



Urban sustainability assessment for Environmentally Sustainable Framework by Social practices and practice architectures

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Abstract

Despite the growing literature on sustainability assessment in the urban context, the resulting approaches and methods use several different theoretical frameworks and lack a unified perspective and operational practices. Countless tools and instruments have been created for specific purposes and relatively limited purposes. Strangely, these tools and instruments are unable to track and assess sustainability in vernacular forms and traditional built environments, even though environments such as these clearly have principles of sustainability in addition to aesthetic values and spatial attributes. This paper examines the theoretical background underlying current sustainability assessment methods in the urban context to identify their general limitations and specific application to indigenous and traditional built environments. Also, this paper discusses some cultural and spatial characteristics of the traditional form to identify its embedded sustainable strategies and functions. The paper concludes with a general conceptual framework for developing general principles of sustainability for traditional built forms in response to their natural and cultural contexts. This qualitative study of secondary schools in England included interviews with stakeholders and student focus groups in twelve schools in Greater London and the Thames Valley region (Berkshire, Buckinghamshire, Oxford shire), where 142 people including teachers, students, parents, governors and school staff (leadership, facilities, finance) participated in the research. The literature review of the concepts of sustainability assessment in the urban context and the sustainable principles embedded in the native and traditional format is followed by the thematic analysis of its limitations, which is fed from a new framework based on principles to this conceptualization. A total of 10 principles of sustainability have been proposed to evaluate sustainability in traditional built environments, taking into account the diversity of the site and the specific context of the site.

Keywords: Sustainability, resilience, Urban sustainability, Sustainability Assessment, Traditional built environment



1. Introduction

2.1. Urban sustainability, historical background

In recent decades, sustainability has become a prominent approach in urban development. The obvious effects of urban sprawl have prompted authorities and decision makers to look for alternative development approaches. Most of the existing sustainability assessment methods and tools have been developed by countries in response to the global call for sustainable development.

Efforts to measure sustainability in the urban context help cities monitor their current state of sustainability while encouraging future developments to adopt more sustainable principles and strategies.

The primary focus of any development has always been to target economic growth, but calls for integrating the natural environment into the planning process began in the 1970s. The works of Ian McHarg and the book *Design with Nature* in 1969 regarding ecological planning and architecture played an important role in the environmental movement (Kaur & Garg, 2019). Rachel Carson's *Silent Spring* in 1962 and Barry Commoner's *Closing Circle* in 1972 also contributed to the modern environmental movement. This wave of writers, who later emerged in the 1960s and 1970s, discussed the ecological and social impacts of global human development. Some of the most influential writers of this period include: Jane Jacobs, Herman Daly, Anders Gander Frank, and Whiston Sprin. In addition to the Limit to Growth team report in 1972, which was an important milestone in drawing international attention to the consequences of unsustainable actions on a global scale (Wheeler and Batley, 2014).

On the other hand, the Brundtland Report, following the World Commission on Environment and Development (WCED) definition in 1987, suggests: "Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs." In the 1980s, there were concerns about environmental constraints on economic and resource adequacy and inequality between developed and developing countries. (Moore, 2016). However, certain concepts were developed during this period before the Brundtland Commission, such as environmental development (CIDA, 1979) and global conservation strategy (IUCN, UNEP and WWF, 1980).

The concept of ecological development encourages the participation of local conditions and cultures in the development process, while the global conservation strategy promotes habitat conservation in order to secure local livelihoods (Gibson, 2006).

Many definitions of the concept of sustainability since the Brundtland Commission follow the concept of "three pillars" or "triple line" which includes equal importance for environmental, social and economic aspects in any development process (Pope et al., 2004). However, the "three-pillar" approach still fails to cover key aspects related to local conditions, including environmental and socio-cultural aspects specific to the region (Gibson, 2009; Kaur and Garg, 2019).

In the early 1990s, indicators and tools of urban sustainability appeared in scientific and practical fields. In particular, these indicators started after the Rio Summit in 1992 (Felky et al., 2018). According to Paris and Keats (2003), more than 500 sustainability indicators have been developed by governmental and non-governmental organizations that are applicable at variable scales and global, national, provincial, and local levels (Sigis et al., 2009). The rating system tools first appeared in 2004 as a sustainability assessment of buildings, before versions



to assess neighborhoods and built environments such as BREEM, CASBEE-UD and LEED-ND communities (Kaur & Garg, 2019; Sharifi & Murayama, 2015).

