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INNOVATIVE LEARNING ENVIRONMENTS

Constructing Education: An Opportunity Not to Be Missed



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Foreword

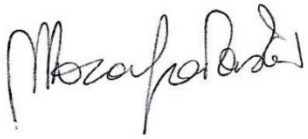


The Council of Europe Development Bank (CEB) is committed to supporting social investments that foster inclusive and resilient growth in its 42 member countries. The education sector has represented a significant share of the Bank's total lending throughout CEB's over sixty years of existence. While most of its financing is directed towards physical infrastructure, the CEB's ultimate goal is to support education outcomes to foster economic growth and social cohesion.

The importance the CEB attributes to supporting the learning process is reflected in its practice, which is documented by the series of publications on Innovative Learning Environments that have been issued over the last three years. Drawing on its long-term experience financing the education sector as well as in-depth Thematic Reviews conducted in Espoo, Finland (2018), Seine-St-Denis, France (2019), and Malmö, Sweden (2020), the CEB has developed a robust framework to guide investments in the sector so that they can better contribute to promote students' learning outcomes.

The framework has been developed in cooperation with and validated by scholars from different countries and by education experts from the International Financial Institutions that are part of the 'Network for Effective Learning Environments'. Their review and feedback provided on earlier versions of this report are kindly acknowledged.

We look forward to applying this framework in future lending operations with the goal to enhance students' learning outcomes.



Monica Scatasta
Director, Technical Assessment and Monitoring Directorate
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Preface



Countries invest a significant amount of resources in the construction and renovation of schools. Indeed, according to Eurostat, in Europe alone, EUR 48 billion was allocated to this activity. International Financial Institutions (IFIs) play a key role in supporting countries in their efforts to expand and renew education infrastructure by facilitating their access to the necessary financial resources at attractive rates and conditions and by ensuring that high quality standards are applied to their design, implementation and operation.

Investing in school buildings is usually seen as essential to ensuring access to education and safety at school for all, but it also plays a key role in the education process by ensuring that students are provided with adequate conditions for learning. It is not by accident that under the 2030 UN Agenda for Sustainable Development, Sustainable Development Goal number 4, on the need to ensure inclusive and equitable quality of education for all, includes *building and upgrading safe schools* as a key target.

It is critical to examine the relationships between teachers, students and space.

The Covid-19 pandemic has had a significant impact on education and will change how we think about schooling. School closures across the world highlighted the importance of space and materials to the total educational experience, but also showed how learning depends on so much more than a school building. It is clear that it is not possible to keep considering the school premises in isolation, as sometimes happens when the focus is on construction and investment. In addition to supplying the school building, it is necessary to understand how the physical and other resources are used in the learning process. It is necessary to examine the relationships between teachers, students and space, seeing how teaching and learning are enabled or constrained. Although changing the school premises or providing digital technology can be aspects of developing new approaches to learning, these attempts will only succeed through broader support for change combined with attention to the detail of how teachers use a space and resources. A learning environment can go beyond ensuring that the adequate conditions for learning are in place. It can also promote and support changes in teaching and learning practices. An innovative learning environment can inspire school staff to develop new practices to better respond to today's expected student learning outcomes.

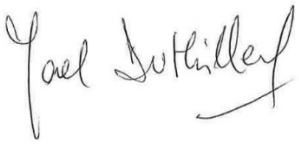
This report argues that financing education infrastructure provides a broader opportunity to support learning processes. To seize it, infrastructure and education investments need to be conceived from the beginning as a single, intertwined process. One of the key messages of the report is that financing effective education infrastructure requires supporting school staff develop the pedagogical environmental competencies needed to appropriate the new spaces and make effective use of their learning potential.

The report proposes a framework to guide investments in education infrastructure along four distinct phases, from the initial design brief to the full occupation and use of the new premises. It presents a series of activities that can be undertaken along the various phases to promote more effective use of the learning environments financed. National decision-makers can make a difference by including the costs of these activities, which is generally marginal, in the total costs of the investments. And IFIs can play a key role by encouraging the inclusion of these additional costs in the financing they provide.

The first section of the report reviews the literature, first exploring the links between the physical characteristics of the school setting and student learning, then moving on to the nature of this relationship and the mediating effect of people and use, before drawing its conclusions on the effects of the school setting on student outcomes. The second section builds on this evidence to propose a framework through phases of collaboration among different stakeholders to guide investments in education infrastructure so that they can better contribute to the expected learning outcomes. The third section focuses on the particular role of International Financial Institutions in ensuring the application of the framework. A set of tools to facilitate its implementation are included in the Appendix.

Financiers should use their unique position to support the development of education infrastructure and its effective use to enhance learning outcomes for all.

I hope that the new perspective introduced in this report will contribute to increasing awareness about the responsibility each stakeholder has to ensure that the resources invested truly contribute to quality learning outcomes for all.



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Introduction

The built education environment is now a global concern.

There has been a marked worldwide increase in interest in the built environment of education. This has been driven by a range of factors. In much of Europe, the schools built in the aftermath of the destruction of the Second World War had aged and, by the turn of the millennium, many were getting beyond their intended lifespan and had to be replaced. Migration, both internal, driven by urbanisation trends, and external, by the flux of refugees, has impacted on the demand for additional schools. Nordic countries such as Finland and Sweden are responding to the recent influx of migrants with new constructions, while in countries such as Iceland, internal migration to the capital has fostered the development of new urban areas that require new schools. Even in countries with more stable demographics, certain areas are growing more rapidly than others, as in the case of the department of Seine-Saint-Denis in France where major investments are underway to build new secondary schools to respond to the population growth of a highly diverse population.

Natural disasters also impact on the demand for new education infrastructure. Recent seismic disasters have led Italy and Turkey to launch major renovations and strengthen efforts to rebuild their schools. Concerns for the environment and the need to reduce the carbon footprint and energy consumption have also been major drivers for investments in education infrastructure. This was one of the major challenges for the post-Soviet states in the 1990s, which inherited an education infrastructure that was very inefficient in terms of energy consumption and very costly to maintain. It has also been one of the major drivers of EU countries' efforts to comply with the EU's 2030 Climate and Energy Framework that aimed to reduce greenhouse gas emissions by 40% (from 1990) by that same date. It will continue to be a driver in the years to come through the EU Green Deal, which provides a strong political boost to invest in educational infrastructure in order to meet more ambitious targets sooner and for Europe to become a carbon neutral continent by 2050.

Finally, and not least, developments in the understanding of the learning process, combined with IT progress, have led to reconsiderations of pedagogy and the teacher's role (Leat et al., 2012). These new conceptions of learning underpin calls for new learning environments, with implications for school space, both physical and virtual. The type of competencies and skills expected of graduates today go well beyond basic literacy and numeracy skills. To facilitate the development of the 4 Cs of critical thinking, creativity, collaboration and communication skills called for by the 21st century requires new learning spaces to foster the appropriate teaching practices and interactions. This demand for Innovative Learning Environments (ILEs), conceived as settings for learning that can encompass social, educational and technological requirements, and materialised through flexible spaces of different sizes to better meet different education objectives and individual student needs, is also part of recent calls for investments in education infrastructure.

The global commitment to 'Education for All' (UNESCO, 2000; 2015), and the resulting increased enrolment, followed by the more recent global commitment to meet the UN Sustainable Development Goals, has produced in many developing countries a 'demand for more and better school facilities' (Sifuna, 2019: 568), while the existence of a global discourse about the importance of school space is demonstrated by the various OECD initiatives and publications (e.g. OECD, 2013, 2017). Beyond the many national programmes in Europe, the need to increase investments in education was a priority of the Finnish EU Presidency in 2019. The EIB and the CEB were invited to present their experiences at the EU High-Level Group on Education and Training in October 2019 in preparation for the first joint EU meeting of the ECOFIN and Education Ministers in November 2019. Even if significant amounts of funds are invested in education infrastructure in Europe today, (on average, 6% of education expenditures or about EUR 48 billion, were allocated in 2017, according to Eurostat), according to recent studies, these amounts are insufficient to meet the growing needs and have been declining over the last decade. An increase of 25% was recommended by the High-Level Task Force on Investing in Social Infrastructure (ELTI, 2018) to meet present needs.

In light of this increased interest and activity in school construction, and the related upturn in awareness of the importance of the physical environment of education, now exacerbated by the new challenges brought about by Covid-19, its implications for health and safety in schools and an effective and equitable access to technology to support quality learning for all, there is now an opportunity not to be missed for influencing educational outcomes through investing in facilities that can adequately respond to these new expectations. 'Leveraging infrastructure investments' has been presented as a means to recruit teachers, enhance student outcomes and sustain community engagement (Woolner and Uline, 2019). It is necessary, however, to consider exactly how educational infrastructure investments can be used to support the education process in order to achieve the intended student outcomes. This matter has led to the need for this publication, which will consider the research evidence for the way that a school building interacts with the education process, particularly in the case of new or changed space. The aim is for the resulting synthesis of research relating to school environments, the design process, educational change, and teaching and learning practices to inform recommendations to maximise the educational benefits resulting from investing in the physical space.

Investing in education facilities is an opportunity not to be missed for influencing educational outcomes.

In most countries, it would not be possible to write now, as education researcher, Helen Clark, did in 2002 in relation to the UK position that, '*The neglect of school buildings in the past quarter of a century corresponds with a lack of educational research into their use. Investigation into the physical environment as a variable influencing learning outcome has been largely ignored in favour of research into pedagogical, psychological and social variables'* (Clark, 2002: 3).

In the last fifteen years, significant research has clarified the importance of school facilities, demonstrated the potential of new learning environments to support expanded conceptions of the learning process, but has also revealed the challenges of changing educational space and practices. The evidence from these different lines of research will be presented in order to help develop a framework to better guide investments so that the process of financing new school buildings and premises can be used to change or develop education, and so improve educational outcomes.

We must ensure that new school buildings are used to achieve high quality learning outcomes for all.

For International Financial Institutions committed to supporting the development of education infrastructure, a challenge that becomes central is to ensure that the financing provided to enable the construction and renovation of school premises does indeed support the educational processes and expected student outcomes.

This means going beyond having new and modern buildings, as it is ensuring the buildings are used to achieve high quality learning outcomes for all that justifies the investment in the first place from an economic and development point of view.

1 What Does the Research Show?

The limits of 'evidence' in education

Over the last two decades, there has been growing discussion as to the nature, purpose and worth of education research. Drawing on developments in medicine in the 1990s, the 'What works' agenda has gathered pace: there is increased demand that education research should produce unequivocal, empirical *evidence* on which both policy and practice can be *based.* Although the extremes of this position, such as proposing that research funding should be concentrated on the 'gold standard' of randomised controlled trials (Slavin, 2002; Goldacre, 2013), seem to be mainly an Anglo-American phenomenon, there have been indications of the rhetoric spreading within Europe. For example, the Danish Clearinghouse for Educational Research, established in 2006, aims to provide 'access to reliable, informed knowledge about upbringing, teaching and education that can be used in practice and policymaking' (http://www.eippee.eu/cms/Default.aspx?tabid=3240).

Moreover, European scholars have found it necessary to engage with and critique this narrow, misleading conception of valid research. Most prominently, Gert Biesta has argued 'Why *what works* won't work' (Biesta, 2007) and Tone Kvernbekk (2011) sets out the lack of philosophical underpinnings for 'evidence-based practice'. Kvernbekk draws on the philosophy of science to consider how evidence can provide grounds for belief in a hypothesis. This leads to rejecting the supposition that 'practice could and should be *derived* from a foundation of evidence' (Kvernbekk, 2011: 523). In fact, as philosophy makes clear, 'A hypothesis, or a teaching strategy, is not *based* on evidence; instead it is *supported* by it' (Kvernbekk, 2011: 523, italics in original). This key idea should be understood as inherent to the approach to evidence of this report.

This report proposes a coherent framework to be used for making recommendations about school design and build processes, which could condition the investment.

Further, it is not possible to bring together the diverse range of relevant knowledge and empirical findings into a single systematic review or meta-analysis, although, as we will see, it might be worth attempting such a synthesis within specific, defined areas of the wider enquiry. Therefore, this report will develop a narrative understanding, working logically through empirical and historical research in education to build a coherent framing of this complex area that is supported, but not be determined, by the accumulated evidence, and which, importantly, can be used to make recommendations about school design and development processes that could function as conditions for investment.

The foundational question underpinning most initial inquiries into the relationship between school space and education is a variant of 'Does the physical environment affect learning?' Reviewers then comb the research literature across a range of disciplines including psychology, education, sociology, architecture, building management and environmental engineering, looking for evidence to answer this question. As will be described below, it becomes evident that although this question can be answered with a 'yes', the usefulness of this conclusion is severely limited since it immediately provokes a barrage of harder questions along the lines of 'how?', 'when?' or 'where?' and, crucially, 'What can be done to gain most advantage for students, in terms not only of learning but also of their wider educational experience?'.

However, for completeness, we will first answer this initial question by considering the evidence base directly, before moving on to what this overview and the conclusions of a number of reviews (Weinstein, 1979; Higgins et al, 2005; Blackmore et al., 2011; Byers et al., 2018) of this evidence tell us about how to answer the harder questions.

Underlying physical characteristics of the school setting

There are two main research paradigms that concern themselves with measuring aspects of the underlying physical environment and relating these measurements to quantifiable student outcomes. These need to be considered together to answer the question of the impact of the physical environment on learning, whatever the nature or style of the intended learning.

We need to consider different types of research to see how the physical environment can influence learning outcomes.

