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Sustainability, transdisciplinarity and built environment research

Adetokunbo O. Ilesanmi *

Department of Architecture, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract

Research into the Built Environment has engendered discourses that cover a range of issues including: economic, social-cultural, political, participatory and sustainability-related, at global and local levels. Evidences in the field in Nigeria however suggest that the knowledge-base of the built environment disciplines has been more uni- and multi- than trans-disciplinary in nature. This paper interrogates the narrow conceptualization of the built environment as primarily focusing on the aesthetics of form and space, to the exclusion of broader issues. It explores the question of what knowledge base the design disciplines such as architecture should be founded on. Based on a review of related literature, the paper distinguishes between transdisciplinarity, the confined territories of uni- and sub-disciplinarity, and clusters of cross-, multi-, pluri- or inter-disciplinarity. It examines emerging environmental issues relating to the built environment that make the increasing demand for the transdisciplinary approach imperative. It concluded that the transdisciplinary approach can offer significant intellectual benefits to the field in terms of methodological insights, critical analysis of conventional assumptions, and the provision of new perspectives. Recommendations are made that could enhance effective application of transdisciplinarity to the built environment research in Nigeria.

Keywords:Built environment, Disciplines, Research, Sustainability, Transdisciplinarity

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* Corresponding author. *E-mail address:*aoikcom@yahoo.com

1. Introduction

Sustainability as a subject has received increased research attention since Brundtland (1987). Sustainability research has however been a highly challenging task, being a complex issue that is intricately connected with societal dynamics (Balaceanu and Apostol, 2014). Now, it is virtually a universal norm that: "Everything is connected to everything else" (Commoner, 1971). In addition, a varied range of people are stakeholders in and affected by the built environment. Research on sustainable built environment should therefore preferably be conducted in such a way as to accommodate its complexity and strong societal relevance. Research into sustainability and the built environment is particularly relevant in the context of Nigeria, where the past three decades have witnessed remarkable increase in the demand for professionals in the built environment disciplines. This had consequential impact on the demand for the requisite research, knowledge, skills, and education to meet the shortage in high and middle-level manpower needed for the built environment. Architects, Builders, Quantity Surveyors, Estate Surveyors and Valuers, and Urban and Regional Planners, were urgently needed to be trained for the planning, design, construction, and management of physical facilities for the country's social, economic and technological development. Four decades back, built environment education was limited to five pioneering institutions, but the situation has changed drastically. For example, the number of accredited institutions awarding degrees in architecture has risen to twenty-eight (10 federal, 11 state, and 7 private universities) (NIA, 2016).

As institutions become increasingly aware of the need to evaluate the relevance and effectiveness of their programmes, built environment research and education will come under closer scrutiny, in terms of how they can best meet present needs and future expectations. The intellectual tradition of the built environment disciplines in Nigeria however suggests that their knowledge-bases have been more 'mono', 'multi' and 'inter' than 'trans' in nature. Most undergraduate degree programmes in these disciplines operate in isolated silos. They are mainly based on discrete curricula which prepare students as professionals – architects, builders, estate surveyors and valuers, planners, quantity surveyors, and construction managers – with limited interdependencies.

Students are seldom exposed to projects in their coursework or studies which challenge them beyond the theoretical and hypothetical, and assist them in becoming adequately responsive to the real needs of diverse groups in the society. Design students are rarely equipped with collaborative, communicative and interpretative skills required to engage with 'real-life' community projects, having worked usually on briefs within discipline-specific groups, as prepared by their studio coordinators. Research into the built environment seems to have suffered from this lack of collaboration – a situation of more rhetoric than reality.

This paper therefore examines the question of the appropriate knowledge base for the built environment disciplines. Through a literature review, it distinguishes between transdisciplinarity, the confined zones of uni- or mono-disciplinarity, and the clusters of cross-, multi-, and inter-disciplinarity. It highlights emerging issues relating to the built environment which make the increasing demand for the transdisciplinary approach imperative. It further recommends ways to overcome the challenges to applying transdisciplinary research, and draws appropriate conclusions.

