I wouldn't, because you could start.....I mean, those models are more about language than they are about the reality of this thing, I think. They're an abstract, conceptual thing. I'd put them to one side. You can always come back and make another detailed one
89	S10	Or what I'd do is I might really get a sharp knife and slice through it to help me do my section (laughs)
90	T4	Or you could use clay and 'perspecs' and start making it very much like a play doh
91	S10	Yeah hopefully, if I get like a proper form, it would be really nice model of it like that, with like clay
92	T4	No, I wouldn't another one (at this stage) because conceptually you've got it there. You know what you want to do.
93	T4	You've just got to start planning, work out, what these galleries, what these various.....if they're workshops, what are they're all about. And then start building up a series of diagrams which locate things, circulation space, public and private space. You know, what's open to the public and what isn't. Circulation strategy, entrances, exits down to the lifts, fire escape, service access. Initial writing and display concepts. So you know, you might want to think about that
94	T4	That's why I think that little house is worth thinking about, it's all integral
95	S10	....and then all the walls and the floors become that 'thingy' (gestures)
96	T4	(gestures).....become the walls. Very fluid. The seatings form part of the wall. You know, it's all (carved) out, doesn't it? It's very continuous, something that flows into space
97	S10	That foreign office one. It's about that runaway job-bie. Looking at that the other day as well
98	T4	Quite lots of thing to look at really, It's still new this stuff, (it's worth) exploring, fluid forms
99	S10	Even in like...I don't know...you probably haven't but have you been down West Street, down the bars? In (Vodka) Revolution, the new one, have you been in there?

100	T4	No
101	S10	Because even in that, I can't remember which way around it. But it's either, because behind the bar, it's just wood and it's really like veneer and really nice. But it either becomes a (broad) ceiling and then.....it's just all like that (gestures). Just love it. That's a lot, like, heavy and then darker but fine
102	T4	Right, I think you could start getting into all that but I think you need to have some idea of how this building is going to work on Friday. Think about materials. You know, is this a concrete building with solid, meshy (much more of glass)? And meshy things referring to textiles, the solid (parts) are there as there will be solid fabric but they are keeping daylight and sun light out
103	T4	You can start building up a strategy. To do kind of thought through, and sketch sections with one of the key areas might (open) the whole of the ( ) as well as the plans. Just so that when you go away in easter, you're absolutely clear what this thing is doing. You've got ( ) the form's emerging. You have to spend a couple of days on it just to keep it going. Because you're going to be really struggling when you get back to get to where you want to. You have to prepare yourself
104	S10	So we get back and we've got two weeks?
105	T4	You've got one week and in the second week. So again you only have a week to go
106	T4	And I am going to want to see another model for (that). So plans sections and models ( ) come in and how you get around this building, what it is all about, what spaces you're experiencing....
107	S10	And then how long have we got after that?
108	T4	Only two or three weeks
109	S10	So if we got a building then where do we move on to, like, presentation and showing it and just.....?
110	T4	Drawings of construction
111	T4	Think about construction, servicing the bits. You can start thinking about plants
112	T4	You know, how the thing links from plant room to the (whole) building
113	S10	There's so much to do!
114	T4	There's a lot to do. And particularly as we're dealing with museum space, lighting humidity control will be key. If you can really get in towards that...
115	S10	How do you find out humidity control and everything then?
116	T4	Look at the AJ Metric Handbook. Do that. It's a really good guideline as to what you should have ( ) as to what level humidity ( ) Have a look. You've got to get the grips of it now. Yeah, it's a lovely idea. I mean you know what's it doing
117	T4	You've thought about a lot of things. What you now need to do is partly demonstrating it
118	S10	I think some times I don't realise what I thought about as well. It's just about getting it all out and how far I'm going to go (for)
119	T4	Get a pad of tracing paper. Start layering it up. Level one, it's going to be some landscaping, it's got an entrance. And from the edge, you can just start coming up here (sketches) and it's this ( ) and it comes to the gallery space
120	T4	I mean at first it will be quite crude, isn't it? It doesn't matter. No, I just wanted you sort of see the reality start to come out. Otherwise if you're making the models, that's all you will be making the whole of this week
121	T4	You don't need to, the concept's there
122	S10	I think during the holidays, I will try and look at that again and go back into the concept again
123	S10	That's one thing that he said on the review, 'well where's the whole tactile concept?' Because he thought it was a bit thin. So I need to kind of...

124	T4	Well that can't stop you on the planning
125	T4	Because do you remember what you're displaying? It's more fashion
126	S10	Fabrics
127	T4	Fabrics. But it's more sort of technology and fashion orientated
128	S10	Yeah, like, more like a bit of an art museum in a way it displays like pieces of fabric like items of textiles that are more like sculpture, you know. And the history also, like, a bit on the (Midland) in the history
129	S10	Because I thought, I don't know whether I explained it well, the main gallery would also be the evening event place. So there'd be like a cat walk in the middle. But during the day it's kind of, it's proper gallery space and it's kind of more back drop, you know, it kind of informs what the space actually is because it's like to give the back drop of like a fashion thing. You know....but then...
130	T4	Are you orientating everything around (this)? I mean physically the key space's in the centre. That is at an upper level?
131	T4	I mean that could be quite interesting. That it's not on the ground level, it suddenly comes across half way up the building. So the cat walk could be on a platform rather than basically on the ground floor. They could be on the ground floor, so everyone then looks back down ( )
132	S10	Yeah I was thinking....because the bit that I would want to include, like, a balcony bit that looks down, back over Bradford. And then inside of that, it would go right around and be a looking down in the ('job-bie')
133	T4	Yeah.....have you thought about these things?
134	S10	Yeah, I'm trying to start drawing them sometimes though and it just always end up wrong. I can't really draw the interior space. I get the perspectives wrong and like this bit which was is me trying to show like how the cat walk comes out in the middle and that was a bit of a plan..... (reference to student's sketch)
135	T4	You probably can't draw it because you haven't got it (planned/set) (gestures)
136	T4	So as soon as you've got all these things, if you know from level 3 that level 3 is only that bit but it's wonderful viewing space then you can start putting what's happening below you now in 2 and 1 because you planned it. You'll be able to draw this and it's important to keep track of this, it's so useful
137	T4	But until, you know, I mean you've slightly suggest over here, aren't you? (reference to student's sketch)
138	S10	Yeah, it's kind of a 'plan'ish
139	T4	Only you can come up with what you can do as well because you know what's best you can do and what you can't do
140	S10	Yeah, I did, I wrote my own brief. Did I show you? I don't know whether it's included everything yet. Here's a kind of defining it a little bit more (brief). But I don't think some things I have included in there that I want to put in
141	S10	I'd would have to add to it as I go along
142	T4	I mean basically it's about past and present. And maybe as it involves the present, it can wire on the past. It may ( ) you can play with that tension between the two things
143	T4	And have a connection between the two zones
144	T4	Look at that (original brief) again just to, visit the storage again, that plant....but you know, it's absolutely fine (conversation ends at 26:28)

