

Article

Landscape Architecture Professional Knowledge Abstraction: Accessing, Applying and Disseminating

Yue Qiu ¹, Zheng Cong ², Karla Nicole Opiniano ³, Xuesong Qiao ⁴ and Zheng Chen ^{5,*}

¹ School of Architecture and Urban Planning, Huazhong University of Science and Technology, Wuhan 430074, China

² Shanghai TIANHUA Landscape & Design Co., Ltd., Shanghai 200235, China

³ UNLV School of Architecture, University of Nevada, Las Vegas, NV 89154, USA

⁴ Shanghai Urban Construction Design and Research Institute (Group) Co., Ltd., Shanghai 200125, China

⁵ Key Laboratory of Ecology and Energy-Saving Study of Dense Habitat, Department of Landscape Studies, College of Architecture and Urban Planning, Tongji University, Shanghai 200092, China

* Correspondence: zhengchen@tongji.edu.cn

Abstract: Rigorous abstract knowledge, such as academic knowledge, is vital to a profession's resilience against other modern professional competition. In the field of landscape architecture, a growing number of concerns about a lack of rigorous knowledge have been observed, which may jeopardise the jurisdiction of its professional practice. A study was conducted that collected behaviours and attitudes from various members of the American Society of Landscape Architects (ASLA) regarding how they accessed, disseminated, and applied knowledge in practice. Their responses concerning the knowledge were analysed by dividing and ranking the options according to the degree of knowledge abstraction. Knowledge abstraction refers to theories and commonplace best practices that are established within a profession through shared knowledge, experience, and research. The results showed that (1) most practitioners tended to access new knowledge through tacit experience, which is indicative of a lower level of abstraction in their practice; (2) design decisions were based less on higher and rigorously abstracted knowledge such as research findings and, in circumstances where it was deployed in the design process, such knowledge was seldom used to guide design independently; (3) the majority of practitioners rarely share knowledge through high-abstracted publications; and (4) compared with accessing relatively diverse levels of knowledge abstraction, practitioners were less resourceful in knowledge application and even less in dissemination. The knowledge acquired, used and circulated in the workplace of landscape architects—as indicated by this survey—is still not comprehensively abstracted to a rigorous level, which may provide an insight into the concerns of practitioners regarding this profession's breadth of knowledge and jurisdiction.

Keywords: landscape architecture; profession knowledge; knowledge abstraction; knowledge accessing, applying, and disseminating



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1. Introduction

In July of 2023, the US Department of Homeland Security designated landscape architecture as a Science, Technology, Engineering, and Mathematics (STEM) profession, with the American Society of Landscape Architects as an advocate for this decision [1]. Historically, landscape architecture as a practice has relied on a broad spectrum of knowledge in which tacit knowledge plays an especially pivotal role [2]. The early practitioners in this profession, in the United States, for example, were generalists with practical skills and various interests in construction, preserving natural landscapes, and offering opportunities for urban residents to access nature easily [3]. The training of landscape architecture practitioners has traditionally focused on preparing students to practise in their profession

through studio-based apprenticeships [4,5]. This hands-on approach to learning is congruent with tacit knowledge, which is evidently difficult to acquire solely through research and is, therefore, difficult to disseminate or share within the workplace [6]. Despite traditional means of training successfully establishing the profession as a key role in modern society—especially in the wake of worldwide concerns regarding climate change and rapid urbanisation—it remains questionable whether this field’s daily practices warrant its new science-based designation. Modern professionals are expected to offer sound professional services and justify the uniqueness and necessity of their expertise in their services [7]. Abraham Flexner, an American educator who was a key figure in legitimising the medical field and higher education in the 20th century, states the several tenets of what defines the concept of a “profession” [8]. One of these tenants suggests, “[A profession] must add and improve our stock of theoretical and stock knowledge” [9]. This, therefore, expresses that the profession of landscape architecture has been developed largely on tacit knowledge, but in order to meet the qualifications of a profession that needs to gradually function as a scientific and scholarly discipline, knowledge established within the profession must be structured systematically in conjunction with antecedent knowledge to justify and improve performance in professional practice.

Concerns about a lack of rigorous knowledge have been a recurring subject of interest amongst practitioners and academics of landscape architecture [10–13]. This is due, in part, to having greater difficulty in efficiently deriving information from larger systems of knowledge for landscape architecture than other professions such as engineering or medicine, which possess explicit abstractions [14]. Landscape architecture, as addressed by several landscape architects, does not seem to be structured in a way that can identify research needs, support a response to those needs, or integrate this response into the practice of landscape architecture [15]. Clients’ need for data in relation to a post-construction evaluation was sometimes, if not often, left unsatisfied due to a lack of academic research [16]. Fellows of the American Society of Landscape Architects (ASLA) revealed a shared concern about the profession’s “losing ground” due to an overly broad scope and knowledge base that is not academically rigorous enough. They suggest that landscape architects need ‘better knowledge’ in order to be regarded as part of a more sophisticated and holistic profession. It is a broad concern that is defined in the following three ways: a need for better theoretical and/or technical expertise; a need for research; and a need for greater academic rigour [17] (p. 68). Albert Fein also commented in his report on a survey of the profession in the 1970s that tacit abstracted artistic ability, or design creativity, was only one factor by which individual practitioners differentiate their solutions; however, all solutions, in order to be valid, must satisfy certain scientific needs and criteria with explicit abstraction [18]. Additionally, as Andrew Abbott explained in his award-winning book *The System of Professions* [7], the survival of a modern profession from competition with other related professions relies on a profession’s control of knowledge or its knowledge abstraction and logical consistency. A higher level of abstract explicit knowledge allows practitioners to expand their jurisdiction to adjacent jurisdictions. Compared with explicit high abstraction, tacit low abstraction is often more vulnerable in terms of logical consistency and scientific rationality, which could leave a profession’s jurisdiction vulnerable when demonstrating its cultural legitimacy to the public [7].

As a response to the concerns about knowledge and jurisdiction above, some disciplines or professions have begun to consider the abstraction of professional knowledge in their respective disciplines. The civil engineering profession enhanced its body of knowledge, defining the knowledge, skills, and attitudes necessary to enter the practice of civil engineering at a professional level in the 21st century [19]. The audit profession further examined a scenario where jurisdictions and boundaries between professional groups are ambiguous [20]. Recent developments in the profession of landscape architecture have gradually led to a more rigorous research tradition. Longitudinal questionnaires on landscape architecture educators indicate that there has been an increasing pursuit of solid knowledge and evidence-based practice in landscape architecture over the past few decades.