In April 2022, the UK Department for Education published a new sustainability and climate change strategy with a vision to make the UK a leading education sector in sustainability and climate change by 2030. The document outlines ambitious plans for climate education, decarbonizing school buildings and operations, and restoring nature on school grounds. As a policy document – as opposed to legislation – the strategy did not change the national curriculum or school funding in England (teaching is a devolved subject and controlled separately by the governments of Scotland, Wales and Northern Ireland). However, the roadmap potentially raises the school sustainability profile to the highest level since the 2006 National Framework for Sustainable Schools, which set a target for all schools to be sustainable by 2020 and was quietly abandoned after the 2010 election. School sustainability research has emerged from the field of environmental education based on the recognition that the physical environment of education and the way schools operate can reinforce or contradict sustainability messages in the classroom. Energy consumption of schools has also been investigated through energy and greenhouse gas emission modeling and feedback studies to building users. While energy research has engaged with social action theories in recent years, the focus of much environmental education research is rooted in individual pro-environmental behaviors and behavior change.

Since sustainability and sustainable development is still a different concept without consensus in its definition and concepts, different methods and approaches have been developed to evaluate sustainability in the real world. Some describe sustainability assessment as a process in which the consequences of an initiative on sustainability are evaluated, where the initiative can be a policy, plan, program, project, law, or an existing practice or activity (Pope et al., 2004, p. 595). Others define sustainability. Assessment as a "complex assessment method is undertaken to support decision-making and policy-making in a broad environmental, economic and social context and goes beyond a purely technical/scientific assessment." (Sala et al., 2015, p.314 quoted by Kaur & Garg, 2019). However, with more than 200 definitions of sustainable development in use since 2003, it has proven to be very difficult and even controversial to implement (Parkin et al., 2003). Despite these problems and lack of consensus, however, the concept Sustainability inevitably progressed in various dimensions including urban development (Cohen, 2017).

Therefore, the lack of agreement and lack of broad definition of the concept of sustainability and sustainable development led to the creation of several approaches and methods to assess sustainability in built environments. However, despite all these theoretical and methodological activities, the need for local and specific approaches and tools, especially in the field of sustainability assessment in the context of local and traditional built environments, has not been considered as it deserves. The purpose of this article is to address this gap, to provide an approach for how to track and evaluate sustainability and sustainable development in indigenous and traditional forms. In general, to clarify our definitions: vernacular architecture refers to a building, typology, style or form, while traditional refers to a settlement or community that shares similar values, history and place.

2. Application of urban sustainability tools in traditional settlements and indigenous forms



The lack of theoretical background and misunderstanding of the concepts of sustainability and sustainable development create several methods and approaches to assess sustainability in the built environment. Despite all the concerns raised, these methods and tools can be used in different cases at the same scale: building, neighborhood or city. Sustainability may be rated and evaluated differently based on the tools applied and enhanced by their change. However, most current urban sustainability tools are not suitable for assessing sustainability in a traditional or vernacular built environment.

The first and basic reason for this can be derived from the nature and philosophy of current assessment tools. Most of these tools have been developed to measure sustainability performance in existing developments or future scenarios, but not in a historical context. Therefore, this proposal is presented with the premise of the contemporary urban structure of today's living city or tomorrow's dream city. As a result, the methods used, selected indicators and criteria, and data collection techniques will not be applicable to historical or traditional settlements. A review of climate and energy education found that educators focus primarily on individual energy consumption behaviors, and researchers call for environmental and sustainability education that "clearly addresses the role of collective action, multi-agent networks, and socio-technical innovations in shaping energy transition processes." Scholars have also criticized sustainability and climate change policies for focusing too much on individual choice and behavior change rather than the broader context of social structures and practices. This research project examines school sustainability through the lens of social action, examining patterns of activity that contribute to school environmental impacts and the factors that maintain unsustainable practices or are needed to enable more sustainable practices.

Another limitation of current sustainability assessment tools is that they do not cover cultural and spatial aspects. Some instruments, such as Marwarid (United Arab Emirates), include culture as a separate aspect. Also, CASBEE (Japan) added a specific assessment for indigenous buildings, but still in a very limited trial. According to Luce et al. (2018), two approaches currently exist when assessing sustainable development in the context of dominant heritage. First, there is the assessment by the same tool used for modern buildings or projects.

