

Designing for the future : adaptive expertise and organizational learning in design

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ABSTRACT

Design is now at a crossroads where the roles and responsibilities of designers are being recognized and elevated in the knowledge economy as important catalysts, capable of generating new ideas and shaping change. How should designers and design educators respond to this challenge? Design has the potential to become the hub of decision-making and critical discourse in an age of super complexity. How do we educate our future designers to design for the unknown within constantly changing contexts that verge on the exponential?

This paper proposes that in order for design to take on this role, designers need to develop to a level where they exhibit adaptive expertise on an individual and an organizational level. This requires a shift in current design practice, research and education to produce designers and design organizations that are 'learning', 'adaptive' and 'expert'. This is a complex undertaking and will need to evolve over time. It raises many questions about the nature of design research, design practice and design education itself.

Through the examination of adaptive expertise and organizational learning, the alignments between these concepts begin to suggest how design and design education might respond to the new super complexity it now faces to become learning, to produce learning organizations. This is in essence a process of strategic renewal, a process for design to explore and learn new ways of designing that approach and frame design problems with adaptive expertise.

INTRODUCTION

If design is to reach its full potential as a profession, it faces considerable challenges in a super complex networked global knowledge economy. The need to be world class is ever more pressing not just to provide the potential to expand consultancy services or the rate of project completion but rather to continually provide solutions that have integrity and that address the social and economic needs of the global community in more socially responsible ways (Ashton, 2003; Margolin, 2002; Mok, 2003). The demands this places on education are greater than ever before and this pressure will continue (Freidman, 2002).

As designers we are already dealing with complex problems that at best are 'ill-defined' (Cross, 1984) relating to both 'determined', objective, and 'undetermined', subjective, criteria or constraints (Dorst, 2003). As the rate of change and the growth of technology increases, potentially

to an exponential rate when information exchange, knowledge growth and discovery across fields become instantaneous (Broderick, 1998), designers and the process of designing require new strategies to negotiate design outcomes to appropriately shape future scenarios.

These strategies need to develop appropriate capabilities and approaches within design practice to deal with super complex contexts and open ended design scenarios.

To answer the future needs of today's society, design requires a holistic systems approach to each design problem, an adaptable work practice and design methodology that encompasses generative learning (Cross, 1984; Week, 2002). This would suggest designers who are expert, adaptive and learning which in turn suggests an engagement with the concepts of adaptive expertise and organisational learning.

A. Adaptive Expertise

Whilst design problems can be defined as novel problems and the process of design as generally non routine, this does not automatically equate to designers exhibiting adaptive expertise (McDonnell, 2003).

The concept of adaptive expertise was first introduced by Hatano (1988). Through his research Hatano recognized that there are different types of expertise including routine and adaptive expertise. However, there are characteristics that can be seen as common across all domains and types of expertise. Hatano summarized these in six points;

1. Experts possess rich and well-structured domain knowledge (consisting of "chunks" or "patterns" of information) that can readily be used
2. Gaining expertise requires years of experience in solving problems in the domain
3. The acquisition of knowledge and skills is accompanied by socioemotional changes
4. The process of gaining expertise is assisted by other people and artefacts
5. Expertise occurs in socioculturally significant contexts; as a result, in expertise, learning is not clearly separated from solving socially significant problems and performing tasks
6. Expertise is distributed (Hatano, 2003).

Hatano's initial studies looked at the transferability of mathematical strategies cross culturally, comparing expertise in the use of the Chinese abacas, and street math used by

Brazilian street vendors. The street math, though not as fast as the abacus, was less procedural and rule based and provided more flexible and adaptable strategies that could be applied to new situations. These experts exhibited 'adaptive expertise' and can be 'characterized by their flexible, innovative, and creative competencies within the domain, rather than in terms of speed, accuracy, and automaticity of solving familiar problems' (Hatano, 1988).

