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Title: Ownership and agency through learner-led design of shared learning spaces: a multi-case study approach.

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Abstract:

Studies have shown that the way in which learning spaces are designed has a direct impact on the nature and quality of the learning and teaching that takes place within them. However, considerations of space remain largely absent from educational policy and practice in the UK and internationally. Furthermore, there are few opportunities for learners themselves to influence the design of these spaces. This article draws on two case studies where 73 learners aged 9-22 used a *Learning Space Design Toolkit* to design their own educational spaces. Considering learning space design through an ecological lens, the cases reveal that taking the lead in the design process allows learners to develop a sense of ownership of their learning and provides opportunities to articulate their perceptions of how space impacts on wellbeing. We contend that greater consideration of ‘spatial literacies’ in teacher education programmes is crucial for supporting futures-thinking learning and teaching.

Key words: learning space design; spatial literacies; teacher education; shared learning; learning spaces

Introduction

Concepts of space are well established in academia. Consideration of spatial thinking has been incorporated in studies in Geography (Stratford et al., 2021), Human Geography (Botterill & Hancock, 2019), Art and Design (Lerner, 2018), and Science (Bednarz & Kemp, 2011). In education, research evidence has demonstrated that in formal learning contexts, space can impact on modes of learning, motivation to learn, and on learners’¹ cognitive capacity to inquire and solve problems (Closs et al., 2022; Bradbeer et al., 2017; Ellis & Goodyear, 2018; Barrett et al., 2015). Furthermore, there is evidence that the planning and design of classrooms impacts on young people’s sense of belonging (Brillante & Mankiw, 2015). Despite this, concepts and considerations of space are largely absent from educational policy and practice in the United Kingdom and internationally (McNeil & Borg, 2018; Lane et al., 2019; Imms et al., 2016), and rarely feature on teacher education programmes (Coyle et al., 2021). This is even more surprising given the COVID-19 pandemic has altered the ways in which we interact with space, and in education has highlighted the need for more dynamic, flexible, and adaptable learning spaces. In this context, it is vital that both learners and educators develop into spatially literate thinkers (Lane & Sorby, 2021). Our paper therefore addresses the gap in knowledge around approaches to raising awareness of spatial literacies and the impact of space on learning amongst both educators and learners.

This study explores the extent to which understanding the strengths and challenges of spatial literacies, as applied through learning space design, can create opportunities for educators and learners to collaboratively develop inclusive, responsive environments and

¹ The paper involves learners of a range of ages, from Primary, Secondary, and College Education in Scotland, UK. We use ‘learners’ as an all-encompassing term to refer to them.

pedagogies. Learning space design is conceptualised as an ecology where learners, teachers, space, and learning interconnect and interplay in any educational setting, whether a new-build school, an older Victorian-style building, or anything in-between. Through analysis of two case studies where learners in various educational settings explored using a *Learning Space Design Toolkit*, we investigate the extent to which involving young people as designers of their own educational spaces can develop agency and a sense of ownership of their learning. Finally, through the Findings and Discussion we set out some considerations for teaching practice and teacher education, including ways in which newly acquired knowledge and confidence around spatial literacies can enable educators to actively engage learners in co-designing *their own* environments for learning (Green, 2014).

Spatial Research

In the seminal report *Learning to Think Spatially*, The National Research Council define 'spatial thinking' as a collection of cognitive skills, a "constructive amalgam of three elements: concepts of space, tools of representation, and processes of reasoning" (NRC, 2006, p.12). Spatial thinking is understood as a fundamental and essential mode, which is fostered through education and design for learning, yet a notable 'missing link' in curricula (Janelle et al., 2014; NRC, 2006). Indeed, spatial thinking can be a powerful tool, fundamental to problem solving in a variety of contexts (Lane et al., 2019).

In everyday life, spatial skills are required at very different levels, from manipulating and understanding physical objects, for instance in assembling furniture, to visualising and conceptualising spatial representations of objects not physically present, for example working with graphs or maps (Lane & Sorby, 2021). Though spatial skills are embedded in the evolving nature of specific disciplines such as Science, Technology, and Geography, there has been a recent significant shift in thinking. The 'Spatial Turn' as set out by Montello et al. (2014) established the notion that the importance of spatial thinking moves beyond subject disciplines and allows interaction and comprehension of the natural and cultural worlds. Whilst literacy studies involving multimodal meaning-making are gaining momentum, including as an explicit aspect of STEM learning (Lane & Sorby, 2021), space remains a relatively unexplored aspect of pedagogy (Lane et al., 2019).

