

# The threshold of uncertainty in teaching design

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# The Threshold of Uncertainty in Teaching Design

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## Abstract

In many of our universities and colleges there is a long established approach to teaching design through practice. For most students their end goal is to achieve a level of capability to function as designers in the professional world. Their education helps them construct a passport to enter this community of professional practice. Part of the legacy of the funding initiative in England to support research into teaching has been the development of a better understanding of a practice-based approach to design pedagogy. This was a principal focus in two centres funded by the initiative in which 'signature pedagogies' were identified as a distinguishing characteristic for developing student capability within various types of design practice, each of which contains those elements, which are characteristic of the discipline. This notion moves the emphasis away from the content of the curriculum and explores the importance of practical, embodied and experiential ways of knowing. Where these were investigated for product and automotive design the concept of transformative practice was identified as crucial. Designers typically employ two simultaneous interacting cognitive styles. From a five-year longitudinal study involving 89 design students, it became clear that in order to develop the confidence to match these two modes of thought, neophyte designers needed to surmount a barrier, or a threshold concept, which we labelled the toleration of of design uncertainty. Accommodating effective arrangements to accomplish this has reinforced the importance of employing the traditional arrangement of studio teaching and given it a greater focus.

## Key words

design pedagogy, higher education, liminal spaces, curriculum

## Introduction

Much design education is based on mimicking what professional designers do. Designers engage in the activity of designing to produce designs, and within this process there is a greater emphasis on their being able to accomplish the process of designing than their being a repository of specialist knowledge. Similarly in design education there is a dominance of design practice in which students engage in the process of tackling design exercises, which mimic professional design practice. There is a long tradition of teaching design in this way in our universities and colleges. The purpose of the design project activity is to enable students to become more proficient as they

tackle projects, which develop in intensity and detail. Typically they are able to tackle progressively more complex design problems and the end goal is that of achieving a level of capability to function as designers in the professional world. In other words they wish to become part of the community of design practitioners and their education could be regarded as the system they negotiate to enable them to construct a 'passport' to enter this community [Tovey, 2012].

For students the design portfolio could be seen as the physical manifestation of their passport to design practice. They demonstrate that they can tackle design problems to a standard which is recognisably that of their professional community in this selection of their design work. Conventionally the work in the portfolio has been primarily visual, and good representational work including drawing and modelling skills are very important. In many cases, the traditional portfolio has been replaced by a virtual document, but the material will continue to be principally visual. It is important that it demonstrates that the students can think in a 'designerly' way, engaging in a 'solutioning' process. Demonstrating the ability to engage in creative synthesis is probably the most important ingredient in the mix required to achieve this passport to enter a community of design practice.

## Communities of Practice

There are many separate groups of designers specialising in different areas. Across the wide spectrum of design practice, each of them could be considered as a separate professional group which would constitute a community of practice. A typical community is a group of professionally qualified people in the same discipline. All of those involved will negotiate with and participate in a mutually understood discourse which is both explicit and, very often tacit. The signs of membership are usually clear and recognisable [Osmond, 2012].

The Community of Practice Theory, devised by Jean Lave and Etienne Wenger [Lave and Wenger, 1991], offers a way of understanding such groups. It has provided an innovative foundation for many researchers as a social theory of learning which highlights the value of our 'lived experience of participation in the world' [Wenger, 2007]. For members of a group learning takes place through a deepening process of participation in such a community of practice.

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Within a community of practice, learning is an experience of identity formation. In addition to the accumulation of skills and information, this is also a process of becoming. In the case of design communities this means becoming a particular kind of creative and critically minded design practitioner. Wenger call this “transformative practice”, and within a professional community of creative design practitioners that learning can become a source of motivation, meaningfulness and personal and social energy.

## Design Communities

Each of the many groups of designers represents a significant group of professional practitioners and each one could be regarded as a community of practice. For example we could include architects, industrial designers, design engineers, graphic designers, interaction designers, fashion designers, interior designers, craft designers, furniture designers, jewellery designers and many more. Some of the categories are sufficiently large that they subdivide into groups of more specialist designers. Thus for example graphic designers might distinguish between those concentrating on corporate identity, media graphics, or information design, and industrial design contains the large sub-categories of product design, and automotive design.

