PLANS to PEDAGOGY

Activity Report

What impact does 'innovative' furniture have on student engagement and teacher practices?

2019

Plans to Pedagogy: Vasse Primary School

NorvaNivel

Vasse Primary School
EST 1869

The University of Melbourne

Australia ECU Edith Cowan University

Title: Plans to Pedagogy Activity Report 2019: What impact does 'innovative' furniture have on student engagement and teacher practices?

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Executive Summary

Phase One of this project, conducted during the 2019 academic year, used an A-B-A withdrawal design to rotate (terms 2, 3 and 4) the furniture in five primary school classrooms[1] from 'innovative' to 'traditional' furniture arrangements[2]. Three-weekly repeated measures were taken across the year of (1) student perceptions of their cognitive and behavioural engagement, (2) teacher actions in these classrooms, and (3) photographs by students of their preferred furniture, with annotations explaining this preference. Once-a-term measures included (4) teachers completing a Teacher Mind Frames survey, and (5) teachers participating in a structured interview with the researchers.

The aim of this phase of the study was to determine if types of furniture impacted student engagement and teacher pedagogies.

Statistical, graphical and thematic analyses were applied to broadly examine the data. In summary, this phase of the study found that;

- Students' perceptions of their engagement in learning were not affected by particular furniture arrangements.
- Regardless of consistent engagement, students felt that furniture did impact their learning.
- Teachers altered how they taught according to particular furniture arrangements, with increased student-centred learning occurring in designated innovative furniture arrangements.
- Teacher-centred pedagogies increased in designated traditional furniture arrangements.
- The intervention furniture arrangements resulted in an increase in effort by teachers to maintain student engagement levels.
- In all classrooms, teachers utilised more 'high-impact' pedagogies in the designated innovative furniture arrangement.

Evidence from Phase One (now requiring greater scope and detail in Phase Two) indicated that students believed their learning was enhanced by innovative furniture arrangements. Innovative furniture arrangements supported inquiry-based, student-centred learning. Teachers increased their 'high-impact' pedagogic strategies in the innovative furniture arrangements. While measures of student engagement levels did not change to statistically significant degree during this A-B-A study, teacher pedagogies did change. This phenomenon was consistent (in favour of 'innovative' furniture arrangements) with three of the four teachers, including the 'reverse intervention' teacher.

Analysis suggests that years of school-wide teaching innovation resulted in a 'persistent' student engagement attribute that proved resilient to the relatively short-term intervention to 'traditional' furniture arrangements. However, the load of maintaining this engagement level fell on teachers, who each reported increased workload and discomfort with having to change what they felt was established successful pedagogies in order to 'teach well' in more traditional settings.

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1 Three classrooms moved from 'innovative' to 'traditional' to 'innovative' furniture arrangements. The fourth classroom (a 'reverse intervention' group) moved from 'traditional' to 'innovative' to 'traditional'. In each case the 'A' component was the teacher's standard operating furniture arrangement. The fifth classroom served as a control and did not change.

2 Innovative furniture arrangements were characterised by multiple styles of tables and seats, storage solutions and other portable items (see Appendix A), which allowed teachers or students to easily change furniture arrangements within the classroom. Traditional furniture arrangements were decided by the participating teachers as being as opposite to 'flexible or innovative' arrangements, but in general were characterised by groups of tables with hard backed chairs facing a nominated 'front' of the classroom.

Results from Phase One can be used to make the following claims regarding the types of innovative furniture used in the site school, which were developed by NorvaNivel™:

- 93% of students feel innovative, flexible furniture has a positive impact on their learning.
- Comfort and flexibility are the two most frequent reasons students work with particular furniture, and this is often related to addressing their perceived physical (back pain), learning (concentration) and behavioural (energy) needs.
- Teachers work with more student-centred pedagogies when they have flexible furniture arrangements compared to traditional arrangements.
- Teachers' workloads increase when planning collaborative and inquiry-based learning in traditional settings, whereas flexible settings allow these types of learning to happen more organically.
- Teachers feel they build better relationships and trust with students when they are working with flexible furniture arrangements.

The report provides detail to explain these findings, and a summary of proposed Phase Two activity (the latter subject to school, ethics, and Western Australia Education Department approval).

NorvaNivel™ Furniture

What impact does 'innovative' furniture have on student engagement and teacher practices?

What were we trying to do?

Vasse Primary School has, for some time, collaborated with NorvaNivel™ furniture to create learning spaces with unique furniture arrangements. It is a project the school believes contributes to a positive learning environment for its students; they feel the variety of furniture made available by NorvaNivel™ allows teachers greater flexibility in how they teach, and students how they learn. This, they feel, supports the implementation of a core component of the school's pedagogic vision - a 6-tiered model of 'engagement' (Figure 1).