Hatano later summarized characteristics of adaptive expertise as;

- Inventing new procedures derived from expert knowledge to solve novel problems
- A tolerance for ambiguity
- Fluidly adapting to new situations / contexts
- Performing minor variations in procedural skills and examining their effectiveness in new contexts
- Engaging willingly in active experimentation and exploration, and
- Being sensitive to internally generated feedback such as a surprise at a predictive failure or being perplexed by alternative explanations of a phenomenon (Adams et.al. 2003; Hatano, 2003)
- Ability to cross boundaries between domains to find better solutions (Hatano, 2003)

Hatano's research (supported by Wineburg 1998 and VanLehn, 1989) also found that experts in a given domain may fail to go beyond procedural efficiency whilst others can move beyond routine competencies. These experts can be seen as exhibiting adaptive expertise (these experts may not be adaptive in all situations). The focus within adaptive expertise moves from process behaviours themselves, mechanistic approaches, and rule based responses to a focus on knowledge and values about process behaviours.

In addition, Wineburg found that domain knowledge was not necessarily a prerequisite for adaptive expertise but rather the ability to work through confusion, resist an urge to simplify, recognise a lack of knowledge of the situation and reorient to the problem at hand. (Adams et al., 2003). From this observation Hatano concluded that within each domain there will be 'different types of experts' which would indicate that there exists 'situational and individual determinants of types of expertise' (Hatano, 2003). This implies that different learning experiences can develop adaptive expertise (Bransford et al., 1999).

The characteristics of adaptive expertise can easily be seen as relevant and desirable for designers to deal with complex open ended problems. For example 'creative design experts tend to design from first principles rather than using existing solutions, seek knowledge or flexibly adapt their existing knowledge to new situations in which key knowledge is lacking' (Adams et al., 2003) and actively experiment and explore assumptions (Cross, 1984; Clayburn & Cross, 1998; Candy & Edmonds, 1996).

There is now a growing body of literature on adaptive expertise including the value of adaptive expertise in design. Research exploring adaptive expertise in design has primarily focused on the relationships of adaptive expertise to the design process, problem definition or framing, and collaborative practices.

Working collaboratively encompasses many of the factors and characteristics that lead to the development of adaptive expertise and organisational learning (Ashton, 2003; Candy and Edmonds, 2003) and as design is predominantly a team activity this is highly relevant.

As defined by Candy and Edmonds the characteristics of team expertise in collaborative design practice include;

- Existing domain knowledge with relevance to creative work – preferably various forms
- Engagement in furthering expertise through personal development
- Range of areas of expertise that support analysis
- Cross disciplinary skills
- Ability or willingness to share knowledge
- Cross domain knowledge, connection and migration
- Diversity in interests, skills, training, education
- Openness
- Opportunity for self expression or sense of ownership
- Learning as a central motivator
- The unknown, the new, the challenging
- Ability to identify opportunities for change
- Ability to leverage what is known
- Ability to identify what is unknown and what is similar
- Willingness to deal with ambiguity
- Risk taking, willingness to try new approaches
- Ability to recognise assumptions and make them explicit
- Ability to test assumptions against criteria

These characteristics map on to adaptive expertise and organisational learning and highlight the ability of the individual / organisation to recognise the gaps in knowledge and schemas, value learning, strive for best outcomes, take risks and recognise personal bias and assumptions.

B. Organisational Learning / Learning Organisations

To answer the needs of today's society design requires a holistic approach to each design problem, an adaptable work practice and design methodologies that encompass generative learning (Week, 2002).

Work cultures that are creative/generative are continually learning and are organisationally self-actualising. In order for this to take place the learning must be generative, double-loop, as opposed to adaptive single loop learning. The work culture of generative/learning organizations is creative. There are many definitions of what might constitute or characterise organisational learning and in turn a learning organization all of which are still being debated.

It has been claimed that organisations learn and through this learning evolve to be more than just the collection / sum of individual parts / participants. Learning organizations integrate thinking and action on all levels (Senge, 1990) and through their organisational culture they embed approaches and values into strategies, they self assess, reflect and integrate what they have learnt in order to develop and change (Argyris and Schon, 1978; Senge, 1990). When, as

an organization, they become self actualising they are seen to have creative cultures (Albrecht and Albrecht, 1988).

The concept of organizational learning particularly in the US has stemmed from systems thinking and the recognition of the ability of an organization to develop, learn, and to behave as a network (Siemens, 2003) or a living ecology (Loi, 2003) where entities, actions, and information are interconnected and become embedded and in turn influence strategies operations and cultures to allow the continuing adaptation of the organization (Popper and Lipshitz, 2000). This also aligns with aspects of Total Quality Management and Best Practice and the concepts of network creation.