University administrators increasingly apply teaching services and research as evaluation indicators for landscape architecture faculty, with research outputs, particularly publications, generally recognised as the most essential [21]. The role of academics has shifted from a focus on professional education to one that includes contributing to the research and development of the discipline [4]. At the same time, professional institutions and firms have begun to take steps to contribute to disciplinary research. Through a professional lens, a landscape architecture firm that has been pushing the boundaries of research and applying design to the field is the OLIN studio [22]. With two offices located in Philadelphia, Pennsylvania, and Los Angeles, the California OLIN studio possesses a dedicated lab focused on landscape architecture research [23]. The labs' purpose and mission state that "OLIN Labs acts as a conduit between academia and practice, recognizing the value of open dialogue and knowledge sharing among individuals with different expertise and methods but with common purpose" [24], maximising innovations by approaching their research through a multi-disciplinary lens. In December of 2022, two OLIN lab representatives published an essay discussing "New Modes and Models for Purpose-Driven Design", further supporting the notion that professionals of the landscape architecture field are acknowledging the professions' shared concerns and developing methods of advancement in the industry as a solution [25].

Despite the growing abundance of rigorous abstract knowledge in landscape architecture, the gap between explicit academic knowledge and tacit professional knowledge remains a concern. In fact, the existing literature generates contradictory results when talking about what research is or what attitudes the practitioners may have about research. Although landscape architects certainly agree, research is important to landscape architecture, and current research seems unsatisfactory for broad application [26]. For example, dedicated research facilities, such as OLIN labs in association with landscape architectural design, are unique to large-scale firms that perform international services, while smaller, local firms still struggle to implement quantitative research and structure into their design practice. As a result of this stagnation, research questions such as the following have rarely appeared in the literature, which relates to the professional application of the scientific knowledge of landscape architecture created by academics: What types of knowledge do landscape architecture practitioners use in practice to support their decisions? How abstract is such practical knowledge? How much of it comes from rigorous academic research, either directly or indirectly? Where do practitioners acquire new knowledge? How many practitioners keep records of academic updates? When practitioners obtain new knowledge, how do they disseminate it? How efficient is such knowledge dissemination on a professional level? What levels of knowledge abstraction may we observe from landscape architecture? In order to resolve these issues, it is important to understand how professionals access, use, and disseminate knowledge in practice and the knowledge abstraction gained from them.

This study collected first-hand empirical data about landscape architecture practitioners' research from three aspects: accessing, disseminating, and applying knowledge in practice. Through a survey given to members of the American Society of Landscape Architects (ASLA) regarding knowledge use and perceptions, we sought to understand how abstract knowledge is implemented in practice. Specifically, how much abstraction of knowledge is involved in accessing, supporting decision making, and disseminating in professional practices?

2. Methods Section

2.1. *The Classification of Knowledge*

Abbott (1988) argued that modern professions are a type of occupation control through the legitimisation of expertise, as well as structural guarantees [7] (p. 54). In order to legitimise this jurisdiction, some design-based professions have attempted to classify research knowledge of the profession. For example, civil engineering proposed six levels of categorisation to systematically differentiate outcome characteristics, including knowledge,

comprehension, application, analysis, synthesis, and evaluation. The aerospace profession describes knowledge-generating activities into seven types: transfer from science, invention, theoretical engineering research, experimental engineering research, design practice, production, and a direct trial [27]. Landscape architecture is a young discipline relative to these fields, so it needs to have clearly defined knowledge domains recognised by other disciplines and the public [28]. Some researchers have proposed a “research circle”, which locates design at the beginning of the research process as the incentives or topics of research and locates research at the end of the circle as an application of the insights and understandings acquired from the results. This circle can include research into design, research as a response to design, or research leading to or informing design [4]. A study used four sources of forms of evidence to identify ten types of core landscape architecture knowledge domains, none of which were unique to landscape architecture [28]. However, it is unclear which research domains should form the core of the future landscape architecture research agenda [29].

Today’s landscape architecture research, as in many oversimplified categorisations, has much of its action and interest centred in the borderlands between categories. Past categorisations that only indicate implicit and explicit knowledge may not be sufficient to describe the many types of research work conducted and published in this field. For example, recent research suggests that technology has evolved into an important area of the landscape architecture profession and that this discipline has shifted from a binary art–science narrative to a tripartite core of emerging 21st-century concepts comprised art, science, and technology [30]. Therefore, this study divides the categories of professional practice into the following four types of knowledge: tacit knowledge, operational knowledge, conceptual knowledge, and systematic knowledge. This classification draws heavily on the research of Nanaka and Takeuchi et al. [31] and reorganises the order of the four types of knowledge according to Abbott’s understanding. The proposed method of classification has logical similarities with the ‘research circle’ [4], other scholars’ assertions of knowledge systems, and the classification proposed by the civil engineering profession [19].

2.2. *The Levels of Knowledge Abstraction*

In this study, tacit knowledge and systematic knowledge are set as two datum points of the degree of knowledge abstraction. Tacit knowledge is considered to be the lowest level of abstraction, which embodies the nature of landscape architecture as an anthropocentric design profession that inherently relies upon human experience [10,32]. It includes knowledge that can be gained through common sense, intuition, individual experience, etc., which can be gained without the practitioner undergoing a systematic and disciplined university education or professional training. Operational knowledge is considered to be a lower level of abstraction, which consistently influences decision making in the design process [33] and, additionally, may influence performance [34]. Fundamentally, operational knowledge is “knowing how thing work”. Conceptual knowledge is considered to be a higher level of abstraction, which makes tacit knowledge explicit and codifies it as principles and protocols [35]. This type of knowledge requires practitioners to have a basic knowledge of scientific research and to be able to generalise tacit and practical knowledge. For the purpose of this study, the highest degree of knowledge abstraction is systematic knowledge, which often advances system knowledge building in modern professions through rigorous research. Such advancements are “knowing propositions of a factual nature” [34], such as the discovery of the truth and facts, which require practitioners to have had a systematic university education and research experience, and the ability to explore research and generalise theories. The explanations generated from systematic knowledge often define the prestige of a modern profession. This leads to a gradual increase in the degree of knowledge abstraction from tacit knowledge to systematic knowledge.

2.3. Constructs and Measurements

This study measured the level of knowledge abstraction in practice from three perspectives: access to new knowledge, knowledge dissemination, and knowledge that supports decision making. Questions were designed based on previous peer-reviewed published research on this subject, like Fein's survey [17] of a similar topic in landscape architecture and Milburn and Brown's study [4] on academic contributions in landscape architecture, and these options have been adapted to the literature in recent years in the areas of design practice, research themes [36,37], and methods of investigation (Supplementary Materials).

The perception of where and how landscape architects obtain new knowledge in this profession was gauged by ASLA members' answers to the following two questions: one question asks how ASLA members obtain new information in this profession and how frequently they interact with other professionals in complementary fields that exhibit higher levels of knowledge abstraction (e.g., engineers). This study used a four-degree scale to measure the first question: rarely, occasionally, often, very often, and unsure. For the second question, a five-degree Likert scale was utilised: not at all, not too much, a fair degree, great extent, and very great extent.

Regarding where ASLA members disseminate their research findings, this study considered the following four modes—writing, teaching, presentations, and others—using the question, "How often do you use the following media to disseminate your research findings?"—measured by self-reporting frequencies (rarely, occasionally, often, very often, and not sure).

The degree of knowledge abstraction that supports decision making in practice was measured by self-reporting the frequency of types of thinking or sources of knowledge that are considered during the decision-making process in practice. This study also considers ASLA members' responses to finishing the statement, which types of knowledge is utilised in the practice of landscape architecture today. This question was measured through self-reporting on a scale of not at all, not too much, a fair degree, great extent, very great extent, and or not sure.

