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THE ACQUISITION OF KNOWLEDGE AND EXPERTISE IN CONSTRUCTION: UNDERSTANDING CONSTRUCTION PROFESSIONALS

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Education programs these days especially in Construction Management have been designed and updated to response to market and stakeholder needs. However, there still exists a need for educators to understand how construction practitioners develop their expertise. Understanding the development of expertise is essential for providers of university education and training to enable them to develop programs to establish on which new professionals can better develop their appropriate expertise. This paper builds on earlier research and further explores how expertise develops in construction professionals. It also explores the similarities and differences in development of that expertise in construction practitioners from the perspective of knowledge from various regions, which includes Thailand, Australia and Ireland, through the use of interviews with active and experienced construction professionals. To understand how construction practitioners', gain and use knowledge in their career can offer further extension to theorising about expertise in construction and through active application of this knowledge in courses and programs in AEC, enabling productive communication between industry and academia. AEC graduates in the future will need to be highly technical, adaptable, collaborative, good communicators and lifelong learners. The goal of creating those experiences that address these competences provides the modern academic with many challenges and those in industry have much to contribute to making this challenge more focused and appropriate.

Keywords: expertise, practice, knowledge, discourse, construction

INTRODUCTION

Previous research undertaken in Australia and Thailand has shown construction expertise derives both systematically and often for some professionals in an ad hoc manner from various forms of knowledge, either or both from authoritative and non-authoritative knowledge sources (Kanjanabootra and Corbitt 2016; Kanjanabootra 2017; Jordan, 2014). These forms of knowledge are constrained deliberately and politically by accreditation bodies, government authorities and by the market. However, our understanding of the development of expertise in Construction Managers (CMs) is still too limited to develop more comprehensive theory and apply that universally to the discipline. Education programs these days especially in CM have been designed and updated to respond to market and stakeholder needs. However, there still exists a need for education providers to understand how

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construction practitioners develop their expertise (Scott 2016). Understanding the development of expertise is essential for providers of university education and training to enable them to develop programs to establish the foundations on which new professionals can better develop their appropriate expertise. This paper explores the similarities and differences in development of that expertise in construction practitioners from the perspective of knowledge from various regions, which includes Thailand, Australia and Ireland, through the use of interviews with active and experienced construction professionals. The intention of this paper is not simply about how construction professionals acquire explicit or/and tacit knowledge, rather the research question asks how do professional accreditation bodies shape and control how construction professionals acquire initial knowledge and how does that impact their life-long learning and their expertise development?

Reviewing the Literature - The Challenge

The challenge in understanding construction professional knowledge and expertise acquisition and development is that at a superficial level it appears to be systematic. However, in reality this process is rather convoluted and complex from the beginning of the process. We argue that by studying the process of expertise development in CMs and then theorizing the process, a more universal, less complicated and less complex process will emerge, enabling universities to enable course improvement and enabling industry to provide better channels for knowledge acquisition and expertise improvement. At an informal level this could provide students with the capacity to enable lifelong learning. Expertise development is argued to be a lifelong process and can be seen from the perspective of processual understandings of expertise (Wood, 2002). However, such a non-structured perspective assumes all readers can differentiate the various structures that are necessarily part of knowledge and expertise acquisition as these structures and socially imposed, as university courses, professional development courses etc. The processual perspective is useful which looking at the history of the processes but needs to enable reflection on these structures which are formally recognised. Since our intent is to develop some theorization and therefore offer possible solutions, it is essential to be able to see not only the entire process, but the parts of that process. In doing this we believe that we can begin to unravel complexity, rather than desiring less complexity (Langley, 2013).

It is generally accepted that most occupations expertise development have similar patterns which start with initial training in formalised and structured education systems such as university or vocational training (Elvira *et al*., 2016; Tynjälä 2008). Everything else then can be added on in professional practice via a 'learning on the job' basis (Edum-Fotwe and McCaffer 2000). In fact, expertise development process is far more complicated than just two isolated chunks of learning as mentioned, especially in the AEC industry where there are vast numbers of stakeholders involved. The result is that every stakeholder from a specific discipline domain need their graduates to be trained in a certain way with a specific set of competencies before entering the industry (Callanan and McCarthy 2003; Jackson 2016). Then specific practice discourses in each profession in the AEC shape and control how practitioners develop their life-long expertise development.

