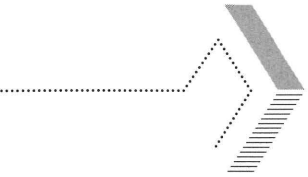

# 01 A Study on the Revelations of Design Students' Thinking Styles in Reflective Journals

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## ABSTRACT

Thinking, considered as part of the core skill set of a designer, is equally significant in learning and design processes. An awareness and understanding of a personal thinking style is therefore important for both teaching and learning. Using well-established theories of thinking and using an in depth multiple case method, the author explores the possibilities of exposing students' thinking styles through the medium of reflective journals. Eight journals are carefully examined in terms of where student attention is located, how they communicate and how they are thinking. A further aim is to provide a guideline that can aid teachers to analyze the journals as feedback for the ease or difficulty associated with their teaching strategy. While the study is framed within a university design program, its findings may be of more general application.

"Design is not one way of thinking, but several. In particular it is a mix of rational, analytical thinking and creativity" (Lawson and Dorst 2009, 28). In a psychological sense, the complex mental processes of design relates to cognition, intelligences and thinking styles thereby having a direct bearing on the process of learning and acquiring knowledge in the realm of education. While the aim of design education has always been the attainment of higher order thinking skills, evidence of such attainment might not be easily apparent. Reflective journals, sometimes promoted by educators as a learning tool, might be a source that could reveal the student's thinking. This research seeks to not only reveal students' thinking styles, but to study the reflective process in depth and the importance of reflective thinking in fostering creativity.

## BACKGROUND: REFLECTIVE THINKING — DIFFERENT PERSPECTIVES

Dewey, one of the earliest proponents and most influential psychologists in the area of reflective thinking defines reflective thought as "Active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends" (Dewey, 1960, 9).

Researchers like Boud, Keogh and Walker (1985) and Kolb (1984) have emphasized the role of reflective thinking in experience-based learning. Schön (1983) in his work on reflective thinking in professional practice mentions that the construction of practitioners' knowledge is by means of "reflection-in-action" which occurs during a learning activity and "reflection-on-action" which occurs after the activity is completed. Further, reflective thinking is often used in conjunction with metacognition. Self-reflection, according to Zimmerman (2000) forms an integral part of self-regulation that is the evaluation and monitoring of one's cognition in the learning process.

### THE IMPORTANCE OF REFLECTIVE THINKING

The importance of reflective thinking in design education and design practice has increased as the pace and demands of study and workplace often compromise the value of design (Meredith Davis, 2007). Its importance in education has been long realized by Dewey (1960) who feels that...

*reflection provides opportunities for students to discern their personal values and beliefs, find meaning in education and learn their strengths and weaknesses.*

Schön (1983) argues that the limitations of "Technical Rationality" in dealing with "divergent" situations in practice can be dealt with by the artistry of reflective thinking.

King and Kitchener's (1994) Reflective Judgment Model is especially useful in improving students' cognitive abilities while dealing with ill-structured or uncertain design problems and is useful in studying the learning process of students as well. Similarly, according to Lawson and Dorst (2009), reflective thinking develops students' problem-solving capabilities in a design situation thus developing design thinking capabilities (Cross, 2001). Reflective thinking generates new forms of thinking, helps to connect the different forms of thinking and promotes the idea of a life-long learning process (Kolb, 1984). Finally, it gives teachers an opportunity to study students' understanding of the subject thereby helping teachers to reflect on their own teaching and pedagogical strategies (Kolb, 1984; Boud et al., 1985).

### MODES OF REFLECTIVE THINKING

Not everyone reflects in the same way. The thinking style of each person affects the way they reflect. Thinking styles in turn affect learning style as modeled in Kolb's Experiential Learning Cycle, (1984). In contrast, Sternberg (1997) has categorized thinking styles into the functions, forms, levels, scopes and leanings of mental self-government. Thinking styles can also be classified into perception and divided into visual, auditory and kinesthetic learners. However, there are also several categorizations of thinking styles according to right- and left-brain capabilities. One study on design thinking is based on analyzing design cognition by interpreting design activities (Cross, 2001), another by types of design thinking strategies used during the design process (Lawson and Dorst , 2009).

### UNEXPLORED AREAS OF REFLECTIVE THINKING

Reflective thinking and thinking styles are areas that have been extensively researched. Recently, research has been done on reflective thinking tools such as portfolio, journal writing, technologically enhanced reflective tools and critiques. Little work has been done on how different thinking styles affect reflective thinking in design students. An area of exploration in the context of design education was to study the link between reflective thinking and thinking styles through the medium of design students' authorship of journals.

## THE RESEARCH QUESTION

*Do reflective journals reveal the thinking styles of design students?*

### STUDY ASSUMPTIONS

1. Journals are considered an appropriate means for reflection
2. They are given importance in the curriculum and assessment
3. They have been used to evaluate the students' understanding and learning process

### SUPPORT QUESTIONS

1 What are the expectations of teachers when they evaluate the journals?
2 What do students usually reflect on? Do they meet the teacher's criteria for reflection?
3 Are there any changes in the students' thinking based on the teacher's comments or based on contexts?
4 Is there any pattern in the thinking styles of design students?

### IMPLICATIONS OF THE RESEARCH

1 To make students aware of their own thinking styles and for self- improvement
2 To provide the teacher with a deeper understanding of the thinking and cognitive styles of students and how it relates to design thinking capabilities
3 To provide insights for teachers to reflect on their own teaching style, strategies and methods
4 Though the study was conducted in the context of design education, the findings of the research might be applicable to other disciplines as well...

*The research aim was to study how student thinking styles affect their reflective thinking abilities by studying its manifestations in journals.*

The word "reflective" implied that students used reflective thinking while making entries in journals. The "thinking styles" was to be determined by the researcher.

## LITERATURE REVIEW

### REFLECTIVE THINKING

Dewey (1960) regards reflective thought as a better way of thinking because its structure and purpose leads to a conclusion. Moreover, the act of inquiry aims to give a firm and rational basis to beliefs based on evidence. He stresses the need to make reflective thinking an educational aim by explaining that its values are of an intelligent action directed towards an aim of pre-arranging thoughts and of adding meaning to things. A habit of reflective thinking in students can be developed by drawing on the resources of natural curiosity, spontaneity of ideas in the form of suggestion and mental ordering. Teachers are urged by him to be engaged in reflective practice to add to the quality of teaching and make students realize the connections between their experience and studies.

Reflective activity according to Dewey has five stages:
1 suggestions — popping of ideas,
2 intellectualization — solving problems,
3 generating a hypothesis — observing and forming a guiding idea,
4 reasoning — extending and developing ideas
5 testing ideas — experimentation and verifying ideas by action.

Dewey's work laid the foundations for studies on experiential learning. Kolb (1984, 38) defines learning as "the process whereby knowledge is created through the transformation of experience." The learning process goes through four cyclic stages:
1 concrete experience
2 reflective observation
3 abstract conceptualization
4 active experimentation.

Kolb goes on to create four knowledge forms based on the four stages that generate the four learning styles (discussed later). His theories seek to link experiential learning to education and work by "translating the abstract ideas of academia into the concrete practical realities of people's lives (p 6).

Focus on the reflection stage was done by Boud, Keogh and Walker (1985). According to them, reflection in experience-based learning occurs in three stages of the activity:
1 preparation
2 engagement
3 processing.

This process is promoted by providing the circumstances for reflection to happen and by offering various techniques and activities to support learning (*figure 1*).

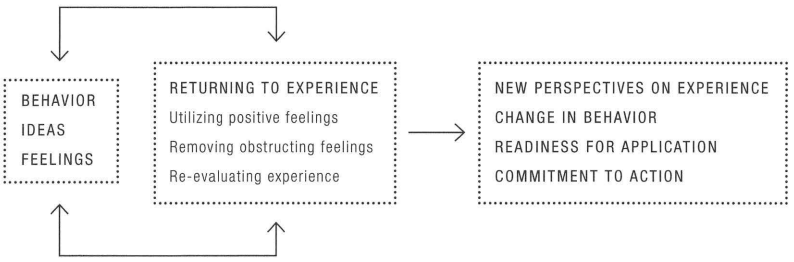



**FIGURE 1** *The Reflection Process in Context (Boud et al., 1985, p 36)*

Dealing with problems, especially those of an uncertain nature, according to Schön (1983) cannot be effectively solved through scientific techniques. He proposed a new epistemology in practice called "reflection-in-action" (p 54) which in fact stems from a practitioner's "tacit knowing–in-action" (p 49). The practitioner when faced with a problem applies his / her experience to invent new methods to solve it directly in situ. Schön has taken examples from architecture and psychotherapy to explore his theories in a collaborative atmosphere where reflection happens conversationally between teacher and student; where the student is pushed into thinking about the solutions for the problems through reflective questions aided by the experienced teacher.