2.4. Data Collection and Sampling

As this study is primarily concerned with the level of knowledge abstraction in practice, landscape architecture practitioners are the best sources of information. Therefore, members of the American Society of Landscape Architecture (ASLA), the largest professional association for landscape architecture in North America (15,155 members), were chosen for this study [38]. In order to keep the survey more manageable, this study only randomly sampled a small portion, about 5%, of the selected population, who were all full and honorary members with valid email addresses listed in the ASLA online member directory. In addition, considering the advantages of the Internet and email today, such as collecting and organising a large amount of data at a relatively low cost [39], quick access [40,41], less time-intensive and more participant-controlled surveys [40,41], etc., this research conducted online surveys for data collection via the software SurveyMonkey[®], which was used to manage the questionnaire design, distribution, and maintenance.

An invitation email was delivered to all the 769 individuals who were able to successfully receive an email from the sample with a link to the questionnaire website. Conclusively, 239 complete responses were collected. The response rate (adjusted response rate = 31%) is around the average of other web-based surveys in recent years [42]. The distribution of age, gender, educational degree, serving organisation, and job function suggested that the sample was not heavily skewed on any of the background variables.

2.5. Data Analysis

This study used the following three analysis techniques: descriptive statistics, dimension analysis, and cross-analysis.

2.5.1. Descriptive Statistics

Descriptive statistics were used to describe the general research use and perceptions of research by survey participants. The data collected were concluded from multiple-choice, measured on a four or five-degree Likert scale and were treated as quantitative data for most statistical analyses [43].

In multiple-choice questions, options were coded as numbers. This study coded options for each question; the four-degree scale options 'rarely, occasionally, often, very often' measured by frequency were assigned from 1 to 4, and the option 'not sure' was assigned 0. The five-degree Likert scale options 'not at all, not too much, fair degree, great extent, and very great extent' were assigned from 0 to 4.

Standard data in the descriptive statistics are reported by frequencies or by proportion, and unexpected patterns are highlighted. All statistical analyses were conducted using IBM SPSS statistic software (version 26).

2.5.2. Dimensional Analysis

Dimensional analysis breaks down the research objects chosen into different dimensions and then assesses each of these different dimensions. It was used to help classify items into meaningful groups that are easier to understand.

Questions that utilised a scoring system were categorised into two kinds of eigenvalue: the options with scores 0–2 were assigned a value of 1, indicating that the participants considered the option to be less critical or less frequent in the given situation, and the options with scores 3–4 were assigned a value of 2, which expresses the fact that they are considered to be more critical or more frequent.

To represent the gradient change in the degree of abstraction of knowledge more clearly, this study reclassifies the options based on their features and definitions of the four types of knowledge, ranking them according to their degree of abstraction. The classification is as follows: 'accessing to new knowledge' into seven categories (daily life, Internet, consult, conference, design materials, professional printed media, academic materials), 'knowledge dissemination' into five categories (teaching co-workers, Internet, conference, teaching in university, academic materials), and 'knowledge that supports decision-making' into six five categories (rational and intuitive thinking, consult, individual experiences, professional materials, technical standard, academic materials). The specific classification results are summarised in the following table (Table 1).

2.5.3. Cross-Analysis

Cross-analysis is a data-basic analysis method used to describe the interrelationship between variables; this method crosses two or more indicators to find the relationship between variables and discover more features of data [44]. Researchers have proposed that the connections between knowledge domains, rather than the domains themselves, might more appropriately define the core domains of landscape architecture [28]. In this study, to find out the co-occurrence relationship between different variables, multidimensional cross-analysis was performed on options of the same category and options in different categories to count the frequency of the co-occurrence of variables.

Among them, quantitative data are statistical in the same category represented by string diagrams, which are mainly used to show relationships between multiple variables. The line connecting any two segments on the circle is called a string, which represents the relationship between two variables. This diagram is adequately suited for analysing the relationships of complex data, especially bi-directional relationships and the flow of data. On the other hand, quantitative data are represented in different categories utilising a Sankey diagram; this is a specific type of flowchart where data flow from the left option to the right option, and the width of the extended line corresponds to the quantity of the data flow, the same line width is consistent back and forth, and the total number stays the same regardless of how the data flows. These two types of charts were created via an online

software called dycharts (<https://dycharts.com>, accessed on 1 November 2023), which is used to create various types of charts online.

Table 1. Categorisation of options completed according to the definition of the four types of knowledge. (The background colour is consistent with the legend in the results, the darker the colour the higher the abstraction level).

	Access to New Knowledge	Knowledge Dissemination	Supports Decision Making
	Travelling; Everyday life;	Common sense Logic and reasoning;	Teaching in co-workers
	Internet;	Intuition;	
Tacit knowledge	Clients; Related professionals; Architects and planners; Engineers; Behavioural scientists; Natural scientists; Humanistic academicians; Applied artists; Liberal artists; Systems analysts and computer specialists;	Client expressed desires; Other specialists;	Publishing on website
	Professional conferences; Short courses and workshops;	Your professional experience; Your professional education;	
Operational Knowledge	Other landscape architects; Design historic precedents; Design competitions;	Specialised knowledge and skills developed by its practitioners; Other specialists; Historical information; The work of other landscape architects;	Presentations and lectures other than conference; Presentations and lectures at professional conferences
Conceptual Knowledge	Professional newsletters; Professional documents and reports; Professional magazines; Professional databases	Technical standard	Teaching in university
Systematic Knowledge	Books; Refereed journals	Research findings; Scientific knowledge from natural sciences (e.g., forestry and biology); Scientific knowledge from social sciences (e.g., psychology); Abstract knowledge from humanistic disciplines (e.g., history; and art)	Writing books; Writing articles for refereed journals

3. Results

3.1. Access to New Knowledge

Practitioners primarily relied on more common and less abstract knowledge to keep updated with new knowledge (Figure 1). They expected this knowledge to guide professional actions directly, while explanations and justifications for these actions were of little concern to them. They more often supported new knowledge in the profession through tacit knowledge (50.23%), consultations (27.77%), operational knowledge (20.61%), and design materials (12.45%). These paths have a lower degree of abstraction and access threshold, making access easy and timely. They also relied on conceptual knowledge like professional magazines (7.82%), as well as documents and reports (5.68%) to obtain new information about landscape architecture, all of which often provide first-hand practice-oriented knowledge with a low degree of abstraction. Fewer practitioners accessed the

highest level of abstract systematic knowledge through books (6.9%) and refereed journals (2.48%), both of which are often used to describe the discovery of the truth and facts.