Walker [Tovey 2012, Walker 1989] has developed a representation of the range of design specialisms which gives some sense of their historical development. By showing diagrammatically the interrelationships between design disciplines, he suggests that each has its roots in traditional craft skills and methods such as drawing, modelling and simulation. These have developed and spread into more specialised activities. The range is from graphics and fashion for example, which rely on artistic sensibilities to science-dependent activities such as engineering and electronics. Some designers may spread across more than one area, and others may be more narrowly active. This helps us to understand the diversity of design and understand its interrelationships and development [Cooper and Press 1989, Tovey 2012a], within the context of a family of related design communities each with its own history and traditions.

## The Centres for Excellence in Teaching and Learning

There was major funding for the development of teaching and learning in universities in England between 2005 and 2010. For the Higher Education Funding Council for England (HEFCE), the Centres for Excellence in Teaching and Learning (CETL) initiative represented its largest single funding initiative in pedagogy to date. The project had two aims: to reward excellent teaching practice, and to further

invest in that practice. The ambition was that CETLs funding would deliver substantial benefits to students, teachers and institutions. [HEFCE 2011]. In total 74 centres were funded during the period. They covered a range of universities, and within them a huge variety of types of pedagogic research and development was undertaken. This was across all discipline areas, and much of it was interdisciplinary and collaborative.

It was noticeable that Communities of Practice (CoP) figured quite significantly within their range of activities, particularly in the area of professional development. For the initiative a CoP was defined as ‘a group of people coming together from different disciplines or within a discipline for a common interest’. This could be pedagogical or subject focused, and sometimes these were formally organised within a discipline, and sometimes cross-faculty. This can be seen as evidence of the widespread currency of the notion at that time and within the initiative.

Some 17 of the 74 funded centres, touched on ‘creative arts and design’ and thus may have been working in areas directly relevant to design pedagogy. In addition, many generic approaches which the centres engaged with would also have covered areas relevant to it. However, a much smaller number of centres had a direct location in design schools, and two covered work which focused directly on the development of practice based education as a preparation for entry to the design profession by focusing on signature pedagogies.

These were the Creative Learning in Practice (CLIP) CETL at the University of the Arts London, and the Centre of Excellence for Product and Automotive Design (CEPAD) CETL at Coventry University. CLIP had the specific aim to identify, evaluate and disseminate effective practice-based teaching and learning in the context of the creative industries. Similarly CEPAD was specifically orientated to identifying the crucial transformations for fledgling designers that would facilitate the creation of portfolios to provide access to the community of international industrial design practice. Since 2010, staff who had been involved in those two centres have carried on with developments in these areas.

## Developments out of CLIP

CLIP (Centre for Learning In Practice) was based in the University of the Arts in London. Thus it had access to a wide range of art and design disciplines across the federation of specialist colleges within the university. It was particularly well located to investigate disciplinary difference [Simms 2008]. Researchers in the Centre were able to

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investigate the differences between Fine Art, Graphic Design, Fashion Product Design and Design for Performance and they were able to identify distinctive characteristics, and the spaces in which they occurred. There were a number of conclusions in this study including the importance of social approaches to teaching and assessment. This work has made it possible to identify the signature pedagogies which characterise particular groups and are common to such activities [Shreeve 2007]. They develop in students the characteristic ways of thinking, being and acting in the discipline which is common to the group.

There was a particular focus on the development of the community of student practice as an approach to student learning support based within the course of study [Shreeve 2007] in CLIP's research. The key to accommodating students from a diverse background lay in more inclusive participation in learning activities where students are encouraged to undertake responsibilities with the tutors acting as facilitators or guides. This emphasised partnership and collaboration over traditional didactic approaches.

## Developments out of CEPAD

The notion of signature pedagogies was also reflected in the research carried out within Coventry University's Centre of Excellence for Product and Automotive Design (CEPAD). Based in the School of Art and Design, the Centre's close links with the design profession, especially in the transport industry, have enabled it to develop what could be considered as the signature pedagogies for automotive design and product designers. It assumes that in order to function effectively as designers students must engage in a designerly way of knowing. It is argued that this is a core capability which is shared across different types of designer. In the practice based approach to design education the intention could be seen as one of combining the generic designerly thinking with the domain related specialised knowledge of a signature pedagogy, to produce a level of overall capability sufficient to gain entry to the relevant community of design practice.

