Learning Environments Research (2020) 23:307–329
https://doi.org/10.1007/s10984-020-09311-4

ORIGINAL PAPER

Space matters: framing the New Zealand learning landscape

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Received: 31 May 2019 / Accepted: 23 March 2020 / Published online: 11 April 2020

Abstract
Significant funding is devoted across the world to transforming traditional classrooms into flexible learning environments. These efforts are often motivated by a desire to create learning spaces attuned to twenty-first century competencies, which involve learning how to communicate, collaborate, think creatively, and how to become critical users of technologies engaged in both the consumption and production of knowledge. In New Zealand, these flexible learning spaces are seen as part of innovative learning environments (ILEs), which are conceptualised as ecosystems involving learners, educators, communities, pedagogical practices, knowledge, and digital and material resources, including buildings and furniture. In line with ILEs, the notion of place-based spaces for networked learning foregrounds learning activity as enmeshed in an assemblage of elements—involving physical spaces, artefacts, digital technologies, people, ideas and tasks. In this paper, we adopt a networked learning perspective to frame the New Zealand learning landscape. Key findings from a national survey with 222 primary teachers, 126 secondary teachers and 163 school leaders, show that most teachers and leaders perceived their schools as being in-transition to ILEs. Findings highlight the importance of having a shared vision and leadership dedicated to supporting teachers' experimentation with new practices in innovative spaces. The survey details the digital and material resources, the social configurations used in classrooms, the types of learning tasks students are engaging in and a range of emergent practices in innovative and traditional environments for learning across New Zealand.

Keywords Design for learning · Innovative learning environments · Learning spaces · Primary schools · Secondary schools

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Introduction

Schools in New Zealand have recently begun transitioning into new spatial arrangements that disrupt traditional one-to-many classroom configurations with students organised in rows oriented towards the teacher at the front. This move—supported by the Ministry of Education through policy, standards and guidelines (ERO 2018; MOE 2015)—is changing classrooms across the country into flexible learning spaces that often require educators to rethink their teaching and learning practices (Beetham and Sharpe 2013; TKI 2019). Navigating these changes requires experimentation, adaptation and deep consideration about what is valued and what is possible in these newly-configured spaces, including the role of emerging technologies and the development of teaching practices that support team teaching and collaboration.

New Zealand's policies, standards and guidelines reflect both global trends and dominant narratives in education, which suggest that these alterations to the designed environment are likely to support alterations in teaching and learning practice (Alexander et al 2019; ERO 2018; Freeman et al. 2017; Mulcahy et al. 2015; OECD 2015a, 2015b, 2017). The aim of these policies is to support the creation of learning spaces attuned to twenty-first century competencies that involve young people learning how to communicate, collaborate, think creatively, and how to become critical users of technologies both in terms of the consumption and production of knowledge. But many New Zealand educators appear to be struggling to align their pedagogical models with these new learning spaces and the use digital technologies for learning. Students are also being challenged to develop new habits and routines, while many of their parents are having their views about schooling challenged (Benade 2017).

Uncertainty about the effectiveness of these environments is raising concerns in local communities which are often highlighted in the media. In a recent example, a principal of a leading secondary school praised flexible learning environments as spaces in which children could learn to work collaboratively, whilst also expressing concerns about the effects of these changes on children's relationships with their teachers (Sissons 2018). In this article, we make the case for an increasingly-nuanced understanding of spaces for learning. We start by mapping the current New Zealand learning landscape based on results from a national survey exploring school teachers' and leaders' experiences of their current learning spaces. This article contributes to the lack of in-depth research into how primary- and secondary- school teachers are responding to challenges resulting from major changes in classroom design across the country.

In framing the New Zealand learning landscape, we acknowledge the indirect influence of the built environment on learning activity. In line with Gislason (2010), we believe that school design can be conceived as part of "a network of elements that together shape the learning environment" (p. 142). This resonates with ecological perspectives in learning that situate learning activity in multiple contexts, social practices and tools (Damşa et al. 2019; Säljö 2010; Vartiainen et al. 2018). Similarly, the New Zealand Ministry of Education, adopts a holistic view of learning based on OECD (2015a), referring to Innovative Learning Environments (ILEs) as "an ecosystem that includes learners, educators, families/whānau, communities, content and resources like property and technology" (TKI 2019). This conceptualisation of ILEs goes beyond the material elements or the flexible furniture, spaces and technologies to encompass how educators moving into these spaces embrace the notion of ILEs, their willingness to explore the subtleties of how the properties of these new materials are likely to influence learning activity (Sørensen 2009), and

how these spaces can be (re)configured to accommodate different forms of curricula and social arrangements (Carvalho and Yeoman 2018).

The notion of ILE is well framed using the concept of *place-based spaces for networked learning*, in which learning activity is seen as embedded in and arising out of a network of physical spaces, material artefacts, technologies, people, ideas and tasks (Carvalho and Goodyear 2014; Carvalho, Goodyear and De Laat 2017; Carvalho and Yeoman 2018). Using this networked learning perspective, we identify connections between physical spaces, artefacts, digital technologies and learning activity, and frame the experiences of primary- and secondary-school teachers and school leaders across New Zealand, exploring their current teaching and learning practices and the types of physical learning spaces in which these activities unfold. We argue that mapping the New Zealand learning landscape is a necessary part of supporting positive processes of transformation because of the need to understand and account for educators experiences, in order to develop support mechanisms capable of helping them and their students engage in the networked societies of the twenty-first century.

Mapping learning spaces

Existing literature about learning spaces reveals that interest in connections between technology and learning spaces is not new. There are many ways to model how new technologies are shaping innovative spaces for learning. Radcliffe's (2009) pedagogy-space-technology (PST) framework focuses on embedding the use of new technologies through design and how technology extends the built environment for learning. Wilson's (2009) 'places for learning spectrum' explores different modalities of learning, how these align to particular learners, and the degrees of formality within the built environment. These representations offer ways to explore spaces and technologies in relation to learning. Other models, such as the networked learning landscape model (Nordquist and Laing 2015), foreground the power of networks in learning and extend beyond the idea of learning as something that happens in a contained space. Gislason (2010) also explores how the physical design of a school contributes to the quality of the learning environment, but notes several non-architectural factors that influence the experience of a particular setting. In Gislason's (2009) research, the physical design was considered to positively contribute to collaborative, multidisciplinary teaching practices and, in one school, the open-plan architecture was considered to positively influence school social climate. In particular, student interviews revealed a preference for open-plan classrooms, based on how these designs facilitated social connections with peers, relative to other more-enclosed environments (Gislason 2009).

Other studies of the role of physical space in shaping educational practices focus on the role of policy, design or pedagogical practices (Benade 2017; Cardellino et al. 2017; Daniels et al., 2018; Imms et al 2017; Wood 2019; Woolner 2010; 2018). One study involved surveying 822 school principals in Australia and New Zealand about the types of learning spaces and teaching practices in their schools (Imms et al. 2017), with the aim of providing an overview of the current state of affairs in relation to ILEs. A study of the influence of design on the perceptions and actions of students and teachers in UK secondary schools (Daniels et al. 2018) aimed to go beyond traditional post-occupancy evaluation to connect environmental and social factors. That study demonstrated that, where design and practice are well-aligned, practitioners are more likely to perceive the newly-designed space as creating opportunities to engage in transformation. Where they are not, newly-designed spaces

are perceived as creating a 'significant challenge' that is accompanied by a sense of dissatisfaction and discomfort (Daniels et al. 2018).

