A proposed model of how landscape architecture knowledge develops through interactions between individual practice, studio or practice settings, and the profession and discipline – the knowledge formation process (image by author, 2024).

LANDSCAPE REVIEW

Building collective know-how: Part 2: A framework and recommendations

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Procedural knowledge is central to landscape architecture. By gaining a better understanding of how this knowledge is formed, it is possible to strengthen its use within the profession. Based on knowledge creation theories found in professional practice literature, this paper proposes a framework for knowledge formation processes. The framework includes a process model consisting of three stages: knowledge construction, peer review and knowledge use. It also identifies mechanisms, such as metaphors, maxims and models, that act as 'carriers for theoretical ideas' in building procedural knowledge. Building a procedural knowledge 'toolkit' – a repertoire of multiple concepts, models and frames used with the profession – could strengthen procedural knowledge in landscape architecture. Knowing the appropriate tools and selecting them for each situation is an important part of practical wisdom.

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Introduction

How does one design? Landscape architecture, like most professional practices, takes knowledge from multiple sources, including past education, current best practices and the immediate context of the project at hand. How all that substantive knowledge is integrated into a design project is frequently called procedural knowledge. As I argued in part 1 of this inquiry, designing is the core activity of landscape architecture, and building procedural knowledge is key to growing the knowledge of the profession and improving its impact on the world; yet procedural knowledge is taken for granted, overlooked and underdeveloped in the discipline (Melcher, 2023).

Most procedural knowledge is passed on through one-to-one interactions in studio instruction or on-the-job training. Procedural knowledge can be shared more broadly through written reflections by practitioners (for example, Eckbo, 1950; Halprin, 1970; Hester, 2006; McHarg, 1969; Steiner, 2000), systematic case studies (Francis, 2001) and conference presentations. Some of this know-how is consolidated into textbooks, such as Michael Murphy's (2016) *Landscape Architecture Theory*.

Still, the construction of shared professional knowledge out of practical experiences remains piecemeal, haphazard and ad hoc. Individual case reports frequently fail to add up to a coherent body of knowledge; and, at the same time, they are considered too personal and subjective to fit into traditional scientific criteria for generalisability (Berger, Corkery and Moore, 2003; Deming and Palmer, 2005; Swaffield 2017). With a better understanding of how procedural knowledge is developed, shared and validated, we can better evaluate its rigour and start to consider it a legitimate form of disciplinary knowledge.

Approach

This paper proposes a framework to explain how procedural knowledge is formed in professional practice. This framework was developed from knowledge creation theories within professional practice disciplines such as education, health care and business (Eraut, 1994; Higgs, Fish and Rothwell, 2004; Kolb, 1976; Nonaka and Takeuchi, 1995; Schön, 1983). It consists of a model of the knowledge formation process and a description of some of the key mechanisms that help this knowledge develop.

KEY WORDS
landscape architecture theory; epistemology; reflective practice; professional knowledge; phronesis

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The aim of this framework is to move beyond the assumption that all procedural knowledge must remain tacit. By providing a language of shared concepts, I hope that this framework can help landscape architects examine procedural knowledge more closely, better identify how it is formed and, ultimately, work to strengthen it across the profession and discipline as a whole.

Knowledge creation theories

Theorists from several different fields have proposed models for how knowledge is developed out of professional practice. These knowledge creation theories include theories of reflective practice (Schön, 1983), tacit knowledge (Polanyi, 1967), practice knowledge (Higgs et al, 2004), professional knowledge (Eraut, 1994) and practical wisdom (Flyvbjerg, Landman and Schram, 2012; Kinsella and Pitman, 2012). In the review of this literature, I found three models that illustrate parts of the knowledge creation process: Kolb (1976), Nonaka and Takeuchi (1995) and Higgs and colleagues (2004).

David Kolb's (1976) model of experiential learning envisions knowledge creation as a four-stage cycle. The four stages are: concrete experiences; observations and reflections; the formulation of abstract concepts and generalisations; and then testing the implications in new situations (figure 1).