Spatial thinking and spatial skills converge in the concept of 'spatial literacies', which traverse disciplines, knowledges, and contexts. Moore-Russo et al. (2012) describe a spatially literate person as one with the skills to: visualise spatial objects; reason about properties of and relations between spatial objects; and communicate and receive information about spatial data. In formal educational contexts, research evidence demonstrates that space impacts on the cognitive capacity of learners to inquire and solve problems, their motivation to learn and build self-esteem, and ultimately on achievement (Berris & Miller, 2011; Barrett et al., 2015). Across the curriculum, learners require guidance and activities which enable them to better understand spatial relations, thereby making inferences and discoveries, and developing social, communication and literacy skills (Comber & Nixon, 2008). However, Imms et al. (2016, p. 6) have identified that educators have limited resources and capacity for taking pedagogical advantage of learning spaces. There is, therefore, a need for educators to be supported with tools and approaches that allow them to harness spatial literacies, to raise awareness of its importance to education, and to co-create more equitable learning environments with their learners.

The ‘pedagogical silence’ surrounding space is especially conspicuous given that the COVID-19 pandemic has increased awareness of the importance and impact of space (Pokhrel & Chhetri, 2021). Across the world, and in Scotland, UK, where this study is based, schools closed and reopened repeatedly during the pandemic, with a variety of new regulations introduced which influenced both the experience and conception of space. The inequalities and power imbalances inherent in learning spaces have also been made more visible by the pandemic; for example, in relation to access to online and outdoor learning spaces (Brooks et al., 2020). Against this background, our study will explore how learners engaging in the design of their own educational spaces may raise awareness of spatial literacies, of which ‘explicit attention’ is required for equipping the next generation for life and work in the 21st Century (NRC, 2006, p. 10).

Design of (Shared) Learning Spaces

International literature on the design of learning spaces often focuses on physical characteristics and architecture, with less consideration for how space may align with pedagogy and practice (Acton, 2018). Furthermore, exploration is required both on how space impacts on learners, and the ways in which they may influence the design of their learning environment (Cleveland & Fisher, 2014). Though researchers have begun to investigate how evaluation of educational environments may further incorporate the voice of learners (Closs et al., 2022), there is a relative dearth of projects which position learners as designers who actively shape space themselves. Where this has been explored, engaging in the design of learning spaces has been shown to prompt learners and educators to rethink and reimagine space, and offer “inroads for young people into critical literacies, which are material, imaginative, and creative” (Comber & Nixon, 2008, p. 234).

Attempts to explore links between learning space and learners include the development of ‘shared learning spaces’, which connect educators, learners, and other stakeholders within and across educational sites, with each participant playing a role in co-creating the space (Coyle, 2013). These shared spaces embrace agile learning and connect with other spaces, usually through a range of digital tools, bringing the outside in and the inside out, across physical and temporal boundaries. Connecting educational sites in this way has been shown to facilitate action research, co-operative teaching and learning, and school-based inquiry; therefore, presenting opportunities for educators to translate theoretical principles into classroom pedagogies (Florian & Beaton, 2018), and for learners and teachers to discuss different perceptions of learning (Wang & Wiesemes, 2012; Marsh et al., 2009). Learning spaces can become ‘shared’ in the sense that learners can develop positive relationships with one another, forming both individual and collective experiences and a sense of belonging (Coyle et al., 2021).

As outlined below, in both case studies the concept of shared learning was employed across educational settings and contexts, for learners and educators to collaborate on learning space design. This was of particular importance in the context of COVID, where it was not possible for participants and researchers to meet in-person. Additionally, participating in shared learning spaces is one way in which learners can take greater control of their learning, for instance by using platforms to share and reflect on their perceptions of ‘successful learning’ (Coyle, 2013). Therefore, developing and utilising shared learning for learners to interact and collaborate was a crucial aspect of the design process, where such shared spaces could act as a catalyst for conversations around the spaces and the learning that takes place within them.