The school, and NorvaNivel™, have consistently reflected on this alignment of engagement and furniture, but to date have not collected robust analytical data to test their perceptions of the phenomenon. The P2P[1] @ Vasse project was designed to collect such data. Its broad focus comprised, *'What impact has innovative furniture had on Vasse student engagement and teaching practices?'*

This was addressed through two key research questions:

1. Do levels of student perceptions of their engagement in learning correlate to types of furniture provided in their classrooms?
2. Do teaching styles (pedagogies) change with differing furniture arrangements?

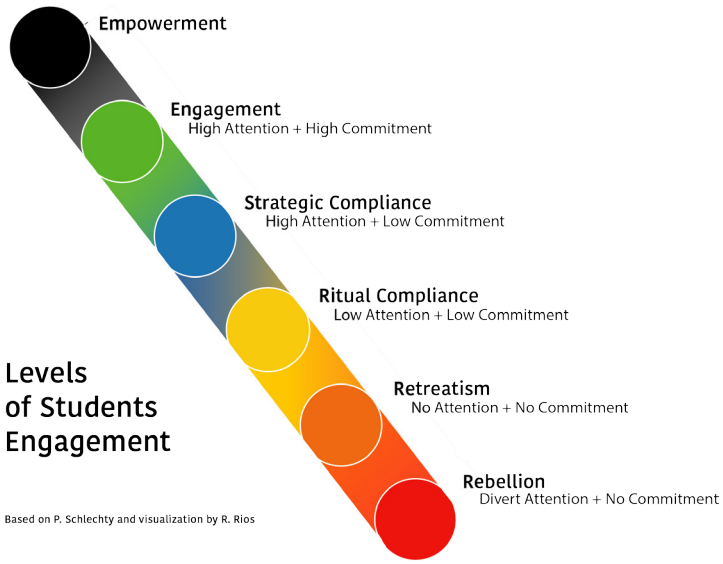


Figure 1: The Schlechty engagement model, adapted by Vasse Primary School

1 *The Plans to Pedagogy (P2P) Project is a University of Melbourne initiative, through its Learning Environments Applied Research Network group. P2P constitutes approximately 11 schools across Australia and New Zealand that focus on developing research capacity in schools aimed at maximising the educational impact of learning environment design and use. P2P@Vasse is one such project, developed and run through the Edith Cowan University. See https://research.unimelb.edu.au/learnetwork/projects/plans-to-pedagogy-p2p for more detail.*

How did we do it?

We needed to isolate furniture as a variable; we felt the best way to do this was through an A-B-A design across three school terms where teachers alternated between traditional and flexible furniture arrangements. 'A' was a classroom's normal furniture arrangement, with 'B' being the opposite. This approach allows the first 'A' setting to provide baseline data, giving us a measure of what was 'normal'. 'B' was the intervention, the alternative furniture arrangement, and the second 'A' the return to 'normal' (a withdrawal). Because this change happened with other variables controlled (the same teacher, teaching the same students, across a full term for each stage), one could argue that if the measures for 'B' differed, the cause was most likely the furniture arrangement.

The project recruited five volunteer teachers from grades 3 to 6. Three agreed to have their classrooms' flexible furniture arrangements changed to traditional in term 3. One of the four teachers was a 'reverse intervention' – they normally used a traditional furniture arrangement and agreed for to convert to a more flexible arrangement during the 'B' stage. The fifth acted as a control with no changes to furniture arrangements, effectively doing an A-A-A design.

In order to gather data, a repeated measures approach was used, meaning the same measures were conducted at regular intervals, regardless of whether teachers were working in an 'A' or 'B' furniture arrangement.

Figure 2. Examples of a flexible (top) and traditional (bottom) furniture arrangement as defined by the school

In order to address the research questions, those measures were:

Short student surveys, done each three weeks.	This measured engagement: they provided an ongoing measure of how students felt they were behaviourally and cognitively engaged over the past three weeks.
Observations of teaching, done each three weeks.	This measured pedagogies: conducted by one school-based researcher, they provided an 'objective' assessment of teaching practices. An on-line observational metric was adapted from the Byers[1] model, and embedded in Novum's Learning Environments Analysis Survey App (LEASA) platform[2].