One approach works with a large data set to correlate some measure of the quality of the building with student outcomes, often relating to academic achievement (e.g. Uline and Tschannen-Moran, 2008; Maxwell, 2016), but alternatively to attendance (Durán-Narucki, 2008) or behaviour (Kumar et al., 2008). Much of this research has been conducted in the US, where state or district level databases of buildings assessment results and student test scores across schools lend themselves to secondary data analysis. However, a study in the UK, where researchers conducted their own assessments of physical characteristics at the classroom level (Barrett et al., 2015), is a notable and recent addition to this collection of studies. Also, on occasion, a study of this type will focus on a particular physical characteristic that can be measured across schools, such as area per student (Maxwell, 2003), and correlate that with student outcomes. Overall, this body of research tends to find a small, but positive relationship between school building quality and student outcomes (Woolner and Uline, 2019). There have been some occasional exceptions (e.g. Picus et al., 2005), but Roberts (2009) argues convincingly that these result from assessing physical factors, such as boiler efficiency, that could not be expected to influence learning or, consequently, student outcomes. This brings us to the central limitations of these studies: although large in scale and quantitative, the logic of this work is correlational, demonstrating a relationship, but one that is not necessarily causal, between aspects of the physical space, which are not always well-defined, and student outcomes.

To arrive at an answer to our question of whether the physical environment actually affects learning, it is necessary to consider the correlational research studies that assess the wider learning environment, alongside the other type of research. These complementary studies are narrower, often focusing on the impact of one physical variable, such as temperature, air quality or noise, and are often small scale. They range from experimental work, generally but not always conducted in laboratory conditions, to investigations into the incidence and effect of specific, physical deficiencies within the school setting. By suggesting some mechanisms whereby aspects of the physical environment can influence learning they lend credence to the correlational findings, so we will consider some seams of this research.

Many years of research into the impact of noise shows that noise interferes in the short term with learning tasks (Salame and Wittershiem, 1978; Hygge, 2003) as well as being distracting and annoying (Cohen et al., 1980). Research in school settings demonstrates that they are often noisy (Shield and Dockrell, 2004), and indicates that long-term exposure to external noise impairs learning (Evans and Maxwell, 1997; Haines et al., 2001), seeming particularly to interfere with language development (Maxwell and Evans, 2000). Such external noise may have other consequences for physical and mental health (Haines et al., 2001). Historically less well researched than noise, the impact of air quality on learning has been studied in real educational contexts. Earlier research that examined the link between the level of particles (pollutants and pollen) in the air and attendance (Rosen and Richardson, 1999) was suggestive, but not conclusive, about the long-term effects of poorer air on health and, therefore, on student outcomes. More recently, a very elegant experiment (Bakó-Biró et al., 2012) using a real classroom and varying the ventilation in a way that was not evident for the participants, found that carbon dioxide in a standard-sized, enclosed and unventilated classroom containing a class of 30 students rose within an hour to a level that impairs learning. Ongoing measurement and intervention studies from the Nordic countries (e.g. Ahman et al, 2000; Toyinbo et al., 2016) testify to the problems of mould and carbon dioxide resulting from inadequate ventilation in schools in a challenging climate. Temperature has been similarly investigated in authentic educational settings (Marchand et al., 2014) and evidence produced that raised temperatures negatively affect learning. Although there is some disagreement about how hot is too hot (Wong and Khoo, 2003), this is yet another piece of evidence that the physical environment does influence

learning, resulting in the relationship found between school building measurements and student outcomes. The other foundational physical characteristic that has been researched in relation to learning is light, but here the evidence is less conclusive. Nevertheless, lab studies can, unsurprisingly, show impairment of performance on tasks when light levels are low (e.g. Smith, 1976) and, conversely, if light levels are high, there is some indication of problems with glare, such as headaches (Barnitt, 2003). However, what has not been established, despite some attempts, is evidence of an effect on learning of daylight over (adequate) artificial light; neither is there much suggestion that the variation in light levels found routinely in schools affects learning.

Noise, poor air quality and extreme temperatures have a negative effect on learning.

A final quantifiable variable that has been related to learning is student density within a space, which results from class numbers intersecting with the available area. In her review of 1979, Weinstein considers this factor and concludes that lab experiments provide some suggestion of a negative impact of crowding on learning. In addition, some school-based research in the UK and US has, on the one hand, found a relationship between density and student attainment (Maxwell, 2003) and, on the other, some evidence for reduced space having a negative effect on student attitudes that could lead to such reduced learning outcomes (Clift, 1984). Furthermore, the negative effects of noise, temperature and poor air quality discussed above could all provide mechanisms through which student density could affect learning.

Research evidence warns of the negative effects of a poor environment, but leaves open the question of whether a particular school space supports or constrains 21st century learning.

Across the reviews that have been conducted, and similarly evident in the discussion above, is the fact that most of the evidence tends to warn of the negative effects of a poor environment. For example, considering indirect effects on learning, Weinstein comments that 'there is considerable evidence that the classroom environment can affect *nonachievement* behaviours and attitudes' (Weinsten, 1979: 598, italics in original). The conclusion about negative impacts, important though it is, leaves open 'the extent to which the physical school environment needs to be more than adequate' (Higgin et al., 2004). Although this reasoning could be seen as unsupportive of the further development of an educational setting, at least to achieve narrowly understood learning outcomes, it leaves open how the school space supports or constrains the wider range of educational processes inherent in 21st century skills. Blackmore and colleagues suggest going beyond 'these conditions [that] are considered as basic yet optimal conditions in which students are best able to perform' (Blackmore et al., 2011: 9), since a central conclusion of their review is the need to attend to how school spaces, whether basic or more elaborate, are used to better understand the potential impact of the physical environment.

With that in mind, we now turn to the impact on learning processes and outcomes of the organisation of the space and the arrangement of furniture, which are variables that have been quite well-studied over the years. Comparisons of student attainment in open plan and traditional school environments were made in the 1970s (see e.g. Horwitz, 1979), and then, in the 1980s, more focused and experimental research compared outcomes for students sat in rows and around tables (Wheldall et al, 1981; Wheldall and Lam, 1987). These studies have been updated with more recent comparisons of teacher and student behaviours in traditional and interactive environments in schools (Horne-Martin, 2002; Sigurðardóttir and Hjartarson, 2011; Byers et al, 2014) and in universities (Park and Keum Choi, 2014; Brooks, 2012). A recent systematic review that set out to establish whether 'different learning environments have an impact on student learning outcomes' (Byers et al. 2018) essentially brought some of these newer studies together with the earlier comparisons of open plan and traditional schools to conclude that the evidence base supports the existence of an impact on student outcomes but not one that is inevitably positive or negative. A further complication is that this impact appears to vary across the students within a space. A body of work that was discussed by Weinstein (1979: 578-581) looked at the impact of seating position within the rows' arrangement on student outcomes such as grades, but also considered the relationship of position with behaviours such as responding to teacher questions, and concluded that students' positioning within a space is related to learning processes and outcomes.

However, we are now finding the discussion moving away from establishing a simple and direct effect of the physical environment on learning outcomes towards the question of how it has that effect. As will be argued in the next section, it is necessary to make this move explicitly and logically from looking for an impact to exploring the nature of this effect.

The nature of the impact on student learning

The physical environment is influential: it affects learning processes and so impacts student outcomes.

The brief overview presented above of the evidence relating to the physical school environment and student learning strongly suggests that we can indeed conclude that the physical environment is influential. Research over some decades, in naturalistic settings and laboratory conditions, shows effects on learning processes, and also a relationship between learning environment and student outcomes. Despite noting research gaps, methodological problems and inconsistencies in the evidence, this is also what reviews across 40 years (1979 to 2018) have concluded. We will briefly consider these reviews' conclusions. Although written in English and reviewing only research reported in English, we note that reviews written in other languages, and so with a potentially wider range of research to include, have reached broadly similar conclusions (Stadler-Altmann, 2016) and, in fact, discuss much of the same, English language, research (Muñoz-Cantero et al., 2015).

Although Weinstein did not feel that she had found 'solid proof' of 'impact on achievement', she finds evidence of changes in student 'attitudes and behaviours [that] may eventually result in improved achievement' (Weinstein, 1979: 599). Similarly, the review by Higgins and colleagues concluded that 'Physical elements in the school environment can be shown to have discernible effects on teachers and learners' (Higgins et al., 2005: 36), but again pointed out the complexity of tracing these effects through to impact on student outcomes. Blackmore and colleagues suggest that, 'The connection between learning outcomes and built environment and use of learning space is thus mediated by tangibles (e.g. quality of air, light, spatial density) and intangibles (school and classroom culture, sense of belonging and self-efficacy)' (2011: 5). Finally, as noted above, the quite different approach of Byers' team in conducting a systematic, as opposed to a narrative, review, also produced evidence of an environmental effect on learning, but with outcomes for learners being either enhanced or compromised by an 'innovative' environment, which again suggests complexity.

Back in 1979, Weinstein highlighted a number of narrow questions (p. 599) about the immediate effect on learning of features of the physical environment that have either been answered or are now being addressed by research. Her call for research into 'the effects of realistic classroom noise levels' has been answered by, in particular, the work of Shield and Dockrell, while the popular 'assumption that circular arrangements are more conducive than rows to verbal participation' has indeed now been 'tested empirically' (Brooks, 2012; Byers et al., 2014) and found to hold. Although Weinstein's concern for more understanding of 'privacy in the classroom' has not been matched by that of recent researchers, current research within 'innovative', flexible and more open spaces in new and remodelled Australian and New Zealand schools might yet return to this issue (see e.g. Mulcahy and Morrison, 2017, for some suggestion of this direction). Furthermore, it is this body of ongoing research that is definitely addressing Weinstein's overarching conclusion that 'the relationship between physical design and educational program has been relatively neglected by educational researchers [...and...] research is needed to explore and document the ways in which physical factors and instructional programs interact, and to develop research-based guidelines for those engaged in creating educational settings' (Weinstein, 1979: 599-600).

Physical environments can have multiple indirect impacts on students, through learning and teaching processes.

This brings us to an apparently simple conclusion that should be drawn from the evidence, but which, as we shall see, has far-reaching consequences for policy and practice relating to school infrastructure. This is the fact that research into the effect of the physical environment demonstrates few direct impacts on student learning, but suggests many indirect effects achieved via both learning and teaching processes. This is

an important conclusion reached by Weinstein, who illustrated her point about the changes that may 'eventually result in improved achievement' (Weinsten, 1979: 599) with an example of a setting that improved perseverance on a task and the idea of designing a classroom to reduce interruptions to teaching, and so increase learning time. Such indirect effects must also lie behind the range of results found by the studies that correlate building quality with student outcomes. A clear need, emerging from this conclusion, is that more research is needed to investigate the long chains of activities that mediate between the physical environment and student outcomes. As the CEB review of schools in Espoo, Finland states very clearly, 'the ultimate goal is not to produce a wonderful school, but to produce a school that is wonderful because it works so well for students. The facilities must, as a priority, aim to improve student learning experiences and outputs' (Duthilleul et al. 2018: 21).

Understanding process: the mediating effects of people and use

Within the evidence base relating to the impact of the learning environment that has been considered so far, there is limited research that investigates the teaching and learning taking place within the setting to produce outcomes for students. As Blackmore and colleagues pointed out, 'the literature focuses on the quality of conditions or perceptions and not educational practices or how the space is used and to what effect' (Blackmore et al., 2011: 5). Fortunately, this situation is changing, with much more of the research published in the last decade asking not whether a school setting affects learning, but instead investigating how the material and physical resources influence the teaching and learning activities and processes that underpin student achievement and other outcomes. It is to this research that we now turn, beginning with the activities of the teachers and students, but then moving on to consider the systems within which they operate, and so the importance of leadership at school level and beyond.

The relationship between the type of educational space and the activities that take place there is key.

Focusing on the learning and teaching processes within a setting, research shows a relationship between the style or type of educational space and the activities that take place there (Horne-Martin, 2002; Sigurðardóttir and Hjartarson, 2011; Brooks, 2012; Park and Keum Choi, 2014;). In cellular classrooms where student desks are organised to face the front, there tends to be a more teacher-centred approach to learning with less student collaboration (Horne-Martin 1999; 2002; Sigurðardóttir and Hjartarson, 2011). Most importantly, some studies demonstrate an apparently causal effect in that when learning spaces are rearranged, behaviours and opinions change. In a university setting, Brooks (2012) observed parallel sessions of a specific course taught by the same lecturer using the same materials to classes of the same size, but in differing rooms, with highly significant differences observed in teaching activities and lecturer behaviour. A recent study within a school (Imms and Byers, 2017) compared student reports of teacher and student activity and student engagement within three different learning environments that varied from a traditional space to one designed for collaboration and interactive ICT use. Again, statistically significant differences were found in reported behaviours and attitudes, favouring the collaborative, ICT enriched environment, and an impact on student achievement was found for two of the three class groups involved in the experiment.

Yet such a positive effect of non-traditional, student-centred school space on learning processes and achievement has not been found consistently, and it is important to understand why so that we can ensure that spatial and digital innovation in the post-Covid-19 educational world is successful. As noted above, a recent systematic review included a subset of studies from the 1970s that compared open plan to traditional school spaces. Although students within the open plan spaces did demonstrate enhanced creativity and perseverance, the studies found higher student achievement on such measures as reading and mathematics tests in the traditional school spaces. This somewhat mixed, but definitely not encouraging, picture was mentioned by Weinstein (1979: 598) and in the conclusion of a contemporaneous systematic review into the impact of the 'open classroom' (Horwitz, 1979).

