A Different Kind of Black and White

Freehand drawing is enjoying a widespread renaissance and one more interesting setting is in its role in fostering epistemic development – the practice of wise thinking skills in the management and resolution of complex problems such as those found in engineering and industrial design.

This book explores how moral and ethical dimensions of thinking and decision-making can be helped to flourish across different ways of knowing, with a focus on visual intelligence. The connecting processes of perception are the primary way we make sense of the world, by creating and using systems of classification and boundaries. These systems influence the way we make choices, sometimes also inhibiting us from learning to see things differently.

The author suggests that one way in which these boundaries can be dissolved, and our minds liberated, is to develop visual intelligence, through exploring relationships between metaphor and generative drawing, metaphor being a mental activity of thinking and imaginative leaps, while drawing is knowledge-making through the cooperation of hand and eye. Bringing these together flexes the mind to seek new ways of understanding, a feature of epistemic development.

These ideas were developed in the setting of a postgraduate industrial design course for graduate engineers, Innovation Design Engineering, at the Royal College of Art, London when the author was the Senior Tutor on the course, the study resulting in a PhD from the Graduate School of Education, University of Bristol, in 2012.

The book discusses approaches to epistemic development in relation to experiential learning, quoting from the students' descriptions of their encounters with ways of knowing based on value judgments rather than the safety of facts, and the often alien activity of free-hand drawing, and what might be discovered from it. Chapters on prehistoric Cave Art and early medieval practices of the Art of Memory provide further reflections on what it means to draw, and what a drawing is. A chapter on the history of engineering education discusses the narrowing effects of the persistent prejudice that sees abstract and theoretical approaches to knowledge as superior to practical skill and experience.

While the research was initially conducted within the domain of industrial design engineering, its concerns and recommendations are relevant to many other areas of professional practice. Different kinds of knowing are needed to engage with complex problems with conflicting social, economic and cultural criteria. Responsibility leads to the realisation that we are everywhere connected, and sometimes implicated, a starting point for the development of wisdom.

These principles hint at a deeper role for the university especially for post-graduate education, beyond the narrow instrumentalist training agendas of current economic and government thinking, to a larger vision of the meaning of professional development.

The book includes a wealth of teaching ideas applicable to undergraduate and postgraduate design and engineering education in pursuit of the aims described above.

A Different Kind of Black and White:

Visual Thinking as Epistemic Development in Professional Education

By

Prue Bramwell-Davis

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Visual Thinking as Epistemic Development in Professional Education

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INTRODUCTION

Engineers and designers have enormous social responsibility in our manufactured world, much of which is characterised by the generation and consumption of a limitless range of capital and consumer products underpinned and driven by a market economy. How should these players be educated in the values that enable them to take a responsible role in this process that produces such social and environmental challenges? This book explores the proposition that a rather unexpected subject – freehand drawing – can and should play a principal part in the education and professional development of engineers and designers. Its potential to foster the imagination and to promote reflection provides a sophisticated route to transformational learning, epistemic development and wisdom. Freehand drawing is also an experience that can bring the hidden and multi-dimensioned processes of learning into the open, bringing learning-to-learn to life, where more conventionally vocational subjects might be assumed to have obvious priority.

I would like to suggest, as have others, that design education is a very good setting for developing such higher levels of learning and thinking, and that such lessons from design education are also applicable in many other fields.

I might say that it is a many-linked chain that joins these ideas, but in fact it is more of a net. I have attempted to portray this multi-dimensional net and its strengths in several different ways. The study consists of a series of essays on what seemed to be the most salient subjects in a very varied landscape of academic disciplines, epistemological domains and cultures. Themes and arguments appear in different forms, an illustration of the interconnectedness of everything, itself one of the main ideas. The texts move between disciplines, finding common ground as well as juxtapositions, and attempting to go beyond the conventional separations between intellect and intuition, mind and senses.

The local setting and background of the study is the Industrial Design Engineering[1] (IDE) joint course with Imperial College of Science Technology and Medicine (ICSTM), at the Royal College of Art, London (RCA) during the time I was Senior Tutor between the years 1994 and 2004. Graduate engineers came to this post-graduate course to learn Industrial Design and to explore how to integrate its practices with their existing knowledge and experience in preparation for a more holistic professional design career.

Different disciplines and different ways of knowing and learning necessarily shared company in such a cross-disciplinary course. Being able to integrate them had the potential to become a driver of transformational learning, a level of understanding where processes of learning can be experienced as well as their results.