In 'Designerly Way of Knowing' [Cross 2006], Cross characterises design as an activity involving tackling 'ill-defined' problems through a 'solution-led' problem-solving approach. Cross notes that the designer's attention oscillates between the problem and its solution, in an appositional search for a matching problem-solution pair, rather than a propositional argument from problem to solution. This picture of the thinking processes involved in designing corresponds with the classic analysis-synthesis description of the design process. It would seem that the two processing modes are typically employed at the same

time and interactively, and that a more complete understanding of any particular problem arises from the matching of initially separate simultaneous mental operations. The 'dual processing' strategy employed by designers involves a 'conversation' taking place between these two modes [Tovey, Bull and Osmond 2010]. The result of this 'conversation', in what Tovey describes as an 'incubation period', enables a designer to arrive at a 'solution' [Tovey 2012]. The evidence from the Centre's research was that for neophyte design students being able to arrive at this match and thus a solution, was a threshold capability. However achieving this solutioning process involved surmounting a key barrier, which we have labelled the threshold of design uncertainty.

## Threshold Concepts

The research carried out by CEPAD was framed by the notion of threshold concepts, first introduced by Meyer and Land in 2003. Using this framework, six industrial design students were interviewed at least twice per study year from entry in 2005, to graduation in 2010.

The research was reinforced by qualitative data gathered from other industrial design students throughout the five-year longitudinal study, including some postgraduates. In all, including the core six, a total of eighty-nine students took part in the research.

In essence, the threshold concept theory speaks to the idea that there are crucial transformations that take place as students progress through their studies. These relate to specific learning events within the curriculum but also to identity transformations.

In other words, grasping a threshold concept transforms a student's worldview, and equips them to move onto the next stage of their learning. Meyer and Land often refer to threshold concepts as 'portals' or 'gateways' and that they enable a focus on the 'learning episodes' that facilitate understanding of transformative concepts (Meyer et al 2008:71).

A threshold concept is defined thus:

*'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)

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As well as the transformational aspect of threshold concepts, Meyer and Land posit that they include other notable characteristics. These include irreversibility (once learnt, impossible to forget), integration (enables conceptual leaps within and outside the discipline field), and troublesomeness (uncomfortable, resistant acceptance).

This latter characteristic is often due to the presence of previous knowledge, which can get in the way of acceptance. To expand on an external (to academia) example offered by the authors – that of new parenthood – this would relate to a first time parent holding an ‘ideal parent figure’ in his or her mind, only to be faced with a real live baby who will not conform to this picture. This means that the first time parent will have to negotiate not only a learning curve in terms of the practical aspects of parenthood, but also negotiate the identity shift involved in recognising that previously held knowledge about who they thought they were, now has to change. And so, letting go of the ‘ideal parent figure’ can be troublesome, difficult and be encountered with strong resistance.

Underpinning such resistance are several types of knowledge, one of which is *ritual*, or intuitive understanding, that which is offered in response to a question, such as names and dates; *inert* knowledge – stand alone knowledge with no connection with a wider context; *conceptually* difficult knowledge – that which, if not grasped, can result in mimicry of a subject; *alien* knowledge – that which is counter-intuitive, and *tacit* knowledge – that which operates unseen and is often the background knowledge that informs particular disciplines or subject areas (Perkins 1999).

Consequently, grasping threshold concepts within higher education courses can be uncertain and unsteady events for students. Meyer and Land posit that because of the transformational aspect of threshold concepts, the gateway or portal is often an uncomfortable and uncertain space. Successful negotiation of these spaces is dependent on a number of factors, such as the student’s knowledge of the discipline ‘game’ before entry, his or her confidence in deciphering the game once entered and his or her ability to inculcate the learning curves and thus move towards the next gateway.