An additional suite of three measures provided more in-depth information on the two key variables described above:

Student photographs (with annotations) of furniture, done each three weeks in flexible spaces.	This photo elicitation process provided student comment on what furniture they preferred for learning, and why.
Teacher Mind Frame surveys, done at the end of each term.	This provided a measure of the incidence of 'high impact' teaching strategies.
Teacher semi-formal interviews, done at the end of each term.	This 'unpacked' the previous term in terms of teacher perceptions of their teaching, their students' engagement, and the use of furniture.

In terms of procedure, the P2P research team (the P2P@Vasse Project Leader from Edith Cowan University, and the P2P Program Leader from the University of Melbourne) visited Vasse once a term to interview the volunteer teachers, to meet with the Vasse Spatial Learning Team (comprising four senior teachers) and twice a year to conduct recruitment and provide a briefing to the school staff.

In mid Term 2, 2019, an additional teacher was recruited to the Spatial Learning Team (SLT) and was provided teaching relief for one day a week to gather and organise data. They conducted all observations, implemented the student surveys each three weeks, and facilitated the photo elicitation exercise with students.

1 Byers, T. (2016). Evaluating the effects of different classroom spaces on teaching and learning. (Doctoral dissertation), University of Melbourne, Melbourne, Australia.
2 Unpublished correspondence, Novum Architects, December 2019.

What did we find?

Question 1: Do levels of student perceptions of their engagement in learning correlate to types of furniture provided in their classrooms?

Survey data

Only one data set directly addressed this question – the repeated measures student survey – but the photo elicitation measure provided some insights into the survey results. In regards to the survey, Table 1 shows the difference in mean scores across both behavioural and cognitive engagement when students experienced changed furniture arrangements.

Little change was found in engagement in learning when flexible furniture options were taken away. While there was a large range of scores[1] in each scale (from 2-5 for behavioural engagement and 1-5 for cognitive), the majority of students rated highly on both scales across the year.

Photo elicitation data

While the results of the survey showed very little movement in engagement in learning, the photo elicitation measure was used to explore how students were engaging with the flexible furniture arrangements on offer. Though these data cannot be linked to students' engagement in learning, they do provide an explanation of the types of furniture students prefer and students' perspectives on how these furniture options support them to learn better.

Figure 3 shows students' most preferred furniture items when working with flexible furniture options. Photographic examples of these items can be found in Appendix A.

Table 1. Range and mean scores for student engagement scales across differing furniture arrangements

Engagement Scale	Furniture Arrangement	N	Minimum	Maximum	Mean	Standard Deviation
Behavioural	Traditional	298	2	5	4.25	.719
	Flexible	299	2	5	4.26	.746
Cognitive	Traditional	307	1	5	4.01	.569
	Flexible	307	1	5	4.02	.838

1 *Minimum and maximum scores for a 5-point Likert scale, 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree and 5 = strongly agree.*