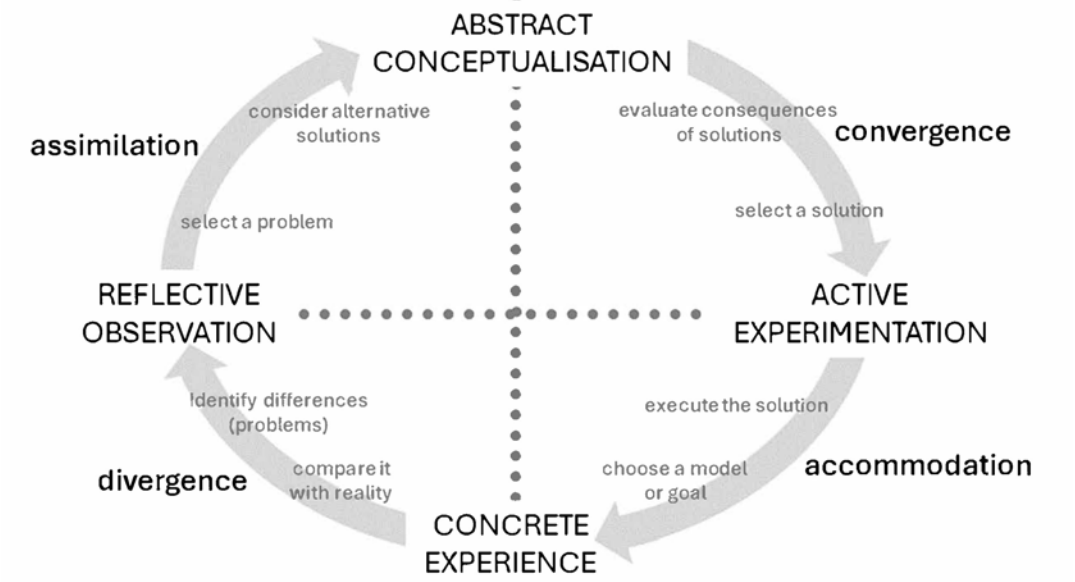

Figure 1. Kolb's (1976) experiential learning model (adapted by author, 2024).

Kolb's model depicts how knowledge develops out of practical experience, but it does not address how that individual experiential knowledge becomes shared knowledge. Through their SECI model, researchers Ikujiro Nonaka and Hirotaka Takeuchi (1995) hypothesise how knowledge moves from individuals and small groups into organisational systems. The SECI model describes how organisational knowledge creation cycles through four phases (figure 2).

1. *Socialisation (S).* In this first phase, individuals share experiential knowledge through direct one-to-one communication. The knowledge remains largely tacit.
2. *Externalisation (E).* In the next phase, this tacit knowledge is expressed through dialogue and reflection; it becomes conceptual knowledge.
3. *Combination (C).* In the third phase, ideas from different individuals, groups or situations are arranged into an organisational framework (using models or narratives), which becomes systemic knowledge.
4. *Internalisation (I).* To close the loop in the last phase, this system-wide knowledge is shared with individuals. Through practical actions, individuals internalise this knowledge into their daily professional practice.

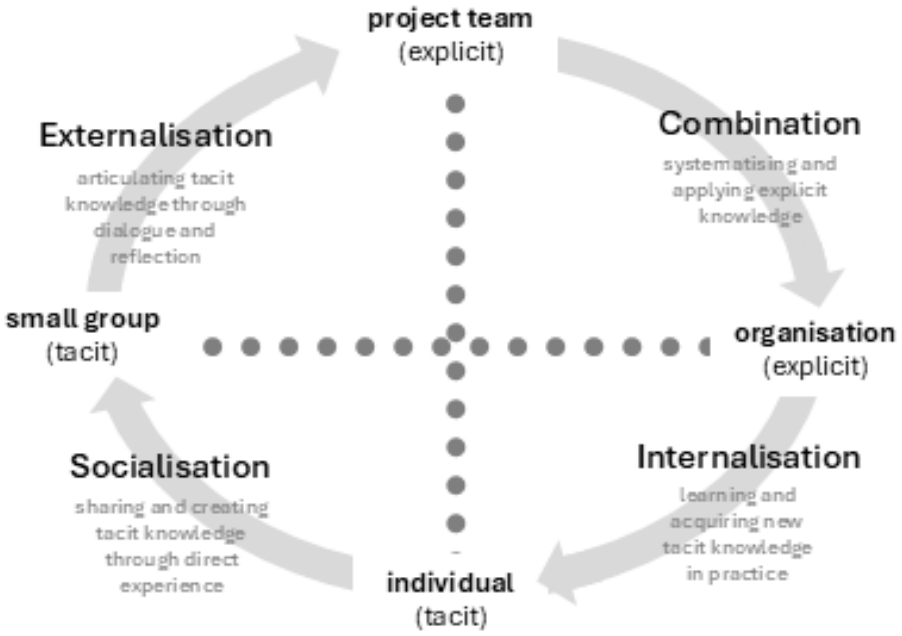

Figure 2. The SECI spiral model (Takeuchi, 2006, adapted by author, 2024).

The SECI model addresses knowledge creation within an organisation, such as a business or agency. However, it does not address how knowledge is created at the more abstract and diffuse level of disciplines and professions. Based on their experience within the health professions, Higgs and colleagues (2004) propose a model (figure 3) that illustrates how knowledge develops from individual practice into generalisable knowledge through 'a loosely sequenced series of activities which can be included in the process of making sense of the world' (p 97). Its five phases are: (1) becoming aware, sense-making and formulating ideas; (2) cross-checking and critiquing; (3) verifying; (4) articulating; and (5) disseminating and peer reviewing.