Cowan (1997) extended Schön's work by adding a "reflection-for-action" which anticipates that a learner brings forward ideas before and after the learning activity and becomes a reflection-for-action regarding the next activity; the process involves analytical questioning.

Levels in reflective thinking are explained by King and Kitchener (1994) in their Reflective Judgment Model. It is comprised of 7 stages grouped into 3 levels of reflection:

1 *pre-reflective* — where students believe there is a direct answer to problems,
2 *quasi-reflective* —students realize that certain problematic situations will have uncertain answers and that judgments should be based on evidence and
3 *reflective* — students acknowledge that judgments on complex problems can never be certain and that knowledge is constructed in a context.

Moon (1999, 123) has classified three approaches to learning by students: Surface, Strategic and Deep. The deep approach implies reflection where the intention is to understand ideas by relating to past experiences, looking for patterns and principles and critically examining course content and establishes its significance in learning, termed "transformative learning."

Others have contributed to reflective schemas as well (Gibbs, 1998; Rolfe et al., 2001; Flavell et al., 1993; Zimmerman, 1990). See *Table 1* for a summary of these ideas.

| ASPECT(S) OF REFLECTIVE THINKING | THEORY/ PROPONENT | MODEL / FEATURES |
|---|---|---|
| Inquiry, Experience, Values, Attitudes, Analytical Reasoning | Dewey (1960) | Stages in reflective activity :<br>Suggestion<br>Intellectualization<br>Hypothesis generation<br>Reasoning<br>Testing of ideas |
| Experience | Experiential Learning Cycle by Kolb (1984) | Concrete experience<br>Reflection<br>Abstract conceptualization<br>Active experimentation |
| | Boud, Keogh & Walker (1985) | Reflection in stages of learning activity:<br>Preparation<br>Engagement<br>Processing |
| Problem-solving | Schön (1983) | Reflection-in-action<br>Reflection-on-action |
| | Cowan (1997) | Reflection-for-action |
| Questioning | Reflective Model by Gibbs (1998) | Description<br>Feelings<br>Evaluation<br>Analysis<br>Conclusion<br>Action plan |
| | Rolfe et al. (2001) | What<br>So what<br>Now what |
| Levels in reflection | King & Kitchner (1994) | Pre-reflection<br>Quasi-reflection<br>Reflection |
| Reflection in learning approaches | Moon (1999) | Approaches to learning:<br>Surface<br>Strategy<br>Deep |
| Metacognition / Self-regulation | Flavell (1993)<br>Brown (1987) | Categories of metacognition:<br>Metacognitive knowledge<br>Metacognitive monitoring |
| | Zimmerman (1990) | Self-regulated learning<br>Use of strategies<br>Monitoring outcomes and decision making<br>Interdependent motivation |

**TABLE 1** *Theoretical framework for reflective thinking*

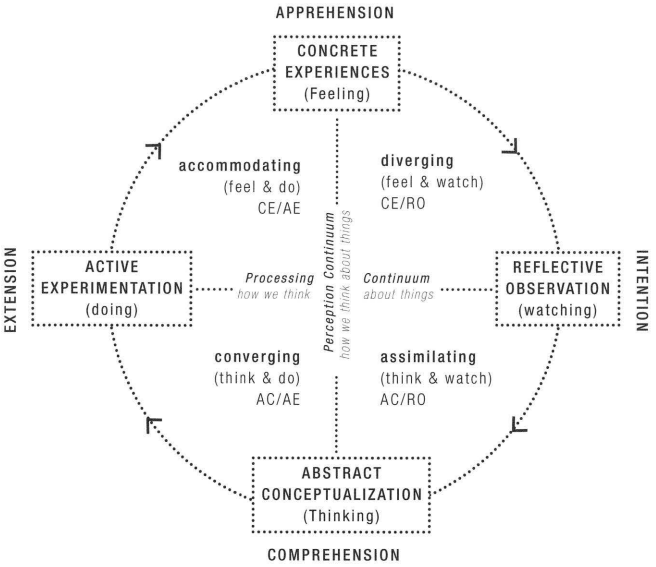



**FIGURE 2** *Kolb's Learning Styles adapted from www.businessballs.com/kolblearningstyles.htm*

Kolb's Experiential Learning Cycle divided the learning process into two basic dimensions: Prehension (perception) and Transformation (processing). The two prehension processes are apprehension and comprehension and two transformation processes of intention and extension are contradictory yet related to one another and "their synthesis produces higher levels of learning" (Kolb, 1984, 61). The combinations of the four modes or processes determine the four learning styles in a matrix proposed by Kolb (*figure 2*). They are:

1 *Divergence* (concrete reflection) — learners are more imaginative, good at brainstorming, feeling-oriented and are observant
2 *Assimilating* (abstract reflection)— emphasis is on reasoning inductively, creation of models and theories based on logic
3 *Convergence* (abstract action) — strengths are problem-solving, practical application of ideas, decision-making; task-oriented rather than feeling-oriented
4 *Accommodation* (concrete action) — learners with this style are action-oriented, adaptive, risk-takers, use trial and error to solve problems

In Kolb's view, an individual programs his/her own unique structure of learning based on psychological characteristics, experiences, environment, decisions and contextualities. There is a tendency to

be stronger or lean towards one or more learning styles. Several other factors might shape and change learning styles (social environment, age, education, job requirements, etc.). However learning is more effective with the emphasis and development of all four modes.

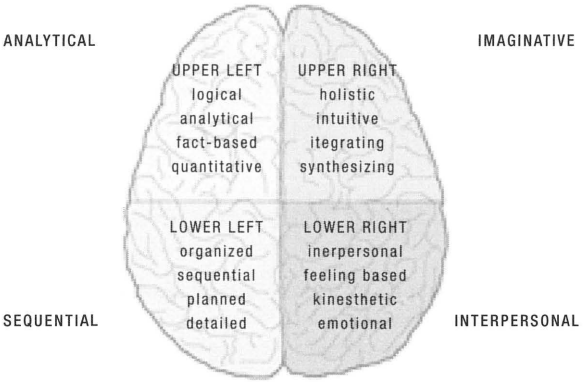



**FIGURE 3** *Herrmann's Whole Brain Model (Adapted from Herrmann, 1996, p 15)*

Ned Herrmann's (1996, 17) Whole Brain Model (*figure 3*) is also divided into quadrants, "based on the physiology of the thinking brain" – two halves of the cerebral cortex and two halves of the limbic system. The four thinking parts are interconnected and function "together situationally and iteratively" (p 16), however one is generally more dominant which determines thinking preferences in individuals. Herrmann associates the quadrants with four styles: Analytical, Sequential, Imaginative and Interpersonal. This tool is also useful for understanding creative competencies and limitations at an individual, group and organizational level.

## DESIGN THINKING

Analyzing design cognition, Cross (2001) uses concepts quite unlike ones from scientific cognitive studies. Using the method of protocol analysis he has studied the following areas:

1. *Problem formulation* — designers look for ways to structure an ill-defined problem; concentrating more on gathering information about the problem than defining it. They tend to frame the problems and simultaneously work on their solutions
2. *Solution generation* — designers tend to jump to solutions, get attached to concepts; generate a wide range of solutions. Creativity does not happen suddenly, it is based on problem-framing, co-evolution and generation of concepts, sketching used as a tool to explore concepts

3 *Process strategy* – a flexible approach seems to be the key to success, designers also make cognitive or modal shifts between problems and solutions, "intuitive features of design behavior is most effective" (p 93) in the design process.

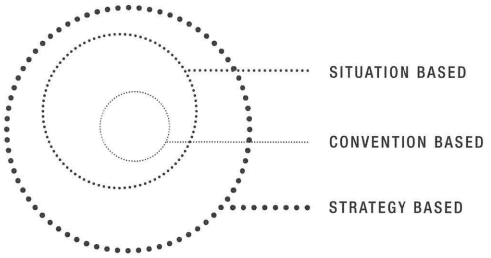



**FIGURE 4** *Design Thinking Strategies*

Lawson and Dorst (2009) present three approaches designers use to find solutions to problems (*figure 4*):

1 *Convention-based* — applying conventions and rules in design practice in knowledge-based design problems
2 *Situation-based* — arriving at a fitting solution through creative application of knowledge and skills in the context of the design problem
3 *Strategy-based* — changing the situation to create new situations, resulting in different design proposals that requires a higher form of design expertise

| THINKING STYLES BASED ON: | THEORY/ PROPONENT | MODEL / FEATURES |
|---|---|---|
| Learning preferences | Experiential Learning Cycle Kolb(1984) | Learning styles: Divergent Assimilating Convergent Accommodating |
| Physiology of the brain (Left and Right dominance) | Whole Brain Model Ned Herrmann (1996) | Thinking styles: Analytical Sequential Imaginative Interpersonal |
| Design cognition (problem solving) | Cross (2001) | Problem formulation Solution generation Process strategy |
| | Lawson & Dorst (2009) | Convention-based Situation-based Strategy-based |

**TABLE 2** *Theoretical framework for thinking styles*

### JOURNAL WRITING

Writing is co-related to reflection and learning. Writing gives form to converting experience into learning (Moon, 1999, 187). In the opinion of Rolfe et al. (2001), ...