Matrix of Cognitive Interaction

Tutorial Session 11 (Tutor T4, Student S10)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S10		F		SY		PRO		L	0.583
2	S10	T4	F	E	SY	SY	PRO	PRO	L	V	0.350
3	T4	S10	E	E	SY	SY	PRO	CON	V	L	0.567
4	S10	S10	E	F	SY	SY	CON	CON	L	V	0.150
5	S10	S10	F	F	SY	SY	CON	PRO	V	V	0.400
6	S10	S10	F	F	SY	CO	PRO	CON	V	L	0.050
7	S10	T4	F	F	CO	CO	CON	CON	L	V	0.050
8	T4	S10	F	F	CO	SY	CON	PRO	V	V	0.283
9	S10	T4	F	F	SY	SY	PRO	CON	V	L	0.117
10	T4	S10	F	F	SY	SY	CON	CON	L	V	0.050
11	S10	T4	F	F	SY	SY	CON	CON	V	V	0.400
12	T4	T4	F	F	SY	SY	CON	CON	V	L	0.100
13	T4	T4	F	F	SY	SY	CON	PRO	L	L	0.150
14	T4	T4	F	F	SY	SY	PRO	CON	L	L	0.283
15	T4	T4	F	E	SY	SY	CON	PRO	L	L	0.317
16	T4	S10	E	F	SY	SY	PRO	CON	L	V	0.167
17	S10	T4	F	M	SY	SY	CON	PRO	V	L	0.167
18	T4	S10	M	M	SY	SY	PRO	PRO	L	L	0.367
19	S10	S10	M	M	SY	ST	PRO	PRO	L	V	0.117
20	S10	T4	M	F	ST	SY	PRO	PRO	V	L	0.067
21	T4	T4	F	M	SY	SY	PRO	CON	L	V	0.100
22	T4	S10	M	F	SY	SY	CON	CON	V	V	0.350
23	S10	T4	F	M	SY	SY	CON	PRO	V	L	0.467
24	T4	S10	M	F	SY	SY	PRO	PRO	L	V	0.233
25	S10	T4	F	M	SY	SY	PRO	PRO	V	L	0.867
26	T4	S10	M	F	SY	SY	PRO	PRO	L	V	0.133
27	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.083
28	T4	S10	F	F	SY	SY	PRO	PRO	V	V	0.083
29	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.050
30	T4	S10	F		SY		PRO		V		0.033
31	S10	T4		F		SY		PRO		V	0.150
32	T4	S10	F	F	SY	SY	PRO	PRO	V	V	0.150
33	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.117
34	T4	S10	F	M	SY	SY	PRO	PRO	V	V	0.017
35	S10	T4	M	F	SY	ST	PRO	PRO	V	V	0.350
36	T4	S10	F		ST		PRO		V		0.050
37	S10	T4		F		SY		PRO		V	0.633
38	T4	T4	F	M	SY	SY	PRO	PRO	V	V	0.133
39	T4	S10	M	F	SY	SY	PRO	PRO	V	V	0.033
40	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.050
41	T4	S10	F	F	SY	SY	PRO	PRO	V	V	0.050
42	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.250
43	T4	S10	F	F	SY	SY	PRO	PRO	V	L	0.083
44	S10	T4	F	E	SY	SY	PRO	PRO	L	V	0.067
45	T4	S10	E	F	SY	SY	PRO	PRO	V	V	0.167
46	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.050
47	T4	S10	F	F	SY	ST	PRO	PRO	V	V	0.117
48	S10	T4	F	F	ST	SY	PRO	CON	V	V	0.283
49	T4	S10	F	F	SY	SY	CON	PRO	V	V	0.033
50	S10	T4	F		SY		PRO		V		0.033
51	T4	S10		E		SY		PRO		V	0.050
52	S10	T4	E	M	SY	SY	PRO	PRO	V	L	0.383
53	T4	S10	M		SY		PRO		L		0.033
54	S10	T4		M		SY		PRO		V	0.100
55	T4	S10	M		SY		PRO		V		0.067