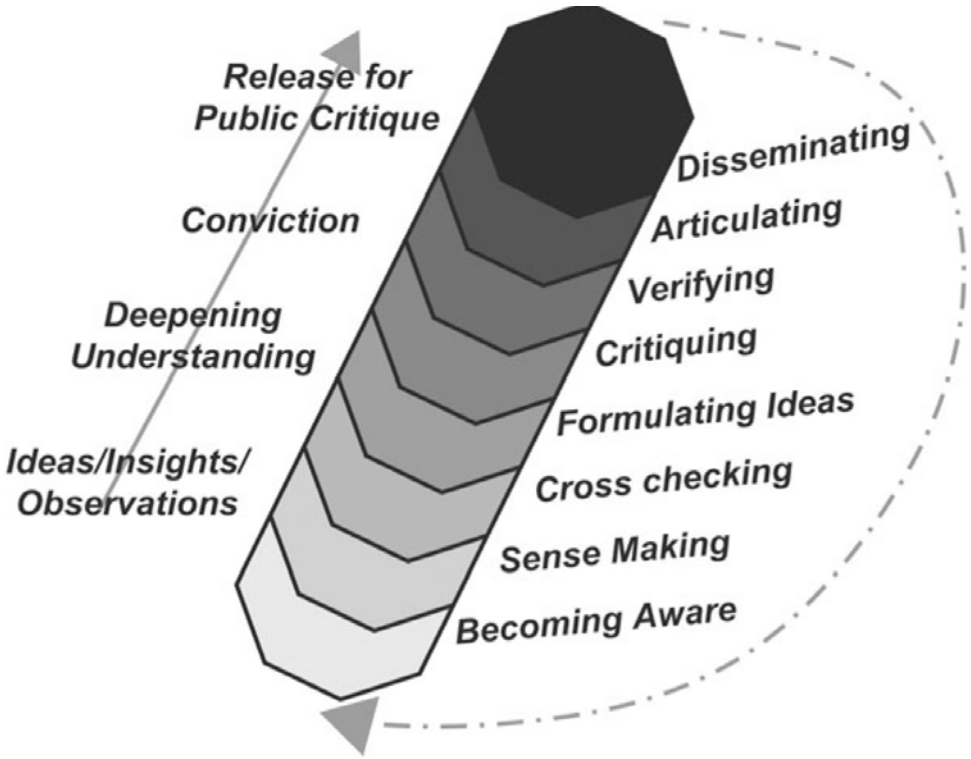

Figure 3. Appreciating practice knowledge (with permission from Higgs, 2012).

The following knowledge formation model was developed by combining these three models with descriptions of professional practice knowledge from Michael Eraut (1994) and Donald Schön (1983). Specifically, Eraut (1994) provides a useful description of how knowledge is transformed through its use in professional practice settings. In addition, Schön's concepts of reflection and framing are two key activities within the knowledge formation process.

A knowledge formation model

Four key assumptions from these theories provide the basis of the knowledge formation model described below and illustrated in figure 4.

1. Professional knowledge has multiple forms and sources. It can be developed through practice or research or some combination of both (Eraut, 1994; Schön, 1983).
2. Professional knowledge is constructed through a process of observation, abstraction and evaluation (Eraut, 1994; Kolb, 1976; Nonaka and Takeuchi, 1995). Collectively, these actions make up the process of reflection (Schön, 1983).
3. Knowledge develops through a cyclical movement of ideas from particular experiences to generalised ideas and back again (Eraut, 1994; Kolb, 1976; Nonaka and Takeuchi, 1995).
4. The cyclical or spiralling nature of knowledge development can also be used to describe the movement of ideas from individuals to groups to larger social structures such as disciplines and professions (Eraut, 1994; Higgs et al, 2004; Nonaka and Takeuchi, 1995).

Figure 4. A proposed model of the knowledge formation process (image by author, 2024).

Similar to Kolb's model, this model is based on two axes. The vertical pole runs from the particular/concrete context of practice (bottom) to the generalised/abstract disciplinary knowledge (top). The horizontal pole runs from knowledge construction/reflection (left) to knowledge use/experimentation (right).

The model also includes three knowledge generators displayed as interacting levels: individual practitioners, organisations such as firms and universities, and the profession and discipline as a whole. Knowledge is generated at the individual level when practitioners select from multiple forms of knowledge, put those ideas into practice and reflect on the results (Kolb, 1976; Schön, 1983). Organisational knowledge generation comes out of workplaces where learning-by-doing is shared through direct interaction, studio culture and organisational policies (Nonaka and Takeuchi, 1995). Finally, the profession and

discipline generate knowledge by defining what counts as landscape architecture's body of knowledge, disseminating knowledge through presentations, conferences and publications, and reinforcing it through accreditation and licensing procedures (Deming and Swaffield, 2011; Eraut, 1994; Higgs et al, 2004). Conceptualising how knowledge moves between these generators is key to building shared procedural knowledge.

The model presents three general stages of activity.