Initial Training Challenges

There are specific complications with how education providers such as universities and vocational institutions design their degree structure and how each course is designed to meet a complex set of graduate attributes set by various accreditation

bodies (Altbach and Knight 2007). Some degree programs have to comply with multiple accreditation bodies (Becerik-Gerber *et al*., 2011). This means that the degree structures have to be designed to accommodate all of the graduate attributes that each accreditation requires. The challenge is that the degree will be packed with large amount of attributes, more than one student wants/needs. The university degree has a specific time frame (4 years, 8 semesters). Typical university degrees are full of practical courses with little space for non-technical courses, which some argue are essential for life and for the workplace context (Gambrill and Gibbs 2017). Hughes and Hughes (2013) showed that the expanding jurisdiction of professional institutions and their inability to address changing practices are somewhat responsible for eroding professional judgement.

Practice Challenges

Findings from earlier work (Kanjanabootra and Corbitt 2016; Kanjanabootra 2017) show that approximately 10-15% of knowledge used in professional practice is gained from an initial degree or training. Then practitioners gain the rest of their knowledge from doing their day-to-day job. New graduates have to acquire significant job specific, practical knowledge when they start their first job. Because each organization has different training practices in their firms as this training have been tied up with practice and tasks, this creates a discrepancy between professionals in development of their expertise (Boud and Hager 2012). Accreditation bodies or registered professional associations offer substantial Continuing Professional Development (CPD) courses for professionals in work contexts. Multiple professional associations also offer the programs/ courses in a non-systematic, and non-integrated way, but which are also controlled and very politicized. To understand how construction practitioners', gain and use knowledge in their career can offer further extension to theorising about expertise in construction and through active application of this knowledge in courses and programs in AEC. AEC graduates in the future will need to be highly technical, adaptable, collaborative, good communicators and lifelong learners. The goal of creating educational experiences that address these competences provides the modern academic with many challenges and those in industry have much to contribute to making this challenge more focused and appropriate.

The Cycle of Practice

At a theoretical level the Tynjälä's Model (2008) and the application of that model by Elvira *et al*., (2016) reflect the essential role that integration of the three elements of expert knowledge (conceptual/ theoretical knowledge; practical/experiential knowledge and self-regulatory knowledge) play in the development of expertise.

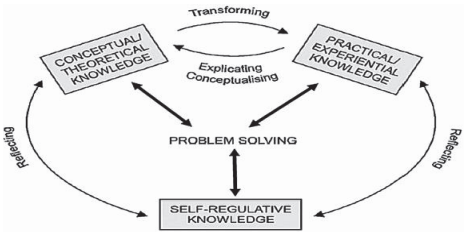

Figure 1: Generalised Model of Expertise Development (Elvira et al., 2016, based on Tynjälä (2008)

Previous research (Kanjanabootra and Corbitt 2016 and Kanjanabootra 2017) has shown that the cyclic process proposed by Tynjälä was not as complete, resolving

through focus on the elements of Practical/Experiential Knowledge and Self-Regulative Knowledge and that 'reflecting' was constrained by the economic imperatives of project controls and was subsequently inconsistent and often weak.

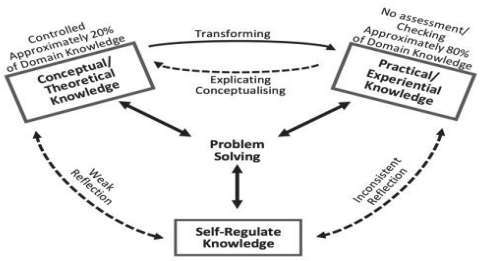

Figure 2: Expertise Development in Construction (based on Kanjanabootra and Corbitt 2016)