2. Literature review

2.1. Disciplines and their relationships

First, the terms 'discipline' and 'disciplinary knowledge' need to be put into proper perspective. According to Bracken and Oughton (2006), 'Discipline' refers to 'a branch of learning or scholarly instruction which is defined by institutional boundaries constructed by the needs of teaching, funding, administration and professional development' (p. 372). Modern scholarship – with its predominantly Western cultural inclination – has emphasized specialisation, which denotes the segregation of knowledge into discrete 'disciplines'. Disciplines are therefore not inviolable, but are social constructs that evolve through historical processes. They are discrete bodies of organized or specialized knowledge, which may take the forms of *mono-* or *uni-disciplinary* (distinct disciplines) and *sub-disciplinary* (segments or sectors of a discipline) approaches. Disciplines may involve not just particular subject matters, objects and methods of study, but also systems with social and functional dimensions (Harris, 2002). The functional dimension incorporates a set of rules that delineates the 'problem', evidence, or methods of producing, evaluating, and transferring knowledge. The social dimension provides a common language, concepts and tools through which a discipline creates identities, peers, careers, and professional status and security (Petts et al., 2008). These social and functional dimensions give disciplines their strong structures, to the extent that there is a risk of insularity or disciplinary parochialism.

There is however increasing awareness across academia that complex societal problems do not respect disciplinary boundaries, hence the need to bridge them. Mono-disciplinary approaches are inadequate in addressing 'wicked problems' that span orthodox disciplinary divides and between academia and society (Turnpenny et al., 2009). It is important to conceptually distinguish between variants of disciplinary connections (Stock and Burton, 2011). Jantsch (1972) developed a five-part theoretical scheme for interrelations among disciplines: multidisciplinarity, pluridisciplinarity, crossdisciplinarity, interdisciplinarity, and transdisciplinarity. These are arranged in an ascending order, depicting an increasing degree of coordination among disciplines.

2.2. Disciplinary Variants

First, the terms 'discipline' *Multidisciplinarity* involves disciplines working independently alongside each other on a common problem, but each using its own standard frames of reference and methods. It occurs where a variety of disciplines are encountered concurrently in settings where the possible relationships between them are not made explicit. It is the joining together of disciplines with zero degree of cooperation, and little or no integration; the parallel existence of discrete bodies of knowledge in proximity to one another (Jones et al., 2009). The first step towards integration begins with *pluridisciplinarity*, which requires the deliberate juxtaposition of different disciplines aimed at enhancing connections between them. Communication between disciplines is encouraged but not coordinated, and the nature of any integration is largely incidental. In *crossdisciplinarity*, one discipline dominates another. Although it introduces an element

of coordination into the link between disciplines, one discipline imposes its disciplinary concepts and goals on the others, thus emphasizing control above cooperation.

Interdisciplinary approach involves some attempt to integrate or synthesise the different perspectives and approaches that disciplines bring to the same problem. It entails a synthesis of knowledge whereby understanding is modified in the interplay with other perspectives. It implies a sustained process of dialogue, and often requires shared framework, common methodology and language (Adelson et al*.,* 2008; Chettiparamb, 2007). Interdisciplinary knowledge is formed when concepts and ideas well established within their respective disciplines are integrated for the creation of new meaning. For example, in responding to an environmental problem, ideas could be brought from ecology, public health, and sociology respectively, and then integrated to find a solution, new meaning, the knowledge of which is interdisciplinary knowledge. Jantsch's (1972) taxonomy assumes that true interdisciplinarity occurs when separate disciplines surrender their concepts and goals, and collectively define themselves by reference to a common set of strategic concepts and goals.