1. *Knowledge construction*. Knowledge emerges out of particular, concrete situations, such as practice, and includes 'acquiring, accessing accumulating, codifying, and storing knowledge' (Nonaka and Takeuchi, 2021, p 3).
2. *Peer review*. Knowledge is evaluated by a peer group. Knowledge that remains within individual practice, as tacit and intuitive know-how, does not have to pass through this stage.
3. *Knowledge use*. Abstracted or more generalised knowledge gets translated into new practice situations, including 'putting it to use, disseminating it, and converting it into action' (Nonaka and Takeuchi, 2021, p 3).

Stage 1: Knowledge construction

In the first stage, knowledge emerging from a concrete experience is reflected on and transformed into more abstract and generalisable concepts (Higgs et al, 2004; Kolb, 1976; Schön, 1983). By reflecting in and on practice, professionals turn their experience into knowledge. Although the term 'reflection' might be interpreted to be an internal, subjective experience, the best reflections include feedback from others involved in the project, such as clients, contractors and end users. According to Higgs and colleagues (2004), knowledge-building reflection involves becoming aware, sense-making and formulating ideas. To make sense out of these reflections, it helps to connect them to one's previous knowledge, which can include past experiences, personal hypotheses, professional models and disciplinary theories. It also helps to research similar cases and bring in additional outside knowledge at this point.

Connecting reflections to other knowledge also involves critical thinking, judging how compatible the new experience is with existing frames of knowledge. As Higgs and colleagues (2004) explain:

> In seeking to make sense of a new idea, an insight, an observed pattern or inconsistency, practitioners often explore their existing knowledge base. Does the new idea sit well with what I already know? … How can I connect my findings or activities across a number of cases …? … Self-questioning and reflection play a major role here in appreciating the subtleties of a situation and developing understandings and explanations. (p 99)

Connecting to existing knowledge involves conceptualisation, where experience is simplified and useful elements are distilled. It also involves developing the concepts, models, 'definitions, explanations, illustrations, examples and arguments' that make up the theory of the field (Higgs et al, 2004, p 102). As such, conceptualisation that goes beyond individual experience requires the use of a shared theoretical language.

Stage 2: Peer review

While individuals can put their tacit knowledge directly back into practice, collective knowledge needs to be reviewed, evaluated and accepted by a peer group. Through this review procedure, knowledge achieves rigour (Higgs et al, 2004). This stage involves sharing the knowledge, undergoing peer review and disseminating results.

Sharing knowledge can take many forms. It can be presented in formal venues such as journals, other publications, conference presentations and award submissions; or more informally through conversations, meetings, social media postings and the like. But to be well received, the ideas need to be articulated 'clearly, sensibly and in a form and language meaningful to the knowledge-using community' (Higgs et al, 2004, p 102).

Academic disciplines have clear criteria and procedures for peer review (for landscape architecture, see Deming and Swaffield, 2011). Professions and organisations also have methods for judging rigour, even if they are less explicit. In a policy context, Eraut (1994) observes, validity is determined by a small group of experts drawing from a combination of research, reports and their own judgement. With further dissemination, validity continues to be judged via critique throughout the profession, discipline or organisation. Therefore, facilitating dialogue surrounding the sharing and evaluation of ideas contributes to a practice of continually checking the validity of procedural knowledge (Eraut, 1994; Nonaka and Takeuchi, 1995).

Stage 3: Knowledge use

The knowledge used in practice comes from many sources: public, collegial and personal (Eraut, 1994). This knowledge also comes in different forms, such as theories and concepts, practical principles and specific propositions. It comes from both inside and outside the profession, and it can be transferred in different ways (through publications, direct instruction or experience, for example) (ibid).

Knowledge coming out of peer-reviewed research is often viewed as the most complete form of knowledge. But Eraut (1994) points out that 'the process of using knowledge transforms that knowledge' (p 21). He suggests that how one uses knowledge influences what that knowledge becomes. Eraut outlines four ways knowledge is put into use.

1. *Replication* happens when a practitioner recalls the exact steps learned and executes them without any changes.
2. *Application* is the use of a set of principles or rules to guide action in a new (yet relatively similar) situation.
3. *Interpretation* takes the general meaning of a concept and uses that understanding to inform one's actions.
4. *Association* is a 'semi-conscious, intuitive, mode of knowledge use … that … often involves metaphors or images' (ibid, p 49). These metaphors or images can be used to frame a situation in a manner that provides new insights and helps deliberate between alternative actions.

According to Eraut, the first two modes of use (replication and application) are technical skills, while the latter two (interpretation and association) are distinctly found in professional practice. Interpretation and association are valuable methods for deliberation and decision-making; they are at play in 'an intuitive capacity to digest and distil previous experience and to select from it those ideas or procedures that seem fitting or appropriate' (Eraut, 1985, p 125). This capacity is otherwise known as 'that mysterious quality we call "professional judgment," practical wisdom, or *phronesis'* (Eraut, 1994, p 49).