Second, there is a situation where the heritage aspects of a particular assessment are considered within the very narrow framework of cultural heritage management. It has been observed that "heritage aspects have received limited attention as a single indicator or sub-indicator. Many elements that are necessary for the integrated sustainability assessment of specific cases, such as cultural heritage sites, are simply ignored in value-based heritage management (Leus & Verhelst, 2018, p. 1). Therefore, most of the indicators in this tool do not reflect the realities of a traditional settlement that may be assessed in terms of its sustainability as a built settlement. For example, energy and waste management (natural environment) and transportation and infrastructure (built environment) did not and do not exist in them.

Today, Other indicators such as water consumption and air quality (natural environment), safety and crime rates (social) and job opportunities (economic) seem more practical and valid, but the required data are difficult to obtain due to the lack of government authorities or the technology needed to generate such data, especially in abandoned settlements. Furthermore, although some data are partially available in some cases,



establishing a threshold measure or measures related to things like poverty, education, or gender roles is complex.

Sustainability in traditional and indigenous settlements cannot be measured by indicators such as biodiversity and recycling rates, access to public transport, percentage of flush toilets, cycling routes, GDP or broadband internet availability. At the same time, one cannot simply claim that a particular settlement is not sustainable due to the absence of these indicators. Sustainability assessment in traditional built environments should be evaluated with appropriate methods and have a different approach.

3. State of the art

4.1. Evaluation of urban sustainability

4.1.1. Theoretical Framework

In general, it can be noted that Brundtland's definition serves as a suitable frame of reference for sustainability as a concept. As a result, equal attention to environmental, social and economic aspects includes the concept of sustainable development. According to this framework, in this section, it has been tried to deal with the definitions of sustainable evaluation and the theoretical propositions that most of the current methods and approaches refer to. However, it is beyond the scope of the current paper to trace all current tools and methods or to draw a comprehensive synthesis. We limit our discussion to a review of the more influential and prominent studies to help frame the discourse sufficiently to initiate a new conceptual framework.

Cohen (2017) argued that guiding principles for urban sustainability assessment cannot be identified in the literature. His review of urban sustainability assessment showed that most evaluation tools incorporate indicators or index-based frameworks. He stated that "the basis of evaluating urban sustainability based on the fundamental principles of sustainability science is by no means a common practice" (Cohen, 2017, p. 9). Although the literature shows that the sustainability dimensions of three pillars plus one (institution) are the most. He argued that in the usual framework of marker selection, this may lead to bias and the selection of appropriate data. He called for a principles-based approach to avoid oversimplification and reductionism (Cohen, 2017).

Another strong argument was made by Gibson (2009), that since sustainability is essentially an integrated concept, then sustainability assessment should follow an integrated process and provide frameworks to enhance decision-making for all physical and non-physical commitments. He argued that the possible benefits of so-called "triple approaches" would be to build expertise in the three domains (environmental, social, economic), organize data sets collected separately, and distribute responsibilities among the relevant public authorities involved (Gibson, 2006). However, he argued that this approach may lead to overlooking the interdependence of these factors and treating them as antagonistic rather than complementary factors. He stated that "the three-pillar approach is often associated with the assumption that sustainability is about balancing, which contradicts both key insights about the interdependence of factors and the need to mutually support developments on all fronts."

Also, it encourages exchanges, which may be necessary but not as a first option. (Gibson, 2009, p. 263). On the other hand, some authors claimed that the current "next generation" sustainability assessments are Environmental Impact Assessment (EIA) and Strategic Impact Assessment (SEA). The purpose of this integrated assessment tool is to assess the negative impact of a development on the natural environment. Therefore, most of



