---

**Article:**
Stevenson, F. orcid.org/0000-0002-8374-9687 and Kwok, A. (2020) Mainstreaming zero carbon : lessons for built-environment education and training. Buildings and Cities, 1 (1). pp. 687-696.

https://doi.org/10.5334/bc.84

---

Buildings & Cities

Stevenson, F., & Kwok, A. (2020). Mainstreaming zero carbon: lessons for built-environment education and training. *Buildings and Cities*, 1(1), pp. 687–696. DOI: https://doi.org/10.5334/bc.84

EDITORIAL

# Mainstreaming zero carbon: lessons for built-environment education and training

Fionn Stevenson[1] and Alison Kwok[2]

**Highlights**

Education and training are identified as a key means of reducing carbon emissions from buildings to help address the climate emergency. Institutional, industry and organisational responses are shown to be failing in this regard. This editorial introduces the themes and individual papers in the special issue and then explores the current state of the art through pedagogy, theory, training, policy, practice and standards. These areas are interrogated through three fundamental questions. How can education and training be rapidly changed to ensure the creation of zero-carbon built environments? How can this transition be implemented successfully? What positive examples and models can be drawn upon or adapted? In proposing an agenda for change, a new approach to education is set out which combines learning outcomes with new standards and personal values within a continual questioning and holding to account of all stakeholders involved through evidenced outcomes. This draws on evidence from the special issue and Capability Theory which allies competency with personhood to create capability through agency. The process to make this change requires: (1) government intervention, to ensure that the lowest common denominator is zero-carbon best practice within a negotiated, holistic approach to developing the built environment sustainably; (2) new ethical, interdisciplinary and collective educational working practices underpinned by new pedagogical theory and accreditation processes; and (3) rapid auditing and upskilling in climate literacy to bring pressure to bear on governments and institutions to carry out reforms.

**Keywords:** accreditation; built environment; capability; climate change; education; practices; policy; reform; sustainability; training; zero carbon

## 1. Introduction

Reducing carbon emissions from buildings is a key part of the response to the climate emergency (BEIS 2017; European Commission 2019; IEA 2019). There is an urgent need to achieve net-zero operational carbon emissions in this sector in the next decade and overall net-zero carbon emissions by 2050, according to the World Green Building Council.[1]

What does this mean for organisations and the workforce responsible for creating, operating and maintaining a sustainable and healthy built environment? They need to have the capacities, capabilities (knowledge and skills) and competencies to rapidly decarbonise built environments and reduce environmental degradation for both new construction and the existing building stock. However, this workforce[2] currently lacks the appropriate low-carbon and knowledge skills at national and global levels. This has immediate and long-term negative consequences due to the longevity of buildings, infrastructures and cities. The decisions and designs made today will continue to impact for 60 and more years. A rapid transition is therefore needed in universities and training colleges in the scope and nature of the knowledge and skills that are provided to students and existing professionals/workers.

Many of the traditional organisations and journals that support architectural education, for example, are curiously bereft of an effective focus on the climate crisis. A scan of the Association for Architectural Educators in the UK revealed that none of its conferences had focused on this issue since its formation in 2013. Equally, the media promoted in architectural education (and admired by students) still valorises unsustainable architecture that is clearly not demonstrating an emphasis on low-carbon design. While there is evidence that professional institutions are beginning

[1] University of Sheffield, School of Architecture, Sheffield, UK. ORCID: 0000-0002-8374-9687

[2] University of Oregon, School of Architecture & Environment, Eugene, OR, US. ORCID: 0000-0001-5403-7181

Corresponding author: Fionn Stevenson (f.stevenson@sheffield.ac.uk)

to target training in zero-carbon design for their members (*e.g.* RIBA, 2020), this has yet to translate into guidance, requirements and evaluative processes for educational training before qualification.

This special issue therefore targets the need to rapidly mainstream zero-carbon[3] approaches in initial education as a crucial first step. It deliberately focuses on the foundational training given to built-environment students (and not on continuous professional development). Three key questions arise regarding this initial step:

- How can education and training be rapidly changed to ensure the creation of zero-carbon built environments?
- How can this transition be implemented successfully?
- What positive examples and models can be drawn upon or adapted?

Answers to these questions involve mainstreaming, policy and leadership, transitioning, teaching (pedagogical theory, practice and organisational structures), upskilling and certification and are addressed in this editorial and the papers that form this special issue.

The special issue grew from discussions about architectural education at the 2019 international Reynolds Symposium[4] entitled 'Education by Design', organised by the University of Oregon.[5] This led to the development of a proposal for a special issue and an open call for papers. The initial call for papers elicited 32 abstracts. A rigorous and highly selective process resulted in the nine papers published papers, as shown in **Table 1**.