Research indicates that learners having a voice and influence over their learning leads to them feeling more included and connected to their educational environment (Biddle, 2018). However, while Mitra (2004) holds that learner voice has an impact on the development of agency, Hall (2016) notes that it is crucial to consider how this ‘voice is heard’, so that it is something that enables learners “individually and collectively, to contribute in a *new way*” (p. 189). If agency is conceptualized as a function through which “personal influence is exercised” (Moore, 2022, p. 1), ownership can be seen as the function through which this agency is realised and enacted, creating opportunities for learners to engage meaningfully in their learning (Chan et al., 2014). Indeed, developing student ownership of the learning environment has been shown to have positive outcomes for both learners and teachers (Ennis & McCauley, 2002). However, educators must be willing to “listen meaningfully to what the [learner] voice is saying” (Moore, 2022, p. 3). There is, therefore, a need for a critical approach to any participatory processes that seek to provide learners with a greater sense of agency and ownership (Clark & Richards, 2017). There is a danger that efforts to foreground ‘learner voice’ and develop agency in the classroom may be merely tokenistic, simply reinforcing existing hierarchies and inequalities (Street, 2022).

Although processes of learning space design have the potential to act as platforms for learners to take the lead in the make-up of their educational environments and develop stronger connections to their learning, these processes are also at risk of being viewed as tokenistic. Literature on the design of educational spaces still frequently affords “little attention to the enacted processes through which learning spaces are (co-)constructed (in activity)” (Damša et al., 2019, p. 2077). There is, therefore, a need for a more critical lens on learning space design; one in which the process can actively deconstruct power relations and hierarchies of learning. In this sense, the space and the learner must be conceptualised as interconnected and interwoven, one impacting on the other, with the learner at the centre of decision-making about the design of the space for learning.

This research framework is informed by ‘Learning Ecologies’ (Jackson, 2013), which are conceptualised as spaces of ongoing and dynamic re-configuring of meaningful interactions through which learners gain access to memorable and powerful learning. Specifically, we draw on Damša et al.’s (2019) model of learner-constructed learning spaces. While there is particular focus on digital technologies, the model recognises that:

“Learning is not a confined, internal process but instead involves mutually constitutive relationships between individuals and their (social, intellectual, and digital material) environments, where both person and environment are transformed.” (Damša et al., 2019, pp. 2077-2078).

In this paper we understand learning space design through an ecological lens, with both ‘space’ and ‘learning’ actively co-constructed by learners through interaction and dialogue and facilitated by pedagogy. The focus is on learner and educator perspectives, using a sociocultural framing, where interactions with space provide opportunities for learners to recognise rights, and exert agency, diversity, and creativity. While concepts of the agentic role of space are largely outside the framing and scope of this paper, we draw on Pickering’s (2013) theory of ‘performative dances of agency’ between people and things, in which agency is in a constant state of emergence and becoming. Space, pedagogy, and learning are therefore

recognised as actors with which learners and educators interact and react, though the impact on learners is the focal point².

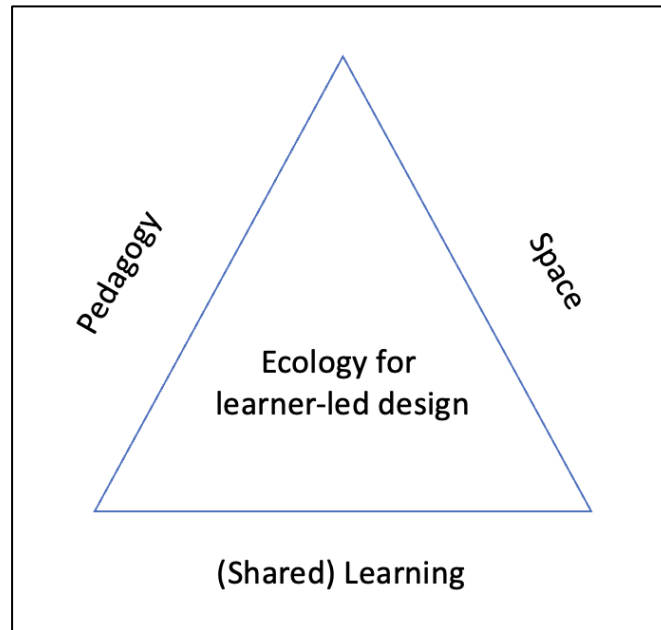


Figure 1: Model for learner-led design of shared learning spaces

Through explorations of learning space design, participants are encouraged to create and develop spaces in which the values which drive and underpin learning are key, rather than requirements or metrics that learners are expected to meet. Further, our model takes account of the social and cognitive aspects of learning spaces, and the ways in which these interact and are interconnected for both learners and teachers (Ellis & Goodyear, 2016). It is through this ecological lens that we consider the potential of learning space design in our two case studies for *sustaining* learner agency and ownership. Firstly, we set out the overarching Methods and Research Questions for the case studies, before turning to Findings and Discussion.

