

Perceived interplay between flexible learning spaces and teaching, learning and student wellbeing

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Received: 31 May 2017 / Accepted: 31 October 2017 / Published online: 4 November 2017
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Abstract In recognition of the evolving learning needs of twenty-first century school students, changes to teaching practices and the incorporation of technology are increasingly accompanied by modifications to the built classroom environment. Typically rows of desk and chairs are replaced with a range of furniture that can be configured in various ways to facilitate teaching and learning. This article explores the perceived relationship between these flexible learning spaces and teaching, learning and wellbeing outcomes. The perceptions and experiences of 12 school principals, 35 teachers and 85 students from four primary and four secondary schools in Australia were examined. Flexible learning spaces were reported to facilitate student-centred pedagogy and selfregulation, collaboration, and student autonomy and engagement. Modified spaces were reportedly more enjoyable, comfortable and inclusive and allowed greater interaction. The findings are discussed in light of Beaton’s five key design principles of student-centred learning environments to explore the connection between the physical classroom environment and teaching and learning. Self-Determination Theory is used to interpret how elements of the physical space facilitate the creation of a social environment that encourages greater motivation to learn and increases student wellbeing. The research contributes to an understanding of how flexible learning spaces are used and with what effect, thereby addressing a present gap in the literature.

Keywords Autonomy · Collaboration · Engagement · Learning environment · Physical environment · Student-centred · Wellbeing

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Introduction

There is widespread acceptance that the teaching and learning landscape in schools is rapidly evolving, requiring educators to employ innovative approaches and adjust to the digital age to ensure twenty-first century school students stay engaged whilst having their learning needs met (Kuhlthau et al. 2015; NSW Department of Education 2016). This is evidenced by the paradigm shift in the educational sector over the last few decades from didactic teacher-led instruction to constructivist approaches to learning (Jonassen and Land 2012; Prain et al. 2013). As educators rethink pedagogy and increasingly employ a student-centred approach, the industrial-age layout of classrooms, typified by rows of desks and chairs, no longer lends itself to the educational practices taking place (Byers et al. 2014; Fisher 2010). The integration of the virtual space into the teaching and learning environment further necessitates modifications to enable and capitalise on the learning that can occur (Chandra and Mills 2015). This has led to modifications in school learning spaces internationally, creating new generation learning environments that allow more dynamic teaching and learning (Cleveland and Fisher 2014).

In parallel to the changes taking place in practice, there is a growing body of research documenting the relationship between the built learning environment and student outcomes (Blackmore et al. 2011). When effectively designed, learning environments have been found to facilitate constructivist pedagogy and student engagement (Cleveland 2016; Stern and Etheridge 2008). Gifford's (2002) analysis of the impact of the environment in educational setting revealed that classroom space and how it is arranged have implications for student performance, with more open environments having a positive effect on learning outcomes. Aesthetics too has a favourable influence on student grades, although this varies with gender and age. Classroom noise, in contrast, was found to interfere with learning (Gifford 2002). Barrett et al. (2015) found that three dimensions of *naturalness*, *individualisation* and *stimulation* contribute to our understanding of how school students experience built spaces and their impact on learning. Within these broader dimensions, they concluded that light, temperature, air quality, ownership, flexibility, complexity and colour all could support improvements in students' learning. These findings provide evidence of the impact of building design on human performance and wellbeing. Research conducted in low socio-economic settings in rural Australia has further identified that conditions, such as teacher professional development and support in adapting to new settings, use of virtual technologies and a whole-of-schools approach to curricula, promote academic success and wellbeing in open-plan learning environments, suggesting that a personalised learning experience underpins high-quality learning and wellbeing (Prain et al. 2015).

According to Awartani et al. (2008), educational institutions will increasingly be expected to take responsibility for the overall development of students, including their wellbeing. In the Australian school context, student wellbeing is defined as "a sustainable state of positive mood and attitude, resilience and satisfaction with self, relationships and experiences at school" (ACU&EI 2008, p. 24). Connectedness, achieved through high-quality relationships between students and teachers and among students, is recognised as a significant contributor to student social emotional wellbeing (CESE 2015). Gislason (2009) found that open classrooms facilitated social connection. Further, a review by Higgins et al. (2005) concluded that there is evidence of the potential detrimental effects on student wellbeing of physical elements of the classroom such as air quality, temperature, lighting and acoustics.

The connections between physical wellbeing and learning are well established (Awartani et al. 2008), with symptoms such as headaches and back problems being

affected by the built school environment. According to Wingrat and Exner (2005), increasing student comfort through soft furnishings can reduce behaviours, such as rocking, fidgeting and position changes, which occur when students are expected to sit for extended periods of time. Stand-biased furniture, which aims to reduce sedentary time, gives students a variety of postural options (Aminian et al. 2015; Ucci et al. 2015) and also facilitates comfort in the classroom.