these tools derived from EIA and SEA have been extended to integrate social and economic aspects (Pope et al., 2004). Other studies suggest a process-oriented approach to provide criteria for life cycle assessment or LCA, rather than commercial rating and labeling tools (Vandevyvere, 2013). Furthermore, some studies argue that since sustainability is a solution-oriented discipline, urban sustainability assessment should be structured around achievable goals and objectives derived from guiding principles. This enables the selection of appropriate indicators and the tracking of progress towards sustainable development (Cohen, 2017). A number of researchers have investigated the relationship between social practices and learning. Love and Wenger's seminal work on situated learning identified participation in social practices as a key aspect of learning, for example, how trainees move from marginalization to full participation in a community of practice. Drawing on the evolution of the theory of cultural-historical activity by Vygotsky and Leontief, Engstrom highlighted the possibility of learning to change practices: "Extensive learning is a type of learning that is needed and is created in fundamental transformations of entire systems of activity and fields of activity." Kimis - discussing the relationship between practice and learning with Schatzky - defines learning as "the awareness of how to continue practicing, or the ability to continue practicing, or engaging in practice in a different way, or more simply, practicing differently." Social practices can be understood in relation to three broad areas of function and purpose of education in society: competence, socialization and subjectification. While competence describes the formal curriculum and transfer of knowledge and skills to learners, socialization includes the hidden curriculum of "cultures, traditions, practices" and subjectification refers to the development of agency and "our freedom to act or not to act". In school, both through competence and through socialization, young people are recruited as carriers of actions.

4.2. Native forms and traditional settlements

4.2.1. Background

In the last twenty years, the typology of vernacular architecture has emerged in the discourse of cultural heritage as well as sustainability and sustainable development (Olukoya & Atanda, 2020). According to Stubbs (2004), the historical building, city and landscape acquire its value as today's heritage because it shows the values and beliefs of people of the past: "Heritage is a selected part of the past, only a part of which is interpreted for today's consumption" (Stubbs, 2004, p. 287). Therefore, the loss of indigenous architecture equates to the loss of traditional knowledge, local identities, collective memories, crafts and technology, lessons that are all emphasized in the context of sustainable development (Olukoya & Atanda, 2020). But in architecture, the interest in native and traditional buildings started earlier and although sustainability was discussed, the main motivation to pay attention to these items was more on style, aesthetics and regional identity. According to Oliver (1969), vernacular means "the language or dialect of a country or region" because it is "metaphorically appropriate" when used as a "constructive term". However, he argued that "nevertheless, the assumption that vernacular architecture implies something native to the country and not borrowed from, or learned from, remains open to question" (Oliver, 1969, p. 11).

Rudosky (1964) urged architects and architectural historians to pursue "non-pedigree architecture" rather than a grand public architecture built by professional architects—professional architects represent a small fraction of the world's monuments. He expanded the term by referring to "communal architecture", which he defined as "communal art, produced not by a few intellectuals or specialists, but by the spontaneous and continuous activity of a



whole people with common heritage acting under a community of experience" (Rudosky, 1964, p. 7). In the same context, Fathi (1973) argued that "every people who produce architecture evolves their favorite forms, as much as language, dress or popular culture is specific to that people" (Fathi, 1973).

According to tradition, it is defined as: "social comparison of personal habit, [which] has the same effect in art and frees the artist from annoying and unnecessary decisions, so that he can focus all his attention on vital decisions" (Fathi, 1352, p. 24). Frank Lloyd Wright also praised "vernacular buildings" that people produce in response to their needs and environment and that deserve to be studied in comparison to other monuments (Oliver, 1969, p. 16). Many other architects and historians have praised the features of vernacular architecture and traditional settlements, and have also looked for ways to update them for today. And this discourse is particularly strong in countries like Japan, which have seen an almost convulsive shift from traditional to modernist and back again to traditional values. Consequently, it is argued that there are many architectural and spatial features that can be found in the vernacular form and traditional built environment. However, we focus here on aspects related to the concept of sustainability and sustainable development.

There are 2,408 independent schools in England with a total of 591,954 pupils, or 6.5% of all primary and secondary school pupils (many private schools cover the primary and secondary years and government statistics do not provide a more detailed breakdown). Despite the small percentage of students in privately funded education in England, Dayton's UK Inequality Review found a significant difference between state and independent schools in terms of resources per pupil throughout their education, as well as future academic achievement and financial rewards as a result of their education. In this article, the terms "independent school", "private school" and "privately funded school" are used synonymously based on common usage identified by the Ministry of Education.