Methods

A mixed-methods, multiple case study approach was employed (Stake, 2013), with data gathered from two interconnected and complementary research initiatives with participants exploring learning space design: the first in a primary school involving 56 learners aged 9-10 and eight staff; the second a collaboration between two secondary schools and a college, involving 17 learners aged between 13 and 22, and three staff members. The decision was taken to focus on learners ranging from age 9-22 to explore how agency in learning space design was enacted at different ages and stages, and in the context of primary, secondary, and tertiary education. Each of the two cases acted as “an arena or host or fulcrum to bring many functions and relationships together for study” (Stake, 2013), converging around key research aims related to the design of learning spaces and its impact on learners. The two cases both followed similar methods and were guided by related overarching research questions, with activities conducted and overseen by the same research team. The timeline of the two cases was comparable, taking place over the course of a school year. Both cases were also situated in

² Also out with the scope of the current study, but an area for further research, is debates on humanist and post-humanist conceptualisations of learning space design, where the space may be seen to operate ‘as learning’ rather than simply for learning (see Barad (2007), for example, on agential realism and intra-actions of space).

Scotland, UK. A key element of both studies was that participants engaged with, explored, and utilised the *Learning Space Design Toolkit* (hereafter referred to as ‘The Toolkit’). Fully informed consent was sought and gained from each of the participants involved in the study before the collection of data.

To give clarity to the nature and the purpose of the research activities, the Toolkit is first outlined, followed by the context of each case study, before the overarching research questions are set out.

Learning Space Design Toolkit

The Toolkit is a dynamic resource for learners and educators to collaborate on the co-design of educational spaces³. It was developed in collaboration with Architecture and Design Scotland and City of Edinburgh Council, and contains a set of symbols which aim to make the principles of learning space design accessible to a wide range of users. The Learning Typologies, adapted from Thornburg’s (2007) *Campfires in Cyberspace*, signify different ways of learning: scaffolded, independent, collaborative, experiential, and celebratory.






				
Campfire	Cave	Watering Hole	Fields	Mountain Top
(Focused, scaffolded input)	(Independent, reflective learning)	(Collaborative learning)	(Experiential learning)	(Celebratory, shared learning)

Figure 2: Learning Typologies

The Toolkit was used throughout both case studies, with the aim of creating a ‘shared language’ for learners and teachers to discuss and collaborate on learning space design. First the symbols and concepts underpinning them were introduced, and then participants mapped these against the various values and spaces they imagined for their designs. Learners were given the opportunity to interrogate and challenge the symbols, and come up with their own versions.

Case Study Context

The first case study involved 56 Primary 6 pupils⁴ aged 9-10 and eight members of staff at a Primary School in Edinburgh, Scotland, designing their own learning space in a specialist classroom (the STEAM⁵ Room).

The class teacher used the Toolkit over the course of a school year to assess spaces in the school and discuss learning with pupils. The symbols were introduced to the learners gradually and used in lesson planning. Pupils then identified *the classroom wall* as an area that

³ A pilot version of the Toolkit was used in this study. The full toolkit was published by Architecture and Design Scotland in March 2023, available online here: <https://www.ads.org.uk/resource/shared-learning-toolkit>.

⁴ In Scotland, learners at Primary School and Secondary School level are referred to as pupils.

⁵ STEAM education is an approach to learning incorporating Science, Technology, Engineering, Arts, and Mathematics.

they would like to (re)design. Funded by the local authority, pupils developed their own designs for the wall, to be presented to an interior designer in an online event. The learners worked in groups of four or five to create their designs, first sketching out ideas, and then making 3D models and putting together display boards. Following the presentations, the interior designer organised an online session where she outlined design ideas incorporating elements of all the pupil designs. The design was then finalised, with work beginning on the wall re-design over the summer break.

Due to the COVID-19 pandemic, it was not possible for researchers to visit the school, so the teacher led on several research activities, with guidance from researchers. Such an approach, with the participant acting as co-researcher, is not without its challenges, for instance in terms of positionality and unequal power distribution between researcher and participant; however, it has also been shown to be beneficial for forging closer links between research theory and practice, with positive outcomes for both researchers and educators (Mariguddi, 2021).