56	S10	T4		M		SY		PRO		L	0.083
57	T4	T4	M	M	SY	ST	PRO	PRO	L	L	0.150
58	T4	S10	M	F	ST	SY	PRO	PRO	L	L	0.050
59	S10	T4	F	M	SY	SY	PRO	CON	L	L	0.333
60	T4	T4	M	E	SY	SY	CON	CON	L	V	0.167
61	T4	S10	E	E	SY	SY	CON	CON	V	V	0.083
62	S10	T4	E	M	SY	SY	CON	PRO	V	V	0.217
63	T4	S10	M	F	SY	SY	PRO	PRO	V	V	0.167
64	S10	T4	F	M	SY	SY	PRO	CON	V	L	0.217
65	T4	S10	M	F	SY	SY	CON	CON	L	V	0.550
66	S10	T4	F	E	SY	ST	CON	CON	V	V	0.400
67	T4	S10	E	F	ST	SY	CON	PRO	V	V	0.067
68	S10	T4	F	M	SY	SY	PRO	PRO	V	L	0.250
69	T4	S10	M	E	SY	SY	PRO	PRO	L	V	0.083
70	S10	S10	E	M	SY	SY	PRO	PRO	V	V	0.050
71	S10	T4	M	M	SY	SY	PRO	PRO	V	V	0.150
72	T4	S10	M		SY		PRO		V		0.117
73	S10	T4									0.117
74	T4	S10									0.167
75	S10	T4		M		ST		PRO		L	0.467
76	T4	S10	M	E	ST	SY	PRO	CON	L	V	0.083
77	S10	T4	E	F	SY	SY	CON	CON	V	V	0.050
78	T4	S10	F	F	SY	SY	CON	CON	V	V	0.050
79	S10	T4	F		SY		CON		V		0.100
80	T4	S10									0.033
81	S10	T4									0.317
82	T4	S10		F		ST		PRO		L	0.700
83	S10	T4	F	F	ST	ST	PRO	PRO	L	V	0.167
84	T4	S10	F	F	ST	SY	PRO	CON	V	V	0.133
85	S10	S10	F	M	SY	SY	CON	CON	V	V	0.050
86	S10	T4	M	M	SY	SY	CON	PRO	V	L	0.083
87	T4	S10	M	M	SY	SY	PRO	PRO	L	L	0.033
88	S10	T4	M	M	SY	SY	PRO	PRO	L	V	0.367
89	T4	S10	M	M	SY	SY	PRO	PRO	V	L	0.067
90	S10	T4	M	M	SY	SY	PRO	PRO	L	L	0.117
91	T4	S10	M	F	SY	SY	PRO	PRO	L	V	0.117
92	S10	T4	F	M	SY	SY	PRO	PRO	V	V	0.067
93	T4	T4	M	M	SY	SY	PRO	PRO	V	L	0.550
94	T4	T4	M	M	SY	SY	PRO	PRO	L	L	0.083
95	T4	S10	M	F	SY	SY	PRO	PRO	L	V	0.033
96	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.200
97	T4	S10	F	F	SY	SY	PRO	PRO	V	L	0.117
98	S10	T4	F	F	SY	SY	PRO	CON	L	L	0.150
99	T4	S10	F	F	SY	SY	CON	PRO	L	L	0.117
100	S10	T4	F		SY		PRO		L		0.033
101	T4	S10		F		SY		PRO		V	0.367
102	S10	T4	F	M	SY	SY	PRO	CON	V	L	0.533
103	T4	T4	M	M	SY	SY	CON	PRO	L	L	0.617
104	T4	S10	M		SY		PRO		L		0.033
105	S10	T4									0.133
106	T4	T4		M		SY		PRO		L	0.350
107	T4	S10	M		SY		PRO		L		0.067
108	S10	T4									0.067
109	T4	S10		M		SY		PRO		L	0.050
110	S10	T4	M	M	SY	SY	PRO	PRO	L	V	0.067
111	T4	T4	M	M	SY	SY	PRO	CON	V	V	0.083
112	T4	T4	M	F	SY	ST	CON	CON	V	V	0.050
113	T4	S10	F		ST		CON		V		0.017
114	S10	T4		M		SY		CON		L	0.117
115	T4	S10	M	M	SY	SY	CON	PRO	L	V	0.067
116	S10	T4	M	M	SY	SY	PRO	PRO	V	V	0.433
117	T4	T4	M	M	SY	SY	PRO	PRO	V	L	0.100

118	T4	S10	M	E	SY	SY	PRO	PRO	L	L	0.150
119	S10	T4	E	M	SY	ST	PRO	PRO	L	L	0.317
120	T4	T4	M	F	ST	SY	PRO	PRO	L	V	0.300
121	T4	T4	F	M	SY	SY	PRO	PRO	V	V	0.083
122	T4	S10	M	M	SY	SY	PRO	PRO	V	V	0.067
123	S10	S10	M	F	SY	SY	PRO	PRO	V	V	0.150
124	S10	T4	F	M	SY	SY	PRO	PRO	V	L	0.033
125	T4	T4	M	F	SY	SY	PRO	PRO	L	L	0.083
126	T4	S10	F	F	SY	SY	PRO	PRO	L	V	0.017
127	S10	T4	F	F	SY	SY	PRO	PRO	V	V	0.050
128	T4	S10	F	F	SY	SY	PRO	PRO	V	V	0.283
129	S10	S10	F	F	SY	SY	PRO	PRO	V	L	0.350
130	S10	T4	F	F	SY	ST	PRO	CON	L	V	0.117
131	T4	T4	F	F	ST	SY	CON	CON	V	V	0.250
132	T4	S10	F	M	SY	SY	CON	CON	V	L	0.250
133	S10	T4	M		SY		CON		L		0.050
134	T4	S10		E		SY		PRO		L	0.200
135	S10	T4	E	F	SY	SY	PRO	PRO	L	V	0.100
136	T4	T4	F	F	SY	ST	PRO	PRO	V	V	0.317
137	T4	T4	F	E	ST	SY	PRO	PRO	V	V	0.083
138	T4	S10	E	E	SY	SY	PRO	PRO	V	V	0.050
139	S10	T4	E		SY		PRO		V		0.133
140	T4	S10		F		SY		PRO		L	0.367
141	S10	S10	F	M	SY	SY	PRO	PRO	L	V	0.150
142	S10	T4	M	F	SY	SY	PRO	PRO	V	L	0.300
143	T4	T4	F	F	SY	ST	PRO	CON	L	V	0.350
144	T4	T4	F	M	ST	SY	CON	CON	V	L	0.167

APPENDIX 12

PROTOCOL TEXT
Tutorial Session 12 (Tutor T4, Student S11)