In resolving this apparent contradiction between previous and more recent experience, the important issue is whether the settings were actually being used in ways that could be expected to support student learning. As Weinstein wisely points out in relation to the 1970s research and practice, the studies 'do not attempt to define and describe the type of instructional programme' (1979: 597-8) that was being enacted in the learning spaces of the schools included in the reported comparisons. The suspicion that many open plan schools were not operating along the student-centred, active learning lines that the environments had been designed to support was steadily proved correct by research that accumulated through the late 1970s and into the 1980s. Detailed observation within open plan schools, of the sort envisaged by Weinstein, was conducted on both a small (Cooper, 1982; Proshansky and Wolfe, 1974; Rivlin and Wolfe, 1985) and larger scale (Bennett et al, 1980). Although some teachers in some schools were using their new spaces to enable students to be active learners, supporting the engagement and application to learning that should enhance outcomes (see e.g. Bennett et al., 1980: 212-216), it was also common for traditional, teacher-centred instruction to be attempted. Given that an open design is thoroughly unsuitable for such practices, with the openness and arrangement of furniture tending to distract students from focused concentration on the teacher, it should not be surprising that negative effects on achievement were sometimes found.

Are school spaces actually being used in ways that could be expected to support student learning?

The behaviour of teachers and students in a specific learning environment, however, will always be influenced by factors beyond the immediate space, and it is important to consider how organisational factors and curricular intentions contribute to the day-to-day use of school space. For example, Gislason (2009) studied an American school where the 'advantage offered by the school's design is that the layout and organisation of the houses provide a scaffold for the interdisciplinary [team] teaching that underpins the core curriculum' (2009: 29). The physical space is aligned with curriculum decisions and appropriate timetabling, all founded on a shared educational culture that values the school's particular approach. The means to arrive at such an alignment of the material, organisational and social aspects of the educational environment is suggested by a study of an Icelandic school designed through a collaborative process where the school principal and teachers planned curriculum, student grouping and space (Sigurðardóttir and Hjartarson, 2016): the design team moved 'through a series of design steps, with each step built on decisions from previous steps. The team first defined fundamental ideas and values to underpin work at the new school, and then moved on to define the structure of pedagogical work. Finally, the team made decisions about the building itself' (Sigurðardóttir and Hjartarson, 2016: 64). The flexible, shared spaces of the resulting school continue, mainly, to be used as planned to support learning that is more student-centred and less passive than in some comparison schools (Sigurðardóttir and Hjartarson, 2011). The possibility of achieving this alignment more widely, beyond the individual school, is suggested by the new Finnish national curriculum and the parallel redevelopment of school buildings. In terms of school design, traditional walled-in classrooms and rows of desks are being replaced by large flexible, multipurpose halls linked to spaces of differing size, with all new schools incorporating such an open, flexible design and flexible furniture at least to some extent. The new basic education curriculum (POPS, 2014), issued in 2016, includes the promotion of learning across disciplines and emphasizes learner-centred and inquiry- based approaches, technology-enhanced learning and student autonomy within a school learning community. A special section of the new curriculum addresses the importance of a flexible learning environment to support the new vision that learning takes place everywhere, is not confirmed to a classroom and is facilitated by social interactions.

What teachers and students do in a specific learning environment will be influenced by factors beyond the immediate space: organisational features and curricular intentions contribute to the day-to-day use of school space.

It is important to remember that the relationship between physical setting and users is dynamic and two way. The teacher may rearrange his or her furniture to suit an activity or to enhance the use of digital devices (Byers et al., 2018), but at the school or district level there can be opportunities for more permanent change to achieve general educational aims. Some case studies conducted in Virginia, USA, into schools performing well in economically disadvantaged areas, found users shaping their school space to match their needs and values

(Uline et al., 2009). The larger scale correlational study from which these case studies were chosen showed that 'school climate plays a mediating role in the effects of the quality of school facilities on student achievement' (Uline and Tschannen-Moran, 2008: 66). A more recent study (Maxwell, 2016), also in the US context, similarly proposes a model where the school 'social climate' mediates between the school build quality and student achievement. Implicated in any discussion of school ethos or climate are leadership decisions and approaches, and we will now briefly consider research that has investigated leadership in the context of new school designs.

New innovative learning spaces might need new innovative teaching.

Within the research currently being conducted in new educational spaces in Australia and New Zealand, evidence is accumulating of the significance of leadership (Morrison and Kedian, 2017) for success in using innovative learning environments (ILEs). Although there is still an incomplete understanding of how to lead a school through the change to ILEs specifically, there is some highly relevant literature related to school change more generally and which considers leadership does exist. In the context of the current rediscovery of flexible designs for schools, it is important to understand the factors behind the apparent failure of child-centred education within open plan environments in the 1970s. Suggestive of the challenges for school leaders in taking a school into a redesigned environment, is more recent research focused on teachers' practices within flexible, open spaces (Campbell et al, 2013; Saltmarsh et al, 2015; Deed and Lesko, 2015), since it reveals difficulties for teachers in adapting their methods. There is some suggestion of differing understandings across principals and teachers of the influence of the physical space (Mulcahy et al., 2015), which does not bode well for attempts by school leaders to work with their staff to adapt. The centrality of teachers to the change process is without doubt, since it is their practices that mediate directly between physical space and student learning. Yet the difficulty of changing practices in education recurs again and again within the literature, within and beyond research into change in the school setting. It is to the accumulated knowledge on the difficulty of change of any sort in education that we now turn.

The difficulty of changing practices in education is well known.

Educational change in spaces and practices

As Thomson succinctly concludes from her review of research relating to educational change, 'Whole school change is elusive in practice and in the literatures' (Thomson 2007: 10). Looking beyond the institutional level of the school, the failure of policy-led, system level reforms is a recurring topic in US scholarship. For example, Tyack and Tobin (1994) detail the way that the 'grammar of schooling' appears to resist change, while Cuban has devoted much of his career to investigating the way that several movements for pedagogical change through the twentieth century fizzled out. His analysis of documentary and photographic evidence shows clearly that discussions of change did not pull through into the day-to-day classroom practices – 'how teachers taught' (Cuban, 1993). Counter to the proposal sometimes made that teachers are *resisting* change, is the suggestion of Young and Muller that the 'structural conservatism of educational institutions' (2010: 15) is problematic, but is also an inherent aspect of their role in conveying knowledge and ideas from one generation to the next.

Against this overall finding of limited educational change, however, it is important to remember that 'change does occur' (Priestley et al. 2011: 267) and, in particular, to investigate when and how this happens. Such an approach is evident in work such as the exploration by Cohen and Metka (2017) of the areas of US education where reforms have succeeded and in Priestley's research into curriculum change in the UK. A suggestive example of occurrence of school level change, where researchers attempted to establish both the possibility of change and some ideas about how this might occur, concludes that 'the direct involvement of staff seemed to have played a part in encouraging school-wide innovation' (Ouston, et al., 1991: 9). Similarly, Fullan identifies three elements of successful school change, which are: being embedded in school structures, having a critical mass of school staff trained and committed, and having a procedure for continued support (Fullan, 2007: 102). These suggestions of the importance of involving school staff in any change process concurs with suggestions

that open plan environments floundered in the 1970s when teachers were presented with new space that they did not know how to use. Furthermore, research into school change has found that teachers may be willing to forego some individual professional autonomy in return for 'much needed direction' from principals (Szczesiul and Huizengo, 2014: 181) or being 'very explicitly part of a team' (Ouston et al., 1991: 10).

It is vital to involve school staff throughout any change process.

Thus, in many ways, the problems that teachers have adapting to new school spaces are a particular example of the general difficulties of educational change, particularly if the new spaces are of a very different design to what they have been used to. However, the tangible and visible nature of a new space, as opposed to less explicit changes, such as a new pedagogical approach or curriculum, may present particular opportunities for developing shared understandings of what is required for successful change. Teachers certainly notice and engage with their physical setting and material resources (Saltmarsh et al., 2015: 320; Cardellino et al., 2017) and there continue to be calls for more support to enable them to develop their 'environmental awareness' (Horne-Martin, 2002) and 'environmental competence' (Lackney, 2008) through professional development and initial teacher education (Morrison and Kedian, 2017: 5). Meanwhile, ideas about the moral and practical importance of user participation that have developed, firstly in urban planning (Arnstein, 1969) and latterly in architecture (Blundell Jones et al., 2005), are particularly pertinent in relation to change involving the school-built environment (Singer and Woolner, 2015) and provide ways forward to education policy-makers and practitioners. Specifically, they also offer some concrete suggestions for ways to pursue a participatory approach and frameworks with which to assess the quality of any attempts, which we will return to.

Teachers engage with their physical setting, but might need to develop their 'environmental awareness' and 'environmental competence'.

A final reflection with which to conclude this review of the literature on educational change in relation to developing school space is that the framework developed by Priestley and colleagues to understand how and why change succeeds, which 'allows us to disentangle the various aspects that contribute to the unfolding of a given social situation, enabling us to make judgements about the relative causative weight of culture, structure and agency' (Priestley, 2011: 7) can be seen as paralleling Gislason's understanding of aligned elements within a successful learning environment, but enabling us to see beyond the system of the individual school and to consider change over time. The organisational elements of the learning environment, such as curriculum, timetabling and student grouping that Gislason considers are clearly structural aspects of an educational system, whether the system under observation is a single school, a district or a nation. Meanwhile, the educational ideas held by staff, that Gislason found to enable or constrain individual teachers' ability to use an educational space effectively, will be part of the cultural beliefs and assumptions held within the school but also beyond it (see also Lackney, 2008, for a typology of individual, social and organisational factors that contribute to teachers' environmental competence). Priestley's research shows how change needs to be enacted at all levels in an educational system, from shared culture through appropriate structures to the individual actions of teachers. With the school facilities viewed as a key part of the educational structure, as has been argued from analysis of change enacted across space, curriculum and pedagogy in two English schools (Woolner et al., 2018), this view of change parallels Gislason's model of the learning environment as a complex material and social system.

Understanding the effects of school setting on student outcomes

To succeed, change must be enacted at all levels in an educational system, from shared culture through appropriate structures to the individual actions of teachers.

The research reviewed above, synthesising studies conducted in a variety of disciplines and paradigms over the last half century, conveys a network of influences and interactions. The emerging understanding centres on relationships between the school physical environment and other resources including technology, the organisational factors and the various users, with these leading to student outcomes, via teaching practices and learning processes, but all occurring within the 'culture' of the school and wider society.

As we have seen, there is an inherent interconnection of organisational factors with the physical setting and other resources. In considering the 'outcomes' for students, it is important not to overlook the actions and beliefs of those students. The teaching and learning activities and processes that occur in any setting depend on the 'interpretations of the learner, in the diverse ways in which learners make sense of the situations they encounter. While we may want to refer to the activities of teachers as interventions … we should not think of these interventions as causes but as opportunities for students to respond and, through their response, to learn something from them' (Biesta, 2007:9).

A school's physical environment is interconnected with organisational factors, and together they affect teaching and learning processes, impacting on student outcomes. But all this occurs within the cultures of the school and of the wider society.

The precise way in which the network of influences functions to produce an effect on student learning will be different at different times and in different schools. In this way, our general understanding of the relationships between the material and social aspects of education and student outcomes could be adapted to reflect a specific school context. This understanding can also be used to consider where alterations to the normal flow of effects would be possible, so that we can intervene; but it is important not to lose sight of the whole web of influences in focusing on just one relationship.

As discussed above, the approach to enhancing the positive impact of innovation in school learning environments that is best supported by the totality of the relevant research evidence needs to consider what can be done at cultural, structural and individual levels when schools are built or renovated. The following section will suggest how this might be done in practice and elaborate on what will be targeted by action at each of these levels, with a specific focus on the role the International Financiers can play across these levels.

2 How Can We Ensure that Investment in Educational Infrastructure Results in Effective Learning Environments?

The question posed as the heading for this section extends the challenge that Imms considers in a recent chapter discussing how the development of innovative learning environments (ILEs) in Australia can avoid the pitfalls of earlier attempts to move from enclosed classrooms to flexible, more open, learning spaces. As he points out 'history teaches us ILEs are not a catalyst for change, rather an agent. Handing over the keys does not guarantee teacher change or improvement in learning outcomes for students, but it does provide teachers another device to help them teach even better... What is required is work that focuses on helping teachers make the most of these environments' (Imms, 2018: 11). Furthermore, it is important to remember that 'the problem of environmental competence concerns the entire organisation, not just its individual members' (Lackney, 2008: 153). Those financing new school infrastructure are in a unique position, enabling them to oversee activity and processes that address the challenges of changed educational space and practices. Moreover, without such action, the consequence is that 'schools become enmeshed in the *wasted investment* quadrant when they invest in new spaces but have not yet invested in new teaching practices' (French et al., 2019: 2).

Those financing new school infrastructure are in a unique position that enables them to oversee processes that aim to address the challenges of changed educational space and practices.

There are benefits to having more flexible school space, in terms of expanded opportunities for diverse learning activities and teacher-student interactions, but if school users are less '*locked* into classrooms' and teachers less '*tied* to one set of students' (Deed and Lesko, 2015:227), this does change the experience of teaching, tending to result in more interactions and collaboration. Particularly in more open, innovative space, teachers will need to adapt to 'no longer being alone' (Campbell et al., 2013: 220) and could require support to reduce their 'sense of exposure' (Alterator and Deed, 2013: 326), suggesting a need for both ongoing professional development and attention within initial teacher education programmes (Morrison and Kedian, 2017) in order to develop teachers' capabilities and so their 'professional agency' (Toom et al., 2015) within these spaces. However, the wider literature on educational change makes it clear that any interventions centred on teachers changing their practices must also consider the structural and cultural systems in which they work. In recognising that a teacher's agency depends on both their individual capacity and the situation, so that 'individuals who exercise considerable agency in one setting might be disempowered in another' (Priestley, 2011: 8), we can note that teachers might be disempowered by a new innovative space or new technology, but also by other structural and cultural features of their school.