Meyer and Land refer to these spaces as ‘liminal’ and, referencing variation theory, discuss four separate stages that students will need to negotiate (Meyer et al 2008). Firstly, there is the sub-liminal stage, which concerns student knowledge of the existing rules of engagement (or episteme, Perkins 1999) within the discipline. Depending

on a student’s previous educational background there will be variations of understanding on entry. This stage is followed by pre-liminal variation which will shape how confident students are as they approach the threshold concept portal. The third stage is the actual portal itself – as the students enter this, there will be variations in how well they handle being suspended in an unsafe space, and whether or not they can pass through it. The fourth stage is post-liminal – when students finally emerge on the other side of the portal, the type of conceptual variations present and how these relate to continued progression.

For Meyer and Land, threshold concepts – or what they also call the ‘jewels in the curriculum’ – can shape curriculum design by pinpointing diagnostic points for tutors and thus are ‘literally...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)

## Liminal spaces

These liminal spaces are echoed within the creativity literature (see De Bono 1995, Perkins 2001, Claxton 2006, Kleiman 2008). This courage needed to embrace creativity is echoed 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. Similarly, Davies et al (2013) advocate a pedagogical environment that encompasses both freedom and structure:

*‘...the provision of [a] ‘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)*

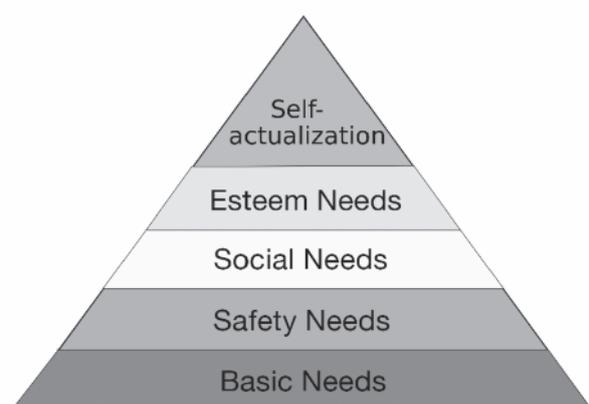


Figure 1. Maslow’s Hierarchy of Needs (Mcleod 2013)

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In addition, liminal spaces are also acknowledged in the design literature (see Wallace 1992, Dorst 2003, Cross, 2006) and Tovey's notion of right/left brain thinking involving an incubation period (1984). Also Wallace's notion of leaping between problem bubbles, and sometimes having to start again, has resonance. Daly et al (2012) outline how professional designers typically approach design briefs from one of six 'lenses', and that these lenses can be seen as hierarchical in nature. Daly et al's hierarchy can be compared to Maslow's Hierarchy of Needs.

According to McLeod (2013) within Maslow's hierarchy, the lower level (basic) needs must be satisfied before progressing to the next level, with the ultimate aim of self-actualisation being a culmination of the previous stages (Figure 1).

By the same token, Daly *et al* advocate a progression through a hierarchy, (see Figure 2). Firstly fledgling designers are more likely to use 'evidence-based decision-making' when approaching a brief, and as they gain experience, they will progress to 'organised translation, which adds a consideration of the solution in terms of the end goal. The next stage is 'personal synthesis, which sees the designer as the conduit, bringing knowledge and experience to bear towards the finished design. The fourth is 'intentional progression and this includes acknowledgement of the temporal and future implications for the wider field within which the design will sit'. The fifth is 'directed creative exploration, which recognises the need for flexibility, experimentation and possible changes in course. The final (in Maslow's terms – self actualisation) is 'freedom', which allows for facilitated ambiguity and limitless possibilities from beginning to end of the design task.'

However, in contrast to Maslow, Daly et al advocate six instead of five stages, and they also argue that designers

do not have to satisfy the previous levels in order to reach the 'freedom' stage, although it could be argued that this is the preferred aim of design teaching in higher education. Instead they argue that each professional designer will approach a task from one or more of the lenses, depending on their level of experience/preference.

Liminal spaces and the industrial design curriculum As touched on above, the research carried out between 2005-2010, identified a liminal space linked to a threshold concept which applied to first year industrial design undergraduates (see Osmond et al 2008, Osmond and Turner 2008, Osmond 2009, Tovey et al 2010, Osmond et al 2010, Osmond and Turner 2010, Bull and Osmond 2013 and Osmond 2015).