4.2.2. Are the principles of sustainability embedded?

As mentioned, sustainability as a term was clearly absent from the early discourse of vernacular architecture and traditional built form. However, similar terms were often used to denote the same concept. These terms were often used in more romantic and philosophical ways. Some terms tend to recur, such as "honesty", "truth" and "respect" in response to the use of local materials or in relation to the building's features and limitations. "Wisdom" about how to integrate a settlement with its environment and resources or use construction techniques. "Rightness," "proportion," "appropriateness," and "naturalness," which describe moral judgments about the merits of tradition and its associated lifestyle. An "economy" that represents the efficient use of local and natural resources. And "rootedness" and "connection" express a genuine relationship with the land, its history and cultural values. Sustainability activities in schools that integrate the environmental performance of facilities, the impact of operations and learning outcomes for students are often referred to as "whole school" approaches. A preliminary review of whole-school sustainability programs provides the following definition of this comprehensive approach: "Whole-school approaches to sustainability encompass all elements of school life such as school management, instructional approaches, curriculum, resource management, school operations, and grounds. Whole school approaches can imply links and/or partnerships with the local community. According to El Sayad et al. (2011), there are four principles for the sustainability of indigenous tradition. These include 'materials and site suitability', where indigenous materials are produced locally



and used effectively in relation to their surroundings. "Response to climate", where native forms and materials respond to climatic conditions by default. "Socio-cultural benefits" which include the idea that the production process strengthens social bonds and reduces costs. And finally "adaptability", the assumption proven by long histories of use that vernacular architecture is remarkably flexible and extensible (Alsayad & Arboleda, 2011).

Native architecture and traditional settlements can offer many sustainability lessons. Some of these principles, such as building materials and integration with the surrounding environment, can be easily considered. Other sustainable principles such as low-impact construction techniques and use of natural resources are incorporated into the planning and construction process. Also, there are many Local sustainable practices are related to the way people live and interact as communities, which requires deep ethnographic understanding and further analysis to assess its impact on sustainability as a concept. But in general, the usual principles of sustainability found in native architecture and traditional built environments are categorized into three environmental dimensions (including natural and built environment), social and cultural dimension, and economic dimension. From an environmental perspective, eco-friendliness and passive technology rooted in vernacular architecture provide knowledge and values for use in contemporary practices (Olukoya & Atanda, 2020). According to El Sayad et al. (2011), environment was one of the main aspects of Rudowski's approach. He praises the "climatic advantages of underground houses in Tangquan, China." Narrow and cool streets of Zanzibar. Domestic courts in Morocco; and coolness and warmth in the cover Streets of Banabare, Spain, Gobbio, Italy and Kharga Oasis in the Libyan Desert" (quoted in Alsayyad & Arboleda, 2011, p. 137).

Furthermore, Alexander argues that traditional builders not only understood the importance of avoiding any damage to nature, but also sought to improve the natural landscape (Alsayad & Arboleda, 2011). National Framework for Sustainable Schools (2006): This policy – introduced by a Labor government but stalled by the Conservative-Liberal Democrat coalition government – outlined eight 'doors' to sustainable schools and influenced schools' future investment in building new teaching facilities.

Finally, the discussion of sustainability assessment in the urban context highlights some of the main limitations and shortcomings in this field. In addition, in native and traditional settlements, most urban sustainability assessment methods are not applicable due to various limitations. The traditional built environment now incorporates principles of sustainability that require an appropriate approach to assessment. In the next section, an attempt is made to develop an alternative assessment framework that uses the main principles of sustainability to identify sustainable qualities in indigenous settlements.

4. A framework for evaluating the sustainability of indigenous and traditional built environments

5.1. Theory

For the purposes of our alternative model, some clearer definitions of the terms sustainability and sustainable development need to be explained in order to establish a sound theoretical basis. This is an important step to provide a common understanding of sustainability in order to develop a methodology for assessing sustainable development that includes key principles linked to key indicators. For our purposes, sustainability can be defined as "the effort to bring society within the planetary boundaries of Earth while raising the global population above basic living standards" (Cohen, 2017, p. 2). In this framework,



Radwell (2003) defined sustainability in terms of conservation as "the wise use of resources to ensure continuity of supply, with minimal interference with cultural (physical, social, economic, artistic) context and identity." and constructive evolution versus destructive revolution" (quoted in Stubbs, 2004, p. 286).