Transdisciplinarity is a knowledge orientation that is liberated from disciplinary boundaries; it defines and solves its problems independently of any individual discipline. This approach tries to cross disciplinary boundaries, norms and procedures in order to address real-world problems, overcome the divide between 'expert' and 'lay' forms of knowledge, and close the gap between research and policy (Wickson et al*.,* 2006; Lawrence and Després, 2004; Klein, 2004b). It embraces interdisciplinary and participatory approaches. Being participatory infers creating a dialogue between policy institutions and civic society, and the complementing of expert knowledge by individual life experience and social norms (Feldmand and Westphal, 1999, Lawrence, 2004). Transdisciplinarity is able to create new knowledge, insights, and solutions to many questions. In contrast with interdisciplinarity which is primarily located in scholarly environments, transdisciplinarity fuses academic and non-academic knowledge, theory and practice, discipline and profession (Abdel-Hadi and Salama, 2009; Lawrence and Despres, 2004; Polimeni, 2006).

Viewed as a continuum, Hunt and Shackley (1999) describe multi-disciplinary, interdisciplinary and transdisciplinary approaches respectively as: the '*science of interaction*' whereby disciplines co-exist in a particular context but retain their boundaries; the '*science of integration*'' – a search for coherence between the forms of knowledge that are produced by different disciplines; and the '*science of hybridisation*', which transcends, re-negotiates and re-casts traditional disciplinary boundaries. These variants could therefore be conceptualized as a *continuum* of approaches rather than neatly packaged categories. Evans and Marvin (2006) for example, distinguish between two types of interdisciplinarity: 'cognate' which occurs *within* natural, physical or social sciences; and 'radical' which takes place *between* them, spanning the natural and social.

The clamorous calls for collaborations indicate a qualitative shift in the nature of relationships between science and society, which has been described as a shift from 'Mode-1 science' towards 'Mode-2 knowledge production' (Barry et al., 2008; Doucet and Janssens, 2011). Mode-1 science involves autonomous disciplinary research producing knowledge within academic confines; while Mode-2 encompasses transdisciplinary research produced across many sites, by academic and non-academic stakeholders

(Nowotny et al., 2001). It is argued that whilst disciplinary research preserves scientific autonomy, it may be inadequate in seeking innovative solutions to complex problems that are characterised by high levels of uncertainty, and may be unaccountable to the many stakeholders beyond academia that are implicated in these problems. An extensive body of literature on how to conduct, interdisciplinary researches addresses their histories, success stories, barriers, facilitators, incentives, forms of collaborators, practices and outcomes (Klein, 1990, 2004a). Until recently, less attention has been given to transdisciplinarity, particularly with reference to the built environment (Klein, 2013).

2.3. Built environment issues and knowledge base

Research into contemporary Built Environment has engendered discourses that cover a range of issues including: economic, social-cultural, political, participatory and sustainability-related, at global and local levels. On the global stage, large-scale, mega-projects reflect the increasing complexity, particularly in urban environments. Aspects of the built environment such as transportation systems and infrastructure, building construction and operation, housing stock, and land-use planning intricately relate to both climate change and human health (Younger et al., 2008). At the local level, the term 'residential environment' for example, is used to represent an aspect of the overall built environment at the domains of home, housing, neighbourhood, and community. Architecture, anthropology, engineering, geography, planning, psychology, and sociology, all contribute to the multidisciplinary and interdisciplinary studies of residential environments (Tognoli, 1987).

The multi-faceted nature of the built environment requires that it be understood through multi-disciplinary, interdisciplinary or transdiciplinary scholarship that involves multiple levels and domains of analysis. The universe of the built environment embraces diverse issues and concepts, and transverses disciplinary boundaries; issues as diverse as: design-related (Stanek and Kaminer, 2007); neighbourhood spatial patterns (York et al., 2011); affordable housing (Salama, 2011); carbon-reduction (Lomas, 2010); environment-behaviour (Sommerville and Rapoport, 2002); housing-health interface (Lawrence, 2004); health, environment, and sustainability (Annerstedt, 2010); and aging (Hennessy and Walker, 2011). Figure 1 illustrates a proposed descriptive framework of the built environment from a transdisciplinary perspective. It shows how the diversity of issues, spread across the levels of the built environment (from the room to the region), are over-arched by emerging paradigms, such as sustainability, vulnerability, resilience, flexibility, and quality.