Seg. No	Contributor	Protocol Segment
1	S11	So I did this painting (reference to painting). From this I did some in the sketch book. And then I did these, these main works (sketches)
2	S11	And I came up with this idea for my theatre of memory, which is a ramp. The ramp shows the journey and continuity for a (number) of bridges, show the connection between different memories. And then, these little separate rooms coming up with like temporary exhibition in. So, this ramp will show like the journeys of different people like migrating. So it starts from the past and then coming up to the future at the top
3	S11	So, and then, this is like a linear form. That's the ramp (sketches)
4	S11	So I'm trying to express some like (hot) in the atmosphere and the memory by architecture like, whether it's dark or light or enclosed or whatever. And then to go from past to future
5	S11	And these are some ideas about how to show it (sketches)
6	T4	So does the future for you very different from the past?
7	T4	I mean, by the time you get to here, looks like you're repeating the same kind of experiences (reference to student's sketches)
8	S11	Well that's what I don't know if I should maybe research what the archive will be or whether I can just generalise it and say this will be a nice memory and this will be a bad memory. Or whether I should go away and look up and see if I could find a person's memory, whether they're good or bad. Because I'm not sure how easy it will be to find that
9	S11	Because it's all about them migrating and from into Little Germany
10	S11	And so that's one thing I was kind of a bit stuck on because Suzi said I should have some firm ideas about what the archives should be rather than just as general. But then in the review they didn't say it. They said that that didn't really matter. So, it's kind of a bit.....
11	S11	And I looked at that (Wye Muir Bridge) is it? With those (memory)?
12	T4	Yes
13	S11	But I didn't....because I didn't really know what I was going to get out of that. Because Suzi said I should look at that
14	S11	So I kind of...this I got quite stuck on the archives. I think that's where my weakness is I think maybe
15	S11	But then, anyway this is my ramp in my model. And I looked at it whether it will be a kind of light structure with a very heavy sort of like box surrounding or whether it will be a really heavy enclosed structure within a lighter ( ). So I'm going to do it like really heavy within light. So that it will be really confined. It's like masonry....
16	T4	Core
17	S11	Core, yeah, with this ramp going up
18	S11	And then these are my plans that I did. This was for my review (reference to plans). So it's like the offices in here and these green bits like the office block and then this core in the middle and then the public areas around here
19	S11	And in my review they....that's my model for that as well (reference to model)....in my review they suggested that I moved this to the outside, so it's kind of infringing on the surface
20	T4	Sort of like a little bump
21	S11	Yes (reference to sketch book). So this is like on the edge (they're) coming out of it

22	S11	Well, I found quite confusing because Suzi said that it will be nice if it was embedded right in the middle of the building but then Dave and Sam went oh it would be really nice if it was infringing
23	S11	So I now did the plans (in the end) infringing on the outside to see how I could fit everything all around that
24	T4	Do you know the Tate of St.Ives? It's a building by Evans and Shalev. And they've used a drum. It's not quite like yours in that it's not surrounded by lightweight everywhere. But it's the way this, the drum, engages with the sort of the site. And it's used as an entry point
25	T4	So you come in and you ramp up, I think, and there's a little courtyard, almost like a little arena in the drum or in front of the drum. And then, the drum becomes walkways
26	S11	Is that the whole building or is that....?
27	T4	No, it's not. The drum's just part of it. It's a very, you know, ( ) solid element but then it becomes part sort of the viewing gallery where you look back out into the drum and then out to sea but it also becomes part of the gallery and I think the café's actually in it
28	T4	I mean, I'm not that familiar with it myself so... but it just might be worth having a look at it. It's the use of the drum as a sort of device It's very heavyweight thing and it's carved away slightly
29	S11	Because I had this as sort of using it as an entry as well. So that the drum will be above and you'd enter and go up underneath it and see up into it as you go underneath
30	S11	But then Andy wants you to go underneath but then Suzi kind of put me off the idea. So I think I'm quite confused about where to go really
31	T4	You've probably gone, as you say, you've already have done a lot. You've gone quite a long way down the line. Conceptually it's there really, isn't it?
32	T4	I mean, you've got (to) tighten up certain things like the archive. You've done quite a lot of thinking about it
33	T4	I would have a look at that building, I don't know whether it would be helpful at all. It might not be the right sort of thing. I probably look at it again later
34	S11	Who is it by again?
35	T4	Evans and Shalev and it's Tate's of St. Ives. I mean, architecturally, it might not be anything in it, you might go 'ugh' but it's just interesting that it uses a big sort of circular form in the way they've used it as part circulation, part gallery, part viewing area, part external auditorium. It's quite a clever sort of....
36	S11	Because mostly, in most circular parts of buildings are that they're used as a sort of circulation kind of atrium space....
37	T4	Somewhere to come back to, aren't they?
38	S11	Yeah.....rather than actual museum
39	S11	Because I was looking at Richard Meier's work. And he's got, in one building, he's got quite a light exterior. But then it's got this really solid drum in the middle. And I don't think it's got like any....I'm not sure what it's got inside just some (marks) maybe like for circulation but it's quite prominent, like, from the elevation. Like sticking out at the top
40	S11	But I think there's two options really, whether to have it completely in the middle or (gestures).....it's (probably my own personal preference really)
41	T4	Does it work well for you conceptually in the atrium?
42	S11	Or in a way I think it's nice for it to be in the middle because it does completely confine it but then, if it's in a different material and got this void going around it as well, then it's going to be completely separated anyway in which case it might be quite nice to show it on the outside because it is, right, the main part of the building. But then it's also quite nice to have it completely in the middle and then seen to do so