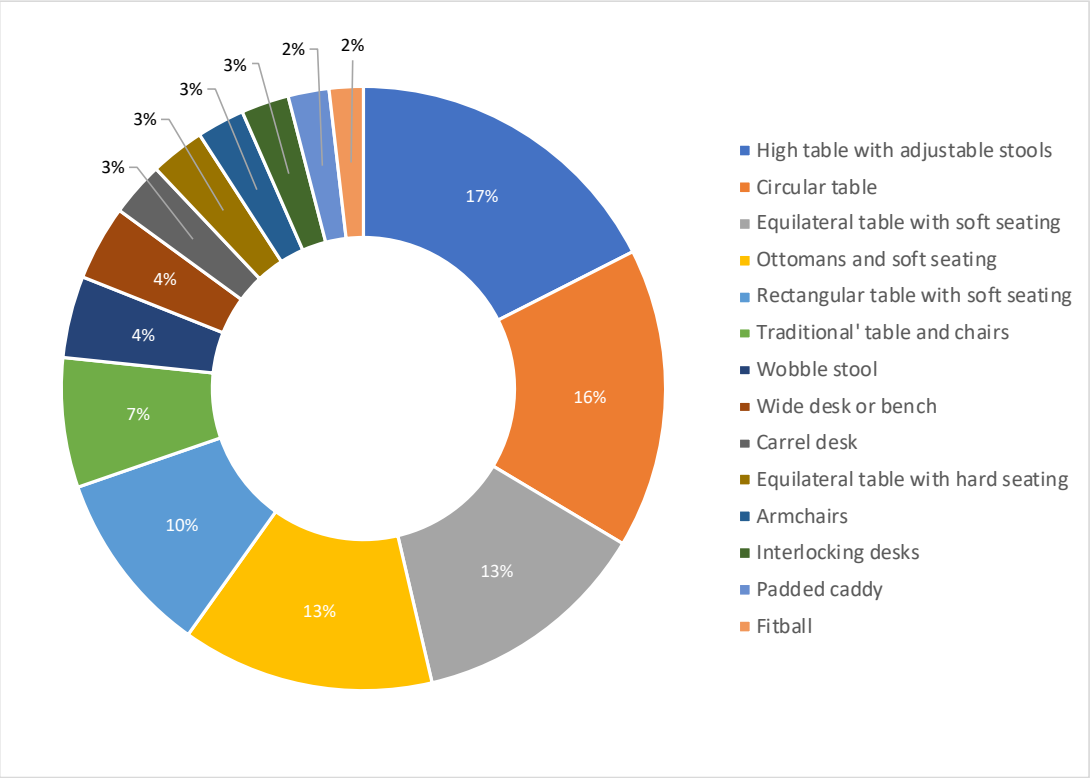


Figure 3. Primary students' most preferred furniture items

High tables, circular tables, equilateral tables with soft seating, and ottomans/soft seating accounted for approximately 60% of students preferred furniture items. Annotations from the students have been provided below to explain their reasoning for selecting these specific items as their most preferred.

High tables with adjustable stools were the most frequently selected item of furniture. Students selected this item for a range of reasons including:

- Self-managing their behaviour: '[My feet don't] touch the floor because when we had the other fernichair [sic] I used to mess around.'
- Allowing them to sit in their preferred space within the classroom without compromising learning: 'It's high up and at the back so I can see over people and still be at the back [of the classroom].'
- Supporting good posture and the management of injuries: 'Its tall and high, but it also helps my back because its strait [sic] and you can't wobble on it.'
- Providing flexibility: 'Its high up and u [sic] can stand or sit at it.'

Circular tables were also frequently rated as a preferred item, for reasons including:

- Proximity to peers for comfort: 'It can fit lots of people around it.'
- Working collaboratively or seeking support from peers: 'You can communicate with your peers when doing activities' and 'it's more collaborative.'

Equilateral tables with soft seating options were rated third most frequently, alongside ottomans and soft seating options (without a desk/table). Students gave the following reasons for working at equilateral tables:

- Writeable surfaces: 'You can draw on the table and use it for working out instead of wasting paper' and 'you don't have to get a whiteboard from the shelf.'
- Working collaboratively: 'it is easier to chat' and 'better for group work.'
- Amount of working space: 'you're not squished and you have lots of room.'
- Comfort (in relation to ottomans at equilateral tables): 'you can sit enny [sic] way on them', 'on soft things I'm more focussed', 'I move less.'

In addition to the comfort of ottomans at equilateral tables, students also gave the following reasons for sitting on soft seating options in the classroom:

- They are portable: 'It is easy to carry and use.'
- They allow students to self-manage behaviour: 'If I am feeling fidgety I can rock on it.'
- They support concentration on learning: 'It is more comfy and it helps me concentrate.'
- They are a source of fun when students use multiple cushions or padded blocks to build seating for themselves: 'fun to build.'

Reasoning for students' selections of furniture items, including and in addition to those listed above, are summarised in Figure 4. Definitions of the codes applied in this analysis can be found in Appendix B.

Comfort was important to students when selecting their preferred working space (54%). As identified above, comfort was mostly associated with soft seating options, although there were a range of students who also identified adjustable stools as being most comfortable as these allowed better flexibility for taller students, and in term 4 (after the majority of students returned to flexible furniture from a more traditional arrangement) more students identified chairs with backrests as beneficial as they 'can lean back instead of slouch' and 'don't get a sore back.'

Flexibility and height were mostly associated with high tables. Flexibility was used as a key term for both stool adjustment ('I like how the chairs can go up and down') and desk height adjustment ('The desks are high, low, medium levels').