This is to say that organizational learning is an ongoing process not simply a list of attributes. For the purpose of comparing the alignment between adaptive expertise and organizational learning this paper will only focus on the characteristics of learning organizations.

O'Sullivan has summarized a number of alternatives for what characteristics define a learning organization:

- A perception of learning as a cyclical process,
- An acceptance of the different roles of policy, strategy and operations within the organization,
- A free flow of authentic information,
- The ability to value people as the key asset for organizational learning,
- The ability to re-frame information at the strategic level: first and second order change, (Garrett, 1990, pp. 78-79)

- Look to the future by looking at their present,
- Institutionalise reflection-in-action,
- Treat planning and evaluation as learning,
- Pace their learning and development.
- Attend to the new 'disciplines',
- Learn from themselves;
- Are life long learners. (Holly, 1994, pp. 132-136)

- Openness, systemic thinking, creativity, empathy, and feedback
- Personal mastery, shared vision, mental models,
- Team learning
- The fifth discipline', systems thinking (Senge, 1990).

to these lists O'Sullivan adds

- Learning organizations use meta-learning, i.e. they learn how to learn.

This is not to imply that all these characteristics must be present in order for an organization to be learning. O'Sullivan believes that it is not necessary for all characteristics to be present.

Learning organizations value learning and support the individual, however, the type of self development and the motivations for this can be misplaced if they are purely economically motivated (Chappell et al, 2004). Learning should be self-motivated to be most beneficial (Boud, 2005) and this can be enhanced through creative work cultures that have the ability to motivate employees (Albrecht & Albrecht, 1988).

The strength of an organizations work culture can influence the performance of the organization, both at an individual level and an organizational level. The relationships between work culture, its characteristics, predominantly strength, fit to context, and adaptiveness, are all relevant to the long term economic performance, innovation and outcomes of the organization. Organizations with strong, adaptive cultures that have an elastic fit to their context perform better than organizations with only one or two of these characteristics or conversely with work cultures that are weak, reactive, with a non elastic fit to context or simply do not fit at all (Kotter and Heskett, 1992).

The concept of strong, adaptive elastic fit work cultures established by Kotter and Heskett is taken further through the work of Albrecht and Albrecht by examining what they term creative work cultures.

A creative culture is " a company that values creative behavior on the part of all of its members, at all levels, and in all pursuits. Creative corporations are places that allow, enable, and encourage people to come up with ideas" (Albrecht and Albrecht, 1987)

The concept of a creative culture also involves the concept of applied creativity or as Albrecht terms it, innovation: the process of making a creative " idea concrete, practical, and profitable. It results in a successful outcome, a solution or a successful state of affairs" (Albrecht and Albrecht, 1987). These conceptions of organizational learning and creative cultures clearly map onto the characteristics of adaptive expertise.

Unfortunately, the current work culture within design is casual, lacking in formal structures, has little focus on staff development, is potentially devoid of learning mechanisms, reliant on the expertise or innovation of individuals, fast paced and unempowering (Ashton, 2001). There is therefore much for designers and design practice to learn.

C. Pedagogical Approaches

If adaptive expertise and organizational learning are to become integral to design practice then they need to be taught, developed and valued throughout a designer's education and practice. This includes shaping a student's conception of what it is to be a designer and what it is to design (Davies, 2003). This conception needs to be intrinsic.

'Expertise applied in creative contexts requires a degree of motivation and commitment that is intrinsic to the activity as distinct from being driven by extrinsic factors such as financial incentives' (Candy and Edmonds, 2003).

This requirement is also reflected in the conceptions of learning and design that foster deep learning and higher order cognition. Students who engage with 'Intrinsic Meaning' conceive of learning as 'Learning to Innovate and Change '. (Davies, 2003). Learning is conceived to be discovering about themselves, the world, their place in the world and their work or influence within it. So what mechanisms and processes should be engaged? What should students learn to enable this? It is not possible within the framework of this paper to explore and answer these questions but rather to highlight some approaches that pertain to learning adaptive expertise in design and engaging with the principles of organizational learning.