43	T4	It's a little bit like a great court as well, isn't it? It's got that sort, you know, that sense of solid thing with the light weight roof and lots of space around it. I know that's not a lightweight skin
44	S11	But they're light
45	T4	I mean it's difficult to know whether to say well I'm getting my lot to start planning at 1:100 really for Friday because they're all kind at the more conceptual stage and they haven't got....oh no, some of them have started making models like this but...
46	S11	Because I did all these and I just got a bit, kind of, I wasn't really sure where to go next. So I just did those plans just so I had something to discuss in my review which I found really helpful
47	S11	Because I'd already got passed through like the concept stage, I think
48	S11	But I think these need to be bigger because 1:200 seems a bit smaller
49	T4	I would have a look at blowing those up to 1:100 and start working on
50	S11	I did this section actually
51	T4	I mean I suppose by taking this to one side, you actually make some of these spaces probably easier to resolve because if it's in the core you've got this kind of tight pitch space here
52	T4	Having said that, I mean actually it also gives you the opportunity to play with this as an entrance possibly, you know, rather than that (sketch plan)
53	S11	Well the reason the entrance's up here was because it's quite a slope going down there. I mean, I could bring a sort of a walkway down along the edge there and then come in. But because it's on the car park, there's quite a big drop. So it would have to enter here and then whether they come along or (annexe a viewing space in) or whether they just go straight in
54	T4	It's difficult to know whether it's got sort of impact of something that comes out, noses out and gives you a clue as to what's happening inside or whether it's more powerful to use it as an entrance, I'm not sure. Typical
55	T4	You know, that's the difficult stage, you know you've got there and now making it work
56	S11	I quite like it because what happens is that you go up the ramp and then you come down on the lift quite slowly but have these little small windows so you can see back in. Like little snippets back in
57	S11	But then I quite like the view to come down, like The (Baltic). How you come down the lift, there's a view of the bridges. Have that because the views are really good. So come down and have these
58	S11	So that would work quite well having the two there ( )
59	T4	That's going to be an awkward shaped shop isn't it?
60	T4	It's very difficult now you've set this up because you get left with these spaces and the loos are okay because you can sort of make them work ( ) (sketch plans)
61	T4	The red and black model, is that..... (reference to model)
62	S11	That was this. That was just showing the arrangement of space (model). So that's the drum. So this sits like this. That's the office block and that's the.....
63	S11	I have to find that section actually. Here it is. This is my section through this (section sketch)
64	T4	How does the (Rossi?) theatre work that the ( ). Does she (refer to the elder Rossi)?
65	S11	I don't think she had....or she might have in the introductory...
66	T4	Maybe. Just wondering because that's a little theatre and a ramp, doesn't it? For a small number of people, is it? Or am I confusing that with .....
67	S11	I've got all the sheets in here. That's the sheet we had
68	T4	Was there another sheet of brief? Ah, there we go
69	S11	That goes on, that's the actual brief
70	T4	Hmm, I'm sure Aldo Rossi's got a theatre of memory
71	S11	Sure, I'll have a look

72	T4	Yeah, have a look around, I'm just intrigue. I might be very wrong. Aldo Rossi.....I'm sure it's called the theatre of memory. I think it's a travelling theatre
73	S11	What, a temporary....?
74	T4	It's a little tower, a little temporary theatre. But I might get it wrong. But that seem.....mind you, I think it's a stand alone object
75	T4	But then I'm not sure how big it is and what happens internally in it and how he's planned that, and how he get up into it
76	T4	It might be interesting to find out. I think it's on ( ) legs, I'm not sure
77	S11	For this, I was thinking, in my review, I hadn't really thought about the car park. So, bringing it down into the car park, not down to the actual space, but bringing the structure down. And maybe having the ramp get up to the top level of the car park in this as well to carry (that amount) through. And then, this is the office space. I was thinking about having it on the half level so that the (view's to the) offices
78	S11	Because if you're on the ground floor, then people can see in right, like, because I was looking around seeing all the offices when I was there. But if it's just that half storey above, and then have the archive below and the plant room kind of going into the car park. So it's kind of..... I'd quite like it, to be quite, changing levels and kind of angles and drop quite ( ) view but not....yeah (section sketches)
79	T4	(Mind you) You've set up a very strong diagram here, haven't you?
80	T4	His (Rossi?) tends to be more.....
81	S11	.....sketchy
82	T4	.....deconstructed!
83	S11	Yeah, but I don't want it to be very ..... I just don't really like straight lines ( ). I don't think...it's just not right. I don't want it to be like grids and .....I quite like it to be free like messy, not messy but....
84	T4	I wonder whether, you know....because you like drawing and painting....Whether you do, for Friday I would set about working this up to a larger scale
85	T4	To keep working on the plans and how the circulation and everything works
86	T4	But I'd also do painting of that view showing this thing, sort of coming out, nosing out and the glass and the lightweight-ness of this skin that's surrounding the rest of the building and see whether you like it (sketch plans)
87	S11	Yeah, it might be a good idea
88	T4	This thing sort of like popping up out at the top, and how you treat that (sketch plans). What that's made of, you know, in relation. Is it black granite? Or something quite like granite?
89	S11	Really something very heavy yeah
90	T4	Is it a sandstone or a white marble? Or is it, you know, what is it?
91	T4	Well I think your painting might.....a painting showing the glass and how this thing could sort of contrast and you'll be able to see through and maybe get clues as to what you've been talking about, gaps and slots in this thing. Maybe you can read them through this glass elevation as well to get an idea of (how) this thing's inhabited
92	S11	Yeah, do you think I should have little bits through here as well (sketch plan)? It's there (gesture)
93	T4	I don't know. I mean, I think the planning would kind of start telling what now needs to happen
94	S11	For this, I was thinking of having, if this is like (sort of) sandstone

