Industrial Design and Liminal Spaces

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I had a sketch book and I was constantly sketching, sketching...at the very beginning I was quite scared and drawing very neatly – 'oh no I don't want to make a mistake' - but later on got more free and didn't really care. That is when I got my best bits – there was a point where I was really angry - I just couldn't get a design - and scribbled and 'oh actually that's quite good!' (2nd year industrial design student)

Introduction

A recent longitudinal study carried out by the Centre of Excellence for Product and Automotive Design (CEPAD) at Coventry University aimed to identify the crucial transformations that undergraduate industrial design students must inculcate in order to successfully join their global community of practice. The findings showed that the concept of a liminal space is an important factor.

The research, using the threshold concept theory developed by Meyer and Land (2003) followed a cohort of undergraduates from entry to graduation between 2005 and 2010: in total 89 students were interviewed during the lifetime of the research.

The threshold concept theory posits the idea that within disciplines there are conceptual gateways or portals, which - due to their troublesome nature – can make it difficult for students to progress.   As such, a threshold concept is seen as distinct from 'core concepts' – or building blocks – within disciplines, due to the notion of transformation (Meyer and Land 2006:6). In other words, grasping a threshold concept will irrevocably transform a student's understanding, and this transformation can relate to the particular subject at hand, and/or be extrapolated beyond the academy.

Therefore, a threshold concept is seen as a conceptual gateway, and is defined as:

> *'akin to a portal, opening up a new and previously inaccessible way of thinking about something. [It] represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress. As a consequence of comprehending a threshold concept there may thus be a transformed internal view of subject matter, subject landscape, or even world view.' (Meyer and Land 2003:1)*

Meyer and Land identified several possible characteristics of a threshold concept, with the first being 'transformative'. Consequently, understanding a threshold concept will result in a personal as well as conceptual change. As such this transformation will become part of whom the student is, how they see and feel (Cousin, 2006) and will therefore expand personal biographies.

Another characteristic is that a threshold concept is often 'irreversible', as once understood the learner is unlikely - and often - unable, to forget it.

A threshold concept can also be 'integrative', in that it opens up connections between different learning experiences and enables students to make conceptual leaps within a much wider playing field of knowledge: 'the landscape is different' (Meyer et al 2008:70).

Perhaps the most important characteristic of all is that of 'troublesome knowledge': 'knowledge that is conceptually difficult, counter-intuitive or 'alien' (Perkins, 1999 in Meyer and Land 2003:1). This is the

characteristic that receives the most attention, and in essence, this is where students are required to move outside their comfort zone and enter, sometimes disconcerting, new territories. Meyer and Land go on to discuss how previous forms of knowledge need to be challenged in order to master a threshold concept.

Examples given are *ritual* knowledge – that which is routinely offered in response to a question, but which does not evidence the possible complex underpinnings of such knowledge; *inert* knowledge – which can be seen as 'stand alone' and displays no interconnectedness with a wider context; *conceptually* difficult knowledge – that which, if not grasped, leaves students unable to move from their intuitive knowledge, can result in mimicry of a subject and so troubled or limited understanding can occur; *alien* knowledge – that which is counter-intuitive to what students already think they know, and *tacit* knowledge – that which operates unseen and is often the background knowledge that informs particular disciplines or subject areas.

Threshold concepts in industrial design

Since the theory was first posited in 2003, threshold concepts have been identified in disciplines as diverse as depreciation accounting (Lucas and Mladenovic, 2006); caring in health (Clouder, 2005); the concept of the 'other' in communication studies (Cousin, 2006); climate change in geography (Hall 2011); hypothesis in biology (Taylor et al 2012); opportunity cost in economics (Shanahan and Meyer 2006); surface area-to-volume ratio in nano-science (Park and Light 2010); personhood in philosophy (Cowart, 2010); disjunction and problem-based learning (0-Baden 2006); Hallidayan rank scale in languages (Orsini-Jones 2009) and central limit theorem in statistics/entropy in physics (Meyer and Land 2005).

However, the work undertaken with the industrial design undergraduate students at Coventry University is unique, with the journey and results of the research reported in detail elsewhere (Osmond 2012, Osmond and Turner 2010, Osmond, Bull and Tovey 2010, Osmond and Turner 2008, Osmond, Turner and Land 2008).