This liminal space was represented by a lack of creative confidence and the associated threshold concept was entitled 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.'

This threshold concept was mapped against the Meyer and Land characteristics in Table 1:

The qualitative data showed that there was a problem for some students during their first year, linked to a lack of creative confidence. Often this lack of confidence was due to previous educational systems that fostered a mind-set of 'what do we need to do to pass': thus entering a creative course where they were asked to explore their own creative instincts was troublesome and anxiety-provoking. Students could get stuck in a liminal space as they struggled to 'be creative'. This proved too much for some students and they subsequently left the course, but for others the process they went through gave them the

courage to trust their creative instincts and thus increased their confidence to the point where they would debate and defend their designs with industrial design staff.

When this issue was labelled and understood the response was to address the shape of the teaching. The curriculum for first and second year students was redesigned in 2010 to accommodate this liminal space. The redesign mainly involved changing the nature of project work, by inserting a

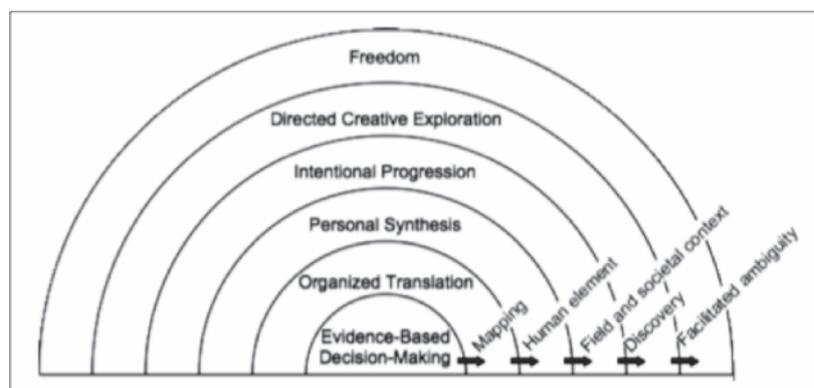


Figure 2. Outcome Space in Hierarchical Form Daly et al (2012)

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Characteristic	
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 surfacing around thinking about subjects that are not directly related to their 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.

**Table 1. Threshold concept characteristic mapping (Updated from Osmond, 2009)**

long quadruple module which spanned each year. Most importantly the grading system was also changed, by assigning the highest percentage of marks to the final stage of the year. And so the first assignment attracted only 10% of the total mark for the year, the second 15% and the third 75%. This allowed students the freedom to be creative and playful for their first assignments in the knowledge that if they did poorly, or failed, not only would it not have a major impact on their final year mark, but also, scaffolded by extensive formative feedback, they then received the guidance they needed to approach the next assignment. The underlying agenda for the redesign was to bolster the students' creative confidence to experiment, something that some students, arriving from a 'what do we need to do to pass' educational culture found difficult and unsafe.

In terms of Daly et al's six lenses for professional designers, it is probable that undergraduates in Year 1 and 2 will find themselves at Level 5 (directed creative exploration) without the underpinning experience. According to a Coventry University design tutor, this can result in either a rush at a brief or, conversely, worry about marks and a consequent restraining of creativity. Either way, students do not have the experience to underpin their work, particularly in terms of whether the design is feasible. This can leave them in a liminal space where they are uncertain of their approach:

Students tend to think that they are free to design anything they like at the start of a course and that 'new is always better'. They do not have enough experience to filter out the 'daft' from the plausible and so put everything forward. When they are being 'taught' they don't appreciate that they need to know how to do things conventionally and properly before they have 'earned' the freedom to experiment freely. There is a danger that they worry about losing marks for producing extremely innovative ideas and so become very conservative. At the other end of the scale some

students do lose marks by doggedly creating something different but not feasible for their final year project. I think that experienced designers recognise how constraints can often provide the best challenges. A good example is the package drawing. Auto students dislike them because they are not seen as creative yet some of the biggest innovations in design have been packaged! (Brian Clough, 2nd year design tutor)

To mitigate this uncertainty, the tutor explains that the weekly tutorial sessions, particularly during Year 2, are of utmost importance:

We try to mitigate against students dwelling for too long in a 'liminal space' and the weekly tutorial sessions are intended to remove uncertainties as quickly as possible and to foster strategies for dealing with design decision-making on a week to week basis. The students may not know 'what they need to know' at the start but the tutorials can show them where and how to look and how to prioritise effort to remove unknowns. By the end of Year 2 the top half of the year will be ready to operate 'professionally' using the first five lenses and the majority of the students will have experienced Levels 1 to 5 to some degree.