In NSW Australia, a small number of government primary and secondary schools have begun to adapt their teaching practices and make changes to the physical environment of school classrooms, transforming them into ‘flexible learning spaces’ (NSW DoE 2016). A key feature of these learning environments is that they contain a variety of furniture options in a relatively open space, which can be configured in various ways to facilitate a range of learning experiences and create opportunities for both individual and collaborative work, whilst utilising a range of technologies to facilitate personalised teaching and learning (NSW DoE 2016). In late 2015, the NSW Department of Education (DoE) committed to a significant financial investment into public school learning spaces that aim to “engage students in ways that reflect twenty-first century learning” (NSW Government 2015) and, in 2017, committed \$5 billion towards public school infrastructure over the next decade. While research in this area is evolving rapidly, the utilisation of these modified spaces is under-researched (Chandler 2009). A review by Blackmore et al. (2011) revealed that studies typically focus on the design phase of learning environments and a gap remains in our understanding of the types of practices that ensue in these spaces, how they are perceived, and with what effect. Fisher (2016) identifies the absence of evidence around what works and why in learning environments and the urgent need for further studies to underpin the significant investments into learning environments by Ministries of Education. This article addresses the lack of data highlighted by reviews of research in this area by providing insights from the users of flexible learning spaces into the perceived relationship between the built learning environment and teaching, learning and student wellbeing.

Methods

We used a qualitative case-study approach to examine the perceptions of school leadership teams and teachers’ and students’ ‘lived experience’ of *flexible learning spaces* in eight Government schools that had independently made changes to their learning environments.

Participants

Purposive sampling (Patton 2002) ensured that participating schools had transformed the built environment of their learning spaces. The NSW DoE identified 12 eligible schools and, of these, four primary and four secondary schools in the metropolitan Sydney and the Illawarra regions of NSW, Australia, voluntarily agreed to participate in the study.

Eight leadership team interviews were held with 12 participants (5 primary and 7 secondary) who served as either school principals, deputy principals or head teachers. Teachers participated in one of eight 45-min focus-group discussions involving up to five teachers. The teacher sample consisted of 35 participants (18 primary and 17 secondary), ranging in experience from early career (0–3 years) to highly experienced (20+ years). Teachers represented primary school classes from Kindergarten to Year 6, as well as all

key learning areas of the secondary school curriculum. The 16 student focus groups involved 5–6 students each and took approximately 35 min. The primary sample contained 45 students (42% female, 58% male) from Years 5–6 (aged 9–11 years). The secondary student sample comprised 40 students (53% female, 47% male) from secondary school Years 7–11 (aged 11–17 years). Students belonged to over 20 cultural backgrounds and the eight participating schools represented a broad range of socio-economic demographics.

Instruments

Standardised open-ended interviews were held with school leadership teams about the broader reasons for and implications of the changes to the built learning environment and the pedagogical approaches employed by teaching staff. Using this method facilitated comparison of answers between schools, whilst still allowing unique thoughts and insights (Patton 2002). For the teacher and student samples, focus-group interviews were used as data generated by the interaction between group participants on a given topic and with standpoints refined in light of the contributions of others (Ritchie et al. 2014). Questions for both the interviews and focus groups were developed on a collaborative basis, taking into consideration the identified needs of the NSW DoE which had contracted the evaluation, and the research team's understanding of the context and knowledge gaps identified in the literature. Some questions were asked of all three participant groups to facilitate source triangulation and ensure robust and comprehensive data.

Procedure

Ethics approval was obtained from the University of Wollongong's Human Ethics Research Committee (HE16/021) and the NSW State Education Research Applications Process (SERAP). Participants were provided with information about the purpose and nature of the evaluation, confidentiality and how the data would be used. Written consent was obtained for all participants.

Schools selected participants based on the following criteria. School leadership teams had to have been centrally involved in leading the transition to flexible learning spaces within their school. Participating teachers were required to regularly teach in flexible spaces. The primary student sample was selected from Years 4–6 to avoid challenges regarding reliability and distractibility (Donaldson 1978). Secondary students represented a range of year levels. Further criteria included gender balance and the involvement of students across the learning ability spectrum.

