DESIGN EDUCATION FOR THE NEW ECONOMY: TEACHING MID-CAREER MASTERS STUDENTS HYBRID DESIGN METHODS TO SOLVE WICKED PROBLEMS

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ABSTRACT:

This paper argues that in an increasingly complex technological and sociocultural environment, designers have to have both explicit and tacit knowledge to enable them to prioritise critical problems and opportunities in order to judiciously propose solutions. Ideal design education must instill in its graduates the ability to carry out data capture, analysis, synthesis, ideation, design and evaluation of system complexity, not only to answer materialistic and technical questions, but also to master human behavioural sciences. This would enable them to transform technology into empirical and experiential meanings that would make products safer, functional, usable and even pleasurable. Designers who are knowledgeable and armed with a hybrid 'logic-emotion' methodology can contribute as scientist, designer, as well as change-agent, while playing a vital role in solving 'wicked' problems, creating value, designing and ensuring successful functionality, usability and viability of systems, products, services and brand innovations. The main focus of this paper is a five-year case study of a Master of Design programme to nurture a range of mid-career designers from across the creative industries with these attributes.

1. INTRODUCTION

This paper posits that design education at postgraduate levels is driven by transdisciplinary research and design methodologies. In this paper, I have framed and contextualised design as an entrepreneurial activity that interacts with art, science and technology to enable business and social

innovation to flourish successfully. Since innovation today is made possible by harnessing the convergence of art, science and technology to create value, effective approaches in research and design have to be evolved and developed to address new and more demanding problems and opportunities for mid-career design professionals who work across the creative industries.

The paper outlines the ideation, design and delivery of a Master of Design Programme that the author has experienced. It is a candid 5-year case study of exploration, experimentation and development of research methods, design and innovation approaches to enable mid-career professionals from across the creative industries to generate empirical information, understanding, and insights to inform their design intentions. Traditional design education has failed to contribute to economic development. In businesses and industries, the key intention of design innovation is to create value and competitive advantage. Innovation engagement between academia and industry has increasingly become the key driver at tertiary and postgraduate levels for nurturing a new creative class of strategic thinkers and implementers capable of driving and managing innovative design strategies.

In this context, one of the key aims of our Masters of Design programme at AUT University is to instill critical, analytical, synthesising and evaluation research capabilities, as well as explicit & implicit knowhow and imagination in behavioral knowledge that are relevant to business and industry. To succeed, we need to school our graduates with an integrative and transformative research capability, provide a pedagogy and learning environment to nurture and develop an acute entrepreneurial ethos in a new bread of graduates with expressive and experiential knowledge and skills. This is a significant challenge the Master of Design is designed to achieve!

2. DESIGN IS A BUSINESS ACTIVITY

This case study has at its core an assertion that *"Design is a business activity that interacts with art, science and technologies to enable innovation to materialize".* There is now an abundance of evidence that design research and strategies for framing competitive advantage are the key drivers for

innovation in the new economy. The new economy favours the agile, young, creative and innovative. Another important challenge in the Master of Design programme is to school graduates in understanding the power of new technologies, and how a lone entrepreneur or a small company can harness them to create value and meaningful, memorable experience for the customers, as successfully as, if not more effectively than, large corporations. We deliberately want to shift design thinking as a value creation process, and explore effective research and design methods to frame this intention.

In the new economy designers are bestowed with new advantages to compete. This ranges from agility to risk-taking, and an infinite opportunity to create wealth on a level playing field alongside the largest corporations. The "webification" of the supply & demand chain in many industries, from electronics to apparel, provides enormous opportunities for an individual, or a small company, to order and sell globally just like global corporations. The rise of cloud computing and crowd sourcing means that small start-ups can compete with global corporations without having to invest in their own IT equipment. This means that a young entrepreneurial musician with a laptop can produce a hit record label through crowd funding. Likewise a creative web designer, through the power of solitude, can create and develop an online business to rival the largest retail giants (Wired Magazine: 17.06).