Furthermore, reviews and discussion pieces addressing the challenge of changing school space suggest the benefits of considering the stages of the process (e.g. Blackmore et al., 2011; 2010). This concurs with conceptualisations of change management that originates in education, such as Fullan's well-known specification of initiation, implementation and institutionalisation, as well as with architectural understandings of the design process (Singer, 2015; see also RIBA's Plan of Work https://www.ribaplanofwork.com/Default.aspx). Bringing the educational and architectural perspectives together to address the issue of educational involvement in school design, Singer and Woolner (2015) proposed that levels of participation could be evaluated at each stage of the process from 'brief' to 'use'. Thus, there is clear agreement that any attempts to understand, and so influence, the change process involved in developing new school space will need to attend to the stages of the process with a focus on participation and collaboration. What does the evidence suggest needs to be done at particular stages?

What does the evidence suggest needs to be done at each stage in a school design and build?

At this point, it is important to consider a key conclusion of Blackmore and colleagues' review (2011). They found that some stages of the process are more discussed and appreciated than others – specifically, what was often overlooked within the literature they reviewed were the transitional stages of moving into and starting to use a new space. This omission seems particularly problematic in the case of innovative school designs where the new learning environments require changed practices. Fortunately, as has been mentioned above, this situation has now changed with a growing body of work from the Nordic countries, Australia and New Zealand, including Blackmore's own detailed evaluation of 'how schools prepare for, and transition into, new learning spaces in ways that encourage innovative pedagogical practices' (Blackmore et al., 2010: 12). This burgeoning research details and discusses the experiences of students, teachers and school principals moving into, and beginning to use, schools comprising new 'innovative' spaces.

The framework we are proposing to support understanding, evaluating and intervening in the process of developing school space will therefore be based on phases of collaboration within which we will consider action at the levels of culture, structure and individual agency. This approach should assist International Financiers in recommendations or requirements for actions/activities that should be put in place during the process to maximise the benefits resulting from investing in the physical space.

Principles for supporting the development and use of effective educational environments

As the review of research evidence presented in Section 1 made clear, there is plenty of evidence that physical space and material resources make a difference to the processes and outcomes of education. As the discussion conveyed, the research supports a concern with the quality of school premises and the aim of developing school space, but does not prescribe specific designs. Basic comfort, health and safety standards need to be achieved (as regards light, sound, temperature and air quality for example), to avoid impacting negatively and directly on foundational learning processes, but, once these are met, the impacts of the environment on student outcomes will be indirect, via the social experiences and teaching and learning activities that the setting supports. Therefore, the educational environment needs to be planned by considering the pedagogy and social relationships that are to be facilitated, including the specific teaching and learning activities that the physical setting, material and digital resources need to be able to support. The way for this to occur is for context specific educational intentions to inform the design and construction of new and redesigned school spaces, with ideas coming from a range of actors in the educational endeavour.

The impacts of a new environment on student outcomes will be indirect, via the social experiences and teaching and learning activities that the setting supports. So we must consider the pedagogy and social relationships that we hope to have facilitated.

There is plenty of evidence that the inclusion of educational ideas and experiences from school advisors, leaders and staff through the design process and beyond can be effective in producing an environment that works for the intended users and educational approach (Uline, 2000; Gislason, 2009; Franklin, 2012; Sigurðardóttir and Hjartarson, 2016). Such involvement seems the best way to enable an initial understanding of the purposes of new features and spaces, leading to attempts at adapting or changing practices to have more chance of success (Sanoff, 1993; Yeoman and Carvalho, 2019). Gislason refers to 'the need for teacher training and curriculum development prior to occupancy' (Gislason, 2018: 187) but these initiatives are more likely to be welcomed and used productively where leaders, teachers and other staff develop and share understandings. As Parnell, from an architectural background, commented optimistically but also with some humility, 'Involving teachers in the process gives them the opportunity to create spaces which they can contribute to, understand, control and use effectively in the future. They might also be more forgiving about the things that do not work so well' (Parnell et al., 2008: 220). This collaborative approach should also enable the design of the new building itself to be reconsidered, and perhaps adapted, if aspects of it are not working as hoped. Such adaptation and adjustment, however, must also extend to changing educational practice within the new space, but staff will need support to adapt. The 2011 review by Blackmore and colleagues noted gaps in the literature at the stages

of 'transition' and 'consolidation' relating to teacher professional development but, as discussed below, there is now more research and guidance on how teachers can adapt their practices, at least where the move is into open, flexible school space.

It must be continually recalled, however, that this co-development of space and teacher practices does not happen in a vacuum. We have emphasised, and made central to our understanding of impact on student outcomes, that, for each school, the space is inherently entwined with organisational aspects, such as timetabling, staffing and curriculum set within wider regional or national policies and processes. It is key that any adaptation of these aspects that is required to make a space educationally effective will involve leadership decisions and wider commitment than that of the individual classroom teacher. Yet, this interplay between the school's organisation and its premises is influenced and constrained by regional or national requirements or policies, the contents and power of which vary across countries. In all national systems, however, the wider culture and societal expectations may prove critical (Woolner et al, 2014; Hargreaves, 2002), so that some adaptations, which could change how a space is used, are not possible at the individual school level. As Blackmore and colleagues concluded from their multiple case studies of innovation, 'it was the instability of the impact of policy and neighbourhood environments that disrupted the internal capacities to manage change in schools' (Blackmore et al., 2010: 48).

We must avoid attempts at innovation that go no further than altering school space or providing new technology.

It is clear that what needs to be avoided is an attempt at innovation that goes no further than an altered school space or the provision of new technology. This is the challenge for International Financiers supporting investments in education infrastructure, since they usually limit their involvement to completing the works, and are not engaged in the evaluation of their subsequent use. The many and severe problems with this limited approach are evident in the literature relating to changed school environments, some of which have been cited above. In addition, the literature discussing educational change more widely enables us to understand these failures as specific instances of the general observation that change enacted only or mainly at a structural level is rarely successful since it overlooks both necessary supportive cultural changes and the required changes at the level of individual action (Priestley, 2011; Szczesiul and Huizenga, 2014). The inclusion of users' perspectives, as discussed above, throughout the change process, goes some way towards enabling a school-level cultural change and facilitating teacher agency to make individual changes. In the framework outlined below, we will consider the detail as to who, among students, staff and the wider community, needs to be involved, when in the process and how this might be achieved in practice. However, some over-arching issues can be introduced here.

The first of these is the need to find the time required for participation of whatever sort and whenever it occurs in the process. Research, as well as experience, demonstrates that participation in a design process requires time (Parnell, 2015), while the development of new curricular or pedagogical approaches must begin well in advance of a move to changed learning environments (Gislason, 2018). Similarly, time consuming is the planning on which collaborative teaching practices depend (York-Barr et al., 2007; Graue et al., 2007) and the development of teaching practice in response to new spatial and digital opportunities (Byers et al., 2018). Indeed, research points to a wider need for collaborative professional learning when educational innovation is attempted (Blackmore et al., 2010: 15). Time, however, seems to be a necessary but not sufficient factor in successful collaboration. Work in both education and architecture suggests the additional support that may be required in terms of relevant outside expertise, in the form of facilitators or trainers (Parnell et al., 2008), and appropriate professional development (Imms, 2018; Gislason, 2018). Fortunately, there are also guides and tools available to help school communities work together to change their space and/or use of it (Yeoman and Carvalho, 2019; Woolner, 2018) as well as international projects to develop such approaches in schools (CoReD:

A key concern is finding the time required for the participation of students, staff and the wider community in the planning and implementation of educational changes.

https://www.ncl.ac.uk/cored/) and assist teachers in transitioning to flexible, more open educational spaces (ILETC: https://research.unimelb.edu.au/learnetwork/projects/iletc).

Shared values can help school users embrace specific changes to space or practices.

Secondly, for the desired educational innovation to reach beyond features of the school space requires that the changes made, and the way that participants are involved, all contribute to this bigger picture. More powerful changes need actions at cultural, structural and individual levels that are mutually reinforcing (Woolner et al., 2018). Concrete examples include considering the spatial location of teachers who are trying to collaborate (Priestley, 2011) or staff who need to interact with students (Frenlin and Grannäs, 2014). School level cultural change through re-imagining the school as a 'green' school (Kensler and Uline, 2017), a community-centred school of enquiry-based learning (Leat, 2017) or one embedding a cross-curricular approach (Gislason, 2009; Woolner and Tiplady, 2016) can provide a rationale for the specific spatial or practice changes.

Closely linked to this higher level system of values and beliefs to support and guide change in a particular direction is the final over-arching factor seemingly needed through a process of developing school space: leadership. Although the literature review by Blackmore and colleagues (2011) highlighted consideration of school leadership as a gap, this is rapidly being filled (see, e.g. Morrison and Kedian, 2017, and the special journal issue that their editorial introduces) and there are now plenty of indications of productive ways for school leaders to work with staff and students to facilitate successful change in spaces and practices. Within more centralised systems, where less flexibility is available at the school level, this leadership and vision will be needed elsewhere, although actions may still take place or have an impact at the level of the school.

Phases of collaboration

As outlined above, our framework to support understanding, evaluating and intervening in the process of developing school space and practice is based on phases of collaboration to achieve a comprehensive programme of design for learning. The framework includes the initial design stage of a space, through planning and trialling its use, to collectively inhabiting it, and finally reflecting on its strengths and weaknesses. Following Blackmore et al (2011) and Singer and Woolner (2015), we have opted for four discrete phases. User participation, particularly the involvement of teachers and school leaders, is central through all the phases, from initial ideas to evaluating, reflecting and adjusting, although different sorts of involvement may be appropriate at different stages (Könings et al., 2017). During each phase, it will be important to consider action at the levels of culture (the need for over-arching shared values and leadership), structure (the interplay of material and organisational features) and individual agency (who does what).

The framework to support the process of developing school space proposes individual, structural and cultural activities across four phases of collaboration.

Table: Constructing Education - A framework of multi-stakeholder collaboration combining an architectural and educational perspective

	Phase 1	Phase 2	Phase 3	Phase 4
ARCHITECTURAL	**BRIEF**	**CONSTRUCTION**	**HAND OVER**	**POE**
EDUCATIONAL	**INITIAL PLANNING**	**GETTING READY**	**MOVING IN**	**REFLECTING & ADJUSTING**
Individuals: actions of teachers and principals, opportunities for agency	Ensure the direct involvement in the design by key individuals – the school principal *and* trail-blazers who will become champions - including operations and maintenance staff.	Devolve responsibility and provide opportunities beyond leaders: establish 'area leads', who are not senior staff, and have either teaching or non-teaching roles to direct specific aspects of planning for change.	Enable the personalisation of individual space (desks, lockers, rooms as appropriate) and develop collective ownership of shared space (staffroom, shared offices, specialist teaching spaces, library).	Establish 'area leads', who are not senior staff, to direct specific aspects of evaluating and reflecting on change process, and to organise the collection of information (use visual methods supported by interviews and focus groups).
Structures: timetabling, curriculum, staff and student organisation	Coherence ensured through curriculum and organisational decisions (student grouping, staffing, timetabling) that align with spatial design. This planning process should involve the wider staff body, but be led by the principal.	Prepare teachers for the new environment, offer support to develop their practices to make full use of the new space. Make time for meetings: for teachers, other staff, and with the local community. Find space to trial new ways of working. Ensure communication of progress on the building work – use school website, displays accessible to school users and to the local community. Plan removal and re-installation of useful or loved parts of old building.	Provide time for collaborative planning by teachers and offer continued support in the transition to the new spaces. Maintain communication with local community. Tweak and trouble-shoot in response to user views, including those of students. Make changes to decoration and furnishings. Include items or memorabilia from old premises to make recognition of the past visible.	Use frameworks and tools to investigate the coherence of the space and its use. Make adjustments as required to space and practices, using specialist professional development as appropriate. Where coherence is achieved, consider further developments – such as to the outdoor space, library, or specialist teaching spaces. Continue to protect time for teacher collaboration, further development of their practices, and shared planning. Initiate succession planning.
Culture: school climate, social values, and educational values	Vision for the new or redeveloped school is articulated at school level, drawing on national or regional context and requirements. Clear leadership at school or district level is combined with willingness to listen.	Ensure that the rebuild is understood as part of a bigger (and worthwhile) change.	Acknowledge and manage the sense of loss that will be felt by some staff, students and members of the wider community. Events linked to the re-installed elements could be organised.	Ensure over-arching idea or set of values is articulated, visible and explicitly shared. Consider any adjustment or development that might be needed.

'The design and building of a school is a complex process that involves a large team of people working together over a long period of time' (Sutherland et al. 2014). In successful school redesigns, there are a number of common factors which enable school leaders, staff, students and the design team to navigate the process effectively. Any change is daunting and involves crossing barriers and negotiating difficulties, but participation

can help. How can schools include or respond to staff and student knowledge and experiences through the process of designing, building and using a new school space? It is essential to consider who participates, when in the change process they participate, and the levels of participation that will be achieved.

The individual, structural and cultural actions proposed in the framework do not translate into organisational levels (such as school, municipality, national - not least because the role and influence of actors at these levels varies across countries). Instead, they are qualitatively different sorts of activity – activities of people, essentially on their own, although within a supportive environment; structures that enable or constrain collective and individual actions, which can be put in place by those at various levels of a system; and, finally, the value systems and 'climate' found within schools, but which are underpinned by wider cultural values and beliefs about education. It is also important to note that the direction of influence will not necessarily be in one direction through this system. Instead there are possibilities for influence in all directions and that is why the framework proposes activities for each level, which can be hoped to nudge aligned activity at the other levels. Research shows that educational change is more powerful and sustainable if enacted across the levels of culture, structure and agency, and so the intention of the framework's activities is to enable coordinated change to move between the levels and through the phases.

The individual, structural and cultural actions proposed in the framework do not translate into organisational tiers but are qualitatively different sorts of activity. The intention is to enable coordinated change to move between the levels and through the phases.