Data were collected during school hours. Two members of the research team collected all data, with one moderating while the other took notes. The interviews/focus groups commenced with a brief overview of the study purpose, a reiteration of confidentiality and de-identification of individual responses, and etiquette such as not interrupting others and it being appropriate to disagree. The questions served to initiate discussion about pedagogical approaches in flexible spaces in comparison with traditional classrooms, the learning experience and the relationship between flexible spaces and the physical, social and emotional wellbeing of students. Perceived strengths and weaknesses of flexible learning spaces were also examined. Probes were used throughout to encourage further elaboration of participant responses. All interviews and focus groups were audio-recorded and transcribed verbatim. The transcripts were then imported into NVivo 10.0 software.

Data analysis

As suggested by Patton (2002), data analysis began during fieldwork. Patterns were discussed during a peer-debriefing process (Lincoln and Guba 1985) and, as insights deepened, interpretations emerged. As anticipated, data saturation was reached by the last interviews and focus groups.

Content analysis was conducted in NVivo based on the protocol described by Braun and Clarke (2006). A deductive process was used to look for concepts derived from discussion with the DoE, an understanding of the research literature and from field-based analytical insights. To complement this, inductive analysis or ‘open coding’ (Strauss and Corbin 1998) was used to further develop codes and explore key patterns. Upon review and comparison of the coded data, latent thematic analysis (Boyatzis 1998) was used to identify five key themes and corresponding sub-themes across the three sets of data (leadership teams, teachers, students). To heighten the ‘trustworthiness’ of our interpretations, the themes were discussed and refined by the research team.

Results

The changes made to learning environments in this study encompass the physical, pedagogical and social context in which learning occurs. In all, eight schools leadership teams and teachers identified that, in traditional classrooms, increasing numbers of students had become disengaged from educational content and processes and it was felt that students were no longer being adequately prepared for the demands of society and contemporary workplaces. This resulted in a reflection on teaching practices and gave rise to these schools embarking on a journey towards flexible learning spaces.

As schools began to shift to the student-centred approach, they found that traditional classroom configurations inhibited them from teaching how they now wished, and so they began to adapt the physical classroom environment (see Figs. 1, 2). These ranged from removing rows of desks and chairs and replacing them with furniture such as couches, ottomans, beanbags, standing desks and coffee tables, to structural changes such as taking down walls, creating open space and offering smaller break-out areas for quiet work. Technology incorporated into these learning environments included iPads and laptops to allow access to the Internet, Apple TVs, smart boards and a range of educational software to enhance collaboration, creativity and feedback.

The schools were all at different stages of the transformation, with some having had flexible learning spaces in place for several years, and others having adapted their pedagogy and physical spaces within the preceding months. It was evident that schools underwent a transition period when teachers adapted their pedagogy and became familiar and more confident in their new teaching approaches. Similarly students required time to ‘learn how to learn’ in these modified classrooms and to define new ‘rules of engagement’ regarding their rights and responsibilities.

Five main themes were identified from the interview and focus-group data in response to the research questions (Table 1). These served as umbrella themes for a range of corresponding sub-themes, which provided structure and further meaning to the data (Braun and Clarke 2006). Themes one and two related directly to the teaching and learning experience of teachers and students in flexible learning spaces compared with traditionally designed classrooms. The third theme captured the main challenges experienced by



Fig. 1 A flexible learning space in a primary school



Fig. 2 A flexible learning space in a secondary school

teachers and students in these spaces. Themes four and five related to the social, emotional and physical wellbeing of students.

Theme 1: Student-centred learning

All schools reported a shift in pedagogy from predominantly teacher-led instruction to an increasingly student-centred approach in their flexible learning spaces. This was driven by the belief that didactic teaching in traditionally-arranged classrooms no longer met the needs of twenty-first century students. School leadership teams felt that students increasingly required higher-order skills such as critical and creative thinking, problem solving

Table 1 Themes, sub-themes and description

| Theme | Sub-themes | Description |
|----------------------------------|--|---|
| Student-centred learning | Self-regulation, collaboration, technology | How students are central to their own learning and engage in and with processes and resources |
| Student engagement | Autonomy, motivation | How pedagogy and physical space impact on student motivation and engagement |
| Teaching and learning challenges | Distraction, noise, managing behaviour | Physical and behavioural factors that undermine teaching and learning and wellbeing |
| Social and emotional wellbeing | Ambience, interaction, inclusiveness | How space, layout and pedagogy enable social and emotional wellbeing |
| Physical wellbeing | Comfort, ergonomics, movement | How furniture and student choices affect physical wellbeing |

and collaborating because, as one secondary school principal stated: *Students will inhabit a very different future.*

As the focus moved to teaching higher-order skills, explicit instruction occurred less frequently. Teachers stated that flexible learning spaces both facilitated and necessitated the adoption of student-centred pedagogies, highlighting that the pedagogical approach is integral to maximising the potential of flexible learning spaces. Teachers reported employing project-based learning¹ and differentiated instruction² and increasingly incorporated technology as a means for offering students an enhanced personalised learning experience by enabling follow-up and deeper investigation into areas of personal interest beyond what is delivered to the whole class:

We have laptops to do research on things that we want to know about... the things that I'm interested in and no one else really cares about.