Accounts of their first-hand experiences by students on the course are set alongside and up against the essay texts in different places, to illuminate each other. While these inevitably produce a reading sequence, the intention is also to provide a figure and ground experience for the reader, the texts and voices in a process of conversation that will give more meaning to both. Comparing different kinds of experience, in this case of the voices of students, of myself, and the voices of academic text can produce a new field of ideas.

Many professions now recognise that learning how to learn is an essential aspect of training for practitioners. Such learning enables them to work effectively in today's rapidly changing knowledge environments, and in the interconnecting networks and systems of social, cultural and technological factors that are now the context of advanced professional practice. Since engineering and designing produce the environments we inhabit, and the objects and tools we use, it is these professions that structure much of the cultural and social as well as the physical worlds we live in. Professionalism in practice necessarily includes responsibility for the effects of this work. As awareness of these effects grows, so practice needs to be responsive to them, and should provoke education and training to adapt in their light.

[1] Now called Innovation Design Engineering.

Inevitably this cyclical process cannot run as smoothly and efficiently as it might since it consists of human beings and the histories of their cultural practices. As both are naturally resistant to change, there is a tendency for the epistemologies of different professional subject areas to stay thoroughly distinct, where there would be much benefit from the loosening of their boundaries.

Industrial Design (sometimes called Product Design[2]) requires its professionals to be able to think in different ways, for instance imaginatively and abstractly, analytically and holistically, and to act creatively and responsibly in diverse cultural and social settings. The profession encompasses the innovation and design resolution of products and tools which primarily address the marketing agendas of commercial enterprise. While less typically so at the time of this project, industrial design also addresses the needs of particular constituencies such as the elderly and the disabled. More recently a recognition that all design should be user-centred has considerably broadened and deepened the complexity of issues taken on by the profession. The need for a responsible use of energy and materials has added sustainability issues to professional design's criteria. All designers need to be able to balance creative thinking outside accepted ideas with evaluating and satisfying multiple constraints into a successful outcome that resolves a project's goals and constraints in the best possible way.

In mainstream undergraduate engineering education the tradition has been that students learn techniques in mathematics and information primarily in physics, to be applied to a range of technical problems. These problems are relatively well defined in the sense that they are not complicated by factors from the larger cultural, social or economic climate in which they are situated. They are similar to the 'normal' problems which are the mainstay of much professional engineering work (Vincenti 1990). Where they are significant in a larger context, these factors do not appear to impinge on the immediate work in hand. Both in training and later in work, however, much technical information is quickly out of date, and the engineer needs to be able to absorb new material, and manage new ways of learning. Also,

[2] See JISCmail discussion group: PhD-Design.

engineering projects are always in fact situated in the inhabited world, where political and cultural attitudes affect how much engineers have to take into account the social effects of their work. Unlike in the past, at least in modern participatory democracies, professional engineers increasingly have to consider the wider effects of their work as constraints in the project brief. This management of complexity requires a range of thinking and social skills that goes beyond the computational.

Nowadays engineers and designers receive much of their training within the university framework, sometimes with placements, working towards accepted standards of practice. The relevant professional associations are involved in this process, and also are responsible for further accreditation of individuals as part of continuing professional development.

The above is a 'short' perspective on the instrumental aspect of learning for professional practice. There is however another, sometimes contradictory role for university education: its concern for the personal development of students, as individuals and as members of society, and for the generation of new knowledge and ideas that may challenge its paymasters. These concerns can go beyond and sometimes run counter to the conventional agendas of the subjects being studied. Epistemic development describes the kinds of learning involved in being able to rethink one's understanding of knowing. In this setting it becomes a relevant set of ideas for exploring how to see learning as essential for participation and engagement in the world. Concepts of epistemic development take learning into the social arena, both as part of what learning *is*, and what it is *for*.

While boundaries may be blurred between goals that are instrumental, professional or personal, it seems to me that to be able to respond to these requirements epistemic development needs to have a central place in university education for the professions, including that of both engineers and designers.