The contemporary sustainability paradigm warrants that most of these issues receive renewed research attention, with fresh insights emerging (Benkari, 2013). Moreover, there is an increasing need for interconnectivity between many built-environment-related concepts. Research in the field is made more complex by the myriad of methods available, and different disciplinary approaches to methodology. Each discipline has unique preferences in collecting data, conducting surveys, and using qualitative or quantitative techniques. Even within specific disciplines such as architecture, the range of methods is extensive (Groat and Wang, 2013). There is the need to re-explore the question of what knowledge base disciplines the built environment disciplines should be founded on.

This paper therefore challenges the narrow conceptualization of the built environment as primarily focusing on the aesthetics of form and space, to the exclusion of broader issues. In the field of housing for example, Lawrence (1997) identified six research approaches: aesthetic or formal interpretation; typological; evolutionary theories and physical explanations such as technology and climatic aspects; social explanations such as defense theory and household structure; socio-cultural factors; and religious practices. Apart from the cost variable, other critical factors impacting affordable housing have in many cases been superficially addressed and in isolation of each other; hence the need to integrate different knowledge bases (Salama, 2011).

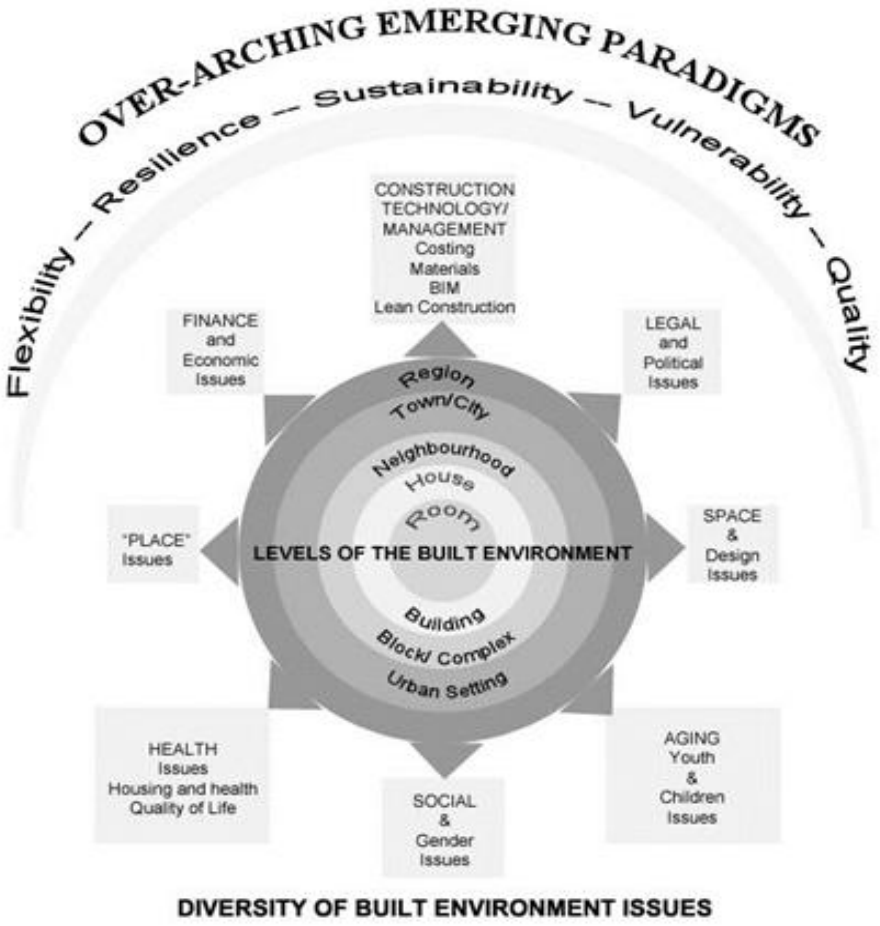

Figure 1. Descriptive framework for the built environment

It is imperative that the built environment disciplines and architecture in particular, engage a broader and more rigorous knowledge base to support their premises and principles. Sanoff (2003) argues that architecture should be based on the knowledge of people's needs, rather than on the creative impulses of architects; giving examples of how service learning and outreach programmes which can benefit surrounding communities, can be incorporated into studio pedagogy. Doucet and Janssens (2011) address the