The response to the call for papers had a surprising paucity of abstracts about the theoretical development of pedagogy and pedagogical frameworks. Instead, there were a high number of interesting case study 'show-and-tell' offerings of individual courses, but without much reflective critique or strong evidence. This suggests further development will be needed in critical and rigorous analysis, in pedagogical theory and the evidence base within built-environment education programmes. There was also little representation of work being undertaking in the Global South and other parts of Europe and Asia. As a result, most of the published papers come from the US or UK, which must also be seen as a limitation. A large number of the abstract proposals engaged with teaching methods, policy and leadership, upskilling and certification, but very few addressed the issue of mainstreaming and rapid transitioning towards zero-carbon education. This reflects the greater challenge of the latter issues and the more instrumental nature of the former.

Many potential authors challenged our narrow, targeted focus on zero carbon and preferred to operate within the broader terms of sustainable development, which is also reflected in some of the papers in this special issue. Clearly a debate is needed within academe about the distinctions between these stances and how change can occur effectively and quickly. However, given the obvious lack of progress in embedding and *evidencing* effective zero-carbon strategies and outcomes within sustainable design and construction teaching and learning, the guest editors believe these strategies and their outcomes need greater prioritisation.

**Table 2** identifies key themes that emerge from the papers in this special issue in relation to five key areas of concern. This editorial considers each theme and ends with a section outlining a vision for change.

**Table 1:** Articles in this special issue 'Education and Training: Mainstreaming Zero Carbon', *Buildings & Cities* (2020), 1(1); guest editors Alison Kwok and Fionn Stevenson.

| Authors | Title | DOI |
|---|---|---|
| F. Stevenson & A. Kwok | Mainstreaming zero carbon: lessons for built-environment education and training (Editorial) | 10.5334/bc.84 |
| S. D. Green & N. Sergeeva | The contested privileging of zero carbon: plausibility, persuasiveness and professionalism | 10.5334/bc.49 |
| U. Passe | A design workflow for integrating performance into architectural education | 10.5334/bc.48 |
| M. Srivastava | Cooperative learning in design studios: a pedagogy for net-positive performance | 10.5334/bc.45 |
| E. J. Grant | Mainstreaming environmental education for architects: the need for basis literacies | 10.5334/bc.41 |
| R. Afroz | Developing a low-carbon architecture pedagogy in Bangladesh | 10.5334/bc.54 |
| M. Mayer | Material recovery certification for construction workers | 10.5334/bc.58 |
| G. Killip | A reform agenda for UK construction education and practice | 10.5334/bc.43 |
| L. Clarke, M. Sahin-Dikmen & C. Winch | Transforming vocational education and training for nearly zero-energy building | 10.5334/bc.56 |
| K. Simpson, K. B. Janda & A. Owen | Preparing 'middle actors' to deliver zero-carbon building transitions | 10.5334/bc.53 |

**Table 2:** Key themes of the articles in this special issue 'Education and Training: Mainstreaming Zero Carbon'.

| Authors | Theme | Interdis-ciplinary | Pedagogical theory | Training and practice | Ethics | Policy and standards | Leadership |
|---|---|---|---|---|---|---|---|
| F. Stevenson & A. Kwok (Editorial) | Overview of the special issue | ■ | ■ | ■ | ■ | ■ | All stakeholders listed below |
| S. D. Green & N. Sergeeva | Narrative turn | ■ | ■ | ■ | ■ | | RIBA[a], ARB[b], NAAB[c] and other professional institutions |
| U. Passe | Thinking and design process | | ■ | | | | Programme leaders |
| M. Srivastava | Cooperative learning | | ■ | | | | Programme leaders |
| E. J. Grant | Alumni perceptions and needs | ■ | | | | ■ | Universities and programme leaders |
| M. Mayer | Reuse and regulatory standards | ■ | | ■ | | ■ | Regulatory bodies and training organisations |
| R. Afroz | Educational standards in Bangladesh | | | | | ■ | Professional Institutions, universities and programme leaders |
| G. Killip | VET policy | ■ | ■ | ■ | ■ | ■ | Industry and government |
| L. Clarke, M. Sahin-Dikmen & C. Winch | VET policy | ■ | ■ | | ■ | ■ | Industry and government |
| K. Simpson, K. B. Janda & A. Owen | 'Middle-out'—agency of educators | ■ | | ■ | | | Universities and industry, programme leaders |

*Notes*: [a] The Royal Institute of British Architects (RIBA) validates educational programmes in the UK and internationally related to architecture. Retrieved October 9, 2020, from https://www.architecture.com/knowledge-and-resources/resources-landing-page/validation-procedures-and-criteria.

[b] The Architects Registration Board (ARB) is a UK government-regulated body that oversees the performance of architects and validation of educational programmes in the UK. Retrieved October 9, 2020, from https://arb.org.uk/information-for-schools-of-architecture/.

[c] The National Architectural Accreditation Board (NAAB) is an agency that validates educational programmes in the United States.
VET, vocational education and training.