Our research draws on the holistic approach taken by the Learning Environments Evaluation Program (LEEP), which was launched in 2013 to examine the impact of physical learning environments on learning, health and well-being (OECD 2019). LEEP develops and diseminates evidence-based guidelines to support the design and use of physical environments to support twenty-first century learning needs, and conceptualises learning environments as "the result of interactions between physical resources (i.e. learning spaces, material and technology), learners, educators, content, learning leadership, society and policy" (OECD 2017, p. 12). Therefore, the physical learning environment is conceptualised as providing the conditions for, and playing a key role in, the mediating relationships that influence student learning activity at a number of levels, including the cognitive, physical and social. In addition, notions of spatiality, connectivity and temporality are also highlighted as playing important roles in mediating learning activity. Spatiality is about the role of space in natural and built environments and how it shapes social relations and practices in schools. McGregor (2003) speaks of spatiality or space–time as going beyond physical or social space as "the recursive interplay between the spatial and the social, the product of complex ongoing relations" (p. 363). Connectivity looks at the role of learning spaces in relation to digital technologies and how together they mediate relationships and teaching and learning practices. Temporality addresses the temporal dimension related to the development, use and impact of learning spaces, reminding us that alterations in the nature and use of physical spaces (such as open and closed; indoor and outdoor; physical and virtual) are directly linked to pedagogical and organisational changes related to time organisation (e.g. team teaching has different time demands).

Building on these ideas, our research aimed to develop new methods of abstracting and foregrounding the relationship between key components of complex learning environments. In what follows, we outline our analytical framework for exploring physical elements and their design, as one dimension of the complex assemblage that constitutes the learning environment in its totatlity.

Framing emergent learning activity

The Activity Centred Analysis and Design (ACAD) framework offers a way to examine the emergent learning activity characteristic of complex networked learning environments (Goodyear and Carvalho 2014). ACAD is a *relational* framework that focuses on (1) designed structures and (2) emergent activity or, more specifically, on how designed structures and human activity relate to one another (Fig. 1). When using ACAD, primacy is given to what learners actually do or their learning activity, including their thoughts and feelings. This activity is described in terms of emergence because it is not designable, and only indirectly *influenced* through design choices made in advance by educators. ACAD supports design for learning by focusing attention on the physical, conceptual and social structures of learning. These dimensions are refered to as (1) the set design—related to the choices about material and digital tools available to learners, (2) the epistemic design—related to the choices about tasks and suggestions of useful things to do and (3) the social design—related to the choices about valued social arrangements such as working in pairs or groups or following scripted roles. ACAD also recognises (4) people's agency to co-create and re-shape what has been proposed. In this study, the experiences of

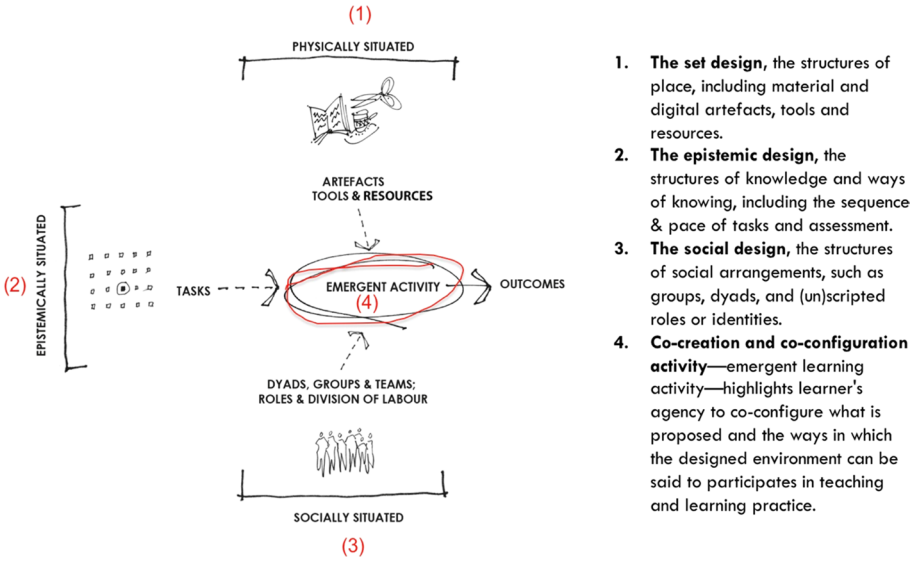


Fig. 1 ACAD framework (Carvalho and Yeoman 2018)

New Zealand school teachers and school leaders were explored through the ACAD dimensions of design (set, social and epistemic) and practices of co-creation.

Study design and methods

This study followed a mixed-method approach with a concurrent nested strategy (Creswell 2013). It involved a national survey of New Zealand schools in which both quantitative and qualitative (open-ended response) data were collected. The online survey was distributed to primary and secondary teachers and school leaders, with the aim of exploring their experiences of both ILEs and traditional environments. Insights from the survey provided an overview of the current New Zealand landscape. The following research question and accompanying sub-questions guided our research:

What are teachers and school leaders experiences of ILEs and traditional environments within the New Zealand context?

- What types of school spaces, technologies and resources are available? (set design)?
- What types of learning tasks (which involve the use of technologies) do teachers propose to their students? (epistemic design)?
- What are the types of social arrangements within lessons? (social design)?

Instrument and participants

The survey instruments were based on the OECD School User Survey: Improving Learning Spaces Together (OECD 2018), but included specific questions exploring the types of tasks (epistemic design), forms of social organisation (social design) and the learning

spaces and resources available (set design), as well as respondents experiences of teaching and learning practices enacted in these spaces (emergent activity).

The survey instrument for primary and secondary teachers was divided into eight sections:

- Section 1 involves information about the school such as school region, type of community (i.e. rural, small town, large city) and type of school and number of students;
- Section 2 involves demographic such as gender, age, years of experience and type of employment;
- Section 3 involves respondents' views of school leadership;
- Section 4 involves information about spaces used by the respondents such as how learning spaces are used, how many teachers share a space, the number of students, types of spaces available, and how often the respondent used these spaces.
- Section 5 involves information about comfort such as noise, temperature and light;
- Section 6 involves information about spatial arrangements used in learning spaces, using representations as in the original OECD protocol, such as layouts for presentation, group work, etc.
- Section 7 involves information about the respondents use of technology;
- Section 8 involves information about overall satisfaction with learning spaces and respondents' views about whether their school is an ILE or not.

The survey instrument for school leaders replicates Sections 1, 2, 3, 7 and 8, with minor changes, and the sections referencing physical spaces were framed to explore learning spaces from the perspective of school management (e.g. allocation of learning spaces, school policy about bringing one's own device, etc.).

Following the OECD (2018) protocol, some questions were phrased as multiple-choice, while others used a five-point Likert scale. Participants also had opportunities to add comments throughout the survey, complementing the quantitative data with more-nuanced accounts of practice. The survey was anonymous. All schools in the New Zealand government database (Education Counts 2019) were sent an invitation to participate via an email to principals and school administrative offices. When a total of 2557 emails were sent, 511 survey responses were returned, including 222 responses from primary teachers, 126 from secondary teachers, and 163 responses from school leaders (e.g. principals and deputy principals of both primary and secondary schools). Table 1 provides an overview of the communities in which the participating schools are located.

Table 1 Percentage frequency of respondents from different school communities

School community	Percentage frequency			
	Primary teachers	Primary leaders	Secondary teachers	Secondary leaders
Village or rural area (less than 3000 people)	16	23	6	13
Small town (3000 to about 15,000 people)	17	11	34	20
Town (15,000 to about 100,000 people)	19	13	16	13
City (100,000 to about 1,000,000 people)	29	32	27	23
Large city (with over 1,000,000 people)	17	18	14	30

Table 2 Percentage frequency of respondents from different types of schools

Type of school	Percentage frequency			
	Primary teachers	Primary leaders	Secondary teachers	Secondary leaders
State	83	81	88	86
State integrated	11	13	8	10
Private	2	2	0	0
Alternative	0	2	2	0
Other	2	2	0	3

Table 3 Percentage frequency of respondents from schools of different sizes

School size	Percentage frequency			
	Primary teachers	Primary leaders	Secondary leaders	Secondary teachers
Less than 50 students	4	12	0	0
51–100 students	8	11	0	0
101–200 students	15	22	0	5
201–500 students	41	39	40	23
501–1000 students	28	13	40	44
More than 1001 students	0	0	6	26

In New Zealand, schools can be characterised as State, State Integrated, Private or Alternative. State Integrated schools are former private schools that have been integrated into the state education system but retain their 'special character'. This means that these schools are funded by the government, but are run by a particular religious faith (e.g. Catholic, Jewish, Muslim) or use special educational methods (e.g. Steiner or Montessori). State Integrated schools are also funded by the government, but some charge compulsory fees to help maintain their facilities. Table 2 shows that most participants were from State schools. State Integrated, Alternative and Other included descriptors such as religious schools, Kura Kaupapa Maori, residential special school, Montessori, Steiner or Democratic.

