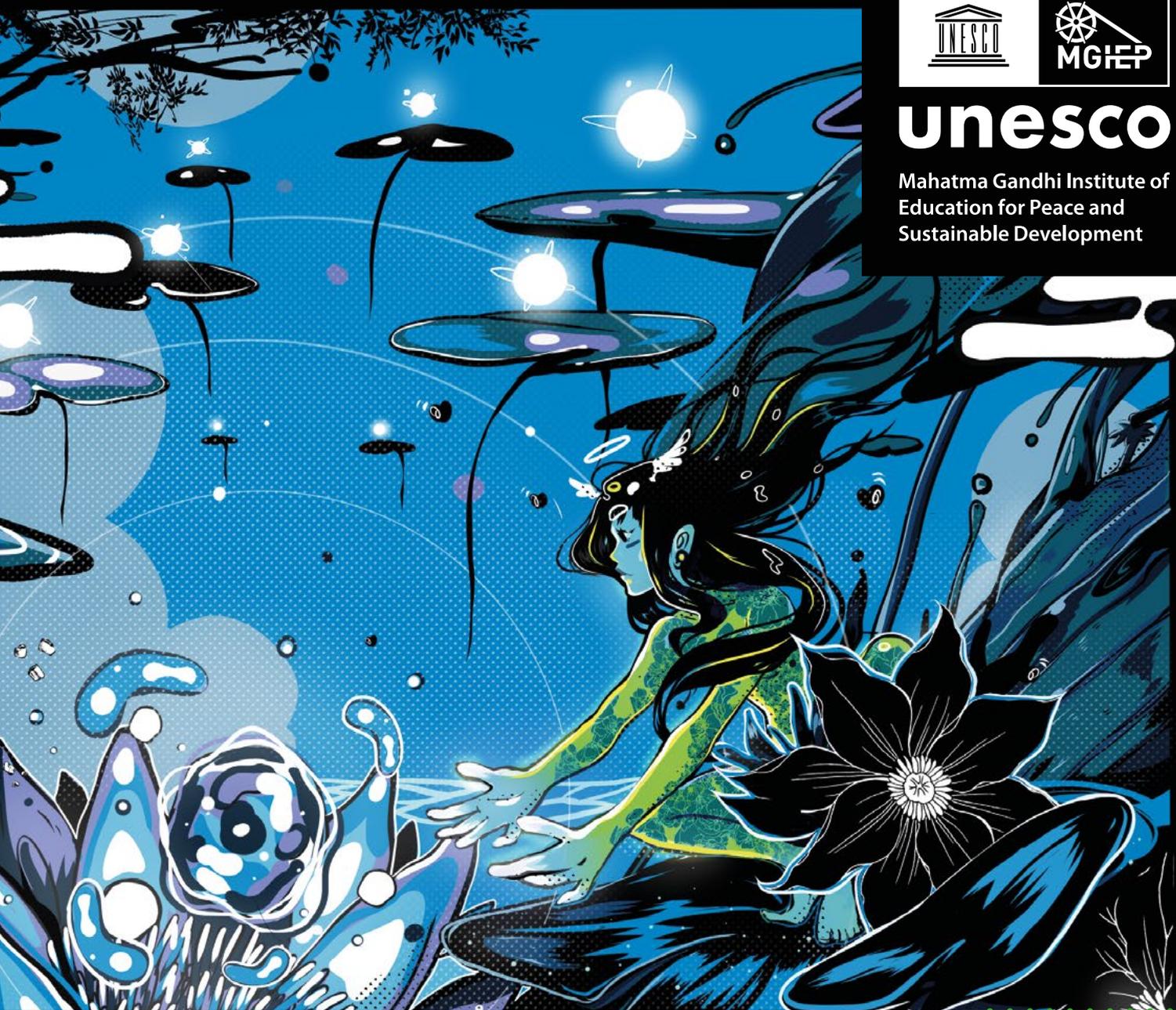




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Mahatma Gandhi Institute of
Education for Peace and
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ASSESSMENT

WORKING GROUP

03

**THE INTERNATIONAL SCIENCE AND
EVIDENCE-BASED EDUCATION ASSESSMENT**

**Education
2030** 



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THE INTERNATIONAL SCIENCE AND EVIDENCE BASED EDUCATION (ISEE) ASSESSMENT: WHY IS IT NECESSARY?

Education matters for people at all stages of life. But what is the purpose of education? This quintessential question must be asked before we can assess if our education systems are delivering on their promise. Should the goal of education be to develop human flourishing, or should it be to meet the demands of ‘homo economicus’?

The way the future evolves very much depends on education. Today’s mindsets on how we live, the economic and political systems we adopt, the formal and informal

rules and regulations – the governance – that societies adopt, the way we perceive environmental and social problems are all very much influenced by the type (or lack) of education provided by past and present generations. The speed at which the world is changing, especially driven by technological progress and in transitioning from an industrial to a knowledge society, suggests that education can never be static and that the discourse on education, as **Dewey in 1923** asserted, ‘should never come to an end’. It should be continuously evolving in response to the needs of society and the planet.

Therefore, now is the time to take stock and look ahead. A starting point is to ask two fundamental questions.

1. Are education systems serving the right purpose?



2. Are they equipped to address the pressing challenges we face today?

To answer these questions, a systematic assessment of the existing knowledge on education and learning is urgently needed. An assessment grounded in science¹ and evidence drawn from a multitude of disciplines, encompassing the entire complexity of learning and education, should consider the following:

- the goals of current education systems and their relevance to today's societal needs;
- the broad sociopolitical contexts in which education is embedded; and
- the state of the art for learning processes drawing from the sciences of learning.

While other reviews and reports have addressed pieces of this complex education ecosystem, a transdisciplinary approach drawing on science and evidence is urgently needed to understand the multifaceted complex education systems across the globe. The International Science and Evidence based Education (ISEE) Assessment is the first to use an integrated conceptual framework that requires the separate streams of knowledge to be integrated to answer the two overarching questions above.

Science and evidence are now widely accepted as a necessary condition for most policy-making. The success of the Intergovernmental Panel on Climate Change (IPCC) in influencing policy by bringing the best science and evidence to the table has been instrumental in shaping climate change policy. However, the road has not been smooth, with many

critics questioning the validity of the science and the evidence provided. The same can be said of the Millennium Ecosystem Assessment, which brought to the fore the power of multidisciplinary science and evidence in informing policy-making for the sustainable use of biodiversity and ecosystem services for the well-being of humanity.

The field of education is no different. However, unlike in the environmental field, no previous attempts have been made to undertake an integrated transdisciplinary international assessment of science and evidence in the field of education. Education policy has been widely influenced by anecdotal information and is seldom backed up by transdisciplinary consensus science and evidence. However, our knowledge of learning processes and their bidirectional relationship with their contexts is rapidly increasing due to advancements in all disciplines addressing educational issues, and particularly over the past two decades by research from the field

of mind, brain and education. But the exchange of knowledge and information across the various disciplines working on education is challenging, as is the translation of new findings from this transdisciplinary research into educational policy.

Recognizing the need for, but absence of, a transdisciplinary approach to education and the limited use of science and evidence in education policy-making further strengthens the need for the ISEE Assessment. The term 'assessment' here refers to a critical evaluation of the state of existing knowledge on education and learning by a team of independent experts drawn from a broad range of relevant disciplines and from across the world. The knowledge base is peer-reviewed scientific literature, but also includes credible grey literature. The Assessment report consists of 25 chapters, which have undergone a blind peer-review process. It assesses findings from across disciplines through deliberative discussions amongst the team of diverse

¹We define science as the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence (The Science Council, <https://sciencecouncil.org/about-science/our-definition-of-science/>).

experts throughout the project. The accompanying Summary for Decision-Makers (SDM) addresses overarching key questions and translates the answers into policy-relevant recommendations. In addition, the Assessment highlights gaps in knowledge and suggests potential future research agendas. To be clear, the ISEE Assessment is of a very different nature from international large-scale student assessments, such as the Programme for International Student Assessment (PISA). Assessments like the one we present here have proved extremely fruitful in other domains (e.g., IPCC) to synthesize information available from a wide range of disciplines. This has never before been performed for education.

THE ISEE ASSESSMENT CONCEPTUAL FRAMEWORK AND STRUCTURE

The ISEE Assessment launched in September 2019 with an expert

meeting hosted by the Chief’s Scientist Office, Quebec, Montreal and including approximately 20 scientists from around the world. Expertise was drawn from a range of education-related disciplines, such as international comparative education, human developmental and education psychology, neuroscience, cognitive science, economy and philosophy. This group gathered over three days to deliberate if an assessment of education would be beneficial, what it could contribute to education and what should be the conceptual framework. Although there were many disagreements among the experts, two common findings emerged: the need for an assessment of this nature; and the need for a transdisciplinary, multicultural and multiperspective lens to rethink the education agenda for the twenty-first century.

Developing a conceptual framework is an essential first step when undertaking an assessment of this nature. The ISEE Assessment Conceptual

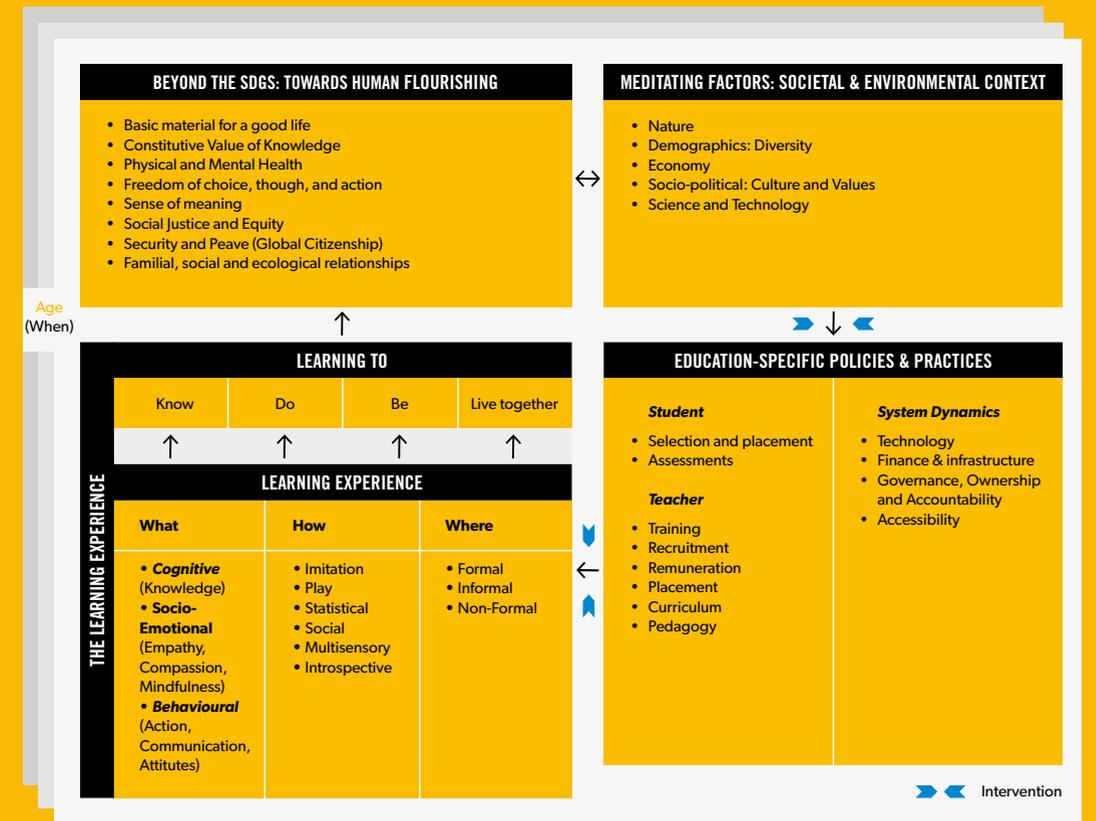


Figure 1. The ISEE Assessment Conceptual Framework of lifelong learning

Framework (CF) aims to capture the key interlinkages between critical components of the education and learning system as understood by the education community represented by the group of experts convened at the first expert workshop. The CF presented in **Figure 1** provides the basis for understanding and unpacking the complexity of the knowledge on education and learning across the world.

WORKING GROUP 1: HUMAN FLOURISHING, EDUCATION AND LEARNING

Working Group 1 on human flourishing unpacks **Box 1** and explores the interdependency between **Boxes 1 and 4** in the CF. **Chapter 1** provides an overview of the working group and the rationale for the chapters presented in the volume. **Chapter 1** also evaluates the concept of human flourishing and explores

whether a definition can be used in education systems that allows context-sensitivity but still offers a common set of parameters. A main finding is that any education system for the future must acknowledge that volatility, uncertainty, complexity and ambiguity are central characteristics of our world, and education systems must rise to meet these challenges. **Chapter 2** reports that since the Second World War, educational policy and, in particular, education's role in human development have advanced along two parallel tracks with the dominant pathway focusing on the economy, while the other track, which takes a broader humanistic view emphasizing non-economic and non-instrumental objectives for human flourishing, is relegated. **Chapter 3** presents recent advances in cognitive and affective science that demonstrate the skills associated with flourishing can be cultivated through education, in the same way as literacy and numeracy. The chapter also outlines that about 82 per cent of teachers in teacher

surveys consider there is a disproportionate focus on exams in education in contrast to the well-being of students. A similar observation emerged with 73 per cent of parents preferring to send their children to a school where they would be happy even if their exams results were not as good as those achieved in high-stress exam oriented schools. Most students (81 per cent) indicated they wanted to learn more about how to look after their mental well-being.

Chapter 4 presents some perspectives and suggestions on curriculum, assessment and teaching reforms towards an education for flourishing following six curricular domains and six learning trajectories: learning to know and think, learning to do and evaluate, learning to learn, learning to live together, learning to live with nature and learning to be and become. This chapter recommends a slight adaptation of UNESCO's four pillars of education, by introducing two additional pillars to equip education systems to better address

today's societal and environmental challenges. Chapter 5 completes the work of this working group by providing recommendations for strengthening schools towards an education for flourishing based on an assessment of existing school practices and environments.

WORKING GROUP 2: CONTEXT, EDUCATION AND LEARNING

Working Group 2 on contexts aims to understand how our social, economic and political systems influence, and are influenced by, our education systems (**the interdependent link between Box 2 and Box 3 in the CF**). Furthermore, they examine how these contextual factors relate to diverse conceptions of the purpose of education (**the interdependent link between Box 1 and Box 2**). The first four chapters look at the macro level: the social, political, economic and environmental contextual factors the group considers as having a critical influence in the design of education systems across the globe. The group looked at the political

economy of education, as well as how global social phenomena such as colonialism and more recently climate change and sustainability issues have influenced education systems. These chapters look at how equitable education systems have been over the past 50 years and develop interesting insights into how meritocracy – frequently touted today as the great equalizer – actually threatens the equity and sustainability of education systems, fuelling acute competitive intensity and narrowing the experience of learning for millions. The concept of 'hereditary meritocracy' is shown to be a rising trend among ivy league educational institutions in the United States, where the majority of the students are from the top 1 per cent of the income distribution while a minority come from households in the bottom 60 per cent. In addition, the chapter informs how socio-economic disparities affect the learning of the over one billion children who are impacted by poverty.

Chapter 2 on environmental contexts highlights the limitations of approaches to ‘education for sustainable development’, given that education remains wedded to a fundamentally human capital oriented vision looking at nature purely from an instrumentalist view rather than as an existential and intrinsic element of human flourishing. An important dimension in today’s education systems is the notion of conflict and its implications for education. **Chapter 5** reports that the psychological impact of conflict (and related, trauma and poverty) on learning is huge and that, as far as possible, education systems must recognize and accommodate these impacts when designing curriculum, assessments and teacher training. Approximately 37 per cent of primary school aged refugee children are out of school, while only 24 per cent have access to secondary education and a dismal 3 per cent to higher education. Both Chapters 5 and 8 (on curriculum) stress the role that education can and often does play in causing conflict, through fostering intolerance, xenophobia and societal division.

Chapters 6 and 7 of Working Group 2 then address the nature and extent of recent advances in neuroscience and technology as these relate to education, assessing how developments in these fields have both influenced, and been influenced by, contextual factors (political, commercial, cultural, etc). The final set of three chapters assesses how contexts have shaped, and are shaped by, key institutional features of our education systems that include curriculum and pedagogy (**Chapter 8**), assessment (**Chapter 9**) and the teaching profession (**Chapter 10**). These chapters elaborate how curriculum, assessment and teacher training is influenced by the political, social and economic climate in which education systems are embedded. Taken as a whole, the analysis presented in **Working Group 2**, while underlining the crucial importance of education in today’s world, also reminds us of education’s darker aspects (e.g. its potential to fuel conflict, as well as ameliorate it) and of its limitations as a resource for solving the world’s problems if the contextual factors are not aligned towards peace and

sustainability. A key conclusion is the need to balance hope in education’s transformative potential with awareness that fully realizing its capacity to promote human flourishing requires far-reaching changes in our political and socio-economic order.

WORKING GROUP 3: THE LEARNING EXPERIENCE

Working Group 3 on the learning experience assesses the relationship between the ‘what’, ‘how’, ‘where’ and ‘when’ of learning, and how they relate to UNESCO’s pillars of education, in light of state-of-the-art evidence from the science of learning, and studies of the socio-economic, environmental and other challenges we face today (**the interdependent links between Box 4 with Boxes 3 and 1 in the CF**). Building on the definition of education and learning as a ‘relational’ process (**Working Group 1**) and insights from brain imaging studies, the role of social and emotional Learning (SEL) is incorporated into all four aspects of learning. Chapter 4 on social and emotional foundations of learning highlights

that the learning experience at the individual level is intrinsically cognitive, emotional and social, as there is no clear dissociation between cognitive and emotional functions of the brain; rather learning occurs from the interconnectedness of neural networks across many functions. The chapter reports that although SEL improves learning outcomes by 7 to 11 per cent, it only constitutes about 7 and 4 per cent of learning in primary and secondary education respectively.

Chapter 2 on brain development and maturation highlights the non-linear nature of brain development and learning as a result of a lifelong dynamic and mutually interacting interplay between nature and nurture, contrary to the long-held belief in the competing forces between biology and culture. Although the themes of individual differences and learning differences overlap to some extent, experts from **Working Group 3** strongly felt that separate chapters on individual differences and learning differences and disabilities were needed. Therefore,



Chapter 3 provides new evidence demonstrating that individual differences in human development and learning arise from reciprocal interactions between biological, psychological and sociological factors. It calls for an integrated multidisciplinary approach to the study of human development, and its conceptualization in education. **Chapter 4** provides details of Social and Emotional Learning (SEL), what it entails and offers to the learning experience. The chapter underscores the high returns to investment in SEL and its contribution to not only academic achievement but also to social issues such as bullying, substance abuse, aggression, and depression among others. Chapter 5 emphasizes the importance of building a strong foundation of academic skills, such as literacy and numeracy, to scaffold other skills and develop flourishing. This underscores the importance of the integration of SEL with the more traditional competencies of literacy and numeracy within education systems to reach for human flourishing, which we call the ‘whole-brain approach’.

The chapter also emphasizes the importance of mother tongue instruction in the first formative years before second languages are introduced to achieve the best possible learning outcomes while highlighting the findings of the **2016 UNESCO Global Monitoring Report** that about 40 per cent of the global population does not have access to instruction in the language they understand.

Chapter 6 raises important questions relating to inclusive education versus special needs education and presents findings suggesting that care should be taken when designing inclusive education policies. Emphasizing that one in every five to ten children express some form of learning difference such as dyslexia or dyscalculia, it highlights that particular attention should be given to disabilities that are invisible but significantly affect learning. About 40 per cent of countries do not collect data on prevalence, school attendance and school completion for students with disabilities/differences, limiting informed and effective

policy-making to close gaps in access and learning under the inclusive education umbrella. The call for universal, preventive screening emerges as a clear policy recommendation, while also recognizing that careful implementation is essential. **Chapter 7** addresses ‘where we learn’ and explores how built spaces, natural spaces and digital spaces affect learning. It looks at the role of these different kinds of spaces for learning, attainment, interpersonal relationships, skills development, well-being and behaviours across UNESCO’s four pillars of learning. The chapter also explores how learning spaces can be actively shaped, felt and understood through practices and policies that occur within and around them.

WORKING GROUP 4: EDUCATION, DATA AND EVIDENCE

The ISEE Assessment was initiated with the idea of using science and evidence as its founding pillars. However, we soon noticed that the terms evidence and data

prompted a slew of questions and clarifications that we did not anticipate. Recognizing the diversity of views and perspectives of what a science and evidence-based assessment means, a small group of experts was commissioned to provide more clarity and guidance on what evidence means and how data can and should be used in education practice and policy-making. This working group’s focus is on seeking the best way to provide answers to the questions, ‘what worked’, ‘what is working best generally’ and ‘will a given intervention work here and now’. A new taxonomy of eight tiers or levels of evidence guides matching available evidence to these questions and assessing the strength of this evidence. The experts in this group provide a deeper understanding of how effect size and consistency of effect sizes influence learning outcomes, and how they can – and cannot – be used in practice and policy guidance. They also illustrate the potential of this modern approach to evidence based education by discussing the EEF (Education

Endowment Fund) Evidence Database, effectively providing a proof of concept regarding some of the key ideas put forward as the new norm.

Working Group 4, in particular **Chapter 3**, highlights the importance of understanding and interpreting uncertainty. The concepts of p-values and statistical significance, together with confidence intervals, are explained and recommended as the new standard practice to be used when presenting empirical evidence in support of practice and policy-making. The core finding from **Working Group 4** is that science and evidence-based education practice and decision-making are evolving into a more complex set of questions, but are potentially very fruitful undertakings, for which it is key to understand the limitations of extant data and evidence in striving to create, obtain and use recent evidence. A clear and transparent discourse surrounding the assumptions and caveats in the analysis should always be provided so that practitioners and decision-

makers are aware of limitations and uncertainties.