As Bull (2014) observes what is required is an approach to this transformative learning experience which is embedded in a studio culture which engages students through design practice. She describes how the scaffolded gateway assessment arrangement at Coventry has been structured so as to engage the students in learning which takes them from aspiration to a strong personal alignment with the standards and techniques of professional design practice. This has provided the space for tutors to work with students to define individual learning pathways which serve to reinforce creative confidence and professional awareness. The evidence from the quality of outputs and student satisfaction gives some early indications of the effectiveness of the revised scheme.

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In summary, the concept of Meyer and Land's liminal spaces are well represented within both the creativity and design literature, and a particular liminal space relating to design uncertainty was identified within the early years of the industrial design course at Coventry University.

## Conclusion

In two universities in England a HEFCE initiative to support pedagogic research has produced developments which help us to understand better certain key ingredients of practice based education. A key theme has been the engagement with communities of practice and how groups of professional design practice have a particular relationship with design education which manifests itself as identifiable signature pedagogies. For industrial design students a key feature of their education involves confronting a threshold barrier which we have labelled the toleration of design uncertainty. In approaching this threshold they are entering a liminal space which is typical in creative disciplines. For design tutors who are organising courses there is a need for arrangements which allow both a safe arena and exploratory time in which this barrier can be surmounted. Traditional design studio teaching can be organised and assessment arrangements modified so as to encourage experimentation and the development of confidence in design solutioning.

## References

- Bull, K (2014) 'Design Practice and Transformative Learning' chapter in Tovey, M. 'Design Pedagogy' Gower, Farnham
- Bull, K., Osmond, J. (2013) 'Design Education and non-EU students: shifts in teaching practice'. DRS//CUMULUS Oslo 2013 Proceedings. Oslo. 14-17 May. Volume 1: ISBN 978-82-93298-01-4
- Claxton, G. (2006) Thinking at the edge: developing soft creativity'. *Cambridge Journal of Education*. Vol.36. September. 351-362
- Cooper, R. and Press, M. (1989), *The Design Agenda: A Guide to Successful Design Management*, John Wiley and Sons, Chichester
- Cross, N., (2006) *Designerly Ways of Knowing*. Springer-Verlag, London
- Davies, D., Jindal-Snappeb, D., Colliera, C., Digbya, R., Haya, P., Howea, H. (2013) Creative learning environments in education – A systematic literature review. *Thinking Skills and Creativity* 8 (2013) 80–91
- Daly, S., Adams, R., Bodner, G. (2012) 'What Does it Mean to Design? A Qualitative Investigation of Design Professionals' Experience'. *Journal of Engineering Education*. April, 101, 2, 187-219. ASEE
- DeBono, E. (1995) 'Exploring patterns of thought: Serious Creativity'. *Journal for Quality and Participation* 18 (5), 12 – 18
- Dorst, K. (2003) *Understanding Design 150 Reflections on Being a Designer*. Amsterdam: BIS
- HEFCE (2011) Summative evaluation of the CETL programme: Final report by SQW to HEFCE and DEL HEFCE, Gloucester.
- Kleiman, P. (2008) 'Towards transformation: conceptions of creativity in higher education' *Innovations in Education and Teaching International* Vol. 45, No. 3, 209–217
- Land, R., and Meyer, J. (2010) 'Threshold concepts and troublesome knowledge (5): Dynamics of Assessment'. in *Threshold Concepts within the Disciplines*. ed. By Land, R., Meyer, J. and Smith, J. Rotterdam: Sense Publishers, 61-79
- Lave, J. and Wenger, E. (1991) *Situated Learning Legitimate Peripheral Participation*. Cambridge University Press, Cambridge
- McLeod, S. (2013) Maslow's Hierarchy of Needs. *Simply Psychology*. Available online: <http://www.simplypsychology.org/maslow.html> Accessed 3 November 2013)
- Meyer, J., and Land, R. (2003) 'Threshold concepts and troublesome knowledge: linkages to ways of thinking and practising within the disciplines'. *Occasional Paper 4* (online). Available from: <http://www.etl.tla.ed.ac.uk/docs/ETLreport4.pdf>. [26th September 2013]
- Meyer, J., Land, R., and Davies, P. (2008) 'Threshold concepts and troublesome knowledge (4): Issues of variation and variability'. in *Threshold Concepts within the Disciplines*. ed. By Land, R., Meyer, J. and Smith, J. Rotterdam: Sense Publishers, 59-74
- Osmond, J. (2009) 'Stuck in the bubble: Identifying Threshold Concepts in Design'. Dialogues in Art and Design: Promoting and Sharing Excellence, GLAD Conference. York St John University. October
- Osmond, J. (2012) 'Passports to a community of practice' in Tovey, M. ed. *Design for Transport*. Gower