Knowledge formation does not end with its practical use. According to Eraut, the acts of interpretation and association do not only integrate knowledge into practice; they also can form new knowledge out of practical experience. Through interpretative use of knowledge, 'An individual's understanding of a concept is expanded, perhaps even altered by each new example of its use' (ibid, p 29). This leads Eraut to claim that 'The interpretative use of an idea in a new context is itself a minor act of knowledge creation, perhaps more original than one of the more derivative types of academic paper' (ibid, p 54). This new understanding can then be 'used interpretively to modify theory' (ibid, p 29). Similarly, Eraut continues, the associative use of knowledge can 'spark' creative theoretical insights (ibid). Interpretive and associative thinking creates a bridge between practice and theory, where theory is used to interpret practice, and then practice is interpreted in a manner that forms theory and generates new knowledge for the profession.

Mechanisms for building professional knowledge

Professional knowledge develops by moving through knowledge construction, peer review and knowledge use. But how does knowledge move from individual experience into shared organisational, disciplinary or professional knowledge? In other words, how does knowledge from a particular practice become a more generalised part of the profession's knowledge base?

Almost all of the theorists cited in this paper observe that communicative tools, such as metaphors, images, stories and models, play a critical role in knowledge formation (Eraut, 1994; Higgs et al, 2004; Lawson, 2005; Nonaka and Takeuchi, 1995; Schön, 1983; Sennett, 2008). These tools share what Schön calls an 'optimal fuzziness', which is a 'thematic character which enables practitioners to use it in their own reflection-in-action' (Schön, 1983, p 319). They are not precise factual descriptions; they do not predict or explain phenomena in a straightforward manner. While the fuzziness or the 'discrepancies and gaps' (Nonaka and Takeuchi, 1995, p 64) in these tools may be frustrating when trying to use them to replicate or apply knowledge, the fuzzy quality is surprisingly useful in interpretive and associative modes of use. Practitioners can use these concepts 'as springboards for making sense of new situations' (Schön, 1983, p 317), and for 'build[ing] and test[ing] their own on-the-spot theories of action' (ibid, p 319).

Through this optimal fuzziness, these tools help to build knowledge in three primary ways.

1. As expressive language tools, they can help practitioners convert tacit and embodied know-how into a shared language. Expressive language can also deepen reflections, inspire new associations and thereby create new insights.
2. As combinatory mechanisms, they can connect experiences to existing knowledge and help practitioners find commonalities between their experiences.
3. As framing tools, they provide suggestive guides rather than determinate rules. They also can help a practitioner frame a situation to better deliberate over possible approaches.

Expressive language

Expressive forms of communication such as metaphors, maxims, images, models and diagrams can help practitioners articulate their inner, tacit knowledge. In writing about craft-based knowledge, Richard Sennett (2008) comments that craftspeople share their knowledge via expressive instructions, such as 'language's powers of sympathetic illustration, narrative, and metaphor' (p 184). Similarly, Nonaka and Takeuchi (1995) comment that 'metaphors, analogies, concepts, hypotheses, or models' are often used to externalise tacit knowledge (p 64).

Expressive language can simplify ideas and make them easier for a person to retain. Eraut (1994) uses the image of a carpenter's tape measure as an example; it can capture and communicate a structural principle (it can bend along one axis but not on the other) without getting into technical details. Additionally, figurative language and images can help people from a diversity of perspectives and experiences quickly grasp the essence of a situation (Nonaka and Takeuchi, 1995).

Expressive language is common in landscape architecture theory. Lawrence Halprin (2002) uses the metaphor of a musical score to explain designing as 'symbolizations of processes which extend over time' (p 43). Practitioners might not be able to recite Halprin's design process step by step, but his metaphor of a score is retained in the collective knowledge base.

Joan Nassauer's (1995) maxim 'cues to care' is another example of expressive language in landscape architectural theory. Based on empirical research into visual landscape preferences, the phrase not only explains the outcomes of her research; it also provides a simple maxim that is easy to remember and interpret for use in new situations. Even if a practitioner does not recall their methods or findings, they can recall the maxim and reflect on whether or not it applies to their design situation.

Beyond making a concept more memorable and relatable, metaphors and other expressive communication tools can add symbolic value or deeper meaning to practical actions. Sennett (2008) comments that metaphorical language can act as an invitation to 'contemplate consciously and intensely the processes' (p 192). From a similar perspective, Nonaka and Takeuchi (2011) state that metaphors help 'convey messages in ways that capture the imagination' (p 65). Associative language can inspire reflection, exploration and creativity in practice.

Combinatory mechanisms

Expressive language not only helps people articulate experiential knowledge; it also can help them to attach their own knowledge to other sources of knowledge (Nonaka and Takeuchi, 1995). Shared concepts or mental models can help practitioners combine their own experiences or attach their experience to the experiences of others. As combinatory mechanisms, they 'help promote "reflection" and interaction between individuals' (ibid, p 64). By providing a point of comparison, these concepts and models help practitioners express and reflect on their own experiences. They can then use those mechanisms to communicate generalisable lessons from a collection of particular and concrete experiences.