*the emphasis should be on the concept of writing-to-learn rather than learning-to-write as writing is not a mere reporting of events or facts but a process of understanding something that results in developing higher and deeper levels of meaning in learning.*

It therefore becomes a purposeful activity that helps the ordering of thoughts, and connecting ideas.

Moon (1999) and Rolfe et al. (1985) agree on the following purposes of writing journals:

1. Record experience
2. Facilitate experiential learning
3. Enhance learning through reflections and metacognition
4. Record problem-solving processes of students
5. Provide a form of assessment
6. Enhance creativity- intuitive understanding
7. Promote group interactions
8. Improve professional development
9. Explore new perceptions

Moon (1999) also mentions the different forms of journal writing:

1. *Unstructured forms* — free writing and reflecting, recording an event, double–entry journals (factual recording and then reflecting)
2. *Structured forms* — autobiographical writing, exercises, questions and answers on selected issues, portfolios (that include other documents, pictures, stories or poetry)

But the writing process runs into problems generally arising due to a lack of understanding what aspects of the experience or learning are to be analyzed; external demands, the extent to reveal emotions, confidentiality and professional consequences (Rolfe et al., 2001;Walker, 1985). Such reasons, apart from the time the writing process takes are why the desired outcomes of reflective writing are not achieved.

## RESEARCH DESIGN AND METHODOLOGY

### RESEARCH METHODOLOGY

The research was more of an exploratory and suggestive kind and did not aim to prove a hypothesis. The analysis of the main variables of reflective thinking and thinking styles suggested that they were

rather complex in nature, were more subjective to each student and were to be studied in the context of their personal journals. All these indicated that a qualitative approach was best suited for this research.

## RESEARCH METHODS

Owing to the uniqueness and particularity of each student's journal, a case study method of qualitative research was considered appropriate. In this case it was a multiple case study method or a "collective case study " (Creswell, 1998) to illustrate the central issue of finding evidences of thinking styles in reflective journals. The appropriateness of the method was established after studying Guthrie (2010), Denscombe (2007) and Creswell's (1998) descriptions of case study characteristics that include an in-depth and holistic investigation of a particular case that occurs in a natural setting, the study of complexities of the processes and relationship within each situation, comparing case studies for similarities and differences, which allows the use of multiple sources and methods for triangulation of data.

The case studies were chosen from different design disciplines. Moreover they were studied from the perspectives of different tutors and from that of the researcher. The process involved the following:

*Semi- structured interview* — this method was chosen as it allowed for probing into the subtleties and complications of the research problem. It also proved more effective than other methods like questionnaires and structured interviews.

*Content analysis* — it is a method that is especially useful to analyze written texts as it can reveal the meanings, thoughts, values and ideas of the writer (Guthrie, 2010, 238). In addition, in this particular study it gave a different viewpoint for analyzing the subject through the eyes of the researcher.

## RESEARCH DESIGN

All the participants belonged to The School of Design (SD) in The Hong Kong Polytechnic University. The students whose journals were researched were selected from different year levels of study (B.A Hons in Design) to get a range of reflective thinking capabilities. The selected works were two each from subjects tutored by four SD professors making it a total of eight case studies. The students belonged to different design disciplines. However the students were not interviewed because of time constraints, practicality and availability issues; the journals were considered as spokespersons for their authors.

Content analysis was done prior to interviewing the tutors to ensure that the researcher was not influenced by their thoughts, thus preserving the interpretation of the findings.

Selection of the students and their work was left to the discretion of the tutors. The four tutors were interviewed based on their prior consent with the selected journals displayed. The interviews were conducted in SD and were video-taped subject to the approval of the interviewees. Video-taping of the interview was ideal as it captured the tutor's "pointing out" to the journal while talking. The questions were mostly open-ended; a sample of the interview questions can be seen in *Table 3*. Each interview lasted for about an hour. Other probing questions were also asked depending on the answers.

All the participants (tutors and students) were assured of anonymity and confidentiality.

| | |
|---|---|
| **WARM-UP** | How long have you taught in PolyU? What subjects do you normally teach? How familiar are you with reflective journals as a means of assessment (in terms of experience)?<br><br>Can you give me a brief background about this subject? What are the submission requirements of this subject? How many students were in the class? |
| **ON REFLECTION** | **1** How would you define or describe reflection? Why do think design students need to reflect?<br>**2** When would you ideally want the students to reflect?<br>**3** When do students need to submit their reflections?<br>**4** What do you expect the students to reflect on?<br>**5** What has this particular student reflected on? Did you find anything unique? What do you think he / she has missed out on?<br>**6** How deep was the reflection?<br>**7** Do you think students have trouble sorting out feedback from tutors and peers in relation to their own ideas?<br>**8** Do you think the students have benefited from reflecting on their work? In what way? Were the students aware of it?<br>**9** What have you learned / didn't learn about the student from his / her reflection? |
| **ON THINKING STYLES** | **10** In your experience from interacting with this student, what is your impression of the thinking skills of this student? Do you think the students were aware of their own strengths and weaknesses?<br>**11** At their level of studies in the course, what kind of thinking development did you expect to see in the students?<br>**12** Do you think the journal can show evidences of the above? (10 & 11)<br>**13** How do you examine the journal? |
| **ENDING** | What are your views on journals as a medium for tracing thinking patterns as well as a medium for reflection?<br><br>Anything else you would like to add?<br><br>Thank you for participating in this interview! |

**TABLE 3** *Sample on interview questions*

## DATA ANALYSIS

### STAGE 1 — CONTENT ANALYSIS OF CASE STUDIES

The students and their journals (case studies) were coded from S1 to S8 and J1 to J8 respectively; the tutors were coded from T1 to T4. It should be noted that, depending on the subject requirements, the word 'journals' included all pieces that were reflective in nature. *Table 4* shows the details of the case studies including the coding, student level, discipline and journal type.

| STUDENT / JOURNAL | STUDENT LEVEL | TUTOR | SUBJECT | DESIGN DISCIPLINE | TYPE |
|---|---|---|---|---|---|
| S1 / J1<br>S2 / J2 | Y1 | T1 | Design Thinking | Advertising<br>Product | Reflective journals |
| S3 / J3<br>S4 / J4 | Y2 | T2 | Information Design | Visual Communications | Reflective journals |
| S5 / J5<br>S6 / J6 | Y3 | T3 | Final Project | Advertising | Reflective reports |
| S7 / J7<br>S8 / J8 | Y4 | T4 | Cultural Research Methodologies | Product<br>Environment & Interior | Reflective Papers |

**TABLE 4** *Case Study Details*

### INITIAL CATEGORIZATION OF RAW DATA

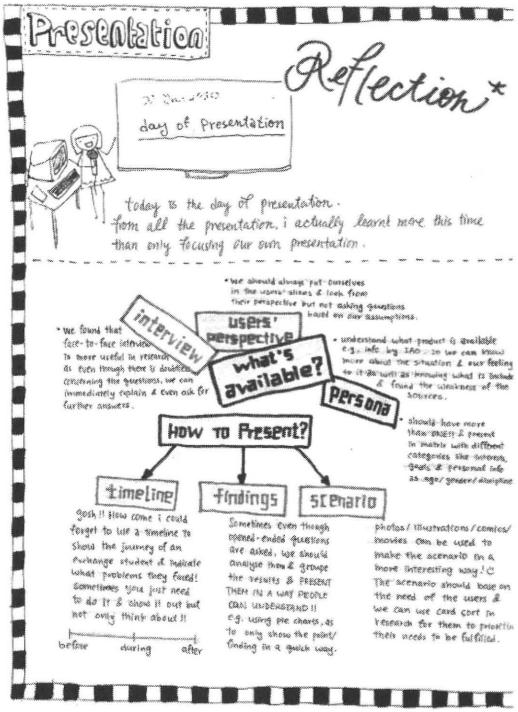
A detailed analysis of J3 is shown as a sample of the analytical process applicable to all the case studies. The analytical steps include: memos, keywords from the memos and a conceptual framework based on the previous understandings. To chunk the data, the journal was analyzed page-wise in the form of memos, keeping in mind the three broad categories of reflecting thinking, thinking styles and journal writing. Keywords or phrases were pulled out that gave a clue to reflective thinking. For example, "What is information design? Should we define...purpose of creation?" implies that the student is using questioning as a means to reflect. The way the content was represented was categorized under memo on journal-writing. Based on the writing as well as the visuals, there was an attempt to interpret the overall thinking of the student (represented as memo on thinking). Sample pages of J3 are shown (*figures 5.1, 5.2, and 5.3*).