As the Senior Tutor on the IDE course I worked with students who had had university training in Engineering, and who were now learning Industrial Design. My experience showed me that, despite much common ground in

later professional practice, (which had been the reason for setting up the joint course in the first place), the aims, principles and conventions of training and education in these two domains were very different, reflecting the broader difference in the cultures of the professions. Hearing certain kinds of oft-repeated remarks from the new students I wondered if design was a setting that could foster development of more mature ways of thinking, where people move towards reasoning that addresses issues of knowing in the face of uncertainty, using reflective judgement and other kinds of thinking at a high level. It seemed that the kinds of knowing used in design were more complex than those in engineering at undergraduate level. In that context maths and physics seemingly constituted objective and factual knowing, whereas design was also based on value judgements and points of view, many embedded in cultural and social history, itself influencing how knowledge is made and evaluated.

Different students had different experiences thinking and learning about what design consists of, what it demands. Coming from a background of engineering they came to realise, in the new setting, that they brought with them frames of mind that had formed the ways they thought about and understood knowledge in the world. Design skills and thinking challenged these ways of knowing at a profound level. Each had to find ways of accommodating and assimilating their experiences into different ways of thinking about what design could be, should be.

I decided to research these issues further, and received a PhD (with commendation) in 2012 from the Graduate School of Education at the University of Bristol.

This extended study reflects on how freehand drawing, an essential part of design thinking, could be a powerful activity for the shifts in learning described above. Sketch drawing involves visual thinking and perception. It uses open-minded processes of intuition and imagination, which can dissolve categories and boundaries around ideas, and show things in relationship rather than as separate entities. Imagination introduces uncertainty and its partner opportunity, and visual thinking then uses metaphoric processes to create new possible connections.

I set out to show that drawing is one of those activities where the interaction between the process and the product is so intimate and active that it can stimulate a heightened awareness. It can lead to an openness to reflection on experience and thus new learning. This may initially be a rather unfamiliar process, different from more conventional ideas of what learning is and how it takes place. Prior experience and habits may hamper engaging with such new processes, however high the motivation.

Much has been written about drawing in different domains of practice and theory. Here it was a case of adults coming upon freehand drawing, not necessarily from choice, but because it is an essential skill in design. Drawing could be, and is, described in curriculum plans for design courses, often in terms of learning outcomes. I have, however, tried to go somewhat below the surface, to see how visual thinking can contribute to epistemic development, by exploring the metaphoric connection between concepts and practices used in drawing, and how we use those concepts in understanding and interacting with the world.

Design has already been described as an activity that affects the lives of others. Designers almost always work with people from other disciplines, often taking a leadership role to coordinate contributions from diverse sources. Complex projects involve the resolution of briefs whose boundaries are always permeable and imperfect. In design training students can, and need, to acquire "the broadest base of decision making" [3] as they navigate the constraints of different kinds of project. By thinking of the furthest implications of their work, they come to realise the extent to which it entangles with and influences the lives and well-being of others. This became the stage on which the stories of epistemic development were enacted for, with and by the students in this study, leading to my contention that learning designing is a powerful way to learn to learn.

Several authors have been particularly influential in this multi-faceted study. Some of their work may have been done what might be described as 'a long time ago', but because their work crosses between disciplines, as does the

[3] *The Information Machine* (1958) Film by Charles and Ray Eames/IBM, discussed in *My Relationship with the Study.*

study itself, their work is particularly relevant in the current climate of renewed interest in interdisciplinary perspectives. These authors include for example Bruner, exploring beyond the boundaries of cognitive psychology to what he termed cultural psychology; Arnheim whose work explores the territories between perception and visual practices; Schön, philosopher and social scientist, who explored the management of systems inside and outside design, and Bucciarelli who, as an engineer, uses anthropological methods to study engineering.

I have also extensively discussed the work of Kolb and Fry, who in the context of experiential learning, developed concepts of learning as a cycle, where different ways of knowing are integrated through a dialectical process, a way of learning increasingly seen as applicable in many different domains. On the IDE course, moving the focus from teaching to learning so that students could become more aware of and take responsibility for their own learning was very relevant. Learning Cycle concepts provided a useful tool for approaching this perspective, which was new for many people, but also recognisable once it was opened up.

I have alluded to epistemic development as a dynamic process, even as a drama. However, development models tend to use other metaphors, usually associated with movement - journeys, routes and paths, involving stages, transitions and bridges, for example. Without trying to map a rigid pathway between engineering and design my approach has been to translate these into visual images for further exploration. I may do this in my mind's eye, in the physical environment as I move through it, or by drawing or looking at pictures. This process involves thinking in visual ways: where are these bridges and paths situated? From what, or whose point of view are they seen - above, below, in plan, in elevation? Are they seen from the viewpoint of a traveller, a pilgrim, or a detached observer outside the frame? How are they lit? Is the viewpoint static or moving or multiple? Are the journeyers purposeful and hasty, or dawdling while absorbing their surroundings, or being dragged unwillingly with not much view of what's round the next corner? (Bramwell-Davis 2007) I have found this a powerful process for exploring otherwise abstract propositions and concepts such as learning.