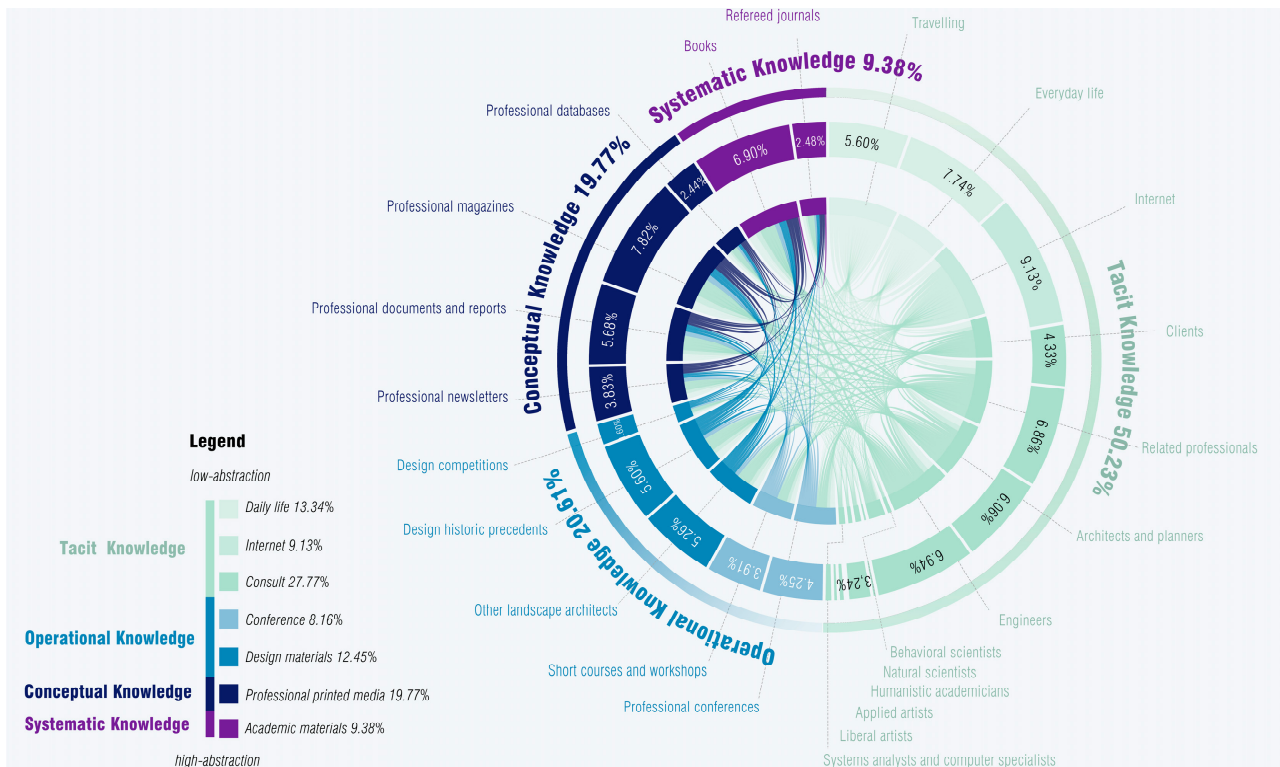


Figure 1. The proportion of practitioners accessing new knowledge at different levels of abstraction and the relationship between access to knowledge in each category, with the outer ring diagram showing the proportion of practitioners who scored 1.5 or more in this category, and the inner string diagram showing the joint selection of categories by each practitioner.

Practitioners who tended to access new knowledge in practice through tacit and operational knowledge rarely accessed new information through systematic knowledge at high levels of abstraction. Parallel to this result, among those who often accessed new professional knowledge through academic materials, only 22.16% also accessed operational knowledge (design materials = 13.66%, conference = 8.5%); another 77.84% acquired new knowledge through other paths. Those who obtained new information through daily life represented 23.12% of respondents. Respondents who acquired knowledge from consult were (28.37%), and 9.06% of respondents acquired the majority of their new knowledge from the Internet. Only 2.12% of respondents acquired new knowledge from only systematic knowledge. In total, 90.38% of those who chose to obtain new knowledge about the profession within their inner professional networks did so through ways other than academic materials, with 18% within this category learning through operational knowledge alone.

3.2. Knowledge Application during Decision Making

Landscape architecture practice, as revealed by the survey, was still perceived as primarily based on tacit (39.83%) and operational (35.71%) knowledge with low abstraction and developed by its practitioners (Figure 2). Practitioners were guided most by rational and intuitive thinking (24.99%), followed by professional knowledge gained from materials (19.10%), including those that are specialised. A relatively significant proportion of practitioners guided their practice through systematic knowledge (16.42%) with the highest abstraction. However, it should be noted that research findings (6.00%) belonging to systematic knowledge are less often used than the individual experience (16.61%), and

technical standards (8.04%) belong to conceptual knowledge. Comparatively, even fewer ASLA members believed that this practice is based on natural sciences (4.68%), humanistic knowledge (2.57%), or social sciences (3.17%); together with research findings, these aforementioned subjects constitute research-oriented knowledge that supports decision making in practice. Therefore, these results might imply that professional practice focuses more on providing design solutions than on justifying them through knowledge with a high degree of abstraction.