The proposed model accepts the following facts and criteria as its basis: The level of uncertainty is related to the concept of sustainability, as mentioned by Gibson (2006). As discussed by Vandover (2013), there are "definitive" and "normative" terms of environmental and social sciences. And as mentioned by Gibber (2019), subjective competence is involved in the selection process of key indicators. This thematic comparison shows the similarities and differences between these different frameworks, although there is potential for more overlap in the implementation of these programs. For example, the seven-step Eco-Schools process includes a step to connect selected topics to the curriculum, and the Let's Go Zero campaign has created an online action planner that includes pathways for community, culture, curriculum and campus. While these existing sustainability plans cover many dimensions of the whole school approach, there are notable exceptions. For example, while sustainability content is mentioned in the curriculum in many programs, they do not explicitly address how this content is taught and learned—the entire school curriculum. Furthermore, while other initiatives may imply the need for staff training and professional development to achieve sustainability-related goals, a whole-school approach highlights this need for capacity building. These initiatives also include aspects not covered in the whole school model, especially in terms of global communication and future careers. Among these frameworks, the Eco-Schools program has been widely adopted, with the Environmental Education Foundation reporting that more than 59,000 schools in 68 countries participated in Eco-Schools between 1994 and 2019. In England, 1,478,364 young people attended Eco School in 2020-2020. Like 96,580 students in garbage collection and 37,865 trees planted in school grounds. Research has shown that Eco-Schools initiatives have mixed effects in terms of learning outcomes and behavior change, and that the transformative change promised by whole-school approaches remains elusive. The sustainable school frameworks above provide an entry point for dialogue with school stakeholders and an initial reference point for reflective thematic coding of interview and focus group data. A number of schools that participated in this study were involved in both the Eco-Schools and Let's Go Zero programs, and both initiatives were discussed in the interviews.

5.2. Selection of principles / indicators

Determining and measuring indicators is at the center of sustainability assessment (Cohen, 2017). According to Leus et al. (2018), a holistic perspective is very important in creating a set of indicators: "Indicators describe complex phenomena in a (pseudo)quantitative way by simplifying them so that communication with specific user groups is possible" (Leus & Verhelst, 2018, p. 4). Therefore, the indicators should be a clear and measurable reflection of the priorities of the local urban environment (Kaur & Garg, 2019).

Cohen (2017) suggested that it may be useful to frame public metrics and indicators around a set of shared guiding principles against which researchers can set goals and objectives. This principles-based approach was promoted by a number of studies as an alternative to the triple bottom line (TBL) approach. Pope et al. (2004) reinforced Gibson's argument for a "principles-based approach". Instead of promoting conflicts and exchanges,



which avoids the limitations associated with the TBL approach, it emphasizes the interrelationships and interdependencies between pillar areas (Pope et al., 2004, p. 610). Therefore, sustainability assessment should consider the main characteristics of a specific place, the normative nature of sustainability, changes in perception and the dynamics of an urban environment (Sharifi and Murayama, 2015). Also, indicators should be simple, comprehensive and measurable with available data that reflect the triple bottom line of sustainability (Felki et al., 2018). Sigis et al. (2009) also added that indicators should be developed along with the measurement unit, data source, review and analysis methods, and evaluation criteria. In this case, the level of complexity of interrelationships is reduced to make evaluation easier (Sigis et al., 2009).

Focus groups were held with students of ten schools with the presence of 61 sixth grade students. A focus group format, using interview-like questions, was chosen to maximize the voice of potential students as well as meet the safeguarding requirements of the participating schools. Table 3 shows the number of interviewees and focus group participants by stakeholder group and school type, and the results section shows the use of the combined code by school type and stakeholder group (for example, S1-L would be a member of senior leadership in a public school and I2-G a governor in an independent school). Interview transcripts and focus group recordings were coded using reflective thematic analysis to develop and iteratively refine common themes in the results section. This analysis was also done through critical discourse analysis, especially from the perspective of the relationship between language and social practice.

In a more heritage-based context, Leos et al. (2018) argue that indicator selection depends on pragmatic factors such as scale and heritage typology, and subjective factors related to subjective attributes, such as "legitimacy, validity and salience" as defined by Clarke et al. In this sense, salience refers to the type and scale of heritage and its long-term impact on sustainability. Validity refers to the feasibility and availability of the collected data. Legitimacy is related to "scientific credibility", which means the degree of acceptance of indicators by experts and stakeholders. They stated that "creating a set of indicators is a methodological compromise between local relevance, practical feasibility, data availability, and theoretical justification" (Leus & Verhelst, 2018, p. 5). This paper argues that the proposed framework and guiding principles can be used to evaluate any traditional and indigenous form. Also, local variation in traditional settlements can be traced by following the same approach. Adding more principles follows a simple procedure: the principle must be linked to sustainability as a core concept (meeting current and future human needs) and then considered at the appropriate scale and time. The main advantage of this approach compared to current tools is that it first starts with sustainable principles, then evaluates to what extent it has been realized in the target settlement. Most of the proposed principles have been intensively discussed in the indigenous sustainability discourse (Alsayad & Arboleda, 2011; Harm_ancescu & Enache, 2016; Olukoya & Atanda, 2020; Paridah et al., 2016; Pollalis & N, 2016).