**MEMO ON JOURNAL WRITING**
Use of different fonts and borders, verbal, visual, bold titles, use of symbols, sketches, mapping

**MEMO ON THINKING**
Visualization of learning through mapping, verbal, and visual thinking, analytical thinking

| MEMO ON REFLECTIVE THINKING | KEYWORDS/PHRASES TAKEN FROM WRITING |
|---|---|
| Summary and understanding of lesson through diagrams | After discussion, key point, reflections, first lesson, generally talk about, card sort, I think useful, because, get ideas quickly, interesting questions, discussion, however, brief, questions arise after class, get more ideas after lessons, or from books borrowed today |
| Reflection on teaching method → | |
| More questions leading to generation of ideas → | |
| Attempt on furthering knowledge through books → | |

**FIGURE 5.1** *Sample of page-wise analysis of J3*

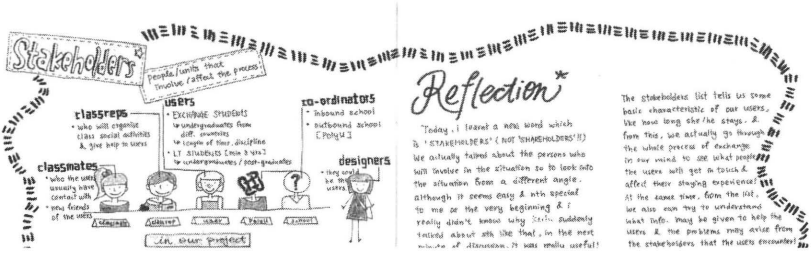



**MEMO ON JOURNAL WRITING**
Scenario depictions, use of cartoons, content divided into parts, feeling expressed

**MEMO ON THINKING**
Evaluation, deep analysis of parts, visualization of learning

| MEMO ON REFLECTIVE THINKING | KEYWORDS/PHRASES TAKEN FROM WRITING |
|---|---|
| Group evaluation, but no mention of other groups → | Today, from all presentation, I actually learn more, we found, gosh, how come, sometimes need, should always, but not, assumptions, understand, more than one, in a way understand what products, can be used, more interesting, need of users, prioritize their needs |
| Analyzing mistakes suggestions for improvements → | |
| Evidence of new learning → | |
| Analyzing users' needs → | |

**FIGURE 5.2** *Sample of page-wise analysis of J3*




**MEMO ON JOURNAL WRITING**
Verbal and visual change in border and fonts, pictorial representation, cartoons

**MEMO ON THINKING**
Visualization of learning, analytical, finding usefulness of learning

| MEMO ON REFLECTIVE THINKING | KEYWORDS/PHRASES TAKEN FROM WRITING |
|---|---|
| Evidence of new learning | Learnt a new word, different angle, didn't know why, suddenly, really useful, users, |
| Analyzing user psychology and problems | affect their experience, understand, the problems |

**FIGURE 5.3** *Sample of page-wise analysis of J3*

Using the memos, a mind map was created to give a holistic picture of the student's reflections with categories that showed a broad grouping of different aspects of reflective thinking derived from the data. Some of these categories were common to all case studies. The areas that had been most concentrated on were chosen for further analysis.

## CONCLUSIONS ON ALL INITIAL FINDINGS

At this stage there was more evidence of analytical than creative skills in J1, J2, J7 and J8. Evidences of analytical, creative and strategic skills were shown in J5 and J6. Reflections on the conceptual development in design projects were seen in J3 and J4. There was an indication of a change in thinking in all journals and of learning something new. The journals were used in different ways — as a medium for communication / conversation, as a sketchbook or as a presentation tool. All the students were given guidelines on how to reflect in the respective subjects.

## CATEGORIZATION USING A CONCEPTUAL FRAMEWORK

Since there was difficulty in interpreting the thinking styles, the concept of reflection as learning was used to find a link to thinking styles. Accordingly, the reflections were categorized into the 3 interactive areas: ways of learning, ways of thinking and ways of communication; learning and thinking as internal processes externalized through communication. This basic model (*figure 6*) integrated previously mentioned theories to support journal analysis. There was more concentration on evidence that pointed to thinking skills particular to design.

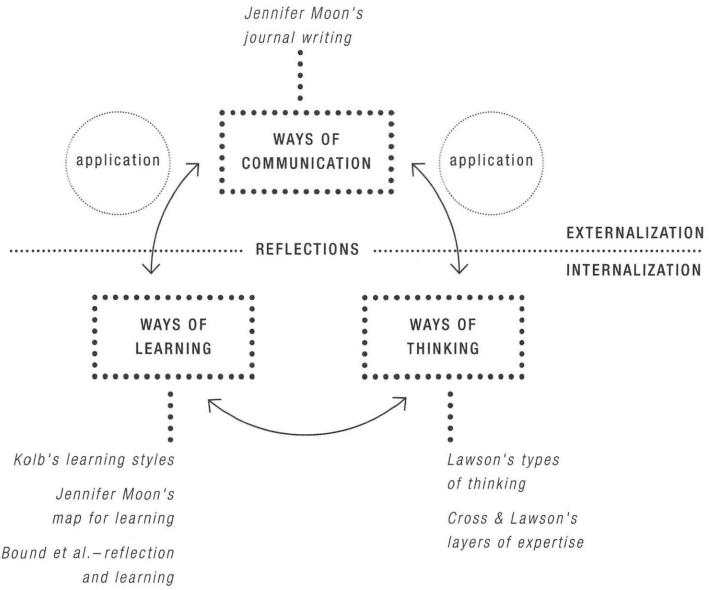



**FIGURE 6** *Conceptual framework of analysis*

Several levels of analyses were conducted to narrow down to areas of reflection that could be interpreted as ways of learning. There was an attempt to generalize the categories for all case studies by finding common patterns of reflection, but this was easier for reflections within the same subject and discipline. Working from the Conceptual framework in Figure 6, a logical chart derived from Journal 3 (J3) shows the main areas that Student 3 (S3) chose to reflect on (*figure 7.1*). The missing or incomplete areas suggest that these could be possible ways of learning as well as clues for detecting thinking skills.