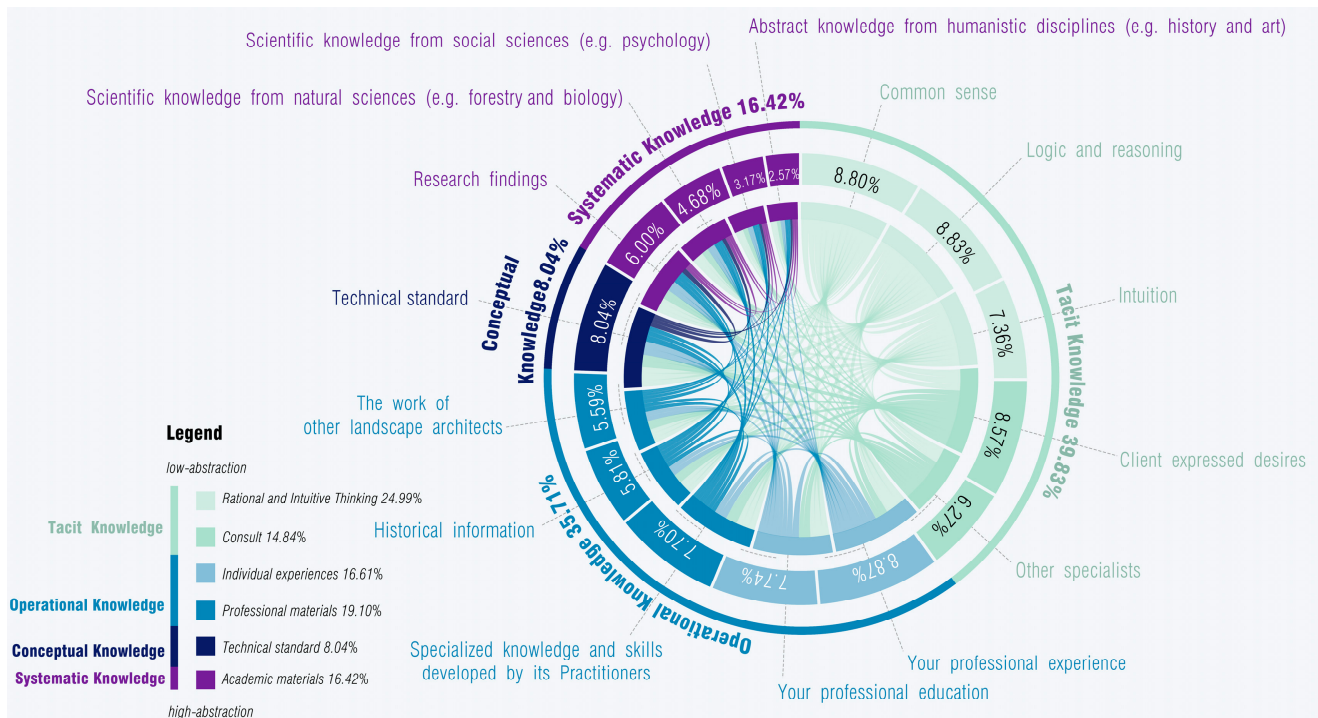


Figure 2. The proportion of practitioners applying new knowledge at different levels of abstraction supports decision making and the relationship between applying knowledge in each category.

Similarly, for obtaining and applying knowledge, about 20.04% of practitioners who applied the highest level of abstraction and used systematic knowledge to guide their practice referred to operational knowledge as well, 64.31% referred to both systematic and other knowledge, and only a small number referred to systematic knowledge only (15.65%). In practice, rational and intuitive thinking, individual experience, professional materials, and technical standards were considered in combination, and systematic knowledge also played an important role but was considered not sufficiently independent to guide practice. Less abstract operational and tacit knowledge still dominate in guiding decision making.

In addition, among the ASLA members who chose systematic knowledge to guide their practice, significantly fewer members thought that landscape architecture practice was based on humanities knowledge (3.41%) or social sciences (3.32%) than members who considered this practice to be based on natural sciences (4.58%). Due to their difficulties in justifying empirically, judgmental design knowledge and human systems knowledge were perceived as less vital, and practitioners could be less motivated to seek out and learn from research studies that fall under this category.

3.3. Knowledge Dissemination

ASLA members often disseminated tacit knowledge via co-workers in working environments (48.61%), which is usually a very small circle, possibly influenced by the traditional design studio pattern of designers taking on apprentices and the confidentiality required for some professional outputs (Figure 3). The dissemination and sharing of operational knowledge through conferences and oral presentations (26.39%) were also one

of the significant ways of dissemination, which can reach both researchers and practitioners, as well as business collaborators, government officers, institution organisers, and so on, and which can help them to expand their social network to access more information and resources. These two pathways of knowledge dissemination via oral communication could be modified using the expression of the expresser and, together with other modes of expression, to effectively reduce the abstraction of knowledge. A few ASLA members disseminated knowledge to a larger audience via other sources, such as tacit knowledge via the Internet (5.56%), conceptual knowledge via the university curriculum (10.07%), and fewer members disseminated knowledge systematically via academic materials (professional magazines = 4.86%, refereed journal articles = 2.43%, and books = 2.08%) to disseminate. These pathways required disseminators to have the ability to discover facts and truths and to summarise them into research knowledge at a high level of abstraction.

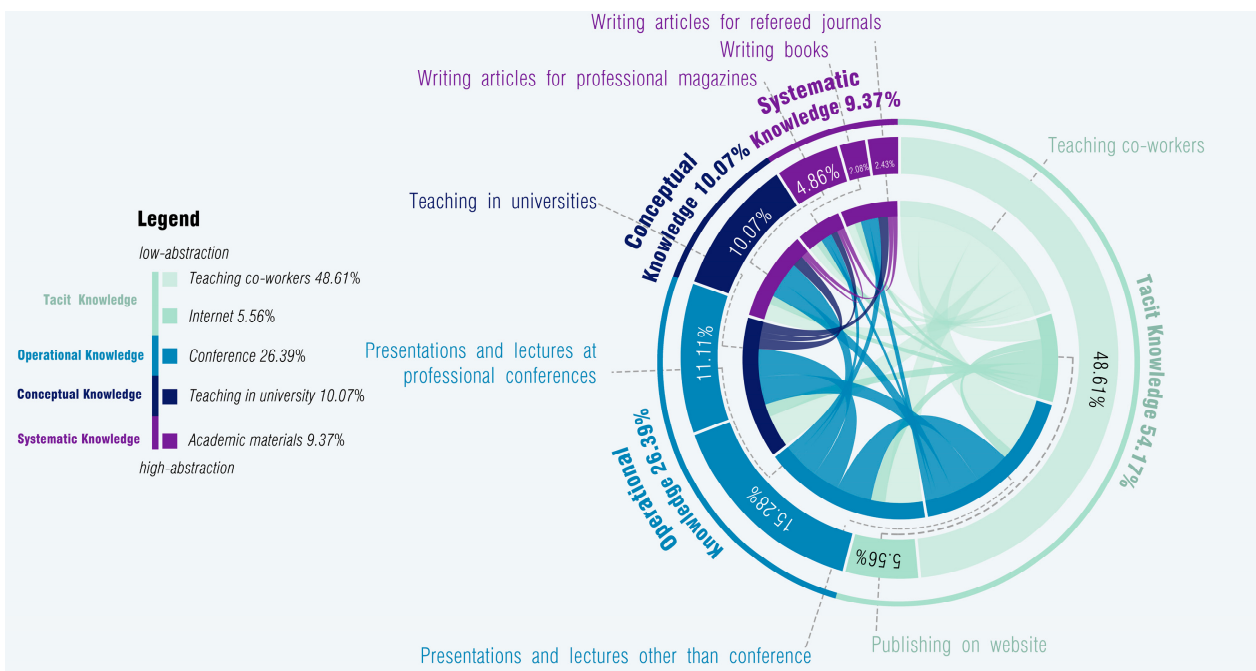


Figure 3. The proportion of practitioners disseminating new knowledge at different levels of abstraction and the relationship between disseminating knowledge in each category.

Most practitioners choose to disseminate tacit and operational knowledge by teaching co-workers and presenting at conferences, respectively, with fewer members disseminating both high-abstraction knowledge and other knowledge as the level of knowledge abstraction increases. Fewer members disseminated only high abstraction knowledge. About half of the practitioners who disseminated by teaching co-workers also did so through presenting at conferences (51.82%), and less than a quarter did so through university teaching (18.18%) and academic materials (18.18%), respectively. When looking into sub-categories, it can be seen that from dissemination through presentations at professional conferences (18.10%) to teaching at the university (14.74%), professional magazines (9.33%), peer-reviewed journals (5.97%), etc., the percentage of members flowing into these categories decreases as the level of knowledge abstraction gradually increases. For members who disseminated their knowledge systematically through academic materials with high abstraction, 14.95% disseminated only through the various subcategories of academic materials and more disseminated through other ways, with 38.31% disseminating through conferences and oral presentations as their main additional ways of dissemination.