GOVERNANCE AND SOCIAL PROCESS OF THE ISEE ASSESSMENT

The ISEE Assessment is a first of its kind for the field of education. Most studies reviewing education and learning primarily take a single disciplinary lens with very little collaboration, especially across traditional educational study disciplines and the newer science of learning disciplines. A key component for a successful endeavour of this nature is mutual respect and acceptance of multiple perspectives and a culture of ‘agree to disagree’. In addition, an open culture is needed in which experts keep an open-mind, truly listen to others and are fearless in asking questions to ensure transparency in assumptions and terminology. Finally, there must be a process in place to facilitate consensus building across all experts in order to create a synthesis of findings to be used by policy-makers. Achieving the above will

strengthen education systems and facilitate learning for the benefit of the individual and society.

An Advisory Board guided by two co-chairs was formed, comprising eminent persons from academia, business and policy, to provide support and guidance to the Assessment. The primary function was to ensure the relevance and credibility of the Assessment exercise. The overall scientific work of the Assessment was guided by the two Assessment co-chairs, one from the social sciences and the other from the natural sciences. The primary responsibility of the Assessment co-chairs was to ensure smooth collaboration across the various disciplines within and across working groups and to ensure the strictest scientific rigour was applied to the Assessment exercise. The co-chairs also were responsible for synthesizing the Assessment findings in the SDM document and a shorter headlines documents that conveys the key messages and policy recommendations from the ISEE Assessment.

Each working group had two senior co-chairs supported by a junior co-chair, which always combined experts from traditional educational studies and the sciences of learning community. Recruitment for these positions was a non-trivial process. Many early invitations were politely rejected because the work was outside individuals’ comfort zones, as well as the necessity requiring them to find common ground and come to shared consensual conclusions with experts and scientists outside their own communities and bubbles. This itself was an important finding as a new social contract for education is designed and implemented by member countries in response to UNESCO’s Futures of Education report released in November 2021.

Once the group leaders were identified, the arduous process of identifying the authors and structure of the chapters for the various working groups took place. The tendency to identify familiar faces and colleagues was only

natural and therefore stringent requirements for each chapter to ideally have at the minimum two disciplines represented were established, alongside the strong recommendation to reach a representative author team in terms of geographic location and gender. However, the process was not always perfect and sometimes a chapter has leaned further towards a particular discipline or perspective than we ideally attempted.

In order to minimize disciplinary bias but also to ensure scientific credibility, a blinded peer-review process was put in place. Review editors, again from different disciplines, were identified to oversee the review process to ensure legitimacy, credibility and the optimal selection of the most appropriate reviewers for each of the chapters across all four working groups. The secretariat overseeing the logistics of the assessment were responsible for compiling the review comments and supporting the review editors to ensure all review comments were adequately addressed by

the respective chapter authors before they were approved for publication.

THE OUTPUTS

The results of the ISEE Assessment are presented in four volumes, each presenting the findings from each of the four working groups. As mentioned earlier, three working groups present the state-of-the-art of the knowledge on education and learning based on the Conceptual Framework developed for the ISEE Assessment (**Figure 1**), and one on the meaning and use of data and evidence. Needless to say, there are many interlinkages across these working groups and attempts have been made to insert cross-references where necessary.

A Summary for Decision-Makers (SDM) is an essential output from the ISEE Assessment. The SDM is presented not as a summary of each working group, but a synthesis across all the working groups. The SDM is structured along five key questions of

relevance for policy-makers. This meant ‘harvesting’ the answers to each question from all four volumes and presenting them in an integrated fashion that reflects the complexity and interconnectedness among the various components within the education sector. The SDM presents the overarching key messages, findings and recommendations that emerge from the full ISEE Assessment report.

A headlines document forms part of the overall package, providing a brief overview and reflecting the key take-home messages and policy recommendations. It is meant to offer a snapshot of the ISEE Assessment and is a quick reference primarily for decision-makers and policy-makers.

CONCLUDING REMARKS

The ISEE Assessment is a first for the education sector. It brings together a critical mass of experts

and scientists working in the field of education. The process of bringing together over 250 experts and scientists from a range of disciplines has been a challenging task but offers an exciting learning experience of transdisciplinary collaboration within education. The two-and-a-half year journey produced new insights but, more importantly, provided the basis for future such assessments. The assessment process and the findings suggest that transdisciplinary research and collaboration is a necessary condition for any education policy-making, especially at the global level. The insights emerging when a range of disciplines combine their relevant research and perspectives are invaluable, offering understandings that sometimes contradict conventional intuitions. It is also important to emphasize the process of consensus building among experts coming from multiple disciplines on findings which might be controversial or uncertain.

This first assessment highlights the richness of evidence

SYNOPSIS

and data on learning and education systems, but it also demonstrates how fragmented and compartmentalized these are across the world. Another key observation from the assessment is that many of the experts and scientists were uncomfortable assigning confidence levels to the findings and the subsequent recommendations. This will need attention if we are to ground the science of learning into education policy-making. An international science organization representing multiple disciplines with a mandate on education should ideally carry out an assessment like the ISEE Assessment periodically in the future.

In 2021 UNESCO called for a new social contract in

‘Reimagining our futures together: a new social contract for education’. We are optimistic that the take-home messages, key findings and policy recommendations put forward by the ISEE Assessment will guide countries across the globe when designing the blueprint for this new social contract. An education for human flourishing using a whole-brain, learner-centric approach acknowledges the interconnectedness between cognitive, social and emotional dimensions, and how these are influenced heavily by societal and contextual factors. Furthermore, recognizing and understanding the vast individual differences in development and learning is key when designing any social contract on education in any part of the world.

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WORKING
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03

EDUCATION *& the Learning Experience*

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CONTENTS

Working Group 03

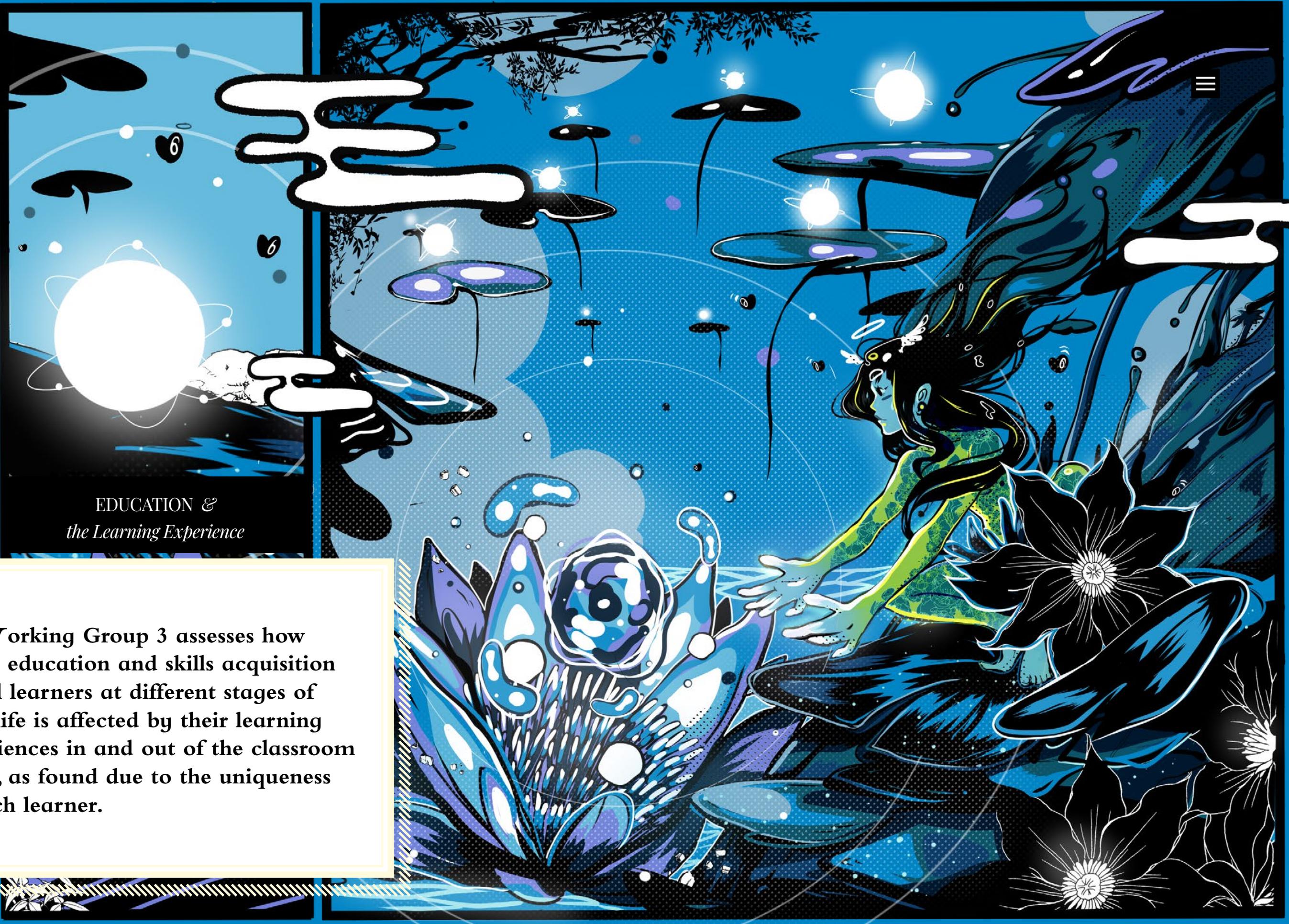


- Ch1 **Towards** an integrative view of the learning experience in the context of human flourishing
- Ch2 **Brain** development and maturation in the context of learning
- Ch3 **Individual** differences and influences on learning
- Ch4 **The social** and emotional foundations of learning
- Ch5 **Foundations** of academic knowledge
- Ch6 **Identifying** and supporting children with learning disabilities
- Ch7 **Learning** spaces: built, natural and digital considerations for learning and learners

03

EDUCATION &
the Learning Experience

Working Group 3 assesses how education and skills acquisition for all learners at different stages of their life is affected by their learning experiences in and out of the classroom space, as found due to the uniqueness of each learner.



Learning spaces: Built, natural and digital considerations for learning and learners

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Abstract:

The goal of this chapter is to assess research that can inform understandings of places and spaces of learning. The chapter assesses evidence across three types of learning spaces: built spaces, digital spaces, and natural spaces. It looks at the role of these different kinds of spaces for learning, attainment, interpersonal relationships, skills development, wellbeing and behaviours – across four pillars of learning to know, to be, to do and to live together. The chapter also explores how learning spaces can be actively shaped, felt and understood through practices and policies that occur within and around them.



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7.1

Introduction

The goal of this chapter is to assess research that can inform understandings of spaces of learning. In addition to legislated formal schooling, different kinds of educational settings and experiences have become embedded in people's daily lives around the world (Sefton-Green, 2013). To some extent, all forms of collective and organized activities for children and young people are 'educational'. People learn everywhere, including in what have been termed formal, informal and non-formal 'learning environments' (e.g. Eshach, 2007). These learning spaces are connected to learning contexts such as primary and secondary

education, including home schooling and alternative formats, higher education and community-based and non-profit organization learning provision. The fact that such provision is often funded not only by governments, but also via philanthropy, civil society and other kinds of welfare provision (Poyntz et al., 2019) means that who gets to define and evaluate what counts as learning (and learning spaces) is not straightforward.

While building on the work that has been done on 'learning environments' (e.g. de Kock, Slegers and Voeten, 2004) what is distinctive about this chapter is that it specifies 'environment' as a spatial category. As an entry point,



People learn everywhere, including in what have been termed formal, informal and non-formal 'learning environments.'

learning 'spaces' are understood to be the built and 'natural' sites in which learning occurs. However, as many human geographers have argued, physical spaces are not simply containers for human action; they cannot determine learning in a singular or simple way; and physical spaces do not exist in a social vacuum, somehow separate from the action that happens 'in them'.

Space can be understood as the ways in which geography shapes social relations and practices, connecting things and people (e.g. Lefebvre, 1991; Massey, 2005). This is sometimes called 'spatiality' (Keith and Pile, 1993), which identifies the coming-together of the physical and the social in different ways across more localized places, such as through migration, technology, or other aspects of mobility in and across land, cities and continents. In thinking about this in relation to education, this means attending to the role and characteristics of particular places of learning, but also the connections (and

divisions) present and enabled among them, for example, as learners move between home and schools, migrate to new countries and communicate with others and with information from across the globe. While having physical (or material) characteristics, places are also shaped and imbued with social meaning culturally, historically and spiritually, as well as spatially connected and influenced by places elsewhere. This combined sociomateriality of places is centred on relationships, among people, with the built environment and other species, and with the land and its histories and future possibilities. While often taken for granted as a backdrop for human activity, place plays a central role in the shaping of human interactions, philosophies, belief systems and actions. Thus, a spatial perspective is important in education, but in some approaches it has not been explicitly considered as a component of learning. In this chapter, we focus on assessing research on learning spaces.



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It is also important to note how this chapter frames learning. The chapter includes a wide variety of research on: (1) explicit, visible and measurable learning, such as prioritized in curricula or measured through assessment outcomes; and (2) implicit or hidden learning that extends beyond the explicit curricula of education. This means that the chapter addresses the link between learning and spaces in two ways. Firstly, the chapter makes reference, where relevant, to aspects of the pillars of learning outlined in the Delors Report (**International Commission on Education for the Twenty-first Century, 1996**).

In other words, we consider how learning in spaces includes and extends beyond academic learning to also include important elements of social and emotional learning (SEL), such as learning to know, learning to do, learning to be and learning to live together. The extension of these pillars into corresponding and interrelated areas of cognitive, socioemotional and behavioural learning is also

relevant for the work that is outlined in this chapter (**UNESCO, 2015**). This includes, for instance, where school classrooms are designed to prompt certain kinds of interactions between children that foster ways of living together, or where learning outdoors can teach ethical ways of being with the natural world. The chapter assesses how learning spaces can enable or inhibit these pillars and areas of learning and their associated educational outcomes (e.g. academic knowledge, citizenship and values, behavioural and action competences, social and emotional skills).

At times we have used the specific UNESCO pillars and domain terms for learning, while in other places we have indicated where these terms overlap or are cognate with other descriptions of learning from within specific fields. This is particularly the case where there may be an over-emphasis in these framings on orientations from the Global North (**Sharma, 2018**). As such, this assessment

...a spatial perspective is important in education, but in some approaches it has not been explicitly considered as a component of learning.

chapter also considers the ways in which learning spaces and places are experienced, constituted, and practised differently across varying identities, cultures and geographies, including in relation to the Global North and South, and by Indigenous and non-Indigenous learners. This is important as it points to not only the diversity of learning spaces and experiences, but also the ways that inequity and colonization can be part of the geographies of education (**Haluza-Delayet et al., 2009**). One way we might think about this is to look at how categories such as ‘formal’ and ‘informal’ may mean different things in different places or may simply not be appropriate. For instance, we want to be particularly cognisant of not equating formal education with classrooms, particularly because doing so may not tally with approaches outside of those dominant in the Global North. To ensure that this chapter does not only discuss learning sciences from the limitations of the Global North, we include authors and

theories that speak to theorizations of learning spaces in and from the Global South (**Connell, 2007**). Other chapters in this publication look at some of the contextual social, environmental, political and economic factors that affect (particularly) access to learning - including transport, the availability of water/energy and investment in schooling. However, with a focus on learning spaces themselves, this chapter seeks to acknowledge different conceptions and understandings of place (and particularly ‘land’) that extend beyond western notions of the term - both in terms of the examples and the philosophical perspectives on which we draw, including centering Indigenous and Global South scholarship as part of the assessment of existing research in this area.

Secondly, the chapter uses an explicitly geographical frame to help expand the possibilities of what it means to talk about learning, that is, how where you are influences what and how you



learn, in some cases beyond the intended curriculum, assessment or aims of the education. In this chapter this includes, among others:

- the recursive relationship between building design, classroom layout, outdoor or non-built places, and learning technologies (whether analogue or digital) and the curricula and values of the societies in which they are located;
- the experiential and immersive aspects of formal and non-formal learning, including new forms of technological augmentation;
- the ways in which digital, outdoor or 'alternative' learning spaces might seek to reconfigure both the sites and processes of more 'traditional' forms of education.

Driven by a focus on the importance of space and place to learning, the chapter draws in part on a body of work by historians that has traced the evolution of (especially) school buildings

since the nineteenth century, and the ways in which changing school architectures reflect changing views of education (**and vice versa; Burke, Cunningham and Grosvenor, 2010**). However, with an interdisciplinary remit, it also extends that historical work through an assessment of contemporary learning spaces and issues, including through contributions from fields such as Indigenous studies, neuroscience and psychology, sociology, and sustainability studies. It also broadens the scope by extending to spaces beyond the Global North, and to learning spaces beyond school architectures – specifically digital spaces and land and the natural environment.

Finally, we note that this chapter was not based on a systematic review, but rather was topic driven based on the identifying contributing authors with key expertise to write short syntheses of research on learning spaces. As such, this chapter is an expert-based appraisal of the current

research landscape. While this process could be described as 'subjective', it draws on the contributing authors' extensive engagement in their areas of study. Contributors have taken care to include references to scholars whose work is robust, while also from groups that continue to be marginalized in academic referencing (e.g. women, People of Colour [POC] and/or scholars from outside Europe/the United States).

Broadly, the contributing authors used a combination of online searches, manual searches of authors' own resources, and follow-up searches in bibliographies of works cited. Contributing authors undertook the following specific steps to locate relevant and appropriate literature: (1) used keyword and search string strategies in a variety of databases (e.g. EThOS, JSTOR, Scopus, ProQuest); (2) referred to a mix of academic and grey literature; (3) where available, aimed to synthesize insights from

systematic reviews, meta-analyses or narrative reviews; (4) attempted to provide a balanced account of the state of their fields while prioritizing highly influential contributions (e.g. high number of citations relative to publication date); and (5) oriented the selection of literature towards combining general overview research, and more specific case studies and/or topical focus within a broader field.

The rest of the chapter highlights a range of established and nascent research related to the effects and effectiveness of learning spaces (for instance in terms of learning, assessment, behaviours, human and planetary well-being, friendships and belonging). However, given the complex causality between learning spaces and these outcomes, we urge caution in drawing overly simplistic conclusions about the relationship between, for instance, classroom design and learning outcomes.



7.2

Key questions addressed in this chapter

What is the role of learning spaces in education? In other words, how does where we learn affect what we learn through education? This is considered in three subsections.

1. What is, or what can be, the role of built spaces in learning?

2. What is, or what can be, the role of digital spaces in learning?

3. What is, or what can be, the role of natural spaces in learning?



7.3

Key findings

The chapter assesses the state of research through three domains of ‘learning spaces’: built spaces, natural spaces and digital spaces. Within each, we identify and assess key trajectories of research and provide examples from different styles of education and types of provision (e.g. formal,

informal, non-formal, alternative). Given the embeddedness of built environments on land and with digital spaces, we also point to ways that these three types of learning spaces interact with each other in shaping overall learning experiences.



Although education spaces exist outside those sites designated as ‘schools’, the vast majority of research on built educational spaces has focused on schools and school buildings.

7.3 .1 BUILT SPACES

7.3 .1 .1

INTRODUCTION

Our assessment in this area indicates increased attention in academic research to the ways in which built spaces can influence educational outcomes. Indeed, the OECD is undertaking an ongoing programme of consultation around ‘Effective Learning Environments’ (OECD, 2013), by which they mean built learning environments. The research literature shows that school and other physical spaces can affect learning, including attainment, engagement, perceptions of student–teacher interactions, interpersonal competencies, well-being and behaviours (i.e. across all four pillars) (Blackmore et al., 2011). However, as Blackmore et al. (2011) also indicate, causality between the design of physical spaces and outcomes is hard to clearly determine (given

the presence of multiple other factors), and in some cases robust and/or internationally comparative evidence is lacking.

This section therefore begins with a general overview of the existing evidence of how built environments (may) affect learning – both from the perspective of architects’ and designers’ aspirations, and the evidence around outcomes. It then adopts a broader view of the relationship between built design and learning, examining how social practices may interact with built design in shaping educational experiences. It explores learner participation in school design as a specific form of ‘learning to do’, and the experiences of learners and teachers themselves. Although education spaces exist outside those sites designated as ‘schools’, the vast majority of research on built educational spaces has focused on schools and school buildings. The notion of built spaces can be extended to designed aspects of playgrounds and outdoor settings (these are

While ‘schools’ may have been housed in a range of buildings, by the end of the nineteenth century mass compulsory education had become established across the industrialized nations of the Global North.

reviewed in more detail in section 7.3.3). Where appropriate, evidence from other settings is reviewed, although this is more limited.

7.3 .1 .2

BUILT LEARNING SPACES AND THE INTENTIONS OF THEIR DESIGNERS

This subsection examines research that has focused on the intentions of architects and other built environment professionals for learning spaces. It is important to recognize that any connection between the built environment and learning starts with the ways in which aspirations for learning are, effectively, ‘built-in’ from the very design stage. Evidence in this area is based on a series of important, large-scale, systematic projects although is limited to the twentieth century, mainly to school architecture, and, largely, to the Global North. This is linked to the emerging field of learning spaces research in higher education that has focused on the design, evaluation and management of learning

environments in universities (Ellis and Goodyear, 2016). Starting with schools, these projects set out a series of key issues and challenges for learning space design that are expanded in subsequent sections of this chapter (divided here, as in most research, between evidence from the Global North and Global South). In addition, some examples of the research literature on the intentions of the built environment of other types of learning spaces is included at the end of the section.

School architecture has a fairly recent history. While ‘schools’ may have been housed in a range of buildings, by the end of the nineteenth century mass compulsory education had become established across the industrialized nations of the Global North. The global reach of the classroom as the basic component of schooling was also established if not yet achieved. School architects were generally employed by the nation-state and designed schools according to contemporary educational principles and norms (Burke and Grosvenor, 2008).



A significant driving force behind much twentieth century school design, especially in the Minority Global North, was the idea that school buildings could promote good health and physical well-being.