The number of students attending the schools represented in this study are summarised in Table 3. Most primary and secondary teachers and school leaders came from medium to large schools (between 201 and 1000 students).

Findings and discussion

After exploring how participants characterised their schools, we analyse their responses using the lenses of the ACAD framework to explore physical and digital resources (set design), the types of learning tasks proposed (epistemic design), and the types of social arrangements in place (social design).

Innovation often involves the introduction of new things, ideas or ways of doing something. According to Sawyer (2009), innovation emerges from interactions in complex social systems that involve ongoing communication, collaboration and knowledge sharing,

and it is often the product of visual processes that enable ideas to generate other ideas. Collaborative environments accelerate innovation because they accomodate people working alongside one another, and this increases both the potential for generating ideas and the volume of ideas produced. Therefore, in considering aspects related to participants' emergent practices, we focused on whether or not teachers and school leaders expressed a shared vision regarding their teaching and learning practices, if experimentation was encouraged and nurtured, and if collaboration was part of the school culture. These were important characterisations, because teachers and leaders might share a vision about how learning spaces should be used, but this vision might not necessarily lead to innovative practices in the classroom.

Perceptions of the learning environment: innovative, traditional, transitioning or reverting?

Participants were asked to reflect on a short description of ILEs put forward by the New Zealand Ministry of Education (TKI 2019) that ILEs include:

> ... the physical, social, and pedagogical context in which learning occurs. An innovative environment supports strengths-based teaching and learning. It offers students and teachers flexibility, agency, ubiquity, and connectedness. Working in an innovative learning environment where teaching and learning is collaborative, reflections and inquiries are shared, and communities engaged leads to a more robust, continuously improving community of practice (TKI 2019, online).

It was important to situate the conceptual framing used in our research so that participants understood that ILEs extend beyond the physicality of the learning environment (TKI 2019). Having read the statement above, participants were asked whether their school was an ILE, a traditional learning environment, an environment 'in transition' showing some aspects of ILEs, or had been an ILE but was now reverting to a more-traditional learning environment.

Table 4 shows that primary-school teachers were more likely than secondary-school teachers to agree with the statement that their school was already an ILE (primary teachers 31%, secondary teachers 14%). Both groups were similar in their agreement that their school was in transition (primary teachers 51%, secondary teachers 46%); and secondary teachers were more likely to say that their school was traditional or had moved back to traditional (secondary teachers 38%, primary teachers 17%).

Table 4 Percentage frequency of respondents from different types of learning environments

Type of learning environment	Percentage frequency			
	Primary teachers	Primary leaders	Secondary teachers	Secondary leaders
Innovative learning environment	31	33	14	25
Traditional learning environment	15	32	35	20
Learning environment in transition	51	32	46	50
Reverting to traditional learning environment	2	0	3	5

Table 4 also shows that primary leaders were more likely than secondary leaders to agree with the statement that their school was already an ILE (primary leaders 33%, secondary leaders 25%). Secondary leaders were more likely than primary leaders to agree with the statement that their school was already in transition (secondary leaders 50%, primary leaders 32%) and primary leaders were more likely to say their school was traditional or had moved back to traditional (primary teachers 32%, secondary teachers 25%).

These data suggests that New Zealand primary schools are more likely to have adopted ILEs than secondary schools, but many schools have not fully transitioned, highlighting the need for careful consideration of what it means to be in-transition and how educational researchers and policy-makers can support teachers and school leaders in this period of transition. In reflecting on their school's positioning along the traditional–innovative continuum, a few teachers referred to the need for adaptation or for practices that combine aspects of innovative and traditional environments. For example, the following respondent mentioned that his/her school was seeking a balance of what was most successful for their students, who came from diverse backgrounds, including both new and traditional learning environments:

> We take what is useful from the new and retain many of the important features of the old. We consider everything in the light of how it will affect our unique school with the children's varied ethnic, cultural and socio-economic backgrounds.

Another respondent commented that her school moved carefully towards ILEs in order to avoid alienating teachers. Whilst undertaking renovations to create innovative learning spaces, teachers kept some traditional classrooms so that they did not feel compelled or obliged, at this stage, to see themselves within the ILEs framing:

> The school has undertaken some renovations to allow for innovative learning environments, but also keeps traditional classrooms to cater for all learners and not force teachers into innovative learning.

In the following quote, another participant suggested that teachers are working together through the challenges, with some teachers eager to collaborate and share insights with those less familiar with ILEs, as well as those not yet wanting to engage with them:

> We generally experiment, allowing teachers to work to their pedagogical beliefs then share our learning with our colleagues. While some staff are highly read on best practice others are late adaptors and resistant to modern teaching and learning practices.

Overall, these respondents were signalling that their schools are moving towards ILEs but doing so carefully, in a constructive way, to make sure that all staff are on board and that the changes are experienced positively by pupils. This is a subtle but important move, because alignment between design and practice is crucial and misalignment is more likely to be be perceived as challenging and accompanied by discomfort and dissatisfaction towards ILEs (Daniels et al. 2018). Similarly, ERO (2018) foregrounds the need for the development of "a culture of continuous improvement to support [a] vision" towards ILEs and the maintenance of "coherence across all domains of the school, aligning everything to the vision" (p. 5) as key factors influencing the development of successful ILEs.

Other comments about ILEs revealed the importance of acknowledging current trends (Freeman et al. 2017):

> I'd like to think our school is 'up with the play' and we are continually reflecting and self-reviewing in order to improve practice and raise achievement.

Interestingly, the distinction between 'innovative' and 'traditional' practices is sometimes portrayed as being 'resolved' through practical divisions, such as school year:

> Seniors could be seen as working in an innovative learning environment (years 7–8 in particular). Years 1–4 are largely traditional.

This comment, however, conflicts with our data indicating that secondary schools were more likely to report traditional spaces and practices, whereas primary schools were more likely to report active engagement with innovative learning environments.

Set design—New Zealand school spaces, technologies & resources

Spatiality includes natural and built environments, with both influencing social relations and practices in schools (OECD 2017). Thus, the survey explored the types of spaces available in schools and how often teachers taught in them. Most primary (85%) and secondary (87%) teachers had access to a library and an assembly hall (primary 78%; secondary 88%). Primary teachers reportedly have more access to collaborative teaching areas (55%) than secondary teachers (38%), and those teaching in secondary schools (80%) report more space configured as traditional classrooms than in primary schools (59%). Table 5 summarises the types of spaces in New Zealand schools:

The spaces most commonly used by primary and secondary teachers were traditional classrooms (Fig. 2) with no breakout spaces (used every day by 42% primary and 47% secondary teachers). Traditional spaces with direct access to breakouts were used every day by 32% primary and 23% secondary teachers. Collaborative teaching areas were used by 32%

Table 5 Percentage frequency of respondents from different types of internal spaces