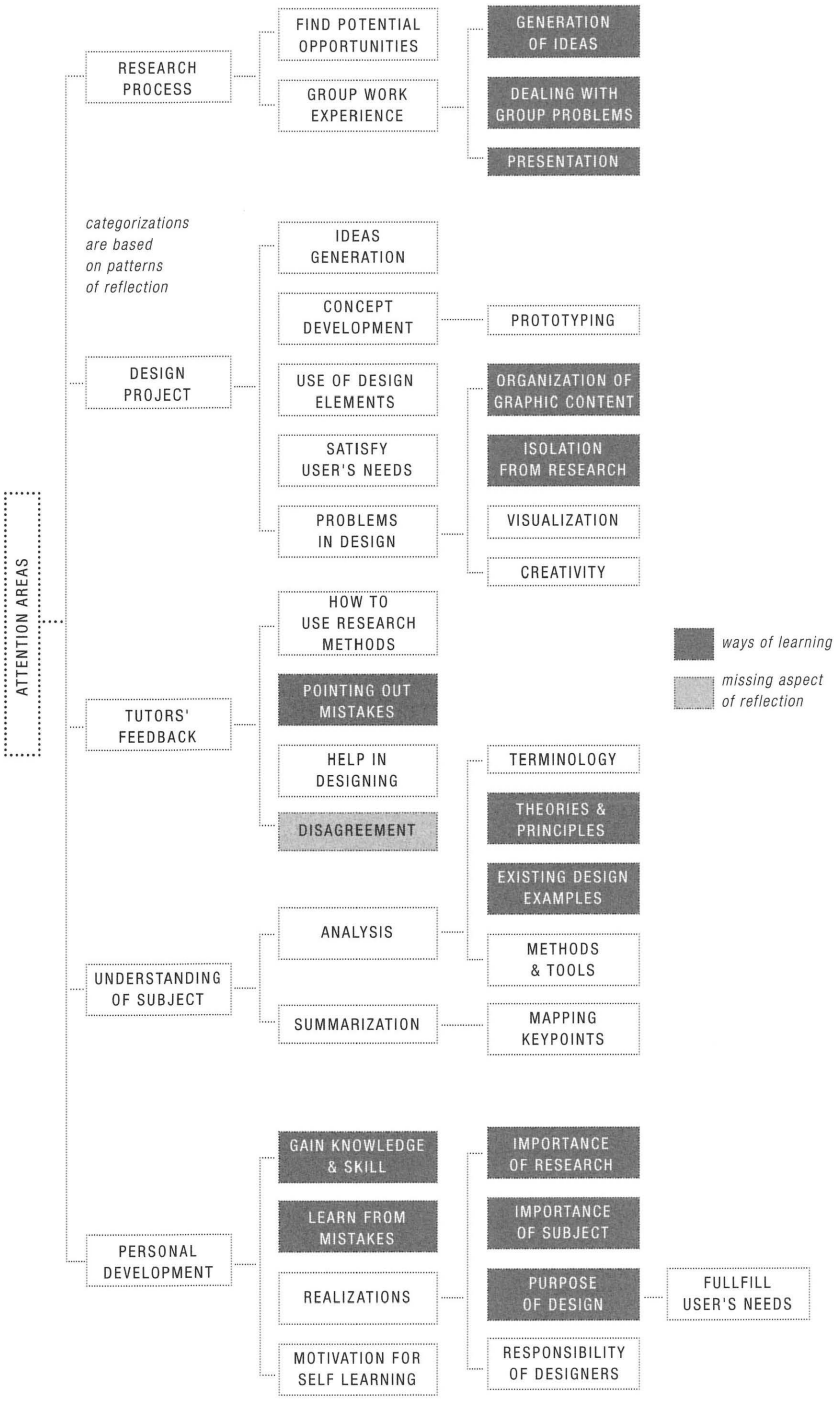



**FIGURE 7.1** *Analysis of J3 using the conceptual framework*

A similar chart (*figure 7.2*) was made for ways of communicating according to the content layout, use of texts and visuals in the reflections.

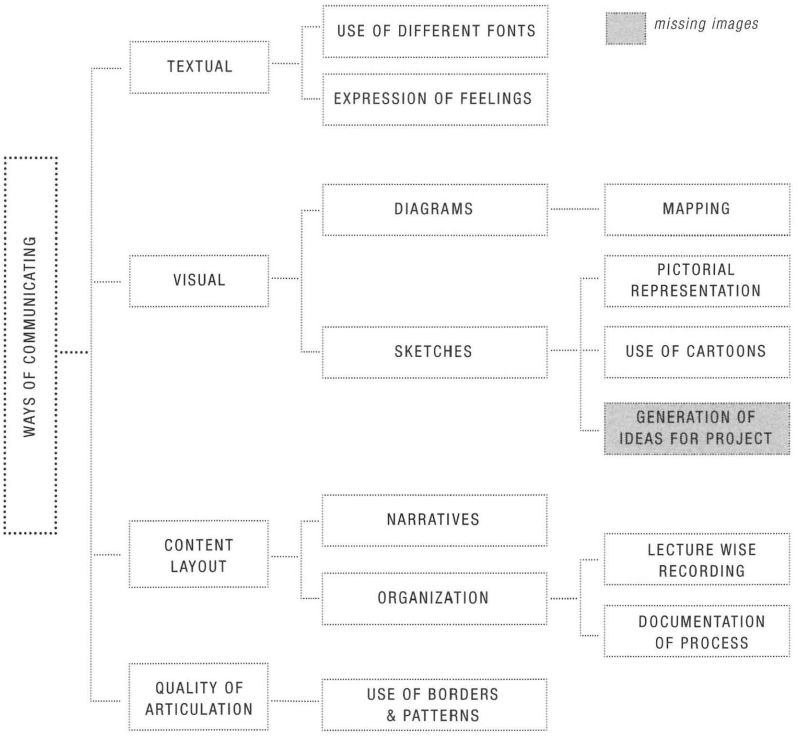



**FIGURE 7.2** *Analysis of J3 using the conceptual framework*

The two charts (*figures 7.1 and 7.2*) were combined to create a chart for thinking (*figure 7.3*). Ways of learning might give clues to the preferred learning style. Learning through the design project provided clues of thinking skills that were developed by the student especially for the purpose of design, while communicating is also a way of thinking.

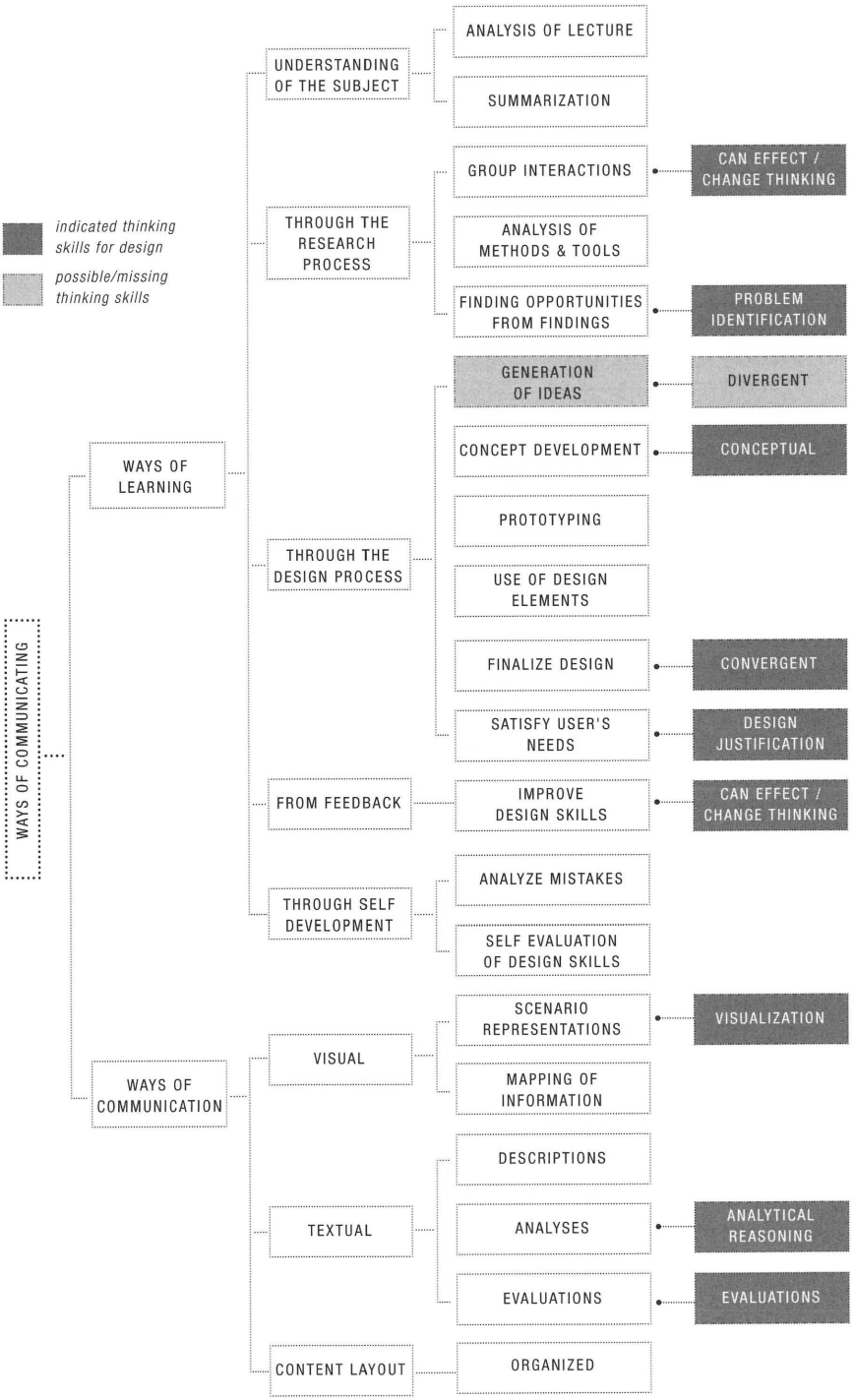



**FIGURE 7.3** *Analysis of J3 using the conceptual framework*

*Table 5* is a summarization of the strengths and weaknesses of students' reflections using common categories across all the case studies.