I have taken this use of metaphor into the exploration of more specific connections between visual and other kinds of thinking that are more directly connected to the challenges of epistemic development. To lead me back to my focus on the students' experience of drawing I have devised and developed a scheme of terms which have meaning in the making of visual work, and which also describe concepts used in the struggle to change or open up our ways of thinking, see things in a new light: in short - learn. As well as being explored from these two points of view, mine and the students', these concepts are illustrated with excerpts from the interviews to bring their usage back into the central focus of the students' experience on the stage of epistemic development.

This study approaches its subject from many points of view. However, designing makes one realise everything is connected. Innovations change the cultural, social and physical ecologies they are introduced into - whether this is a suddenly desirable new washing machine, or a more obviously debatable hydro-electric barrage. In 2011 a Chinese teenager secretly sold one of his kidneys to buy an iconic Apple product, itself only affordable in Western markets because of the low cost of labour producing it in China. We are everywhere implicated, threaded into the network of designing and consuming.

Connectedness, however, can bring its own problems in the context of a research project about people's experiences. As mentioned above, my own experience of doing the research was drawn into the project as it developed, as I saw that there was a certain mirroring of my struggle to believe in the validity of qualitative approaches and some of the dilemmas experienced by the students, where the certainties of engineering were challenged by the perspectives of art and design. Whilst this connection is there, it is also limited, not least by the difficulties involved in describing experience itself, one's own or another's.

I have explored experience through the lenses of stories and images of how we interact with and in the environment we inhabit.

Drawing constructs one such lens, and a multi-facetted one. What it offers is different from, but related to other more abstract languages we use to connect with experience of the world. It is a metaphorical medium that can also provide a high degree of precision and structuring. As a tool of epistemic development drawing has unique features, and it is these that I have attempted to highlight. Seeing drawing in this way showed me that my ideas about enactment and drama as metaphors for the students' experience were about the experienced spaces of imagination, problem-solving, insight, and growth. It has been difficult to find a suitable structure for presenting a set of ideas all interconnected. Nonetheless the germ of the work is this - experience is realising the connection; realising the connection is the experience of learning.

MY RELATIONSHIP WITH THE STUDY

A long way into this study I came to realise that I too had to rethink my views on what constitutes knowledge. I had embarked on the study as an objective account, to provide answers evidenced by data from interviews. Whilst I was necessarily some kind of participant observer, my presence in the project would not affect it beyond providing some more focused observations about 'the researched'. At a certain point, however, it was clear I did not have the kind of data necessary for that model of research project, and that a different approach could in fact make more useful propositions. I came to see that I could more effectively explore epistemic development using ideas founded in my own professional training and practice as a designer, educator and visual thinker. I had initially experienced difficulty in accepting that this way of working and its insights, however authentic, could constitute worthwhile knowledge. I then recognised that, ironically, this mirrored the struggles I was proposing that the students underwent in seeing value in the new ways of knowing for them presented by visual and design thinking.

This reflecting and reflexive feature could provide a pointer to where further, more thorough enquiry in the study could be pursued, at the same time as providing a monitor to control the wilder chains of associations of ideas so easily stimulated by this multidisciplinary approach.

To a certain extent this project has grown out of my personal background and interests. I see now that its genesis was some 40 years ago when I was an industrial design student at Hornsey College of Art (HCA) in London between 1965 and 1969, a course which included completing an Ordinary National Certificate in Mechanical Engineering, attended as a sandwich course at a local technical college. Several strands of the project emerged at this time - the political role of design, visual thinking, the importance of

learning to learn, and how design itself can be a powerful site for holistic learning.

Design as a political activity

I was much influenced by ideas about the purpose of design that were current at the time. Not much more than a decade earlier the 1951 Festival of Britain had heralded the idea that design could contribute to the reinvigoration of the post-war economies. Design was a necessary aspect of the producing of goods for home, work and all aspects of daily living. It was not difficult to see that design necessarily had a political dimension. Beyond utility, and the need for design for hospitals, schools and the work place, design as a partner to new consumer product development had been well established in the pre-war economies of affluent societies in Europe and the USA. Consumerism, as an essential dimension of capitalist societies, already had its critics in Karl Marx and Thorstein Veblen for example. The use of design, it seemed, could be interpreted as advancing, avoiding or impeding different social agendas.