Type of internal space	Percentage frequency	
	Primary teachers	Secondary teachers
Traditional classroom with no access to breakout spaces	59	80
Traditional classroom with direct access to breakout spaces (e.g. for collaborative group work, project work or individual work)	52	52
Collaborative teaching area (2 or more teachers) with the teachers and students sharing a variety of connected learning spaces (e.g. for collaborative group work, project work or individual work)	55	38
Space in a corridor outside the classroom	44	54
Library	85	87
Assembly hall/auditorium	78	88
Cafeteria/ tuck shop/ canteen	14	78
Science laboratory	12	85
Workshop/studio space for art, music or design	23	86
Computer laboratory	7	78
Kitchen/food technology space	46	84
Workshop space for technology (wood, metal, plastics, robotics)	15	79
Space for working with special needs students (e.g. literacy tutoring room)	45	73
Marae	1	39

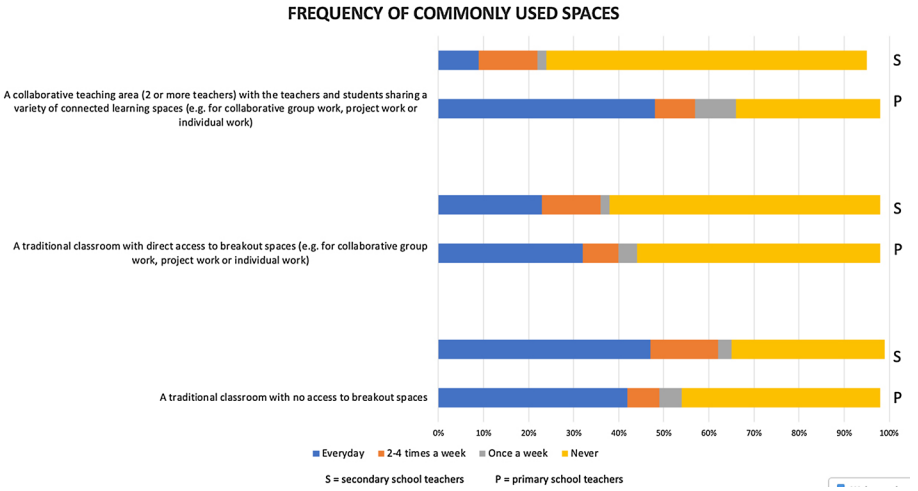


Fig. 2 Frequency of commonly-used spaces

of primary teachers every day, whilst only 9% of secondary teachers used these space every day. Figure 2 uses P to refer to primary school teachers' responses and S refers to secondary school teachers' responses.

All New Zealand schools have access to external spaces (Table 6), such as playgrounds, grassed areas, sports courts/fields or vegetable gardens. These outdoor learning spaces might be important in the context of health and wellbeing, as well as creating opportunities for environmental learning within schools. Other spaces mentioned included natural trails, beaches, bush walks, bike tracks, swimming pools, rivers and farms.

Because one of the key areas of our research was understanding connections between the use of digital technologies and ILEs, the survey explored the types of technologies to which teachers and students have access in their learning spaces, as well as how often they use these resources. This relates to the concept of connectivity (OECD 2017) and allows exploration of the role of learning spaces in relation to digital technologies, as well as how

Table 6 Percentage frequency of respondents from different types of external spaces

Type of external space	Percentage frequency	
	Primary teachers	Secondary teachers
External (outside) space—usually with seating (e.g. a playground)	97	9
Grassed area (not a sports field)	81	89
External (outside) hardball court/ sports court/ hard paved area	95	92
Sports field	86	92
Vegetable garden	78	64
No external (outside) spaces	0	2
Other	30	18

together these can mediate relationships and teaching and learning practices. Table 7 summarises the types of technologies available in primary and secondary schools in our study. While there are differences in the availability of digital technologies across New Zealand schools, 86% of primary and 88% of secondary schools reported access to Wireless Internet in all learning spaces.

The availability of these technologies and resources does not necessarily mean they are used. Figure 3 summarises the frequency of their use in both primary and secondary school settings. Wireless internet access is used every day in most secondary and primary schools.

Epistemic design—Learning tasks involving the use of technologies

Figure 4 summarises the types of tasks involving the use of technology for learning reported by primary and secondary teachers. These tasks were those in the original OECD instrument (2018). However, the use of technology per se does not necessarily lead to innovative practices, because teachers might repurpose new tools for traditional purposes. But these findings provide a baseline for discussion and future exploration of how such technologies and tasks are being interpreted and enacted in ongoing teaching and learning practice. A range of tasks are reported, with Online research being an everyday task in both primary (24%) and secondary (32%) classrooms.

Social design—Group and individual arrangements

Most secondary-school teachers reported being the only teacher in their classroom (73%). However, nearly a third reported that two or more teachers were present in their classroom (29%). In primary settings, teachers were more likely to report team teaching arangements than their secondary counterparts (Table 8).

Social design encompasses the different types of groups and various divisions of labour in a learning situation (Goodyear and Carvalho 2014). For example, teachers could ask students to work in small groups or individually, or the lesson could be delivered in a one-to-many lecture configuration. In traditional learning environments, one would expect an increased incidence of the lecture mode, but those working in ILEs also might adopt this configuration together with other social arrangements. Teachers were asked to consider four different types of social arrangements in relation to their teaching practices and their students' learning activity (Fig. 5).

Figure 6 shows the frequency of use of a number of different layouts in both primary and secondary schools. Type A layouts support explicit instruction and are used in both primary (48% every day; 16% 2–4 times a week) and secondary settings (40% every day; 22% 2–4 times a week). The most commonly-used social arrangement in both settings was Type B involving students work in small groups (this layout is used every day by 79% of primary teachers and 48% of the time in secondary schools). Type D, or team teaching, appears more commonly in primary schools (40% every day; 15% 2–4 times a week) than in secondary schools (10% every day; 11% 2–4 times a week), with 67% reporting never or hardly ever using this layout.

Because alignment between the tools and resources (set design), social arrangements (social design) and proposed tasks (epistemic design) is critical for the emergence of productive learning activity in ILEs (Carvalho and Yeoman 2018), we investigated the ways and frequency with which teachers organised their settings to suit intended social arrangements for specific tasks. Figure 7 shows that teachers in primary settings were

Table 7 Percentage frequency of respondents reporting different levels of availability of different technologies and resources

Technologies/resource	Percentage frequency of respondents reporting levels of availability							
	All spaces		Most spaces		Few spaces		None	
	Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
Interactive AV display (Interactive whiteboard or interactive screen)	21	12	15	12	13	15	49	60
Wireless internet access	86	88	12	10	1	1	0	0
Ability to project sound and vision for a group of students (such as a projector or large TV with audio)	55	61	34	31	6	3	4	3
In-school laptops/ notebooks (stored in that room)	46	27	28	10	9	27	14	33
Desktop computers	10	6	12	3	27	50	49	39
Tablets (e.g. iPads, Surfscebook)	40	2	28	3	19	39	11	54
Charge points (for mobile devices)	52	35	22	23	14	27	11	13
Cabled internet access	23	18	19	22	15	30	41	28
No internet access	2	1	0	1	9	9	87	65