Research Activity	Conducted by	Stage of Project	Participants
Two online interviews with P6 Class Teacher	Research Team	Midpoint and end	1 class teacher
Staff member interviews	P6 Class Teacher	Midpoint	7 staff members (3 class teachers, 3 pupil support assistants, 1 depute head)
Pupil focus groups	P6 Class Teacher	Midpoint	17 pupils
Dragon's Den online presentation	Research Team	End	56 pupils
Online session finalising the design	Research Team / Interior Designer	End	55 pupils
End of term P6 pupil survey (quantitative and qualitative questions)	P6 Class Teacher / Research Team	End	46 pupils

Table 1: Case Study 1 Research Activities

The second case study concerned a partnership between two Secondary Schools and a college in the East of Scotland, involving 17 learners aged between 13 and 22, and three members of staff. The impetus for the partnership was the development of a new Community Learning Campus bringing together the college and two schools on one site. At one of the schools, teachers and the pupils had recently experienced learning and teaching in several temporary sites while school buildings were being repaired. With development underway and a projected finish date for the 2024-25 school year, the project offered an opportunity for learners to influence the new campus design.

11 S2 and S3 pupil volunteers (aged 13-15) from the two schools took on the role of ‘Responsible Activists,’⁶ developing designs and considering how best to communicate their ideas to a range of audiences. Six student volunteers from the college (aged 16-22) acted as ‘Agile Consultants,’⁷ forming consultancy teams to support and offer advice to the activists as they worked on their designs. A group of ‘Mentors,’ including teachers, advisers and experts from the schools, college, and university acted as a support network. As in case study 1, the COVID-19 pandemic had an impact, as the workshops and final event had to be held online rather than in-person. Consultants and Activists initially worked separately in two sessions in the lead up to the workshops, to plan and sketch out their ideas, before working together in a series of two online workshops to refine the designs, using the Toolkit as a guide and reference throughout. A final project event was held online, with pupils and students presenting their designs and communicating their experiences to key stakeholders, including representatives from the local council, the college, and architects working on the new campus.

Research Activity	Conducted by	Stage of Project	No. of Participants
Two online introductory sessions for students	Research team	Beginning	6 student consultants
Two in-person introductory sessions for pupils	Teachers	Beginning	11 pupil activists
Two online collaborative design workshops	Research team	Midpoint	11 pupil activists; 6 student consultants; 2 teacher mentors
Student Survey	Research team	End	6 student consultants
Online Reflection Session	Research team	End	6 student consultants, 1 staff mentor
Final Presentation Event	Research team	End	11 pupil activists; 6 student consultants; 2 teacher mentors

Table 2: Case Study 2 Research Activities

Research Questions

Taking Yin’s (2003) view that theoretical propositions are the catalyst, rather than the outcome, of case study analysis, through the cases the researchers sought to investigate the

⁶ The ‘Responsible Activists’ title was chosen to give emphasis to the role of pupils as articulate and creative problem-solvers, and agents of change.

⁷ The ‘Agile Consultants’ title was designated to give emphasis to the flexible role of students as providing advice, expertise and support to the pupils, drawing on their own experiences.

extent to which taking the lead in the design of educational spaces allows learners to develop a greater connection to and ownership of those spaces and provides opportunities for deeper learning.

Both case studies were guided by three overarching research questions developed by the research team, seeking to investigate teacher and learner perspectives.

1. What are the key outcomes of learners taking the lead in the design of their own learning spaces?
2. To what extent can engagement in learning space design develop learner confidence, agency, and ownership of learning?
3. In what ways can teachers use the principles of learning space design to enhance learning and awareness of wellbeing in their classrooms and learning spaces?

Sub-questions were also developed, using the three overarching questions as a guide, to address the contextual and situational factors of each case (Stake, 2013).

Data Analysis

Detailed qualitative and quantitative analysis was undertaken of the interviews and surveys for each individual case, cross checking against the research questions. Each case study was arranged in terms of their situational issues in a way that allowed interpretation of patterns within each case, and analysis of cross-case findings to discover associations and common themes (Stake, 2013). This cross-case analysis was conducted first by individual members of the research team, before bringing together insights and forming ‘substantive categories’ (Maxwell, 2013, p. 108). Categories and interpretations were then examined to develop a range of findings, with three key themes emerging: (i) Connecting space, learning, and wellbeing; (ii) Agency and ownership through design of learning spaces; (iii) Towards new conceptualisations of learning spaces.