These models are adapted and refined as they pass through peer review processes of sharing, evaluation and discussion. Eventually, if they are shared widely enough, they become part of the profession's knowledge base. These discipline-wide methods and theories become, then, concepts that provide guidance for practitioners in future scenarios.

One of the most well-used combinatory mechanisms in the design fields, including landscape architecture, is the design process model – diagrams of the phases of design (Lawson, 2005; Murphy, 2016). Process models and other combinatory mechanisms are useful for teaching beginner designers how to design. They can function as loose instructions, indicating a starting point and general sequence of actions. But as design expertise grows, designers are likely to improvise and deviate from these staged process models (Dreyfus, Athanasiou and Dreyfus, 1986; Lawson, 2004; Mangiante, 2021).

One model cannot capture all design approaches that exist in practice. As Lawson (2005) points out, 'The extent to which these ideas actually help you to understand design better is probably more to do with your personal cognitive style, interests and preferences rather than due to some absolute correctness in the model' (p 303). Perhaps the greatest utility of process models is not in describing or prescribing a design process, but in acting as a combinatory mechanism. They can provide a shared language so that designers can describe their own processes, compare them with those of others and enter a larger conversation about what design processes are. They help 'create a framework within which debate about design can take place' (ibid, p 290). Proposing a process model can be viewed as an invitation to others to discuss and debate what it captures, what is missing and what could be changed.

Frames and placements

Because one cannot predict with certainty which knowledge will be useful in future situations, procedural knowledge is best developed as a plurality – a repertoire of models and concepts from which a practitioner can select (Buchanan, 1992; Schön, 1983). To guide this selection, practitioners use what Schön calls frames and Buchanan calls placements. A placement 'gives a context or orientation to thinking' (Buchanan, 1992, p 13) and provides a structure for viewing a situation.

Frames can also help practitioners sort through their repertoires and select the most appropriate tools; they help 'determine their strategies of attention and thereby set the directions in which they will try to change the situation, the values which will shape their practice' (Schön, 1983, p 309). As Lawson (2005) explains:

> This selective focus enables the design to handle the massive complexity and the inevitable contradictions in design by giving structure and direction to thinking while simultaneously temporarily suspending some issues. (p 292)

A frame could be the adoption of a particular school of thought, or it could be the use of a metaphor like 'balancing act' to explain one's role (Schön, 1983, p 310). Frames in landscape architecture theory include Crewe and Forsyth's (2003) landSCAPES typology, which sets out six distinct approaches to landscape architecture, each with specific values, project types, methods and objectives. Hester's (2002) 'design against, for, with, and by people' (p 53) could also be considered a framing mechanism for different forms of practice. More recently, Melcher's (2022) description of three definitions of aesthetics provides three frames through which designers can view their aesthetic intentions.

Framing facilitates the deliberation involved in professional judgement. If a practitioner is aware of the framing process, they can '"try on" a way of framing the practice role, getting a feeling for it and for the consequences and implications of its adoption' (Schön, 1983, p 315). Additionally, frames can be a source of creative problem-solving in design. Applying a different frame to a new situation 'can generate a new perception of that situation and, hence, a new possibility to be tested' (Buchanan, 1992, p 13). Both Lawson (2005) and Buchanan (1992) comment that the skill and creativity of a designer often come from their ability to select and apply different frames to new situations.

Because 'the construction of a role frame is superordinate to and longer lasting than the setting of particular problem' and frames can 'pass from one situation to the next' (Schön, 1983, p 310), they also make important contributions to the generalised procedural knowledge of a profession. Frame analysis – which involves identifying and studying the different frames employed in practice – is an area of research that could contribute significantly to professional knowledge (Goffman, 1974; Tversky and Kahneman, 1981).

These tools of expressive language – metaphors, maxims, models and the like – act as 'carriers for theoretical ideas' when building procedural knowledge (Eraut, 1994, pp 49–50). They move ideas from individual practice into collective knowledge. They help practical know-how become generalisable and help practitioners select from a repertoire of generalised concepts while in practice. Their 'optimal fuzziness' helps explain tacit knowledge, connect ideas across experiences, provide suggestive guidance for future practice and help the practice processes of deliberation and reflection.

No one tool or set of tools is appropriate for all practices. This suggests that building procedural knowledge is about more than data collection and analysis. In particular, it is about developing a repertoire of these theories, models and concepts. This repertoire can serve as a toolkit of sorts from which a practitioner can select the best frames and concepts for expressing, combining and creating ideas related to practice. Additionally, the purpose of procedural theory differs from other existing categories of theory, such as: predictive/instrumental, interpretive or critical (Swaffield, 2006); or resistant, explanatory or normative (Herrington, 2013). Although procedural theory can contain elements of each of these, its key purpose is suggestive in nature. It is less about prediction, finding meaning or critically questioning the status quo; and more about suggesting procedures and concepts that might be useful to others.