In summary, a threshold concept was identified for first year undergraduates, namely **the toleration of design uncertainty**, defined as:

> *'…the moment when a student recognises that the uncertainty present when approaching a design brief is an essential, but at the same time routine, part of the design process.'*

The toleration of design uncertainty can be mapped against the characteristics of threshold concepts developed by Meyer and Land as follows:

Transformative	Students accept that the toleration of design uncertainty is the jumping off point to innovative design
Irreversible	This transformation incurs a cognitive shift in terms of students design confidence
Integrative	Students recognise that everything they learn and experience is a legitimate source of inspiration - for example, accepting that those moments when they surface around thinking about subjects that are not directly related to the task may turn out to be the most important part of the process.
Troublesome	Students accept that they will constantly experience and re-experience this 'surfacing around' as they hunt for a solution, even when they attain the status of professional designer.

Updated from Osmond (2009)

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Liminal spaces

Underpinning the characteristics of a threshold concept is the notion of *liminality*. Meyer and Land argue that whilst students are trying to grasp a threshold concept, they can remain 'stuck' whilst they oscillate between previous and new understandings, thus experiencing a disjunction, particularly in relation to problem-based learning (Savin Baden 2000). Examples of such liminal or conceptual spaces include the period between adolescence and adulthood and first-time motherhood: once entered there 'can be no ultimate full return to the pre-liminal state' (Meyer and Land 2005:376).

This notion of liminality is reflected within the creativity literature. Firstly, perhaps the most well known definition of creativity is that of 'Eureka' moments, epitomised by the example of Archimedes in his bathtub. Perkins (2000) addresses this but argues that the breakthrough in this case was not the result of a sudden realisation but the result of a process involving a 'long search', 'little apparent progress', 'precipitating event', and a 'cognitive snap and transformation' (p9). For our purposes, the liminal space in this instance is found in the long search and little apparent progress - here Perkins gives the examples of Archimedes struggling with Hiero's problem and da Vinci fussing 'endlessly with flight'.

Kleiman with his 'creativity-as-process' theory, also touches on this when he argues that 'playing for the sake of playing' (2008:213) is important to the creative process, as does De-Bono (1995) when he advocates that both time and space are needed for creativity to flourish – in this case time and space to try on different coloured hats, such as 'ideas and proposals' and 'evaluating the alternatives'. For Claxton - describing a creative approach entitled 'Thinking at the Edge' (TATE) - focus is important: 'learning the knack of delicate inward attention to a somatic process of epistemic evolution, in which hazy, pre-conceptual ideas are given time to unfold into novel forms of talking and thinking. (2006: 351)

Courage is also needed as argued by White when she cites Nickerson – 'timidity is not conducive to creativity' (2006: 436) and so the confidence to take risks is important. Further, she argues that teachers need to nurture their own creativity in order to enhance this within their students.

The time, space and courage needed in order to enhance creativity should be underpinned by a space of safety and structure, as discussed by Davies et al (2013) in a review of educational research, policy and professional literature on teaching creativity in schools. The review results fell into three main categories - the physical environment, the pedagogical environment and external partnerships. As well as time to work without pressure, and opportunities for immersion in activities, the authors identified that within the pedagogical environment a combination of freedom and structure is needed in order to foster creativity:

> *'..the provision of 'safe' structure appears to be particularly important to enable pupils to take risks, to think creatively and critically, and to question…best served by an equal balance between structured and unstructured work.' (2013:85)*

> *Secondly, and perhaps more importantly, the notion of a liminal space identified by the CEPAD research is also echoed in the design literature relating to professional designers. Thus the notion builds upon the work of design theorists such as Tovey (incubation period, 1984), Cross (oscillation between problem and solution, 1992), Dorst (tightrope walking, strategic thinking and visionary designer category, 2003); Wallace (problem bubbles, 1992) and Daly et al (personal synthesis, directed creative exploration and freedom, 2012).*

> *In more detail, Tovey's incubation period relates to right/left brain thinking, and he argues that it is only when both sides of the brain are in agreement after a period of incubation – where there is 'considerable interaction and interference' between each side - that the design process is 'concluded' (1984:226).*

> *For Cross, a similar process takes place, which he calls 'oscillation':*

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'…designing seems to proceed by oscillating between sub-solution and sub-problem areas, as well as by decomposing the problem and combining sub-solutions' (2007: 78)

In other words, Cross argues that preliminary models of the problem and solution can be found side by side in the brain where oscillation then takes place. Eventually when the two are reconciled – typically via a 'bridge across the chasm between problem and solution' - a creative leap takes place. (IBID)