Primary School Student (S3S)

Self-regulation

Students recognised the different teaching practices used in flexible spaces compared with traditional classrooms and embraced the student-centred approach. Overall, students demonstrated a high level of reflexivity, articulated their individual learning needs and described how their preferences for how to learn changed, based on the subject, task or mood. It was also common for students to regularly reflect on their choices with the teacher in order to determine whether or not these were conducive to their learning. Both teachers

¹ Project-based learning is engaging students in investigation. Within this framework, students pursue solutions to non-trivial problems by asking and refining questions, debating ideas, making predictions, designing plans and/or experiments, collecting and analysing data, drawing conclusions, communicating their ideas and findings to others, asking new questions and creating artefacts (Blumenfeld et al. 1991).

² Differentiated instruction is an organised, yet flexible, way of proactively adjusting teaching and learning methods to accommodate each child's learning needs and preferences to achieve maximum growth (Tomlinson 2014).

and students viewed the student-centred approach as fostering self-regulation and the skills needed for university and the workplace.

We explicitly teach part of it, and then the space supports them - through trial and error - to develop those skills to self-regulate. We need to give them the opportunity to experience those successes and failures so that they learn from that and are able to manage their learning.

Secondary School Teacher (S6T)

As a consequence, teachers needed to relinquish some of their authority in the classroom to empower students to take responsibility for their learning goals and outcomes:

She doesn't instruct us much on what to do. We get to tackle the challenge in any way we want to; so we can do it with technology, we can do it on paper or we can do it in groups or individually. It's all unique and we get to do the work we want to in our own way.

Secondary School Student (S6S)

This resulted in teachers and students being viewed as equal partners in learning, rather than the teacher being a central, authoritative figure. The teacher's desk, often a dominant feature in a traditional classroom with a perceived 'no-go zone' around it, was removed altogether or replaced with a small, unassuming table in flexible learning spaces. This also contributed to the shift in power dynamics:

In the [traditional] classrooms... it's overwhelming. You feel like the teacher's in power, so when you are in the flexible space it's like you are equal.

Secondary School Student (S5S)

Collaboration

One of the most-frequently noted changes to learning in flexible spaces was the increased collaboration between students. This was reported across all year levels and participant categories. Collaboration was facilitated by grouped table layouts and the use of larger tables as an alternative to individual desks, enabling students to participate in discussions and group work:

The round tables force the students to get together and work and engage with one another, including students who wouldn't otherwise engage with other kids because they're facing them.

Secondary School Head Teacher (S8T)

Students reported peer teaching during class time as a key benefit of collaboration. Senior students in particular preferred to ask their friends if they did not understand something and found this iterative process to be both enjoyable and academically beneficial.

When you don't understand a concept, it feels like I can't go and just ask the teacher because they've just explained it to us 10 times. Could someone give me a new insight on what this kind of concept is? Then your friend explains and then you also explain to each other and it's just really beneficial in the long term, like teaching your friends kind of just solidifies it in your mind as well.

Secondary School Student (S7S)

While the majority of students appreciated the opportunity to work in groups, they also valued the option to work independently and identified that group work often took more time to complete and could be challenging for introverted students.

Technology

Across many of the participating schools, technology was integrated into almost every lesson and shaped how students conducted their work and the types of activities that they undertook. The use of technology supported both teaching and learning. The Internet was frequently accessed for research purposes and technology assisted the collation of work outputs from group tasks, presentations and student assessments. A range of devices and educational school software was routinely incorporated into flexible spaces and were highly valued by teachers and students.

Now that I've got my iPad and my devices and my Apple TV, I can actually present from anywhere in the room so I tend to stand in the middle of them because they really like it... and we sort of just chat more than me being the drill sergeant in the front of the room (i.e. you must listen and I will impart my knowledge).

Secondary School Teacher (S7T)

Theme 2: Engagement

Teachers and leadership teams reported student disengagement and lack of motivation as an increasing concern prior to making changes. It was believed that the introduction of flexible learning spaces had contributed to turning this experience around and, in some cases, to translating into improved learning and behavioural outcomes:

It became pretty clear pretty quickly that teachers wanted to work in that space, that most students wanted to work in that space, that their engagement levels had increased, and that the quality of work they were producing had improved.

Secondary School Principal (S6E)

We've seen an improvement in engagement and we can actually measure that. Not just through attendance but in terms of positive behaviour.