3. DESIGNING, DESIGN THINKING AND WICKED PROBLEMS

A 'wicked problem' is a concept used to describe complex systemic, social or business interdependencies that are difficult or impossible to solve because of the lack of sound research and design methodologies. The term 'wicked' is used to describe the efforts invested to solve a challenging problem, which may reveal or create other problems. Wicked problems are common in areas like policymaking where the problems faced in education, ageing, migration, poverty, and sustainability are all of this nature. They are difficult to define, ambiguous, unstable, do not have one solution, and are beyond the realm or mandate of any one department or discipline. It is also experienced in the design and business communities, where operating in a "wicked state" challenges existing innovation and entrepreneurial processes. Unfortunately, current design and business processes don't help enterprises to innovate

successfully in the 'wicked' environment. Trying to define the problem, without systems thinking and integrative methodologies is a never-ending task. The amount of information a researcher can gather is almost infinite, and current design and planning techniques are not generating fresh ideas.

Scientists are practicing in isolation through deductive positivism (Gray, 2009). Artists and designers are working in silos through inductive interpretivism (Collins, 2010). These two research paradigms are at opposite ends of the innovation continuum. Tension is created in the centre between these two poles, as we attempt to harmonise the explicit and implicit elements needed for true innovation. This paper proposes a 'hybrid logic-emotion continuum' to bridge the gap between hard and soft design elements for generating actionable insights. Designers have to be mindful of answering incomplete, contradictory, and changing requirements that are often difficult to recognise in the 'wicked design space'. The logic-emotion continuum opens up opportunities for designers to work across a seamless 'art-science paradigm', to construct implicit and explicit outcomes. The logic-emotion continuum presents considerable advantage for the researcher-designer to work across this:

"Data-information-knowledge-insight-creativity-wisdom continuum"

to drive evidence-based design in wicked design environment more successful. Working iteratively across this continuum enables the researcher-designer not only to benefit from a hybrid paradigm, but also to triangulate various information with visualisation, enabling them to judiciously present design outcomes based on inductive, deductive and abductive considerations.

If the creative industries operate in this "wicked space", how can a Master of Design programme prepare mid-career graduates with research and design tools to create and innovate in this challenging environment?

The Kyoto Design Declaration (2008) proclaimed that a paradigm shift from technology driven development to human-centred development is in progress to seek better methods to design new values, new ways of thinking and adaptation to change. However, conventional design as a subject for creating

materialistic values has no robust methods or tools for developing a grounded theory to build a body of new knowledge to survive in the new economy. The development of science and technology is advancing at an alarming rate. Design methodologies, methods and tools have not shifted to address these changes. Norman (2010) argues that the tasks of the designer have increasingly become more complex to address or design organisational systems, social innovation, human-machine interactions, service design and experience design. "As a result designers have become behavioural scientists".

4. HUMAN-CENTRED DESIGN THINKING

The tenet of human-centred design thinking is integrative, collaborative, and warrants serious consideration as a possible creative response to wicked problems. For innovation and entrepreneurship, design thinking is a discipline that harnesses the designer's senses and sensibility, and research and design methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity (Brown, 2009). It is the design DNA of the future. It is not a panacea, but given the sluggish development of design research methods and their integration into design practice – to create value for business and industry - design thinking for designing products, enterprises and social innovations has gained popularity in academia, business and industry. This popularity is driven by the fact that traditional problem solving processes are not capable of solving complex wicked problems.

Design thinking recognises that the creative process is not sequential, but iterative, cyclical and integrative. It is multidisciplinary and increasingly transdisciplinary in nature. It necessitates collaboration from people with different disciplines and backgrounds. It is aggressive, scholarly, argumentative, and requires the integrative thinking of a new breed of "T-Shaped Creative Strategists" (Tim Brown, 2009). It is about applying creative processes to enhancing market successes by 'failing forward', rapid prototyping to discover problems and learn, and using the wisdom of crowd sourcing and cloud surfing. Design thinking provides an alternative platform for creativity, design and problem solving in the flourishing wicked design

space where businesses have to compete. Many design schools have programmes to develop "T-Shaped" graduates (Brown, 2009). However, they are not sufficiently trained for increasingly complex design environment where business and industry have to compete in.