Authors from widely differing fields threw light onto the processes and effects of designing, presenting the ethical dilemmas in product design work. Vance Packard's (1957) book *The Hidden Persuaders* linked product advertising and politics, and his (1961) *The Waste Makers* started to discuss issues later to be called 'sustainability'. Rachel Carson's (1962) *Silent Spring* exposed the real workings of ecological systems, as she showed the wide-ranging effects of chemical pesticides beyond their intended targets. Victor Papanek's *Design for the Real World* was published in 1971[1]. Later, in 1973 Ernst Schumacher's book *Small is Beautiful* exposed the inequalities between rich and poor resulting from mainstream development economics, and provided another platform for a critique of the role of design.

Cybernetics was a growing field, and its feedback model for how systems work, originally conceived for engineering and mathematical use, was

[1] 33 years later Boradkar's (2004) review of 'Citizen Designer: Perspectives on Design Responsibility', in the journal *Design Issues* reports that the design profession still faces these dilemmas but has made little progress in dealing with them.

increasingly seen as applicable to the workings of human and social interactions as well as any applied science. Norbert Wiener's (1950) 'The Human Use of Human Beings' was required reading on my course, as was Osborn's (1957) Applied Imagination, on the teachability of creative thinking. Wiener's book set the agenda for the use of cybernetics as a model to propose more humane ways of seeing and facilitating the relationship between workers and technology, people and society, with everywhere the central role of learning, from feedback, in this cyclical process. An apparently mechanistic model provided a powerful diagnostic tool that could promote more humanistic ways for people to interact with all their environments. There was a central role for design at the level of the systems involved, at the interface between people and objects and tools used in everyday and specialised activities, and in all kinds of communication between people and the worlds around them.

This concept went on to play a fundamental role in my design teaching, particularly in the area of human factors (ergonomics and psycho-ergonomics). I introduced this aspect of design onto the IDE course during the period under consideration in this study, and it became a particularly critical site for stretching ideas about design's potential for improving quality of life beyond immediate consumerism. Frascara (2007) juxtaposes design as philosophy with the urgent need for design's professional skills to be used in solving obvious problems in society. This reflects my own view: we partake in the world where there are many problems and so we should engage with them. People can do this in many ways but designers have very relevant tools. As a course designer I struggled with the conundrum of impressing this value judgement on others, and resolved it by diverting my design educator skills to providing contexts where students would be better able to make up their own minds from the broadest base of information. It is obviously a continuing issue for the design education community.

Visual thinking

The Coldstream Report of 1960 proposed that Art and Design Education should move into the university sector. This could be achieved by moving its primarily crafts-based trainings into activities more in line with

undergraduate liberal arts courses. Many traditional studio practices, such as drawing from life and nature were diluted, or entirely removed. In a parallel debate, however, visual thinking was increasingly recognised as central to any design activity.

In 1944 Gyorgy Kepes, a Hungarian designer and artist, published in the USA a book called *The Language of Vision*. It was the first in a series of books published until 1974 by Studio Vista called 'The Vision and Value Series'. The books aimed to bring ideas from the Gestalt school of psychology and the principles of the pre-war Bauhaus school of design in Germany up to date, and to expose them to a wider audience, not only in art and design education, but as part of a broader social and political agenda for rebuilding international society at the end of the war. The books contained papers by a wide range of social thinkers and theorists, artists and designers, psychologists and philosophers. The series was very influential, not only in broader debates and proposals for art education in the 1960s and beyond, but on me personally at the time.

Amongst other subjects, chapters in the books explored and propounded the central role of the sense of vision not only in understanding the world, but also affecting it through design.