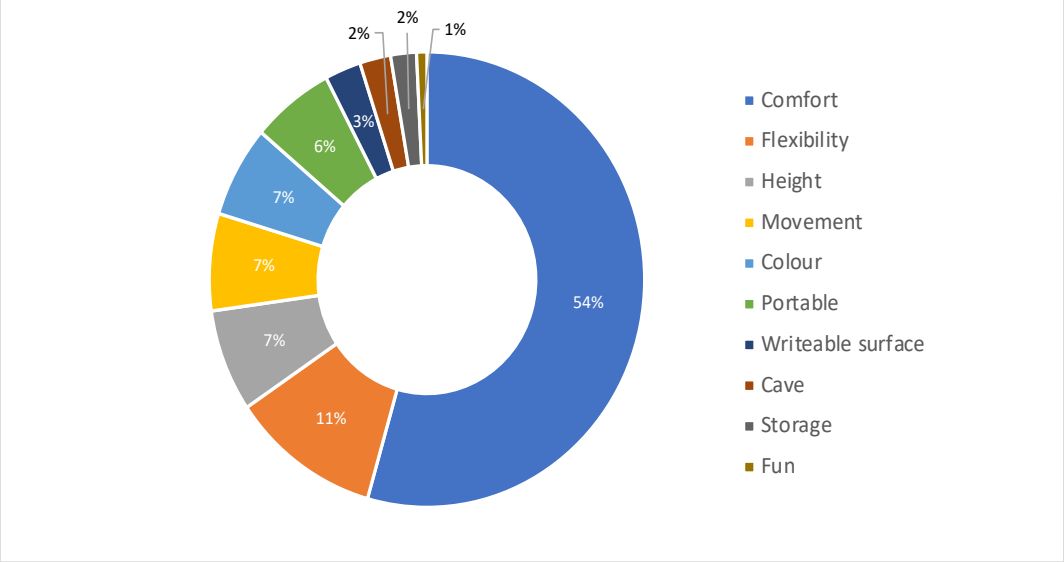


Figure 4. Beneficial characteristics of furniture items as indicated by primary students

These options allowed students to alter the way they were working: 'It allows me to either stand or sit while being comfortable.' Flexibility was also mentioned in relation to whiteboard equilateral tables that provided both a good working surface and the ability to draw ideas directly onto the table. Equilateral tables were also mentioned as flexible because of the amount of space they provide, allowing students to work comfortably at the table for both collaborative and independent tasks.

Movement referred to the students' ability to move while on the item of furniture, for example, rocking on ottomans and sitting on wobble stools or fitballs. In relation to sitting on fitballs, one student wrote 'I like how you can do small bounces on these which is relaxing.' This was typical of comments made about movement, which was seen to relax students and make them more comfortable in their learning environment. Students were particularly fond of wobble stools because 'if you have lots of energy, you can try to tire yourself out on the wobbly stool.' Rolling or rocking on ottomans, which had the added benefit of being height adjustable, was also beneficial for releasing excess energy while working.

Colour was not identified in term 2 data (when students were working within flexible furniture arrangements) but was identified by one class in the study in term 4 when they returned to flexible environments from more traditional furniture arrangements. The consistent comments by students in this class resulted in a high frequency for colour as important overall. Students in this class wrote about colour in terms of its effect on their emotional state: 'It is bright so it makes me feel happy and focused.' They sometimes referenced furniture items as having their personal favourite colour, or enjoyed the 'vibrancy' of the furniture in the classroom.

Concentration was supported when students could move furniture to be in a particular space in the classroom, as 'you can maneuver [sic] to be in the right spot which helps you concentrate.' For some students this included finding personal space in the classroom, with one student describing how they felt 'less distractions because I'm facing the wall.' However, concentration was also assisted by comfort. For example, students described how their physical posture in their chosen seats helped concentration: 'It helps me concentrate because instead of slouching over I can sit straight.' Students particularly sought out furniture arrangements that supported both collaborative and independent work:

'It helps me to stay focused because I have to turn my head to socialise with my friends and if I do that too much my neck will start to hurt so, it helps me stay focused because I look and the wall and don't get distracted.'

While the majority of students preferred to sit at tables with small groups of people that also allowed for independent work, some of the students also enjoyed working with peers to support their concentration as it meant they could maintain engagement with their tasks: 'I can discuss if I am not sure of something and it helps me get my work done on time.'

Comfort and safety was the second most frequent reason given for how furniture supports learning. Similar to the comments given previously, comfort was associated with better concentration: 'I'm comfortable and focused.' Comments coded under comfort and safety included having choice to adjust position on the item, 'Because it is comfortable and I can sit however I like' and support given by the item, 'the cushioning is great.' Again, the majority of comments were related to soft seating which was anticipated due to the prevalence of soft seats in the item selection question. In term 4, direct comparisons were made between soft seats and the more traditional chairs provided in the 'traditional' furniture arrangements: 'Yes, because it is more comfortable than a hard plastic chair.' Safety was added to this theme because some students (approximately 1%) identified it specifically: 'By making me feel safe and secure' (in relation to a floor cushion at a low table) and 'You feel like you're very safe!' (in relation to an ottoman against a wall, with the student working on a table). It is important to note that students identified a wide range of furniture options as making them feel comfortable and safe, providing evidence that students need diverse furniture options in the classroom to meet their individual needs.