"Design schools do not train students about these complex issues, about the interlocking complexities of human and social behavior, about the behavioral sciences, technology, and business. There is little or no training in science, the scientific method, and experimental design" (Norman, 2010).

5. TRANSDISCIPLINARY RESEARCH AND DESIGN METHODS

The challenges facing designers to solve problems in the complex world can no longer be subsumed in the current model of design practice that is supported by a heuristic paradigm for craft production. Current design problems and opportunities have necessitated researchers and designers shift current design thinking and conceptualising in product, system and service designs, not only to a preferred one, but one that would change the cultural perception of how designers harness, use and transform advanced technologies in the future.

Explicit research information to support design propositions is increasingly being demanded to align left brain rationality with right brain creativity. This requirement and expectation of the designer has led to the merging of human factors, technology, and business models in value envisioning in 'Design Thinking' approaches in design consultancies. Creativity in the design processes must be deliberated within the confines of rationality of the design transformation: the expressive-experiential function that connects the rational and creative minds, in both a hybrid symbiosis, and in a reflective, seamless and iterative manner.

I am a qualified industrial designer with an MSc and PhD in human factors engineering (ergonomics). This paper details a five-year case study in which I have been personally involved in my capacity as the program director for an international Master of Design Program offered at AUT University in New Zealand. During the past five years, I have been the paper leader for

teaching Design Methods and Context; Design Innovation, Technology and Entrepreneurship; Branding Strategy; also I have supervised Design Projects.

The Master of Design is a one-year taught program with associated research, aimed at developing innovative and strategic leadership for the design and business environment. Students are exposed to a range of design research, and innovation methods and practices. The focus is on improving and extending creativity and understanding the design of products, environments, services and brands within market contexts. This involves user-centered design of products and services, and exploring how design thinking and the power of design can deliver new forms of value, experience and competitive advantage for business, and environmental sustainability.

Students in the past five years have come from disciplines across the creative industries – fine art, architecture, engineering, advertising and branding, film, fashion; product, digital, graphic, interior design – as well as those with MBAs.

The focus of my presentation is on my teaching transdisciplinary research and design methodologies to cohorts of mid-career designers who are averse to studying research and design methodologies. I will demonstrate a mapping, diagramming, visualising and triangulation approach, which I have evolved, to make teaching and learning more meaningful and fun for the design students.

6. FROM HARD SCIENCE TO DESIGN

The essence of design thinking in product, service, system or brand innovation is essentially an empirical process that necessitates scientific methods and processes. Design thinking and human-centred design are human factors that apply empirical and scientific methods to investigate *expressive and experiential* insights to inform the design and evaluation of products, services or systems. User-centred design employs scientific methods in observations, hypotheses, predictions, experimentations and evidence-based conclusions in its research and design processes. A human-centred designer (or a multidisciplinary team) must have the scientific

methods and tools, on at least three levels, to generate understanding and insights to enable them to design desirable products:

Understanding behaviour for designing needs and wants,

Enabling behaviour in interactive design, and

Influencing behaviour in persuasive design.

This section of the paper is focused on delineating and questioning the effectiveness of human-centred methods and tools as a research science for the generation of data and understanding of the customer or user, and the application of this information in the design of functional, usable and desirable human-equipment-environment systems in evidence-based system design. This often calls for the synergetic insights of pragmatism, creativity, empathy and the senses and sensibility of design thinking in human-centred design research and practices. Abduction assumes a key role in transforming actionable insights – generated from induction and deduction encounters – into innovative outcomes that are valued and desired by customers.