Dorst describes this process as 'tightrope walking' and that there is no certainty that a successful design will result, or how long this could take. (2003:97)

For Wallace, this process is put into the context of 'problem bubbles' within which designers jump from idea to idea (bubble to bubble). Stating that personal design thinking is not a 'linear flow', he argues that effective designers tend to immerse themselves within the bubbles, but at the same time have the ability to consciously 'hover above' them which enables both the determination of patterns and control over the process. (1992:80)

More recently, Daly *et al's* paper outlined findings from interviews with twenty professional designers from a range of design disciplines. The authors found that designers typically approach designing from six distinct design 'lenses' or categories. They argue that individual designers will emphasise one of the lenses within their repertoire: also that the approaches can be structured hierarchically (see Figure 1). Thus the 'results of this work reveal outcomes of how designers combine the skills, knowledge, and experiences they have with design and what aspects of design they emphasise.' (2012:210)

[INSERT FIGURE ONE HERE: OsmondFigure1Daly]

Figure 1: Outcome space in hierarchical form. Daly et al (2012)

In more detail, the lenses/categories are described as follows:

Category	Type	Description
Level 1 lens	Evidence-based decision-making	Designing from a basis of grounded evidence
Level 2 lens	Organised translation	Adds a consideration of the solution in terms of the end goal
Level 3 lens	Personal synthesis	Sees the designer as the conduit, bringing knowledge and experience to bear towards the finished design
Level 4 lens	Intentional progression	Includes acknowledgement of the temporal and future implications for the wider field within which the design will sit
Level 5 lens	Directed creative exploration	Recognises the need for flexibility, experimentation and possible changes in course
Level 6 lens	Freedom	Allows for facilitated ambiguity and limitless possibilities from beginning to end of the design task.

Adapted from Daly *et al* 2012, 198-204

As can be seen from the literature, the concept of a liminal space is well represented, and it is argued here that the toleration of design uncertainty as a threshold concept has resonance to three of Daly *et al's* design lenses. Specifically, lens 3 (personal synthesis), 5 (directed creative exploration) and 6 (freedom). All of these levels speak to needing confidence - confidence to negotiate creativity and trust in one's personal judgment, confidence in the ability to be flexible, and confidence to tolerate ambiguity. Without this confidence each lens could be considered an unsafe space for student designers, who will often be

meeting these concept lenses for the first time in creative courses that typically emphasise individual agency and are often underpinned by tacit knowledge and 'wicked problems' (Buchanan 1992).

Thus, undergraduate students are encouraged to bring their creativity to the fore, perhaps through play and experiment, but, as novice designers, they will not possess the requisite skills, knowledge and experience - but, most importantly the confidence - to successfully negotiate the attendant uncertainties inherent within these concept lenses, in particular in terms of the freedom aspect of lens 6.

Impact on the curriculum

The need to provide safe spaces within the curriculum for students to experience intense uncertainty is recognised by Meyer and Land when they talk about the 'jewels in the curriculum' that encourage transformative moments in the student learning journey. Using these jewels as central points, the curriculum can offer a framework of engagement to promote conceptual understandings, and also can be used as diagnostic points for tutors.

Claiming that threshold concepts 'literally are the waypoints to be navigated…they are what really matters in the course and where the key transformations educators wish to bring about take place.' (Land and Meyer 2010:75), the authors discuss how the liminal states that students enter as they approach the jewels in the curriculum are key points at which assessment practices can be used to assess how, and if, students have reached a point where they are able to inculcate a threshold concept.

This, they argue, is of utmost importance if assessment practices are to identify and address students who can 'produce the right answer, while retaining fundamental misconceptions' (p.62) and thus allow a moving away from the notion that students arrive at the 'finish line' of a course at the same time.

And so a 'one size fits all' assessment method will not capture the variations in student understanding (p. 63-66). Variation in this case relates to the 'extent or degree to which individuals vary and perform understanding.' (p.64). The key to this is a recognition of liminal variation whilst students are suspended in the liminal space, which - once recognised - can result in new and creative methods of assessment. This process will necessarily involve deviation and unexpected outcomes and so a course design that focuses on a prescribed outcome will preclude such a journey. Therefore, the threshold concept theory 'to some extent 'rattles the cage' of a linear approach to curriculum design that assumes standard and homogenised outcomes.' (Land et al 2005: 59).