95	S11	And then this void running around going right up with just little bridges like going across one of those entrances. Whether to have this as a glazed wall here, like inside. So there will be like, the masonry structure there and this glass running around here. So this would just be opened to the air or whether just to have the floor lines coming up to here and have a glass roof on top. Because that's one way of separating them. So I could like, really try and separate them by having stone and then gap and then glass and then the rest of the building. Or do it more. I don't know. That's all my....(sketch plan)
96	T4	That's a detail, isn't it, but....?
97	S11	Yeah, but that might.....if that's reflected on this, then you know (this might change the) relationship between the two (sketch plan)
98	T4	I think just set that up that view ( ) painting or how you're going to do it of that will test this whole idea, you know, given that's actually located in the right place for you
99	S11	Because it can go, it can move slightly in any.... I think that's why I might end up spending next month just moving this (laughs)
100	T4	Which you don't want to do, you know, you want to decide
101	T4	And also you need to start working up because you're quite, you know, you've got quite a good way in. And I think, you can start kind of working some of these things up to a larger scale. Once you've kind of decided, you'll obviously be seeing Suzi on Friday, you know, you're going to say I think I'd resolve this
102	T4	Now, have a look at Rossi, have a look at the St.Ives as well, the use of the drum
103	T4	Whether that gives you any clear clue as to how you just might relate other parts of the building to the drum. How the other sort of more orthogonal shapes, now I know you don't want to do orthogonals, but, how they actually key in to the drum. Because it's not just it is a drum building, it's a series of forms
104	T4	And I'd be very interested to see the plan of it because I don't know how it works. I'm sure I've got it somewhere in the magazine, it will be in the publications ( ) but it's good
105	S11	How old is it?
106	T4	I think, it could be even as much as ten years. They haven't done, as architects, they haven't done huge amounts since then. But Tate's St.Ives and Evans and Shalev should give you enough to do. I'm sure you have publications running on that far
107	T4	It's difficult to be....I don't want to kind of steer you in any wrong direction because obviously Suzi is more familiar with, you know, the whole thing
108	S11	I've been steered in two directions and now I....
109	T4	How does, sorry I'm being completely stupid about it, how does the archive work within?
110	S11	Within there (sketch plan)? This is the ramp like this (3D image). Well, I've got another drawing. So would be this.....
111	T4	What I like about these drawings is it looks like a linear thing but it's not, is it, as a space? (reference to sheet of section sketches)
112	S11	It's more of a diagram like
113	T4	So how does it work within this? (reference to sheet of section sketches)
114	S11	So this is like two and a half metres wide going on up to (1:12). Yeah, so they'd be the paintings or the drawings or photographs, films
115	S11	This is what I think I need to find out what these are going to be
116	T4	So that's a little bit like the Museum of Modern Art isn't it? The idea of the ramp and the things being displayed as you go on up
117	S11	Yeah, but quite continuous. So, there'll be a strip of slides about one person and then maybe have them like on the floor so you could read them on the floor as well

118	T4	Could they be housed in a slotted showcase that's carved into the wall of this thing that's just continuous? (section sketch)
119	S11	Yeah, I drew that somewhere, yeah
120	T4	Right, like that, yes. That could be amazing. That snakes its way up as you snake you way up
121	T4	And if it's lit particularly subtly (section sketch)
122	S11	Because if I had light....If I had my void in here and so there's light coming in. Maybe somehow the light could come in as well. I'm not sure about that but, that one might be one possibility of lighting up this (section sketch)
123	T4	It could, except that you've got things mounted on the rear?
124	S11	Yeah
125	T4	It's not going to work, is it? I mean you could have this little tiny spot in the top there, 'soffited' for the display case
126	S11	(You could maybe funnel it in). That's what they suggested in my review, that this void be used to light up (the display case)
127	T4	Oh right, ok. Looking at the model, there's some interesting spaces, aren't they? I like the way you've opened this up (reference to a sketch)
128	S11	Because if this is to be quite solid, I want this to be quite minimal and open, sort of. So I was thinking of maybe using timber for this part or something like (it) and then have this very solid. Sort of like reflect the materials with the heaviness of the materials with the heaviness of the.....(model)
129	T4	But I think, have some thoughts about what that's made out as well (model) in contrasts with these light weight things. And it could be something like...depends what's sort of atmosphere you want to create with, if it's just sort of.....
130	S11	(Something black could be quite nice). It would be quite nice if it was quite striking. Because I did just think it could be sandstone because outside it would fit in then with the rest. So it's like that's Little Germany's sandstone we're using in it. So, it's kind of reflect that and then this would be different (model). But then that might be quite nice to be very (lump) and shiny or something
131	T4	It could be sandstone on the inside and like granite on the outside. So you think, God what is that thing? Once you get inside, you think I'm in familiar territory
132	S11	Yeah, that will be nice that. Because I was just, I don't know, I was thinking of white museum, you know, but I don't. I just thought that because that's what is the likely thing to do nowadays
133	S11	I'm trying to be more organised this time by having.....because these were all on like a million sheets. So I'll try to condense on to A3 sheets. So, I'm trying to do more on my sketchbooks. I'm not like....I've only got....these are my only (right) little pile, it's quite.....(laughs)
134	T4	I know you know where they are. You always know where they are, don't you?
135	S11	I can't.....I thought (of) this project now and I'll go in and not (laughs)....it's because I watch this thing and oh, I'll just get a sheet.....
136	T4	But as long as you come to present it at the end because I know that one of the criticism of your portfolio was that there's too much going on in each sheet. Just remember that when you finally pin these up
137	S11	Because my presentation really let me down I think on the portfolio, because I got Cs for that but I've got Bs for the rest of it, so I need to....I've started doing that, but I really need to make...but I think that's pulling me down
138	T4	Does that help you?
139	S11	Hmm...But I thought this project, I'd go in as I start (as I mean) to go on (laughs). So far, it hasn't worked. Well, it has like, I get by like....60 or I'll be

140	T4	You have one thing to a sheet. A minimum of ten sheets (laughs)
141	S11	I've got loads of models as well
142	T4	It's going well. I mean if you keep going at this pace because the more you kind of do it, the more time there is to kind of get it right
143	T4	So, I think for Friday, (I'd just) consolidate what's happening on the archive here, I mean you seem to have a clear idea. But think about the theatre, the impact of the theatre of the memory on the street elevation and how that relates to the rest of them, the building form, what materials are you going to.....what language of materials you're going to build up
144	T4	And I'd start kind of bump in the scale up to 1:100
145	T4	So you can start testing some of these rooms and spaces
146	S11	Because they're just pretty much boxes or shapes aren't they?
147	T4	They are at the moment. Some of them still, for me, feels quite awkward
148	T4	And you will probably start finding out or finally testing them when you get to larger scale
149	S11	Ok
150	T4	It's fine. I just like this diagram. I'm intrigue by it (section sketch)
151	T4	Because you can imagine little building like that, it will be fantastic
152	T4	This one long route that gets stuff slightly.....you know, you walk over all kind of different textures, go through dark spots, and there's little anti-rooms off it (gestures). That's what I've thought you've done as an archive space
153	S11	I could have as a ramp running around the building like...but I did have that. But then I decided to do it as very confined...
154	T4	Yeah, you know, I think it's right, you know, to...where it is (Conversation ends at 28:41)

Matrix of Cognitive Interaction

Tutorial Session 12 (Tutor T4, Student S11)