## 2. Pedagogy, methods and theory

The notion of zero-carbon design is often tacitly subsumed within sustainable design education, with broader criteria applied and resistance to making mandatory any numerical targets that 'reduce' the 'difficult whole' (Schon 1983) of architecture and its construction. However, carbon literacy amongst students is a problem. There is insufficient teaching on how to undertake evidenced-based feedback exercises in relation to students' own proposals (Stevenson 2019). Addressing this also immediately raises the wider question: Should educators prioritise energy-related zero-carbon design targets within wider sustainability issues as set out in the United Nations' Sustainable Development Goals (SDGs)?

*Green and Sergeeva* point out the danger of prioritising zero-carbon targets without considering other issues, which can lead to unintended consequences. They frame pedagogy within contesting narratives, seeing it as inextricably intertwined with issues of professional identity. They contend that design is an inherently social process (involving many actors, not just designers) and zero-carbon targets must therefore be accommodated alongside multiple other priorities. In their view, a radical shift in the nature of educational provision may prove to be counter-productive. Instead, they argue instead that professionals (and, by implication, educators) should continuously hold themselves and others to account on the basis of the plausibility of their zero-carbon narratives.

This leads to deeper questions about professional identity for both the professions and their regulators. What exactly is meant by a 'designer' given that consequential building performance and whole-life-cycle issues are now being included in the responsibilities for designers? How does this change their identity, role and professional requirements? Given the

urgent need for education in interdisciplinary teamworking within educational institutions, should we be developing 'architects' or 'archineers' (a combined role of architects and engineers)? An 'archineer' is a 'T-shaped' professional. The vertical bar of the 'T' demonstrates expert knowledge and experience in a particular area, while the horizontal bar refers to an ability to collaborate with experts in other disciplines and to have a willingness to use the knowledge gained from this collaboration. An 'archineer' is also capable of embracing numeracy as well as aesthetics, and can converse with engineers as well as architects in their own language. Who should provide the skillsets for such interdisciplinary working and how can we ensure that these skills are subsequently used? These questions are addressed below.

*Passe* offers an innovative and intensive postgraduate studio-based structured 10-step workflow to help accelerate students in designing carbon-neutral spaces within buildings, integrating and predicting the dynamic performances of light, sun, heat and air movement within a holistic understanding of architecture based on evidence. This ensures that alumni

> know enough to have a conversation with the engineers, and understand metrics and data, and be familiar with the main tools

even if 'most of the deep performance modelling is done by the engineers'. Passe's method can be readily deployed within existing educational frameworks, providing the architectural tutor uses their agency to do this, guided by their own personal values and narrative.

Another key barrier to prioritising zero-carbon design lies in the fixed mental models that educators carry within their practice. Educational design studios often engage in 'single-loop learning', which simply passes on accepted knowledge (Nicolaides & McCallum 2013). This approach is problematic because the existing sustainable design assumptions that bind the decision-making are not questioned. The information and feedback in this approach are often given within parameters that are not appropriate for zero-carbon design, *e.g.* using outdated insulation levels and omitting thermal bridging considerations. 'Double-loop' learning strategies challenge students and tutors by deliberately questioning assumptions and reframing problems. This can facilitate a rapid transition to zero-carbon design by encouraging educators to break free from outmoded assumptions about targets and standards and to engage with future-orientated practice.

*Srivastava* uses a 'double-loop' pedagogical approach in an iterative cooperative work structure for students to test and learn through. Ownership of work is grouped together through iterative group discussions in the design studio. This is based on thematic commonalities and reassigned ownership, where ownership is allocated by interest and available skills rather than by authorship. This strategy can be particularly effective for introducing students to shared ownership of ideas, teamworking and cognitive diversity through critical reflection. It also offers educators a means of questioning their own design assumptions and mental models. The suitably ambitious aim is to produce net-positive buildings through new knowledge generated in a short space of time.

*Clarke et al.* and *Killip* introduce the notion of '*savoir être*'. This term relates fundamentally to developing an appropriate value-based attitude or a moral dimension to personal capability. Killip describes this as 'moral character', which includes the development of responsibility, integrity and agency. Killip successfully argues that competence depends on the combination of knowledge, skill and character. The combination of developing attitudes related to given standards is a powerful means of creating an appropriate set of professional ethics to guide zero-carbon pedagogy. Clarke *et al.* show that vocational training is ahead of architecture training in this respect. This emphasis on moral character also addresses *Green & Sergeeva's* (499) call for personal commitment:

> University educators could do much more to encourage students to embrace the quest for zero carbon as an essential part of their identity, and to encourage them to project this identity by continuously challenging the status quo.

## 3. Policy, practice and standards

### *3.1 Context*

The revised 2020 Conditions[6] and Procedures[7] for Accreditation approved by the US National Architectural Accrediting Board (NAAB) state that educational programmes must address the shared values of the profession, including environmental stewardship. Currently, however, each programme still defines its own level of 'understanding' and 'ability'. The American Institute of Architects (AIA) Committee on the Environment (COTE) had previously submitted a five-page document to the NAAB outlining a series of recommendations and evidence for strengthening and mainstreaming climate action and implementing a zero-carbon pedagogy. This included inserting a new criterion for accreditation:

> Climate Action—The Programme must demonstrate how the curriculum prepares all students to apply climate action goals of decarbonization and adaptation with an understanding of the performance outcomes of integrated design solutions.