Primary School Principal (S4E)

Autonomy

Teachers observed greater levels of engagement among students who had been prone to 'switching off' in traditional classrooms. This was demonstrated through disengaged students becoming increasingly empowered by the opportunities to step up and take on the responsibility to self-regulate. Students valued the level of autonomy that they were afforded to make choices in flexible spaces, with options to work in groups or individually, made possible by a variety of furniture and the use of technology. Students were found to capitalise on the furniture and layout choices available to them in flexible spaces and this was seen to complement and reinforce the pedagogy.

Some personalities I found are going towards certain furniture. I'm finding that they're more engaged and a lot of the more lower-ability kids almost feel relieved.

Secondary School Teacher (S5T)

Motivation

Students described experiencing increased motivation, a more positive attitude towards learning and greater enthusiasm. This was observed in the form of both self-motivation and as motivation among their peers.

English is probably my least favourite subject - but we've gone from a more traditional classroom to the new classrooms and I feel that English isn't as much of a struggle to go to now.

Secondary School Student (S7S)

All three participant groups attributed this increase in motivation and engagement to both the changes in pedagogy, that allowed them to be more self-directed, and the modifications to the physical space, which they perceived as being more suited to their learning needs.

Theme 3: Teaching and learning challenges

Several challenges to teaching and learning in flexible spaces were consistently reported, though it was believed that these could be overcome with effective teaching practices and as students became more accustomed to learning in these spaces. It was acknowledged that both teachers and students required support during the transition phase.

Distraction

Students reported that they were more frequently distracted in flexible spaces. This was because of the increased focus on collaboration, with students being encouraged to discuss their learning with their peers in class, without them necessarily possessing the self-discipline to stay on topic. Becoming distracted was further facilitated by the layout and furniture options. With the freedom to work in different locations (e.g. in the corridor or a secluded booth), students found themselves being observed less by the teacher and more easily distracted by their peers:

It's tricky for a lot of our class to keep more in control of themselves in those classrooms.

Secondary School Student (S7S)

Teachers also recognised this and reflected on their role in assisting students to stay on task:

It forced us to think outside the box in terms of how we were going to present things too because you know your kids are going to sit there and chat and get off task if you don't put something in front of them that forces them to work with each other and engage.

Secondary School Teacher (S7T)

Noise

Flexible learning spaces often have the capacity to hold more students than a traditional classroom, can be more open plan, and do not have walls or dividers to provide isolated spaces. Coupled with the collaborative pedagogy that was generally employed, primary school students felt that classrooms could become quite noisy as a consequence:

Well, some people take advantage of the flexible learning space and some people just go and sit with their friends and talk. So sometimes it can be noisy.

Primary School Student (S1S)

Secondary school students, on the other hand, generally reported that flexible spaces provided a calmer, quieter workspace, suggesting the increased capacity of this age group to self-regulate.

Managing behaviour

Teachers advised that it was important to set classroom expectations and boundaries around how to engage with the space and furniture. Without clear boundaries, classroom management was seen as difficult, particularly for casual teachers who were not familiar with expectations for classroom behaviour. This again highlights the transition phase and the skills needed to teach effectively in these spaces. Students also recognised challenges faced by teachers as they adapted their approaches.

Theme 4: Social and emotional wellbeing

It was widely perceived that the teaching and learning taking place in flexible spaces had a positive impact on the social and emotional wellbeing of teachers and students:

...really important are those social outcomes too. Particularly in this day and age when we have the levels of anxiety amongst our youth and the depression, it's really amazing how kids interrelate when working together.

Secondary School Head Teacher (S7E)

Ambience

Students strongly felt that the aesthetics of flexible learning spaces had a positive impact on how they felt towards learning. Factors such as brightly coloured furniture, natural light, air quality and indoor plants were all reported to improve students' sense of emotional wellbeing (e.g. feeling calm, happy and motivated) in the classroom and resulted in improved attitudes towards learning:

... now there's awesome coloured furniture and it's a lot more vibrant now. I'm more excited about coming to school.

Primary School Student (S3S)

Students also reported that teachers predominantly seemed more at ease teaching in flexible spaces:

The teachers are more kind of laid back. They're not as strict.

Secondary School Student (S6S)

Students remarked that they felt valued by their schools for creating these spaces for them and this resulted in all three participant groups noting a significant reduction in vandalism of furniture compared with other classrooms.

Interaction

School leadership teams and teachers believed that physically open space, coupled with the pedagogies used, allowed teacher–student interaction to become more frequent. Fewer items of furniture in classrooms removed both physical and social barriers between teachers and students, which greatly facilitated interaction and was highly valued by participants. Rather than the teacher being tied to their desk, moving around the space encouraged interaction with students:

“It’s good because sir can weave in and out and see what we’re doing.