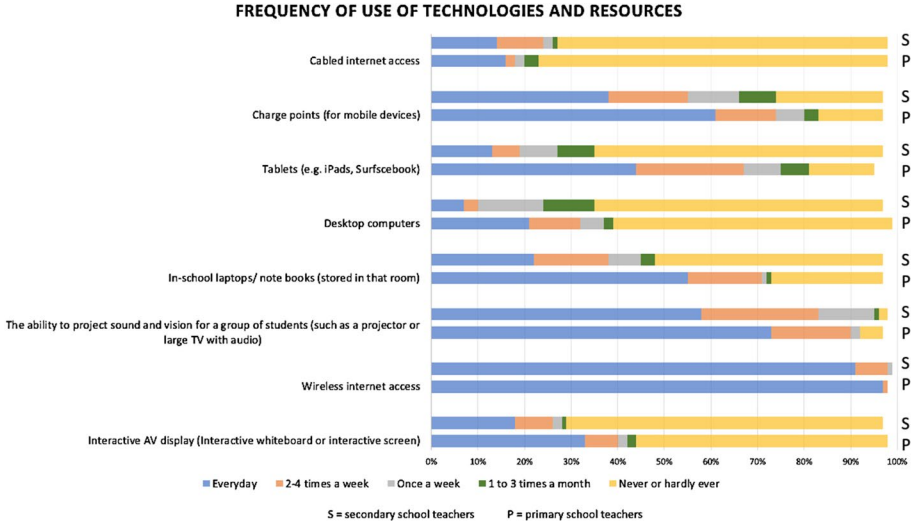


Fig. 3 Frequency of use of technologies and resources

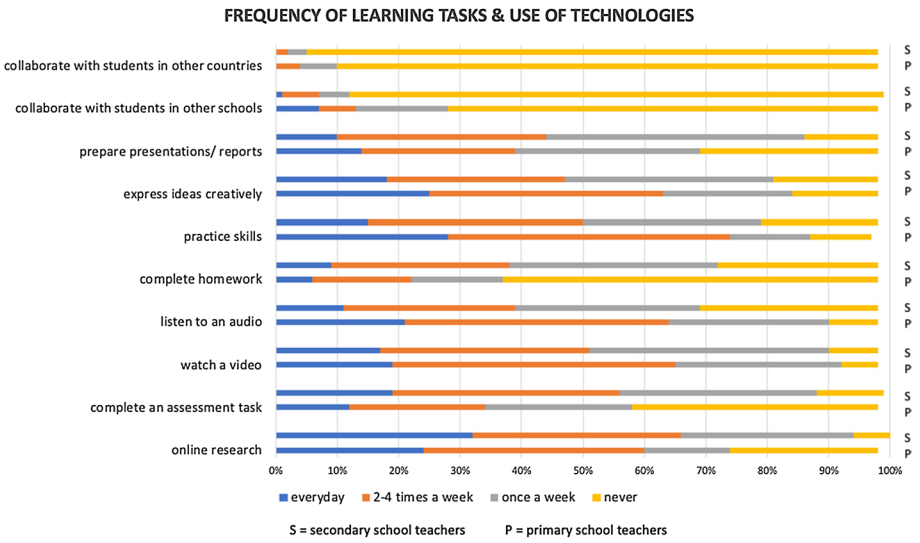


Fig. 4 Frequency of learning tasks and use of technologies

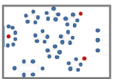
Table 8 Percentage frequency of respondents from different teaching arrnagements

No. of teachers in classroom	Percentage frequency	
	Primary teachers	Secondary teachers
1 teacher	58	73
2 or more teachers	45	29

Type A - Presentation:
Layouts that support explicit instruction/presentation to the whole group.

Type B - Group:
Layouts that support approaches where students are required to collaborate and work in small groups to share ideas and help each other.

Type C - Individual:
Layouts that support approaches where students work independently to write, read, research, think and reflect.



Type D - Team teaching:
Layouts that support approaches where two or more teachers work collaboratively with groups of students sharing the same space.

Fig. 5 Types of social arrnagements (OECD 2018)

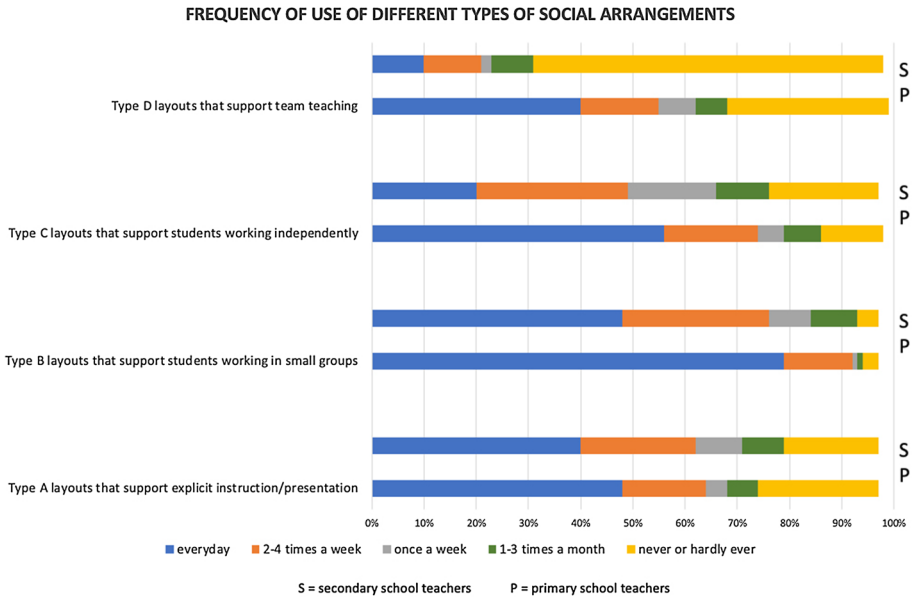


Fig. 6 Frequency of use of different types of social arrangements

more likely to encourage the movement of students, rather than re-configuration of furnishings (this is done every day by 69% of teachers in primary settings and by 30% in secondary settings). Regarding reconfiguring furnishings, only 8% of primary teachers and 10% of secondary teachers reported arranging tables and chairs or modifying aspects of the space prior to a lesson on an everyday basis. In addition, only 10% of primary teachers and 16% of secondary teachers changed the layout, within a lesson, on a daily basis because it suited a particular task. Engaging students in moving furniture to suit specific social arrangements was reported only 23% on a daily basis and 20%

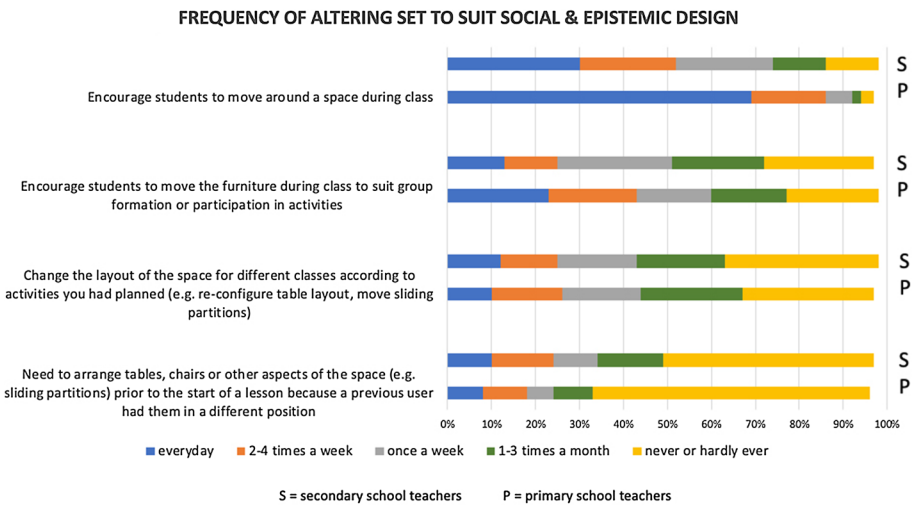


Fig. 7 Frequency of altering set to suit social and epistemic design

between 2 to 4 times a week in primary settings, while 23% and 12% were the corresponding frequencies in secondary settings.

These results can be explained by Wall's (2016) considerations that, while flexible furniture can accommodate students' comfort and well-being, at times, it also can restrict flexibility because of the need for re-arrangement between learning activities. In other words, flexible furniture is seen as demanding more effort. However, when teachers were asked to consider what supports or hinders their use of different spatial arrangements, they did not express such a view. Teachers seemed somewhat reluctant to modify spaces to suit the needs of a particular task or social arrangement, but they did not find it difficult to re-configure their learning spaces. Figure 8 shows that both primary and secondary teachers said that it is relatively easy to re-arrange their space, with 70% of primary teachers and 58% of secondary teachers either agreeing or strongly agreeing.