The NAAB did not approve such specific recommendations. Instead, individual institutions are only required to show how their programme might achieve and evaluate the broader programme criteria of 'Ecological Knowledge and Responsibility' using a self-assessment of their own learning outcomes. The terms 'energy' or 'carbon' do not even appear in the NAAB's document, though the general phrase 'enabling future architects to mitigate climate change responsibly' is mentioned as part of the ecological criteria. US schools of architecture thus continue to define 'understanding' and 'ability' without any reference to a higher standard of demonstrable competency related to energy use or carbon literacy.

Equally, the UK's Royal Institute of British Architects (RIBA) professional validation criteria[8] for architectural programmes currently only require graduates to evidence 'understanding' and 'knowledge' of sustainable design and its consequences. There is no requirement for specific 'skills' and competencies to meet particular standards related to a principle. In response, 1500 students, practitioners and educators sent a letter to RIBA and the Architecture Registration Board in 2019, titled 'A Call for Curriculum Change', advocating for an education that:

> inherently provides an ecological and political basis to meet the uncertain future with socially and environmentally informed practice.[9]

The proposed 2020 'Themes and Values' educational framework for undergraduate programmes being developed by RIBA (2020: 6) to replace the current validation criteria only:

> *places attention* upon those curricular areas which *contribute to* the RIBA's concept of Mandatory Competences for addressing climate change. (added emphases)

No mandatory demonstration of evidenced skills or capabilities is a required at this stage. The careful wording leaves the demonstration of these to industry to deliver. This approach is likely to simply reproduce the current problem with climate literacy in architectural education.

### 3.2 Evidence from research

*Grant* considers alumni's perceptions of their engagement with environmental sustainability in the US. Their feedback on their education, whilst studying architecture at Virginia Tech School of Architecture + Design, provides useful insights into whether and how a curriculum enables readiness for sustainable design practice. *Grant* found that while many graduates felt a sense of obligation to protect the natural environment through their design efforts, they lacked the tangible means to achieve this goal in the design of buildings, and particularly in the reuse of buildings. The use of alumni feedback provides strong evidence of readiness, and this should be gathered regularly by more built-environment departments. Although *Grant's* research is focused on one course at one university, it could be representative of many built environment departments. A major concern is that current educational policy and standards are not providing young architects entering the workforce with sufficient knowledge and competencies.

*Afroz* explains the educational situation in Bangladesh. This country is one of the top 10 nations most vulnerable to climate change. Although mitigation and low-carbon development policies are part of Bangladesh's national agenda, this has not been incorporated into the educational or professional requirements for architects to deliver mitigation or adaptation. Low-carbon design and sustainability issues in the curricula of the five different schools of architecture examined are still in the initial phases of development. There is a lack of awareness, inadequate education and training, and a lack of alignment between curricula orientation and the national agenda. Fewer than half of the responding architects and educators felt that competence in sustainable low-carbon design should be a requirement for professional membership, which is particularly worrying. *Afroz* suggests a set of scalable solutions and recommendations for education and training for architectural students.

*Mayer* demonstrates the importance of reducing future carbon emissions through the reuse, remanufacture or recycling of embodied energy-intensive components at the end-of-life phase, and how this is often overlooked, with inadequate standards and associated training in place to cater for this process. He argues that an appropriate combined certification and training programme is needed to ensure that all building professionals are well positioned to supply products and design and construct buildings that could be reused or recycled. The development of a bespoke product certification is then demonstrated, using a two-tier framework that focuses on the recovery of building products, alongside a parallel certification system for professionals. A rating system is used to establish recovery potential, using a series of evaluation criteria related to the materials themselves and their assembly into products. Such a rating system could also help to establish these considerations earlier on within educational programmes, provided that professional validation criteria take note of this important aspect of the building life-cycle.

Policy levers and incentives for upskilling and transitioning built-environment education can be enacted at many different levels through codes and regulations, licensing, accreditation for programmes, professional organisations, and curricular innovation around climate change mitigation, sustainability and environmental responsibility. Killip evaluates the cognitive, practical and civic dimensions of learning in the construction industry. Vocational competence is defined as theoretical knowledge, practical skill and, importantly, integrity of character as an ethical dimension.

A new combined hierarchy of these learning attributes is offered through a new learning framework. *Killip* argues that the UK industry is comparatively weak in skills development, with a narrow focus on the built product rather than a competent workforce, and with no financial reward for adequate training. Thus, half the UK construction labour force has the lowest level of training (National Vocational Qualification (NVQ) level 2) or no training at all. For any educational policy reform to work, *Killip* shows that it needs to be accompanied by government intervention and structural reforms in industry, *e.g.* introducing a licence to trade to address market failure, and increasing applied research capability to provide the necessary feedback mechanisms which ensure quality.