Secondary School Student (S7S)

Students found that they developed high-quality relationships with their peers because of increased opportunities for group work and collaboration. Building relationships with peers was also perceived to be important for increasing student inclusiveness:

I think I’ve made more friends with the group work, I know we’ve been in the same school for about three years but, with the group work, you become a bit closer.

Secondary School Student (S6S)

Inclusiveness

All participating groups perceived that flexible learning spaces provided a more inclusive environment for students than a traditional classroom. From the perspective of many school leadership teams and teachers, flexible learning spaces allowed students to excel as individual learners rather than having to conform with the traditional student mould. It was noted that the pedagogy and layout of the space catered for individual student needs, particularly students with special learning needs, and created an environment that facilitated inclusiveness:

I’ve got a child in a wheelchair... I feel that it’s such a more inclusive environment for him because everyone is at different levels and there’s no judgement ... and he can access everything in the room because he’s not getting through rows of chairs and tables.

Primary School Teacher (S1T)

Theme 5: Physical wellbeing

A further theme from the data was regarding students’ physical wellbeing in the modified classrooms, with responses from each of the participant categories overwhelmingly highlighting the positive impact of flexible learning spaces on wellbeing.

Comfort

Flexible learning spaces were generally reported to be more comfortable spaces to learn in, and students spoke at length about their appreciation for the available seating options such as padded chairs, couches, Ottomans and beanbags. The majority of students agreed that being comfortable resulted in higher engagement with their work:

Instead of us having to sit in chairs and sit up straight, we get to relax on the furniture, which is really comfortable, and so you get to learn better.

Primary School Student (S1S)

As can be seen in Fig. 3 the variety of furniture in this flexible primary school classroom allowed students to work upright at standing-desks, sit at traditional desks, on the floor at low tables, on floor-seats with back support or in a cushioned corner. It was generally reported that unless the teacher was providing instruction to the whole class, students were free to work where they felt comfortable.

Ergonomics

Schools used a wide range of furniture to fit out their classrooms. Some were purchased at generic stores and others were purpose-built for the school, taking into consideration form and function. Students reflected on the range of shapes and sizes and how multiple physical needs had to be met simultaneously. Some concerns were raised from the perspective of physical discomfort, particularly in regards to seating without back rests on ottomans or the floor, and writing on tables of inappropriate height:

(The ottoman) doesn't have a back rest and sometimes it gets a little bit difficult having to hold your back up.

Secondary School Student (S6S)

The coffee tables are great but I'm always hunching over to get to write.

Secondary School Student (S64)

A noteworthy difference between traditional classroom settings and flexible spaces was the choices afforded to students to be comfortable, coupled with the freedom to move between items of furniture. Because students were not required to use an item of furniture for an extended period of time, leadership teams and teachers perceived that any negative impact of furniture not ergonomically designed for schools would be negated. Further some schools recognised the need for adjustable furniture to cater for the range of body types and heights in a typical class:



Fig. 3 Furniture in a primary classroom

Most of the furniture we have also bought is multileveled. It can be raised to 6 different heights.

Primary School Teacher (S3T)

Movement

A key feature of flexible learning spaces was the increase in open space in rooms where walls had been removed. Furthermore, in spaces where there was an overall reduction in the amount of furniture, teachers and students appreciated the space that had been opened up. Coupled with the increase in group work, students felt invited to move around the space more frequently. This was viewed positively and as beneficial to health and wellbeing:

We get to move a lot... and that's really comfortable, because you're not always sitting.

Primary School Student (S2S)

I walk around a lot during a class. I will get up and go to talk to someone else about what we're doing. When my friends get a bit distracting... I might move a bit closer to the teacher.

Secondary School Student (S7S)

Teachers reported that many students struggled to sit still for extended periods of time and that a flexible learning space enabled these students to move as needed without resulting in them feeling as though they were disturbing the lesson, or without the teacher needing to reprimand the student and guide them back to their work.

Discussion

Overall the findings suggest that modified physical learning environments which accommodate a variety of furniture options, layouts and resources were perceived to be beneficial to teaching, learning and students' social, emotional and physical wellbeing. The findings also highlight the interplay between the built environment and pedagogy and how together these influence learning and wellbeing outcomes.

Physical space facilitating a student-centred approach

In all participating schools, a shift in pedagogy preceded any physical changes made to classrooms. Modifications were made specifically to create physical spaces, furnished and resourced, to enable a student-centred approach. According to Baeten et al. (2016, p. 44), there are five design principles of student-centred learning environments.