Indeed, social design and the (re)configuration of spaces for learning are influenced by the temporal dimension, which is implicated in the development, use and impact of learning spaces (OECD 2017). As mentioned earlier, alterations to the nature and use of physical spaces (e.g. open or closed; indoor or outdoor; physical or virtual) are often connected to pedagogical and organisational changes that play out over extended time frames. For example, a move towards team teaching implies different demands on time than solo teaching, and the high-level changes in pedagogy involved in ILEs require time and effort to contextualise in ongoing teaching and learning practice. Next, we consider the experiences of school teachers that connect learning spaces and practices enacted in these spaces.

Teacher's perceptions of emergent practices

In this section, we summarise teachers' responses to the qualities associated with learning spaces, including how well they can hear students and control temperature and lighting. Also collaborative practices and support for innovative practices within the New Zealand learning landscape are considered.

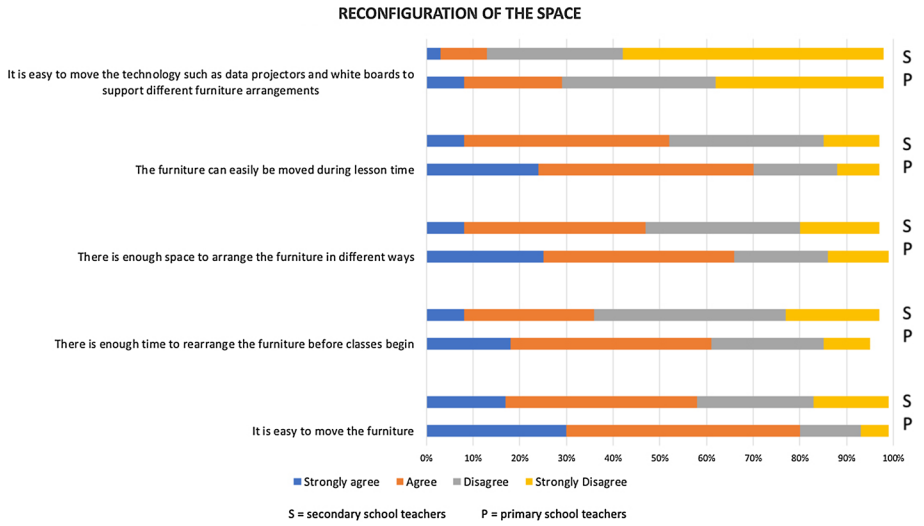


Fig. 8 Frequency of agreement with statement about reconfiguration of space

Qualities associated with learning spaces

Although flexible learning spaces can produce noise levels that disturb or even disrupt learning activity (Wall 2016), learning depends not only on students' ability to hear a single voice, but also to effectively communicate with others to productively curate information and co-create knowledge. To do this well, learners must develop a range of skills and capacities to support interaction, not only with their peers but also with materials such as tools, resources and the buildings that accomodate them (set design). Students need to be able to understand how various spatial arrangements support or hinder certain types of learning activity (Woolner 2010) and to develop a range of strategies to navigate increasingly-diverse learning environments.

In thinking about learning spaces, respondents were asked if they felt disturbed by noise levels (outside, inside) and whether they could clearly hear their students. Figure 9 shows that most primary teachers were able to hear their students clearly, in all (39%) or most (53%) spaces. Similarly, most secondary teachers reported being able to clearly hear their students in all (39%) or most (51%) of learning spaces.

Because the ability to regulate different variables within a space also can affect the comfort and well-being of teachers and students (OECD 2017), respondents were asked if they felt they were able to control heating, air conditioning, glare, lighting and ventilation in their learning spaces. Windows, lighting and glare were often controlable by both primary and secondary teachers. Figure 10 shows that more primary-school teachers reported being able to control heating (45%) and air conditioning (36%) than secondary teachers (24% and 15%, respectively).

In addition, comments by respondents also alluded to specific qualities of spaces and how they influence students' learning activity. For example, the following participant

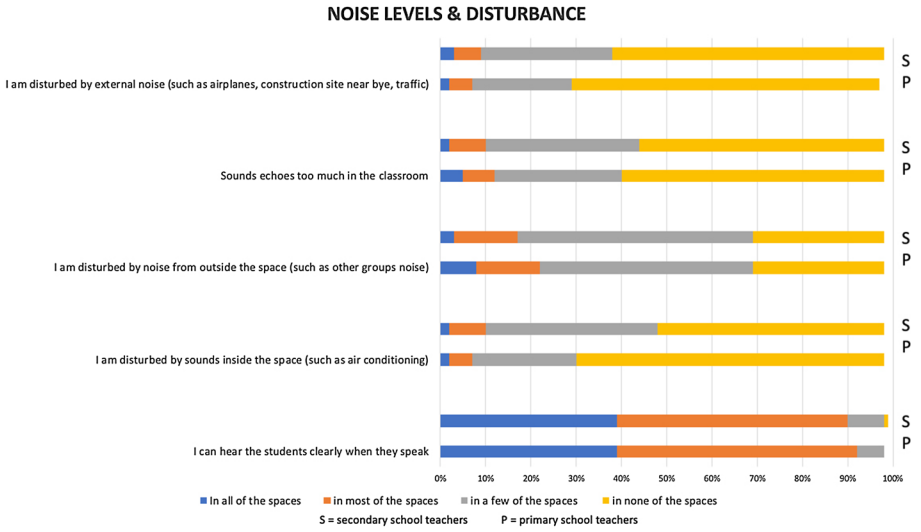


Fig. 9 Frequency of agreement with statement about noise levels and disturbance

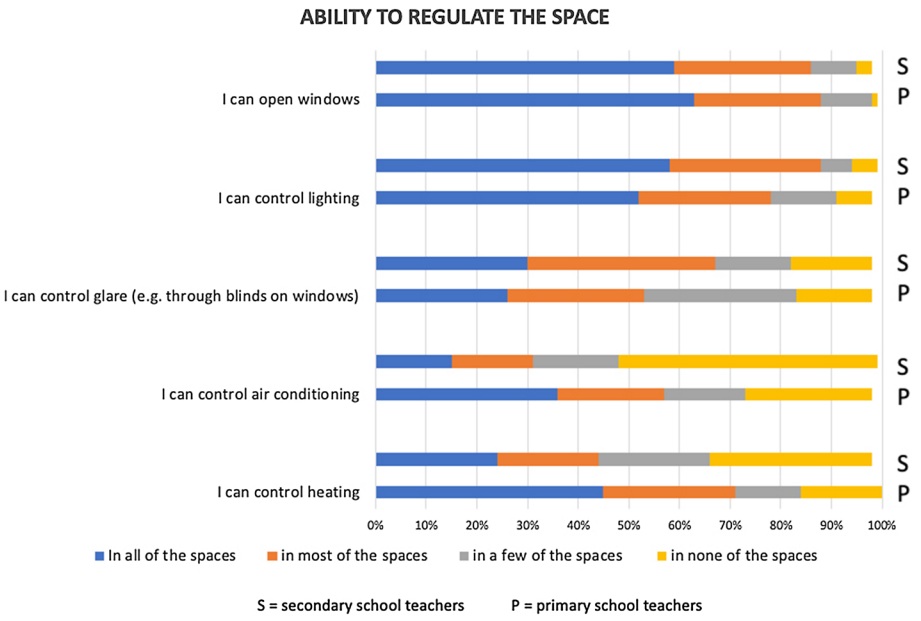


Fig. 10 Frequency of agreement with statement about ability to regulate the space

highlighted that 'being comfortable' helps students to focus and that their freedom to choose is perceived as supporting students' agency:

> Students can choose between multiple spaces depending on where they feel most comfortable. Being comfortable helps students focus. Being able to choose their spaces also allows them agency in their learning.