hybridisation of knowledge production in space-related research in the context of architectural (and urban) discipline and profession. They explore hybrid modes of inquiry that challenge many of architecture's longstanding dichotomies, such as: between theory/history and practice, critical theory and projective design, and adoption of top-down or bottom-up approaches.

Contemporary social, economic, environmental and ecological problems, therefore necessitate solutions informed by multiple backgrounds that singular disciplines seem unable to provide, and possibly, are even incapable of providing (Stock and Burton, 2011).

2.4. Sustainability, architecture, and transdisciplinarity

The processes of producing the built environment involve the use of natural materials, the consumption of energy, and localised impacts on habitats. The cumulative result of these short-range activities is that more significant long-range impacts, environmental and others, only become fully apparent to future generations, with implications for sustainability. This demands an understanding of the social, economic, technological, juridical, and other dynamics and mechanisms which are required to transform the existing built environment to a more sustainable state. The evaluation of the built environment for sustainability conceives it as a dynamic scenario; as the 'product' of urban planning and architectural design processes, and various construction activities which occur in defined spatial settings. The multi-dimensions of sustainability are interconnected in a way that makes the analysis of this 'product' complex (Brandon and Lombardi, 2011).

There is presently no transdisciplinary language across the built environment that links the diversity of interests necessary to assess the diverse impacts. In evaluating the built environment for sustainability, the disciplines involved bring their own classification systems and techniques to the problem and they are generally inflexible in considering the views represented by others due to the lack of a common vocabulary or a systematic methodology which allows for productive dialogue. The task therefore, is to find an integrating mechanism to aid decision-making processes in planning, design, construction and management of the built environment.The ability to design holistic solutions within the complexity of the built environment requires close inter-working between the professions, hence the need to overcome the disciplinary constraints of current education and research. Opoku et al. (2015) further emphasize the role of appropriate leadership in driving the sustainability agenda; as well as the need for inter and transdisciplinary approaches to research to drive the needed change, in both academia and practice, towards a sustainable built environment.

3. Discussion: Imperatives of transdisciplinarity

The imperatives of transdisciplinarity as the key response to the sustainability challenge in the built environment are three-fold, namely: (1) global environmental issues as drivers; (2) benefits and prospects of transdisciplinarity; and (3) barriers to transdisciplinarity.

3.1. Drivers of transdisciplinarity

The paradigm shift towards transdisciplinarity is driven primarily by the imminence of global environmental problems which impact the built environment. Globalization, climate change, demographic dynamics, and environmental degradation are current examples of problems with a new kind of structure (Hummel, 2008). Such hybrid problems are characteristically marked by a high degree of complexity in terms of causation, ranging along spatial, temporal and social scales: from local to global; current events to long term effects; and from action in everyday contexts to policies of global regimes and multinational organizations. Dealing with these complexities requires an informed process of decision making and intervention, to ensure that society's capacity to act is increased in a sustainable manner and its knowledge base deepened and broadened. New approaches and forms of knowledge production, capable of adequately grasping the complexities, are required.

Most environmental problems transcend the borders of any particular discipline. Moreover, many of these have global or seemingly remote origins, thus demanding broader views of the built environment than the conventional style- or movement-based perspective. The conceptualization of the built environment which focuses on the aesthetics of form and space, to the exclusion of broader social, cultural, economic, ecological, and political issues, will no longer suffice. Transdisciplinary research as an emerging field of research in the knowledge society relates science and policy, and is increasingly being used to address issues such as: migration, new technologies, public health, violence, poverty, and social change. It thus complements basic and applied research in the socially relevant problem fields and those characterized by complexity and uncertainty (Klein, 2013).