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- Osmond, J. (2015) 'Industrial Design and Liminal Spaces'. In Tovey, M. (ed) *Design Pedagogy*. Gower
- Osmond, J., Bull, K., Tovey, M. (2010) 'Threshold concepts and the transport and product design curriculum'. In *Art, Design and Communication in Higher Education*. Special edition. Issue 8.3. ADM
- Osmond, J., Turner, A. (2008) 'Measuring the creative baseline in transport design education.' In Rust, C. (ed) *Improving Student Learning – For What?* OCSLD. Oxford
- Osmond, J., Turner, A. & Land, R. (2008) 'Threshold Concepts and Spatial Awareness in Automotive Design.' In Land, R., and Meyer, JHF. (eds) *Threshold Concepts within the Disciplines*. Sense Publishers. Rotterdam
- Osmond, J., Turner A. (2010) 'The Threshold Concept Journey: from identification to application'. In JHF Meyer, R. Land & C. Baillie, eds. *Threshold Concepts and Transformational Learning*. Sense Publishers. Rotterdam.
- Perkins, D. (1999). Quoted in Meyer, J., and Land, R. (2003) 'Threshold concepts and troublesome knowledge: linkages to ways of thinking and practising within the disciplines'. In C. Rust. ed. *Improving Student Learning Theory and Practice – 10 years on*. Oxford: OCSLD, 412-424
- Perkins, D. (2001) *Breakthrough thinking and the Eureka Effect: An interview with Professor David Perkins*. Harvard Graduate School of Education. 1st December 2001. Available from <http://www.gse.harvard.edu/news/features/perkins12012001.html>
- Shreeve, A. (2007) Learning development and study support – an embedded approach through communities of practice in *Art, Design and Communication in Higher Education* Vol.6 Number 1, Intellect Ltd, London
- Tovey, M. (1984) 'Designing with both halves of the brain'. *Design Studies*, Volume 5, Number 4, 219-228
- Tovey, M. (2012a) The Passport to Practice chapter in *Design and Designing: A Critical Introduction* Editors Garner, S. And Evans, C. published by Berg, London
- Tovey, M (2012)., *Design for Transport: A User Centred Approach to Vehicle Design and Travel* in the Design for Social Responsibility Series, Gower, Farnham
- Tovey, M., Bull, K., and Osmond, J. (2010) 'Developing a Pedagogic Framework for Product and Automotive Design. In Proceedings of *Design and Complexity*, 'The Design Research Society Biennial Conference'. Montreal, Canada. Available from <http://www.drs2010.umontreal>
- Walker, D. et al. (1989), *Managing Design: Overview Issues*, P791, Open University Press, Milton Keynes
- Wallace, K. (1992) 'Some Observations on Design Thinking' in *Research in design thinking*. eds. Cross, N. Dorst, K, Roozenburg N. Netherlands: Delft University Press, 75-86
- Wenger, E. (2007) *Communities of Practice Learning, Meaning and Identity*. Cambridge University Press. Cambridge
- White, J. (2006) 'Arias of learning: creativity and performativity in Australian teacher education'. *Cambridge Journal of Education*. Vol.36. No.. September. 435-453

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