The ability to see the whiteboard or smartboard was raised in 13% of responses. Seeing the 'board' was identified as critical to engaging in school work, and furniture assisted this in a range of ways. The majority of annotations in this theme were linked to working at high tables: 'The tall desk helps me learn more effectively by all of us being able to see the board and none of us need to move or shift or turn around to see it.' High desks also gave better sight lines: 'I like the height of the desk so you can see over people to look at the board.' Other students identified the arrangement of furniture in the classroom (as opposed to the item itself): 'It helps me learn because I don't need to turn my head to the whiteboard and its very comfortable.'

The amount of working space and/or storage space was the fourth most prevalent category, accounting for 9% of the overall responses. Storage was listed more prominently in term 4, after students had worked in traditional spaces. Students appreciated keeping working spaces clear, typified by annotations such as, 'it has good space to keep all your books so you have more space to work.' These comments were often connected to keeping their possessions safe: 'I can work knowing that my stuff won't fall off the desk.' It was also important to have enough space on a working surface for collaborative tasks or when working at the same table with peers: 'there is enough room for everyone's work.'


Punctuation
I am for ending.
I am for yelling.
I am for talking.
I am for resting.
I am for asking.

Question 2: Do teaching styles (pedagogies) change with differing furniture arrangements?

Teacher observation data

This question was addressed by the repeated measures teacher observations, which provided direct objective measures of what was seen to occur in the classrooms. The once-a-term teacher interviews unpacked these observations, and the Teacher Mind Frames survey provided a measure of participants' attitudes to teaching.

A total of 23 observations were conducted in the intervention group while in flexible furniture classrooms, and nine observations were conducted with traditional furniture arrangements. The figures below show the average amount of time (as a percentage) teachers spent: in more teacher or student focus modes, using a range of pedagogical styles, conducting learning activities in various sized groups, and using a range of activity types to support student learning.

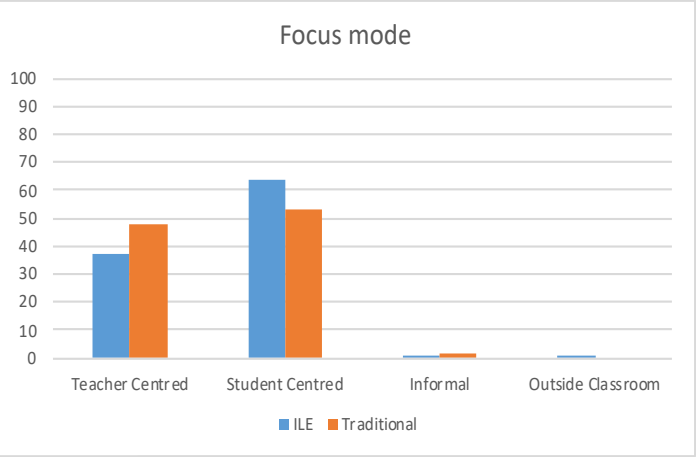


Figure 6. Comparison of mean times for focus mode in flexible and traditional furniture arrangements

Figure 6 shows that teachers spend more time conducting learning that was student-centred when they have flexible furniture arrangements, and more time in a teacher-centred approaches when teaching with traditional classroom furniture.

A Mann-Whitney U test, which compares the difference between groups, was conducted to see if the amount of time in a teacher-centred mode was statistically different when teachers worked in flexible compared to traditional furniture arrangements. The result showed a significant difference at the .05 level (ILE: *Mean Rank* = 14.74, $n = 23$; Traditional: *Mean Rank* = 21.00, $n = 9$), $U = 63.00$, $z = -1.70$, $p < .05$, providing evidence that teachers spend more time in a teacher-centred mode when working with traditional furniture.

As anticipated, a significant result was also returned when examining the student-centred mode, with clear evidence that teachers conduct more student-centred learning experiences when they are working in classrooms with more flexible furniture arrangements (ILE: *Mean Rank* = 18.35, $n = 23$; Traditional: *Mean Rank* = 11.78, $n = 9$), $U = 61.00$, $z = -1.78$, $p < .05$.

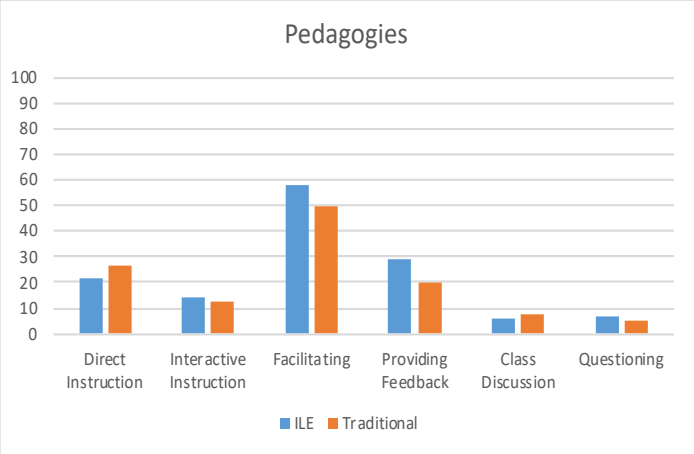


Figure 7. Comparison of mean times for teacher pedagogies in flexible and traditional furniture arrangements