A key, overarching feature of early school design was international knowledge exchange. Architects engaged in school design used study tours of varying lengths of time, scope and intensity to inform themselves of what was considered best practice in the wider world. For instance, British architects visited North American cities to determine the best school forms for the growing metropolis (Burke and Grosvenor, 2013). Most famously, architects David and Mary Medd from England spent an entire year travelling around North America visiting schools and meeting with educationalists (Burke, 2013).

A significant driving force behind much twentieth century school design, especially in the Minority Global North, was the idea that school buildings could promote good health and physical well-being. For instance, architects collaborated with medical specialists in determining that buildings should be well ventilated. In Europe, the first ‘open-air’ schools were designed with removable walls from the 1890s. In the decades after the

1940s, architects working for the United Kingdom Ministry of Education made detailed measurements of children in school buildings calculating the reach of their limbs and their sight-lines so that scaled fittings and furnishings could best be designed for learning.

From the 1950s onwards, the urgent need to reconstruct school buildings across Europe coincided with a concern to examine how architects could enhance the strengthening of democracy through education. In Italy, for example, the preschools of Reggio Emilia emphasized through design how the building could have agency as a teacher. In England, efforts to open up and make use of all spaces in schools beyond the traditional classroom came to influence architects across the world, and especially in ‘alternative’ education settings such as Steiner schools (Kraftl, 2006). In these settings, architects and teachers attempted to experiment with ‘traditional’ Western classroom layouts – for instance, in the creation of more ‘home-like’ environments in

Steiner kindergarten through the use of soft furnishings and a circular floor plan, and through the use of highly organized learning materials (by size, colour and purpose) in the Montessori classroom (Kraftl, 2013).

In the past 30 years, architects and built environment professionals active in the field of learning environment research have historically been informed by environmental psychology and ‘person-environment fit’ studies (and latterly emerging work in the neurosciences), with the purpose of evaluating the impacts of built spaces on learning outcomes (Fraser, 1991). There has been an emphasis on recording the measurable sensory qualities of internal environments. For instance, Barrett et al. (2015) propose three principles that should therefore inform school design: naturalness (light, sound, temperature, air quality and links to nature); individualization (ownership, flexibility and connection); stimulation (appropriate level of complexity and colour). The relationship between school buildings and

learning here is conceptualized as directly impacting the brain’s functioning (Barrett et al., 2015). Learning is understood in this context as the rate of academic progress based on formal pupil achievement.

There is also more limited evidence about school design principles and aspirations from the Global South. Although learning spaces pre-existed colonial rule, much of the historical research on such sites starts with the colonial period, in particular because of the ways that European notions of education and ‘school’ were imposed. Additionally, many countries in the Global South have an historic legacy of colonial school buildings, which persists into the stock of contemporary school buildings and more generally into approaches to learning space design (Uduku, 2018). The oldest were built more than a century ago by missionaries who made education and schooling essential to Christian conversion (Fafunwa and Aisiku, 1982). There are examples of the mission school across the world, particularly in India, Africa and Latin America.

The relationship between school buildings and learning here is conceptualized as directly impacting the brain’s functioning



Teaching and school design up until the post-Second World War period thus were modelled on European educational standards.

Often these early schools and classrooms were first built using locally obtainable materials and to the specifications of missionary building handbook formats, centred upon Christian educational principles (Waddell, 1970). The missionary-developed design guidelines for these schools were further standardized by colonial governments as in the case of schools in former British colonies to create colonial school design standards (Uduku, 2018). Until 1945, the funding for colonial schools was linked to grants in aid and all schools (government, private or missionary run) had to comply with a number of criteria, including design standards, successful examination pass rates and teacher qualifications, to receive this funding (Ajayi, 1969). Teaching and school design up until the post-Second World War period thus were modelled on European educational standards.

From the post-war period, with the involvement of international organizations such as UNESCO and the World Bank, school

design in the Global South became more international in its standardization (e.g. De Raedt, 2014). UK and US educational facilities researchers collaborated in the production of the UNESCO school building guides (Uduku, 2018). These UNESCO offshoots developed design guides related to local climate conditions and encouraged construction using local materials and the design of child-scale school furniture, as well as the initiation of child-centred learning. For instance, in Nigeria, the demonstration schools project was developed by a Nigerian firm in association with UNESCO consultants and produced climate sensitive school designs across Nigeria's climate zones (Uduku, 2018).

The collapse of many Global South economies from the mid-1970s to 1980s meant that most classroom design did not evolve as had been hoped, often deteriorating in quality with a lack of investment. However, so-called 'aid' built schools have, since that period, tried to address these challenges, particularly in rural contexts (Amin, 2014). More

recently there has been a more concerted effort by international organizations and NGOs to address the need for education as a Millennium and now Sustainable Development Goal. The key emphases here have been on school design that is sensitive to local intersections of climate, culture, natural materials and contemporary teaching methods (Uduku, 2018).

As a result, significant evidence shows that school buildings are not and have never been merely containers for learning – they relate to their surrounding communities in a range of ways. In other words, there is considerable evidence that the 'external' relationships (some involving different forms of informal and formal learning) are just as important as the 'internal' relationships that buildings foster (Collins and Coleman, 2008; Holloway and Pimlott-Wilson, 2011; Kraftl, 2012). As defined above, the geographical concept of 'spatiality' offers a lens through which to understand these broader sociospatial processes. These approaches need not be detached from studies

of the internal, material details of school buildings; indeed, key studies (including those cited above) have examined how the material properties and arrangements of objects in schools have fostered specific learning relationships that are embedded in pre-existing social relations, such as computer suites that assume individualized learning, and the building-in of neoliberal educational ideals into school building programmes (McGregor, 2004, p. 356; Kraftl, 2012). Others have addressed issues such as the wider role of the school aesthetic in advancing (both within and beyond the 'school' community itself) forms of surveillance, citizen formation, reproducing dominant economic ideologies and constituting urban relations (Gulson and Symes, 2007; Pykett, 2009; Christie, 2013).

Moving to the present day, a further important finding stemming from studies such as those above is that despite strong international trends in educational architecture, school design is tied closely to national

The key emphases here have been on school design that is sensitive to local intersections of climate, culture, natural materials and contemporary teaching methods.



Education, like architecture, has become increasingly marketized, with schools distinguishing themselves visually and commercially, and calling on architecture for assistance.

and international shifts in political economy. Where neoliberal governance has been strongest, for example, the social ambitions of both architecture and planning have shrunk, via different mechanisms. Profession-wise, architects' capacities for effecting real change have been curtailed through downgraded statuses and fewer, reduced roles in public building procurement. Education, like architecture, has become increasingly marketized, with schools distinguishing themselves visually and commercially, and calling on architecture for assistance (see Rowe, 2017, pp. 136-137 for discussion of Australian schools and architectural brand-management). In the design professions more generally, a 'tendency to abdicate from futuring' (Tonkinwise, 2015, p. 88) means disengagement from 'big' issues, such as social inclusion.

Meanwhile, particular social and political issues have become explicit – more urgently and clearly social problems requiring spatial responses. For example, Uduku (2018, p. 118) has shown how post-apartheid, racial

integration in South Africa necessitated new school building design guidelines and, for primary schools, increases in net space to accommodate schools' extended roles as centres for feeding programmes. In the US, Erickson (2016, p. 563) has explored planners' and educationalists' joint work designing vast educational campuses aimed at encouraging desegregation by drawing on students across multiple, racially- and economically segregated city zones.

Although smaller in scope, there has been an increasing focus on the built learning spaces of universities and other forms of higher education. These emerging literatures have responded to trends – especially in the Global North – towards increased investment in the built environments of (particularly) university campuses (van Heur, 2010). The imperatives for such innovation are diverse but centre on the marketization and neoliberalization of University education – as campuses are seen as key 'selling points'

Although smaller in scope, there has been an increasing focus on the built learning spaces of universities and other forms of higher education.

to attract students and as nodes for urban and regional innovation (van Heur, 2010). Significantly, although including investments in spaces such as lecture theatres and libraries, these intentions often extend beyond the specifics of learning to the commercial functioning and roles of universities (Amcoff, 2020). However, as evidence in the next section attests, the (re) development of campuses is also related to different domains of learning – both in terms of its effects on and support for, more flexible, less didactic kinds of learning interactions, and in terms of the creation of cultures and communities of learning (Temple, 2009). Significantly, many studies focus on the latter – how campus spaces can be turned into places of learning that attempt to (literally) concretize the aspirations of universities for the kinds of learners they want to produce, with a focus on capacities such as flexibility, innovation, creativity, sustainability and individual responsibility (Berti, Simpson and Clegg, 2018).

There is also a wide range of literature that considers the intentions of built learning spaces beyond primary to higher education. For example, there is quite extensive research on the learning contributions of built religious environments. Vosko (1991) writes about his work as a designer of religious spaces for adult learning, including undertaking 'audits' of the environmental factors of built religious spaces in terms of their implications for participation and congregational learning. Considerations in these learning spaces include invoking a sense of hospitality through building materials, lighting, temperature and ensuring physical accessibility for all. Vosko (1991) also discusses shifting relationships between teachers and learners in religious settings, often with a move away from environments set up for the dispensation of knowledge, and instead providing rooms and seating arrangements aimed at mutuality and collaboration (see also WG2-ch8). Other factors such as sightlines, use of digital media and signage are also considered aspects

Additional areas that have considered the built environment across a range of ages and learning dimensions include community centres, libraries, zoos, aquaria, science centres, botanic gardens and museums.

of built religious environments that maximize participation and learning. In reviewing work in Jewish education, Lynn-Sachs (2011) discusses synagogue-based education relative to other spaces such as Jewish day schools and preschools, camps and community centres; as well as comparing the features of these spaces to congregation-based Christian education, as well as secular schools. Other researchers have also documented the mirroring of synagogue schools to the institutions of public schooling throughout the twentieth century (Cuban, 1995; Weinberg, 2008). Additional areas that have considered the built environment across a range of ages and learning dimensions include community centres, libraries, zoos, aquaria, science centres, botanic gardens and museums (e.g. Gupta et al., 2019; Cole, Lindsay and Akturk, 2020; Hassinger-Das et al., 2020). Due to the scope of this literature, in the following sections on particular learning outcomes related to built spaces, we focus in particular on primary to higher education learning environments.

7.3 .1 .3

EVIDENCE ABOUT HOW BUILT ENVIRONMENTS AFFECT COGNITIVE LEARNING OUTCOMES FOR SUBJECT-BASED ACADEMIC KNOWLEDGE

Whilst the intentions of architects are an important starting point for assessing the relationship between the built environment and learning, those intentions – and the experiences of learners – are also based on evidence about the relationship between physical design and learning outcomes (Trask and Khoo, 2021). In this section we discuss ‘learning’ in relation to cognitive outcomes and skills (WG3-ch5) directly related to intended aims of education, such as those of curriculum, skill and subject outcomes, although there are overlaps with other outcomes such as behaviours (see following section). However, it must be noted immediately that evidence about the direct relationship between design and cognitive learning is limited. This is because the connection

Large-scale quantitative studies have attempted to evaluate the effects of light, ventilation, colour and flexibility of furniture on student and teacher performance.

between learning outcomes and built environment is mediated and complicated by tangibles (e.g. quality and design of ventilation) and intangibles (e.g. school and classroom culture) (Blackmore et al., 2011; Higgins et al., 2005, p. iii).

In terms of primary and secondary schools, conventionally, building performance is assessed against measurable attributes and subjective reports, to optimize conditions for learning. There are several established frameworks such as ‘Post Occupancy Evaluation’ (POE) and ‘Building Performance Evaluation’ (BPE). These assessments have been limited due to high cost, although a number of assessment tools have been developed in an effort aimed at standardization (e.g. **Organising Framework on Evaluating Quality in Educational Spaces (OECD, 2009)**, Design Appraisal Scale for Elementary Schools (Tanner and Lackney, 2006)). Furthermore, their value to users of existing buildings is frequently unclear.

Investment in schools’ built environments seeks to create learning spaces conducive to developing desirable learner

capabilities of team work, communication, interpersonal and intercultural interaction, emotional and digital literacies (Filardo 2008; Temple, 2009; Lippman, 2012). Yet no significant body of evidence indicates that the quality and design of the building can be causally linked to learning outcomes as measured by standardized assessments (Higgins et al., 2005). Importantly, Blackmore et al.’s (2011) literature review found research concentrated on the design phase, with less research undertaken on the educational practices and outcomes that arise.

Large-scale quantitative studies have attempted to evaluate the effects of light, ventilation, colour and flexibility of furniture on student and teacher performance (Keep, 2002; Lackney and Jacobs, 2002; Higgins et al., 2005; Durán-Narucki, 2008; see the next section). Incremental improvement in student achievement is gained when renovating low or medium quality built environments when connected with improved attendance, reduced illness and

...naturalness (light, etc.), personalization (flexibility) and stimulation (colour, aesthetics) ‘contribute to student progress in learning’.

teacher retention, particularly in disadvantaged communities (Schneider, 2002; Buckley, Schneider and Shang, 2005; Mendell and Heath, 2005). These factors can have an impact on school climate, but that effect plateaus at a certain point (Higgins et al., 2005; Loi and Dillon, 2006; Temple and Reynolds, 2007; Gislason, 2009). Recent quantitative studies aiming to ‘control’ through research design for familial background, type and location of the school and teacher quality provide some evidence that naturalness (light, etc.), personalization (flexibility) and stimulation (colour, aesthetics) ‘contribute to student progress in learning’ (e.g. Barrett et al., 2015; Barrett et al., 2019). Early childhood studies based on play-based measures of developmental learning find that more natural outdoor environments do improve cognitive, affective and physical outcomes (Morrisey, Scott and Wishart, 2015). However, these studies generally ignore mediating intangible variables such as peer relationships, teacher practice, pedagogy and other school-related factors.

While there is a growing body of evidence on the links between physical environment – aspects such as toxins like lead, and access to clean water – and student development, especially in early years, including cognitive and SEL, the majority of studies relate to the Global North. Nonetheless, an international review of research in this area found that despite a paucity of research, similar issues on links between the physical environment and learning are found in the Global South from water pollution in Mexico to the effects of lead in Egypt on development (Ferguson et al., 2013). A mixed methods study of Ghanaian inclusive schools found an urgent need to improve ventilation, and less obvious factors such as colour schemes of walls, in order to better include a diverse range of students (Ackah-Jnr and Danso, 2019). The COVID-19 pandemic has blurred the boundaries between the physical learning spaces of home and formal schooling, with lack of adequate conditions exacerbated in the Global South. An overview of the South African educational



response to COVID-19 shows that many students are severely disadvantaged by lack of appropriate facilities at home, including infrastructure to support distance learning. However, the longer-term effects on learning outcomes are yet to be determined (Soudien, Reddy and Harvey, 2022).

Specific evidence around the introduction of more flexible and/or open classroom spaces is,

however, more robust (although this does not mean that these environments are somehow necessarily more effective than ‘traditional’ designs). Mobile furnishings and technologies can be a catalyst for teacher experimentation to meet students’ learning needs by enabling group learning, collaborative peer interactions and student agency (Blackmore et al., 2011; OECD, 2013). Personalized spaces can impart



...it has been found that temperature ‘comfort zones’ can impact upon students’ learning - for instance, extreme cold, heat and noise have negative impacts.

a sense of security (Lee, 2007; Woodman, 2016). With a shift from teacher-focused to student-focused pedagogies, critical factors are schoolwide planning for use of flexible spaces, teacher professional preparation, resourcing, building maintenance and serial redesign over time as digital technologies develop (Clark, 2010; Blackmore et al., 2011; Deed and Lesko, 2015; Woodman, 2016; Imms and Byers, 2017; Blythe, Velissaratou and OECD, 2018). However, open learning spaces can increase teacher anxiety if not well prepared and supported (Saltmarsh et al., 2014; Barrett et al., 2017) and can have a negative impact in terms of learning outcomes on students with visual, speech or hearing impediments (Klatte, Bergstrom and Lachmann, 2013).

Within higher education settings, there are fewer studies about the relationships between the built environment and cognitive learning. These are similarly inconclusive about the direct effects of (for instance) learning space architectures, light, temperature and other conditions because, as with schools, these effects are complex and combined

with a range of other influences. In higher education settings, it has been found that temperature ‘comfort zones’ can impact upon students’ learning – for instance, extreme cold, heat and noise have negative impacts (Marchand et al., 2014). However, as with several studies, these findings are based upon students’ perceptions of learning rather than standardized testing outcomes (e.g. Sörqvist, Halin and Hygge, 2010; Halin et al., 2014). Indeed, Scott-Weber et al. (2013) argue that post-occupancy studies of higher education student outcomes in (predominantly) university classrooms are generally lacking. In one of the most comprehensive attempts to address this gap, Scott-Weber, Strickland and Kapitula (2013) introduced a three-part methodology – drawing on self-reported engagement factors, secondary data and emerging brain science – finding statistically significant improvements in student engagement as students moved from old to new, purpose-built classrooms (although the built/designed details of the spaces are not specified in their

work). Rands and Gansemer-Topf (2017) report similar findings in a separate study. There is also still the issue here that this and other studies rely heavily on student self-report in terms of ‘engagement’, even if specific engagement factors – motivation, collaboration, focus, feedback – are specified, noting again that these are not only contingent on the built environment (Temple, 2009; Tampubolon and Kusuma, 2019).

7.3 .1 .4

EVIDENCE ABOUT HOW BUILT ENVIRONMENTS AFFECT BEHAVIOUR, HEALTH AND WELL-BEING OUTCOMES

This subsection focuses on assessing the existing research on how primary to higher education built environments may affect student behaviours, health and well-being – in other words socioemotional and behavioural outcomes that may connect with, but also extend beyond, the specifics of cognitive learning (WG3-ch4). As with cognitive learning outcomes

(see the previous section), while environmental quality evaluation frameworks do not systematically assess student well-being, behaviour or experiences, there is some evidence of these impacts. Lopez-Chao et al. (2020, p. 2) review a wide range of studies that have, for instance, demonstrated the impact of lighting and noise on children’s attention, the effects of thermal changes on problem-solving and the impacts of views of nature (or even green walls) on feelings of restoration, maths performance and vocabulary. They find a positive but complex relationship between maths performance and ventilation, room size, views and place attachment, but that higher chair comfort and thermal comfort actually decrease performance (López-Chao et al., 2020, p. 10). Research tends to ignore the wider range of learning competencies associated with the four pillars of learning, as well as a lack of robust methods for evaluating them (Byers et al., 2018).

Nevertheless, recent studies (although largely confined



Over the past decade there have been important developments in the interdisciplinary field of neuroarchitecture...

to Australia) have begun to investigate the impacts of flexible learning spaces on health and well-being. In schools that have removed traditional rows and desks and replaced them with more lounge-like furniture and open/break-out spaces, there have been improvements in learning engagement and student well-being (Kariippanon et al., 2018). Attempts to introduce physical activity interventions (e.g. moveable furniture) have led to a positive effect on working memory but no impact on BMI or bodyfat (Parrish et al., 2018). There is currently much hope and expectation that advances in environmental neuroscience and psychology will provide the necessary insights for school designs that are more nature-based, physiologically informed and better for mental health and well-being (Salingaros et al., 2008). However, there is much discipline bridging groundwork that remains to address the gap in understanding of how neurobiological processes link with environmental drivers of behaviour (Berman et al., 2019).

Moreover, flexible spaces do not on their own necessarily improve learning outcomes and more ‘traditional’ designs may be equally appropriate depending on the curriculum, approach, values and outcomes desired in a particular learning space.

Over the past decade there have been important developments in the interdisciplinary field of neuroarchitecture (Eberhard, 2009), examining the effects of spatial design, building layouts, urban form and aesthetic characteristics on various aspects of human experience, including perception, cognition, well-being, stress, spatial perception, way-finding, memory and behaviour. However, again, there is little evidence that this approach is yet being applied in the design and architecture of school environments, as confirmed by a recent review of the field (Karakas and Yildiz, 2019). There is enthusiasm to develop neuroscientific approaches in learning environment research should the field move beyond the experimental stage (Noriega et al., 2016).

A key focus in work on the geographies of education has been on the power relations that operate in built learning spaces.

Finally, in the absence of reliable research about the direct effects of school buildings on learning outcomes (and especially cognitive learning outcomes), there has, by contrast, been a very large body of work on learners’ and teachers’ experiences of being in physical learning spaces (Daniels et al., 2019). This research has extended across a number of disciplines, but it is most prevalent in human geography – in the so-called ‘geographies of education’ (Holloway et al., 2010) – given a focus in that research on critically analysing the workings of educational spaces, and upon listening to the voices of those doing teaching and learning (Kraftl, 2020).

A key focus in work on the geographies of education has been on the power relations that operate in built learning spaces (and which are perhaps unique to spaces called ‘school’). As Kraftl (2013) evidences in his work on alternative education, it is the combination of rules, behaviours, uniforms, smells and physical design (corridors, classrooms, furniture) that makes up what is understood as a ‘school’. Indeed,

he shows how families who withdraw their children from mainstream schools do so because of the perceived negative effects of the environment on their children (also Conroy, 2010). There is an established body of evidence that has explored how children and teachers experience and attempt to subvert power relations in schools (Youdell, 2006; Taylor, 2013; Catungal, 2019). For instance, Pike (2008) examined how children negotiate the micro-spaces of UK school dining halls in order to subvert rules imposed on them about what they can eat, and when, and how they can move around the space (see Berggren et al., 2020, for a similar Swedish study).

A second important body of evidence has focused less on the intended outcomes of built learning spaces for learners than their experiences of those spaces, especially in respect of the development of identities and friendships (Newman, Woodcock and Dunham, 2006; Holloway et al., 2010; Kraftl et al., 2021). Valentine (2000) showed how the ‘informal’ parts of the learning campus – corridors, for instance – are critical



...‘informal’ parts of the learning campus - corridors, for instance - are critical places where children and young people negotiate ‘narratives of identity’ related to bodily size, gender, sexuality and character traits.

places where children and young people negotiate ‘narratives of identity’ related to bodily size, gender, sexuality and character traits (WG2-ch4). This work has shown how students with certain capacities or bodily traits – such as disabilities – may feel excluded by combinations of built form and expected behaviours that make them feel unsafe, ‘different and thus “out of place”’ (Holt, 2004, 2007; Pyer et al., 2010; Holt et al., 2012). However, often in conjunction with architects and other built environment professionals, scholars have attempted to demonstrate how such exclusionary forms of design (in association with rules, norms and teaching practices) can be changed to create more inclusive environments. For instance, Newman, Woodcock and Dunham (2006) demonstrated how ‘nurturing’ environments that were less rigid in their design (through the use of colours, soft furnishings and more informal layouts) feel safer and more welcoming to pupils.