Seg. No	Contributor		Cognitive Action		Cognitive Organisation		Domain of Knowledge		Transformation		T (min)
	Precede	Current	Precede	Current	Precede	Current	Precede	Current	Precede	Current	
1		S11		F		SY		PRO		L	0.133
2	S11	S11	F	F	SY	SY	PRO	CON	L	L	0.533
3	S11	S11	F	F	SY	CO	CON	CON	L	V	0.100
4	S11	S11	F	F	CO	SY	CON	PRO	V	V	0.300
5	S11	S11	F	F	SY	CO	PRO	PRO	V	V	0.067
6	S11	T4	F	F	CO	SY	PRO	PRO	V	L	0.050
7	T4	T4	F	F	SY	SY	PRO	CON	L	V	0.100
8	T4	S11	F	E	SY	SY	CON	CON	V	V	0.433
9	S11	S11	E	F	SY	SY	CON	PRO	V	V	0.150
10	S11	S11	F	E	SY	SY	PRO	PRO	V	V	0.300
11	S11	S11	E	F	SY	SY	PRO	PRO	V	L	0.033
12	S11	T4	F		SY		PRO		L		0.033
13	T4	S11		E		SY		PRO		V	0.183
14	S11	S11	E	F	SY	SY	PRO	CON	V	L	0.133
15	S11	S11	F	F	SY	SY	CON	CON	L	L	0.417
16	S11	T4	F	F	SY	SY	CON	CON	L	V	0.017
17	T4	S11	F	F	SY	SY	CON	CON	V	V	0.100
18	S11	S11	F	F	SY	SY	CON	CON	V	L	0.333
19	S11	S11	F	F	SY	SY	CON	PRO	L	L	0.217
20	S11	T4	F	F	SY	SY	PRO	CON	L	V	0.033
21	T4	S11	F	F	SY	CO	CON	CON	V	V	0.250
22	S11	S11	F	E	CO	SY	CON	PRO	V	V	0.217
23	S11	S11	E	F	SY	ST	PRO	PRO	V	V	0.233
24	S11	T4	F	F	ST	SY	PRO	PRO	V	L	0.433
25	T4	T4	F	F	SY	ST	PRO	PRO	L	V	0.183
26	T4	S11	F	F	ST	ST	PRO	PRO	V	V	0.017
27	S11	T4	F	F	ST	ST	PRO	PRO	V	V	0.367
28	T4	T4	F	M	ST	SY	PRO	PRO	V	V	0.217
29	T4	S11	M	F	SY	SY	PRO	CON	V	L	0.183
30	S11	S11	F	E	SY	SY	CON	PRO	L	V	0.183
31	S11	T4	E	E	SY	SY	PRO	PRO	V	L	0.233
32	T4	T4	E	M	SY	SY	PRO	CON	L	L	0.133
33	T4	T4	M	M	SY	SY	CON	PRO	L	L	0.083
34	T4	S11	M	F	SY	SY	PRO	PRO	L	V	0.017
35	S11	T4	F	F	SY	SY	PRO	PRO	V	V	0.467
36	T4	S11	F	F	SY	SY	PRO	CON	V	V	0.117
37	S11	T4	F	F	SY	SY	CON	CON	V	V	0.033
38	T4	S11	F	F	SY	SY	CON	CON	V	V	0.050
39	S11	S11	F	F	SY	SY	CON	PRO	V	L	0.450
40	S11	S11	F	F	SY	ST	PRO	CON	L	L	0.167
41	S11	T4	F	F	ST	SY	CON	PRO	L	V	0.117
42	T4	S11	F	F	SY	ST	PRO	CON	V	V	0.467
43	S11	T4	F	F	ST	SY	CON	PRO	V	V	0.217
44	T4	S11	F	F	SY	SY	PRO	CON	V	V	0.067
45	S11	T4	F	E	SY	SY	CON	PRO	V	L	0.267
46	T4	S11	E	F	SY	SY	PRO	PRO	L	V	0.250
47	S11	S11	F	F	SY	SY	PRO	PRO	V	L	0.083
48	S11	S11	F	M	SY	SY	PRO	PRO	L	L	0.067
49	S11	T4	M	M	SY	SY	PRO	PRO	L	V	0.150
50	T4	S11	M	F	SY	CO	PRO	PRO	V	L	0.067
51	S11	T4	F	F	CO	ST	PRO	CON	L	L	0.200
52	T4	T4	F	F	ST	SY	CON	CON	L	V	0.167
53	T4	S11	F	F	SY	SY	CON	CON	V	V	0.383
54	S11	T4	F	F	SY	SY	CON	CON	V	V	0.233
55	T4	T4	F	F	SY	SY	CON	PRO	V	V	0.100