*Clarke et al.* examine these learning processes and attributes in more detail in different construction apprenticeship training schemes operating currently in six European countries. They conclude that only the policy in Belgium effectively mainstreams the knowledge, skills and competences required into formal initial vocational education and training (IVET) curricula. This standards-based approach successfully embeds low-energy construction elements, seeks to overcome occupational boundaries, and develops a holistic and ethical understanding of the construction process. *Clarke et al.* show that an approach to vocational education and training (VET) based only on learning outcomes and targeting specific skills is too narrow and lacking in depth to allow for the systematic application of theoretical low-energy construction knowledge to practice. This research challenges the whole notion of 'learning outcomes' as a policy aspect of pedagogy that is inherently divorced from particular content and standards.

*Simpson et al.* use Janda's 'Middle-out theory' to show that building professionals are important 'middle actors' within a community of practice who can either enable or inhibit the transition to zero-carbon buildings. Professionals are not perfectly responsive to policy push or market pull, but exert their own agency and influence downstream to customers and clients, sideways to other middle actors and, occasionally, upstream to policy-makers. Thus, a sideways collaboration between academia, vocational training and industry could better enable delivery of zero-carbon buildings. Middle-actor groups can share training routes, knowledge-support systems and professional networks to facilitate change from the 'middle out' in a way complementary to top-down change driven by policy and bottom-up changes led by citizens and educators. Interestingly, Simpson *et al.* see vocational professionals as the priority group of middle actors to build capacity, knowledge and influence.

## 4. An agenda for change

### *4.1 What positive examples and models can be drawn upon or adapted?*

Sen's (1993: 30) capabilities represent the 'actual ability to achieve various valuable functions through the act of living'. According to Sen, the 'capability' of a student depends on many factors, including how they live their lives and their personal characteristics (*cf. Green and Sergeeva's* discussion about professional identity). Capability thus depends not only on a given set of 'functions' that students learn, but also on their 'agency' to freely and personally choose between those functions in order to promote the wellbeing of self and others. This differentiates value-driven and lived 'capability' from the purely functional and utilitarian notion of 'competencies' and 'skills' currently embodied in the learning outcomes of built-environment curricula described above, but—critically—split off from personhood.

'Skills' in built-environment education traditionally relates to the ability to design and construct in response to structural and construction integrity, resource use, cost, and human needs (including aesthetics) as a task. However, as emphasised by several authors in this special issue, this ability also needs to be embodied within the student as an act of lived values. 'Skills' are currently 'acquired' as entities that are inherently external to the student's original ethical value system, but this is insufficient. There is an urgent need to align skills with values, ethics and standards within educational programmes. This will help to deliver model student learning that is accountable in terms of sustainable design criteria and standards and allied with student personhood (*cf. Killip's* argument about *savoir être*).

Students often perceive teachers in architecture to be individuals first, rather than part of an interdisciplinary programme team. This is reinforced by professional validation criteria that insist on the individual person being accredited, rather than a student design team working with a team of tutors. Without interdisciplinary teamwork to inform individual ability and values, architecture students, for example, lose out on the essential technology and engineering aspects of zero-carbon design that can deliver evidenced-based performance. Teamworking is also essential for learning the social aspects of interaction with colleagues: drawing out, sharing and challenging knowledge across disciplines. Teachers can lead change here by redesigning their teaching methods to ensure that zero-carbon technology and engineering is integral and not treated as a 'bolt-on'. Both papers by Passe and Srivastava offer clear ways to do this.

Holgate & Jones (2019: 134) further suggest that:

> staff/student collaboration towards co-creation of inquiry-led projects encourages reflective practice and avoids uncritical connoisseurship.

They argue that:

> Real-world professional practices, social skills and ethical judgements can be addressed within the scaffolded environment of the (educational) institution, supported through contact with other stakeholders, contexts and processes that lie beyond the institution.

This can typically be done through interdisciplinary zero-carbon 'Live Projects' as a norm, where professional practice as enquiry can help to overcome the traditional division between research, teaching, practice and service.

### 4.2 How can this transition be implemented successfully?

Given the urgency and high levels of risk arising from the climate crisis, the collective need to have widespread graduate and vocational capabilities warrants top-down pressure on education and training programmes. Policy change from accrediting bodies can play a significant and central role in the effort to mitigate change by ensuring the workforce is fit for purpose.

Institutional mandatory standards, to be demonstrated through graduate capabilities, can set the agenda and help deliver a trained workforce that can genuinely and meaningfully design and construct zero-carbon buildings. These standards need to include the wider impact of the embodied carbon of buildings, recognising that designers today are required to deliver zero-carbon systems and services as well as zero-carbon buildings within a sustainable approach overall. Ultimately, all such standards and targets must also relate to the wider need for humanity to operate within identified overall planetary limits, related to place, biotope, resources, energy and health.[10]