3.4. Relationship between Knowledge Acquisition, Knowledge Application during Decision Making, and Knowledge Dissemination at Different Levels of Abstraction

Practitioners who tended to access knowledge at various levels of abstraction disseminated tacit knowledge through the less abstract way of ‘Teaching co-workers’ (54.58%). The probability was that the level of abstraction of knowledge accessed and disseminated by the same practitioner was inconsistent, similar to those who accessed tacit knowledge with the most disseminated systematic knowledge and the highest abstraction. In total, practitioners tended to gain tacit knowledge through the lowest level of abstraction, ‘daily life, internet, and consult’, most of them disseminated their tacit knowledge through co-workers (55.03%), and less disseminated their systematic knowledge through the pathway of academic materials (6.7%). Only 8.01% of the practitioners who obtained operational information disseminated academically, while the other 51.57% disseminated through the teaching of co-workers. In total, 7.14% of the practitioners acquired systematic knowledge through academic materials and then disseminated them academically, while the other 55.10% disseminated their tacit knowledge by teaching co-workers. Those who tended to acquire systematic knowledge at a high level of abstraction might not have the capacity or preference to disseminate systematic knowledge (Figure 4).

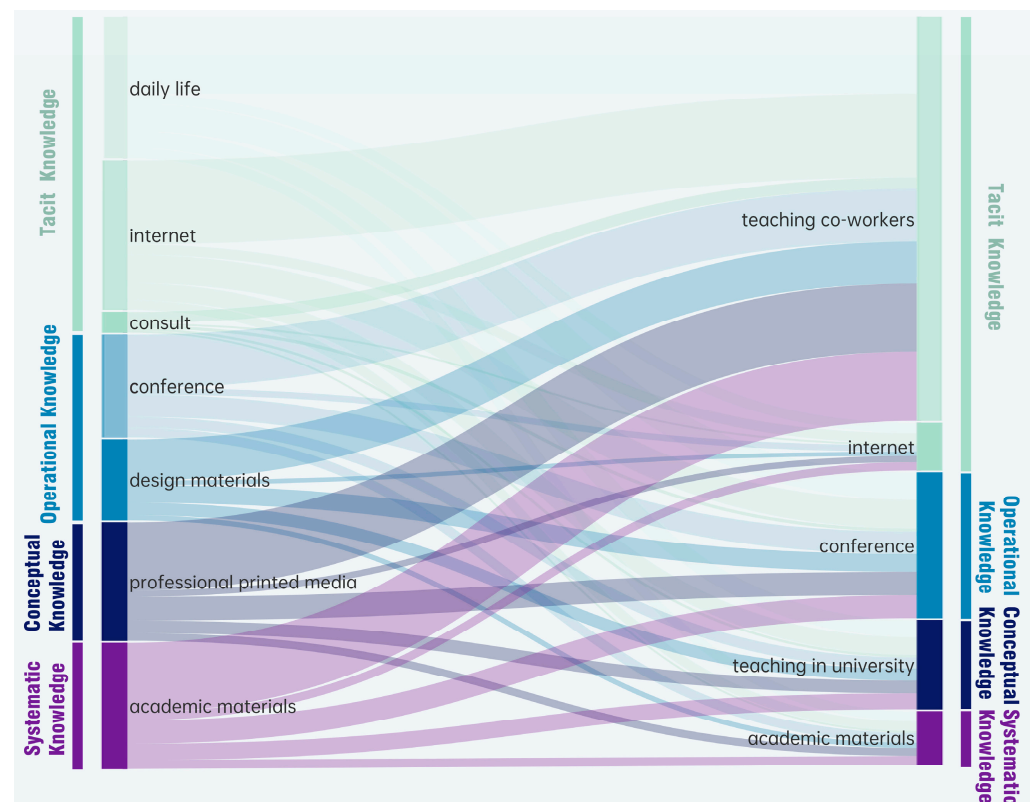


Figure 4. Relationship between knowledge acquisition and dissemination at different levels of abstraction. (The categories shown contain subcategories detailed in the Section 2).

Most of those who accessed knowledge with various levels of abstraction guided their practice by transforming it into tacit and operational knowledge, which are of a lower level of abstraction. In total, 77.10% of the practitioners accessed various knowledge, and guided their practice through other less abstract tacit and operational knowledge, with tacit knowledge (rational and intuitive thinking and consult) guiding the practice the most (40.15%), followed by operational knowledge (individual experience and professional materials) (36.95%). Only a few members who acquired systematic knowledge through academic materials also guided their application through academic knowledge (4.27%), while those who guided their practice through rational and intuitive thinking (20.16%),

consultation (20.28%) and individual experience (20.52%) still predominated, and the same tendency was applied to those practitioners who acquired tacit knowledge through daily life; this meant that for both those who acquired systematic knowledge from a high level of abstraction and those who acquired tacit knowledge from a low level of abstraction knowledge, they ultimately tended to guide their practice through tacit and operational knowledge like rational and intuitive thinking, consulting and individual experience with lower abstract (Figure 5).

Practitioners who disseminated knowledge with low abstraction also tended to apply low abstraction knowledge to guide practice, whereas those who disseminated knowledge with high abstraction were less likely to apply high-abstract knowledge to guide practice; furthermore, practitioners who applied high-abstract knowledge to guide practice might not be able or willing to disseminate high-abstract knowledge (Figure 6). Those who disseminated tacit knowledge by teaching co-workers guided their practice mainly through tacit knowledge (40.05%), followed by operational knowledge (36.82%), which is in line with the basic pattern of traditional landscape studios, where experiential knowledge is disseminated mainly through a tiny circle, actions are orientated by task requirements, and there is a need to keep their projects secret. Only 3.95% of those who disseminated systematic knowledge through academic materials applied systematic knowledge to make practical decisions. In general, those who disseminated their systematic knowledge in an academic way had fewer people guiding their decisions through all kinds of knowledge, which might mean that fewer members who tended to disseminate this way were likely to practise. Only 5.36% of practitioners who applied academic knowledge to guide their practice disseminated systematic knowledge in an academic way, implying that those who were able to apply high abstraction knowledge to guide their practice might not possess the ability to condense their knowledge into high abstraction to disseminate, or may not be willing to do so.