Findings

Connecting space, learning, and wellbeing

In case study 1, the class teacher conceptualised learning space design as a vehicle through which to enhance the learning taking place in her classroom. The Toolkit was used for structuring activities and lesson planning, for example using the ‘Mountaintop’ symbol as a platform for learners to celebrate their achievements, and as a goal to aim for through the activity and lesson. The teacher viewed the classroom space as a ‘blank canvas,’ and learning space design as a means of generating enthusiasm and greater engagement.

It's looking at if and how a space can maximize learning... how can it enrich learning? How can we get the children excited about learning? I think that's part of the design as well. How can we get them excited to come to a place that they know so well? (Teacher)

The symbols provided a common language for pupils to discuss learning with the teacher. They were able to identify and communicate the type of learning they enjoyed, for example independent learning as represented by the Cave, and the teacher was able to plan around this: “*They're quite good at saying, oh, actually, the Cave part I love*” (Teacher). The

Toolkit continued to be used by pupils during home learning in the COVID-19 lockdown, exploring both the digital space and their own home learning environment. Pupils saw the Cave symbol as representing a ‘safe space’, and identified different areas at home which they viewed as their ‘Cave,’ such as their bedroom or living room. Teachers at the school also commented that discussing the symbols could develop understanding and empathy in relation to different ways that people learn and interact with space: *“The cave reminds me of the need for safe spaces in the classroom, but also out with the classroom for pupils to have time on their own and to be able to reset and re-regulate their emotional sense”* (Depute Head Teacher).

In their designs for the classroom wall, using the language of the toolkit, learners were aware of both their own needs in relation to wellbeing and those of their peers, and how the design of space could impact on this.

It’s important to have that space because it could be a little bit loud or a little bit too cramped so as you go up the tree, in the Cave, it’s a nice place to sit and relax for a minute or two, just to get your head together. (Pupil)



Image 1: Learner design of classroom wall for Dragon’s Den presentation

In case study 2, the Responsible Activists (11 Secondary School pupils) at the two schools developed three designs for learning spaces at the new campus, in collaboration with the Agile Consultants (8 college students); a communal learning space, a communal ‘Quad’ area, and an Art classroom. Common themes across the designs included agile, flexible, and adaptable learning spaces, which could support different types of learning: scaffolded (Campfire), independent (Cave), collaborative (Watering Hole), experimental (Fields), and celebratory (Mountaintop); in many instances they mapped these against the Toolkit symbols to communicate the function and learning intentions of the space.



Image 2: Learner design for communal quad space for new campus

A key consideration for the Activists and Consultants was that learning spaces needed to be inclusive and accessible. They drew on and championed the wider experiences of learners at their school and college. In the workshops, one key question that the Consultants asked the Activists about their draft designs was, “*how can you make this learning space more accessible?*” The Activists took on the challenge and it was evident in the final designs; for example, one learner stated: “*I want to make sure that we've got good facilities for people with special needs or that need additional help... it's really important to make sure that they get the learning and achievement they need, as well as people that don't need any extra help*” (Responsible Activist). Engaging with the toolkit and design therefore expanded both educators’ and pupils’ ‘semiotic repertoires’ (Comber & Nixon, 2008), in both case studies, allowing them to rethink and reimagine learning spaces for the individual and the collective.

The COVID-19 pandemic and lockdown had also had a clear influence on the Activists’ thinking. Home learning had prompted them to think about how space and environments can impact learning, and to consider how their designs could build on this knowledge. One learner focused on the social isolation that had been experienced by many during lockdown, which had prompted them to focus on communal spaces where everyone could feel included.

For the past year or so we've been quite isolated in the way that we've been at home, working by ourselves. The change from coming back to school made it strange being able to socialize with others. We just wanted to make sure that everyone else in this new building would get to have that inclusive aspect, to make sure everyone got to share their ideas and be equal while doing their learning. (Responsible Activist)

Agency and ownership through design of learning spaces

In the end of term survey in case study 1, in answer to the question “Do you think pupils should be able to design their own learning spaces?”, 95% (38 of 41) of the responses from learners indicated agreement. Several suggested it was an important means of expressing their views and creativity: “*Yes, because it frees our minds*” (Pupil). Several pupils suggested learners should be able to design their learning spaces because they were the people who

ultimately would be using the spaces and spend the most time there. One pupil went further to state that learners “*should have a right to design classes.*”

The class teacher believed that pupils had been able to develop a connection to the learning space and agency over the design of the STEAM Room and their own learning. She was particularly pleased that pupils felt a sense of pride and achievement through their work in the project: “*They felt successful, I saw individuals feel really proud of themselves. The personal achievement and the way they viewed themselves was very positive*” (Teacher). In their survey responses, pupils were positive about how the design process had helped them to develop confidence in their own abilities: “*It felt like you had responsibility*” (Pupil). The design process here allowed learners to not only exercise agency in meaningful ways (Moore, 2022), but to witness the impact first-hand in the emerging redesign of their classroom wall.