For the early career graduate professional, the nature of knowledge and expertise development surrounds gaining practical/ experiential knowledge through the application of learnt conceptual/theoretical knowledge where an advancement to self-regulated knowledge achieved by way of exposure to real tasks and objective mentoring. In particular, the significance that education has in contributing to both knowledge and professional practice is an important factor that impacts on expertise and knowledge development. This differs from Professional Body Frameworks which are functionalist and specific, detailing knowledge as skills and capabilities, almost always without seeing their interconnectedness. The codification of any discipline refers to what it knows through codes of practice, bodies of knowledge and the production of journals and other reading matter. Kuhn (1967) argues that disciplines are defined by paradigms through 'models of thought'. As the CM discipline is a relatively young discipline, consensus has not been fully achieved. Langford and Hughes (2009) however, have argued that CM meets the three criteria and therefore can assert itself as a discipline.

We have used an alternative perspective to underpin this research. Hibbert (2013) describes the increasing routinization and instrumentalised contexts of professional practice where educators disseminate information, reproduce routine and students or practitioners receive training. Flyvbjerg *et al*., (2012), Kanjanabootra (2016) and Antonacopoulou (2010a, 2010b) argue that learner reflection is needed so that skills and practice can be evaluated and then shared. In this way they argue, knowledge grows and collaboration of knowledge emerges. This is part of seeing how expertise develops in students initially and then in practitioners within the socially formed structures evident within the profession. At a conceptual level this involves the transfer of knowledge to problem solving as shown in Fig 2 above. To provide a framework to consider both this acquisition and transfer process, the research uses the approach of Kanjanabootra and Corbitt (2016) focusing on three elements related to expertise development in construction, the existential (who am I and what kind of person do I want to be as a practitioner?); the relational (how do I as a practitioner relate to others and to the world around me?); and praxis (understanding the self-conscious, questioning expertise development as both past actions and future possibilities).

RESEARCH APPROACH

This research aims to gain a better understanding of how the architecture, engineering and construction (AEC) sector understands and conceptualises Discipline knowledge and expertise. As this research is exploratory (Fellows and Liu 2015) seeking insights

about expertise development in construction managers, the research methodology employs techniques to both gather and then analyse rich data (Geertz 1973) with the intent of further theorization. The research reports the narratives offered by the construction managers' own objectivity and their narratives reflect their learning and expertise development. Vygotsky (1978, 1986) argued that learning is a reflection of socially mediation informed by its social, historical, and cultural contexts and that learning is self-reflected in the narratives or stories respondents tell in the research process. Contextual analysis enables the meaning and inner workings of our main variable of interest to be better illuminated (Collins *et al*., 1999). George *et al*., (2015) also argue that context functions outwards, by encouraging researchers to examine a broader range of relationships that may influence outcomes of interest, in this case expertise development in construction managers. Only through the respondent themselves telling their story can a 'richer' understanding of how construction managers learn and develop their expertise be gained. This methodology was used here to elicit the types and forms of knowledge that informed the practice and subsequent development of expertise of the construction managers, seeking to further add to what Addis *et al*., (2016), Chan (2016), Sage (2016), Kokkonen and Alin (2016), Mogendorff (2016), Scott (2016), Newton (2016) and Kanjanabootra and Corbitt (2016) have already proposed about expertise development in construction.

Each conversation between participant and researcher was recorded. The interviews were transcribed and then analysed using an iterative analysis trying to determine themes. The structured interviews generally took about 45 minutes each. All the interviews were audio recorded where permission was granted by the interviewees. Otherwise, notes were taken, as were during discussions and meetings. The qualitative data (e.g. the notes and transcripts of interviews) was analysed using the 'content analysis' method, i.e. following the logic of identifying the codes, themes and patterns. Use of NVivo and then thematic coding assisted in identification of themes in the interview data as they related both to knowledge and learning, and to expertise (Fereday and Muir-Cochrane 2006).