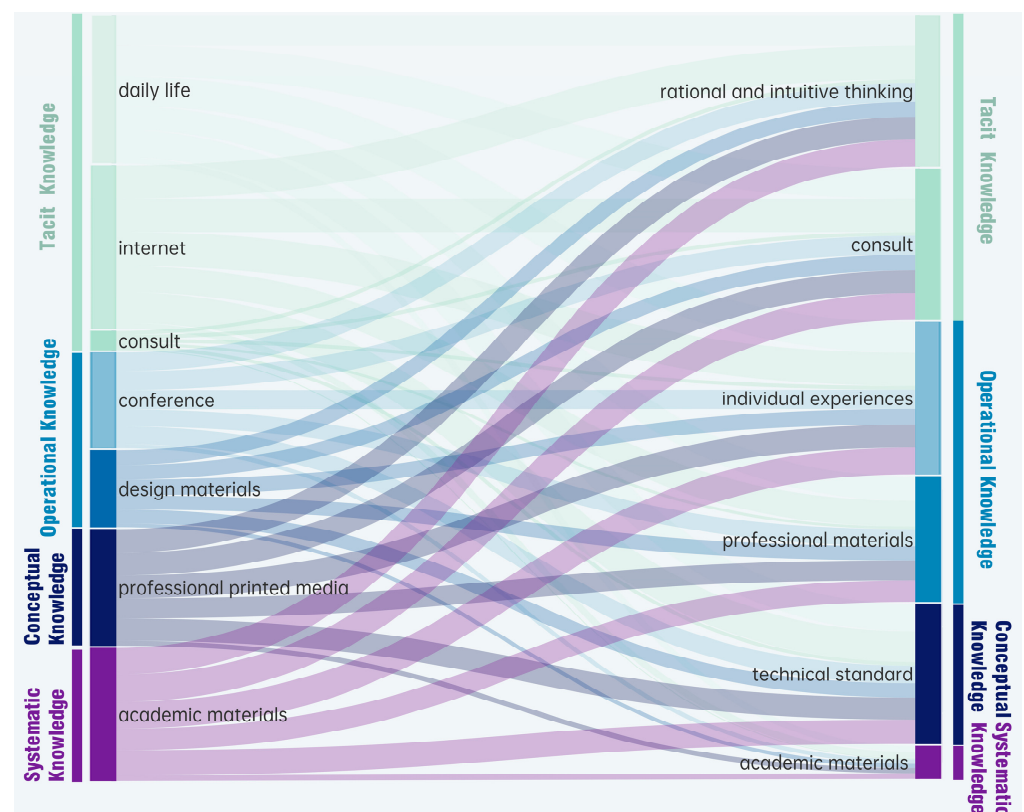


Figure 5. Relationship between knowledge acquisition and knowledge application during decision making at different levels of abstraction.

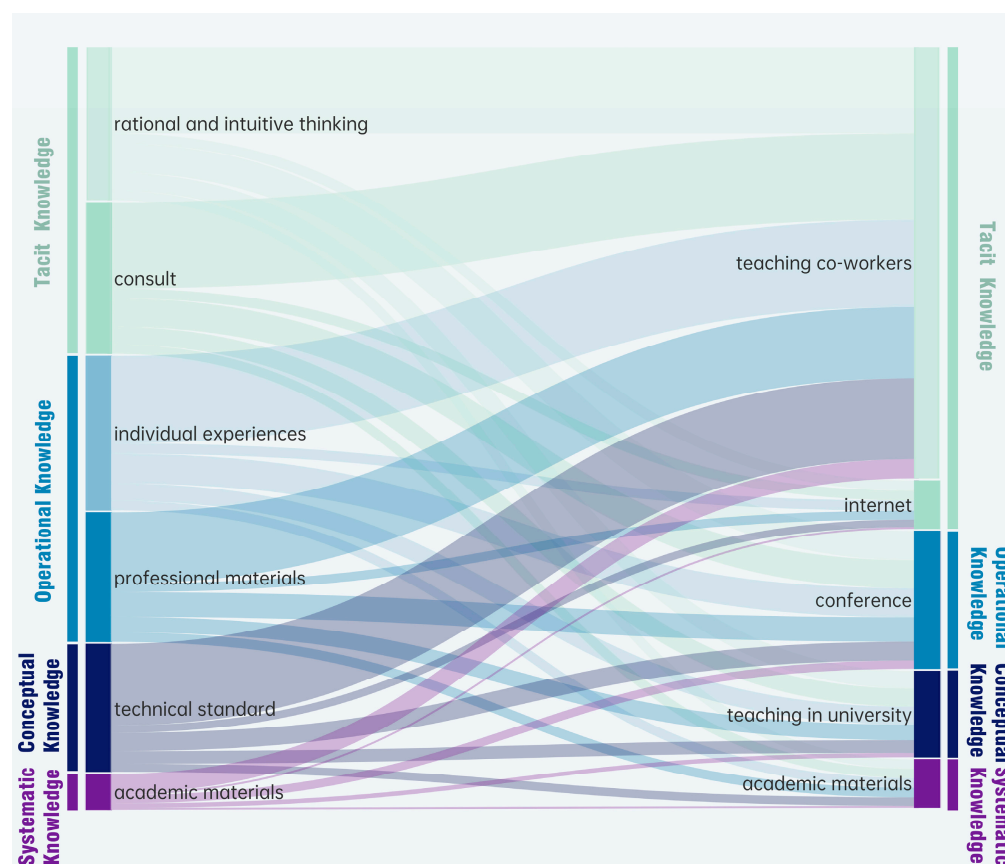


Figure 6. Relationship between knowledge application and knowledge dissemination at different levels of abstraction.

4. Discussion and Conclusions

The ability to demonstrate expertise through rigorous knowledge and research with high abstraction is vital for the survival of landscape architecture as a modern profession. Therefore, modern practitioners are expected not only to perform professional actions successfully but also to be able to back up their ideas with facts and offer rational explanations for their actions. To justify their design actions, the profession expects research to build a solid system of knowledge on which to base justifications. However, as found in a literature review, most independent landscape architecture research is not connected by any subject matter to each other, which may mean that the profession does not yet have an interconnected system [45]. This study's results also confirmed that knowledge used and disseminated in landscape architecture practice still remains at a lower abstraction level compared to other professional fields.

This study investigated the degree of knowledge abstraction in 'accessing', 'disseminating', and 'supporting decision making' aspects of landscape architecture practice. This study aimed to provide researchers and practitioners with information on the state of the profession's knowledge system building and what factors and segments may prevent the profession from enhancing its knowledge through research, which is intended to contribute to removing barriers and eventually facilitating the construction of its body of knowledge. The following section discusses the main findings of this study in the order of access, support for decision making, the dissemination and relationship between them, and the study's main limitations and improvements.

4.1. Major Findings and Suggestions

Professional decisions were made largely based on tacit knowledge (39.83%) and operational knowledge (35.71%). The results showed that design decisions were made more on

professional materials (19.10%) and logical and reasoning (8.83%) than research findings (6.00%). Professional knowledge and skills are less abstract, developed, and mastered by practitioners. Research findings are not considered sufficient to guide practice independently, which might not indicate the sufficient contextualisation of academic knowledge and its application. Instead, research findings are more often used in combination with common sense, individual experience, professional materials, and technical standards. This result could be because, in the empirical approach, practitioners often approach design solutions through trial and error [46]. Practitioners gradually improve their solutions and, meanwhile, gain knowledge by learning from their own practice and practice from others. This process does not necessarily involve rational explanations for why specific actions should be taken. Suppose this profession is expected to build a research-oriented practice. In that case, it would need to change its perceptions about research and advance its knowledge through the empirical approach instead of the rational approach. More post-occupancy evaluations can be performed systematically to evaluate new or renovated environments and to identify any mismatch between the original design intent and the actual delivered environment so that evaluators can summarise knowledge from the design solutions derived from their repeated experiments and rectifications can be made (if feasible) to obtain a better match in the future [47].