Implications

The expressive language tools are common in landscape architecture theory. They are used to convey substantive knowledge coming out of research (Nassauer, 1995) and procedural knowledge developed through research (Crewe and Forsyth, 2003), as well as procedural knowledge formed through reflective practice (Halprin, 2002; Hester, 2002). Knowledge creation theory can help us identify these mechanisms, but how can this identification help us build shared knowledge out of individual cases?

The case study dilemma

Case study methods work well in complex situations of practice because they provide rich, contextual details. Because they are of such high quality, case studies are a key source of knowledge in professional fields (Eraut, 1994; Flyvbjerg, 2001; Francis, 2001; Schön, 1983; Swaffield, 2017). Francis (2001) goes so far as to claim that case studies in landscape

architecture 'provide the primary form of education innovation, and testing for the profession' and 'also serve as the collective record of the advancement and development of new knowledge in landscape architecture' (p 15).

But many case studies include detailed descriptions without additional reflection on theoretical knowledge gained from them (Berger et al, 2003; Deming and Palmer, 2005; Thering and Chanse, 2011). Deming and Palmer (2005) call this the 'case study dilemma': how can a vast and diverse collection of cases 'have relevance beyond the individual events or situations being investigated' (Swaffield, 2017, p 107)? How can they become 'idea[s] useful for action' (Schön, 1983, p 318) for other practitioners?

When cases studies do not connect to greater patterns or themes or to a broader theoretical context, much of the knowledge within them does not transfer (Berger et al, 2003; Deming and Palmer, 2005). As Berger and colleagues (2003) comment on cases of studio instruction, 'Unless there is a theoretical construction or deconstruction of the process of the studio it is difficult to engage the reader' (p 2). At the same time, it is often left up to the reader to identify the themes, patterns and conclusions relevant to professional practice (for an example, see Deming and Palmer, 2005, p vi). Even if the reader has the time, inclination and conceptual tools to undertake this endeavour, their conclusions will mostly likely remain tacit and private.

Using conceptual tools such as metaphors, maxims and models more explicitly and more frequently within case study reports can better connect cases to the larger body of knowledge in the field. Recognising the various conceptual tools that are frequently invoked in practice can help develop a shared language for case study reporting. Research into the language of landscape architecture, such as the studies by Bowring (1997) and Napawan and colleagues (2023), can help practitioners to identify (and question) these tools. Connecting specific cases to these conceptual tools can make the learning gained from these cases more relevant to other practitioners. Conversely, using cases to reflect on the usefulness of these tools in differing contexts can help with refining them for future use and contributing to the broader knowledge base.

The question of validity

Even if conceptual tools are more explicitly identified and used within case studies, their fuzziness still begs the question of whether they have sufficient rigour and validity. Rigour can be defined broadly as:

> both an intention (to seek truth) and an approach (including providing transparency of method to facilitate critique, being systematic and thorough to test truth with open-mindedness in the pursuit of clarity and truthfulness). (Higgs et al, 2004, pp 100–101)

But criteria for rigour vary by discipline. Because of variations in what counts as rigour, peer critique becomes important as a way of 'validating knowledge by exposing it to the professional community' (ibid, p 101). Because landscape architecture knowledge comes from multiple disciplinary traditions, rigour is especially challenging to pin down, making the quality of peer review even more important (Bowring, 1999).

A profession and discipline can rely on peer review processes to judge the rigour of knowledge construction, and Deming and Swaffield (2011) have outlined key criteria for how to judge rigour in peer review. But the question of validity remains. What counts as valid procedural knowledge? The value of procedural knowledge lies in its usefulness. As Eraut (1994) comments, for the practitioner, 'nothing is valid until one has tried it and, by implication, adapted it for oneself' (p 32). The value of knowledge for practice is judged by how well it helps the practitioner achieve their goals. More generally, validity criteria for procedural knowledge can be summarised in Eraut's words, as 'what knowledge helps inform "wise judgment under conditions of considerable uncertainty"' (ibid, p 17).

It is challenging to predict what knowledge will become valuable in practice because the usefulness of knowledge depends on its mode and context of use and the inclinations of the practitioner (Eraut, 1985; Lawson, 2005). Lawson (2005) comments that the

usefulness of a mental model 'is probably more to do with … personal cognitive style, interests and preferences rather than due to some absolute correctness in the model' (pp 302–303). Eraut (1994) agrees: 'Functional relevance often relies less on presumed validity than on ability and willingness of people to use it – mainly determined by individual professionals and their work-context' (p 43).

Peter Downton (2023) suggests that research and practice make up a Janus figure, with research looking backward and practice looking forward. The same could be said for the validity of traditional academic research and the validity of procedural knowledge. To judge the validity of academic research, one looks backward, evaluating the researcher's questions, methods and procedures. But to judge the validity of procedural knowledge, one must look forward, speculating as to what might be useful in future situations of practice. There is no one point in the knowledge formation cycle where one can claim that procedural knowledge is fully verified and complete. Procedural theory is always in the process of being made and remade. Dynamic, continual debate and critique are of critical importance in keeping procedural theory relevant and valid. Discussions and evaluations (formal and informal) of conceptual tools should occur at all stages in the knowledge formation process, not just at the peer review stage.