There has also been some limited scholarship on the

relationship between ‘green’ or ‘sustainable’ learning space design and SEL outcomes, with some evidence that ‘early attitudes and knowledge [of sustainable design] shape the later thinking of adolescents and adults’ (Leeming, Dwyer and Bracken, 1995, p. 3). Indeed, the National Research Council of the National Academies of Science enlisted a group of scholars to investigate the possible relationship between green schools and student achievements and they had difficulty in finding any research available that addressed the topic (Earthman, 2016). However, a key, recent piece of research from Australia – data from 624 children, aged 10–12 years old, who completed a survey adapted from the New Ecological Paradigm (NEP), and General Ecological Behaviour (GEB) scales for children – has shown that the physical learning spaces of sustainably designed schools can act as pedagogic tools that influence children’s environmental attitudes and behaviours (Tucker and Izadpanahi, 2017). Analyses indicated that

...children’s environmental attitudes and behaviours, and that children attending schools designed for sustainability had more pro-environmental attitudes and behaviours than children in conventional schools

sustainable design in schools was a powerful predictor of children’s environmental attitudes and behaviours, and that children attending schools designed for sustainability had more pro-environmental attitudes and behaviours than children in conventional schools (Wake and Eames, 2018, report similar findings in New Zealand). The above study corroborates prior research recognizing the impact of sustainable design in schools on children’s environmental learning (Newton, Wilks and Hes, 2009; Cole, 2013), and suggests that experiential learning via sustainability features at school, such as solar panels, use of recycled water and natural daylight, provides children with the opportunity to be mindful of, and to affect, consumption of energy and water (Kang et al., 2015). Experiential education, such as learning in outdoor classrooms and schoolyard gardening, can also increase students’ relationships with nature and their sense of contributing to action on sustainability issues (Wake, 2004; Wake and Birdsall, 2016).

Meanwhile, literature also reveals contradictory results in cases where green school programmes might not necessarily enhance student sustainability outcomes (consciousness knowledge attitude, behaviour). Some studies found no significant relationship between sustainable building attributes and environmental attitudes (e.g. McCunn and Gifford, 2012). Similarly, Olsson et al. (2016, 2019) suggest that investment in a green school project (in their case in Taiwan) had no benefits in terms of sustainability knowledge, attitudes and behaviours among students. The findings indicate that the intended ‘education for sustainable development’ in schools had a small positive effect on students’ sustainability consciousness, while in grade 9, the effect was negative (Olsson et al., 2019).

As with cognitive learning outcomes, research on socioemotional and behavioural outcomes in higher education settings is more limited. It also focuses largely on students’, teachers’ and university managers’/ leaders’ perceptions of the benefits



...key work by geographers of education has highlighted how - particularly for students from minority ethnic and religious groups - the physical spaces of a university campus may be exclusionary.

of (for instance) investment in new buildings (e.g. Temple, 2009, 2014). This research should be interpreted carefully given that critical scholarship on neoliberal university systems has identified how campus investment is often linked to competitive imperatives to attract (fee-paying) students (Ball, 2012; Breeze, Taylor and Costa, 2019). Moreover, the range of 'outcomes' is fairly disparate - from the positive effects of increasing pedestrian walkways on physical activity (Sun, Oreskovic and Lin, 2014), to measures to increase bicycle uptake on campus (Chevalier, Charlemagne and Xu, 2019), to - in one of the most comprehensive studies - the positive effects on self-reported well-being/behaviours of functionality and layout, cosiness and pleasantness, concentration and comfort, and 'modern' design (Castilla et al., 2017). The first two factors - functionality/layout and cosiness/pleasantness - were found to be consistently the most important for nearly 1,000 students across thirty classrooms (Castilla et al., 2017). Finally, mirroring scholarship on school-based power-relations

and identities, key work by geographers of education has highlighted how - particularly for students from minority ethnic and religious groups - the physical spaces of a university campus may be exclusionary since they can embody and symbolize majority cultural norms (Hopkins, 2011; Bunce et al., 2019). Meanwhile, several important studies have demonstrated how the campus, halls of residence and purpose-built social spaces are key places at which students develop senses of identity (particularly those learners living away from home for the first time and transitioning to adulthood), belonging and 'home' (Brooks, Byford and Sela, 2016; Holton and Riley, 2016; Sykes, 2016; Cheng and Holton, 2019).

7.3 .1 .5

INVOLVING LEARNERS AND OTHER STAKEHOLDERS IN LEARNING SPACE DESIGN: PROCESSES, OUTCOMES AND CHALLENGES

This subsection looks at fairly well-established evidence about the processes and benefits of

involving learners - especially children - in the design of built learning spaces. Given that the vast majority of available evidence is about school design, this is the focus for the section. After considering different approaches to, and structures for, learner participation in design, it examines the benefits and drawbacks of participation, in a context where it is usually assumed that learners' involvement in design processes is unequivocally beneficial. It also examines some of the evidence about the outcomes of participation for learners - including, although generally less well-established, in terms of learning outcomes.

Children's involvement in school design takes many guises: from informing the vision for major new buildings, extensions or refurbishments; to ongoing, everyday spatial and material adjustments and appropriations in an existing school as part of a participatory school culture¹ (see also den Besten, Horton and Kraftl, 2008; den Besten et al., 2011;

Kenkmann, 2011; McCarter and Woolner, 2011; Chiles, 2015). The primary motivations for involving children and the wider school community in the process of creating school spaces differ according to the agenda of those who initiate the process. While child-initiated emancipatory processes might represent a participatory ideal (Hart, 1997; Chawla, 2001; Fielding, 2001), the impetus for a new or reconfigured environment, centred on children's learning, most often emerges from priorities set by adults.

Government-initiated school design and construction programmes have sometimes identified involvement of the school community as a requirement, citing the need for engagement as a means to achieve higher quality school buildings, offering educational benefits to the students involved and a sense of ownership for the wider school community (Heppellet al., 2004). Individual schools extending or renewing their physical spaces have also initiated processes of

The primary motivations for involving children and the wider school community in the process of creating school spaces differ according to the agenda of those who initiate the process.

¹ <http://www.designingwithchildren.net/> <http://www.designingwithchildren.net/>



engagement, commissioning design teams that prioritize user participation (e.g. **Sanoff, 1999; Hubner, 2005; Yanagisawa, 2007; Jilk, 2009; Hofman, 2014; Chiles, 2015**). Significantly, some school buildings would not be realized without the vision, commitment and voluntary labour of the local community. In community

development and humanitarian aid contexts, a school building might be built by volunteers from the school community, often including children in that building process, alongside international volunteers (**Narea, 2017; Fan and Tanoue, 2019**). Such construction sites have also become contexts for skills training

and capacity building, sometimes also formalized through links to further or higher education (**Cuevas, 2018**).

Also underpinning approaches to participatory design are attempts to challenge (European) norms of architectural practice and power. In the Canadian context, the concept of ‘design sovereignty’ recognizes the danger that Indigenous forms of built learning spaces are exploited by designers and architects, and that the only way to counteract this is through the appointment of Indigenous people as lead architects (currently only 18 out of 10,000 registered Canadian architects are Indigenous) (**Fortin, 2020, p. 243**). This principle of self-determination could be applied across other forms of exclusion from design of built learning spaces. For example, in Northern Ireland, **McAllister and Sloan (2016)** involved young people aged 13–18 with autism spectrum condition (ASC) in a school design study to instruct designers on what they thought made up an autism-friendly environment,

Also underpinning approaches to participatory design are attempts to challenge norms of architectural practice and power.

recognizing that a person’s interaction with their environment is not always a positive one and that the experiences of children with ASC regarding playgrounds, security, noise, comfort, circulation round the school, simple legibility of space and break out space should be built into school design.

The structural constraints on education as a context for participation mean that it is important to also consider speculative, exploratory design activities with children to be a part of the wider ‘School Participation Project’. Competitions such as ‘The School I’d Like’ in the UK (**Burke and Grosvenor, 2003**), and similar contests in the US and Australia, have invited children to rethink the relationship between physical space and learning. School design projects that invite children’s involvement are almost always of low priority when it comes to establishing such fundamental principles. Some critics would therefore argue that participation in this context can only ever be limited to influencing relatively token decisions about



...a wealth of positive impacts and benefits associated with learner participation in school design are identified.

space, materials and use, never really challenging assumptions about education, learning and space (den Besten et al., 2011). Notwithstanding these limitations, a wealth of positive impacts and benefits associated with learner participation in school design are identified.

Most school design participation activities by children are framed in developmental terms and linked to the formal curriculum. Learning activities can build upon or use the school design project as a resource linking to almost any subject area. The benefits of this approach lie in the school building project becoming a ‘worked example’ in learning (JIA, 2020). Learning and achievement are aided by providing ‘first-hand, relevant experiences that contextualize learning.’ (Kendall, Muirfield and Wilkin, 2007a, pp. 17–18; Kendall et al., 2007b) Interactions between the design or construction team and the students can offer inspiration as well as insight into possible professions (Sutton and Kemp, 2002). Students have also been shown to learn technical knowledge relating to building and architectural

principles, including materials, structure, construction and sustainability (Parnell, Cave and Torrington, 2008).

Beyond the subject-based curriculum, there are many overlaps, firstly, with the benefits of art and design education and secondly, with voluntary activity and enterprise education. Participants and their teachers commonly perceive improvements related to creative development – such as capacity to experiment, take risks and problem-solve – and improvements related to aspects of personal and social development – such as self-confidence and self-esteem, communication skills and working with others (The Sorrell Foundation, 2006; WG1-ch4; WG2-ch8; WG3-ch4). Wider education-related benefits include motivation to learn, improved behaviour, enjoyment of school and ability to learn independently (for summaries of reported benefits see Bentley, Fairley and Wright, 2001; Sorrell and Sorrell, 2005; Parnell, Cave and Torrington, 2008; Deveson, 2008). A few studies have related pupils’ participation in the design of school buildings

School participatory design processes have provided student participants with opportunities to develop collaborative, cooperative and dialogic relations with other actors, resulting, in some instances, in the development of empathy and open communication skills.

to improvements in their academic achievement, attendance and behaviour, although Day, Sutton and Jenkins (2011) point out that this claim has been disputed elsewhere (Sutton and Kemp, 2002), as with other studies of the relationship between school design and learning (see earlier section about how built environments affect cognitive learning outcomes for subject-based academic knowledge).

The sense of environmental competence that can be developed through place making activity has been linked with increased well-being resulting from children’s improved abilities to exercise control over their environments (connected with their wider rights as children, as enshrined in the United Nations Convention on the Rights of Children), and to derive health and educational benefit (Day et al., 2011, p. 51). School participatory design processes have provided student participants with opportunities to develop collaborative, cooperative and dialogic relations with other actors, resulting, in some instances, in the

development of empathy and open communication skills. Adult–child relations have also been shown to adjust, with the attitudes of both staff towards students and students towards staff taking on a new form; each seeing the ‘other’ not in their role, but as ‘more human’ (Parnell, Cave and Torrington, 2008).

Perhaps the most fundamental rationale for children’s involvement in school design is that it will lead to more appropriate spaces, ultimately therefore improving children’s comfort, well-being and the inclusiveness of experiences of school and learning. The task of examining and evidencing such relationships, however, is complex to the point of being prohibitive (in parallel with attempts to evidence the relationship between built space design itself and different learning outcomes (see preceding sections). One of the common effects of school community engagement during the design phase, however, is a sense of ownership among diverse participants (Higgins et al., 2005). Whether this is due to the process or the resulting product is difficult



to ascertain. However, children's experiences and perspectives often differ greatly from those of the adults who are tasked with designing the space that they will inhabit – not least due to obvious physiological differences. It follows then that architects and designers who have engaged with children in the school design process have reported that they have gained knowledge, insights and 'ways of seeing' that have informed their spatial design and of which they would otherwise have been ignorant of (Sorrell and Sorrell, 2005, p. 60; Clark, 2010; Hofmann, 2014).

All of the above potential benefits and positive impacts of school design participation are dependent on positive and appropriate processes. Badly implemented and disingenuous processes of involvement have been shown to provide contexts for coercion and manipulation, or have simply wasted participants' time and effort by being ineffectual, resulting in negative attitudes and participation fatigue. The benefits of involvement in school design and re-design are by no means guaranteed, and careful attention

needs to be paid to the implicit politics in architecture and spatial organization (den Besten et al., 2011; Kraftl, 2012).

Textbox example: Sustainable Community Schools in Chicago

In contrast to the neoliberal moment of severe government austerity, there are localized efforts to ensure that historically marginalized communities are able to secure the resources they have been structurally denied. Cases such as Sustainable Community Schools (SCS) in Chicago straddle concerns with built learning environments (section 7.3.1) and place-based and community education (section 7.3.3), as they question the necessity for learning to take place within the walls of dedicated, built spaces such as 'schools'. They also reference the wider built environments in which (potential) learners live and attempts to address forms of structural inequality. In Chicago, Illinois, given the realities of the built environment in cities for Black and Latinx residents experiencing poverty and structural racism in

'sustainability' in Chicago Public Schools (CPS) appears in the form of permanent resources secured by a justice-centred teachers union.

the form of disinvestment, food deserts, housing insecurity and dwindling educational resources, 'sustainability' in Chicago Public Schools (CPS) appears in the form of permanent resources secured by a justice-centred teachers union (Chicago Teachers Union). Targeting twenty schools on Chicago's West and South sides, the SCS initiative seeks to infuse historically disenfranchised schools with resources in the form of lower class sizes, support for English language learners, long-term relationships with community organizations, ending harsh discipline policies and access to early learning. Moving from austerity practices where governments remove resources from communities that have historically had the least, SCS has targeted communities and schools that have been historically marginalized to provide them with resources usually provided to schools that are prioritized in the district. Similar to the logics of environmental sustainability, SCS views schools as viable centres of education if they are replenished with what is needed

to create thriving communities inside the school walls, with a longstanding commitment to inclusion (e.g. along the lines of race, class, gender (dis)ability and sexual orientation). At the same time, the large emphasis is on 'if'. As funding for SCS was secured as part of a union contract negotiation, late-stage capitalism in the form of budget shortfalls and the current COVID-19 moment unfortunately give school districts and big government the chance to rescind efforts that prioritize marginalized communities. In the broader fight against white supremacy and capitalism – which takes place beyond as much as within school walls – SCS has the opportunity to stand as a model of government accountability rooted in a commitment to address expressed community need (Chicago Teachers Union, 2018).

7.3 .1 .6

CONCLUSION

This section has examined evidence about built learning



Built learning spaces can - in conjunction with various rules, norms and teaching practices - have both positive effects on issues beyond academic learning, too - especially around learners' own experiences of power relations, identity and exclusion.

spaces in learning, with a focus on primary to higher education built learning spaces. The section reviewed the intentions of architects and other stakeholders involved in the design of built learning spaces in terms of the effects and outcomes they have sought to engender. It then assessed a range of international literatures exploring the relationship between built learning spaces and learning outcomes, behaviours and student experiences. The evidence on the relationship between built spaces and cognitive learning outcomes remains unclear: certain kinds of (especially flexible) spaces can have benefits for some kinds of learners, but the sheer range of intersecting and complicating factors makes it difficult to be definitive. The evidence about the potentially positive impacts of built spaces on behaviours and senses of well-being is clearer, with, again, flexible environments leading to a range of positive effects and affects. Built learning spaces can – in conjunction with various rules, norms and teaching practices – have both positive

effects on issues beyond academic learning, too – especially around learners' own experiences (and subversion) of power relations, identity and exclusion. Thus, listening to learners' own voices as well as 'measuring' learning or behavioural outcomes is key; this principle is also central to an established body of work highlighting the many benefits (but also challenges) to including learners in the design of built learning spaces. Those benefits can be many, but include a greater sense of 'belonging' with the learning community, greater willingness to learn and the wider benefits of social inclusion and acquiring skills not usually learned in the classroom.

7.3 .2

DIGITAL SPACES

7.3 .2 .1

INTRODUCTION

While it can be assumed that the digital is distinct from the

Hybrid learning spaces can be understood as (i) physical (with virtual aspects), and (ii) virtual (with physical aspects), with understandings of the latter being contributed to from learning sciences, computer supported collaborative learning and human computer interaction studies.

'physical', this divide is hard to sustain in practice as much of what is discussed as digital learning spaces is an extension of the types of built spaces outlined above – that is the embeddedness of different technologies within built educational spaces (See **WG2-ch6 for a discussion on educational technology**). Hybrid learning spaces can be understood as (i) physical (with virtual aspects), and (ii) virtual (with physical aspects), with understandings of the latter being contributed to from learning sciences, computer supported collaborative learning and human computer interaction studies (**Ellis and Goodyear, 2016; WG2-ch6**). While there are numerous reports in the literature of beneficial educational effects associated with a wide variety of computer-based teaching systems, especially when used in well-resourced experimental situations, evidence of significant, sustained beneficial effects at scale is mixed (**Pane et al., 2014**).

This section on digital learning spaces examines work on the promises of digital technology in education, with the most sustained

research being in the areas connected to Learning to Do, and Living Together or the behavioural aspects of learning, with limited evidence about the connections between digital learning spaces and cognitive learning outcomes. Alongside these promises has come a range of criticisms that the digital technologies of the past 40 years have failed to deliver improved education (**Selwyn et al., 2018**). To examine the ways in which different positions on digital education have implications for what types of learning spaces are conceived and introduced, this section is based on what Ash, Kitchin and Leszczynski (**2018**) outline as 'geographies produced by the digital' which indicate that 'the digital is mediating and augmenting the production of space and transforming spatial relations' (**Ash, Kitchin and Leszczynski, 2018, p. 29**). This includes a focus on the unevenness of access to technology and notions of a 'digital divide', that can be about divisions in physical aspects like urban areas and nations, and divisions between and within social categories

...critical studies of technology that start to examine not only the pedagogical and curriculum, or practice aspects of these learning spaces but also the politico-economic geographies of learning spaces.

like race, class, gender and so forth (Ash, Kitchin and Leszczynski, 2018; McLean, Maalsen and Prebble, 2019). Geographies produced by the digital can also encompass infrastructure and software studies, and critical studies of technology that start to examine not only the pedagogical and curriculum, or practice aspects of these learning spaces but also the politico-economic geographies of learning spaces (e.g. forms of privatized data driven learning spaces, Williamson, 2018).

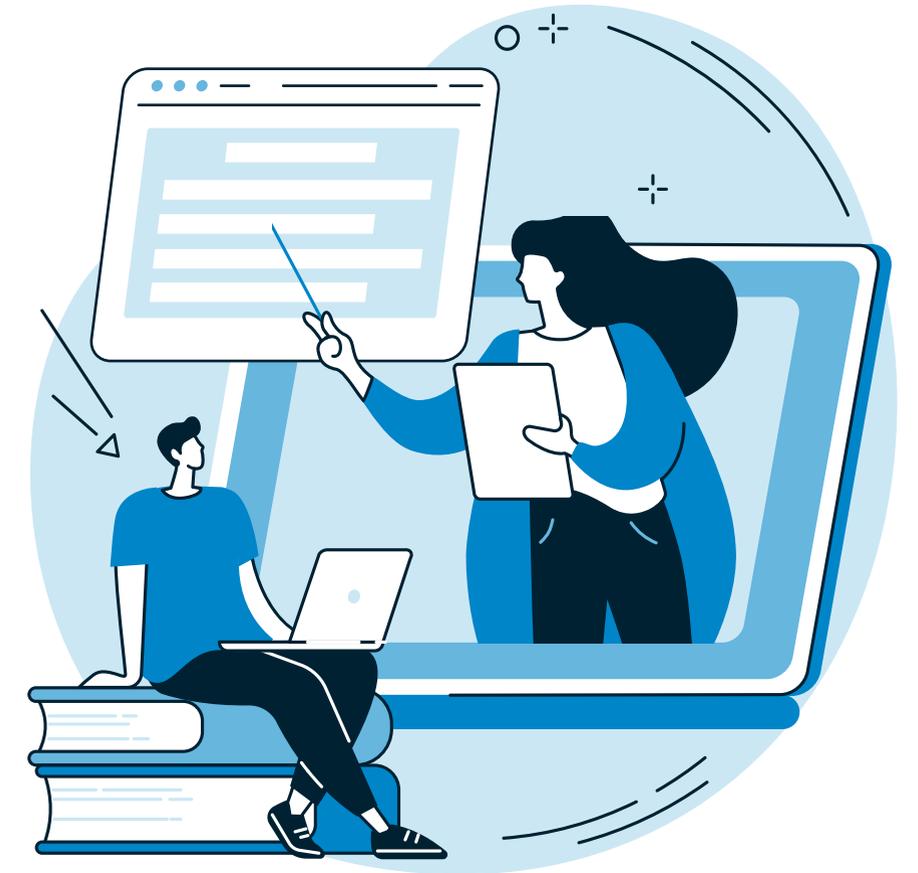
Focusing on geographies of the digital allows us to look at the ways in which technologies are creating new types of learning spaces, including those that we might see as topological – in which students, teachers, schools, universities, lecturers and so forth – are connected via new networks of infrastructure and the introduction of technologies like virtual reality. These new spaces lead us to questions about what sort of learning, teaching and assessment is being created in these spaces. What is outlined below also speaks to both the ways digital technologies may

hasten an end to the traditional classroom, understood as an historically relatively stable walled enclosure, while also extending the possibilities of such classrooms (Benade, 2017).

7.3 .2 .2

DIGITAL TECHNOLOGIES IN FORMAL SETTINGS

This section outlines the extensive research on computer-based digital tools in primary, secondary and higher education classrooms. This has been the primary body of work that has connected technology, teaching and learning. This section highlights that while this has been an area of much focus, particularly in higher education, with significant comparative and large-scale research evidence of how digital learning spaces reshape teaching and learning, there is little substantive research that identifies links between digital technologies and educational achievement. These digital technologies produce material spaces and create new connections between digital and physical spaces.