This school-level change management needs to be supported by those with wider authority or influence, which is where the oversight of financiers can be pivotal in avoiding the 'wasted investment' (French et al., 2019) of new space unaligned with old practices. As argued by Singer and Woolner (2015: 185), 'collaboration needs to extend 'beyond' the building: it is not necessarily a sequential process - rather one that needs to be layered and choreographed across the whole cycle of planning, design, occupation and management to future planning of school buildings to be truly effective'.

It is therefore recommended that (i) different people are involved at different times in the process; (ii) a participatory approach to use, as well as planning and design, is developed and (iii) the potential benefits for the school (and individuals) of being involved through the process and beyond the final design are considered.

The following sections present detailed descriptions of each phase from an education perspective. A set of proposed tools to facilitate their implementation is included in the Appendix.

Phase 1: Initial planning

Educational values should inform the original design: plan early for later success.

As proposed above, the logic of our understanding of the influence of the school space on learning is that the space supports (but could also constrain) desired educational activities facilitated by the teacher. As Gislason concludes from his studies of schools attempting innovation in their designs and practices, 'early planning contributes to long term success' (Gislason, 2018: 187). Therefore, educational values and understandings must inform the original design. It seems to many practitioners and researchers involved with school architecture that a productive way to achieve this is to involve the school users in creating the original design. The CEB report on the Espoo schools recommends the creation of 'spatial learning teams' (Duthilleul et al., 2018: 21), to counter the tendency for only the school principal to be involved at the design stage. Bringing very specific expert knowledge and experience to the collaboration are site management and operations staff who, if involved early, can advise on key practical aspects of making a design work, such as access (Alhava et al., 2015) or maintenance (Woolner et al., 2010). Having studied a number of Australian schools that successfully transitioned into ILEs, Cleveland concludes that: *'Participation of school leaders, teachers and students in the design phase was...found to be beneficial for two primary reasons: firstly, teachers and students were able to contribute valuable ideas that informed the design of the learning environments, and secondly, their involvement enabled them to develop early understandings of what their new spaces would look like and how they might use them'* (Cleveland, 2018: 16).

Such a shared collaborative process was also successful in designing a new school for a new neighbourhood in Reykjavik, Iceland (Sigurðardóttir and Hjartarson, 2016; see also Example 1A), but other successful and innovative schools appear to have been designed through a collaboration that only involved senior school leaders working with the architects (Cardellino and Woolner, 2019; see also Example 1B for a description of similarly principal-led school design in Italy). Given that it might not always be possible to achieve a broad collaboration at this early stage in the design process, and that subsequent staff changes might render it less immediately relevant, it seems important to consider what else was pivotal to success for these schools. The key feature would appear to be the achievement of coherence between the planned space and organisational aspects, such as student groupings, curriculum and timetabling. Such structural coherence is seen in the ongoing success of the School of Environmental Sciences studied by Gislason (2009: 2015), where a cross-disciplinary curriculum, dependent on team-teaching, is underpinned by large flexible spaces as well as specialist learning areas, including a pond. Gislason has produced checklists to help judgements be made through the design process about the coherence of these aspects within the complete learning environment (Gislason, 2015; 2018). As discussed previously, a shared vision generated within school or elsewhere can provide important cultural framing for the spatial design and organisational decisions.

Plan together for the complete learning environment so that the new space aligns with organisational aspects, such as student groupings, curriculum, and timetabling.

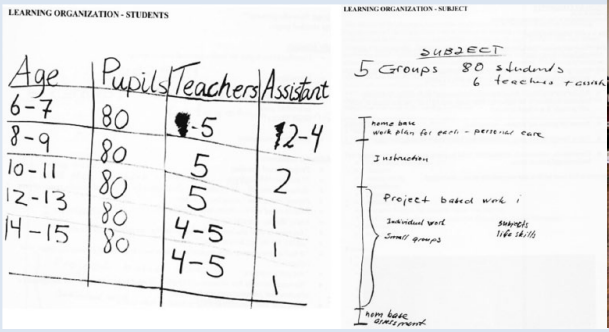
In discussing participatory planning and designing, however, it is important to acknowledge that the potential for school users to affect the design may be limited by the use of standardised designs, an approach that is more common in some contexts and countries than others. Yet, even where standardised designs are used, a form of participation can still be achieved with benefits for individual school users and for structural planning of how the new space will be used. As the CEB review of new schools built to a single functional model in Seine-Saint-Denis, France, recommends, 'The planning process can be refined to give more opportunities to engage the school communities in imaging the future and subsequently adapting the standard model to their own school vision' (Duthilleul et al., 2019: 19).

Various planning tools can enable educators to develop coherent educational plans and, if appropriate and possible, to communicate their ideas to architects. It appears important to make ideas visible so they can be shared and developed collaboratively (Woolner, 2018), as occurred during the planning of the Icelandic school (see Sigurðardóttir and Hjartarson, 2016: 65), and many of the tools developed in the last two decades do this. A recently publicised approach developed in Australia and New Zealand, and based on the theorisation of the Activity Centred Analysis and Design (ACAD) framework (Goodyear and Carvalho, 2014) uses the ACAD wireframe (Carvalho and Yeoman, 2019; Yeoman and Carvalho, 2019; see below and Appendix 1A) to underpin a series of activities to support educators, working in multidisciplinary groups to develop their ideas. The intention is to plan the designable elements, which are the material setting, the social organisation of learners and teacher, and the presentation of the learning tasks, at differing levels of scale while checking for coherence across elements and between levels. Another tool that has been widely used in a range of countries, both to start conversations about learning space and to enable user, staff and student, evaluation of their own settings, is 'diamond ranking' of images according to whether they depict 'good places for learning' (Woolner et al., 2010; Niemi et al., 2015; 2018; Sigurðardóttir, 2018; see Appendix).

An important aspect of the ACAD framework is that it involves thinking about each of the settings, social organisations and tasks at various levels of abstraction from over-arching philosophical understandings of intentions down to moment-to-moment actions. This aspect would appear to make it an ideal tool to use in developing the over-arching 'vision' for the school, the cultural understandings that can then frame structural decisions and opportunities for user agency, and that many believe is key to the brief that the architects will work from. The CEB review of schools in Espoo, Finland, concluded that developing 'a clear educational vision for the school appears to make a difference in working with a design team' (Duthilleul et al., 2018: 15) and the authors' argument that this 'set of beliefs [needs] to originate from the actual school' (Duthilleul et al., 2018: 15) answers the concern that designs should respond to particular school contexts (Blackmore et al., 2011: 11).

Example 1A: Shared initial planning

A primary school for a new neighbourhood outside Reykjavik, Iceland was designed through the 'Design Down Process' (Jilk, 2002) by a group of 40 different stakeholders including Reykjavik's director of schools working directly with an architect. The group began from first principles of intended school values, next worked through organisational aspects and only then considered the physical design of the building. The resulting building, in being centred on shared space rather than enclosed classrooms, is very different in design to older Icelandic schools. The premises broadly continue to support the mixed age and interdisciplinary teaching for which it was intended, suggesting the benefits of a broad, collaborative design process.



Initial planning of envisaged organisation



Flexible, open spaces built to accommodate the groupings

Example 1B: Principal-led initial planning

An approach more centred on the principal's ideas and values was taken to the design of a similarly innovative German medium primary school in South Tyrol, Italy. The designing of a new building had begun in 2000, as the principal was appointed, but the building was not finally completed until 2009. It was based on some foundational ideas, including the 'school as community' and the intention that the children (approximately 100, aged between 7 and 12 years) would be treated as individual learners, developing competencies and moving to the next challenge. The resulting design centres on teaching and learning spaces spread over the second and third floors of the school, which combine contained classrooms opening onto shared space that is used primarily for student self-directed learning. The principal's vision, his 'pedagogic concept', is enacted through the space and resources of the school, with a supportive school culture that is intimately linked with the local community in this high mountain region.

For more about shared planning of the primary school in Iceland, see Jilk, B. A. (2002) and Sigurðardóttir, A.N. & Hjartarson, T. (2016). For the wider context of Italian school design in South Tyrol and some mention of this school, see Weyland, B. et al. (2019).

Phase 2: Getting ready

Activities at the stage where the new school space is under construction will vary considerably depending on the scale of the redevelopment, but will in any case centre on structuring time and space so that individual users can get ready to inhabit the new setting. A small, possibly school led, redevelopment will probably allow for more active involvement by staff (see Example 2), with more obvious possibilities for individual teachers to take the lead on particular aspects. Such devolving of responsibility, providing opportunities for individual agency, has been important to the curriculum change pursued in Scotland (Priestley et al., 2011) and has been found to be effective within a programme intended to change pedagogy and develop the curriculum in some English primary schools (Woolner and Tiplady, 2019). During a complete build, or rebuild, of a school, the lengthy period of construction may appear to offer little opportunity for educational involvement at any level. However, it is at this stage that participation in the change process can be broadened out, from leaders to teachers and other staff, staff to students, or out to the wider community, thus including more individual actors. For some of these actors, involvement might be quite low level in participatory terms, mainly being 'informed' (see Arnstein, 1969, for a description of a ladder of participation where informing is low ranked), but this could be appropriate and useful, developing the cultural sense of what is happening. The building itself can assist in this process by being a tangible sign of change at the school, which will be more easily communicated if there is an explicit over-arching understanding of what the school is trying to achieve. Such a conception clearly links to the educational vision developed at Stage 1, but could be further cohered by the articulation of a 'big idea' for the school, such as environmental sustainability or project-based learning.

At this stage, participation in the change process can be broadened out, from leaders to teachers and other staff, staff to students, or out to the wider community.

For staff and students within the school, good communication at this stage could enable them to develop the 'early understandings', recommended above by Cleveland, of what their new school will be like, and so be prepared for the new setting. For staff, this should involve working together to plan how the new space will be used and to develop agency relating to the alterations to their practices that will be needed (Cardellino and Woolner, 2019; Rosen Rasmussen, 2019; Example 2; Appendix). There is good recent evidence, as well as the historical examples of open plan, that where this re-imagining of practice, time and space does not occur, the transition from enclosed classrooms to more open, shared space is likely to fail (Gislason, 2015: 110-13; Woolner et al., 2014; Jędrosz, 2016; Wood, 2017; Daniels and Tse, 2018).

Time needs to be set aside for teachers to plan together; and space may need to be found for practical trialling of new ways of working. Begin teacher professional development that can be continued into Phase 3.

Time therefore needs to be set aside, particularly for teachers to plan together; and space may need to be found for practical trialling of specific practices to make better use of the potential that the new spaces will provide, as was found to be effective in a recent English rebuild (Daniels and Tse, 2018). This is also the ideal point in the process to begin offering teacher professional development if the new design includes quite different spaces and technology that require new teaching practices. This will avoid the problem noted by Campbell and colleagues in the Australian context where they observe that there has been 'a lag in the delivery of the needed professional learning support and mechanisms required to realise this potential [of the flexible spaces in the new schools]' (Campbell et al., 2013: 220). These professional development initiatives can be continued into Stage 3 (see below).

Example 2: Getting ready: Preparation and trialling

Using two English schools which have been through innovative redesign processes of very different scales, we can see how Stage 2 can be used to enhance participation and better prepare staff for the new space. In one school, this was through giving real responsibility to teachers in a small redesign and, in the other, through enabling staff in a major rebuild to familiarise themselves with the new design before moving in.

Jesmond Gardens Primary School was rebuilt under the 'Primary Capital Programme', a major school building initiative that centred on a 'pedagogical approach' to school design. The principal, appointed while the school was still residing in its old 1901 building, worked with the architects to develop her vision for the new school. The design is extremely innovative, open and flexible, based on series of interconnected, near-circular learning areas, each intended for teams of 90 students and 3 or 4 teachers. During the construction period, staff used plans of the new interior and counters to represent users to plan how they would use the new spaces, which were very different from the enclosed classrooms of the old premises. The plans they made for timetabling and collaborative working were then put into practice when they moved in.



Innovative, flexible space in use



An unusual space for reading and imaginative play

At Stephenson Memorial Primary School, Early Years teachers were asked to take ownership from the beginning of their classroom redesign, since they were best placed to understand the specialist needs and particular requirements of the youngest children in the school. During Stage 2, these teachers were involved in the choosing and purchasing process of all the furnishings, and as a result created a multi-purpose learning environment, where all the moveable furniture could be used in different ways to create a variety of seating options and to split the large classroom into smaller zones. These zones could be transformed according to the teaching and learning requirements, allowing for personalised learning to take place, independent work and groupwork to be conducted, and display areas to be used for children's work. The teachers involved in the planning not only thought about the practicalities of the classroom, but the potential innovative features that the large open space could accommodate – such as a small fishing boat which could be used as a reading and imaginative space, and large cupboards with wipeable doors which doubled as areas for children to draw and write.

For more detail on the design and use of Jesmond Garden Primary School see Cardellino, P. and Woolner, P. (2019).

Phase 3: Moving in

Along with the challenges, this stage offers opportunities: the chance for all the school's users to appropriate the new space.