**TABLE 5** *Summarization of Stage 1 analyses*

| | REFLECTION STRENGTHS | | | | WEAKNESSES |
|---|---|---|---|---|---|
| | **Demonstration of Understanding of Subject** | **Construction of Learning** | **Personal Development** | **Development of Thinking Skills** | |
| **S1** | Through self-learning and analysis of the subject's purpose | Through interactions and analysis of learning activities | Discerning values, developing new perspectives, learning new skills and abilities, understanding design and role of designers, expressing feelings | Analytical, reasoning, unclear creative skills | No reflections on learning difficulties, group work problems (too positive), tutors' feedback<br><br>No evidence of concept development and divergent thinking<br>Few sketches or diagrams |
| **S2** | Through visual representations and analysis of learning activities | Through interactions | Understanding the purpose of the subject, learning new skills and abilities, drawing inspiration | Analytical, visualization, unclear creative skills | Little reflection on tutors' feedback<br><br>No evidence of concept development and divergent thinking<br>Analysis not deep |
| **S3** | Through visual representations and applications in research and project | Through interactions, from feedback, critical analysis of experience, through mistakes | Deep understanding of subject's purpose, purpose of design, role of designers, expression of feelings | Analytical reasoning, conceptual, problem-solving and visualization, unclear creative skills | Little evidence of divergent thinking<br>No mention of disagreements with tutors' feedback (personal viewpoint)<br>Not enough critical evaluation of designed product |
| **S4** | Through analytical reasoning and applications in research and project | From feedback, critical analysis of experience | Strong opinions on the subject's purpose, role of designers, deep self-evaluation | Analytical reasoning, evaluation, problem-solving, unclear creative skills | Little evidence of divergent thinking<br>Too textual, few visual representations |
| **S5** | Through design and execution | Through interactions, by pausing =for reflection, through self-evaluation | Discerning values, achievement of design purpose | Analytical reasoning, evaluation, strategy, problem-solving, change in thinking and new approaches, unclear creative skills | No reflection on research methodology, final presentation critique<br><br>No mention of learned theories<br><br>No images of final presentation or product |

| | | | | | |
|---|---|---|---|---|---|
| **S6** | Through design and execution | Through feedback, by stepping back, through self- evaluation | Justifying design actions, achievement in translating the concept | Analytical reasoning, evaluation, creativity, strategy, problem-solving, change in thinking and new approaches | No reflection on choice of topic, team-work process, final presentation critique<br>No mention of learned theories |
| **S7** | Unclear | Through interac-tions, through analysis of research findings, personal experiences, comparison | Discerning values, developing new skills | Maybe analytical, reasoning and logical skills, no creative skills | No reflection on subject (research methodologies), tutors' feedback, design project<br>No visuals |
| **S8** | Unclear | Through inter-actions, through analysis of research findings | Realization of the im-portance of the subject | Maybe analytical, reasoning and logical skills, no creative skills | Brief reflection on subject (research methodologies)<br>No reflection on tutors' feedback<br>Brief mention of design project<br>No visuals |

## STAGE 1 — COMMON PATTERNS

While it was difficult to create general categories across all the case studies, certain common patterns emerged as mentioned in *Table 5*.

S1, S2, S7 and S8 all had not reflected on tutors' feedback; this was something that needed to be clarified while interview-ing the tutors.

At the same time, since both S7 and S8 had not reflected on 'research methodologies' (the subject's focus) this indicated that it might have been a missed learning goal with regard to understanding the subject. Therefore, while not aiming to be prescriptive, the chart developed in Figures 7.1, 7.2 and 7.3 provides an idea for tutors on how to examine the journals in terms of their own expectations and goals.

Additionally, at the discipline and program outcomes level, it is possible to look for evidences for transferable skills like critical thinking, strategic thinking, visualization skills and perhaps communication and interpersonal skills. Creative thinking was found only in one instance (S6). This is again dependent on the strength, scope and requirements of reflections and the nature of subject, project or course. Examples of thinking processes that involved the use of different thinking skills could be also be understood, such as problem-solving or concept development as suggested in the table.

The conceptual model that was developed was partially helpful in detecting learning styles. For instance, in the case of S4 it

was clear that the preferred learning style was that of 'Assimilating,' as the student showed an inclination towards learning theories and concepts. Similarly S1 and S3 were more of the 'Divergent' learning style as they seemed to be imaginative and feeling-oriented. S6 could be both 'Divergent' and 'Accommodating.' But it was not possible to be as conclusive in the other case studies, because of the subjective and personal nature of reflective writings, the diversity of students and subject context. Ways of communication however revealed the verbal (S4) and visual thinkers (S2and S3).

### STAGE 2 — INTERVIEWS WITH TUTORS

The aim of the interviews was to not only obtain the tutors' views on reflective thinking and its importance in the curriculum but to also learn about their expectations, way of assessing and use of journals to reveal students' thinking styles. The transcribed interviews were re-organized into common categories across all the transcriptions for the purpose of cross analyzing against the researcher's analysis and to cross analyze among the four tutors, to triangulate the data and to get different perspectives.

Cross analyses of the case studies were performed in two ways: *Table 6* compares each tutor's analysis of their students' case studies with that of the researcher's, concentrating on the aspects of reflective thinking, journal writing and thinking styles; data from the tutor's interviews were examined. Some of the significant categories used for cross analyses were:

1. Meaning of reflection
2. Strong vs. weak reflections
3. Benefits of reflection
4. Disadvantages of reflection
5. Factors affecting reflective thinking
6. Advantages of and hurdles in journal writing

| | POINTS OF AGREEMENT WITH TUTOR | DIFFERENCE IN OPINION / NEW PERSPECTIVES | |
|---|---|---|---|
| | | TUTORS' | RESEARCHER'S |
| **S1** | Self-critical, lots of questions, justifications, reflection on design, different perspectives, self-motivation to learn, strong analytical and reasoning skills | Reflections on a wider context, creativity through reflections, no theoretical basis for rationale | No reflection on personal problems and feedback, no concept development sketches, expressive writing |
| **S2** | Good summarizations and documentation, descriptive, analysis not deep | No wider context | Strong visualization skills, organized, no reflection on feedback, no concept development sketches |
| **S3** | Pictorial representations of subject, deep understanding and analysis of subject, strong visualization skills | Interpreted teaching, hierarchical and nested thinking, taxonomy, reflection on a wider scale, poor creative skills, not a good doer of design | No evidence of divergent thinking, too much agreement with tutor's feedback |
| **S4** | Deep analysis of the subject and theories, connections, strong opinions on purpose of design and role of designers, strong writing skills, unclear thinking pattern | Linear thinking, contemplative and deep, intellectual approach, poor creative skills, not a good doer of design | No evidence of divergent thinking, too much agreement with tutor's feedback, few sketches |
| **S5** | Reflections on feedback, few sketches, no evidence of final product, random and unrelated images | No evidence of creativity, no expansion of ideas, linear and fragmented thinking, realistic thinker | Indication of change in thinking, evidence of analytical reasoning, conceptual, evaluative and strategic skills, no reflection on research, no indication of theories |
| **S6** | Constantly questions actions, needs confirmation through feedback, evidence of creative thinking, new approaches, strongly linked writing, good guided report | Creativity through clear reflections, pattern of linked segments and reflection, creative process, idealistic thinker | Strong justification of design, evidence of analytical, reasoning, conceptual, evaluative, strategic skills, no reflection on team work |
| **S7** | Good critical thinker, organized and logical | Comprehensive - project and progress, asks questions | Related learning to personal experience, discerning values, evidence of analytical and reasoning skills, no reflection on the subject and feedback, no evidence of concept |
| **S8** | --------- | no time to process the thinking | Not organized, stopped short, no time to process the thinking Logical and clear, evidence of analytical and reasoning skills, no reflection on subject and feedback, no evidence of concept development, no sketches |

**TABLE 6** *Cross analyses of Case Studies*

There were points of agreement between the tutors and the researcher. However, the tutors were sometimes more successful in tracing thinking patterns, primarily because of their constant interactions with the student, although such evidence was not found in the journals. Though learning was a central purpose of reflections, they were also looking at the scope of reflections (breadth and depth). All of them believed in the connection between reflective thinking and creativity. But the tutors differed in their expectations of subject reflections, discussed in the next section.

## DATA SYNTHESIS

### SYNTHESIS OF STAGE 2 OF ANALYTICAL FINDINGS

The following topics inform and synthesize the main results of the analyses of stage 2 backed by some of the theoretical perspectives explored earlier.

Reflection and learning: T1, T2 and T4 mentioned reflection as a process of internalizing the teaching, and interpreting it in a new way, of making connections (T1, T2, T4) or for self-awareness (T1 and T4) also known as metacognition (Flavell, 1997 and Brown, 1983). This closely follows Kolb's Learning Cycle (1984) of reflecting on experience to make abstract conceptualizations to be tested later. Questioning is an important aspect of reflection (T1, T2, T3 and T4) and is supported by reflective models of Gibbs and Rolfe et al. (1998). See *Figure 8*.