The knowledge accessed by landscape architecture is primarily less abstract, like tacit knowledge. The results showed that most practitioners rely more on tacit knowledge with the lowest abstraction level, such as consultations (27.77%), daily life (13.34%), and the Internet (9.13%), but less on systematic knowledge with the highest abstraction such as books (6.90%) and refereed journals (2.48%). It may indicate that high-abstraction knowledge is not sufficient to support the broad scope of landscape architecture practice or not able to generate practical design knowledge efficiently [48]; therefore, professionals still have to largely rely on less abstract forms of knowledge acquisition. However, while low abstraction may be sufficient to guide professional actions, knowledge of high abstraction is more important to demonstrate or justify professional actions such as diagnoses, inferences, and treatments, which may impair public trust in the jurisdiction of the landscape architecture profession. Meanwhile, practitioner flows between academics and practice still appear to be limited since practitioners who tend to acquire new knowledge from operational knowledge often do not tend to acquire new knowledge from systematic sources and vice versa. This is consistent with the results of previous literature reviews, and researchers may be inclined to conduct studies independently [45]. Therefore, in order to strengthen the body of knowledge in the landscape architecture profession, practitioners and researchers should work more closely to share the responsibilities regarding knowledge growth. If the competitive advantage of a profession is a concern, they should consider the advantage only in the short term but also in the long term, which requires their investment in knowledge and research. In addition, in practice, they could use research as a prerequisite goal and choose design as a method of realisation in 'research through designing' (RTD) or actively employ the task of designing within the research process [49].

Practitioners mostly share knowledge through low-abstracted tacit knowledge, like teaching co-workers in the workplace (48.61%), similar to traditional apprentice-based studio forms, which have been the designers' traditional forte [50]. In the knowledge dissemination stage, the most chosen 'colleague knowledge-sharing model' is often used in sharing design knowledge [6]. This knowledge is often advanced through an approach in which designers reflect on their previous practical experience, and the tacit nature of this knowledge cannot offer solid justifications for design actions. This form of knowledge sharing is not efficient enough for modern professions in a fast-changing society, and the practitioners in landscape architecture are also not very motivated to conduct or share research. Both may impede the advancement of knowledge in landscape architecture in a fast-changing world and prevent the profession from entering the research world and enhancing academic knowledge. Therefore, practitioners need to externalise this knowledge for more efficient knowledge sharing [51], and the ASLA members need to

be more aware of their responsibility to advance knowledge and actively expand how it is disseminated.

Based on the analysis of these three problems, this study also explored the level of abstraction of each practitioner's knowledge choices in the different stages. The results showed that practitioners who tend to access new knowledge through various levels of abstraction and coincidentally chose to disseminate knowledge through tacit knowledge with the lowest level of abstraction, like teaching colleagues (54.58%) and guiding their practice using tacit knowledge like common sense, logical thinking, and intuition; those who disseminate and guide their practice through low abstract knowledge at the same time overlapped, for the most part. In addition, practitioners may not prefer to use knowledge with similar levels of abstraction in all three stages of acquisition, dissemination, and supported decision making. They showed a bias toward selecting knowledge at different levels of abstraction depending on his or her needs at that stage. Understandably, they would be conservative about expanding the knowledge of landscape architecture into a deep holistic understanding. Every profession prior to modernisation experienced a gradual increase in knowledge abstraction and implemented holistic methods of practice. For example, the civil engineering profession has gone through similar changes in response to globalisation, sustainability requirements, and emerging technology; the steps they took were to reform the educational manner to prepare civil engineers before entering the practice field, developing a detailed and rigorous set of barriers to entry that "... supports the attainment of a body of knowledge (BOK) for entry into the practice of civil engineering at the professional level" [19] (p. 2). The aerospace profession has gone through similar changes, and they have taken the approach of extending theoretical tools to make scientific knowledge useful for engineers in practice [27]. The origins of landscape architecture were fundamentally developed from tacit and operational knowledge, which then manifested into the explorations of conceptual knowledge in academia. Evidently, the landscape architecture practitioners of today have found themselves at the precipice of an evolution in the field. The future development of this discipline should make reference to the successful experience of other related professions and establish a solid knowledge system as soon as possible so that the discipline can gain an advantage in professional competition. In the profession, practitioners and researchers should collaborate closely together, fostering a cultural consensus at the early stage of professional education to participate in academic discourses via venues and tools that appeal to practitioners. As a profession, we should also work together performing more research that is directly relevant to practise to bridge the gap between the academy and practice. In recent years, a number of professional firms and institutions have explored some instructive solutions. As previously mentioned, to response growing societal concerns regarding worldwide climate change and rapid urbanisation, many design firms (i.e., OLIN labs, Sasaki, SWA) and organisations (i.e., Landscape Architecture Foundation's Landscape Performance Division) have taken proactive measures like labs to progress in the field of landscape architecture to higher levels of knowledge abstraction and jurisdiction [52].

4.2. Limitations and Improvements

This study obtained empirical data on accessing, supporting decision making, and disseminating knowledge in practice, as well as the perceptions of knowledge system-building in the landscape architecture profession. Based on these data, suggestions were provided to enhance knowledge advancement and meet the increasing knowledge and needs of the profession. However, this study is limited and could be improved in the following aspects.

4.2.1. Data Classification

This study divides the answers to questions by the degree of knowledge abstraction and four types of knowledge to help understand the construction of the knowledge system in the three stages of access, dissemination, and support of decision making. This is the

basis for categorising. However, the classification of the four knowledge types is not sufficiently granular, although it is able to cover some knowledge outside the boundaries of these two classifications.

4.2.2. Data Verification

Although online questionnaires can target a larger sample size, they do not allow verifications or articulations of data once they are collected. For example, different practitioners may interpret the same option differently, and the cognitive bias involved cannot be verified. Moreover, the forced-choice questionnaire also limits the depth of inquiry. For example, the results showed that many people chose to disseminate knowledge by teaching their colleagues, but the reasons for this result were not confirmed.

4.2.3. Research Object

Considering the significance of the landscape architecture profession's entry into STEM for the development of the discipline, we currently only administered the questionnaire to members of the American Society of Landscape Architecture (ASLA), but this may have limited the results to the developments, and attitudes of practitioners in the United States.

4.2.4. Future Research Considerations

This study provides suggestions on how the profession can be improved through advancing high-abstraction research; however, the validity of these recommendations and their acceptance among practitioners has yet to be discovered, and the next step could be to raise these issues in the current sampling population to ask these questions and also solicit their suggestions. Additionally, this study obtained the trend of knowledge abstraction in each practical stage; however, the reasons for making these choices have yet to be discovered, and a subsequent study may be able to explore the reasons behind these options further. Furthermore, in order to capture the progress in the construction of the academic system in the discipline more holistically, future research could consider more requirements of academic knowledge when designing and consider more dimensions when dividing data. Finally, the conclusions drawn from this study are not yet demonstrative of the profession at a global scale. Further developments in this research could employ the perspective of those in firms and organisations abroad.

Supplementary Materials: The following supporting information can be downloaded at <https://www.mdpi.com/article/10.3390/land12112061/s1>, Table S1: Questionnaires.

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