Building procedural knowledge in landscape architecture: Recommendations

Even though procedural knowledge is constructed with fuzzy tools that one can never grasp with full certainty, we can strengthen explicit procedural knowledge in landscape architecture by paying attention to the processes of design and the language we use to describe and share those processes. Developing a repertoire, or toolkit, of commonly used models and concepts can help practitioners and researchers construct, vet and use our shared knowledge base.

General recommendations

1. In research and discussions of practice, landscape architects could focus more on describing design processes and practices rather than primarily on projects and outcomes.
2. When studying design processes, a primary focus should be on identifying the expressive language used to build procedural knowledge. Even though these tools often escape the attention of research, they are valuable for sharing and comparing practical know-how. They are also valuable tools for teaching landscape architecture.
3. The validity of these tools could be judged by asking, 'What knowledge helps inform "wise judgment under conditions of considerable uncertainty"'? (Eraut, 1994, p 17). Additionally, tracing a concept's use in differing situations over time can contribute to an estimation of its future validity.
4. At the same time, it is important to acknowledge that there are many ways to solve a design problem, and these tools are never finalised forms of knowledge. All conclusions are only suggestions for future practice.

For reflective practitioners

1. Practitioners should be explicit about the conceptual models, frames and other tools they use to explain their practice. When sharing their experiences, they should use these tools to connect their personal knowledge to existing knowledge in the field.
2. Practitioners can also reflect on the utility of existing procedural knowledge. How useful are existing maxims, models or frames? Can they be adapted to better fit specific conditions of practice? Are there better alternatives?

For research into practice

1. Researchers can study how ideas are passed from one practitioner to another. As Eraut (1994) recommends:

   > one way to develop the knowledge base of a profession would be to study [the] generalisation process, to make it more explicit so that it can be criticised and refined, and to give close attention to specifying the conditions under which any given practical principle or generalisation was held to apply. (p 121)

2. Researchers can contribute to the repertoire of conceptual tools by identifying and consolidating those already used in practice and theory. One possible method is to conduct 'frame analyses' as exemplified by the research of Crewe and Forsyth (2003). Another is to use 'genealogy', tracing how concepts are developed and refined over time, through theory or practice, or both (Foucault, 1977; Sherratt, 2006).
3. Researchers and reviewers should acknowledge and recognise that, as a suggestive form of theory, all propositions developed within procedural theory require additional validation through practice.

For organisations (firms, agencies and educational programmes)

1. Firms, offices and educational programmes are key sources of the conceptual tools used to communicate procedural knowledge. By identifying, documenting and sharing the ways they externalise tacit knowledge, these organisations could help build a collective repertoire of frequently used models, concepts and frames.

For the profession and the discipline

1. Both the profession and the discipline can work together to develop the repertoire mentioned above. Gathering these concepts and models can provide a reference for teaching, building knowledge from case studies, and other endeavours.
2. Additionally, the profession and discipline should have conversations about what is missing from the current repertoire of explicit procedural knowledge. Does the profession already have adequate shared frames of reference? Do more explicit frames need to be articulated in order to better discuss design processes? What aspects of practical experience do not yet have adequate concepts or models?
3. The discipline could develop peer review criteria for procedural knowledge that require the explicit use of reflection, theorisation and framing. Even though validity is realised through individual practice, requiring transparent reporting and explicit explanation of frames and concepts could make case study reports more relevant to future use.
4. The profession could develop programmes and events that foster a sharing of procedural knowledge across individuals and organisations. Eraut (1994) suggests that continuing education programmes can serve this function by providing 'appropriate opportunities for mid-career professional education, whereby professionals can … reflect on their experience, make it more explicit through having to share it, interpret it and recognize it as a basis for future learning' (p 21).

Conclusions

These recommendations for building more explicit procedural knowledge within landscape architecture support the argument that landscape architecture needs the 'development of a more robust theoretical language within the discipline' (Swaffield, 2006, p 16). The more explicit we are in identifying and using the concepts and models that serve as 'carriers of theoretical ideas' (Eraut, 1994, pp 49–50), the stronger our procedural knowledge will be.

In proposing a framework for understanding the formation of procedural knowledge, I hope the conceptual tools used to build this knowledge will no longer be overlooked or

undervalued. If the identification and use of these tools, along with the discussion surrounding them, become more robust within landscape architecture, our procedural knowledge will become stronger.

This presentation of procedural knowledge is also made up from the fuzzy tools of models, concepts and metaphors. Therefore, it is also suggestive in nature. It should be overlaid with and compared to other experience and knowledge. Its validity needs to be judged through use. Does it help explain the knowledge we use while designing and the knowledge we gain from designing? Will it help frame and deepen discussions about procedural knowledge? Will it spark additional models or insights?

About the author

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