Policy problematics such as those relating to climate change, vulnerability, resilience, and disaster management, require the collaboration of diverse disciplines to undertake analysis and develop solutions. There is an academically-driven and policy-related imperative for the 'hard' and 'soft' sciences to collaborate (Simms, 2011). It is therefore apparent that there are multiple pressures on the built environment disciplines to engage in transdisciplinarity (Newell and Bull, 2009).

3.2. Benefits and prospects of transdisciplinarity

Disciplinary research has some obvious benefits: it is specific, specialised and detailed; it combines the views of experts in the same field; and gives elaborate answers to specific questions. However, research on complex issues requires that knowledge on different subjects and expert views from different disciplines be combined. This underscores a shift away from a focus on discrete disciplines of knowledge with their own theories, language and problems, towards an interest in the productive relationships between disciplines. This is uniquely relevant in the built environment research over-arched by sustainability issues, in which problems in architecture, economics, ecology, law, planning, psychology, politics, sociology, or urban design may have to be tackled simultaneously, and disciplinary research often fails to capture the whole picture.

Transdisciplinary research offers significant intellectual benefits in terms of methodological perspectives, critical analysis of conventional assumptions, and invaluable knowledge exchanges between disciplines

(Klein, 2013). Although interdisciplinary research engages researchers from different fields, it may not capture the holistic dimensions of the built environment or consider all relevant stakeholders as much as transdisciplinary research, which has the capacity to address multiple issues simultaneously (Salama, 2007). It is therefore expedient for existing multi- and inter-disciplinary studies on the sustainable built environment to be linked into trans-disciplinary settings in which researchers from different disciplines interact with a variety of stakeholders, such that economic, environmental and social policies can reinforce each other instead of working at variance.

Moreover, that the built environment disciplines are potentially open to other disciplines in the natural and social science domains constitutes an opportunity for fostering transdisciplinarity. Salama (2007) for example, argues for trans-disciplinary thinking in affordable housing research and the integration of varied knowledge types into housing practices. Also, Geographical Information System (GIS) is increasingly accepted across a wide range of subject areas. Jones et al. (2009) for example, present the case of GIS-space syntax collaboration. Space syntax which was developed in the field of applied architectural research (Hillier, 2008), and the more place-sensitive GIS were integrated within a single theoretical-methodological model, implying a dialogue between the disciplines.

Transdisciplinary research provides valuable societal interventions and is normally conducted in the form of projects, and by temporary teams assembled for the purpose at hand. The goal is to have a practical effect beyond science. Transdisciplinarity produces both scientifically validated knowledge and pragmatic knowledge usable in practice. Researchers in many fields, including architecture, are therefore advocating more integrative approaches, which incorporate multiple methods from diverse conventional disciplines. The benefit is clear: each method of conducting research brings with it unique strengths and inherent weaknesses; hence combining methods provides appropriate checks against the weakness in each, while simultaneously enabling the advantages to complement each other (Groat and Wang, 2013).

3.3. Barriers to transdisciplinarity

There are two broad sets of barriers to the adoption and application of transdisciplinary research approaches, namely: epistemological boundary problems and institutional bottlenecks (Petts et al., 2008). Epistemological barriers include ideological differences in approaches to knowledge; issues of disciplinary identity; structure and culture of distinct disciplines; and enduring disciplinary traditions in terms of ontology, problem-framing, methodology, and theory or frames of reference. Institutional barriers include: lack of communication between disciplines and the need to establish a common language (Bracken and Oughton, 2006). Others are: division of labour between disciplines; lack of training for transdisciplinary research; career advancement systems; research and educational funding mechanisms; institutional practices; journals' publication procedures, differences in writing styles, refereeing processes, inadequate peer review and regulation of the professions.