56	T4	S11	F	F	SY	SY	PRO	CON	V	V	0.217
57	S11	S11	F	F	SY	SY	CON	PRO	V	L	0.217
58	S11	S11	F	E	SY	SY	PRO	CON	L	V	0.167
59	S11	T4	E	E	SY	CO	CON	CON	V	L	0.067
60	T4	T4	E	E	CO	SY	CON	PRO	L	L	0.633
61	T4	T4	E	F	SY	CO	PRO	PRO	L	L	0.050
62	T4	S11	F	F	CO	CO	PRO	PRO	L	V	0.233
63	S11	S11	F	F	CO	CO	PRO	PRO	V	L	0.167
64	S11	T4	F	F	CO	SY	PRO	PRO	L	L	0.133
65	T4	S11	F	E	SY	SY	PRO	PRO	L	V	0.067
66	S11	T4	E	F	SY	SY	PRO	PRO	V	L	0.150
67	T4	S11	F	F	SY	CO	PRO	PRO	L	V	0.283
68	S11	T4	F	F	CO	CO	PRO	PRO	V	V	0.400
69	T4	S11	F	F	CO	CO	PRO	PRO	V	V	0.150
70	S11	T4	F	F	CO	SY	PRO	PRO	V	L	0.067
71	T4	S11	F		SY		PRO		L		0.033
72	S11	T4		F		SY		PRO		V	0.200
73	T4	S11	F	F	SY	SY	PRO	PRO	V	V	0.033
74	S11	T4	F	F	SY	SY	PRO	CON	V	V	0.167
75	T4	T4	F	F	SY	SY	CON	PRO	V	V	0.117
76	T4	T4	F	M	SY	SY	PRO	PRO	V	V	0.133
77	T4	S11	M	M	SY	ST	PRO	CON	V	L	0.467
78	S11	S11	M	F	ST	SY	CON	CON	L	V	0.583
79	S11	T4	F	E	SY	SY	CON	PRO	V	L	0.083
80	T4	T4	E	F	SY	SY	PRO	PRO	L	L	0.017
81	T4	S11	F	F	SY	SY	PRO	PRO	L	V	0.017
82	S11	T4	F	F	SY	SY	PRO	PRO	V	V	0.050
83	T4	S11	F	F	SY	SY	PRO	PRO	V	L	0.283
84	S11	T4	F	M	SY	SY	PRO	PRO	L	L	0.150
85	T4	T4	M	M	SY	ST	PRO	PRO	L	L	0.067
86	T4	T4	M	M	ST	SY	PRO	PRO	L	L	0.267
87	T4	S11	M		SY		PRO		L		0.050
88	S11	T4		F		SY		CON		V	0.183
89	T4	S11	F	F	SY	SY	CON	CON	V	V	0.017
90	S11	T4	F	F	SY	SY	CON	CON	V	V	0.100
91	T4	T4	F	F	SY	SY	CON	PRO	V	V	0.333
92	T4	S11	F	F	SY	SY	PRO	PRO	V	V	0.083
93	S11	T4	F	F	SY	SY	PRO	PRO	V	V	0.083
94	T4	S11	F	M	SY	SY	PRO	CON	V	V	0.067
95	S11	S11	M	M	SY	ST	CON	CON	V	V	0.950
96	S11	T4	M	F	ST	SY	CON	PRO	V	V	0.033
97	T4	S11	F	F	SY	ST	PRO	CON	V	V	0.150
98	S11	T4	F	M	ST	SY	CON	PRO	V	V	0.233
99	T4	S11	M	F	SY	SY	PRO	CON	V	V	0.167
100	S11	T4	F	F	SY	SY	CON	PRO	V	V	0.033
101	T4	T4	F	M	SY	ST	PRO	PRO	V	L	0.333
102	T4	T4	M	M	ST	SY	PRO	PRO	L	L	0.100
103	T4	T4	M	F	SY	ST	PRO	PRO	L	V	0.383
104	T4	T4	F	M	ST	SY	PRO	PRO	V	V	0.133
105	T4	S11	M	F	SY	SY	PRO	PRO	V	V	0.033
106	S11	T4	F	F	SY	SY	PRO	PRO	V	V	0.433
107	T4	T4	F		SY		PRO		V		0.200
108	T4	S11									0.067
109	S11	T4		F		SY		CON		L	0.083
110	T4	S11	F	F	SY	CO	CON	CON	L	V	0.250
111	S11	T4	F	F	CO	CO	CON	PRO	V	L	0.100
112	T4	S11	F	F	CO	SY	PRO	PRO	L	V	0.067
113	S11	T4	F	F	SY	SY	PRO	PRO	V	V	0.033
114	T4	S11	F	F	SY	SY	PRO	CON	V	V	0.267
115	S11	S11	F	M	SY	SY	CON	PRO	V	V	0.067
116	S11	T4	M	F	SY	SY	PRO	PRO	V	L	0.100
117	T4	S11	F	F	SY	SY	PRO	CON	L	V	0.217

118	S11	T4	F	F	SY	SY	CON	CON	V	V	0.150
119	T4	S11	F	F	SY	CO	CON	CON	V	V	0.067
120	S11	T4	F	F	CO	CO	CON	CON	V	V	0.117
121	T4	T4	F	F	CO	SY	CON	CON	V	L	0.050
122	T4	S11	F	F	SY	SY	CON	CON	L	V	0.350
123	S11	T4	F	E	SY	SY	CON	CON	V	V	0.050
124	T4	S11	E		SY		CON		V		0.017
125	S11	T4		E		SY		CON		V	0.167
126	T4	S11	E	F	SY	SY	CON	PRO	V	V	0.083
127	S11	T4	F	F	SY	CO	PRO	CON	V	L	0.233
128	T4	S11	F	F	CO	SY	CON	CON	L	V	0.350
129	S11	T4	F	M	SY	SY	CON	CON	V	V	0.267
130	T4	S11	M	F	SY	SY	CON	CON	V	V	0.483
131	S11	T4	F	F	SY	SY	CON	CON	V	V	0.267
132	T4	S11	F	F	SY	SY	CON	PRO	V	V	0.317
133	S11	S11	F	M	SY	SY	PRO	PRO	V	L	0.383
134	S11	T4	M		SY		PRO		L		0.067
135	T4	S11									0.150
136	S11	T4		F		SY		PRO		V	0.183
137	T4	S11	F	E	SY	SY	PRO	PRO	V	V	0.233
138	S11	T4	E		SY		PRO		V		0.017
139	T4	S11									0.300
140	S11	T4									0.183
141	T4	S11									0.083
142	S11	T4									0.150
143	T4	T4		M		SY		CON		L	0.317
144	T4	T4	M	M	SY	ST	CON	PRO	L	L	0.067
145	T4	T4	M	M	ST	SY	PRO	PRO	L	L	0.117
146	T4	S11	M	E	SY	CO	PRO	CON	L	V	0.067
147	S11	T4	E	E	CO	CO	CON	CON	V	V	0.100
148	T4	T4	E	F	CO	SY	CON	PRO	V	V	0.117
149	T4	S11	F		SY		PRO		V		0.117
150	S11	T4		E		CO		PRO		L	0.067
151	T4	T4	E	F	CO	CO	PRO	CON	L	V	0.050
152	T4	T4	F	F	CO	SY	CON	CON	V	V	0.250
153	T4	S11	F	F	SY	SY	CON	CON	V	V	0.167
154	S11	T4	F	E	SY	SY	CON	CON	V	V	0.067