Contemporary design methods and tools are incongruous in the design process for the creation of complex products, services and systems. This incompatibility is discussed in detail to illuminate the fact that in current product, service and system designs, our understanding of the creative process has developed to a point that it is now too vast for the "theory and application" of human-centred design to be subsumed in its existing form. It is increasingly impossible and confounding to delineate the (expressive) human factors and (experiential) design elements separately. Nor is it necessary to do so. It is becoming impossible to decide when the human factors in 'human-centred design' ends and when heuristic design begins during system inquiry, ideation, design and development, and evaluation. There are still considerable difficulties within the human-centred design research and studio processes in transforming theory into sound design practices. One of the main reasons is that most designers are not "interdisciplinary oriented". As artists and tacitly-centred designers, we are not trained to participate in evidence-based research or able to organise our

findings in a format that is useful in the design process to convince business and industry stakeholders.

Research and design, even under its expanded form – Design Thinking – still presents problems in terms of its ability to generate and communicate rigorous information and hard evidence to other disciplines. Disciplinary and application barriers remain: business people solve problems by analysis; designers solve problems by synthesis. The two activities are at opposite ends of the research-design continuum. Wicked design problems cannot be solved by either analysis *or* synthesis. They can only be resolved by analysis *and* synthesis. Contemporary design education has been compartmentalised into the teaching and learning of subjects – theory, history, drawing, design, CAD – in isolation, rather than the immersion of students in system thinking to instill insight in the expressive-experiential continuum. Graduates need deeper understanding and working knowledge in the 'logic' and 'emotion' of human-centred design, and human-centred thinking; and better still, in human-centred design thinking!

7. LOGIC-EMOTION CONTINUUM

A paradigm shift in the way we teach research and design practice at postgraduate levels is long overdue. The answer lies in the creative harmonising and fusion of human-factors or human-centeredness, and design to coerce a more compatible, and integrated approach for design thinking theory and design practice to coexist iteratively and seamlessly. This is the concept of the 'Logic-emotion Continuum' that I instill in my postgraduate students.

The Logic-emotion Continuum, a new hybrid interdisciplinary design paradigm, is discussed here to highlight that the use of human-centred design research and human-centred design practice as separate disciplines militates against cohesive design thinking and the creative processes. Besides, the symbiotic aspects of Research and Design Triangulation, the truly interdisciplinary attributes, become an effective and synergistic design tool that is significantly more powerful and effective than conventional

approaches of applying scientific research and intuitive design as separate disciplines.

Logical and emotion savvy designers play a vital role not only in problem solving, designing and ensuring that the function, usability and safety of intricate human-equipment-environmental systems are well researched and well developed, but they also act as change-agents able to negotiate inductively, deductively, and abductively in business and industry settings.

8. HUMAN-CENTRED DESIGN AS EVIDENCE-BASED RESEARCH METHODS

Generally speaking, science and commerce gather insights of the world inductively and deductively. Designers create the man-made world abductively with insights informed through inductive and deductive activities (Chong, 2006). Effective research methods and tools that enable rational and poetic design solutions to take place simultaneously are not only rare, but they usually exist in disciplinary narrowness that shackles the synthesis process during analysis and insight construction.

Kolko (2010) maintains that it is common for designers to go through the design synthesis in conjunction with problem solving. The process is seldom expressed separately from the process of form giving. The creativity that this involves in the synthesis process usually takes place heuristically in the designers' thought processes. "Regardless of the specific synthesis action the designer takes, synthesis and insight-forming are always generative. It is an iterative process, that besides merely forming ideals and insights, it always produces more data, information and knowledge before the process started". The synthesis or insight-building process therefore is different to the scientific or empirical study that seeks to understand a phenomenon. In design, *"synthesis seeks to understand the facets of things that do not yet exist by bringing them into existence, and the process of synthesis helps to guess what people will do, feel, or think once the thing that does not exist, exists"* (Kolko, 2010).

Design synthesis, insight forming and affective sense making are abductive processes that infer from meanings that have been captured by more factual

scientific or empirical studies, such as in ergonomics, psychology or business. Abduction is an important mental process in human-centred design. This could be an expressive scientific process, or an experiential tacit process, with no evidence to substantiate design intention or outcome. Evidence-based design processes that produce pragmatic insights via the iterative heuristics process to produce new realities is needed in design thinking approaches. While the deductive and inductive processes are fundamentally for the production of new knowledge, abduction is primarily the process of creative reflection to design new things that are informed by data, information and knowledge generated by deduction and induction. The combination of empirical and generative thinking and creative knowhow are some of today's key innovation skills we can instill in our design graduates.