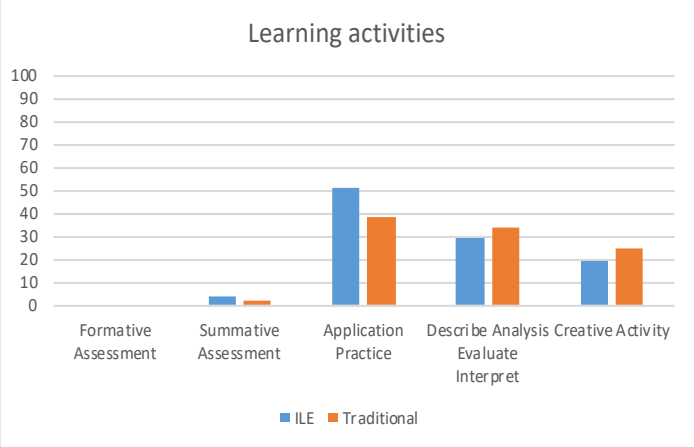


Figure 8. Comparison of mean times for learning activities in flexible and traditional furniture arrangements

Figure 7 shows mean scores for a range of teacher pedagogical strategies used across both flexible and traditional furniture arrangements. Visually, the data show that teachers spend more time using direct instruction and class discussion when working with traditional furniture, but there is not enough evidence at this stage to show any statistically significant difference for these indicators. Similarly, there is not enough evidence to show a statistical difference for the increase in interactive instruction, feedback and questioning when teaching with flexible furniture despite the mean scores indicating that this is the case. This was also the case for 'facilitating', even though the mean ranks showed a much higher count when teachers were working with flexible furniture arrangements (ILE: *Mean Rank* = 17.74, n = 23; Traditional: *Mean Rank* = 13.33, n = 9), U = 75.00, z = -1.20, p = .123.

Figure 8 describes the frequency of learning activities conducted using both flexible and traditional furniture arrangements. Similar to pedagogies, no statistically significant differences were found between these categories based on the current data set. However, the count showed a clear trend towards implementing more activities based on application or practice when in teachers were in classrooms with flexible furniture (ILE: *Mean Rank* = 17.57, n = 23; Traditional: *Mean Rank* = 13.78, n = 9), U = 79.00, z = -1.03, p = .157. It is interesting to note that creative activities were given more time in the traditional furniture terms; this requires further investigation.

Figure 9 describes the learning communities observed during the observations. While a similar percentage of time was spent doing individual or mixed group work, there was more time spent in small groups when using flexible spaces and more time spent in whole class activities when using more traditional furniture. While these changes are not yet statistically significant (eg. Whole class ILE: *Mean Rank* = 14.87, *n* = 23; Traditional: *Mean Rank* = 20.67, *n* = 9; *U* = 66.00, *z* = -1.57, *p* = .061) this is likely due to the number of observations conducted. This strong visual trend requires further investigation.

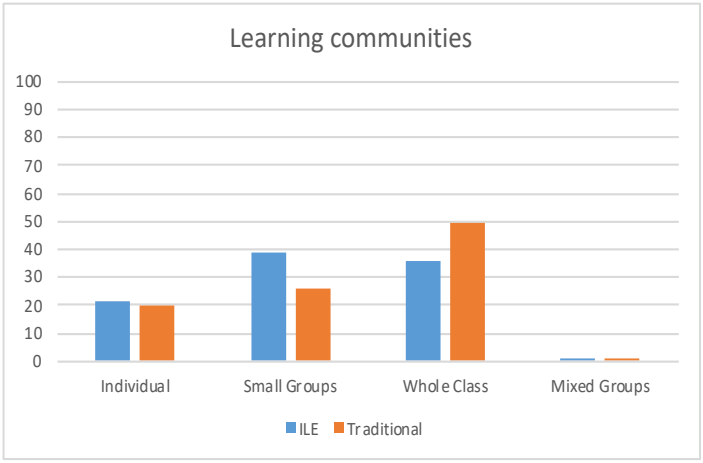


Figure 9. Comparison of mean times for learning communities in flexible and traditional furniture arrangements

Teacher Mind Frame survey data

While the observation data provided a clear overview of the types of classroom learning activities and practices that were being conducted in each space, it did not provide a measure of how teachers felt they were performing using the differing furniture arrangements. Consequently, the Teacher Mind Frame (TMF) survey was conducted once a term to measure the incidence of 'high impact' teaching strategies and an interview was conducted after each furniture change to gather qualitative data. Table 2 shows mean scores for each teacher on the TMF survey across the three intervention terms.