At its core, transdisciplinarity is characterized by integration problems: epistemological, social, communicative and technological. Bruun et al. (2005) identified seven barriers to interdisciplinary research, which may very well apply to transdisciplinarity. These include: structural impediments, lack of knowledge

(unfamiliarity with other disciplines), cultural obstacles (differing assumptions, practices, ethics and language), epistemological distinctions (divergent disciplinary world views), methodological differences, psychological factors (attitudes and disciplinary identity), and reluctant reception (lack of understanding of the value of inter-disciplinary research by non-scientific audiences). Despite these challenges, transdisciplinary approaches provide integrative and synthetic means of addressing complex questions which are often situated at the interfaces between disciplines, and which cannot be captured satisfactorily by a discrete discipline.

4. Recommendations

A number of recommendations could help in bridging the barriers to transdisciplinarity. First, the transdisciplinary approach demands: mutual trust and respect among participants, non-defensive confidence in individuals' disciplines, and appropriate contexts for sharing of knowledge, framing of problems and structuring of methods. Research methods should be developed to reflect the diversity, complexity and dynamics of sustainable processes in the built environment. Guided readings and subsequent presentations of literature selected from other disciplines may enhance an understanding of the differences between the disciplines, help to resolve misconceptions, create an appreciation of how other disciplines work, and understand their unique methods and concepts.

Networking and links between educators, researchers, creative professionals, decision-makers and end-users of research, are vital to the joint design and development of effective sustainable built environment learning and research programmes, through participatory platforms that bridge disciplines, connect systems, and link research and policy. Such platforms would enable stakeholders to share results from projects, generate new issues, and identify relevant policy questions and effective ways to address them. This implies stimulating new transdisciplinary research groups in the built environment field through workshops and consultations with researchers in the field. It is also important to promote coordination among the research funding bodies for transdisciplinary training and curriculum development, with a view to identifying areas in which collaboration would have the maximum impact and reduce the institutional barriers.

Through pre-professional design programmes, students can be introduced to working in transdisciplinary modes and environments where they blur disciplinary boundaries and engage with projects that challenge their world views. The design studio appears to be an appropriate setting for this as students collaborate on projects with colleagues from other disciplines and gain multiple perspectives on issues that impact their projects. Greater emphasis should be placed on emerging pedagogies such as experiential learning through collaboration (industry/academia), service learning and social learning approaches (Wood and Oxley, 2007; Jagla et al., 2015; Keen et al., 2005). Design studios with service learning focus would enable students to engage with complex physical, social and economic scenarios. Social learning refers to collaborative learning within and between different communities of practice, which may help to foster shared meaning and arouse the kind of dynamic required to break with existing unsustainable patterns, routines or systems, and create

trans-boundary coalitions that involve multiple stakeholders, perspectives and levels of learning, leading to the hybridization of knowledge and experience (Collins and Ison, 2009).

5. Conclusion

This paper has examined the significance and applicability of transdiciplinarity to the built environment research, particularly in the light of the current sustainability paradigm. Addressing the problems and prospects of the contemporary interconnected world requires new forms and patterns of intellectual inquiry and discourses that interrogate existing disciplinary and institutional boundaries. Transdisciplinarity could be an effective means of encouraging varying views, gaining fresh insights, and opening up new areas through the intersection, integration, and hybridisation of disciplines, with a view to better comprehend the intricacies of the built environment. The built environment needs to respond to the dynamics of both the spatial and social landscapes, by developing research and professional expertise with sound disciplinary skills, but with the capacity for complexity and resilience to function effectively in a state of flux. Although it demands cooperation, understanding and good relationships, transdisciplinarity will not necessarily erode or destroy disciplinary expertise. The major challenge of the built environment research with respect to sustainability, is therefore to transit from the persistent paradigms of disciplinary and interdisciplinary knowledge, to integrated, transformative and holistic transdisciplinary knowledge in which disciplines not only compare results but interactively work with common conceptualizations towards finding solutions for complicated societal and real-world issues. This calls for built environment theory, research, and applications that are grounded in contexts which consider not only the physical and spatial, but also the psycho-social and ecological to be indispensable factors in the contemporary environmental reality.

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