"Scientists can invent technologies, manufacturers can make products, engineers can make them function and marketers can sell them" (The Design Council, 2011), but only designers can combine insights into all these things and turn a concept into something that is desirable, viable, commercially successful and adds value to people's lives. This statement indicates the importance of a rigorous logic-emotion process to ensure that valid data is used 'reliably' to inform design 'viabilities' seamlessly and symbiotically.

9. EVIDENCE-BASED DESIGN

Evidence is required when we use persuasive design; say in branding, to influence behaviour; to design human-machine interactions to enable behaviour; or to undertake user research in product design to understand operational behaviour. However, as art and design have conventionally used the heuristic process and intuition, it is pertinent that a brief discussion of evidence-based design is included here. Typically evidence-based design is considered as an approach to, for example, healthcare design, that gives importance to design features that impact patient health, well-being, mood, and safety, as well as staff stress and safety.
(en.wikipedia.org/wiki/Evidence-based design).

Evidence-based design is the natural parallel and analogy to evidence-based medicine. An evidence-based designer, such as a logic-emotion designer,

together with an informed client, make decisions based on the best information available from research and project evaluations. Critical thinking is required to develop an appropriate solution to the design problem. As in most design problems the pool of information will rarely offer a precise fit to a client's unique situation. In the last analysis, though, an evidence-based design should result in discernable improvements in the organization's clinical outcomes, economic performance, productivity, customer satisfaction, and cultural measures (Webster Online Dictionary, 2011). The description of the goals and methods is obvious to any scientists who are experienced with the scientific methodology.

10. DESIGN THINKING AS A HYBRID PARADIGM

The logic-emotion, explicit-implicit, empirical-experiential or rational-intuitive continua are positioned here not as mixed methods, but as hybrid paradigms. Each embraces mixed quantitative and qualitative research methods, for the production of new knowledge and tangible design. This disciplinary merging between positivism and interpretivism is necessary for addressing increasing complex societal and technological issues. Friedman (2003) posits that technology and design affects us profoundly. Our daily live is surrounded by, and influence by a vast range of technology that mediates most of how we work, live and play. As the man-made world is increasingly replacing the natural world by the progressive introduction of artifacts that alter our environment, "Design now plays a role in the general evolution of the environment, and the design process takes on new meaning" (Friedman, 2003). Consequently, new technologies, and their successful implementation through design and innovation have evolutionalised the way we view design, from simple craft tradition to increasingly more complex products, infrastructures and systems, and other commercially, industrially and environmentally-altering artifacts.

The complex design problems that we have to solve have led to the evolution and development of blended or mixed modes of research inquiries and design practices. Hybrid technology, which is increasing being harnessed for designing mechanical and electronic hybrid cars, for example, has necessitated the need for the hybrid, pluralistic and synergistic design

methodology I am addressing in this paper. The challenges that face designers to solve problems in the complex world can no longer be subsumed in the current model of design practice that is supported only by a heuristic paradigm for craft production. Current design problems and opportunities have necessitated researchers and designers shift current design thinking and conceptualizing in product, system and service designs, not only to a preferred one, but to one that would change the cultural perception of how designers harness, use and transform advanced technologies, sustainability and social innovation in the future.

In this complex wicked environment, the designer has to have explicit and tacit knowledge to enable her to prioritise critical problems and opportunities to judiciously propose solutions. She has to capture empirical data, as well as analyse, synthesise, ideate and evaluate system complexity via scientific methods, story telling, visualization and prototyping that are based on evidence. "Because a designer is a thinker whose job it is to move from thought to action, the designer uses capacities of mind to solve problems for clients in an appropriate, (empirical) and emphatic way" (Friedman, 2003).