The following principles and indicators are aimed at evaluating the sustainability of native and traditional built form from the following aspects: compatibility, durability, efficiency, compactness, communication, interaction and participation, identity, innovation and creativity, interdependence and self-sufficiency. For the microclimate aspect, thermal comfort can be measured to find temperature variations using local building materials. In the



topographic dimension, the analysis can show the total amount of cut and fill required to create the settlement. In terms of sustainability, minimal intervention is always recommended. Also, it may be easy to see how a targeted settlement could block natural drainage lines and valuable agricultural soil. This will generally have a positive effect on sustainability.

Durability: The main goal is to evaluate the reliability and flexibility of building materials. Age of building and required maintenance; its construction and the quality of domestic products. From the social dimension, this principle may evaluate the durability of social relations. For example, issues such as social structure (family and tribal societies) and the durability of the government system.

It can also be evaluated with this principle:

Efficiency: These principles are one of the main principles of sustainability that can be identified in a traditional settlement. This basic concept derives from the concepts of "wise use" and "optimal substitution". The objective of the efficiency principle is to evaluate the consumption of natural aspects such as energy, water, waste management and natural resource management in a general sense. Also, with the same principle, it is possible to evaluate different aspects of a man-made environment, such as the efficiency of land use and agricultural land. In addition, it can be expanded to evaluate the efficiency of different dimensions including social, institutional and economic dimensions.

Compactness: This principle is more suitable for traditional settlements with native forms. The purpose of this principle is to evaluate the density of a specific urban environment assuming a positive effect.

Connectivity: The purpose of this principle is to evaluate the accessibility and connectivity of the urban form, street networks, open space, mobility and walking. It also tries to evaluate transportation patterns in order to evaluate its impact on the environment and welfare. This principle can be applied mainly to the built environment, but if possible it can be extended to assess connectivity in natural or social dimensions.

Participation: This principle is more related to social aspects and its purpose is to evaluate the level of participation and public participation in the decision-making process. Also, it can be used to evaluate any collective effort, often in the construction process, crafts and materials procurement, or in agricultural practices. In a general sense, this principle assumes that more interaction leads to a more stable society.

Identity: This principle mainly aims to cover cultural aspects related to indicators such as sense of space, locality and local values and principles. Also, it can be extended to the built environment where building type and urban form can be clearly differentiated into a specific culture or region.

Innovation: The main purpose of this principle is to track creativity in local practices and solutions that affect the overall sense of sustainability. This principle should cover different dimensions of sustainability. Ecologically, it can be related to traditional natural resource management systems or rain harvesting techniques. In the built environment, issues such as building materials and construction techniques can be evaluated under this index. Innovation can also be used in the social sphere where Local customs and rituals may affect overall sustainability.

Self-sufficiency: this principle is one of the main characteristics of a traditional settlement. It aims to assess the level of interdependence of a particular region or society and



mainly covers aspects related to the economic and trade dimension. Issues such as market order, product variety, income level and employment can be evaluated in this principle.

Security: This principle is generally used in the social dimension to measure issues related to safety and security.

However, in this context it can be extended to assess environmental aspects such as (natural) resilience to risk, man-made environmental aspects such as building safety, or economic aspects such as livelihood security.

The whole school model shows how it reduces the sustainability of different activities and roles in the school. For example, the community energy project mentioned above touches on the technical infrastructure related to electricity on the school site, the opportunity to study climate and energy solutions in the classroom, and the relationship between the school and the wider community. The whole school model also refers to the combination of discourses, actions and relationships reflected in the parallel practices and architectures of practice that sustain them. However, in the schools of this study, the implementation of sustainability campaigns is often reduced to the individual choices of different actors in a school, for example, the behavior of students in the cafeteria, or the stock market evaluation of capital projects.