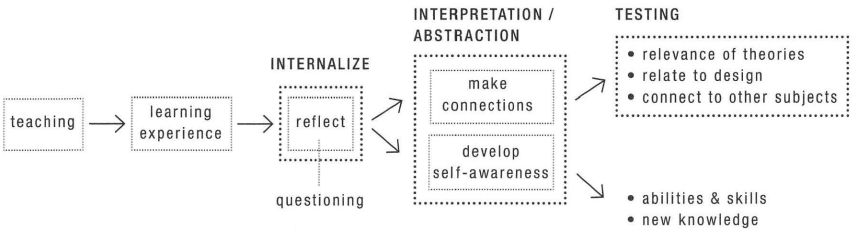



**FIGURE 8** *Relationship between reflection and learning*

Reflective thinking vs. creative thinking: Another way of looking at Kolb's cycle is mentioned by T3, action or creative action is reflected on to change the outcomes for the better (T1, T4). According to T3 design is a 3 step process: research-creation-reflection. Additionally research involves analytical thinking (T1); the insights are used for creation, and reflection again starts after evaluation to aid the decision and implementation of design (*Figure 9*). According to T4, students who are good at critical thinking are good designers. However T3 felt

that reflection can sometimes restrict creative freedom. But T2 and T3 strongly felt that designers need a balance between the left and right sides of their brain (Lawson and Dorst, 2009).

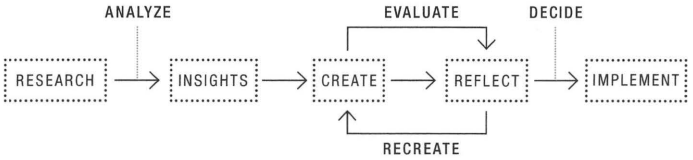



**FIGURE 9** *Reflective thinking vs. creative thinking*

Attitudes towards reflection: The importance of project-based learning in design education implies that students are more involved in the 'doing' of design (T2 and T3) and are more instinctive in their approach (T4). Thus, visual-based subjects require little or no reflection (T3). Besides, reflection takes time, energy and concentration, and the system might not support it (T1, T2 and T4). Therefore, it might be difficult to motivate students to reflect or develop a habit for reflection. At the same time there is also a difference in the disciplines' attitudes towards or requirements for reflection (T1 and T4).

Assessment of reflection: T1 said that there are discrepancies among disciplines while grading reflective works but these might be solved by common agreement despite the nature of design. T4, however, thought that assessment is difficult because of the subjective nature of reflection and because of the abstract nature of subjects; it also becomes difficult to give students concrete guidelines for reflection. The tutors often used their own discretion while assessing or used comparison for assessment (T2, T3 and T4). T1 on the other hand felt that the descriptors in the assessment matrix needed to be improved.

Expectations vs. responses: Though all the tutors provided guidelines and some sort of criteria for reflection, T2 and T4 preferred not giving too many parameters, and rather welcomed the unexpected response that reflection provides. T1 and T2 both expressed their surprise on finding the student emphasized something that they did not think was important in their teaching. T2 was especially excited when one of the students re-interpreted the teaching through diagrammatic reflections. T4 mentioned some of the learning difficulties students expressed through the reflections that were not otherwise revealed in tutorials.

These were important pointers for teaching and for tutors' reflection on their teaching (*figure 10*).

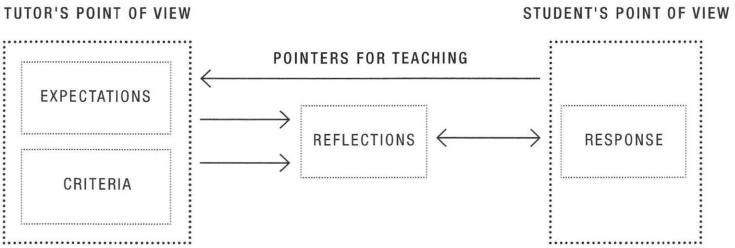



**FIGURE 10** *Expectations vs. Responses*

Reflective learning through interactions: In the subjects lead by T1 and T4, students were immersed in an interactive environment and were encouraged to reflect on peers' works. T2 however felt that the learning environment was lacking and students relied too much on tutors' feedback. T3 echoed this thought and felt that students thought they were not good judges of the quality of their own work. T3 and T4 felt that tutorials and critiques were premises where students sometimes gained insights, that is Schön's reflection-in–action (1983), but according to T4 it was a matter of retaining information and noting these insights.

Writing vs. visualizing: All the tutors agreed that writing didn't come easily to design students because of the perception that writing and reflection were left-brained activities and students couldn't relate it to design (T2). Academic background and lack of language skills might also affect the quality of reflection (T2). T1, T2 and T4 stressed the importance of writing in organizing, filtering and editing thoughts. T2 mentioned that reflections can be a combination of texts and diagrams. Journals served as an effective communication tool for presenting thoughts; communication and presentation skills are vital for designers (T2 and T3). The above skills were noted as learning outcomes, common to all disciplines and served as evidence of learning in the Outcome Based Education System (T1, T2 and T3).

Journals as a means to reveal thinking styles: Though journals were good for tracing the reflective process, evidence for the creative process was in the form of sketches (according toT3) and so the portfolio was a better medium. T2 also felt that the creative part was not seen much in the reflection unless concept development was included. T4 agreed that reflection on the design project should be included in the reports.

All the tutors found it possible to trace thinking patterns of students through the journals as seen in Table 5. In the case of students S4 and S5 it was difficult to trace a pattern because S4's writing was organized in a linear form and S5's writing had no structure and was segmented. On the other hand S3 had a hierarchical structure of thinking from the way the content was re-organized, similar to Sternberg's Theory of Cognitive Styles (1997) and S6's writing was clearly linked. However, T2 commented on the fact that both S3 and S4 were strong thinkers but not good doers. S1 and S3 showed reflections on a wider perspective while S4 was deeper. But S2 showed a reflective pattern of being constantly descriptive. Students S1 and S6 also showed a change in their thinking through their reflections; from convergent to divergent. S5 in comparison did not show progress in thinking. All tutors indicated that personality among other factors (for example, age, background) was associated with reflective writing and thinking skills.

Therefore, there are different versions of thinking in terms of patterns, skills and styles, as seen in *Figure 11*.

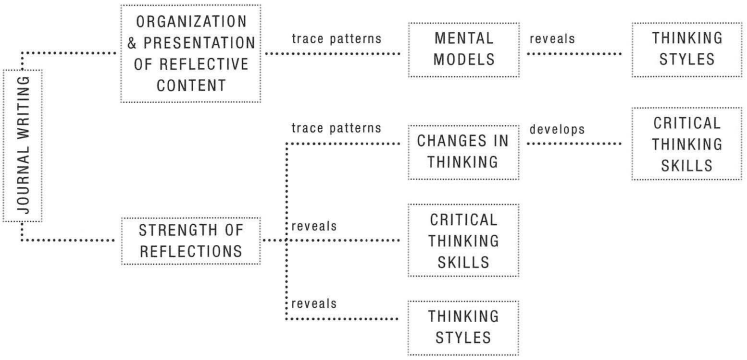



**FIGURE 11** *Journals as a means to reveal thinking styles*

## SYNTHESIS OF STAGE 1 AND 2

The goal was to find a closer relationship between the three main components of reflections, thinking styles and journal writing and to address the research question.

Learning styles can determine thinking styles, the evidence was found in critical self-reflections of the learning experience. Evidence of thinking skills might be another way of revealing thinking styles. It also could indicate left and right brain thinking abilities and conform to Ned Herrmann's Whole Brain Model (1996).

At the same time, as already discussed, tutors had different interpretations of thinking patterns according to levels of reflection, scope of reflections and reconfiguration of teaching. This depended on what the student chose to reflect on and how it was represented. These have been narrowed down in terms of re-organizing and prioritizing of thoughts supported by Sternberg's Theory of Mental Models. Re-configuration could also be an indication of creativity. Notwithstanding the fact that there are several factors such as teaching styles, assessment criteria and student diversity that affect reflective writing, the above ways of finding learning styles, thinking skills and mental models might be able to reveal thinking styles (*figure 12*).