These activities involve a combination of empirical, analytical and intuitive actions. Within contemporary industry and business designs, explicit research information to support design propositions is increasingly being demanded to align left brain rationality with right brain creativity. This requirement and expectation of the designer has led to the merging of human factors, brand strategy, business model and product envisioning in "Design Thinking" approaches in many design consultancies. Creativity in the design processes must be deliberated within the confines of rationality of the design transformation: the mental function that connects both the rational and the creative minds, in both a hybrid symbiosis, and in a reflective and iterative manner – such as the Hybrid Paradigm embraced in 'logic-emotion' provides.

Logic-emotion positions design as a seamless explicit-implicit research method and practice continuum not only to address complex problems, but also to position it as a hybrid paradigm capable of knowledge and theory production. The positioning of logic-emotion as a new empirical-

constructivist paradigm, instead of perpetuating it as a craft subject would enable designers to seamlessly develop new knowledge on the one hand, and practice design intuitively on the other.

11. RESEARCH PARADIGMS

A paradigm is the theoretical framework of a discipline, which influences the way knowledge is studied and interpreted. The choice of a paradigm sets down the intent, motivation and expectation for the research. Hence, logic-emotion can be described as a design approach targeted towards studying the human user or customer, to design and develop usable, functional, safe and desirable systems by the application of evidence-based research and design processes.

Mackenzie (2006) maintains that without choosing a paradigm, as the first step in research, there is no basis for subsequent choices regarding methodology, methods, literature or research design. Interestingly, she claims that mixed methods, such as logic-emotion, "could be used with any paradigm". She classes the four paradigms as: Positivist, Constructive, Transformative and Pragmatic. The Pragmatic Paradigm places the research problem as the central frame of reference for research, data collection and analysis are chosen "to provide insights into the question with no philosophical loyalty to any alternative paradigm" (Mackenzie 2006).

In view of the above statement, logic-emotion, as a Hybrid Paradigm may be placed in this Pragmatic Paradigm category of research approach. "The pragmatic paradigm provides an opportunity for multiple methods, different worldview, and different assumption as well as different forms of data collected and analysis in the mixed methods" that is most useful and suitable for the logic-emotion designer. As an empirical-constructivist researcher the logic-emotion designer tends to focus the research on the human participants' perspective of the situation being studied. Designers as constructivist researchers do not normally begin to construct an idea with theory. They generate or inductively and abductively develop a theory, model or pattern of meanings throughout the iterative design process often impacting the research with their own culture, background and experience.

(Creswell, 2003, p12, cited in Mackenzie, 2003). Both research and design processes in the logic-emotion adopt iterative and cyclical approaches rather than linear ones.

12. DUALITY, PLURALISM AND SYNERGY OF DISCIPLINES

Bioengineering, mechatronics, ergodesign, sociotechnical systems and so on are comparatively current notions of the need for integration and interlinkage between disciplines to enable us to study, understand and construct new knowledge – as hybrid disciplines - in a society that is changing both in speed and complexity (Friedman, 2003). This is to enable a discipline or field to form smart disciplinary clusters to produce new knowledge, to solve problems, improve efficiency, and to ensure that innovation can be harnessed more reliably, viably, creatively, iteratively and borderless. The aim is to capture new
insights via the integration and application of the duality and synergistic perspectives of disciplinary knowledge seamlessly and symbiotically.

To iterate, logic-emotion has been conceptualized to fill an unmet need for a pluralistic, transdisciplinary hybrid methodology to drive evidence-based research, practice and design. The continuum disembowelled potted silo thinking to enable bridging to take place for the capture of knowledge about the behaviour, capability and limitation of the human user/operator in the system, to generate new knowledge, and actionable and transformable insights to inform the design of the system. It is an iterative, empirical, heuristic, and constructive or transformational system process for evidence-based storytelling, visualization and prototyping – that will result in the creation of evidence-based design of products, systems or services that are not only functional and usable, but most importantly, also emotionally desirable.