At this stage, the time and energy of all the school inhabitants will be concentrated on the immediate issues of settling into a new space, with each person developing their own ways of using the premises, partly directed by other structures such as timetabling and curriculum. Gislason has recently pointed out that 'Designing a conventional school is reasonably straightforward because the standard classroom model is deeply rooted in history and it supports traditional teaching well' (Gislason, 2018: 187). For these reasons, moving from an old building into a new one where both are of a traditional design will also be considerably less demanding for staff than the transition into an open, flexible space, the challenges of which are currently being well-documented (Saltmarsh et al., 2015; Alterator and Deeds, 2013; Campbell et al., 2013; Wood, 2017; Daniels and Tse, 2018). Support and professional development for teachers has been presented throughout this report as an important response to these challenges, providing teachers with structures and a culture within which they can develop their own agency over new spaces and practices. Yet it is necessary to acknowledge that in some countries and cultures such advice on how to use flexible spaces might be omitted for fear of trespassing on teachers' professional autonomy by instructing on practices. There is some evidence that this is proving a problem in the move to flexible designs in schools in Finland, as well as some suggestion that teachers at all stages of their careers would in fact welcome support and direction (Duthilleul et al., 2018). In relation to the autonomy of Finnish teachers, which might be threatened by both training and the need for more collaborative teaching in the new schools, it is worth remembering the research into school change that suggested teachers may be content to lose autonomy if they gain in other ways (Ouston et al., 1991; Szczesiul and Huizenga, 2014). It is also important to note that even a relatively straightforward transfer between schools of similar designs will still require some changes from the users, and there will be time taken up with physical adjustments, such as decorating and tweaking or trouble-shooting. Whether moving between traditionally designed schools or into a school with lots of innovative spaces requiring new practices, support should be offered on the basis that 'Teachers' active professional agency is … more than just coping with challenging professional situations' (Toom et al., 2015: 615).

Along with the challenges, however, this stage offers opportunities, centring on the chance for all the users, including teachers, other staff and students, to make the new space their own, both individually and collectively. Duthilleul (2019: 6) recommends 'developing a feeling of belonging to the school and the personalisation of the new space' that can accelerate the ownership process by ensuring school identity is continued and promote 'respect for the building', and indeed, for the redesigned teaching and learning processes. Student consultation can be used effectively at this stage to discover how the new space is being viewed and used by students, and to highlight any issues or problems, which can then be addressed (see Appendix for suggested tools). This could result in alterations to physical or organisational structures, but will also be effective at the cultural level by demonstrating that student views are valued, thus enhancing the school climate. A consultation of this kind, carried out six months after moving into a new English secondary school built to a standardised design, enabled the school to appreciate the students' perspective, to be reassured that some changes had been accepted, and to respond to some negative opinions (Woolner and Thomas, 2017; Woolner, forthcoming).

This consultation also revealed a sense of loss relating to the old school premises which, in hindsight, the principal should probably have anticipated. Yet, her oversight is reflected in the research literature, which rarely if ever mentions this aspect of transition (it seems to emerge in one of the case study schools described briefly by Blackmore et al., 2010). See Example 3 for the approach of an Icelandic principal to addressing this issue as part of the design. Developing and maintaining an over-arching school identity that links old and new could be expected to work at the cultural level within a school to ameliorate any sense of loss, although there is a paucity of research evidence to support this particular use of the educational vision.

Finally, through and beyond the excitement and upheaval of the move into the new space, it is vital to recognise the continued need for collaborative planning, particularly if the new physical and digital resources and practices are very different to the previous ones, and to ensure staff time is found for this. It is by structuring time and organisation that teachers can be supported to develop their individual practices, particularly in relation to working with colleagues or with new technology. A clear assertion of this need is made by Blackmore and colleagues: 'A strong consistent theme across all the case studies is the increased allocation of planning time that is required, considered necessary, and valued as an essential part of maintaining and sustaining an ILE' (Blackmore et al., 2010: 31).

Through and beyond the excitement and upheaval of moving in, there is a continued need for collaborative planning.

Example 3: Moving in: Managing staff and students' emotions

Stage three of the redesign process sees staff and students moving into an adapted or entirely new building. Even in redesigns where teachers and students have been rigorously involved throughout the planning and construction phases, it can be difficult to move from a familiar environment into an unfamiliar one. Blackmore and colleagues noted that within a school's emotional economy, 'emotions are distributed unequally and with different intensity; some enjoy radical change, while others feel that their professional and personal identities are challenged by some reforms more than others and are therefore more risk averse' (Blackmore et al., 2010: 14). Teachers can feel threatened by a radical change, such as moving into a new building, but all school users can be expected to experience some sense of loss.

To alleviate any feelings of loss when the new upper secondary school at Mosfellsbæ, near Reykjavik, opened, the principal had ensured that the design included reminders of the old. This was important as there had been significant changes when the school moved out from its previous older buildings in an urban location to the contemporary specially designed premises on a new site outside Reykjavik. The design team worked with staff and students, using glass walls between classrooms and corridors to include quotations about the School community. The resultant meeting of the old and the new enabled the users to feel more 'at home' in their new building and brought a sense of familiarity to the environment. It was also an economical feature as the 'etched glass' effect is achieved with adhesive film!



The new premises in out of town location



Glass walls including quotations about the school

For more about student views of education in a number of upper secondary schools in Iceland, see Sigurðardóttir, A. K. (2018).

Phase 4: Supporting reflection and adjustments

Once the immediate challenges of inhabiting the new space have been addressed, it will be important to plan for continued evaluation of the use of the school space. Within architecture, the value of 'post occupancy evaluation' is well-established, but so are criticisms relating to whether and how such evaluations are conducted (Cooper, 2001; Hay et al., 2018; Durosaiye et al., 2019). There is a tendency for architects and builders to want to move on to the next project, but the users will not have the same interest, so, if they have been involved through the school design and change process, they will be well-positioned to continue to engage with the built outcomes. Notably, educators value reflection on their practice, so, if given the opportunity to do so, should be able to reflect on the school community's use of the new space effectively and productively. Again, structures need to be in place to encourage and support individual development so that individual actions can then drive further development. Financiers and policy makers have an interest in learning whether the investments financed are being used as expected in order to adjust future designs and plans accordingly. Thus, some of the reflection will be focused inwards on adjusting space or use in the individual school, but some will be looking beyond this school. Such externally orientated reflection and evaluation will need to be overseen, but can still draw on users' experiences, with evaluation activities led by individual staff members with teaching or other roles and particular concerns.

Financiers and policy makers have an interest in learning whether the schools are being used as expected in order to adjust future designs and plans. But for the school, reflection will be focused inwards on how the space is working, and then on making adjustments to space or use.

Initially, evaluations will be focused on how the space is working, considering whether the setting and resources are being used as intended (see Example 4 for a school where continuing cycles of reflection enable ongoing adjustment), and, as at Stage 3, including students' views will be helpful. Research into the use of space from an educational perspective suggests that a robust approach to gathering information from users, both staff and students, is to combine visual methods, such as mapping and photography, with interviews and focus groups (Blackmore et al., 2010 provide details on the methods they used across pages 18-20, but similar methodologies are apparent in more recent research in this area. See Appendix for some suggestions). Such methods also enable a shift in focus from general student experience to considering minority views, such as the students identified within a new Australian open, flexible space who seemed particularly upset by noise levels (Mulcahy and Morrison, 2017). Addressing the challenge of accommodating the full diversity of the student body will require more in-depth reflection and discussion. Similarly challenging, but potentially valuable, will be looking beyond established practices to consider how the space could support an extended range of teaching and learning activities. The CEB review of new schools in Seine-Saint-Denis (Duthilleul et al., 2019) revealed that the dominant pedagogy in classrooms was teacher lecturing while the library space, which was potentially an innovative learning environment, was mainly used for individual student study under the guidance of the librarian. In both types of space, other uses were possible, but not observed, suggesting a need for the schools' users to reflect more deeply on the possibilities available. Where such a radical rethink is attempted, however, schools would be advised to seek external assistance and choose specific professional development, ensuring, as always, that sufficient teacher time is set aside.

If the school is working broadly as intended, this phase can be used to share good practices with other schools and to initiate further development.

If the school is working broadly as intended, and a major rethink is not required, this phase can be used to share good practices with other schools through local networks, supporting teachers to learn from each other and building the wider culture of collaborative innovation. It might also be productive for school users to initiate further development, perhaps in aspects of the built environment that were not included or were less central to the main redevelopment. Often, in a new build, the outdoor space is not very elaborate or is not tuned to the particular needs and interests of the school community, despite research evidence for the positive effects of outdoor learning (UK Department for Education and Skills, 2006) and the relative inexpense

of developing the outdoors. As previously suggested, giving staff members particular responsibility for developing certain aspects of the school environment can enhance agency, but only if the opportunity is genuine, with real control offered, and is backed by resources such as time and money. To ensure that coherence between the various aspects of the learning environment is maintained, a framework or model can be very helpful. External researchers, Cardellino and Woolner (2019), used Gislason's framework (2009, 2018) to understand the success of an innovative, flexible, open school design, and this framing would help school users maintain a shared understanding of their environment, whatever its design.

Example 4: Supporting continued reflection and adjustments

In Gentofte, a municipality north of Copenhagen, Denmark, a large school-development project, SKUB, ran throughout the late 1990s and into the new millennium. At Ordrup School, the redesign team incorporated 'varied rooms with space for differentiated teaching and creative thinking' with the aim of creating 'a space for diversity in both teaching and play where the learning situation can be optimised' (Bosch and Fjord, 2010). Making use of organically shaped pieces of carpet, raised window seating areas, concentration booths and reading tubes, the redesign employed classroom equipment and furniture in innovative ways: 'function wrapped in an appealing presentation, where the rooms themselves become tools in everyday educational activities' (p118). However, after teachers and students had spent some time in the newly designed building, it became clear that some elements were not serving their purpose effectively. One of these was a curved table with high stools which on reflection by the teachers proved not to be as suitable as other areas of the new learning environment. The staff therefore took the decision to convert the table into a seating area by altering its height and moving its position.

Staff commented afterwards that the new seating area was being used by the children as a chillout zone and a space where they could play games and read.



The original table with high stools



The modified table used as a seating area

For more about the SKUB project, see Rasmussen, L. R. (2019) and Coninck-Smith, N. D. et al. (2015).

The various initiatives pursued at this stage will be understood better by individuals and groups of school users if there is a well-articulated set of values or an over-arching idea and a culture they feel part of that the use of space can be measured against. Such an educational vision can also enable remedial work to realign intentions at the cultural level with individual actions and practice. An example of this process is described by Yeoman and Wilson (2019; see also Appendix), who used the ACAD wireframe to identify inconsistencies between the intended, varied, use of a university space and the dominance, in practice, of teacher lecturing. New furniture was installed that supported teacher direction and student presentations from a fixed point, but also conveyed clear expectations of student collaboration through having much of the room designed for small group work. The use of the space was seen to change as the structural adjustments succeeded in connecting up cultural values and daily activities.

Actions taken at this stage will be understood better by school users if there is a well-articulated set of values or an over-arching idea and a culture they feel part of.

Leadership will continue to be important through ensuing cycles of reflection, and consistency of approach can be enhanced by active succession planning, which research on school change suggests is often overlooked to the detriment of schools (Hargreaves and Goodson, 2006).

From the financiers' perspective, collecting systematic data on how the school space is being used as well as the durability and sustainability of the materials and equipment chosen after 12-24 months is key to ensuring future investments avoid potential mistakes and promote a more efficient and effective use of resources. Hence the importance of adding the users' perspective to any POE focused more narrowly on building performance.

3 What is the Special Role of International Financial Institutions in Facilitating Effective Investment in School Infrastructure?

IFIs are key actors in supporting European governments' efforts to secure the necessary financial resources to implement their investment programmes by facilitating access to long-term financing at competitive rates and occasionally making available additional resources to complement investments with grant funds. Through this complementary role, and given their mandates to promote social inclusion and alignment with European policies, objectives and goals, they are an integral part of the process to promote quality learning for all, and need to be considered as central stakeholders in the multi-stakeholder collaboration that we are proposing. Nonetheless, their role is usually limited to the provision of financing to support the necessary infrastructure investments, and loans are considered achieved when the funds are fully spent and the works completed. It is rare for engagement to follow the use of the building over the years to measure the impact on the education process of having new facilities. The purpose of this report is to examine in which ways the financial resources made available by IFIs could be associated to a planning and implementation process that would ensure a better link between the investments in education infrastructure and the effective use of that infrastructure, in order to support the expected student outcomes.

In doing so, IFIs would contribute to reduce 'wasted investments', defined by French et al (2019) as investments in new spaces that do not foresee the necessary investments in teaching practice to enable the full use of the potential provided by the new learning environment.

Along the four phases of collaboration proposed to support the effective development and use of new learning environments, international financiers can play a key role by ensuring the necessary funds to support the activities are included as part of the investment. The point is not just to ensure that the financial resources are made available to carry them out, but that the design of the investment programme foresees their inclusion and provides the necessary time and technical inputs to facilitate the process. More concretely, at each stage, international financiers could ensure the following activities are included in the projects they contribute to co-financing and that the costs associated with them are included in the total costs.

Through the four phases of collaboration, international financiers can play a key role by ensuring the necessary funds to support the activities.

At Phase 1: Initial planning

This first stage can be expected to last on average a minimum of one year, depending on the particular situation of each school location. Ensuring adequate stakeholder consultation as part of the planning process represents an extra cost, both in terms of time and resources, but it is a small amount in comparison to the total cost of the investment which is essential to promote a more effective use of the learning environments created. Resources are needed to finance the time allocated to the process by the main stakeholders or the 'spatial learning team' of each school. But it is not only their time that needs to be foreseen, but also the input of the expert or facilitator to lead the process, an educator or an architect specialising in learning environment planning, the 'pedagogical planning expert'. Such an expert, associated with the department(s) responsible for the financing of education infrastructure at the corresponding level, ensures that the opportunity presented by the investment in works contributes to enacting the educational vision of the school and nation, and fosters the necessary transformations in practice. A clear methodology to facilitate the consultation process must be developed and followed to ensure the school vision and design brief provide the necessary input to guide the investment.

Resources are needed to finance the time allocated by the main stakeholders to the planning process.

When appraising a new project to be financed, ensuring that these activities are foreseen, that the technical inputs and tools are available or planned to be developed, and that the necessary human resources are in place would emphasize the value given to this process.