The use of digital tools is becoming increasingly widespread and heterogeneous. This reflects a conjunction of two trends. Firstly, there has been a strengthening of pedagogical approaches that favour active and collaborative learning, cognitive apprenticeship, guided exploration, learning through participation in valued (knowledge) practices, and experiences that foster learner autonomy (Lave and Wenger, 1991; Bereiter, 2002; Sawyer, 2014;

Lave, 2019). Secondly, personal computers and mobile devices have become much more affordable and widely owned – to the point where, in the richer countries, students are expected to provide their own internet-connected devices. Any such device provides a multiplicity of software and hence opportunities for learning (Ellis and Goodyear, 2019).

The diversity of uses to which a tool can be put means that there



In broad terms, tools can be used productively – to create something – or epistemically – to improve one’s learning – or both.

is little scientific value in trying to quantify the inherent educational benefits of any specific tool. A better approach is to consider the alignment between tool and purpose, and especially to develop strategies that help students make their own well-justified decisions about which tools to use for which kinds of learning (e.g. cognitive, behavioural). In broad terms, tools can be used productively – to create something – or epistemically – to improve one’s learning – or both. Research in this area is now providing better insights into (i) how people develop greater fluency in the use of tools, and (ii) methods for designing and managing learning spaces as complex material–digital ecologies or assemblages of tasks, tools and people. This work includes a focus on new forms of collaboration, innovation and insights into the incorporation of technology into the physical design of learning spaces (Verillon and Rabardel, 1995; Säljö, 1999; Moen, Mørch and Paavola, 2012; Dovey and Fisher, 2014; Dam a and Jornet, 2016; Markauskaite and Goodyear, 2017).

Contemporary technologies – like social media, smartphones and digital gaming – emphasize learners as active co-producers of knowledge (Kafai and Burke, 2016; Goodyear and Armour, 2019a). Research on these digital technologies in schools has mainly focused on the process of implementation, explaining how, why and for whom digital technologies are effective in given contexts (Galvin and Greenhow, 2020; Greenhow et al., 2020). However, too much emphasis has been on the technology itself (Greenhow et al., 2020), with few studies measuring the impact of contemporary media on student learning outcomes (Greenhow and Askari, 2017), how engagement and learning may vary across diverse and potentially vulnerable groups (Galvin and Greenhow, 2020), and/or how classroom practices in schools can enrich and relate to young people’s informal learning outside of school (Goodyear and Armour, 2019b; Rutledge, Dennen and Bagdy, 2020). One notable exception is the work on the links between behavioural learning and student engagement in the area of what are called ‘active

learning classrooms’. Using quasi-experiments, Byers and Imms have found what they claim is a causal relationship between: 1) the use of ‘next generation learning spaces; with a polycentric design; and, 2) improvements in students’ perceptions of the effectiveness of educational technologies, student collaboration, interactivity, collaboration, and preference for the space (Byers and Imms, 2014; Byers, Imms and Hartnell-Young, 2014; Byers, Hartnell-Young and Imms, 2016; Imms and Byers, 2017). Nonetheless, additional research is needed to draw generalizations and to better understand how these contemporary digital media are used in classrooms and in ways that optimize engagement and learning.

There is a body of research that looks at the way digital technologies connect to new forms of Learning to Live Together, superficially work on socioemotional and behavioural aspects of learning. Research exploring participatory cultures (Jenkins et al., 2007; Halverson et al., 2018) and/or the affordance of digital media (Greenhow and Lewin,

2016) helps to explain how digital technologies can create new types of collaborative learning spaces (Halverson and Shaprio, 2013). A participatory culture can be explained as ‘a culture with relatively low barriers to artistic expression and civic engagement, strong support for creating and sharing one’s creations, and some type of informal mentorship whereby what is known by the most experienced is passed along to novices’ (Jenkins et al., 2007, p.3). Evidence highlights how new technologies create spaces for learning through engendering cultures of play, practice and social interaction (compare Greenhow and Lewin, 2016; Kafai and Burke, 2016; Third et al., 2019; Ito et al., 2020). For example, the social networking affordances of social media, while carrying with them negative effects around bullying and discrimination (Waters, Russell and Hensley, 2020), can enable new forms of inquiry, communication, collaboration and identity work in classrooms, while impacting positively on cognitive, social and emotional outcomes (Greenhow and Lewin, 2016; Krukta and Carpenter,

Evidence highlights how new technologies create spaces for learning through engendering cultures of play, practice and social interaction.



As a relatively nascent area of research, there is, as yet, little evidence of the connection between smart classrooms and outcomes.

2016; Greenhow and Askari, 2017). Smartphones and mobile apps afford new pathways for learners to assemble knowledge from diverse sources and in varied formats, rather than a single-source content creator (Halverson and Shapiro, 2013; Gardner and Davis, 2016; Goodyear and Amour, 2019b). Furthermore, commercial and educative digital gaming use in classrooms also provide examples of how game design environments develop different types of spaces to develop expertise, through opportunities for expressions and collaborative problem solving, authentic assessment, automatic feedback, programming skills, creative design, role play and situated decision making (Kafai and Burke, 2016; Kangas, Koskinen and Krokfors, 2017; Hussein et al., 2019).

7.3 .2 .3

HYBRID CLASSROOMS: 'SMART CLASSROOMS', VIRTUAL ENVIRONMENTS AND EMERGING TECHNOLOGIES

This section focuses on 'smart classrooms' in an emerging area of research on technology and

learning in 'hybrid' classrooms, cutting across primary, secondary and higher education. It focuses on technologies such as the increased application of artificial intelligence (AI) in the classroom. While AI has long been part of hybrid classrooms, such as Intelligent Tutoring Systems, new forms of AI are now being used such as facial recognition technologies that aim to not only recognize student faces but also identify and propose learning interventions (McStay, 2019). As a relatively nascent area of research, there is, as yet, little evidence of the connection between smart classrooms and outcomes. However, there is a growing body of both quantitative and qualitative research on the experiences of learners and teachers in these classrooms.

The vision of a smart classroom is 'instrumenting the physical learning space with rich and interactive technologies' (Tissenbaum and Slotta, 2019, p. 424). Smart classrooms are 'technology-rich... equipped with wireless communication, personal digital devices, sensors, as well as virtual

learning platforms' (Li, Kong and Chen, 2015, p. 46). This creates a hybrid physical/digital space for learning and teaching where data captured in the physical learning environment and in digital spaces support a 'rich and interactive' smart learning environment.

Smart classrooms are conceptualized as having a range of new digital technologies that capture learning and teaching data through digital devices, sensors, through online platforms and within virtual environments. These are typically understood as part of the Internet of Things (IoT). This also extends to Internet of the Body (IoB), which involve wearable devices such as smartwatches and fitness trackers, and classroom-based sensors such as video cameras, which automatically collect biometric data for analysis and feedback (Royackers et al., 2018). Ideally, a rich and interactive smart classroom aims to support learner and teacher activities and decisionmaking. Some expected uses would be providing teachers with information on the relationship between pedagogical

approaches and immediate and long-term student social behaviour; engagement in learning and academic outcomes; and even the relationship between these and environmental factors such as the temperature control of classrooms (Liu, Huang and Wosinski, 2017).

There is a considerable amount of research in the areas related to smart classrooms. For example, intelligent tutoring systems are widely studied in the field of AI. In particular, how these can be used and expanded in learning contexts to support teacher decisionmaking, in real-time (e.g. Holstein, McLaren and Alevan, 2017). Intelligent tutors are adaptive technologies designed to be responsive to learners and their changing needs, as they progress through a learning task. Questions need to be asked about how these are embedded in the learning, rather than replicating traditional teaching approaches. Can these be used in ways that are more immersive, such as pedagogical agents and non-playing characters in serious games, and in ways that take advantage of new learning spaces and places?

Ideally, a rich and interactive smart classroom aims to support learner and teacher activities and decisionmaking.



...while local based initiatives have been successful in ameliorating inequitable access to technology for learning, there is little evidence of large-scale systemic success.

7.3 .2 .4

DIGITAL DIVIDES, INEQUALITY, AND UNEVEN ACCESS TO TECHNOLOGIES IN EDUCATION

This section primarily deals with the issue of digital access and inequality, or what is commonly called the ‘digital divide’ (Selwyn, 2004) that connects learning to a range of factors including geography, such as remoteness. The section outlines that the comparative evidence in this area, often undertaken through survey research, has shown that there is significant inequality in technological access. The section also includes evidence that while local based initiatives have been successful in ameliorating inequitable access to technology for learning, there is little evidence of large-scale systemic success. The section includes a case study of the digital divide in Latin America.

Any instance of digital education inevitably bumps up against issues related to ‘digital inequality’. This refers to longstanding (and seemingly persistent) ‘digital divides’ in levels of basic access

to devices and connectivity, alongside less obvious ‘second order’ differences in the quality of digital engagement once an individual is connected, and the outcomes that accrue as a result (Selwyn, 2004; Helsper, 2020). Around the world, levels of digital exclusion are found to be patterned by issues of race, ethnicity, income and multiple intersections therein. Indeed, with around 3.6 billion individuals (47 per cent of the world’s population) still lacking access to the internet (ITU, 2019), any notion of digital technology facilitating a global transformation of educational engagement is profoundly misplaced. Moreover, there are sustained within-population disparities around the world in terms of skills to use technology, levels of media and information literacy, and other competencies required to benefit from digital technology use (Broadband Commission for Sustainable Development, 2017). As such, digital technologies are acknowledged as both exacerbating existing social inequalities and introducing additional layers of disparity to people’s ability to engage in

(and benefit from) educational opportunities.

Nevertheless, many people remain profoundly optimistic about the capacity of digital learning to address (and overcome) societal inequalities. On one hand, digital technologies are seen as a ready means of increasing people’s opportunities to engage in learning regardless of their pre-existing circumstances. Such optimism surrounds current enthusiasm for a shift to home-based virtual schooling – with online technologies believed to give students the ability to engage in education on an ‘any time, any place, any pace’ basis that best fits with their needs. This was certainly the logic at the beginning of the 2010s surrounding the initial introduction of MOOCs – ‘massive open online courses’ – that any individual could engage in for little or no cost (Rohs and Ganz, 2015; Gameel and Wilkins, 2019). This is also the logic of many educational interventions in the Global South. Most notably, perhaps, the much-touted ‘One Laptop Per Child’ initiative in the 2000s distributed millions

Around the world, levels of digital exclusion are found to be patterned by issues of race, ethnicity, income and multiple intersections therein.

of robust self-powered netbook computers to children in some of the most deprived regions with a view to supporting self-directed learning (Ames, 2019). Current initiatives in South Asia and sub-Saharan Africa are continuing this logic – utilizing basic digital technologies such as mobile phones alongside emerging AI technologies to create access pathways to schooling (Gallagher, 2019).

This raises a key tension with regards to the continued application of digital technologies for inclusion and empowerment in education. While these interventions often result in some initial local success, they are usually found to ultimately fail to disrupt or reverse longstanding inequalities and disparities in educational participation. At best these interventions are seen to advantage those who were already advantaged (Tewathia, Kamath and Ilavarasan, 2020). In short, those who benefit most from digital education are those who are already well-educated, well-resourced and without constraining life circumstances –



Although the digital divide is another way to set up borders between wealthy and poor neighbourhoods, there are initiatives that challenge those barriers...

what Tressie McMillan Cottom (2017) terms ‘the roaming autodidacts’. While digital learning might increase the educational participation of these

already privileged classes, it does not usually result in a widening of educational participation to others who were previously not engaged.

TEXTBOX EXAMPLE: DIGITAL DIVIDES AND INFORMAL LEARNING SPACES IN LATIN AMERICA

This case study focuses on Latin America to link non-formal learning with the promotion of social activism to prevent digital divides. According to DaSilva and Ferreira (2016, p. 8, contributor translation), informal learning in reference to social media and digital learning is ‘... the process by which people acquire knowledge, skills, and attitudes through everyday experience and exposure to the environment in which they live’. There are studies exploring this kind of learning in terms of control and responsabilization of youth (Kwon, 2013) in addition to the tradition of positive youth development (Kirshner, 2015), with both

approaches focusing on questions of human development, social integration and possible pathways into employment.

In the community of Abasolo in Chiapas, Mexico, in July 2016, some educators from Escuelas Normales (teacher training schools) created the collective project Ik ta K’op, which in the indigenous language Tseltal means ‘word in the wind’. The initial goal of the project was to share information on the social movement promoted by The National Coordination of Education Workers (CNTE) of 2013 in Mexico. The ultimate result was that, thanks to Ik ta K’op, the community gained internet access and began using common communication platforms, such as WhatsApp, to share information. The main informal learning from this

virtual project was building the meaning of ‘community internet’, ‘right of autonomy’ and ‘internet governance’ in that indigenous community (Lay, 2018). Although the digital divide is another way to set up borders between wealthy and poor neighbourhoods, there are initiatives that challenge those barriers, for instance, a free access wireless network was successfully deployed in Ciudad Bolívar in Bogotá, Colombia, after the community worked with non-

profit and public organizations (Pedraza, Cepeda and Ballesteros, 2013).

Another important consideration is how the virtual and informal production of learning has an ethnic character, such as the case of learning mathematics in Huánuco, Perú (Ramón and Vilchez, 2019) or the development of apps to learn indigenous languages in Mexico (Le Mur, 2018).

DATAFICATION, PLATFORMS,

7.3 .2 .5

AND THE CREATION OF DIGITAL EDUCATION SPACES

This section focuses on the ways in which our understanding of what is a ‘learning space’ has evolved in response to changed economic and technological conditions, chiefly the explosive growth of pervasive internet platforms and related developments driven by the ‘big-tech’ sector (e.g. automation and AI). Evidence of these changing developments has been primarily

based on qualitative studies of the experiences of system leaders, teachers and students, and the ways in which the measurement of learning has changed through these developments. There is little evidence of whether these developments are connected to rises and falls in learning outcomes.

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the opportunities and problems associated with a sudden, hasty ‘pivot’ to online delivery. What kinds of spaces are therefore created when digital technology becomes, in its various forms, part of the educational milieu? There are two parts to this: (1) datafication; and (2) platforms.

Datafication describes the increasing use of digital data in education, which has meant increases in data volume, variety, concentration and speed, which emerged along with the ongoing expansion of digital learning and education management technologies (Lawn, 2013; Williamson, 2017; Landri, 2018; Jarke and Breiter, 2019). The far-reaching promises of datafication include the capacity to better cater for individual student needs, provide better and faster feedback, optimize classroom management, and reduce workload, as well as monitor learning paths and intervene early enough (for instance, through applying predictive measures) (Williamson, 2017). Students and teachers using such technologies continuously leave (digital) data footprints,

which are used for various kinds of data analytics before being fed back into instructional, organizational or governmental decisionmaking. Such data footprints not only include learning performance indicators (e.g. tests), but also, to a growing extent, sociodemographic and behaviour data about technology usage. These technologies have become central to an overlap between new forms of student surveillance and specific forms of behavioural learning (Manolev, Sullivan and Slee, 2019).

Indeed, as digital and automated data increasingly become integral features of educational governance and practice, evidence shows they deeply affect teaching and learning spaces as well as the organization, management and supervision of schools (e.g. Jarke and Breiter, 2019). In doing so, they also show tremendous effects on the (transformation of) subjectivities of teachers and (young) children, which poses new challenges, for example, for professional autonomy and children’s rights (e.g. Bradbury, 2019). These challenges are

augmented where datafication apparently comes with powerful feedback loop effects – that is, data frequently results in a need for more or better data, more standards, and more focus on (good) data production (Thompson and Sellar, 2018). Ironically, however, even though there is more data than ever before on what happens in schools and classrooms, we still seem to know little or even less about how to improve education outcomes. For example, in countries that have been forerunners in the datafication of schooling scores in international assessments such as PISA are declining (Hartong et al., forthcoming).

Alongside datafication has emerged the growing role of digital platforms in the coordination, governance and surveillance of social life, including education (Fuchs, 2010; Bucher, 2012; Kelkar, 2017; Van Dijck, Poell and De Waal, 2018; Williamson, 2019). Educational platforms configure digitally produced spaces where key educational processes (teaching, learning and administration) are affected in

three interrelated ways:

1. platforms are proprietary and controlled virtual environments where multiple educational actors (e.g. teachers and students) and processes can be digitized, datafied and standardized;
2. through digitization and datafication platforms apportion and individualize educational support and guidance; and
3. through standardization and the development of flexible protocols and infrastructures, platforms create openings through which third parties (e.g. external, often for-profit, providers of educational services and products) can enter the virtual educational space as add-ons, integrations and extensions.

At the risk of oversimplification, academic research on the emerging platforms in education tends to take one of two positions: one broadly supportive and optimistic and, while involving critique, generally focuses on these contributing to improved cognitive learning outcomes; the other more critical, circumspect and sociological in scope.

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Some studies report positive learning outcomes within educational platforms compared to traditional environments, but these outcomes do not transfer across contexts.

The first position relies on data intensive methods and computational approaches and argues that platforms create network effects where people can draw simultaneously on the wisdom of crowds and the personalized assistance enabled by real-time and precise algorithms. This research generally goes by the name learning analytics (LA) and is associated with ‘the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs’ (Long et al., 2011). The main aim of LA is the collection of multiple forms of data from a variety of learning platforms and apps, in order to diagnose and predict dimensions of educational performance, and ultimately produce ‘actionable insights’ of immediate and demonstrable instructional effectiveness (Clow, 2013; Siemens, 2013). Other popular trends include using LA to identify variables and behaviours that promote student success and address the need for

quality assurance of educational services (Lester et al., 2017). The evidence supporting these claims is, however, mixed. Some studies report positive learning outcomes within educational platforms compared to traditional environments, but these outcomes do not transfer across contexts (Winne, 2017; Kizilcec et al., 2020). Similarly, experimental research on automation in platforms has found that automated teaching methods have moderate positive impacts, but are only as effective as, and often less effective than, human teachers (Ma et al., 2014; Steenbergen-Hu and Cooper, 2014).

The second position draws attention to various forms of reductionism occurring within educational platforms, as a result of logics of prediction and automation (Perrotta and Selwyn, 2019), as well as the growing interface between surveillance, governance and datafication in education policy (Gulson and Sellar, 2019). In this more critical camp, the main pedagogic feature of platformized spaces is their ‘operational bias’ (Andrejevic, 2020, p. 95), which prioritizes seeking to

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act preemptively, thus removing the need for pedagogic agency (Knox, Williamson and Bayne, 2020). Notable studies in this camp use data analysis to warn against an overreliance on large datasets, collected through digital learning platforms such as MOOCs, suggesting that platforms do not ameliorate familiar challenges in education: self-selected participation and fragmented, socially stratified patterns of engagement (Gillani and Eynon, 2014; Rohs and Ganz, 2015). In other words, big data does not mean good data, and platforms can be just as problematic as ‘traditional’ learning spaces.

7.3 .2 .6

CONCLUSION

This section has highlighted that there is substantial evidence for the connection between the following areas of technology and learning spaces: (1) the experiential aspects of teaching and learning including the use of emerging technologies; (2) the impact of technology

and technology companies, on how learning is administered and governed; and (3) the enduring inequality of technological access. There is far less evidence on the connections between digital spaces and learning outcomes. The COVID-19 pandemic means that the digital spaces of learning have been widely distributed (away from the buildings of schools to homes) and highly differentiated (with implications for learning outcomes, not just between but within countries (Reimers, 2022). There remains the need for critical research on the learning effects of the use of education technology during the pandemic (Williamson, Eynon and Potter, 2020).

7.3 .3

NATURAL SPACES

7.3 .3 .1

INTRODUCTION

This second main section of the chapter’s findings recognizes



that learning experiences are often designed to occur in, or in relation to, the natural or non-built environment, and that all learning is necessarily situated on and in relation to land. We highlight evidence on how considerations of land are embedded within all education (implicitly and/or explicitly), as well as how land and natural spaces can be engaged more intentionally as part of experiences to learning to know, to do, to be and to live together (or learning ‘about, in and/or for’ nature). The section will assess the evidence relating to the roles of natural spaces in trajectories of outdoor and environmental education, community and place-based education approaches, interspecies learning and education, and Indigenous approaches to land and environment in learning and education. Running through these bodies of literature are varying views of whether humans and human-made objects, including built environments, should be considered separate from, or also as part of, the natural world. ‘Nature’ is understood neither

as an objective category or a universal experience; the concept of ‘naturalness’ needs decoupling from individual understandings of the natural world and the intricacies of specific places in which learning might take place.

7.3 .3 .2

OUTDOOR SPACES AND LEARNING

Various forms of education undertaken ‘outdoors,’ or in other words, beyond the built environment, are identified in the research literature as a means to support people’s personal and social development through the building of relationships with self, others and the environment (e.g. **Wattchow and Brown, 2011; Fiennes et al., 2015; Harris, 2018**). With a range of historical roots in locations such as the UK and Scandinavia (e.g. **Sandell and Öhman, 2010; Freeman, 2011**), forms of outdoor education are now popular across many societies and offered by non-profit organizations, sometimes for business or leadership

Proponents of outdoor educational approaches reference them as effective interventions for a range of outcomes such as increased confidence, positive affect and communication skills, and developing concern for others and the environment...

training, and also as a means of learning the curricula of formal education. Proponents of outdoor educational approaches reference them as effective interventions for a range of outcomes such as increased confidence, positive affect and communication skills, and developing concern for others and the environment, including for all ages in a range of settings. Outdoor learning is also noted for its ability to be adapted to support a range of curriculum subjects at the primary to higher education levels of formal education. Indeed, outdoor and environmental education programmes have undergone significant diversification and expansion in recent decades to reach this variety of aims, through a growing call for education that is cross-curricular, locally relevant and emphasizes student responsibility and personal growth (**Beames and Ross, 2010**). As **Gray (2018a, p. 146)** offers, outdoor learning is not new, ‘just newly important’, providing a ‘potent vehicle for alternative learning’ – often premised on experiential learning (**Nicol, 2014**) and making a shift away from transmissive

learning approaches.