Like the primary school pupils in case study 1, the Responsible Activists in case study 2 recognised the importance of young people being given a key role and voice in the design of their learning spaces. They wanted to use the platform they had been given to help create sustainable learning environments that would benefit future generations, even if they might not directly experience the new campus themselves by the time of its completion. They viewed the new campus as inextricably linked to the wider community and felt they had developed a connection to the new learning spaces, even though they did not physically exist yet.

It was most important that we were involved because it's going to impact us directly. It's going to impact on our kids, and future generations of [the city]. We think we need to make it as good as possible and withstand time for the next 60 years, just like this school here. (Responsible Activist)

The Activists in the school using temporary buildings had the experience of learning in several different sites. Drawing on this, they emphasised the importance of accessible learning environments where pupils feel a sense of ownership and belonging: “*We know what it's like to not have a school which is ours... we've used our experience from all the schools and brought it together into what we think is a really nice and valuable space for everyone*” (Responsible Activist).

The Agile Consultants from the college said that they had also developed a connection not only to the new designs but also across the wider shared learning community of participants from the schools, college and the university that were involved in the project: “*It's like all three learning spaces, the school, college, and the uni, so you see those education spaces all working together*” (Agile Consultant). The older learners therefore began to conceptualise learning environments as traversing physical, spatial, and temporal boundaries (Moore-Russo et al., 2012), recognising how shared learning can forge new platforms for enacting collective agency.

Towards new conceptualisations of learning spaces

In case study 1, though several staff recognised that the Toolkit could be used in a variety of different educational settings, others were less convinced; when the Toolkit was shared during a staff development day at the school, some teachers who had not been directly involved in the process questioned how relevant it was for mainstream settings: “*there was a response of, oh that works in a STEAM Room, but that wouldn't work in a normal classroom*” (Teacher). However, the strong positive response from the class teacher and pupils convinced the head teacher to expand the initiative and adopt a whole-school approach where learners had more of a say in the design of their classrooms. Getting buy-in across the school was seen as

vital, and it was felt that greater engagement and exploration with the Toolkit could help to achieve that.

The challenge is making sure that learning spaces and learning environments are bumped right up the priority list, and in the forefront of managers' and staffs' mind that it's key and actually crucial in terms of engagement. You're not going to get anywhere if the learning space is not designed well. (Deputy Head Teacher)

Previous studies have noted that attempts to reimagine or redesign educational spaces can be limited by factors including access to resources, clear links to policy and curriculum priorities, and the enthusiasm of teachers (Comber & Nixon, 2006; Passy, 2014). Such constraints remain a challenge to realising the potential of learning space design.

In case study 2, the Toolkit was found to be very useful in driving discussion between Consultants and Activists, and for developing awareness of the impact of space on learning. However, the Consultants also felt that discussions around the design could have gone further beyond *physical* considerations of learning space design to investigate how social and cognitive spaces impact on learning; and that the pupil Activists could have been encouraged to be more independent in their exploration of space and how learning itself has an impact on their educational environment. The nature of the teacher and learner 'power dynamic' was picked up by several Agile Consultants, as they discussed how this might be deconstructed to create a more equitable space for collaboration, both in terms of the teacher and pupil relationship and that between the Consultants themselves and the Activists.

Again, they were floating back towards the design aspect, the physical and the aesthetic, more than the intellectual. So, it could also be about getting them involved on the same level... including the teacher or whoever's involved with guiding them. (Agile Consultant).

Power hierarchies thus presented both in the learning spaces themselves and in the design process and were perceived as a barrier by the college students. While there was still some way to go beyond concepts of space as more than a 'container' of heterogeneous processes (Murdoch, 2006), engaging in and sustaining conversations about learning space design across shared spaces and involving different ages and stages was viewed as a means through which this could be realised.