Although some pioneering programmes promote evidence-based zero-carbon design, as demonstrated by the papers published in this special issue, these tend to remain niche endeavours that are not necessarily translating as role models for mainstream programmes. Making the transition from broader sustainable design considerations to proven zero-carbon design requires moving on rapidly from the 'easy wins' (*e.g.* developing student and programme manifestos, applying environmental simulation to design work, using case study analysis, organising relevant field trips, and working at the building level only). Greater challenges now lie in embedding ethical practice, stewardship and environmental responsibility to drive forward the transition at scale. This entails a commitment to using design feedback from reality (via the teaching of post-occupancy evaluation (POE) to validate design propositions), improving communication and collaboration with inhabitants and other building users, using a holistic approach to incorporate sustainable design and zero-carbon principles throughout the design and construction life-cycle, and using local (neighbourhood) social and physical resources to generate net-zero-carbon neighbourhoods. These challenges require a further commitment to interdisciplinary collaboration in education between the many built-environment disciplines, and real clients and users in live projects, working at all scales. Success in these endeavours again needs to be measured based on demonstrable outcomes related to appropriate standards. Nothing less will do.

In the UK, for example, a comparison of policy statements from different institutions is telling in terms of such commitment. RIBA's (2019a) *Code of Conduct* principle 13.1 states that:

> Members should consider the environmental impact of their professional activities, including the impact of each project on the natural environment.

By contrast the Institute of Chartered Engineers Code of Professional Conduct states under Rule 4 that:

> In all the work that members do, they must be able to demonstrate, by an appropriate audit trail, that they have taken all reasonable steps to take account of all the relevant factors in relation to the impact upon the environment and the sustainable management of natural resources.

This is a far more powerful ethical statement that binds it members to demonstrate their actions through a consideration of all relevant factors and their accountability through auditing.

The RIBA Ethics and Sustainable Development Commission's key findings and recommendations (RIBA 2018) included three recommendations that are particularly pertinent to mainstreaming zero-carbon design through education using Sen's capability approach:

- 5.1 Address the knowledge and engagement gap in respect of ethics and sustainable development and ensure that everyone entering the profession has adequate knowledge and understanding of ethics and sustainable development.
- 5.2 Ensure that all teaching staff in validated schools of architecture have appropriate knowledge of ethics and sustainable development.
- 5.3 Ensure that the Institute has appropriate systems in place, through validation and CPD [continuing professional development], to confirm that new entrants to and existing members of the profession have appropriate, up-to-date knowledge of ethics and sustainable development.

These recommendations now need to be auditable through, and underpinned by, clearly defined standards such as in RIBA's (2019b) *Sustainable Outcomes Guide*, while at the same time ensuring that any revised validation criteria and learning outcomes are directly linked to these standards, as demanded by *Clarke et al.* for all relevant learning outcomes.

Other countries will, of course, have different governance structures and distributions of responsibilities, oversight and enforcement. The principles and actions described above can be mapped and translated to apply in different circumstances.

### 4.3 How can education and training be rapidly changed to ensure the creation of zero-carbon built environments?

The key to delivering a pedagogical 'turn' towards zero-carbon design as a normative value in built-environment programmes is through changing values and attitudes which in turn generate new practices. *Green and Sergeeva's* notion of the Narrative Turn demands that professionals and, by inference, educators, continually question the legitimacy of their knowledge and understanding as framed by the interpretation of their experience, in relation to the views and experiences of others. They thus suggest that effective *visioning* of sustainable development as a social practice is a more powerful method for change than simply acquiring more and more 'objective' knowledge. As such, they send a powerful challenge to the existing beliefs of a large contingent of building science educators. To embrace this visioning and questioning, the aims and objectives of pedagogical activities must be expanded beyond the basic goals of improving knowledge, understanding and competencies. This will deliver built-environment graduates capable of addressing the current climate change crisis.

At the same time, in order to leverage rapid upskilling and change, there needs to be an honest and urgent skills audit within all built-environment teaching programmes to understand what capabilities exist in relation to teaching evidence-based zero-carbon design targets and to address any deficits. Such skills can then be matched between teaching staff and, where necessary, additional training brought in to rapidly upskill existing staff in this area. Students and practitioners are already engaged in developing rapid auditing and change through extramural curricula such as the 'Architectural Anthropocene' School and various climate emergency committees in the UK, US and elsewhere.

The upskilling of educators in academe is challenging, however, as they are not required by their educational institutions to undertake this kind of continuing professional development (CPD) and time may not be provided as such. Previous efforts to initiate training for architectural educators such as the UK's 'Design on the Planet' initiative (Stevenson *et al.* 2009) and the European Union's EDUCATE project (Altomonte 2012) have failed to deliver adequate zero-carbon design competencies in educators to date. Several communities of practice are attempting to do this, however. The US Society of Building Science Educators (SBSE) and the UK's Architects Climate Action Network (ACAN) are clearly active in creating, sharing and promoting knowledge of zero-carbon buildings and associated educational issues. Other organisations (*e.g.* the UK's Standing Conference of Heads of Schools of Architecture (SCHOSA) and the Association of Architectural Educators (AAE)) have not yet been actively promoting the zero-carbon agenda. To date, however, all these organisations have had little influence on institutional policy and standards.