As research into learning continues there are now divergent theories of what it means to learn and how learning occurs. Knud Illeris (2002) sees learning as encompassing these theories in a tension field of learning with different learning frameworks being more appropriate in different contexts; in essence 'adaptive learning'. This is a view supported by others including Siemens (2003) who views learning as a network forming process. These conceptions of learning are more readily transcribable to organisational learning and adaptive expertise. They are personalised to the situation and the individual, flexible, connected, testing and expanding.

Kurt Lewin's model of situated learning – incorporating the concept of learning cycles, and contextual and collaborative learning also models well onto adaptive expertise and the concept of the coevolution of the design problem from 'problem state' to 'solution state' through a negotiated understanding of complex relationships and possibilities.

Stenberg and Hatano see education for adaptive expertise involving domain-general intelligence, not domain-specific expertise and training for intellectual skills, that is training which gives students opportunities to use the same set of skills in a variety of disciplines and situations, enabling them to think creatively, analytically, and practically always and everywhere (Hatano, 2003; Sternberg, 2003).

Some approaches for encouraging adaptive expertise and intellectual skills in design include :

- Teaching for intelligence (Sternberg, 2003)
- Connectivism (Siemens, 2003)
- Judgement and Empathy (Nelson, 2006; Margolin, 2002)
- Systems thinking (Adams, 2003)
- Scenario building (Manzini, 2001)
- Problem Structuring (Restrepo and Christiaans, 2003)
- Narrative (McDonnell, 2003)
- Abstraction
- Metaphor (Casakin, 2004)
- Analogy (Casakin, 2003) suggest that visual analogy is a cognitive strategy toward expertise in the design process
- Problem Framing (Dorst, 2003)
- Challenge based instruction (Brophy, 2003)
- Inquiry based projects (Brew, 2006; Dorst, 2006)
- Team learning (Candy and Edmonds, 2006)

In order to implement learning approaches successfully learning styles and environments are a further consideration. In all situations the prior learning (knowledge), the learning mechanisms experienced, the environments or settings for learning encountered and the attitudes and conceptions of learning of an individual all contribute to the preferred learning style of that individual. Just as individuals have distinctive learning preferences (Cross, 1991; Caban, 2002) so to professions and organizations have distinctive learning styles (Kelly, 1995; O'sullivan, 1997).

The culture and environment within which learning takes place has a profound influence on the quality and depth of the learning experience. From the work of Dr Marian Diamond and Dr Mihaly Csikszentmihalyi we learn that environments that are nurturing, supportive, stimulating, and offer rich opportunities for interaction and response, have clear rules

and high expectations create more complex neural networks with individuals who experience more 'flow' or 'peak' experiences. They come from what Csikszentmihalyi calls 'complex' families (Dickinson, 1992).

The characteristics of these environments should be developed in design education to facilitate learning that will foster adaptive expertise, just as learning styles should be explored, extended and questioned.

Characteristics of adaptive expertise and organisational learning need to be explicitly identified and assessed within the undergraduate experience through criteria based assessment and graduate attributes in order to embed their value in terms of how students understand what it means to design and to be a designer (Davies and Reid, 2003; Nelson, 2006).

CONCLUSION

Adaptive expertise and organisational learning encompass an array of attitudes, characteristics and approaches that are significantly appropriate to enable designers and design practices to respond to complex open ended problems. The challenge for design educators is to better understand which learning approaches may promote adaptive expertise and learning organisations. This will require the identification and embedding of learning mechanisms in and approaches to design that will foster conceptions of designers and design that are synonymous with adaptive expertise and organisational learning.