At Phase 2: Getting ready

The construction period, usually representing about 18 months for a new school, is an excellent time to support the professional development of teachers to prepare them for the changing learning environment, if change is envisioned. To start with, it is necessary to ensure all teachers in the schools are informed about the project and its implications. If only a small group of representatives participated in the planning process as part of the 'spatial learning team', it is now time to ensure all school staff become familiar with the details of the construction planned. This may go beyond the school staff to the overall school community, including parents and neighbours, to ensure they are ready for the new building. This is also the time to test new environments in order to develop new practices by creating mobile prototype classrooms that reflect the new conception, testing new furniture and equipment, and planning for the use of the space.

The construction period is an excellent time to support the professional development of teachers.

Including professional development activities focused on developing the teacher environmental competencies required to make the most effective use of the potential offered by the new learning environments to meet specific education objectives and individual learner needs then becomes an integral part of the investment project to finance.

At Phase 3: Moving in

The focus of phase 3 is to support the school community in developing a sense of ownership for the building and the new learning environment during the first year of operations. This is a key time to appropriate the spaces to reflect the school identity, values and priorities. It is also a valid time to foster the integration of any new staff to the building and the school vision. In more centralised systems, where the consultation may have taken place at a higher level, this is a key time to ensure the school community is fully on board with the vision reflected by the new spaces, and has the necessary competencies to make use of the full potential available. It is also a time of trial and testing of the new spaces and technology. The first year usually brings many challenges from a technical point of view to ensure the heating, ventilation and IT systems are working properly.

International financiers need to ensure that school principals have the required support to facilitate the transition into the new space.

Ensuring the school principals have the necessary information to manage the process and lead the school community into this process is essential. Appropriate guidance from higher levels of the administration is valuable and the necessary resources to support this first year of operation need to be foreseen.

International financiers need to ensure that school principals have the required support to facilitate the transition and guide their community towards the necessary ownership of the space. Preparing school principals for the unexpected technical problems, ensuring the proper resources are made available to solve them, and encouraging them to mobilise their staff to reflect their own identity requires additional time, and resources should be part of the investment programme. A lump sum to support this process can be made available for each school to implement a collective process that reflects school values and identity throughout the building.

At Phase 4: Reflecting and adjusting

The final stage is key to providing the necessary data to ensure future designs promote an efficient and effective use of the space.

For an international financier, the final stage proposed is key to providing the necessary data to ensure future designs promote an efficient and effective use of the space. Investing in systematic Post-Occupancy Evaluation (POE) two years into the completion of the project is essential for this purpose. The costs of building spaces that end up not being used or not fully used during the day, with technology that is not adapted to the purposes of the building and materials that do not deliver the expected sustainability after use by hundreds of students, need to be taken into consideration when designing new facilities.

To summarise, international financiers can play a key role in ensuring the investment programme foresees the inclusion of the extra costs that these soft activities proposed require. They can play a key catalyst role to ensure the recommended process is respected, by providing the extra funds via grants when appropriate or via their loans as needed. They can also contribute to the discussion by promoting the development of tools to facilitate the consultation and evaluation process, sharing experiences of best practices and promoting an investment culture that endorses these views.

While at the moment there are no precise and systematic data available on the extra costs that financing these proposed activities imply, some inferences from existing country experiences can provide a rough estimate to guide decisions today:

Phase 1, Consultation, spread over a year with an expert facilitator guiding the sessions and a group of teachers attending every session, should represent less than 0.5% of the total cost, including paying teachers and principals the extra time for meetings, with the amount varying according to the size of the school and the number of meetings.

Phase 2, Professional Development, to be carried out during the 12-18 months of the construction process, requiring teachers to test and discuss new practices guided by expert facilitators should also represent less than 1% of total costs, if we consider that annual professional development usually represent 1-3% of annual investments.

Phase 3, Moving in, during the first year of implementation, could roughly represent another 0.5-1% of total costs. As a reference, in France, 1% of total costs are reserved for the inclusion of an art piece in the school building. An equivalent amount could be given to supporting reflection on the school identity and values through a collective collaborative process by the school community.

Phase 4, Supporting continued reflection and adjustments, by carrying out a Post Occupancy Evaluation within two years of completing the works implies a minimum cost. In Helsinki, such an exercise represented about 0.001% of the total costs.

To this estimate, representing less than 3% of total investment costs, should be added the costs of developing the tools to guide the collaboration process, the content training to be delivered and the analysis of the POE data, all of which could roughly represent another 2%. While we need additional data to better refine these figures, we could start with a rough estimate of an additional 5% of total costs to support the capacity of the users to benefit from the investment in innovative learning environments. International Financiers could contribute to such costs, both directly through loans and grants and indirectly, by supporting the development of tools to guide the planning process; by providing some initial training modules and methodologies to facilitate the professional development of teachers, and by supporting the exchange of experiences and best practices to stimulate the process.

International financiers could contribute to the financing of the additional 5% of total costs that we estimate would support the framework activities and thus effectively contribute to developing the capacity of the users to benefit from the investment in innovative learning environments.

Conclusions

European countries have different education systems, but shared ambitions for 21st century learning - including developing spaces and practices.

There are distinct differences across European countries in their education systems, underpinned by some variation in national values and aims for education. Yet, as noted in the introduction to this report, there are some shared ambitions for education, including developing our spaces and practices to better support the collaborative activities, but also the autonomy and critical thinking that our digitally interconnected 21st century lives require. The post-Covid-19 world will bring additional challenges to the design of school space, to ensure the health and safety of students and staff and support an effective utilisation of digital technologies to promote quality learning for all. Whatever the local context and whatever the development or improvement envisaged, the research literature is clear that educational space and its use must be aligned to function successfully and produce the student outcomes expected. It is necessary to consider all the elements of the intended learning environment, paying attention to school organisation, staff beliefs and practices, and student dynamics as well as to the building and material resources. As Gislason points out, achieving this alignment will be more challenging where the new space and practices differ significantly from the well-established model of single teachers and classes spending all their time in enclosed classrooms.

Educational space and its use must be aligned to function successfully and produce the student outcomes expected.

If the opportunities presented by the current wave of school construction and the more recent new challenges brought by Covid-19 are to be used to enhance teaching and learning possibilities beyond the model of knowledge transmission, the involvement of local actors and users is vital. Research shows the value of participatory design, but, as argued above, also coheres around the necessity of the collaborative approach extending to preparation, move in, use and ongoing reflection. There is national variation in where authority lies and decision-making occurs, leading to differing constraints and freedoms at the individual school level, not only in terms of school design but also other aspects of education, such as curriculum and timetabling, which may contribute to alignment within the learning environment.

A collaborative approach is required for preparation, move in, use, and ongoing reflection.

This leaves investors in school infrastructure in a unique position to provide the required oversight, whatever the local conditions, and to make the adoption of the good practices outlined in the framework conditional to their loans. This further develops the approach that has been argued to succeed with post occupancy evaluations, ensuring that they occur through making them 'an integral part of the contractual obligations of the project team' (Durosaiye et al., 2019: 349). Participation can seem difficult to judge meaningfully, so the framework has been compiled to comprise tangible activities and reminders of who to include to achieve genuine collaboration, while leaving space to adapt the actions to national, regional and school contexts. The intention is that the framework can be prescribed and then adherence to it judged, while the experiences of users will continue to build our understanding of what should be included. Reviews of change processes and new school spaces will continue to develop expertise and tools. This responds to a recent study which noted that a 'gap in the literature is actual strategies and tools for stakeholder participation, especially teachers, in the design of new learning spaces as well as in ways of transitioning into these new spaces' (Bøjer, 2019: 45). In the European context, tools in different languages that can be adapted to differing national educational systems are important.

Investors in school infrastructure are in a unique position to provide the required oversight, making the adoption of the good practices proposed by our framework a condition of their loans.

The framework can be prescribed and then the adherence to it judged.

Yet we also know, not least from the British experience with *Building Schools for the Future* (BSF), that mandated requirements for 'participation' might not always produce genuine collaboration. Although there were examples of successful participatory design within BSF, many attempts appear to have been undermined by an absence of dedicated funding for the participation that was required by the programme to happen (Parnell et al., 2008). The same observation about the need for ring-fenced funding is frequently made by architects wanting to make post occupancy evaluation a more standard part of design practice. The conclusions of Blackwell and colleagues about the need for time for teacher collaboration at all stages in developing pedagogical practice might seem like a different argument, except for the inevitable links between time and money. If staff are to meet to plan or evaluate, they may need to be paid for this when it takes place outside their working hours. If time is made available within normal working hours, it might be necessary to provide and pay for cover staff to carry out the normal staff duties.

Therefore, a key requirement that can be built into investments in school infrastructure is that money is set aside to implement the actions recommended in the framework. Using the framework should provide the right balance of prescription and flexibility to enable this money to be spent wisely in response to particular school, regional and national contexts.

Investors can ensure that funding is set aside to implement the good practices defined by the framework, which provides a balance of prescription and flexibility to ensure the money is spent wisely.

Appendix: Tools for Collaboration

This appendix presents tools for use at each phase of collaborative redevelopment to support the members of the school community in thinking, planning and working together in their new school space. A number of the tools rely on activities within the school space and the use of images and maps. Through the phases, such activities can help develop understanding by revealing different or complementary information from the surveys and interviews that school staff might be more familiar with. These 'visual methods' produce different information to that which emerges from simply asking for opinions, as in a traditional interview (Bragg and Buckingham, 2008; Harper, 2002). Visual methods may also be preferred by some participants, as they reduce the 'overt privileging' of verbal interaction (Prosser 2007: 15) and thus potentially increase inclusion and engagement (Nind and Vinha, 2016). Both during and beyond participation in the activities, the resulting visual items will 'act as 'mediating artefacts' aiding communication between the participants' (Clark 2010: 151). In relation to understanding a school space, visual methods enable less obvious or implicit ideas to emerge, and also have the potential to facilitate the development of a collective understanding (Woolner, 2018), which is particularly important in the context of developing, and using, a single learning environment.

Phase 1: Tools for collaborative planning

The tools we suggest for initial planning enable the exploration of ideas about learning and space, supporting participants to think beyond their current setting and its use. The ACAD toolkit enables collaboration to achieve a coherent plan for the new environment and its educational uses, which school leaders, teachers and other staff can develop together. Diamond ranking of images is much a less structured tool, but the activity is easily understood and can be usefully carried out by the whole school community – including all school staff, parents, young children and older students.

ACAD Toolkit

Researchers based in Australia and New Zealand have developed a tool kit to enable diverse groups of stakeholders involved in planning an educational space to engage in discussion and planning. It is based on the Activity Centred Analysis and Design (ACAD) framework and wireframe (Carvalho and Yeoman, 2018; Yeoman and Carvalho, 2019). This was created by bringing together a framing of learning as emergent activity, generated but not determined by the interaction of the physical setting, designed tasks (epistemic design) and social structuring, with an established pedagogical framework (see e.g. Goodyear, 2005) for understanding educators' intentions and actions at differing levels, from philosophical notions of learning down to moment-to-moment 'pedagogical tactics'. The following table shows the ACAD wireframe, and can be used to order ideas or observations about learning in action:

	Set design	**Epistemic design**	**Social Design**
High level philosophy	*'Learning is…'*	*'Learning is…'*	*'Learning is…'*
Macro-global	*Buildings and technology*	*Stakeholder intentions*	*Social systems*
Meso-structural	*Allocation and use of space*	*Curriculum*	*Community*
Micro-details	*Artefacts, tools and texts*	*Selection, sequence, pace*	*Roles and divisions of labour*

The authors describe the toolkit they have developed as follows:

In its current form, the toolkit has four main elements: (1) a set of 100 cards divided into four categories, (2) the ACAD wireframe, (3) three learning scenarios and (4) assorted artefacts (plans and photos) and stationary (post-its, etc.). The cards are a key element. The full set of 100 cards is divided into four categories: the set, social and epistemic designs, and high-level learning philosophy. The deck has been designed to help educational designers consider the alignment of pedagogical practices, space and tools…As such, each of the four sub-sets of coloured-cards is assigned a design function, distributing the cognitive processes of educational designers:

- blue cards prompt conversations about high-level philosophy,
- green cards are reminders about tools, resources and spaces,
- orange cards invite discussions about roles and responsibilities, and
- yellow cards aid in the structuring of tasks and modes of instruction.

Together, the ACAD wireframe and the cards support thinking about part-whole relationships offering reminders to situate design in context. The images of assorted learning spaces provide inspiration or illustrations of points of contention. The learning scenarios offer short descriptions of enacted designs, providing scaffolded opportunities for those who are unfamiliar with the ACAD framework to engage with the underlying concepts, without having to create a new design. The toolkit has been carefully curated to scaffold (structure) design conversations at various scale levels in a manner that does not limit adaptation (agency) across contexts (Carvalho and Yeoman, 2019: 1114-1115).

Diamond ranking of images

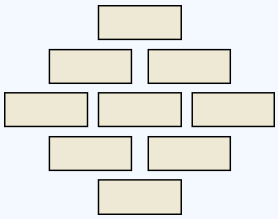
Diamond ranking is a recognised thinking skills tool designed to facilitate talk and encourage people to consider their positions on a given topic. Although traditionally the ranking is of written statements according to a range of criteria (e.g. most important, most interesting etc.), asking people to rank photographs is very effective. Ranking images of school space encourages people to consider their beliefs about learning and teaching in relation to the setting. Additionally, it has the potential to facilitate discussion with and between diverse members of the school community, helping to develop a clear and, importantly, shared sense of the existing issues relating to the educational intentions. The method has been used across a number of cultures and countries to research learning environments, sometimes to inform the redesign of space (Muzir, 2017; Niemi et al., 2015; Sigurðardóttir, 2018; Woolner et al., 2010).

Diamond ranking can be used in two distinct ways, either to establish people's existing experiences and understandings of the learning environment, or to begin to explore alternatives.