Table 1: Professional Background of Participants

	Australia	Thailand	Ireland
Construction Management	5	4	4
Quantity Surveyor	4	-	2
Architect	1	2	1
Engineer	3	6	1

ANALYSIS OF RESEARCH - FINDINGS

Outside the scope of knowledge graduates acquire formally and in the structured context of a degree, the graduates have to rely on both knowledge sharing via informal teaching from more senior practitioners, from peer interactions and from exposure to new products and processes from the commercial sector. Professional relationships with a more senior supervisor will determine what they can learn, and how much they can learn through job or tasks allocation. The research respondents highlighted instances where knowledge was withheld, either deliberately or through allocation of mundane, repetitive tasks, seemingly disengaged from acquiring new knowledge, hence expertise development can happen in a very slow manner. Graduates can learn new knowledge through the tasks that they are allocated to do and work under close supervision of more senior staff.

This learning process for construction professionals over time is determined, according to the construction professionals, by the types and amount of tasks that are allocated in construction projects. This is a complex situation because if the difficulty of the allocated tasks does not match their knowledge level, they might take longer time to execute those tasks. In the case of the QS professional at the end of this two year learning period, graduates also have to be nominated by a specific grade of AIQS member who has the responsibility to evaluate whether they have adequate competencies to be registered as a professional or not (AIQS, 2017). This, it can be argued, represents a continuity of authoritative knowledge through a professional discourse, but relies on the unstructured, almost serendipitous acquisition of less formal knowledge through knowledge transfer and knowledge sharing in the workplace. Newton (2016) argues that knowledge through 'declarative and deliberate practice and knowledge' are integral to expertise development in construction. The construction professionals interviewed in this research exemplify that knowledge transfer and knowledge sharing in the workplace are at times either or both declarative and/or deliberate, both being essential to the development of expertise.

The respondents' data also highlighted individual instances where new professional knowledge can develop through process modification with the introduction of innovations. However, the QS interviewees consistently noted that the Quantity Surveyor role does not really enable innovation to take place as their role is defined in a very explicit way. While in the engineering profession new knowledge derives mostly from either new products or a modification of existing processes, by trial and error to improve designs or processes. This modification of existing processes often comes in a form of new constraints that are project specific. This resulting new knowledge, the engineering respondents noted, develops through the process of finding on-site solutions to address new project constraints.

The respondents highlighted what, it can be argued, exemplifies the effect of a discourse of benign knowledge sharing within what Bernstein calls his horizontal discourse. This benign knowledge sharing can happen through the introduction of technologies such as BIM in the construction workplace. There is substantial evidence for viewing the constraints of this type of supervision, and the demands for professional development career points (CPDS) discussed above, to represent parameters to learning, constraining the development of repertoires of skills/knowledge into formal structure perspectives. That discourse determines what has to be known to maintain professional practice as a career develops. In essence, it can be argued, these may form constraints on the development of an individual's expertise as an example supporting the argument of Sage (2016) that knowledge acquired through technologies can shape, develop and constrain human construction expertise. This process of knowledge sharing and transfer is also indicative of the Authors argument that expertise development is not only constrained by the politics of control, but also by the incremental acquisition of knowledge.

The respondents consistently raised another issue related to the incompleteness of skills sets in the initial set of knowledge accrued in their vocational and degree learning. There was an often cited expectation that the initial knowledge given needed more attention to understanding the importance of lifelong learning and the ability to reflect on 'your own performance'. These findings reflect another professional argument made by Nash *et al*., (2016) that student pharmacists must have their competency standards, lifelong learning and self-assessment skills embedded into their university curriculum to ensure a strong foundation for practice. This, it can be

argued, recognises the importance of understanding not only the value of authoritative knowledge, Bernstein's hierarchical structured knowledge, and the corresponding importance of developing that knowledge through informal learning, professional development and through peer practice. This latter process represents a view that expertise emerges as both Bernstein's 'common- sense' knowledge and supports Chan's (2016) argument about the dynamic nature of expertise being in a state of constant flux, influenced, it can be argued by the constraints of attempts at control through professional politics (Sage 2016), and by demonstration of relevance to construction work (Mogendorff 2016).