Whilst challenging to quantify, there is evidence that outdoor education, when planned and well taught, does lead to positive effects (**Hattie et al., 1997; Rickinson et al., 2004; Fiennes et al., 2015; Ardoin and Bowers, 2020**). For example, the embeddedness of outdoor learning in Scotland’s national Curriculum for Excellence (**Learning and Teaching Scotland, 2010**), and links to the national curriculum in England and Wales (**DfES, 2006; Ofsted, 2008; DfE, 2018**) demonstrate its perceived ability to contribute to a broad and balanced curriculum that promotes spiritual, moral, cultural, mental and physical development (**DfE, 2014’ WG3-ch5**). It also provides a fundamentally different space to the classroom that affords learners the opportunity to explore different behaviours and interactions (**Kraftl, 2013; Harris, 2018**). In terms of contributing to the four pillars of education, ‘outdoor learning’ typically aligns most strongly with Learning to Be and Learning to Do; developing broader ‘essential skills’ (**Angus et al., 2020**), such as



...cultural differences can become a defining pivot in learner's corporeal experiences and associated (negative) interpretations of outdoor learning environments.

teamwork and communication that support the use of specialist knowledge and technical skills, and focusing on personal growth and environmental learning, for example, through an emphasis on decisionmaking and social responsibility.

Research demonstrates that in Global North settings, experiences of outdoor learning do not lead to universally positive experiences. The most obvious (but perhaps perceptively diminishing barrier) is the masculinized Outward Bound model that dominates classic outdoor learning rhetoric (McKenzie, 2003; Gray, 2018b; Riley, 2019). Mycock (2018) points to the exclusionary processes that emerge through material engagements with outdoor learning environments and the politics of nature and natural materials, which may be highly gendered. She observes how 'mud governs individuals and their experiences' (p. 455) in the context of forest school and school garden spaces, acting to reinstate gendered and class-based identities and performances, and limit children's 'muddy

encounters'. Other research has suggested that cultural differences can become a defining pivot in learner's corporeal experiences and associated (negative) interpretations of outdoor learning environments (Friedel, 2011; Hickman Dunne, 2019). Attention has also been drawn to the role of (dis)ability – both physical and intellectual – in perceptions of, and reality of access to, particular, nature-based learning environments (von Benzon, 2011, 2018; Hickman Dunne, forthcoming). These observations point to some deficits in understandings of the contribution of outdoor and environmental learning to learners' holistic education. Firstly, for whom is it an effective educational intervention and why, and under what circumstances might it be less effective? Secondly, how applicable is this model of learning to other cultural and geographical contexts, and do we understand the diversity of outdoor learning activity that is taking place across the globe? Natural spaces can be enablers for the pillars of learning and their associated educational

outcomes. However, there can be a blindness to the exclusive qualities of nature and outdoor environments, particularly when framed from Western perspectives on outdoor learning.

The promotion of alternative outdoor learning approaches, such as slow adventure (Varley and Semple, 2015), and the embedding learning in place through elements of ecopedagogy (Kahn, 2010; Payne, 2014; Dunkley and Smith, 2018), go some way to addressing some of these deficits. There is no doubt that outdoor education practice has developed to reflect the wider diversity of people who now access it. However, further work that pushes empirical understandings of people's socially mediated engagements with outdoor education settings is important, to understand the potential of nature to act as a more inclusive and critical learning space.

7.3 .3 .3

COMMUNITY AND PLACE-BASED LEARNING

The research literature documents diverse trajectories of approaches to community and place-based education, most with intended critical and/or environmental learning outcomes. Also taking place on land, and in – or in relation to – non-built or outdoor spaces, approaches describing themselves as 'community-based' or 'place-based' typically vary from those using the terms 'outdoor learning' in that they are more likely to prioritize social issues and learning (and with environmental learning in much place-based education) (WG3-ch5).

One influential body of work on community-based education builds on the work of Brazilian educator and philosopher Paul Freire in critical pedagogy. Engaging adult learners in community-based education to overcome their conditions of oppression through the co-creation of knowledge (Freire, 1970), this approach has a broad legacy. In Latin America, Freire's legacy strongly influences critical environmental education today, with scholars often highlighting his concept of praxis and the

Engaging adult learners in community-based education to overcome their conditions of oppression through the co-creation of knowledge, this approach has a broad legacy.



...focus on the communities most vulnerable to degradation as a result of social and environmental conditions, such as the Indigenous, peasants, traditional fisher people and slum dwellers, and have inspired promising research strands.

dialectics between ‘denouncing the dehumanizing situation and announcing its overcoming’ (Freire, 2000, p. 37). Such educational approaches focus on the communities most vulnerable to degradation as a result of social and environmental conditions, such as the Indigenous, peasants, traditional fisher people and slum dwellers, and have inspired promising research strands. For example, the ‘education in public environmental management’ project, based on a critical pedagogy framework, aims at promoting participatory democracy in the management of territories; and ‘community-based environmental education’ and has also been inspired by decolonial theories and political ecology (Quintas, 2007; Almeida and Loureiro, 2015; Magalhaes and Loureiro, 2016; Souza and Loureiro, 2018; Vitor, Goncalves and Sanchez, 2019; Melo and Barzano, 2020; Oliveira, et al., 2020; Pelacani et al., 2020; Stortti, Espinosa and Garcia, 2020). A review of critical environmental education research in Latin America (Sanchez, Pelacani and Accioly, 2020) suggests that the urgency of a fairer distribution of wealth and income

and the workers’ rights movement has mobilized grassroots approaches to critical community-based education. This trajectory of critical work has also informed approaches to ecopedagogy and other perspectives on critical environmental education (e.g. Kahn, 2010; Misiaszek and Torres, 2019).

Using a community-as-pedagogy framework (Freire, 1970), a study of a community-based education programme in a Latin American rural high school context investigated how community connections strengthened students’ perceptions of social relationships and environmental leadership (Selby et al., 2020). The results showed an increase in students’ knowledge of the local environment and community environmental issues. It was an endeavour to draw attention to, and encourage engagement in, complex socioenvironmental issues and to help transform ‘youths’ ability to envision, enact, and expand upon community-derived conceptions of “environmental leadership” (p.2).

...those who are marginalized poor, racialized and Indigenous, in both more developed countries and less developed countries, bear the burden of environmental risks...

A second related trajectory of community and place-based learning emphasized in the research literature is the ‘environmental justice’ movement and its impacts on education. In the 1980s, environmental justice emerged in the US as a social movement that linked social justice and environmentalism. Distinct from conservationist forms of environmentalism, environmental justice framed notions of the environment broadly and recognized that all environmental spaces, natural or built, are tied to power relations (Bullard, 1990; Teelucksingh and Masuda, 2014). Structural inequities and differential access to power results in affluent white communities being better able to protect their environments from undesirable land uses (Pulido, 2000). In contrast, those who are marginalized poor, racialized and Indigenous, in both more developed countries and less developed countries, bear the burden of environmental risks, such as pollution, climate change and exploitation of their land and natural resources. The spatial

dimensions of environmental injustice include both the risk distributions that concentrate in areas of deprivation (Bullard, 1990) and also the terms of risk causation, as found in the sociospatial politics that surround truth claims made by competing stakeholders involved in environmental decisionmaking (Waldron, 2018).

Environmental justice is posed in the literature as uniquely tied to both formal and informal learning spaces and the need for integrated visions of learning (Haluza-DeLay, 2014). Formal education settings are key sites to conduct evidence-based research that validates the everyday experiential knowledge of grassroots environmental justice actors. Many of these actors are women and Indigenous people who become activists because of the risks they bear. Schools can also play a role to inform children of their social justice and citizenship rights to access healthy environmental spaces, especially for children who live in communities that suffer from environmental injustices (Peloso, 2007). In turn, grassroots



Theoretically based on theories of social capital and relational power, Warren calls for a new approach to urban education reform that is linked to social changes in America's cities.

environmental organizations, which position marginalized communities as active agents of change, provide informal learning that empowers and fosters environmental resilience.

A wide range of initiatives has also recently emerged across the US in order to promote connections between community-based organizations and schools. Warren (2005) states that such community initiatives can contribute to school improvement through improving the social context of education, fostering parental and community participation in education, transforming the culture of schools by holding school officials accountable for educational gains, and building a political constituency for public education to support the delivery of greater resources to schools. Warren links the success of urban school reform to the revitalization of communities around the schools through developing collaboration between public schools and community-based organizations. In order to do this, they identify a typology of three approaches and exemplar

models for each: the service model (community schools), the development model (community sponsorship of new schools), and the organizing model (school–community organizing). Despite the differences, these three models appear to have a number of features in common and all seek to build stronger and more collaborative connections between and among parents, educators and community members. Theoretically based on theories of social capital and relational power, Warren calls for a new approach to urban education reform that is linked to social changes in America's cities. The review concludes that community-based education can build social capital among educators, parents and community, which can expand the capacities of schools in a way that it calls 'a new view of urban education reform'.

A third central body of literature on place-based and place-responsive education has developed more recently. This research extends prior work on community-based education to account for 'place' in educational

provision, including a focus on communities as well as the land and natural settings within which they are embedded. Place-based education has emerged as an approach, harnessing locally distinctive contexts into teaching and learning, including its geography, ecology, politics and sociology (Woodhouse and Knapp, 2000). For the last several decades, the heterogeneous movement broadly termed here, 'place-based education,' has sought to facilitate learning in local areas through providing students with opportunities to encounter local people, local issues and to experience phenomena in a 'real world' setting beyond the classroom. Other identifiable sub-fields of the loosely linked movement are curricular provisions for place-responsive learning, area studies, urban education and other forms of place-related formal and non-formal education.

In the scholarly research literature, place initially emerged as a key context for 'place-based' pedagogies of various kinds (Gruenewald, 2003; Sobel, 2004; Skamp,

2009). Linking his work to that of Dewey, Smith (2002) suggests place-based education grounds learning in the local or the particular place of students' lived experiences. Early perspectives extended critical pedagogy to take account of the role of the setting or eco-social context of education. Gruenewald (later Greenwood) (2003) theorized 'critical place-based' and 'place-conscious education' and later argued the need for an examination of places to reveal 'the often contestable nature of the dominant beliefs and motives' (Greenwood, 2013, p. 97) that shape our perspectives of places. A number of authors (Ingold, 2000, 2011; Somerville, 2008; Payne and Wattchow, 2009; Wattchow and Brown, 2011; McKenzie and Bieler, 2016) have sought to particularly understand the processes of place-based learning. For example, Sellers (2009) suggests that curriculum itself needs to be considered as a 'milieu of becoming' wherein assembled entities change as they expand their connections to each other and to other newly encountered entities or beings (see also WG2-ch8; WG3-ch5).

Place-based education has emerged as an approach, harnessing locally distinctive contexts into teaching and learning, including its geography, ecology, politics and sociology.



...in addition to enhancing community-school relationships and students' attitudes toward their schoolwork and their communities, place-based education affects student motivation for, and engagement in, learning.

Informed by process philosophies (for e.g. Heidegger and Deleuze), a proliferation of writing has used the term 'place-responsiveness' in an effort to sustain and understand how people and places are in ongoing reciprocal relation via learning (Cameron, 2003). Mannion, Fenwick and Lynch (2013), among others, link place-responsiveness with educational endeavour in the term place-responsive pedagogy, which they define as explicitly teaching 'by-means-of-an-environment' with the aim of understanding and improving human-environment relations. It involves educators' own experiences and dispositions to place, learners' dispositions and experiences, and the ongoing contingent events in the place itself (including the presence and activities of other living things). Other education research has focused on psychological orientations to place and place attachment, and has emphasized various aspects of place that can shape learner identity, including through place-based learning (Chawla, 1992; Ardoin, 2006; Kudryavtsev,

Stedman and Krasney, 2012). In an evaluation of four place-based education programmes, Powers (2004) finds that in addition to enhancing community-school relationships and students' attitudes toward their schoolwork and their communities, place-based education affects student motivation for, and engagement in, learning. A salient emerging theme is that special education students performed better during the place-based learning activities.

Textbox example: School-based garden learning

Teachers, school leaders and communities are responding to increased food insecurity and the need for more outdoor learning spaces by connecting with community gardening and small farming as living classrooms (Williams and Brown, 2012; DiClaudio, Hughes and Savoca, 2013; Williams and Anderson, 2015). Research has found that garden-based learning spaces offers unique opportunities for teachers to connect students with important global nutrition issues and local economic

alternatives for students learning food growing, preparation and consumption, while also learning about important social justice and sustainability issues (McKenna and Brodovsky, 2016; Niewolny and D'Adamo-Damery, 2016). In many garden-based learning spaces, schools and teachers have the opportunity to situate gardens as learning labs for science learning and closely connect students with skills for addressing food insecurities and centering civic engagement around food politics. School and community gardening also offer the opportunity to centre cultural and biological diversity and interdependence. One example of garden learning can be found in Portland, Oregon at the Learning Gardens Laboratory (LGL). This is a 12-acre garden where university students and community members work with young learners through hands-on and place-based education. The LGL is one of a growing number of garden learning spaces in the city of Portland where the focus of learning includes sustainable gardening and healthy nutrition through permaculture (Williams

School and community gardening also offer the opportunity to centre cultural and biological diversity and interdependence.

and Anderson, 2015). Another example is the D-town Farm where Black urban farmers have a Food Warriors programme that engages youth in food systems learning that focuses on a sense of agency through food justice, environmental awareness, diverse agricultural techniques and health food preparation (DBCFSN, 2019). Furthermore, examples of garden learning rooted in land-based education and decolonial efforts are centering Indigenous ways of knowing as central to students learning (Tuck, McKenzie and McCoy, 2014; Bang, 2016; Lever, 2020). Most importantly in both garden-based learning and food pedagogies, is that learning spaces are sites of learning to recognize the multispecies interdependencies and how such systems require critical understanding in order for us not only to survive but thrive together on the planet.

In addition to research on the effects of being in particular places for learning, there is also a literature on the benefits of movement across places, such as the scholarship on walking

Walking pedagogies offer opportunities to circumvent the implicit lessons of institutionalized environments, while also raising opportunities to explore the curricula found in different spaces and places.

pedagogies. Walking is receiving attention for its capacity to enact curricular and public pedagogies, as well as community action, but also because of the critical place engagement that it offers (McPhie and Clark, 2015; Springgay and Truman, 2019). Walking produces opportunities for different forms of socialization and subjectification when compared to sitting in more homogeneous and static environments where students sit at desks in rows, facing one direction. ‘Materialities of classrooms do crucial but often unnoticed performative work in enacting gendered power’ (Taylor, 2013, p. 688), as well as reinforcing racial, colonial, ableist and class/caste powers. Similarly, ostensibly public spaces, notably urban environments, but also rural spaces, have become increasingly commodified and privatized, further shaping how it is possible to be in these places (Richardson, 2015). Walking pedagogies offer opportunities to circumvent the implicit lessons of institutionalized environments (indoor and outdoor), while also raising opportunities to explore the

curricula found in different spaces and places.

Walking pedagogy is, however, not inherently equitable. Walking is a cultural construct and is changeable for different people, in different environments, at/ in different times. Some people are more physically able to walk than others (and some may not be able to walk at all). The shape, position, length of stride and speed of your walk can signal privilege or poverty (Becker, 2016) –for example, where just walking down a street as a person of colour can be taken as an act of criminal intent in some places (Cadogan, 2016). In contrast, the pastime of walking in the countryside for leisure or well-being is most often undertaken by privileged white people in the Global North due to their conceptions of landscape and the urban, and prevailing ableist and privileged notions of health and access. Walking pedagogues have a responsibility and opportunity to consider what their walking pedagogies allow (and for who), what they might reinforce (and to whose detriment), and what



they might disrupt (and for whose empowerment). Walking has been researched as pedagogy in a range of formal and non and informal settings, including in outdoor learning (Beames, Higgins and Nicol, 2012; Gray and Colucci-Gray, 2019), decolonial walking pedagogies (Walsh, 2015), walking libraries for women (Heddon and Myers, 2020), non-ableist walking (Stenning, 2020), participatory methods of research (Snepvangers and Davis, 2019; Borthwick, Marland and Stenning, 2020),

radical performance (Smith, 2015), and First Nations protest and/or liberation (Hamilton, 2020).

7.3 .3 .4

INTERSPECIES LEARNING

Research that focuses on the relationships among humans and other aspects of the material world embraces not only animate beings but inanimate and



...learning takes place, through relations with other agentive beings.

inhuman elements (Ogden, Hall and Tanita, 2013) in opening up new accountabilities in understanding learning spaces (Van Dooren, Kirksey and Münster, 2016). The human is understood to emerge, or in other words learning takes place, through relations with other agentive beings (Rautio, Tammi and Hohti, 2020; see also Hohti and Tammi, 2019). As Tsing (2012, p.141) contends, ‘Human nature is an interspecies relationship’. Thus, growing up is understood to be inherently about co-becoming of humans with other life – animate and inanimate (Hird, 2009).

There is nothing particularly new about a focus on relations – on humans as interconnected with nature per se. It is not historically novel, as Bach (2018) points out, nor is it new to many Indigenous cultures (Ellis, 2005; TallBear, 2011). The newness arises from the current means – technologies and ways of thinking – with which we can learn more about the multispecies webs that enable our existence.

Advances in fields surrounding education proper, such

as childhood studies or childhoodnature approaches (e.g. Horton and Kraftl, 2018; Cutter-MacKenzie-Knowles, Malone and Barrat, 2020; Kraftl, 2020), as well as environmental education (e.g. Lloro-Bidart and Bansbach, 2018; Kraftl et al., 2019), have for some time emphasized attention to connectivity and coexistence through approaches labelled as (new) materialist (Snaza et al., 2016), sociomaterialist (Fenwick, Edwards and Sawchuck, 2012; McKenzie and Bieler, 2016), posthumanist (Snaza et al., 2014) or multispecies inquiry (Rautio, Tammi and Hohti, 2020). Most of these have exemplified a shift of focus both empirically and onto-epistemologically from individuals to relations and multiplicities, from large-scale certainties to micro-scale situatedness and webs of interrelations, exposing, for example, systems of domination at work in curriculum and pedagogy (Snaza et al., 2016). Deborah Bird Rose (2011), among many environmental philosophers, stresses a shift from atomism to connectivity, and from certainty to uncertainty. Education, however, has been

Some process-oriented educational research, sometimes described as ‘new materialist’, or ‘post-human’, now emphasizes our lived and embodied experience in educational settings.

among the slowest of disciplines to attend to these shifts (e.g. Pedersen, 2010), and has instead celebrated universal (e.g. ahistorical, apolitical, geographically and spatially indistinct) ideas of learning (Fenwick, Edwards and Sawchuck, 2012; Snaza et al., 2014).

Some process-oriented educational research, sometimes described as ‘new materialist’, or ‘post-human’, now emphasizes our lived and embodied experience in educational settings (Kraftl, 2013). These researchers actively target the binary of culture/nature and the idea of human stewardship of nature (Taylor and Pacini-Ketchabaw, 2015; Malone, Truong and Gray 2017). Others emphasize the significance of learner embodiment in settings (Hackett and Somerville 2017). Lloro-Bidart (2017) considers the role of non-humans, suggesting that other species and the human can be a ‘community of knowers’. Post-human or ‘more-than-human’ approaches, therefore, seek a revision of modern ideas such as ‘stewardship’ of environments (with its paternalistic associations of mastery and control), challenging learners towards a

greater acceptance of the current state of environmental crisis (for example climate change and biodiversity loss), and foreground the importance of alternative ways of knowing (via, for example, Indigenous knowledge, embodied and affective knowing, and ethical response-abilities). Pederson (2011) and Quinn (2013), clarify that such approaches must decentre the human subject so that we can develop an ‘understanding of what it means to learn with and from rather than about nonhuman animals’ (Pederson, 2011, p. 20).

In-depth research about child–animal relations highlights human children and other animals as co-becomings (Van Dooren and Rose, 2012; Hohti and Tammi, 2019). It is suggested that human–animal relations can, in general, be conceived as powerful relationships intrinsic in their value to children (Risley-Curtiss, 2010; Tipper, 2011), and reviews of research show that caring for a companion animal may promote respect and compassion for all animals and nature (Prokop and Tunnicliffe, 2010) as well as increase general health and



...common worlds pedagogies seek to cultivate pedagogical attention to environmentally damaged places in ways that resist reinforcing the human-centredness on which our current times of environmental precarity were formed.

well-being (McCardle et al., 2011). Childhood nature or child–animal scholarship shows that a situated learning with (cf. learning about) produces connections and a sense of belonging (Taylor et al., 2015; Cutter-Mackenzie-Knowles, Malone and Barrat, 2020). This kind of research further argues that situated relations and forms of education are performative: they are world-making (Haraway, 2008) and, as such, relevant to education far beyond learning.

As one trajectory of work concerned with these framings, common worlds pedagogies propose alternatives to dominant educational approaches that promote universalized understandings of ‘the developing child’, instead situating young children within the actual worlds they inherit and inhabit amidst current conditions of global environmental precarity (Taylor, 2013, 2017; Taylor and Pacini-Ketchabaw, 2015; Kraftl, 2020). While recognizing the importance of children’s physical, emotional and other aspects of well-being, common worlds pedagogies seek to cultivate pedagogical

attention to environmentally damaged places in ways that resist reinforcing the human-centredness on which our current times of environmental precarity were formed. Therefore, rather than re-centering the child, through everyday pedagogical encounters, common worlds approaches work with pedagogies that notice and respond to children-in-relation with the more-than-human as a conduit for creating more livable worlds for all – where the more-than-human includes materials, other species, land, weather and more.