Consequently, the authors seek assessment practices that, to fully utilise the threshold concept theory, would offer ways of assessing student conceptual formations in four stages of liminality, possibly through an environment of 'rich' feedback at identified 'stuck' points (Land and Meyer 2010:76). This should be underpinned with a clarification of variation within each liminal state and also a grading system that can cope with identified troublesome knowledge. Such a strategy would ideally need to take into account variation in student knowledge on entry to the course, how they approach the threshold concept, what coping strategies they employ when within a liminal space and how they move forward when emerging from the space.

In conclusion, Meyer and Land posit that the threshold concept framework enables a focus on the 'learning episodes' that facilitate understanding of transformative concepts. (Land et al 2005:70)

The industrial design curriculum

Therefore effective curriculum design are needed to provide safe spaces that allow students to iteratively struggle, fail and succeed if they are to successfully progress in their studies.

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In 2010, the toleration of design uncertainty was used to redesign the Coventry University undergraduate industrial design curriculum for year one and year two to include such a safe space (see Tovey et al 2010).

Separate quadruple practice modules for year one and year two which spanned each year were introduced with contained assessment gateways which assumed greater importance (in terms of marks) as the year progressed. Specifically the first assessment attracted 10% of the total mark for the year, the second 15% and the final 75%. Accompanying this new curriculum model was the provision of dedicated spaces for the year one and year two students which they could colonise as their own.

The intention was to provide a safe, structured, creative space for industrial design students to allow them the time and space to immerse themselves within a series of design briefs, scaffolded by extensive formative feedback. The outcome, epitomised by the quote at the beginning of this chapter, indicated that the students were managing their anxiety within a supportive environment, and, as expected, there were some indications that students from a 'tick-box' educational background experienced some difficulty with accepting that it was OK to struggle, and sometimes fail, their initial assignments.

More recently, a teaching experience with a cohort of international MA students resulted in a team of tutors redesigning teaching delivery when it became apparent that a liminal space linked to the toleration of design uncertainty made its presence felt within a research methods module. For these students, the struggle occurred when they encountered ill-defined design problems during an initial teaching period which required them to expand their creative thinking from a solution to a problem focus. As reported in Bull and Osmond (2013) although the students understood the mechanics of creativity, they were unable to translate this in terms of a problem-solving context. This left the students in an uncomfortable liminal space as they concentrated on struggling to understand what the tutors wanted, rather than realising that they could experiment and play with ideas. As a result of identifying this, the tutor team recognised that the existing step-by-step delivery method had not helped the students to break out of their boundaried thinking processes and so they focused on a more conceptual delivery. The result was that the students slowly began to experiment with ideas, thus testing and expanding their own creative boundaries and building their design confidence.

Since 2010, other innovations in terms of curriculum design have been implemented in order to enhance students' creativity using the notion of threshold concepts and the concurrent liminal space. As reported in Johnson et al (2013) an important threshold concept is that of cooperative learning. Often students enter the course with the mindset of the 'lone guy with the sketchpad' and from year one, the curriculum is now designed to address this in order to foster co-operative learning. Using some of the characteristics of threshold concepts, year one is considered to be troublesome in that students tend to think in an individual linear fashion. Thus, accepting that they need to work as a team and that their idea is not always the best one to go forward can be difficult. Transformation is the key phrase within year 2, when there is further focus on cooperative work - internally by working on group projects and externally by working with external partners. By year 3, the change in student thinking process is further encouraged through a mandatory work placement module. Students return from external work placements with the realisation that cooperative working is not optional and as such this realisation can be seen as irreversible. Finally, in year 4, the integration of the previous years coalesce into routinely working as teams and becomes part of the students identity as they prepare to enter their professional community of practice.

Conclusion

This chapter has outlined the important of the concept of liminal spaces in relation to an industrial design curriculum within higher education.

Based on the work of the Centre of Excellence for Product and Automotive Design (CEPAD), which identified the toleration of design uncertainty as a threshold concept, there is a consideration of the notion of liminal spaces in relation to both the creativity and design literature.

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It is argued that for student designers, liminal spaces can be unsafe places as they will not have the skills, experiences and confidence necessary to negotiate them successfully and so a curriculum, which firstly identifies its 'jewels' and secondly builds safe spaces around them can only enhance students' creative abilities.

Examples of curriculum changes within the industrial design course at Coventry University are given, most notably a major curriculum redesign for year 1 and 2 students, a module redesign for international MA students and a brief outline of how the threshold concept of cooperative learning is focused upon throughout the four year course.

In conclusion, there seems little doubt that giving students the time, space and structure to immerse themselves into a design brief can only enhance their creativity.

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