The sense that certain valued qualities of learning activity (peer–to–peer discussion) can simultaneously be perceived as both postitive (collaboration) and negative (disruptive to reflection or one-to-many) is pragmatically dealt with in one school:

> If children are frustrated by classroom noise, they can head into the Takiwa (small spacebetween classes that is separated by sliding doors and often a quiet space). Kids get the best of both worlds with opportunities to collaborate and work individually or in groups.

However, while qualities of space are often seen as supporting learning activity, not all New Zealand schools are equally resourced. The following respondent reported a lack of care that is linked to a perceived lack of funding and investment in her school:

> The space is fine in regards to teaching and learning, but the condition of the space leaves much to be desired. Because we have leaky buildings, we have had buckets catching water when it rains and water pouring down the walls, through light fittings and behind the heater. The carpet has rotted due to the amount of water in one area and the carpet is nearly threadbare in other areas. This to me shows a lack of funding, and the kids and teachers are being put in an unhealthy and unsafe environment because of this lack of funding. We would welcome a change.

Although understanding the role of the designed environment is essential, designed physical and digital elements are only part of the puzzle. The next section focuses on issues related to collaborative practices, which play a role in shaping emergent learning activity.

Collaborative practices

As eloquently put by one of our participants, although architecture plays a key part in the enactment of collaborative practices, this is not the only factor. Fostering or nurturing collaborative relationships is also key to successful innovative practices:

> Architecture plays a big part in the ease with which collaborative teaching can occur. In my opinion, our newest buildings are not that well designed for flexible teaching/learning despite having large sliding doors between rooms. As well as architecture, relationships between teachers who are working together need to be strong. Our senior school has very effective collaborative teaching because teachers are a committed group with strong connections to each other. In the middle school, this is not working so well, which has nothing to do with the learning spaces, and more to do with the combination of staff. You can't expect collaborative teaching to occur just because teachers are thrust together.

Similarly, the following participant reminded us that, while aspects of the space (such as breakouts) or access to technology can offer opportunities for collaboration, in themselves digital and material things might not be enough because some teams might be more collaborative than others:

> There are some of our classes which have breakout spaces, allowing more successful collaborative teaching. We all have access to technology, but we do not yet have one

> device per student. We are all teaching collaboratively in teams of 2. Some teams are more collaborative than others.

Indeed, opportunities for collaboration can also be viewed with certain resistance which reveals a dissonance between design and practice (Daniels et al 2018). The following quote provides insight into the experience of a teacher in a school reverting to more-traditional layouts and individual teaching:

> I cannot teach the way I need to as I am aware that other teachers are in the space. True collaborative teaching is not happening at our school even though the space was designed for this. We have recently rebuilt the walls to close the spaces in again! No PD given for collaborative teaching.

In contrast, other teachers perceived great benefits in working collaboratively. The following respondent offered insight into how initial resistance from parents was addressed over time by using these spaces to provide more-stimulating and -effective environments for learning:

> We have had our innovative learning environments (or as I tongue in cheek refer to them..Cafes…Collaborative and Flexible Environments) for 4 years now, despite all of the nay sayers and the negative reactions from parents in the first year. Personally I think they allow us to provide more stimulating and effective environments for our students. I see real benefits in two teachers working collaboratively.

Overall, respondents reported challenges in adopting reflective and collaborative practices. Working in teams requires a willingness to develop a collective vision, shared practices, an ability to identify and solve problems, and resilience to work through the challenges of being 'in transition' into a range of innovative learning environments. Proactive leadership that supports staff to work through these issues is crucial in order that the whole school community can develop a strong shared vision (ERO 2018).

Support for emerging practices

Participants were asked if they felt that leaders and teachers had a shared vision of what constituted 'best use' of their learning spaces. In recognition that this shared vision might not necessarily include innovative practice, we also asked if experimentation was encouraged. We were also interested in whether participants felt that the design of spaces supported collaboration with other teachers, variety in teaching practices or preferred teaching practices, and whether there was sufficient time allocated for providing advice on how to use new spaces well (see Fig. 11).

Regarding to school support for teachers' practices, primary teachers were more likely than secondary teachers to agree that they shared their leaders' vision (88% vs 68%), feel encouraged to experiment (90% vs 74%) and experience adequate provision of time to learning to use new spaces well (49% vs 30%).

Both primary and secondary school leaders reported a shared vision with their teachers (primary leaders 93%, secondary leaders 96%), felt that they offered encouragement for experimentation (primary leaders 94%, secondary leaders 96%) and provided adequate time for teachers to make adjustments (primary leaders 78%, secondary leaders 76%). Figure 11 reports primary school teachers' responses (PT), primary school leaders' responses (PL), secondary school teachers' responses (ST) and secondary school leaders responses (SL).

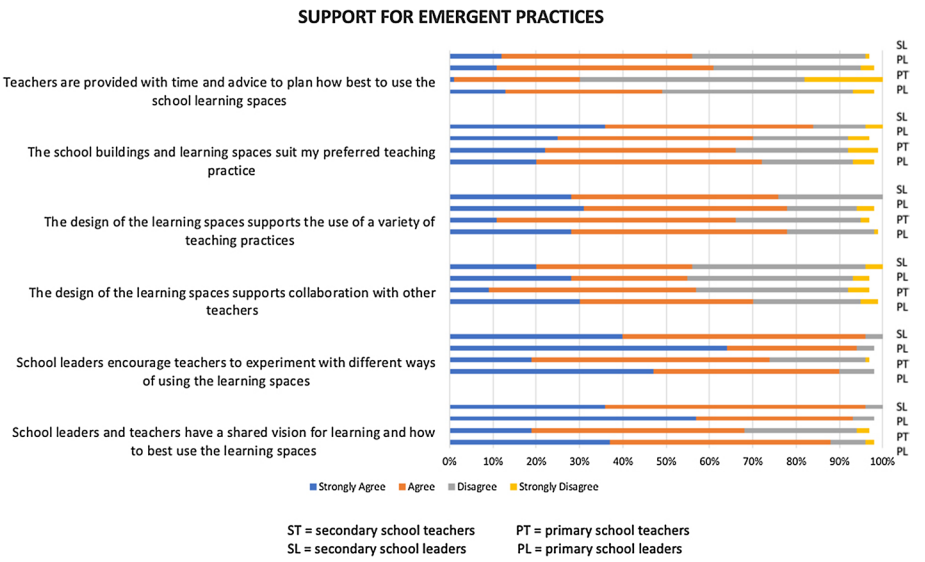


Fig. 11 Frequency of agreement with statement about support for emergent practices

In summary, successful transitions to ILEs involve not only access to specific resources, such as flexible learning spaces or access to digital technologies, but also support for teachers as they work to align new spatial arrangements with contemporary learning theories and pedagogical practices. This is explicitly highlighted in the New Zealand government ERO (2018) which describes effective leadership in terms of building relational trust within school communities, displaying knowledge, skills and a mindset oriented towards innovation that supports experimentation amongst staff. In our surveys, although teachers generally felt supported by school leaders to experiment with different ways of using new learning spaces, they experienced a lack of time and advice in planning how to do this well.

Conclusion

Vartiainen et al. (2018) call for educational systems to move towards organic, complex and adaptive notions of learning networks, with students embedded in much larger ecologies of learning. They describe learning networks as co-evolving and connected to multiple contexts, social practices and tools. Similarly, the New Zealand government is reconceptualising their educational system as an ecosystem, but this is an ongoing and evolving process. Insights from this study suggest that primary teachers are more likely than their secondary counterparts to teach in an ILE or as part of an ecosystem. However, most respondents reported an overall sense of being in transition, which raises important questions for government and policy-makers regarding good ways to support teachers and school leaders through what is a system wide process of transformation.