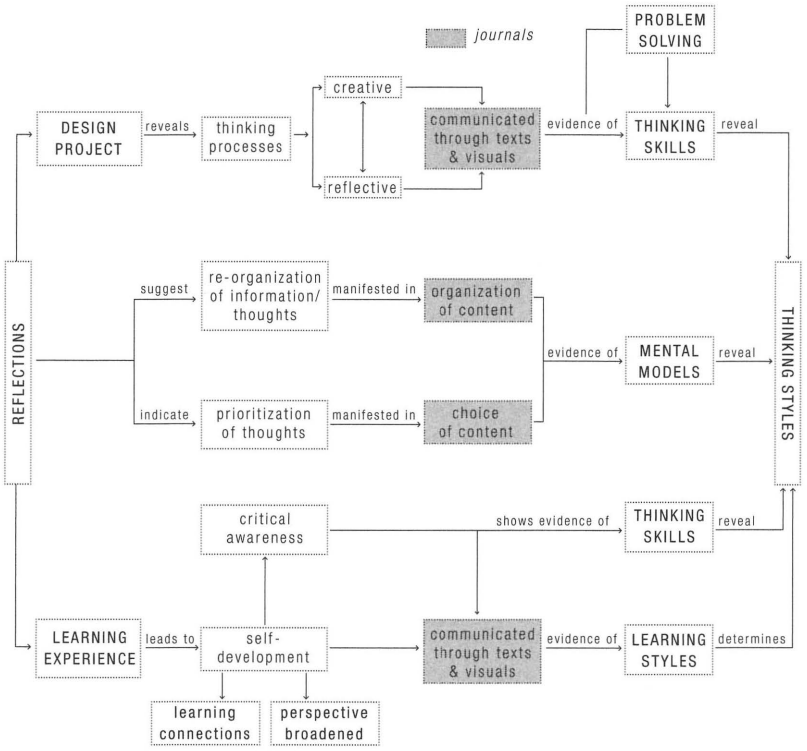



**FIGURE 12** *Synthesis of findings to answer the research question*

Following the above synthesis, a guideline was developed that could give tutors pointers to assess reflective journals and also give them clues to detect students' thinking styles. It covers the various facets

of reflective thinking and writing, as shown in *Figure 13*. This could also help to focus on what the tutor thinks is essential in the course being taught.

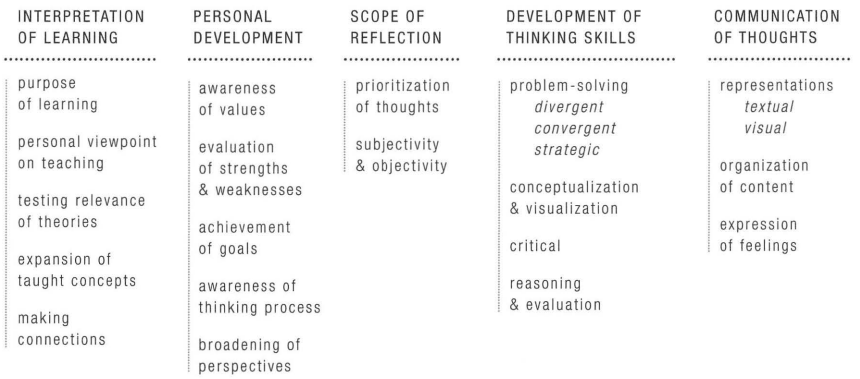



**FIGURE 13** *Guideline for assessing reflective journals*

## DISCUSSION

The revelatory nature of the reflective journals with respect to thinking styles and learning styles of students provide an opportunity for tutors to test the quality of their own teaching, their teaching methods or strategies and to test the tutors' effectiveness in conveying the intent of their expectations to students. It was evident that the students' responses sometimes presented challenges to those expectations.

The guideline encompasses different aspects of reflective writing from various theoretical perspectives. Tutors can select an appropriate approach with which to understand the thinking of the student; they can then communicate this to the student. In this way, the use of reflective journals becomes more focused for both tutors and students. However the effectiveness of the guideline to reveal a holistic picture of the students' thinking is dependent on certain factors such as choice of reflective content and method of communication. It emphasizes the subjective nature of reflectivity and various interpretations in its assessment. As the guideline was synthesized from analyses of a limited number of journals, one might question its validity. In a wider context of research strategies, there is always a question of reliability and validity of a case study method because its results cannot be generalized. However, the study manages to explore the potential of reflective journals to reveal thinking styles and has found some patterns.

*Essentially, this research is about depth rather than breadth, and is exploratory with suggestive results.*

Although a gamut of thinking styles were explored, the study might have fallen short of exploring students who have a disposition to learn by doing, a learning style that is also supported by the studio teaching style and project-based learning in design education. All the same, according to Edward de Bono (1985) it does not imply that doers do not need to think. What might be highlighted in studio-based learning and especially in design practice is the tacit nature of design. Creativity, anticipation of problems, imaging, visualization, perception, aesthetics, intuition and using judgment are all examples of this dimension, a dimension that has been deeply developed by Michael Polanyi (1983). Though Schön (1983) also subscribes to the concept of tacit knowing–in-action, he also appreciates the importance of reflection on the tacit knowledge to improve a task and perhaps provide a way to make that knowledge explicit.

The importance of writing as a reflective communication tool cannot be ignored by students when they present their design work in practice in the form of writing design statements or justifying their design choices especially in a trans-disciplinary environment. The acts of writing and the idea of literacy are however undergoing a change, because digital media alters thinking in many ways as creative interactions or reflective conversations. Similarly, observing interactions in tutorials and critique; recording and analyzing the change in thinking in these situations could provide new directions for research into student thinking patterns. The study also is incomplete and biased because there was no chance to interview and learn the students' perspectives on journal keeping and on their own reflections.

## CONCLUSION

Reflective thinking is an important part of the design thinking process and is critical to learning, therefore it is vital in both the 'knowing-what' and 'knowing-how' of design education. The findings of the research and the assessment guideline might provide tutors with a means to use reflective journals to test the alignment between teaching and learning in the curriculum. While the study offers a glimpse into the existing climate in one school that supports reflective thinking, it can also provide clues on what remains to be examined and incorporated.

*The results of the study can help design students become more aware of their own thinking and become motivated to pursue reflective thinking more actively, developing it into a life-long and transferable learning and designing skill.*

They might come to appreciate that ironically, reflection, as described by Biggs and Tang (2007, p 43) has the possibility to transform them from what they are to what they might wish to become.


## ACKNOWLEDGMENTS

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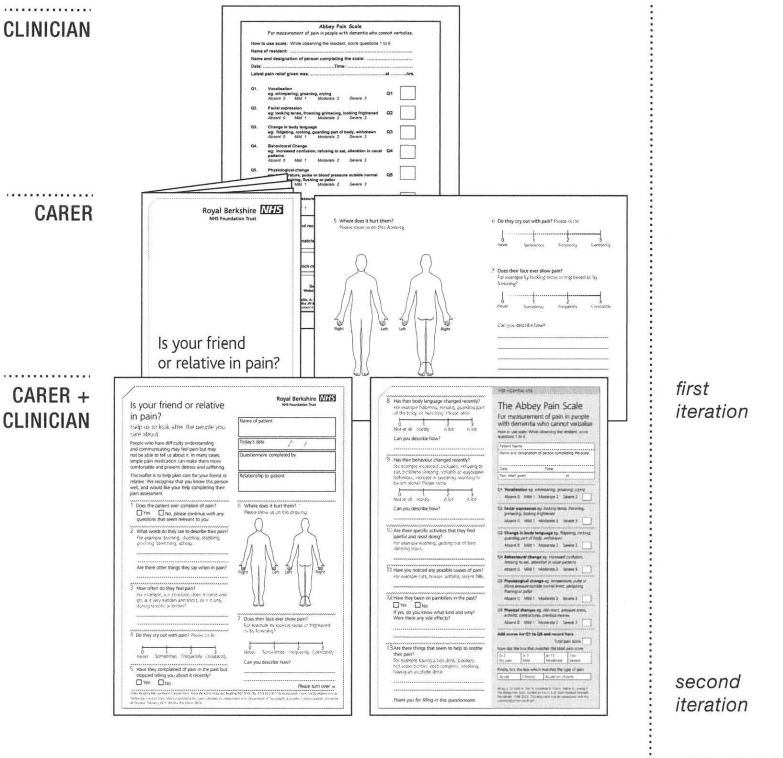
## ABOUT THE AUTHOR

*Born in India, Aruna Venkatesh graduated with a Diploma in Architecture from Rachna Sansad, Mumbai, India. With a brief experience in working with architectural firms in India, she joined the interior design industry in Hong Kong, working mainly on hotel design projects. In the capacity of an assistant interior designer she has been involved in the various aspects and phases of hotel design from concept development, design development, material co-ordination and site inspections. She later started practicing interior design as a free-lancer for a project in India. Having developed a keen interested in teaching design, she went on to do a Masters in Design (Design Education) from The Hong Kong Polytechnic University. Her final dissertation was a research project in reflective thinking studied through the premises of design students' reflective journals. During the course she discovered her passion for design research and hopes to find opportunities to pursue this interest either in academia or in the industry. Her current areas of interest lie in design cognition; to explore how creativity is nurtured in education and then works in the framework of practice.*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