13. THE NEED FOR CONNECTIVITY AND PLURALISM IN INTEGRATIVE RESEARCH

A decade or two ago it was comparatively easy to explain the function of a telephone to a designer, even though the mechanism and voice transfer were complex. In recent times, it is getting significantly more difficult, if not

impossible to do so as the design of the telephone such as the Apple iPhone not only involves mechanics and optics, but also electronics and software. The convergence of functions of such products and processes has necessitated a synergistic integration of the following three *"design-wares"* to drive successful product or service concept ideation, visualization, and prototyping.

Hardware: such as technical knowhow, mechanical engineering, electronics, computer science, materials and processes.

Software: such as usability, interactivity, and

Lifeware: such as culture and insights on customers, including ritual, psychology and other behavioural factors.

The design and development of successful and innovative products is becoming increasingly more complex and pluralistic often requiring more than the knowledge and knowhow of a single discipline. The logic-emotion continuum facilitates design researchers to iterate meaningfully in the lifeware-software-hardware loop while the theoretical, factual and practical aspects are interrogated to produce successful outcomes.

Miller et al (2008) maintains that despite the progress of interdisciplinary research, such as logic-emotion, much difficulty still exists, and cautions scholars, educators, and practitioners to be vigilant of the ways in which interdisciplinary research are conducted. Epistemological pluralism as an integrated approach for conducting collaborative research and practice recognizes valuable ways of knowing that are specific in different disciplines. For example, in terms of logic-emotion, "ergonomics" may be considered as an empirical discipline for generating new knowledge on the capabilities and limitation of the human operator via positivism; however, "design" is an interpretive or heuristic discipline for the design of products, services or systems using ideation, visualization, prototyping and other creative skills via artistic interpretation to construct meaning and experience innovation.

While the benefits of making intimate connection across disciplines, such as in human behaviour and design that are enshrined in the logic-emotion continuum, many joint efforts are hindered by disciplinary problems, including a tendency to privilege a single epistemology and disciplinary perspective of the researcher (Rescher 2003). Instead an open mindset should be cultivated to take advantage of the different epistemologies, or theories of knowledge that each discipline brings to bear in knowledge creation, articulation and application. These are exactly the reasons why logic-emotion has been proposed in order to create new knowledge and design practice more efficiently and seamlessly; and this is what I teach to all my design students.

14. CONCLUSIONS

The need for disciplinary connection or integrated research methods is usually motivated by the realization that the complexity of modern problems in the rapidly changing technological world is difficult to be resolved in any single way or by any single discipline. This paper has argued that in an increasingly complex technological and sociocultural environment, designers have to have both explicit and tacit knowledge to enable them to prioritise critical problems and opportunities so as to judiciously propose solutions. Epistemological connections or pluralism such as in multidisciplinary, interdisciplinary, and transdisciplinary research and application contribute four important elements to research enquiries, according to Miller et al (2008).

It acknowledges the validity and value of multiple ways of knowing.

It asserts that integrating these epistemologies results in a more complete understand of complex issues, such as the management of wicked problems.

It accepts that the inclusion of different disciplines would require cross fertilization that would benefit research and design outcomes, and

It requires that disciplinary researchers work together to find ways to benefit from each other's approaches rather than compromise them.

The appeal and advantage for epistemological pluralism is obvious. It recognizes the inadequacy of the existing knowledge base of the various individual disciplines, and the need for coherence between the knowledge produced by different disciplinary integration (Pett et al, 2008, 596, reported by Cronin, 2008). Logic-emotion is not only pluralistic, but rather it is a symbiotic and seamless hybrid paradigm.

It has been demonstrated that ideal postgraduate design education must instill in its graduates the abilities to capture data for analysis, synthesis, ideation, design and evaluation of product, service or system efficiency, not only to answer materialistic and technical questions, but also to master human behavioural sciences. This would enable graduates to transform new technology into emotional and experiential meanings that would make products safer, more functional, usable and even pleasurable. Designers who are knowledgeable and armed with a hybrid 'logic-emotion' methodology can contribute as a scientist, a designer, as well as a change-agent. At the same time, they can play a vital role in problem solving, value creation, designing and ensuring that the function, usability and commercial viability of systems, products, services and brands are valuable, innovative and competitive – that are based on empirical evidence.

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