To varying degrees, these design principles have been incorporated into the modified spaces discussed by participants, as seen in Table 2, suggesting that the physical learning environment, teaching and learning approaches, furniture, spatial typologies and technologies support their application, and that this underpins the perceived success of these spaces.

Whilst acknowledging the role of direct instruction, the move away from a predominantly 'chalk and talk' approach to encouraging students to be active participants in their learning and to project-based learning as an alternative means of curricular delivery,

Table 2 Design principles, teaching and learning activities and spatial typologies

| Design principles | Teaching and learning activities | Examples of spatial typologies |
|---|--|---|
| Stimulate knowledge construction | Project-based learning Direct instruction Research-based learning Reflective activities Discussion | Group learning areas Breakout spaces Access to technology Individual pods |
| Teacher as facilitator of the learning process | Collaborative and group work Reflective activities Discussion | Group learning areas Breakout spaces No distinct ‘front of classroom’ |
| Implement cooperative work | Collaborative and group work Peer to peer learning | Group learning areas Breakout spaces Access to technology Presentation spaces |
| Use authentic assignments | Project-based learning Research-based learning | One-on-one teacher student conferencing Individual pods Group learning areas Presentation spaces |
| Embed opportunities for self-regulated learning | Self-directed learning Peer-to-peer learning Reflective work | Individual pods Group learning areas |

particularly in primary schools, encourages *knowledge construction* and *authentic assignments*. Through this, students are afforded the opportunity to play an active role in selecting and interpreting new knowledge (Struyven et al. 2010) and applying their findings to real-life problems and projects that interest them. The physical environment supports this through the variety of furniture and resources that allow students to work individually or in groups and to access technology or more traditional resources at different times throughout the lesson as needed, depending on the task and pace at which they are progressing.

The principles of *teacher as facilitator* and *cooperative work* are largely supported through the reduction in the number of furniture items, inclusion of grouped desks and opening up of the physical space. This enables students to work together in different settings around the room, and the teacher to move much more freely to offer targeted advice and guidance specific to the needs of individual groups rather than to the class as a whole. The use of stools could potentially facilitate opportunities for collaboration because students can move on and off stools with greater ease than getting out of chairs. Technology and the lack of a ‘front of the classroom’ enable teaching from anywhere in the room to incorporate resources such as moveable whiteboards, remote-controlled smart boards or interactive TVs.

The variety of choices around engaging with the learning material also facilitates student *self-regulation*. Flexible learning spaces give students the freedom to choose where, how, with whom and with what resources to learn, and to seek support from the teacher and each other as needed. The range of furniture options caters for a range of learning styles and preferences. The built environment, the layout and how the resources are used, thus,

facilitate the shift in responsibility from the teacher to the students to actively shape their own learning.

Further, Table 2 draws on the work of Fisher (2005) who suggested a range of spatial typologies that are ideally found in the flexible learning space, which students can move between as required. It is evident that there is overlap between a range of typologies that lend themselves to the diversity of teaching and learning that can occur in flexible learning spaces that are designed to facilitate a student-centred approach. However, Table 2 is by no means exhaustive and caution should be used when mapping teaching and learning activities against design features or furniture layouts, because the value of the flexible learning environment lies in the offering of opportunities rather than in specifying or directing the setting in which a certain activity should occur.

Self-determination and enhanced engagement and wellbeing

A positive change in student engagement was noted as a consequence of learning in flexible spaces. Niemiec and Ryan (2009) describe human nature as having the tendency to engage the physical and social environment, and people as possessing an innate love of learning. In the classroom situation, they discuss that, when educators impose controls, enthusiasm and joy are replaced with boredom and alienation, resulting in academic disengagement and poorer learning outcomes. Ideally the school classroom creates both a physical and social environment where students are intrinsically motivated to engage for the sake of learning. Self-Determination Theory states that three psychological needs have to be satisfied to sustain intrinsic motivation (Niemiec and Ryan 2009). Behaviour needs to be volitional for students to experience *autonomy*, to feel that they possess the *competence* to master their school work, and to meet their innate desire for *relatedness*, through connecting and interacting with others (Niemiec and Ryan 2009).

It is suggested that flexible learning spaces are perceived positively because these three psychological needs are being met. In flexible learning spaces, students are typically afforded the *autonomy* to self-direct their own learning and the use of resources and space throughout the lesson. Their *competence* is increased as the pedagogy provides more personalised, targeted instruction and encourages collaboration and consequentially peer-teaching, which is also correlated to intrinsic motivation (Benware and Deci 1984). Finally, flexible spaces could enhance *relatedness* through enabling authentic relationships to grow between teachers and their students, and amongst students, because there is increased opportunity for engagement among the users of these spaces.