As Samuel Hayakawa (1944:10) says in the Foreword to the first book *Language of Vision*: "To cease looking at things atomistically in visual experience and to see relatedness means, among other things, to lose in our social experience, as Mr Kepes argues, the deluded self-importance of absolute 'individualism' in favor of social relatedness and interdependence. When we structuralize the primary impacts of experience differently, we shall structuralize the world differently." Kepes himself, in the Preface, sharpens the focus: "Visual language thus must absorb the dynamic idioms of the visual imagery to mobilize the creative imagination for positive social action, and direct it toward positive social goals." (1944:14)

Rudolf Arnheim, a psychologist whose work centred on perception, art and art education, was the author of a chapter called *Visual Thinking* in Kepes' 1965 book in the series *The Education of Vision*. Here Arnheim describes problems arising from the traditional Western intellectual tradition which

assumed that verbal reasoning functioned without recourse to interaction with perceptions from the senses. His argument, in the Gestalt tradition, is that understanding of the world is a holistic activity, and that visual thinking is an essential and integral component of knowledge, whether we know it or not. By 1969 when Arnheim's book of the same title *Visual Thinking* was published, he was asserting that this kind of knowledge resounds to the deepest levels of our relationship with the world. At the very end of the book, under the heading 'The burden of it all' he says:

> "It is not a good strategy, however, to label perceptual sensitivity as artistic or aesthetic, because this means removing it to a privileged domain. Visual thinking calls, more broadly, for the ability to see visual shapes as images of the patterns of forces that underlie our existence – the functioning of minds, of bodies or machines, the structures of societies or ideas" (1969:315).

In 1961 volume 1 of Paul Klee's notebooks, *The Thinking Eye* was published in English for the first time. Klee had assembled these pedagogical notebooks while teaching at the Bauhaus before the war, and was exploring the same ground as Arnheim, but from the perspective and experience of an artist. Their two points of view - from visual working on paper and canvas, and from observing how people perceive and understand the world, strongly reinforced each other in making the case for the potential for visual thinking as a significant kind of intelligence. These books, amongst others in similar vein, were all in common use in design courses. In 1983 Gardner, the developmental psychologist, proposed spatial (using visual imagery) ability as one of his seven intelligences in his unfolding theory of multiple intelligences.

During the 1970s and 1980s I taught undergraduate design students in Product Design and Graphic Design. I had also worked for several development agencies as a designer and researcher, and for the World Health Organisation on a teaching simulation for training in the 'cold chain' management of vaccine distribution. I was part of the team that provided this training in Equador and Liberia, where I assisted in the establishment of the 'chain' itself. Later I did research for the Oxfam Public Affairs Unit.

Much influenced by the ideas of Paolo Freire and Ivan Illich and others, I saw that design thinking in this context involved a powerful set of ideas that could influence personal, social and political development, because its processes suit the identification and meeting of needs, and they involve learning from experience. A course in South-East Asian Anthropology that I undertook at the Western Australian Institute of Technology showed me that both design and learning are culturally framed, and ignoring this has been the root of many time- and money-wasting design and technology aid initiatives.

At that time many developing cultures and societies were not familiar with the now nearly ubiquitous visual language of photography, film and television. People in some cultures not used to Western imagery and media experienced difficulties interpreting photos, diagrams and drawings from Western development sources. Graphicacy (Fugelsang 1973) became for a while a sub-discipline of design for development, and was useful for me in my work. Later when I was teaching on a Master's course in Graphic Design I was able to concentrate attention on concepts of deconstruction as applied to visual images, particularly advertisements. This process involves exploring the use of visual and verbal analogy and metaphor, which was later to resurface in a project I taught on the IDE course as a way to explore visual thinking, and is a central feature of this study. (See *Visual and conceptual thinking*, and *Metaphor*)

Learning and epistemic development

Lifelong learning and learning to learn are concepts now becoming recognised as an essential feature of the educational curriculum. Learning to learn was a core subject within the syllabus of the Industrial Design course I undertook at Hornsey in the late 1960's. Its inclusion in the course was set against a background of discussion already proposing this idea at that time. In the 1960's learning to learn was being promoted by thinkers such as the polymath Buckminster Fuller, the designer and engineer. He recognised that, in the face of exponentially increasing amounts of information in every sphere of knowledge, learning to meet the challenges of the future had to shift from acquiring facts to being able to manage information in intelligent

ways. The theme of his geodesic dome building for the USA at the 1967 International and Universal Exposition, or Expo 67, at Montreal, Canada, was *Creative America*. It appeared two years after he had inaugurated the international movement, the World Design Science Decade. Ten years earlier, in 1958, the pioneering multi-disciplinary husband and wife design team of Charles and Ray Eames had produced a film for the IBM Pavilion at the Brussels World's Fair called *The Information Machine*. This brilliantly economic animated film celebrated human-beings' innate capacity for sorting things out by design, through perception, pattern understanding and problem-solving. It proposed the successful meeting of future challenges through productive partnership of such human beings with the growing information handling capacities of IBM computers. The hero of the film was a woman. In 1961 the Eames's designed an exhibition for learning about mathematics: *Mathematica*, for the opening of the new Science wing at the California Museum of Science and Industry in Los Angeles. Such was its popularity it stayed there for 36 years, and then went on to tour other museums all round the USA.