To ensure a consistent transition, professional institutions need to mandate zero-carbon design CPD and proven competencies for educators as part of their validation procedures. External validation panels should check that those engaged on the validated programme are suitably qualified to teach zero-carbon design. The new demand for greater resilience in teaching as a result of the latest virus crisis (Covid-19) offers an excellent opportunity to take advantage of rapid online educator learning at scale, which can be delivered much more quickly and effectively than face-to-face physical CPD sessions.

New forms of collaboration are also needed between academe and industry to accelerate the creation of zero-carbon capabilities. For example, 'T-shaped' expert practitioners can be deeply embedded within educational programmes in order to objectively ensure that the new criteria and targets are being delivered. At the same time, national industry organisations dedicated to delivering a zero-carbon built environment, such as the Green Building Councils, have a role to play in promoting zero-carbon education as part of their agenda. Firms developing carbon tools should be encouraged to share these freely with educators and educational institutions.

### 4.4 A holistic vision of education incorporating meaningful standards and targets

Given the narrative challenge presented by Green and Sergeeva, it is vital for educators to have a strong holistic vision as part of their pedagogy within which to consider the position of zero carbon in relation to other competing priorities for sustainability.

Nevertheless, zero-carbon principles and targets need to be continuously engaged with at every stage of the student journey, from the setting out of initial project requirements to the final assessment needed to demonstrate whether or not their work and outputs can deliver zero-carbon performance in reality. This also depends on a student's moral character and capability of understanding responsibilities within an organisation and the wider responsibilities to society.

One radical proposition is to create a completely new interdisciplinary educational framework. This vision is articulated and promoted by Ursula Von Der Leyden, President of the European Union, in her State of the Union Address on 16 September 2020:[11]

> I want 'Next Generation EU' to kickstart a European renovation wave and make our Union a leader in the circular economy. But this is not just an environmental or economic project: it needs to be a new cultural project for Europe. […] This is why we will set up a new European Bauhaus—a co-creation space where architects, artists, students, engineers, designers work together to make that happen.

At the heart of Von Der Leyden's holistic vision lies a dedication to meeting new EU energy standards, which in turn can help deliver zero-carbon buildings considered within a sustainable approach. The cultural change in education needed to meet this challenge is huge, but necessary. It requires international and national cooperation through focused

discussion across relevant institutions on how to deliver this vision. There is also an urgent need to acknowledge the range of deficiencies in built-environment education. Educators must move on from unevidenced 'holistic' and 'sustainable' design and attend to the clear and present need to be able to educate students on how to deliver articulated design and construction standards related to meaningful and relevant energy and carbon targets, drawing on good examples of leading-edge pedagogy.

### *4.5 Key recommendations*

To respond to the urgency of meeting the United Nations' 2015 Paris Agreement's commitment to contain global warming to <2°C, the decarbonisation of the built environment must be accelerated. This means the built-environment workforce (both vocational and professional) needs to have additional capabilities. To achieve this, a strategic and rapid transition of built-environment education is required to meet zero-carbon targets within a broader context of sustainability. In light of the findings in this special issue and the guest authors' own research and experience, the following essential actions are urged:

- Government needs to intervene and reform industry, education and institutional practice at a structural level with policies to ensure that zero-carbon best practice is set as the minimum standard within a negotiated and holistic approach to developing the built environment sustainably.
- Built-environment institutions need to rapidly change their accreditation and validation requirements to ensure that educators, trainers and students demonstrate the specific and proven capability to deliver zero-carbon buildings within a negotiated sustainability narrative, including personal values and planetary limits.
- Educators need to embrace new ethical, interdisciplinary and collective working practices to create education and training that specifically evidences student capabilities to deliver zero-carbon work and outputs within a wider programme that meets these new institutional requirements. New pedagogical theory is also needed to address this.
- Students, non-governmental organizations (NGOs) and industry practitioners need to collaborate with educators to audit and deliver rapid upskilling in carbon literacy. If necessary, this can occur outside of institutions and educational establishments as well as within them. Their voices can also be used to apply pressure on governments and institutions to reform their educational and training policies.

## Notes

[1] See https://worldgbc.org/thecommitment?mc_cid=567bfa1534&mc_eid=%5bUNIQID%5d&mc_cid=567bfa1534&mc_eid=c8b642f8ef/.
[2] Professionals, vocational workers and technologists tasked with creating, operating and maintaining the built environment, as well as retrofitting existing building stocks.
[3] The term 'zero carbon' is used here to acknowledge a radical reduction in embodied and operational carbon. There are a variety of terms and different approaches: net zero, carbon positive, *etc.*, but the focus of this special issue is on creating capabilities and capacity. The determination of appropriate metrics and targets is the focus of another *Buildings & Cities* special issue: 'Carbon Metrics for Buildings and Cities: Assessing and Controlling GHGs across Scales' (https://www.buildingsandcities.org/journal-content/special-issues/carbon-metrics.html).
[4] See https://reynoldssymposium.uoregon.edu/.
[5] One of the co-editors of this special issue, Alison Kwok, was a key organiser of this event.
[6] See https://www.naab.org/wp-content/uploads/2020-NAAB-Conditions-for-Accreditation.pdf (accessed October 9, 2020).
[7] See https://www.naab.org/wp-content/uploads/2020-NAAB-Procedures-for-Accreditation.pdf (accessed October 9, 2020).
[8] See https://www.architecture.com/-/media/gathercontent/validation-procedures-and-criteria/additional-documents/validationprocedures2011secondrevision2may2014pdf.pdf (accessed October 9, 2020).
[9] See https://www.architectureeducationdeclares.com/.
[10] Based on a personal communication with Sandy Halliday, 23 October 2020, while discussing educational reform with Bill Bordass, Fionn Stevenson and Richard Aitkins.
[11] See https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_20_1655 (accessed October 9, 2020).