Examples of this work include studies of children’s relations with local impacts of climate change (Rooney, 2019), polluted waters (Nxumalo and Berg, 2020), waste (Hodgins, 2015) and plastics (Kraftl, 2020; Berry, Vintimilla and Pacini-Ketchabaw, forthcoming). Central to an emphasis on children’s place relations and the refusal of human-centredness, is a commitment to considering places and their more-than-human inhabitants as storied, vibrant and active participants

...engagements with children’s place relations also include foregrounding the ways in which childhood pedagogies can disrupt the erasure of Indigenous communities, knowledges and lands.

in children’s relational learning, rather than a mere background for children’s learning. Common worlds perspectives on place and the collective learning therein are transdisciplinary, drawing from Indigenous land pedagogies (Bang et al., 2014; Simpson, 2014), new materialist perspectives on affective pedagogies (Blaise and Pacini-Ketchabaw, 2019; Nxumalo and Villanueva, 2019) and more-than-human geographies of place (Instone and Taylor, 2015), amongst other influences (Taylor, 2017).

Since much of the work of common worlds scholars is situated within settler colonial contexts, engagements with children’s place relations also include foregrounding the ways in which childhood pedagogies can disrupt the erasure of Indigenous communities, knowledges and lands (Nxumalo, Vintimilla and Nelson, 2018; Land et al., 2019; Nxumalo, 2019). In addition, common worlds pedagogies attempt to confront the impacts of settler colonialism through attention to fraught relationships and awkward encounters between children and animals such as raccoons (Pacini-

Ketchabaw and Nxumalo, 2015), rabbits (Taylor, 2020), bees (Nxumalo, 2018) and kangaroos (Taylor and Pacini-Ketchabaw, 2018).

Within a focus on the ethics and politics of children’s place relations, recent common worlds work has drawn on Black feminist geographies and Black speculative storytelling to re-imagine childhood pedagogies as capable of interrupting the absenting and deficit constructions of Black children’s relationships to so-called natural places (Nxumalo and Cedillo, 2017). Taken together, this literature suggests a need to attend to the ways in which place and space are central to Black, Indigenous and other intersectionally marginalized people’s oppression and liberation.

7.3 .3 .5

INDIGENOUS LAND-BASED LEARNING

A final area of research that informs current understandings of ‘natural spaces’ of learning



Formal education systems, a critical component of the machinery of colonization and initially designed to assimilate and enfranchise Indigenous peoples, have been a poor substitute for the pedagogy of the land.

is that of Indigenous land-based approaches to education. Bang et al. (2014) have written that ‘Land is; therefore, we are’, recognizing that within Indigenous cosmologies, existence and identities are inseparable from relationships with the land. When we (Indigenous people) speak of the land, we are referring not simply to the piece of ground on which we might stand but also to the water, sky, human and non-human beings, spirits and forces that, in their reciprocal relationships, form and sustain all life. Over Indigenous peoples’ long history, the land has been our most valuable site of learning and source of knowledge (Simpson, 2014; Cajete, 2015; Wilson and Laing, 2019). This has been disrupted, however, by the colonization, settlement and creation of colonial nation states on our traditional territories – processes that start with and are continuously maintained by the displacement and dispossession of Indigenous peoples from their lands. Settlers’ claims to our territories, resource extraction and industrial activities continue to erode our access

to the land. Formal education systems, a critical component of the machinery of colonization and initially designed to assimilate and enfranchise Indigenous peoples, have been a poor substitute for the pedagogy of the land (Simpson, 2017). Beginning with our children’s forced attendance at residential schools in the mid-1800s and persisting today, educational systems in settler colonial countries have been sites of epistemic and ontological violence against Indigenous peoples (Simpson, 2014; Wildcat et al., 2014; Ahenakew, 2016; Hall and Tandon, 2017; Wilson and Laing, 2019). Both inside and outside the classroom, our lands, bodies, identities and ways of being and knowing have been regulated, controlled, policed and reconstructed by steadily enforced colonial regulations and norms.

Land-based education is one way that Indigenous peoples continue to resist the violence of colonial systems. As Wildcat et al. (2014, p. 1) argue, ‘if colonization is fundamentally about dispossessing Indigenous people from land, decolonization must involve

...the framework for land-based education is a model of ‘self-as-relationship... rooted in the context of community and place’.

forms of education that reconnect Indigenous peoples to land and the social relations, knowledges and languages that arise from the land’. Simply moving students from a classroom to the land is not equivalent to ‘decolonizing’ or ‘Indigenizing’ education. The change in location must be accompanied by ‘a change of philosophy, a change of curriculum, a change of teaching methodologies, a change of content’ (Wilson and Wilson, 1999, p. 138). Rather than the ‘self-in-relation’ model that prevails in Western culture and has formed the basis of educational practice and policy in mainstream school systems, the framework for land-based education is a model of ‘self-as-relationship... rooted in the context of community and place’ (Wilson, 2001, p. 91). This sense of self generates a pedagogy that centres on the land and all our relations (those we share the land with; all that forms, animates and sustains human and non-human life; and our collective and individual experience, knowledge and perspectives) as our primary texts and teachers.

Over the last few decades, a growing number of First Nations and other school systems have moved away from classroom-based teaching and taken up or returned to land-based education. Encouragingly, this has contributed to the revitalization of Indigenous traditional teachings, practices and languages. At the same time, however, many land-based programmes draw on, promote or entrench supposedly ‘traditional’ teachings, ceremonies and practices that, in fact, incorporate colonial dogma, hierarchies, roles and protocols that reflect the influence, internalization and transposition of colonial, Judeo-Christian and Western constructs relating to gender, sexual orientation, race and class (Denetdale, 2006; Wilson, 2015, 2018; Wilson and Laing, 2019). These include, for example, requiring trans or two-spirit people to assume gender roles in ceremonies that conform to the gender assigned to them at birth, imposition of types of clothing, enforcing women to sit a certain way, the professionalization of the role of Elders and the



commodification of ceremonies and ‘traditional knowledge’. The avenue through which Judeo-Christian and Western culture has corrupted misconstrued ‘traditional’ teachings, ceremonies and ways of being has been colonial practices, such as church-operated residential schools and the legally enforced suppression or criminalization of Indigenous spirituality and lifeways. Repetitive experiences of epistemic and ontologic violence have left many of our Elders understandably reluctant, unwilling or unable to pass along teachings and practices from their own families and communities to subsequent generations.

Queering land-based education challenges problematic ‘traditional’ teachings and practices, Hunt and Holmes (2015, p. 156) describe queering as ‘a deconstructive practice focused on challenging normative knowledges, identities, behaviours, and spaces thereby unsettling power relations and taken-for-granted assumptions’. In the context of Indigenous land-based education, this deconstructive practice applies to

both what we teach (including, for example, challenging prevailing essentialist constructs and understandings relating to gender or sexuality) and how we teach (including, for example, our expectations with respect to where teaching and learning take place, who our teachers are, or what appropriate power dynamics might be within a group of students and teachers). Queering land-based education also demands our focus on what might best be described as ‘reconstructive practices’, that is, the radical reclamation and reassertion of Indigenous peoples’ cosmologies, of our relationships with the land, and of the knowledge and practices that have nourished and animated these relationships and have enabled and supported our survival, sustainability and well-being. Taking queer theory out of the classroom and into the bush removes it from the abstract context of a text and situates it and us, as teachers and students, in the multitude of relations that constitute the land and ourselves. Together, we place ourselves in

what Muñoz (2009, p. 22) might call ‘a sort of ontologically humble state’, recognizing that what we think we know about queerness, about the land and about ourselves as teachers and learners will be continually reshaped by a practice of relational accountability, reciprocity, radical listening and a readiness to unlearn and learn anew from and with the land and each other.

7.3 .3 .6

CONCLUSION

This section has provided overviews of key areas of research on the role of natural or non-built spaces in learning. This included diverse bodies of work on outdoor and environmental learning, community and place-based learning, interspecies learning and Indigenous land-based learning. While the framings and research reviewed here are not exhaustive,

they provide a broad sense of the types of ways that non-built or more natural environments can shape learning to ‘know, do, be, and live together’ (International Commission on Education for the Twenty-first Century, 1996). These learnings surpass the intended curricula of formal and non/informal education programming and also include the unintended or hidden learning taken from the ways we implicitly interact with the places and world around us. In considering education that goes beyond academic learning to challenge and provide new directions to the big issues of our times, such as colonialism, racism, gender-based violence, fascism, climate change denialism, technologism and more, the research reviewed here suggests possible critical directions for more intentional engagement with natural learning spaces in the futures of education.



7.4

Key messages (implications for education policy and practice)

The wide-ranging evidence reviewed in this chapter suggests a myriad of implications for understanding and designing learning spaces. Core to its contributions, however, is the growing recognition that where education takes place matters for

what is learned – whether that be cognitive, socioemotional or behavioural learning – both intentionally, as well as unintentionally, through what is afforded or assumed in various leaning environments

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The wide-ranging evidence reviewed in this chapter suggests a myriad of implications for understanding and designing learning spaces. Core to its contributions, however, is the growing recognition that where education takes place matters for what is learned – whether that be cognitive, socioemotional or behavioural learning – both intentionally, as well as unintentionally, through what is afforded or assumed in various learning environments.

As a corollary, trajectories of research have identified that who has access to different kinds of learning spaces also limits or enables what is able to be learned. Inequities of race, colonization, region, gender, income, ability and other factors shape access to various types of digital, natural and built learning spaces, and thus people's access to learning and their experiences of it.

These core understandings, as well as their nuances, have many implications for education policy and practice. In relation to exploring further the 'best place' for various learning foci

and outcomes, this has, to date, been inadequately considered in education policy in primary to higher education settings. Still too often, education is taking place in classrooms that remain unchanged from those envisioned at the beginning of mass schooling. There are miseducative effects if we assume that optimal learning occurs through transmissive modes and stationary bodies, and that all types of learners can equally be engaged through mainly cognitive orientations to education and learning. Understanding learning as requiring doing and being, as involving social and emotional practices and active capacities, then requires more attention to the built and non-built spaces in which learners interact, move and effect change in living together. The assumption that adding datatification and digital platforms to, or in lieu of, classroom-based settings is inherently positive for student engagement and learning also needs to be further problematized. While digital means can, in some cases, provide further access

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to and modes of learning, the evidence suggests they need to be considered critically to determine the circumstances under which they can indeed be beneficial.

The research indicates the scope for education policy and policy-making to further engage with the growing evidence on the benefits of varied environments for cognitive, as well as socioemotional and behavioural, learning outcomes. This includes:

- not only considerations such as accessible and sustainable school design, but also when being outside of school buildings in outdoor, community, place and land-based settings can increase the sense of meaning and connection that learners gain from their education and lives;

- a consideration of the benefits of non-formal/ informal learning; in an age of increasing digital connection and yet personal isolation, and associated lowered mental health outcomes for youth and adult learners, it is critical that formal learning go beyond future

job training, to enable learners to find belonging and purpose in their present contributions to a complex and at-risk world;

- connecting formal schooling with the research on the importance of experiential and place-based learning.

Practitioners often have an experienced understanding of how to engage learners in learning to know, do, be and live together in ways that are experiential and placebased, to move through and outside of schools and university classrooms and digital spaces, to enhance engagement and learning. However, without the support of policy, professional development and parental and community education, they also face challenges in trying to diversify and optimize the use of learning spaces to benefit learners.

Overall, further consideration is needed of how both policy and practice can be advanced to more intentionally engage with the effects of learning spaces for a variety of learners.

7.5

Key recommendations (policy recommendations, future research)

We close by highlighting some key recommendations for policy-making and future research.

7.5 .1

POLICY RECOMMENDATIONS

Based on our assessment, the following have been identified as areas of need for policy-making that further address learning spaces.

1. As outlined above, education policy-makers would benefit

from further considering the 'where' of learning in curriculum and pedagogy (policy-making), as otherwise the 'where' can be at cross purposes, rather than supporting and contributing to, the intended 'what' of education.

2. There is a need to increase education policy's consideration of informal and non-formal learning contexts. This includes recognizing the need for a broader uptake of non-school based learning for furthering socioemotional and behavioural learning outcomes, as well as increasing cognitive



learning outcomes for a diversity of learners.

3. Further consideration is needed of how new technologies and insights in architecture are changing, and can transform the insides of classrooms and schools, their configurations, objects, relationships and other aspects that can optimize or contribute to learning outcomes.

7.5 .2

RECOMMENDATIONS FOR FUTURE RESEARCH

Based on our assessment, the following have been identified as areas of need for future research on learning spaces.

1. Longitudinal and comparative work on changes in learning space design and cognitive learning outcomes. This could focus on outcomes associated with sustainable design (and connected to the SDGs) and hybrid spaces, as well as be more sensitive to the

diversity of spaces and ways in which people learn around the world.

2. Interdisciplinary research on the interconnections of built space, natural spaces and digital spaces.

3. Increased research on non-school learning and the relationship of non-school learning to systems.

4. Research implications of considering other species and objects as influences on learning.

5. Broadened research focus on informing all education with Indigenous and land-based priorities.

6. Expanded research on ethical issues of the use of artificial intelligence and smart classrooms, including data collection on students and teachers.

7. Research on teacher led implementation of smart classrooms and learning outcomes.

8. Displacement, refugee children and associated unique digital education needs.

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ACRONYMS



ABC

AAC: Augmentative and Alternative Communication

ADHD: Attention Deficit Hyperactivity Disorder

ABI: Acquired Brain Injury

AI: Artificial Intelligence

AIED: Artificial Intelligence in Educational Development

ALE: Activation Likelihood Estimation

ASC: Autism Spectrum Condition

ASC: Autism Spectrum Disorder.

AT: Assistive Technology

CA: Canada

CCA: Canadian Council for the Arts

CCE: Climate Change Education

CCL: Canadian Council on Learning

CDA: Cognitive Diagnosis Assessment

CNAT: Clasby Neurodiversity Assessment Tool

CPS: Collaborative Problem Solving

CRPD: Convention on the Rights of Persons with Disabilities.

CSCL: Computer Supported Collaborative Learning

CVT: Control-Value Theory

DEF

DBCFSN: Detroit Black Community Food Security Network

DESD: Decade of Education for Sustainable Development

DfE: Department for Education

DFID: Department for

International Development

DH: Department of Health.

DI: Differentiated Instruction

DNA: Deoxyribonucleic acid

DSD: Department of Social Development

DSM: Diagnostic and Statistical Manual of Mental Disorders

DSMMD: Diagnostic and Statistical Manual of Mental Disorders

DT: Design Thinking

DTI: Diffusion Tensor Imaging

DWCPD: Department for Women, Children and Persons with Disabilities

EBE: Evidence Based Education

ECCE: Early Childhood Care and Education

ECE: Early Childhood Education

EdTech: education technology

EE: Environmental Education

EEF: The Education Endowment Foundation

EEG: Electroencephalography

EFA: Education for All

EFL: English as a foreign language

EfS : Education for Sustainability.

EI: Education International

EN: Educational Neuroscience.

ePEN: Electronic Performance Evaluation Network

ESD: Education for Sustainable Development

ESE: Environmental and Sustainability Education

FEC: Futures of Education

Commission

fMRI: functional Magnetic Resonance Imaging

fNIRS: functional Near-Infrared Spectroscopy

GHI

GDP: Gross Domestic Product

GEB: General Ecological Behaviour

GHG: Greenhouse Gas

GIRFEC: Getting It Right for Every Child

GNP: Gross National Product

GWAS: Genome-Wide Association Study

HCT: Human Capital Theory

HDT: High Dosage Tutoring

HESD: Higher Education for Sustainable Development

HPA: Hypothalamic Pituitary Adrenal

ICD: International Classification of Diseases

ICT: Information Communication Technology

IEA: International Association for the Evaluation of Educational Achievement

IDEA: the Individuals with Disabilities Education Act

ILO: the International Labour Organization

ILSA: International Large-Scale Assessment

IoB: Internet of the Body

IOM: International Organization for Migration

IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

ACRONYMS



IPCC: the Intergovernmental Panel on Climate Change	LTD: Long-term Depression	Program – Literacy and Numeracy	Accomplishment	RtI: Response to Intervention	TUV
IPS: Intraparietal Sulcus	LTP: Long-term Potentiation	NCEE: National College Entrance Exam	PET: Positron Emission Tomography	SCS: Sustainable Community Schools	TALIS: Teaching and Learning International Survey
IQ: Intelligence Quotient	LUOTS: Lightning Up the Old Train Station	NCP: Nature’s Contribution to People	PFC: Prefrontal Cortex	SDGs: Sustainable Development Goals	TBI: Traumatic Brain Injury
IRT: Item Response Theory	MNO	NEA: National Education Association	PGS: Polygenic Score	SEAL: Social and Emotional Aspects of Learning	TFI: Teach for India
ISEE Assessment: The International Science and Evidence based Education Assessment	MA: Millennium Ecosystem Assessment	NEP: New Ecological Paradigm	PISA: Programme for International Student Assessment	SEL: Social and Emotional Learning	TPB: Theory of Planned Behaviour
ISTE: The International Society for Technology in Education	MBE: Mind, Brain and Education	NGO: Non-Governmental Organisation	PISA-D: PISA for Development	SEND: Special Educational Needs and Disabilities	UDL: Universal Design for Learning
JKL	MDG: Millennium Development Goal	NCLB-Act: No Child Left Behind-Act	PTE: Pearson Test of English	SES: Socioeconomic Status	UK (or U.K.): United Kingdom
J-PAL: Abdul Latif Jameel Poverty Action Lab	MDES: Minimum Detectable Effect Size	NRC: National Research Council	PTSD: Post-Traumatic Stress Disorder	SLD: Specific Learning Disability	UKABIF: United Kingdom Acquired Brain Injury Forum
KBS: Keep Back Straight	MEG: Magnetoencephalography	OECD: Organisation for Economic Co-operation and Development	RAN: Rapid Automatized Naming	SOGIE: Sexual Orientation and Gender Identity Expression	UN: United Nations
LA: learning analytics	MOOCs: Massive Open Online Courses	PQRS	RCP: Representative Concentration Pathways	STEAM: Science, Technology, Engineering, Arts and Mathematics	UNCRC: United Nations Convention on the Rights of the Child
LATAM: Latin America	MRI: Magnetic Resonance Imaging	PBL: Project-based Learning	RCT: Randomised Controlled Trial	STEM: Science, Technology, Engineering, and Mathematics	UNDESA: United Nations Department of Economic and Social Affairs
LMICs: low- and middle-income countries	MTSS: Multi-Tier Systems of Support	PERMA: Positive emotions, Engagement, (positive) Relationships, Meaning, and	REM: Rapid Eye Movement		UNDESD: United Nations Decade of Education for
	NAPLAN: National Assessment		ROI: Return of Investment		

ACRONYMS

Sustainable Development	Republics (in short: Soviet Union)	WWF: World Wide Fund for Nature
UNEP: United Nations Environment Program	VRU: Violence Reduction Unit	ZPD: Zone of Proximal Development
UNESCO: United Nations Educational, Scientific and Cultural Organisation	VUCA: Volatile, Uncertain, Complex and Ambiguous.	
UNESCO MGIEP: UNESCO Mahatma Gandhi Institute of Education for Peace and Sustainable Development		
UNFCCC: United Nations Framework Convention on Climate Change		
UNICEF: the United Nations International Children's Emergency Fund		
UNPF: United Nations Population Fund		
UNPFA United Nations Fund for Population Activities		
US(A) (or U.S.A): United States of America		
USSR: Union of Soviet Socialist		

WXYZ

WEIRD: Western, Educated, Industrialised, Rich and Democratic

WG1: Working Group 1 (of the ISEE Assessment)

WG2: Working Group 2 (of the ISEE Assessment)

WG3: Working Group 3 (of the ISEE Assessment)

WG4: Working Group 4 (of the ISEE Assessment)

WHO: World Health Organization

WSSD: World Summit on Sustainable Development

WW2/WWII: World War Two

GLOSSARY

WORKING GROUP - 3



ABC

Academic knowledge

Academic knowledge (or skills) refers to knowledge and skills in domains such as numeracy, literacy, science, physical education, and the arts.

Achievement emotions

In the context of learning and education, achievement emotions relate to achievement activities and their success and failure outcomes, such as enjoyment of learning, hope for success, or anxiety before an exam.

Amygdala

The amygdala is a subcortical brain structure and is part of the limbic system (as are the hypothalamus and hippocampus). The amygdala is critical for learning (e.g., forming memories) about the emotional significance of (positive and negative) stimuli, emotion processing and emotional responses, but has also been implicated in processes such as memory processing, motivation, anticipating reward, and decision making. The amygdala - therefore - is involved in all learning, most notably social-emotional learning. Furthermore, the amygdala is closely linked to activity of the HPA-axis. See also: hippocampus, HPA-axis.

Anterior cingulate cortex

The anterior cingulate cortex (ACC) is a brain region involved in various

complex cognitive functions such as error detection, attention, decision-making, empathy, cognitive/impulse control and affect regulation. The ACC has connections to both the limbic system and the prefrontal cortex.

Anthropocene

The term 'Anthropocene' refers to the period of time during which human activity started to influence planetary systems in highly detrimental ways.

Biological/intrinsic Determinism

Intrinsic biological determinism, or bio-determinism, refers to the viewpoint that biological processes and endowments (such as one's DNA) serve as a blueprint for an individual's future development and outcomes. This viewpoint infers a lack of environmental influences and limited human agency.

Character education

Character education refers to the education of one's character, e.g., morality. Character education carries a political connotation and works on an assumption that morality takes the form of supposedly universal conservative 'virtues' such as self-control, loyalty, and obedience. Character education tends to view individuals' characters as both the cause of as well the solution to a wide variety of social problems including poverty, poor educational outcomes and the gender pay gap, thereby 'responsibilizing' the individual.



Cognition

Cognition is the mental process involved in knowing, understanding and learning.

Cognitive empathy

Cognitive empathy is the ability to put oneself in 'other people's shoes' (perspective taking) to understand their thoughts, intentions and actions.

Computational neuroscience

Computational neuroscience is a (research) area of neuroscience that uses mathematical tools and theories to study the brain.

Cortex

The (cerebral) cortex is the folded outer layer of the brain. The cortex is usually subdivided into different lobes: the frontal lobe, the parietal lobe, the temporal lobe and the occipital lobe. The frontal lobe is significantly involved in learning and has been linked to processes such as working memory, inhibition and cognitive flexibility, which are crucial for the learning process. Deeper in the brain, under the cortex, lie subcortical/ allocortical brain structures such as the amygdala, hypothalamus, and hippocampus. Note that different functions have been associated with different brain regions, but most complex functions such as learning or memory rely on networks of interconnected – rather than individual – brain regions.