DISCUSSION

The comparison of previous studies in Australia and Thailand to additional data from research in Ireland shows that there are some similarities and extension about how AEC practitioners develop their expertise. One of the key affirmations is that in the construction industry learning appears to be tied together with practice. "Learning by doing" is a concept that appears to be universally adopted across regions as learning and practicing are complementary. Practice enables practitioners (graduates) to apply conceptual/theoretical knowledge that they have learnt, in doing so also provides platforms for them to learn more and develop and expand their expertise. Challenging or difficult projects are also a good platform to provide better learning processes. The data suggests that if graduates have to face difficult projects early in their career they face a series of steep learning curves and this challenges their competency and stimulates the need for expertise development. This means that the expertise development process can be/is for many, a life-long process. However, this process is not the same for everyone. This also means that it is difficult to g*et al*l practitioners in the same profession to be on the same pace in their knowledge.

Another issue found in this on-going research is that self-reflection skills appear to be weak in many graduates. Some interviewees mentioned that there were some forms of feedback provided during learning and this they believed had a positive impact on those graduate's ability to develop their self-reflective skills. We would argue is while the provision of feedback during learning process is essential, students also need to develop their own self-reflection skill. This self-reflection is an essential link that helps graduates connect conceptual/theoretical knowledge, with practical/experience knowledge and enable them to self-regulate knowledge elements (Elvira *et al*., 2016).

Evidence in the construction professional interviews done so far in this research supports a view that expertise development goes beyond the professional understanding of the existential - the who am I and what kind of person do I want to be as a practitioner; the relational - how do I as a practitioner relate to others and to the world around me?; and praxis - understanding the self-conscious questioning expertise development as both past actions and future possibilities. That existential, relational and praxis in construction is subject to restrictions in knowledge acquisition and learning imposed as structured dialogue by professional and accreditation associations. Those parameters are often designed and implemented to protect as well as control, however in whichever way they can be seen as inhibitors to the development of expertise through knowledge acquisition along an informal and unstructured discourse that fosters learning through observation and innovation.

Dewey (1938) in his work focused on the importance of experiential learning and was a true advocate of learning through practice. It should be noted that in some respects the phrase 'learning by doing' as referred to by some of the interviewees cannot be

considered as out of place. Certainly those participants in the research who have mentored graduates emphasised the importance of providing the opportunity for new recruits to learn on the job. For instance, to pick up just one example from the discourse with on interviewee:

> The goal of vocational education should not be that of providing the students with a great amount of knowledge but rather it should consist in making the situation where they able to acquire a lot of knowledge. Our function in practice is to create the opportunity for them to apply that knowledge.

It could be plausibly argued that, although Dewey may have been the first to use the phrase, those experienced professionals involved in the AEC sector today understand the meaning originating from the novelty of his philosophy and, in particular, of his ideas about experience and knowledge. Mentoring of new graduates, a practices advocated by many of the respondents, requires a tremendous amount of time for a successful approach. Aside from the time commitment is the commitment toward understanding the idiosyncrasies of each other's knowledge within the discipline. As the AEC sector is so fragmented successfully trying 'to facilitate learning of collaboration across disciplines', the respondents made reference to the requirement of a willingness of mentors to collaborate across those disciplines. While the evidence shared is positive and as mentioned earlier, the research ongoing, for the purposes of generalisability the information collected on the outcomes achievement is not at a point where it can be used for such purposes. The authors intend to focus further research in these areas. The more recent phase of the research supports and confirms the position that expertise development emerges from the dynamic state of knowledge accumulation, transfer and sharing already identified from the earlier work of Kanjanabootra (2017). The research is showing that using knowledge, both authoritative and non-authoritative (formal or less formal) offers potential linkages across the existing theorisations of expertise (Addis *et al*., 2016).

CONCLUSIONS

The changing, constantly evolving nature of the 21st century BE, both in theory and practice, requires new ways of approaching and understanding our urban surroundings. This in turn demands of academics in education that they reassess their attitudes to what they do and how it is done; that assumptions and titles are challenged, in order to remain at the forefront of BE teaching, training and research in CM. What is imperative is that the AEC professionals and leaders of the future get access to quality educational experiences. Going forward as this research project is in the early phases, the authors plan to critically look at the professional bodies' frameworks, such as UK SPEC and the Australian / Irish and Thai professional body relationships and focus on the call for industry contribution from such frameworks to theorizing construction knowledge and expertise.

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