## Acknowledgements

The authors gratefully acknowledge the generous editorial assistance provided by Richard Lorch.

## Competing interests

The authors have no competing interests to declare.

## References

**Altomonte, S.** (Ed.). (2012). *Sustainable architectural education: White Paper*. EDUCATE. Retrieved October 16, 2020, from https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/educate_sustainable_architectural_education_en.pdf

**BEIS.** (2017). *The clean growth strategy: Leading the way to a low carbon future*. Retrieved June 2020 from https://www.gov.uk/government/publications/clean-growth-strategy

**European Commission.** (2019). Commission recommendation (EU) 2019/786 of 8 May 2019 on building renovation. *Official Journal of the European Union*, L 127/34. Retrieved June 2020 from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX%3A32019H0786&from=EN

**Holgate, P.,** & **Jones, P.** (2019). Embedding professionalism in architectural education: Inquiry, reflection and judgement throughout professional development. In A. Jones & R. Hyde (Eds.), *Defining contemporary professionalism: For architects in practice and education* (pp. 132–135). The Royal Institute of British Architects (RIBA) Publ. DOI: https://doi.org/10.4324/9780429347856-34

**IEA.** (2019). 2019 Global status report for buildings and construction. *United Nations Environment Programme*. Retrieved June 2020 from www.iea.org

**Nicolaides, A.,** & **McCallum, D. C.** (2013). Inquiry in action for leadership in turbulent times: Exploring the connections between transformative learning and adaptive leadership. *Journal of Transformative Education*, 11 (4). 246–260. DOI: https://doi.org/10.1177/1541344614540333

**RIBA.** (2018). *RIBA Ethics and Sustainable Development Commission: Key findings and recommendations*. The Royal Institute of British Architects (RIBA). Retrieved October 28, 2020, from https://www.architecture.com/-/media/GatherContent/Work-with-Us/Additional-Documents/EthicsandSustainableDevelopmentCommissionkeyfindingsandrecommendationspdf.pdf.

**RIBA.** (2019a). *Code of conduct*. The Royal Institute of British Architects (RIBA). Retrieved October 16, 2020, from https://www.architecture.com/-/media/GatherContent/Test-resources-page/Additional-Documents/RIBA-Code-of-Professional-Conduct--May-2019pdf.pdf

**RIBA.** (2019b). *Sustainability outcomes guide*. The Royal Institute of British Architects (RIBA).

**RIBA.** (2020). *The way ahead: An introduction to the new RIBA Education and Professional Development Framework and an overview of its key components*. The Royal Institute of British Architects (RIBA). Retrieved October 9, 2020, from https://www.architecture.com/-/media/GatherContent/Social-Value-Toolkit-for-Architecture/Additional-Documents/The-Way-Ahead-brochure-4-Sep-20.pdf

**Schon, D. A.** (1983). *The reflective practitioner: How professionals think in action*. Maurice Temple Smith.

**Sen, A.** (1993). Capability and wellbeing. In A. Sen & M. Nussbaum (Eds.), *The quality of life* (pp. 30–53). Oxford University Press. DOI: https://doi.org/10.1093/0198287976.003.0003

**Stevenson, F.** (2019). *Housing fit for purpose: Performance, feedback and learning*. The Royal Institute of British Architects (RIBA) Publishing. DOI: https://doi.org/10.4324/9780429347870

**Stevenson, F., Roberts, A.,** and **Altomonte, S.** (2009). Designs on the planet: A workshop series on architectural education and the challenges of climate change. In *Proceedings of the 26th International Conference on Passive and Low Energy Architecture*, Quebec, Canada, 22–24 June (pp. 228–233). Presses de l'Universite Laval.

**How to cite this article:** Stevenson, F., & Kwok, A. (2020). Mainstreaming zero carbon: lessons for built-environment education and training. *Buildings and Cities*, 1(1), pp. 687–696. DOI: https://doi.org/10.5334/bc.84

**Submitted:** 26 October 2020 **Accepted:** 26 October 2020 **Published:** 04 November 2020



]u[ *Buildings and Cities* is a peer-reviewed open access journal published by Ubiquity Press OPEN ACCESS