McGregor (2003) reminds us that studies of teachers' workplaces often take spatial dimensions for granted by either ignoring them entirely or "focusing on the spaces of the classroom, staffroom and school as fixed and bounded" (p. 353). Our research focused on how the properties and spatial configurations of materials give rise to emergent learning

activity. This is why we took a networked learning approach in framing the web of connections between specific elements of the set, social and epistemic design (Goodyear and Carvalho 2014). Mapping the learning landscape is the necessary first step in understanding how constituent parts relate to the learning whole, or how design choices regarding space, tools, tasks and social arrangements can support valued learning activity. Furthermore, if change is to be sustainable, it is critical that educators understand *where* to focus their energies (designable elements), *why* alignment between the structural dimensions (set, social, epistemic) of any learning network is so important, and *how* tools, spaces, tasks and social arrangements indirectly influence learning activity. In summary, educators need support in aligning theory, design and practice (Carvalho and Yeoman 2018; Daniels et al. 2018). By mapping the current landscape and framing the relations between constituent parts in this way, we begin the process of understanding how best to support educators through processes of transition that aim to equip learners with the skills and knowledge necessary to take their place in the networked societies of the twenty-first century, both in New Zealand and further afield.

References

Alexander, B., Ashford-Rowe, K., Barajas-Murphy, N., Dobbin, G., Knott, J., McCormack, M., et al. (2019). *EDUCAUSE horizon report: 2019 higher* (Education ed.). Louisville, CO: EDUCAUSE.

Beetham, H., & Sharpe, R. (2013). *Rethinking pedagogy for a digital age*. New York: Routledge.

Benade, L. (2017). The evolution of policy: A critical examination of school property under the National-led Government. *Waikato Journal of Education, 22*(1), 97–112.

Cardellino, P., Araneda, C., & Alvarado, R. G. (2017). Classroom environments: An experiential analysis of the pupil-teacher visual interaction in Uruguay. *Learning Environments Research, 20*, 417–431.

Carvalho, L., & Goodyear, P. (Eds.). (2014). *The architecture of productive learning networks*. New York: Routledge.

Carvalho, L., Goodyear, P., & de Laat, M. (Eds.). (2017). *Place-based spaces for networked learning*. New York: Routledge.

Carvalho, L., & Yeoman, P. (2018). Framing learning entanglement in innovative learning spaces: Connecting theory, design, and practice. *British Educational Research Journal, 44*(6), 1120–1137.

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed method approaches* (2nd ed.). Thousand Oaks, CA: Sage.

Daniels, H., Tse, H. M., Stables, A., & Cox, S. (2018). Design as a social practice: The experience of new-build schools. *Cambridge Journal of Education, 49*(2), 215–233.

Damşa, C., Nerland, M., & Andreadakis, Z. (2019). An ecological perspective on learner-constructed learning spaces. *British Journal of Educational Technology*. https://doi.org/10.1111/bjet.12855.

Education Counts. (2019). New Zealand Schools. Retrieved April 2, 2009, from https://www.educationcounts.govt.nz/data-services/directories/list-of-nz-schools.

ERO. (2018). Leading Innovative Learning in New Zealand Schools. *Education Review Office*. Retrieved May 15, 2019, from https://www.ero.govt.nz/publications/leading-innovative-learning-in-new-zealand-schools-april-2018/.

Freeman, A., Adams Becker, S., Cummins, M., Davis, A., & Hall Giesinger, C. (2017). *NMC/CoSN horizon report: 2017 K–12 edition*. Austin, TX: The New Media Consortium.

Goodyear, P., & Carvalho, L. (2014). Framing the analysis of learning network architectures. In L. Carvalho & P. Goodyear (Eds.), *The architecture of productive learning networks* (pp. 48–70). New York: Routledge.

Gislason, N. (2009). Mapping school design: A qualitative study of the relations among facilities design, curriculum delivery, and school climate. *The Journal of Environmental Education, 40*(4), 17–34.

Gislason, N. (2010). Architectural design and the learning environment: A framework for school design research. *Learning Environments Research, 13*, 127–145.

Imms, W., Mahat, M., Byers, T., & Murphy, D. (2017). *Type and use of innovative learning environments in Australasian schools* (ILETC Survey No. 1). Melbourne: University of Melbourne, LEaRN. Retrieved April 7, 2019 https://www.iletc.com.au/publications/reports.

McGregor, J. (2003). Making spaces: Teacher workplace topologies. *Pedagogy, Culture & Society, 11*(3), 353–377.
MOE. (2015). Designing schools in New Zealand: Requirements and Guidelines. New Zealand Ministry of Education. Retrieved October 10, 2019, from https://education.govt.nz/.
Mulcahy, D., Cleveland, B., & Aberton, H. (2015). Learning spaces and pedagogic change: Envisioned, enacted and experienced. *Pedagogy, Culture & Society, 3*(4), 575–595.
Nordquist, J., & Laing, A. (2015). Designing spaces for the networked learning landscape. *Medical Teacher, 37*(4), 337–343.
OECD. (2015a). *Schooling redesigned: Towards innovative learning systems.* Paris: OECD Publishing. Retrieved November 3, 2019, from https://www.oecd.org/education/schooling-redesigned-9789264245914-en.htm.
OECD. (2015b). *Students, computers and learning*. Paris: OECD Publishing.
OECD. (2017). *Learning environments evaluation program.* Retrieved April 3, 2019, from https://www.oecd.org/education/LEEP_Brochure_OECD.pdf.
OECD. (2018). The OECD school user survey: Improving learning spaces together. Retrieved April 6, 2019, from https://www.oecd.org/education/effective-learning-environments/.
OECD. (2019). *Effective learning environments (ELE).* Retrieved April 3, 2019, from https://www.oecd.org/education/effective-learning-environments/.
Radcliffe, D. (2009). A pedagogy–space–technology (PST) framework for designing and evaluating learning places. In D. Radcliffe, H. Wilson, D. Powell, & B. Tibbetts (Eds.), *Designing next generation spaces of learning: Collaboration at the pedagogy-space-technology nexus*. Brisbane: University of Queensland.
Sawyer, K. (2009). *The future of learning in the age of innovation*: *Review for the Beyond Current Horizons Programme.* Bristol: Futurelab. Retrieved November 4, 2019, from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.504.541&rep=rep1&type=pdf.
Sissons, T. (2018). Modern learning environments—Are they all they're cracked up to be? *New Zealand Herald*. Retrieved May 12, 2019, from https://educationcentral.co.nz/opinion-modern-learning-environments-are-they-all-theyre-cracked-up-to-be/.
Säljö, R. (2010). Digital tools and challenges to institutional traditions of learning: Technologies, social memory and the performative nature of learning. *Journal of Computer Assisted Learning, 26*, 53–64. https://doi.org/10.1111/j.1365-2729.2009.00341.x.
Sørensen, E. (2009). *The materiality of learning: Technology and knowledge in educational practice*. Cambridge: Cambridge University Press.
TKI. (2019). *Innovative learning environments.* New Zealand Ministry of Education. Retrieved May 14, 2019, from https://elearning.tki.org.nz/Teaching/Innovative-learning-environments.
Vartiainen, H., Nissinen, S., Pöllänen, S., & Vanninen, P. (2018). Teachers' insights into connected learning networks: Emerging activities and forms of participation. *AERA Open.*. https://doi.org/10.1177/2332858418799694.
Wall, G. (2016). *The impact of physical design on student outcomes.* New Zealand Ministry of Education. Retrieved May 12, 2019, from https://www.educationcounts.edcentre.govt.nz.
Wilson, H. (2009). The process of creating learning space. In D. Radclife, H. Wilson, D. Powell, & B. Tibbetts (Eds.), *Designing next generation spaces of learning: Collaboration at the pedagogy-space-technology nexus*. Brisbane: University of Queensland.
Wood, A. (2019). Built policy: School-building and architecture as policy instrument. *Journal of Education Policy*. https://doi.org/10.1080/02680939.2019.1578901.
Woolner, P. (2010). *The design of learning spaces*. London: Continuum.
Woolner, P., Thomas, U., & Tiplady, L. (2018). Structural change from physical foundations: The role of the environment in enacting school change. *Journal of Educational Change, 19*(2), 223–242.