Discussion

This article presents a multi-case study involving a range of learners from primary, secondary, and tertiary education, and their teachers, exploring learning space design and the impact of space. The design projects in both cases offered learners opportunities to take the lead in designing their learning environments using a bespoke toolkit. An ecological lens (Damşa et al., 2019) was brought to analysis of the cases, where the space and learner were conceptualised as interconnected and in constant and dynamic interaction. The cases were guided by overarching research questions that sought to determine the extent to which the process of learning space design can develop meaningful and sustained connections to both educational spaces and the learning which takes place within them. The potential for fostering learner confidence, agency, and ownership were explored, alongside the degree to which educators can utilise the underlying principles of the design of educational spaces to develop awareness of the impact of space on learning and wellbeing.

Using the Toolkit to explore the different learning spaces encouraged the pupils in both case studies to reflect on how they like to learn. In case study 1, it also prompted the class teacher to introduce considerations of space into pedagogy and the curriculum through lesson planning and engage in critical reflection about the ways that space can influence learning. However, not all teachers were convinced by the approach, although it is worth noting that the teachers raising these concerns had not been directly involved in the initiative or experienced emergent benefits. This suggests that there was some way to go in convincing other staff at the school that the project was more than a tokenistic exercise (Hall, 2016), despite its positive impact. Further research is required on the extent to which buy-in from teachers across a school can be achieved, and to what degree this is a realistic aim.

The ‘common language’ introduced by the Toolkit and symbols facilitated discussions about learning across different spaces and contexts. It provided learners of different ages and backgrounds in case study 2 with opportunities to come together and communicate with each other about the future of their educational spaces, using shared learning platforms (Coyle, 2013). In both case studies, the Toolkit and design activities acted as a catalyst for learners to develop empathy and awareness of their peers' health and wellbeing; in many designs ‘calming’ and inclusive spaces were prioritised, evidencing a desire to articulate how space can impact on learning, emotions, and a sense of belonging (Brillante & Mankiw, 2015).

Most learners in both case studies, in primary, secondary, and tertiary education, valued the opportunity to have a say in the design of their learning spaces. Many had recently experienced disruption in their learning spaces, and the design initiatives afforded them a chance to (re)connect with and reimagine their educational environments. An important impact of the research was therefore that it raised awareness amongst learners and educators of the impact of space on learning (Comber & Nixon, 2008), and the ways in which they can take agency in designing this space for futures-thinking learning and teaching.

This small-scale study demonstrates that exploration with learning space design does not have to take place in new, high-tech spaces, or involve large amounts of funding. It can be as simple as giving learners of all ages and stages a voice in the make-up of their classroom. However, to move learning space design and its principles beyond the explorations of a small group of interested educators, teacher education has a role to play in promoting awareness and understanding of spatial literacies. The fact that space permeates learning means that the links are already there, but need to be made more explicit, so that newly qualified teachers entering any learning environment are not only aware of the impact of space but understand how to *use space* for learning (Imms et al., 2016). Professional development can and should also be utilised for sharing these concepts amongst all educators, but building capacity through teacher education can lay the foundations for more widespread engagement in the future. Supporting teachers to engage with spatial literacies in this way will afford more learners the opportunity to explore and connect to their learning environment in meaningful ways.

The case studies also showed that the explorations of learning space design had limitations. Learners continued to focus primarily on the physical aspects of learning spaces. Further attention needs to be paid to the cognitive, social and performative functions of space (Pickering, 2013), and learners and educators need to be further encouraged to engage with

these concepts. Furthermore, although both case studies provided learners with a platform for taking greater ownership of their learning, the teacher-learner power dynamic was still very evident (Street, 2022; Clark & Richards, 2017). Opportunities to engage and interact in person, rather than online, may help in this regard. However, there needs to be further exploration and deconstruction of the roles of learner and teacher in the design of space and design of learning. This is crucial for fully realising the potential for ecologies for learning space design.

Further and wider investigation of the ways in which the Toolkit and its underlying principles can be applied across different settings and age groups may give insights into how learning space design can operate in a variety of contexts, with examples and experiences being fed into teacher education programmes. Future studies should also focus on the impact of the finished design on learners, both those that were involved in the design process and those who were not. Collecting longitudinal data concerning the impact of space on learning and vice versa would also be hugely valuable. In this way, we can support learners to be spatially literate and active citizens who partake in ‘authentic collaboration’ in their learning, facilitating a deeper connection to the spaces in which they learn (Green, 2014).

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