Culture

Culture is typically understood as values, belief systems and practises shared by groups.

Cumulative risk model

Cumulative risk models account for risk factors in a cumulative manner. It shows that the cumulation of risk factors explains substantially more variance in outcomes (e.g., education and learning) than a single risk factor.

Curriculum

The curriculum is an organising device that influences the way knowledge is framed and presented in the context of schools.

See also: teaching and learning

DEF

Dyscalculia

Dyscalculia is a specific learning disability characterised by persistent difficulties in processing numerical information and acquiring basic arithmetic skills.

Dysgraphia

Dysgraphia is a specific learning disability characterised by persistent difficulties in acquiring handwriting, spelling skills, or both, despite adequate schooling.

Dyslexia

Dyslexia is a specific learning disability characterised by persistent difficulties in learning to read words and poor decoding, the process by which words are sounded out through letter-sound association.

Dynamic assessment

Dynamic assessment (feedback while the test is being conducted), originally, is a highly deliberate sequence of assessment and teaching, where the baseline assessment is followed by targeted teaching with corrective feedback (and often multiple teaching-assessment components), culminating in a final assessment. The main premise of dynamic assessment is its capacity to establish the level of students' performance by characterising their current level of knowledge, following their progress as they acquire new knowledge, and appraising their learning potential as new learning tasks are formulated.

Education

Education is a societal process that shapes human behaviour and social action. It stands for three central types of activities of teachers and students, namely teaching, learning and evaluation, that each express a particular relationship with the actors involved. Education can be framed as a broad, complex system consisting of a set of human and non-human elements and the relationships between them, e.g., teacher-student, self-other, self-self, self-society, self-ecology. Human elements include students, teachers, administrators,

parents, policymakers, stakeholders and various others. Non-human elements comprise learning spaces - classes, schools, virtual, outdoor, textbooks, etc. The term complex system entails the presence in the system of a group of multiple components working both independently and interdependently that prevent the system from being fully controlled and predicted, hence it is bound to evolve in unexpected ways.

Emotions

Emotions in the context of education and learning include (among others) negative emotions such as anxiety, anger, shame, boredom, and hopelessness and positive emotions such as enjoyment, curiosity, hope and pride.

Emotion Regulation

Emotion regulation refers to recognizing and managing emotions

Emotional intelligence

Emotional intelligence refers to the ability to identify, use and manage one's own and other persons' emotions.

Emotional (Affective) empathy

Emotional Empathy and Affective Empathy are used interchangeably and defined as the capacity to respond with an appropriate emotion to another's mental states. It is based on emotional contagion.



Empathy

Empathy is an emotion through which one shows compassion for another person's distress. Empathy also refers to the ability to understand and share the emotional and cognitive states of others. It is a key social relational function that acts as a pathway to higher-order prosocial behaviour, including bonding and forming meaningful relationships, cooperation, and moral decision-making.

Epistemic emotions

In the context of learning and education, epistemic emotions are generated by the cognitive response to learning materials, such as surprise, curiosity, and confusion.

Environmental injustice

Environmental injustice refers to the observation that those who are marginalised, poor, racialized, and Indigenous, in both more developed countries and less developed countries, bear the burden of environmental risks, such as pollution, climate change, and exploitation of their land and natural resources.

Epigenetics/Epigenotype

Epigenetics is the process by which environments affect the molecular level of human bodies by regulating gene expression, and therefore affect phenotypical behaviours and traits without changing DNA itself.

Research in epigenetics is interested in how social environments affect gene expression. Epigenetics proposes that the environment, including material and social factors, plays an important role in shaping how genes work within human lifetimes and across generations.

Eudaimonic theory of well-being.

Eudaimonic theories of well-being suggest that persons live a life of well-being if they realise goods that are deemed to be objectively good for all people or if they develop or have developed their human capacities to the full (i.e., functioning well).

Executive functions

Executive functions are a class of cognitive processes that are thought likely to facilitate academic performance. Executive function abilities are defined as a set of separable, but overlapping, cognitive skills comprised of: 1) working memory, defined as the ability to hold information in mind and update it; 2) inhibitory control/response inhibition, defined as the ability to inhibit a highly learned response to a stimulus in favour of a less dominant response; and 3) cognitive flexibility/set shifting, defined as the ability to attend to distinct but closely related aspects of a given set of stimuli, such as the ability to group a set of objects by the dimension of colour and then by the dimension of shape. Collectively, these skills enable individuals to focus attention, regulate impulses, switch between competing demands, and engage in goal-directed activities.

Explicit learning

Explicit, visible and measurable learning is learning such as prioritised in curricula or measured through assessment outcomes. Compare with: implicit learning.

Extrinsic motivation

Extrinsic motivation involves investing effort in order to avoid failure.

Family-School Partnerships

Family-school partnerships refer to alliances in which families and professionals confidently build on each other's word, judgement, and wise actions to increase educational benefits to students and themselves. Family-school partnerships are conceptualised as relationships that encompass and surpass parent/family involvement and engagement. Whereas "involvement" refers to families merely taking part in an activity, partnership embodies equity, mutual responsibility, and commitment.

Fixed mindset

A fixed mindset is the belief that abilities (e.g., intellectual abilities) are set and unchangeable.

Formal education

Formal education refers to the structured education system that runs from primary (and in some countries from nursery)

school to university, and includes specialised programmes for vocational, technical and professional training.

Formative assessment

Formative assessment or "Assessment for Learning" is a form of educational assessment used to (daily) monitor students' learning progress and provide feedback over the course of an instructional unit to identify students' learning needs and adjust teaching accordingly to improve students' achievement and enhance ongoing learning.

GHI

Gene-environment interactions

Gene (or genetic)-environment interactions refer to the finding that individual genetic makeup interacts with one's personal (e.g., educational, socioeconomic, etc.) experience.

Social Genomics

Social genomics refers to research methods where genomics methods and insights converge with social scientific modes of analysis.



Global North and Global South

The Global North and Global South (or North–South divide) is a political and socio-economic division of Earth popularised in the late 20th century roughly based on the categorisation of the countries by their economic and developmental status. Generally, definitions of the Global North include Australia, Canada, Israel, Japan, New Zealand, Singapore, South Korea, Taiwan, the United States, and almost all the European countries. The Global South is made up of Africa, Latin America and the Caribbean, Pacific Islands, and most of Asian countries, including the Middle East.

Grey matter

Grey matter makes up the folded outer layer of the brain (i.e., the cortex) and consists mostly of neuronal cell bodies and glial cells.

See also: white matter.

Grit

Grit refers to the persistence and passion that underlie goal-oriented behaviours towards a larger superordinate goal and have been linked to learning in several contexts.

Growth mindset

A growth mindset is the belief that abilities (e.g., intellectual abilities) can be developed and improved through, for example, dedicated effort and learning.

Health

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (World Health Organization, 1948).

Hedonic theory of well-being

Hedonic (or subjective) theories of well-being equate well-being to having positive emotions about life and presume that individuals themselves are the judges of their well-being (i.e., 'feeling well').

Hippocampus

The hippocampus is a brain structure located in the allocortex and is part of the limbic system (as are the amygdala and hypothalamus). The hippocampus is primarily involved in memory processes and learning. Furthermore, the hippocampus is closely linked to activity of the HPA-axis. See also: amygdala, HPA-axis.

Holistic learning

The purpose of holistic learning is to seek a balance between the different dimensions of the being: the body, the intellect, the emotional and the spiritual, as necessary conditions for wellness.

HPA-Axis

The Hypothalamic Pituitary Adrenal (HPA)-Axis is a biological stress system

(i.e., neuroendocrine system) that controls reactions to stress as well as many body processes. HPA-axis activity follows a circadian rhythm and is activated in response to cognitive (e.g. fear, excitement, anxiety) or non-cognitive (e.g. infections) stressors. Furthermore, the HPA-axis is closely linked to activity of the amygdala and hippocampus. See also: amygdala, hippocampus.

Human Flourishing

Human flourishing is both the optimal continuing development of human beings' potentials and living well as human beings. Living well as a human being means being engaged in relationships and activities that are meaningful, i.e. aligned with both their own values and humanistic values, in a way that is satisfying to them. Flourishing is conditional on the contribution of individuals and requires an enabling environment (e.g., fulfil basic biological and existential needs. It can be regarded as a particular interpretation of well-being. Furthermore, flourishing involves community and is an interpersonal, not a personal pursuit.

Hybrid learning spaces

Hybrid learning spaces are 1) physical learning spaces (with virtual aspects), and virtual learning spaces (with physical aspects), with understandings of the latter being contributed to from learning sciences, computer supported collaborative learning and human computer interaction studies.

Implicit (or hidden) learning

Implicit or hidden learning is learning that extends beyond the explicit curricula of education. Compare with: explicit learning

Inclusive education

Inclusive education is a human-rights based approach to education where there is respect for diversity and all members of the learning community are welcomed equally. The central idea of inclusive education is that each student receives the best and most comprehensive education that is appropriate for their needs, and that all students must feel valued, respected, included and listened to. Note that inclusive education is an approach to education, and not necessarily a place. Inclusive education does not mean that a student cannot get specialised help outside the classroom walls. Compare with: special education.

Informal education

Informal education or learning, refers to activities such as free or guided play (e.g., role-playing, singing, counting games) and creative activities, which are closely linked to learning and development in childhood and beyond.

Informal learning

Informal learning is the process by which people acquire knowledge, skills, and attitudes through everyday experience and



exposure to the environment in which they live. See also: informal education

Interdisciplinary/Multidisciplinary/Transdisciplinary

Three terms used interchangeably in the ISEE which refer to combining and/or involving several academic disciplines or professional specializations in assessing education and learning.

Intersectionality

Intersectionality refers to a tool to examine the dynamic and complex ways in which people's multidimensional experiences based on e.g., race/ethnicity, class, gender, sexuality, ability, citizenship, and religion, shape identities and social opportunities. Intersectionality examines the influence of power in shaping people's multidimensional lives by expanding the examination of identity categories beyond simplistic, static, one-dimensional, and additive approaches to understanding the simultaneous and mutual factors of social location and structural disadvantage.

JKL

Learning

Learning refers to coming to make sense of what one is taught and happens when students' potentialities are evoked to come to understanding in agential ways of

being and acting. Learning would fail to be learning, if students' potentials are not evoked in the quest to gain understanding, insight, and be encouraged to embark on an academic, political, economic, social and environmental journey with a quest for human flourishing. The broad perspective of learning encompasses both learning as process, as experience, and as outcomes. Learning is a process of active meaning-making situated in context, based on which relatively permanent changes occur within any one or more of the following: human dispositions, capabilities, knowledge, behaviours, values, attitudes, and/or preferences. Learning thus involves relational, embodied, affective and non-conscious ways of knowing and is inherently social, emotional, relational and affective. Learning is heavily influenced by cognitive, emotional, motivational and social brain processes that are all interdependent, as well as by culture (e.g., value and belief systems and practises shared by groups) and other environmental factors (e.g., socio-economic status/SES). See also: learning experience.

Learning analytics

Learning analytics refers to the collection of multiple forms of data from a variety of learning platforms and apps, in order to diagnose and predict dimensions of educational performance, and ultimately produce "actionable insights" of immediate and demonstrable instructional effectiveness.

(Specific) Learning disability

A (specific) learning disability (SLD) traditionally refers to any (neurobiological) condition that impairs a child's ability to learn. They arise when persistent difficulties acquiring academic skills are unexpected in the context of age and grade level standards. Most common learning disabilities are in the areas of reading (dyslexia), mathematics (dyscalculia), and/or written expression (developmental coordination disorder or dysgraphia). This 'pathology', 'deficit', or 'medical' model views neurological differences as impairments and deficits, and has recently been complemented with the view of atypical learning or neurodiversity. See also: atypical learning, neurodevelopmental disorder, neurodiversity

Learning experience

Learning experience by the International Bureau of Education (UNESCO) is defined as "A wide variety of experiences across different contexts and settings which transform the perceptions of the learner, facilitate conceptual understanding, yield emotional qualities, and nurture the acquisition of knowledge, skills and attitudes. Thus, the learning experience at the individual level is intrinsically cognitive, emotional and social. In educational settings learning experiences are ideally challenging, interesting, rich, engaging, meaningful, and appropriate to learner needs. Previous learning experiences are considered to be key factors predicting further learning". See also: learning.

Learning places

Learning places indicate identifiable or particular settings in which education and learning take place, such as a classroom, a school, a neighbourhood, a territory. See also: learning spaces.

Learning spaces

Learning spaces are physical (built or natural) and digital spaces or sites in which education and learning occurs, e.g., schools, outdoors, nature, virtual/digital. Furthermore, 'spaces' here can be understood as the way in which geography shapes social relations and practises, connecting things and people. See also: learning places.

Learning trajectories

Learning trajectories are descriptions of children's thinking as they learn to achieve specific goals in an academic domain (e.g., mathematics), and a related, conjectured route through a set of instructional strategies and activities designed to move children through a developmental progression of levels of thinking. See also: Pillars of Learning

Long-term Depression

The weakening of a postsynaptic electrical response in the brain.



Long-term Potentiation

The strengthening of a postsynaptic electrical response in the brain.

MNO

Metacognition

Metacognition is “thinking about thinking” or “learning to learn” and refers to processes such as monitoring of attention, emotion and behaviour. Students can use metacognitive processes and strategies to monitor and reflect on their own learning.

Mindset

An individual’s mindset is the beliefs about the nature of human attributes (e.g., intelligence) that affect one’s actions.

Motivation

Autonomous/Intrinsic motivation

Autonomous, or intrinsic, motivation involves being motivated by inherent interest and enjoyment in an activity, or by internal endorsement of the activity and its importance.

Neuroplasticity

Neural plasticity (or neuroplasticity) refers to the anatomical and functional changes

of the brain underlying cognitive and behavioural changes during development in relation to place, time and context-specific experiences or in response to an intervention, e.g. learning or training.

Neurocentrism

Neurocentrism, or neurocultures, is a viewpoint based on the idea that the brain is conceived as the foundation of many aspects of human nature and social life and where the ability to know key truths about the self and the social are dependent upon developments in neuroscience.

Neurodevelopmental disorder

Neurodevelopmental disorders encompass a broad array of (often co-occurring) disorders that involve impaired development of cognitive or motor functions manifest from childhood. There is no consensus across different diagnostic and classification systems for what is considered a neurodevelopmental disorder, but these tend to include specific learning disabilities (SLDs), communication disorders, motor disorders, autism spectrum disorder (ASD), attention deficit hyperactivity disorder (ADHD), tic disorders, and intellectual disability. See also: (specific) learning disabilities

Neurodiversity

The concept of neurodiversity emphasises that variation in neurodevelopment leads to strengths as well as impairments, and that children with disabilities are not

inferior to their typically developing peers. From the neurodiversity perspective, ‘disorders’, such as autism and ADHD, are seen as variations in brain structure and function, which lead to ways of thinking and behaving that are different from most people in society.

Neuromyth

A neuromyth refers to a misconception generated by a misunderstanding, a misreading or a misquoting of facts scientifically established (by brain research) to make a case for use of brain research, in education and other contexts. Neuromyths, broadly, are overly simplified facts about the brain which lead to suggestions about learning in general as well as teaching practises that are incorrect. Their mythical status means they are enduring: even when the claims are repeatedly shown to be false, they continue to circulate as scientifically based truths.

Neuroscience

Neuroscience, as a field of research, includes neurochemistry, molecular biology, electrophysiology, neuroanatomy, neurophysiology, and neural network studies.

New materialist (or posthuman) approach to pedagogy

The new materialist (or posthuman) approach to pedagogy and learner experience speak to creative teaching and

learning methods that embed the learner within their local places, contexts and materialities, dissolving the old binaries between humans and nature, children and their everyday worlds. Although there is no single definition of New materialism, the term is often used to describe a theoretical turn away from the persistent dualisms in modern and humanist traditions whose influences are present in much of cultural theory.

Non-formal education

Non-formal education refers to planned, structured programmes and processes of personal and social education for young people designed to improve a range of skills and competences, outside the formal educational curriculum.

PQRS

Prefrontal Cortex

The prefrontal cortex (PFC) is a brain region located at the front of the frontal lobe. The PFC linked to a variety of complex behaviours and processes such as metacognitive skills including monitoring of attention, emotions and thinking patterns, and executive functioning skills (e.g., working memory, inhibition/cognitive control and cognitive flexibility). The PFC regulates the activity of the limbic system (see Amygdala and Hippocampus). See also: frontal lobe, executive functioning skills.



Prerequisite/foundational skills

Prerequisite, or foundational, skills are skills acquired in non-school and school contexts that are important for acquiring new knowledge throughout school. Examples are vocabulary, letter and number knowledge.

Play

Play is a multi-faceted concept which can be thought of as a disposition, attitude or activity that is voluntary (i.e., undertaken for one's own sake), pleasurable and intrinsically motivating. Play can be scaffolded by skilled adults (guided play) or independent (free play). With reference to education and learning, play is often part of informal educational practises.

Polygenic (risk) scores

A (genome-wide) polygenic score (PGS), or polygenic risk score, for educational attainment is an aggregate data-score calculated from information about a person's personal GWAS outcomes i.e., genetic loci that are associated with educational attainment, cognition and learning environments. Polygenic scores for educational attainment summarise how much of the total variance in educational attainment is influenced by differences in genetic loci. See also: GWAS and PGS.

Pruning, synaptic

Synaptic pruning is a process through which unnecessary connections in the

brain are eliminated, thought to aid in making information processing more efficient.

Randomised Controlled Trial (RCT)

A Randomised Controlled Trial is a research design in intervention research which offers (insight into) causal inference.

SDG4.7

At the 70th Session of the UN General Assembly in September 2015, member states adopted the 2030 Agenda for Sustainable Development. It aimed to engage the nations of the world towards collectively promoting sustainable development, decrease global inequalities, and realise universal quality education. At the heart of the Agenda were 17 SDGs, including SDG 4, which covers education seeking to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.' In SDG4.7, it is highlighted that by 2030 it should be ensured that all learners acquire knowledge and skills needed to promote sustainable development, including among others through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development.

Social emotions

In the context of learning and education, social emotions relate to teachers and classmates, such as compassion, admiration, contempt, envy, anger, or social anxiety in the classroom.

Social neuroscience

Social neuroscience explores the ways brain structure and functioning are affected by social and environmental factors. Social neuroscience focuses on the brain's function in its social context. As a field, it investigates how the brain supports 'communication, social perception and recognition, impression formation, imitation, empathy, competition, cooperation, pair-bonding, mother-infant attachment, bi-parental caregiving, social learning, status hierarchies, norms and cultures, social learning [sic], conformity, contagion, social networks, societies, and culture'

Social psychology

Social psychology is concerned with how individual thoughts and cognitive processes are shaped by social contexts, interactions and influences.

Science

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence (WG1-3)

Self-Awareness

Self-awareness (in the context of social and emotional learning) refers to the ability of a person to accurately recognize their emotions and thoughts, and understand how these influence their behaviour.

Self-Determination Theory

Self-determination theory is a 'needs' theory of motivation positing that humans have three universal psychological needs, namely: the need for autonomy, the need for competence, and the need for relatedness, which promote optimal human functioning and well-being. The need for autonomy is satisfied when behaviour, feelings and thoughts are experienced as one's own choice and self-endorsed. The need for competence describes a sense of mastery in activities that one considers important. The need for relatedness concerns the sense of connectedness with those who are important to an individual, in the school-context e.g., teachers and peers at school.

Self-regulation

Self-regulation refers to skills to regulate behaviour, emotions, and thoughts in the pursuit of long-term goals, and include the ability to delay gratification, pay attention, and control impulsivity.

Social Emotional Learning (SEL)

Social emotional learning (SEL) involves the processes through which



people acquire and effectively apply the knowledge, attitudes, skills and competencies to recognize, understand and manage their emotions, feel and show empathy, care and concern for others, establish and achieve positive goals, develop and maintain positive relationships, make responsible decisions and handle challenging situations.

Special education

Special education provides schooling to students with disabilities (both physical and psychological in nature) in separate educational settings from that of their peers without disability. On its extreme end, children with disabilities are taught in special schools according to their disability. Additionally, these children are often congregated into segregated classrooms according to their disability. Compare with: inclusive education.

Systemic Social Emotional Learning (SEL)

Systemic SEL is an approach to create equitable learning conditions that actively involve all Pre-K to Grade 12 students in learning and practising social, emotional, and academic competencies.

Summative assessment

Summative assessment or “Assessment of Learning” is a form of (often standardised) educational assessment typically given at the end of an instructional unit (e.g., a course or grade level) to assess

student learning outcomes in order to find out whether they have attained a predefined set of standards, expectations or instructional goals, or as a selection method to follow-up educational tracks or the labour market. In addition to evaluating learners, summative assessment also describes the process of evaluating the effectiveness of sequences of instructional activities to provide information for judging the overall value of an education program - as well as for ranking schools and education systems.

TUV

Topic emotions

In the context of learning and education, topic emotions pertain to the topics presented in class, such as empathy with the characters portrayed in a novel.

Transformative Social Emotional Learning (SEL)

Transformative SEL is concerned with advancing equity in access to resources and outcomes in education. Transformative SEL competencies focus on identity, intersectionality, agency, belonging and engagement as central to furthering social-emotional development and achieving equity in education.

WXYZ

Well-being

Well-being is a multidimensional construct covering anything from cognitive appreciation of one’s satisfaction with life up to subjective, highly affective experiences of happiness. In the ISEE Assessment, well-being is seen as an umbrella term of the two central concepts happiness and flourishing.

White matter

White matter is a fatty layer on the brain consisting of an insulating myelin sheath which aids in faster transmission along axons.. Compare with: grey matter.

Zone of Proximal Development

Vygotsky’s zone of proximal development (ZPD) indicates an area of sensitivity that measures what a child can do on her/his own and what she/he can do with assistance of a more experienced other such as adults, peers and digital tools.



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