5. Discussion and conclusion

6.1. Limitations and future research directions

The conclusion that can be drawn here is that the lack of a clear definition of sustainability and sustainable development has led to a distorted theoretical basis from which most of the current tools are derived. These tools and instruments have relative advantages and limitations. In a historical context, sustainability assessment should follow a different approach and be appropriate using principles and indicators derived from vernacular architecture and traditional built environments. In traditional built environments, these principles were not optional choices, but more like a way of life that arose out of necessity. Therefore, the influence of environmental factors can be traced in traditional built forms. But today, the impact of the built environment on the natural environment is a fundamental issue.

The proposed conceptual model can be set as a framework for sustainability assessment in the traditional built environment. The process of selecting appropriate principles and indicators can be a vital exercise to help understand the complexity of sustainability and sustainable development. Also, the alignment of principles and indicators based on the main pillars of sustainability in specific horizons and time scales reveals its potential consequences for sustainability in general. The proposed indicators reflect embedded sustainable principles rather than sustainable performance. For example, adaptability, efficiency, participation and other indicators mentioned above ultimately lead to greater sustainability in general and sustainable development in particular. Therefore, there is no need to set a threshold or criteria at this stage. However, each principle may require further quantitative and qualitative analysis using computer modeling, spatial and ecological analysis, as well as an in-depth understanding of local conditions.

In this research project, a range of stakeholders in twelve secondary schools in England shared their experiences of sustainability and discussed challenges, opportunities and successes. The inclusion of both whole-school sustainability models and social performance theories shifted the focus from the choices and behaviors of individuals, which characterize

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environmental and sustainability education research and practice, to a more comprehensive perspective on the transformation of the school's socio-technical system to respond to climate and nature crises. In particular, the inclusion of practice architectures as a new and fruitful theoretical framework shows the potential to bridge the gap between the disciplines of environmental education and energy research. This research captures a range of perspectives from school stakeholders that show different understandings of a set of actions related to sustainability in schools. The strength of this research is the number of participants involved in semi-structured interviews and focus group discussions and their varied roles and expertise. Whole-school approaches to sustainability are suggested as supporting systems thinking and change that involve all school activities and stakeholders. Initiatives such as the Environmental Schools Green Flag certification scheme provide a process and thematic framework for schools to systematically engage with environmental issues. However, programs such as these often involve a small percentage of the school community, are seen as a time-limited activity rather than a long-term process, and can be limited to a "ticking exercise" rather than leading to school-wide transformation. Combining whole-school approaches with a practical understanding of the discourses, practices and relationships of school life can allow schools to engage with sustainability more holistically – semantically, materially and socially.

In addition, the proposed model and principles allow the evaluation of indicators in a matrix form, that is: the same indicators can be evaluated in response to the relevant principles. For example, an indicator such as building materials can be evaluated in terms of its compatibility, durability and innovation. Also, an index such as (natural) risks can be evaluated with principles such as compatibility and security. Therefore, the evaluation of the same indicators with different principles of sustainability can identify their indirect effects in other dimensions of sustainability. The main advantage of this approach compared to current tools is that it first starts with the principles of sustainability found in traditional settlements with indigenous forms, then assesses to what extent they have been achieved. This assessment is not limited to the physical product, but also considers how the product has developed and performed over time.

In addition, local changes in traditional settlements can be followed with the same approach. Although the proposed assessment is based on principles, the assessed aspects can be classified into common dimensions of sustainability (environmental, social, economic) and institutional aspects. However, there are limitations that must be acknowledged in this conceptual model and sustainability principles proposed by that common criticism of the principles-based approach may refer to the level of subjectivity and transparency associated with it. In this case, a minimum level of expertise in two fields—sustainability and vernacular architecture—may be required to assess appropriate principles that meet sustainability goals and objectives and also find a place in traditional built forms.

The above findings also reflect differences in how public and independent schools engage with sustainability, echoing the Dayton Review of UK Inequality. The research shows that differences in funding and academic performance also affect how schools respond to environmental issues such as climate change and biodiversity loss. This potential disparity in school sustainability could have far-reaching implications for individual and collective climate resilience, at a time when educators are calling for rethinking the state or public education system to support climate mitigation and adaptation. The business model of



privately funded independent schools allows them to invest in physical infrastructure to improve operational sustainability, from building programs to equipment upgrades. The independent schools involved in this research are likely to have teachers or other staff with formal sustainability roles and resources to achieve sustainability-related goals.

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