To underpin my growing interest in design as a way of thinking, in 1985 I undertook the post-graduate Diploma in Teaching and Design in Higher Education, at the Centre for Staff development in Higher Education at London University's Institute of Education (being the first design tutor to do this professional training).

Education and training were shown as having many goals, from personal development to vocational training. Sometimes more instrumental goals could eclipse personal development on a narrow training course, sometimes personal fulfilment could be nurtured at the expense of attention to employability. Elegant and effective course design needs to accommodate both, and frequently does not. Education's constant dilemma became very apparent. Universities and other educational institutions (colleges of further and higher education) are in constant danger of losing their roles as the sources of unentailed knowledge and being the guardians and nurturers of it, in the face of satisfying the more instrumental demands of funders from industry and the state, which are easier to measure.

I was particularly struck by the ideas of William Perry, Head of the Bureau of Study Counsel at Harvard, who, in the late 1960's, in observation of his students' attitudes towards reading, had devised a scheme of stages in the appreciation of the contingency of knowledge. Perry saw these stages as markers in the personal development and maturation of his young adult students (Perry 1970).

The model started with the holding of a view that all real knowledge is objectively true, and comes from authoritative sources. Through various stages the model culminated with the realisation that knowing is a complex marriage between understanding its relative, perspectival nature, and taking responsibility for right action against that background in a pluralist world.

This last stage, admitted by Perry to be nearly unattainable, had some features in common with ideas about fulfilment and realisation described in various esoteric and eastern philosophies I had been exploring at the same time. So a linking thread central to this study is the idea of connectedness between people and their actions, based on how we construct our understanding of the world of sense and thought, and what we do as a result of this.

Perry's ideas also related to the work of Carl Rogers, the American psychologist. In 1961 Rogers had written *On Becoming a Person: A Therapist's View of Psychotherapy* in which he elaborated his concept of the 'fully functioning person'. The emphasis was on those features which enabled people to fulfil their own potential. The concepts were further developed in his book *Freedom to Learn: a View of what Education might become* (1969). This was later partly rewritten for the 2nd edition (1983), when Rogers was able to report that research now supported his original contention that humanistic teaching led to fuller learning. Three of the goals of this book which Rogers described were particularly relevant to me as a design educator. One was "its aim toward a participatory mode of decision-making in all aspects of learning in which students, teachers and administrators each have a part". Here was a hint of a description of learning about how to behave in a multi-perspectival world. A second goal was "its aim toward uncovering the excitement in intellectual and emotional

discovery, which leads students to become life-long learners." A third goal was "even more deeply, it aims towards an awareness that, for all of us, the good life is within, not something which is dependent on outside sources." This last goal held no contradictions for someone focused on design for quality of life for all.

Both Perry's and Rogers's ideas were widely influential in the building of educational ideas about personal development. However it later came to be seen that Perry's work was situated in a very particular political and cultural framework in the USA in the 1960s and 1970s, where it was assumed that the "self-actualisation" (Rogers 1969) of the individual should be uncritically the prime aim in life and education. While this is arguably *an* aim in life, individuals' roles and aspirations are set in societal structures and cultural and community contexts, where "self-actualisation" takes on many more nuanced meanings. Education has a prime role in enabling people to live and fulfil themselves as social as well as individual beings.

Perry's ideas also influenced the Reflective Judgement Model developed by Kitchener and King (1981), King having been an assistant in Perry's programme at Harvard. At the outset of my study, almost the reason for doing it, was the idea that Perry's model seemed of immediate relevance to me as I compared statements of students in Perry's study with those of the IDE students as they started to experience an art-school based design course.

During a design project early in the course one student remarked:

> BN: *Where we come from we all knew we had the right answer when we had the same answer, here it's all different.*

Of a History of Design lecture in the post-modern idiom another said in some bewilderment:

> LN: *I don't know what to do with this lecture. It's difficult to take useable notes. Is this just someone's personal opinion?*

It seemed I had the opportunity to explore in some way a Perry-like developmental progress as an assumed aspect of post-graduate professional education.