There is overlap between the themes on engagement and social and emotional wellbeing. Increased *autonomy* and *relatedness* not only increase intrinsic motivation, but also enhance social and emotional wellbeing (Ryan and Deci 2000). In flexible spaces, interactions between students and the teacher and among students are greatly increased, which reportedly contributes to increased wellbeing and subsequently improved motivation and engagement with school work. However the ultimate effect that this might have on learning outcomes is yet unknown, with a meta-analysis of studies suggesting that, when students have greater control over their learning, motivation improves, but not necessarily subsequent learning (Hattie 2009).

Flexible learning spaces are being designed in ways that prioritise student comfort. The incorporation of furniture items such as stools, for example, can support greater mobility and less sitting because students are inclined to adjust their posture more frequently. Further, the pedagogical approaches used, which allow students to respond to their body's natural tendencies to change posture and break up prolonged bouts of sitting, by getting up

periodically and moving around or finding a different furniture item at which to work, further enhance student wellbeing. With research suggesting that children and youth sit for 6–10 h a day (Owen et al. 2014), and the longest bouts of uninterrupted sitting time occurring on weekdays during school hours (Carson et al. 2013; Harrington et al. 2011), it is encouraging that flexible learning spaces provide students with the opportunity to move more frequently during class time, given the growing understanding of the detrimental health impacts of prolonged sitting.

In addition, it is encouraging that a growing numbers of Australian schools are refurbishing their learning spaces or involved in new buildings that are seeking a Green Star rating (GBCA 2017). Moving beyond meeting minimum standards in building codes, there is greater attention to designing and building learning spaces that are not only better for the planet, but are comfortable, productive and healthy environments for students and teachers. There is an emphasis on maximising air quality, natural light and flexible furnishings, which recognises the benefits of these elements for the wellbeing of space users (GBCA 2017).

Teaching and learning challenges

The majority of study participants acknowledged some challenges associated with teaching and learning in flexible spaces, yet generally believed that these would be overcome in time. However, there are design elements—for example acoustic measures to reduce noise, that are particularly relevant for students with hearing difficulties—which can be incorporated into the built environment to minimise this unavoidable outcome of teaching and learning in flexible learning spaces (Rose-Munero 2016).

The main challenges clearly lie in how the space is used, which is largely in the teacher's hands. Teachers discussed the transition when moving from traditional classrooms to flexible spaces, once again highlighting the central role of the pedagogical approach in maximising the potential for teaching, learning and student wellbeing. Research findings have previously established a lack of 'environmental competence' among teachers (Lackney 2008 cited in Imms et al. 2016, p. 7) which impedes their ability to capitalise on the affordances of the physical learning environment for pedagogical benefit and ultimately improved academic outcomes. This suggests the central role of the teacher and that emphasis should be placed on professional development and ongoing support for teachers to ensure flexible learning environments are used to maximum effect.

Conclusions and further research

We found that differentiated teaching for personalised learning is neither possible nor effective in traditional classrooms and needs to be accompanied by differentiated spaces. Flexible learning spaces, as implemented in the schools participating in this study, offer a range of furniture and layout options that, when coupled with student-centred pedagogy, are perceived positively by the users of these spaces in regards to teaching, learning and student wellbeing. The findings extend the body of knowledge that has applied Self-Determination Theory to the social environment of the classroom, by highlighting the facilitating role of the physical space in shaping the learning environment and ultimately student motivation, engagement and wellbeing. The study further adds to our understanding of how the physical learning environment, furniture and resources can

support and facilitate the student-centred pedagogical approaches being used in flexible learning spaces. When designed and used effectively, flexible learning spaces provide learning environments where students can experience increased autonomy to make a variety of choices about their learning in a way that fosters self-regulation, collaboration and interaction, whilst ensuring their wellbeing. It is suggested that, as funds are increasingly directed towards improving the built learning environment, allowing for extensive refurbishment and completely new buildings, the focus shifts beyond facilitating collaboration and interaction as seen in the schools participating in this evaluation. A greater emphasis on incorporating a broader range of design features, such as breakout spaces, display areas, presentation spaces, maker-spaces, outdoor learning areas, individual pods and storage areas (Fisher 2005), will not only facilitate a student-centred, differentiated approach, but also will allow teachers to cater more effectively for the diverse requirements of the student population, including introverts and special-needs students (Imms et al. 2016). Further research is needed into how flexible learning spaces are used in practice and the impact that this has on learning and academic outcomes.

Acknowledgements We acknowledge the Futures Learning Unit of the NSW Department of Education and Training, especially Kathleen Donohoe and Robert Fraser, for their support and funding. We also thank the participating schools, principals, teachers and students who shared their views with us. This research was conducted with the support of an Australian Government Research Training Program Scholarship.

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