If the aim of the research is to support users in discovering what they know, through experience, about their existing setting, then the photographs used should be of the participants' actual physical environment. However, if the intention is to help participants to discuss less tangible aspects, such as their beliefs about learning and physical space, then the photographs need to be of a range of different spaces that will stimulate more general discussion. Using diamond ranking in this way can start from exploration of existing beliefs about pedagogy and space, but lead to discussion that explore possibilities and alternatives.

Photo libraries for diamond ranking and full instructions in a number of languages can be found here: https://www.ncl.ac.uk/cored/tools/diamond-ranking/
You will need nine photographs representing a range of learning environments, a sheet of A3 paper, scissors, glue and pens. Participants work in pairs or small groups to cut out the photographs and rank them:

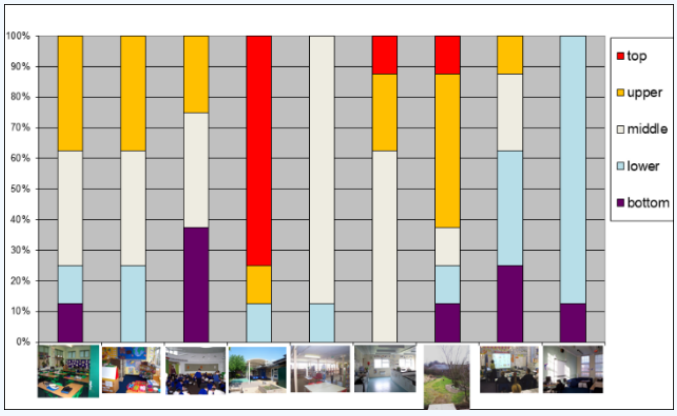
Good place for learning



Poor place for learning

Rankings should be discussed and no gluing should take place until there is a consensus on positioning. Finally, participants can annotate their diamonds with comments to explain the positioning.

The resulting diamonds can be shared and discussed, as well as analysed in two ways. Firstly, the annotations can be collated and any recurring themes noted. Secondly, a quantitative analysis can be undertaken which can highlight overall preferences (e.g. see below) or can be used to compare responses between groups of participants (e.g. staff and students).



Phase 2: Tools for getting ready

Once final plans for a new educational space are available, these can be used to inform a considerably wider group of users and other stakeholders about the design. This has been observed in action in a recent rebuild in the UK where plans of the new school premises were displayed in the entrance hall of the old building (Woolner and Thomas, 2017). Working closely with the plans can also enable key staff to develop ideas for use and address organisational issues such as student groupings or movement. It is sometimes suggested that some people without architectural training can struggle to understand plans, but a doctoral researcher in Northern Ireland found that the use of Building Information Modelling (BIM) greatly aided teaching staff in viewing and discussing the plans of their new school (see also Singer, 2015 for discussion of BIM). Physical trialling of some aspects of the new settings can also help to bring plans to life for the users.

Collaborative preparation and trialling

Engaging with plans of an innovative new school enabled teaching staff who were still working in the old, traditional building to consider how they would collaborate to use the open, flexible spaces in the new building (Cardellino and Woolner, 2019). This planning, using the printed plans and counters to represent staff and students, enabled them to develop the shared understanding necessary to work in teams in a shared space, which, they reported, made the transition to the new premises more comfortable and successful.

Using spaces within the old building to trial teaching and learning approaches can support practical experimentation prior to moving into a new building, (Woolner et al., 2012, 2014; Daniels and Tse, 2018). However, it is important that teachers engage with planning specifically for the new spatial arrangements as well as for any other innovations. Particular concentration on trying to use an open, flexible space that was 'mocked-up' within the old school premises appeared very successful for the teachers in an English school studied by Daniels and Tse.

Baseline survey of students

As noted throughout this report, it is of central importance that the new school spaces are evaluated in various ways to support a range of cycles of reflection and adjustment. Students can be a key part of these evaluations, by collecting and generating a wealth of data about their experiences and use of the new school, as well as their views and opinions. One aspect of this post-move consultation of students could be surveying them about their experiences and views. If such a survey is to be conducted, it can be helpful to have a base-line. A questionnaire was developed in the UK context for a National Foundation for Educational Research (NFER) survey of student attitudes in a secondary school rebuilt through BSF (Rudd et al., 2008), which the researchers used before and after the move into the new school building. This questionnaire has since been adapted and used similarly to survey students before and after they moved into new premises built through the current Priority School Building Programme (Woolner and Thomas, 2017). The report containing all the questionnaire items in English can be found here: https://www.nfer.ac.uk/media/1632/bsy01.pdf

Phase 3: Tools for moving in

Key, at this stage, is gathering a wealth of information about the new environment and how it is being used by all members of the school community. The post-move surveying of school users, which may be extensive, can be complemented by more in-depth discussions with a sample of students or particular groups of staff. We have previously made use of school plans to initiate and develop discussion around 'places that work' (Woolner et al, 2010; Woolner, 2018) with staff in teaching and other roles, as well as students. The maps that are produced can be discussed at the time, used alongside other information to inform tweaks to the space or its use, and returned to at a later date to help evaluate any changes.

Surveying students

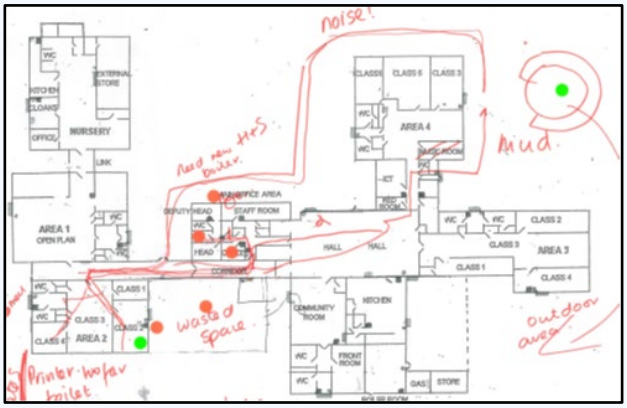
For the post-move surveying of school users recommended above, a student survey can be central. It is an efficient way to gather a large and diverse body of views, given that students use nearly all parts of the school and will have different perspectives from staff. An extensive survey, perhaps involving all the students in the school, will generate lots of information about how the new school premises are being experienced and viewed. Using the questionnaire recommended previously as a baseline enables direct comparisons to be made between student perspectives of the old and new schools (as was done by Rudd et al., 2008 - the report containing all the questionnaire items in English can be found here: https://www.nfer.ac.uk/media/1632/bsy01.pdf). Additional open questions or items specific to this new school can be added as required.

Mapping a day

Participants are provided with a printed plan of the school premises, pens and coloured stickers. Working individually, they are requested to, 'Draw a line to represent your movements through school on a typical day. Use stickers to indicate:

- Places that work (green)
- Places that don't work (red)

Discussion can then be initiated around similarities and differences of opinion, and the reasons behind the stickers, with participants encouraged to add annotations to their mapping (see an example produced by UK primary school staff member below left). To summarise the findings for the wider school audience, a collation of all the stickers can be produced (see an example from a UK secondary school below right):





Phase 4: Tools to support reflection and adjustments

A robust approach to gathering information from school users, both staff and students, has underpinned the compilation of this appendix. As the school moves into Phase 4, ongoing cycles of reflection and development, it is recommended to continue combining visual methods, such as mapping and photography of the premises, with word-based enquiry through questionnaires, interviews and focus groups. Blackmore and colleagues provide details of the methods they used and data they collected (2010: 18-20), which could form the basis of a checklist for a school-initiated evaluation:

- Interviews and focus groups
- A video-recorded 'virtual tour' of the school
- Observation of activities and use of spaces, time, technology and resources
- Mapping exercises and cartographic annotation
- Interviews with community stakeholders such as parents, school council members, outside experts and community partners
- Photographs generated by students.

These approaches to information gathering could then be used by a working party of staff to consider how the intended and actual uses of new school spaces, particularly innovative areas, compare. The ACAD wireframe can support investigation of coherence between elements of the learning environment to inform adjustments that may be needed to bring intended and actual use closer.

Photo voice

There is an increasing interest among social science researchers in using 'photo voice', participant photography, to gather views, particularly from students. In relation to the school premises, and the learning that takes place (Niemi et al., 2014), prompts such as 'I like...', 'I feel safe here…' or 'I can learn well here…' can be productive. Group discussions can then be facilitated by sharing and discussing photos taken by group members, as below:



ACAD Toolkit

It can be useful to compare how the new educational space is being used with the original intentions, particularly where the aim was to be innovative. The ACAD wireframe, introduced above as a Phase 1 tool, can also be utilised in this way. Yeoman and Wilson (2019) report how they used it to re-align intentions, design and use. Their case was a relatively spacious university space that had been intended to support student-centred collaboration, but was instead being used for teacher-led transmission teaching, and using only one section of the room. The ACAD framework enabled them to analyse the design of 'set', 'epistemic' tasks and 'social' structuring at differing levels (see below), establish where 'discontinuities' lay and propose new furniture to better align 'the nested sets of relations that must correspond if deep constructivist and situative theories of learning are to be enacted' (Yeoman and Wilson, 2019: 2096). Observations, backed up with field notes and photographs, of the newly furnished space in use then demonstrated that this 'flexible' furniture was indeed being rearranged by staff and students, thus supporting a range of student and teacher-centred, collaborative and individual, activities.

	Set design	***Epistemic design***	***Social design***
Philosophy of learning	*Learning will be accommodated in a range of blended active, and dialogic spaces.*	*Learning will be characterised by student-centred pedagogies.*	*Learning will involve collaboration between students, and with industry partners.*
MACRO **The global Level I Patterns**	**Buildings and technology** To provide a new faculty home (9 100 square meters, AUD $250 million) on the leading edge of change in higher education**.**	**Stakeholder intentions** To facilitate innovative student-centred learning in a blended environment, supporting the movement of people and ideas into and out of the faculty.	**Social systems** To inspire a new generation of leaders, innovative students, and academics addressing global challenges though socially minded practices.
MESO **The local Level II Patterns**	**Allocation and use of space** A mix of case study theatres, learning studios, computer labs, seminar rooms and lecture theatres.	**Curriculum** A comprehensive range of undergraduate and post graduate business degrees.	**Community** Large cohorts broken into smaller working groups on campus and in workplace settings.
MICRO **The detail Level III Patterns**	**Artefacts, tools, and texts** A single teaching point with network facilities, Wi-Fi, primary and secondary projection, a visualiser, shared writable surfaces, variable lighting, voice amplification, and a mix of fixed tiered and flat-floor seating, fixed small group computing and large computer labs, and various informal learning spaces.	**Selection, sequence, and pace** This level of detail is not specified in the project brief but there is a clearly articulated desire to move from didactic forms of 'transmission' towards increasingly student-centred forms of teaching and learning, and for learning to be authentic, relevant and connected.	**Roles and divisions of labour** Less detail specified in the text. But the range of space types illustrates a commitment to teaching across a broad range of group sizes, in spaces that support varying degrees of student autonomy.

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Notes

About the authors

Yael DUTHILLEUL has been working as an Education Technical Advisor at the Council of Europe Development Bank (CEB) since 2006, in charge of the appraisal and technical monitoring of education projects in its forty-two member countries. In recent years, her work has focused on exploring the links between investments in education infrastructure and school design, on the one hand, and learning outcomes, on the other. Prior to joining the CEB, she worked at UNESCO's International Institute for Educational Planning (2004-2006) and at the World Bank (1996-2003), with concrete experience in both education policy and lending operations in several countries in Europe, Central Asia, Latin America and the Caribbean. Yael Duthilleul holds a Doctor of Education degree in Administration, Planning and Social Policy from the Harvard Graduate School of Education, U.S.A. and a B.A. summa cum laude from Tulane University, U.S.A.

Pamela WOOLNER is a senior lecturer at the School of Education, Communication and Language Sciences at Newcastle University, UK. She has been researching and writing about educational environments for nearly two decades, developing an overview of the potential for school premises to enable change and improvement. Her research includes investigations of underlying issues for the design of learning environments, and examinations of the use and development of space in schools. Pam's published work includes a seminal review, The Impact of School Environments (2005), a book for school users (the Design of Learning Spaces, 2010) and an interdisciplinary edited collection, School Design Together (2015), exploring participatory design of school space. Currently, she is leading an EU-funded initiative, CoReD, which is developing tools for school communities, in particular in six European participating countries, to use to evaluate and change their school space and how they use it.

Alison WHELAN is a Research Associate in the School of Education, Communication and Language Sciences (ECLS) at Newcastle University. After teaching Modern Foreign Languages in various secondary schools in the UK, she explored the impact of self-identifying as a Teacher-Researcher as part of her Doctorate in Education. She now has particular interests in language learning and teaching, project-based learning, teacher training and development, and the creation and implementation of research-based, innovative curricula at primary, secondary, college and HE level. Alison worked on the Erasmus+ funded proPIC Europa project, researching the impact of transnational collaboration amongst trainee language teachers, and is co-editor of "proPIC Europa: Promoting professionalism, innovation and transnational collaboration" (Schwab, Oesterle and Whelan, 2021). She is currently working on the Erasmus+ funded project ENACT Europa, developing a web application to enable users to learn languages through global cultural activities.

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Stefaan Hermans
Director Policy Strategy and Evaluation
Directorate-General for Education, Youth, Sport and Culture, European Commission

"This report provides an excellent framework to involve the users of education facilities in the planning and use of the new learning environment for improved educational outcomes. We look forward to testing the framework in Espoo".

Merja Narvo-Akkola
former Facility Development Manager
Educational and Cultural Services, City of Espoo, Finland

"Sustainable and effective school re-generation requires effective interplay between those who bring modern schools into existence, those who occupy them, and those who evaluate their impact. The proposed funding framework, built on quality research and exhaustive fieldwork, provides exactly this: a practice-based strategy, a long time in coming."

Wesley Imms, PhD
Associate Professor,
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