REFERENCES

- Adams, R.S., Turns J and Atman, C.J 2003 *What Could Design Learning Look Like*. Expertise in Design : Design Thinking Research Symposium 6. University of Technology Sydney
- Albrecht, K. and Albrecht, S 1987 *The Creative Corporation* Dow Jones-Irwin, Homewood, Illinois
- Ashton, Phillipa 2003 *Mechanisms for learning in UK design consultancies : Building a world class design industry through the development of people*. TEXVN. 5th European Academy of Design Conference
- Bransford, John D., Brown, Ann L. and Cocking, Rodney R. eds. 1999. *How People Learn: Brain, Mind, Experience, and School*. The National Academies Press. Washington
- Broderick, D. 1997 *The Spike*. Reed Books. Kew, Victoria
- Brophy, S., Hodge, L. and Bransford, J. 2003 *Adaptive Expertise: Beyond Apply Academic Knowledge*. Frontiers in Education Conference, Savannah G.A.
- Candy L, Edmonds E 1996 *Creative design of the Lotus bicycle: implications for knowledge support systems research* Design Studies 17, pp. 71-90.
- Candy, L and Edmonds, E. 2003 *Collaborative Expertise for Creative Technology Design*. Expertise in Design : Design Thinking Research Symposium 6. Paper 42
- Casakin, H., *Visual Analogy as a Cognitive Strategy in the Design Process: Expert Versus Novice Performance*. Expertise in Design: Design Thinking Research Symposium 6.
- Chappell C., Rhodes, C., Solomon, N., Tennant, M., and Lyn Yates 2003 *Reconstructing the lifelong learner: pedagogy and identity in individual, organisational, and social change*. Routledge Farmer. London:New York
- Cross, N.G. ed. 1984. *Developments in Design Methodology*, Wiley, Chichester.
- Cross N, Clayburn Cross A. 1998 *Expertise in engineering design in Research*. Engineering Design 10, pp. 141-149.

- Davies, A and Reid, A, 2000 *Uncovering problematics in design education – learning and the design entity* Higher Education. 19, 681-685. ASET-HERDSA
- Dickinson, D., 1992 *Lifelong Learning for Business: A Global Perspective*. Lifelong Learning for European Business. Oxford University
- Dorst, K. 2003 *The Problem of Design Problems*. Expertise in Design : Design Thinking Research Symposium 6 University of Technology Sydney
- Friedman, K. 2002 *Design curriculum challenges for today's universities* Ctlad Conference, London
- Hatano, G. 1988 *Social and motivational bases for mathematical Understanding*. New Directions for Child Development 41, pp. 55-70, Wiley
- Hatano, G and Oura Y *Commentary: Reconceptualizing School Learning* Educational Researcher, Vol. 32, No. 8, pp. 26–29
- Holly, P. 1994 *Striving for congruence: the properties of a learning system*. C. Baynejadine & P. Holly (Eds) *Developing Quality Schools* Falmer Press. London
- Illeris, K. 2002 *The three dimensions of learning*. University Press, Roskilde
- Kotter J.P. and Heskett J.L., 1992 *Corporate Culture and Performance*. Free Press, New York
- Loi, D. 2003 *Shared Work Environments as Ecologies: New Ways of Working and Designing*, Taylor and Francis Metapress
- Manzini, E. 2001 *Sustainability and Scenario Building: Scenarios of Sustainable Wellbeing and Sustainable Solutions Development* (Keynote) 2nd International Symposium on Environmentally Conscious Design and Inverse Manufacturing EcoDesign'01 p. 97
- Margolin, V. and Margolin, S 2002 *A Social Model of Design Issues of Practice and Research* Design Issues, Volume 18, Number 4. Massachusetts Institute of Technology
- Mok, C. 2003 *Designers: Time for Change* Communication Arts
- O'sullivan, F. 1997 *Learning Organisations : reengineering schools for life long learning*. School Leadership and Management, Vol. 17, No. 2,
- Pedler, M., Burgoyne, J. & Boydell, T. 1987 *The Learning Company*. McGraw-Hill. Maidenhead
- Popper, M. and Lipshitz, R. 2000 *Organizational Learning : Mecahnisms, Culture, and Feasibility* Management Learning. Sage Publications Vol 31, No.2
- Siemens G, 2005 *Connectivism: Learning as Netwok-Creation*. Elearnspace www.elearnspace.org
- Senge, P. (1990) *The Fifth Discipline: the art and practice of the learning organization*. Doubleday, London
- Sternberg, R. J. 2003 *What is an "expert student?"*. Educational Researcher. 32(8), 5–9. American Educational Research Association, Washington
- VanLehn, K. 1989 *Problem solving and cognitive skill acquisition*. in Posner, M (Ed.), *Foundations of cognitive science* (pp. 527–579). Cambridge, MA: MIT Press.
- Wineburg, S. 1998 *Reading Abraham Lincoln: An expert/expert study in the interpretation of historical texts*. Cognitive Science, 22 (3), pp. 319-346. Cognitive Science Society, Austin, Texas