The data for each of the four intervention room teachers showed that their overall scores on the Teacher Mind Frame survey generally increased when they were teaching with flexible furniture. This was most evident for teachers 1 and 4, although teacher 2 also showed a significant decrease in their overall score after teaching with traditional furniture in term 3. Teacher 3's overall score remained relatively consistent regardless of furniture arrangement.

These data were also examined for changes in each of the eight mind frames measured by the survey (shown in Table 3).

Table 2. Teacher Mind Frames Scores across Terms 2-4[1] [2]

Teacher	Term 2 (Flexible)	Term 3 (Traditional)	Term 4 (Flexible)
1	152	120	151
2	165	148	150
3	165	166	162
4	173	154	169

1 Note: to protect anonymity, the 'reverse intervention' teacher's data has been recoded to align with the other intervention teachers. However, the differences in scores has been maintained to preserve the validity of the data.

2 The maximum score on the survey is a total of 204.

Table 3. Mean Scores for Teacher Mind Frames

Teacher Mind Frames	Flexible Furniture		Traditional Furniture	
	Mean	Standard Deviation	Mean	Standard Deviation
I focus on learning and the language of learning	18.14	2.340	18.57	3.155
I see assessment as informing my impact and next steps	22.14	2.478	24.00	2.944
I build relationships and trust	18.00	1.633	15.57	2.507
I engage as much in dialogue as monologue	20.57	.787	19.71	3.147
I am an evaluator of my impact	17.71	1.976	18.00	3.559
I am a change agent	18.57	2.878	20.14	2.795
I collaborate with my peers	19.00	1.732	18.57	3.155
I give and help students understand feedback	25.57	3.690	24.71	2.215

The only statistically significant change was for 'I build relationships and trust', which was higher when teachers were working with flexible furniture arrangements (ILE: *Mean Rank* = 9.64, n = 7; Traditional: *Mean Rank* = 5.36, n = 7), U = 9.50, z = -1.94, p = .05. This was anticipated due to the wide range of teachers' scores, indicated by the large standard deviation scores reported in Table 3.

Teacher interview data

The end-of-term teacher interviews asked for participants' perceptions of the following domains, all relevant to the just-completed term: (1) how they felt they taught; (2) their perceptions of their students' behavioural, cognitive and emotional engagement; and (3) how they manipulated their furniture.

An annotated analysis of recorded data was conducted of the 15 structured interviews. There were no noteworthy aberrant opinions, the data showing consistency of teacher comments. Not uncommonly for structured interviews about teaching and learning issues, as the interviews proceeded the responses often conflated the three sets of questions. The following themes of responses emerged.

There was overall consistency in terms of covering required curricular content. All teachers expressed the opinion they covered the required material well during each term, regardless of the furniture arrangement. However, some between-term variations on this were expressed – again, consistently across all teachers – most often a product of school-wide projects implemented in 2019. For example, these included the piloting of an inquiry learning model in term 3, and the running of an exposition related to the inquiry projects in term 4. These required some adaption of teaching approaches due to specialist material that needed to be introduced, but each teacher felt this was done expeditiously.

There were comments that the intervention furniture arrangement hindered teaching efficiency. Regarding impact of furniture on achieving content, responses ranged from a low number of indifferent judgements,

'I don't think (the furniture) made a lot of difference, the kids work well regardless.'

to a more common perception that,

'…the flexible furniture allowed me to teach more flexibly, aligning student-to-student, making groups to suit tasks, that sort of thing.'

And,

'The kids worked more efficiently when they had choice where to work, who to work with … That made my teaching easier, I could use my time to engage with the students, not me pushing content down their throat from the front of the room.'

Consistent observations were made about teaching workload in flexible versus traditional furniture arrangements, with the observation that the latter placed a greater burden on the teacher:

'It was a lot more work for me. I had to prepare for one-on-one instruction, I couldn't use the students' peer feedback with each other to facilitate, spur on learning.'

And,

'Preparation had to be more specific. I noticed a quite different type of learning from the students, more process and skills, less self-direction, focus, motivation.'

The observation was made that the more traditional furniture arrangement forced the teacher to teach in a particular way (*'I taught content rather than facilitated learning'*) and students to work in particular way (*'They were focused, engaged, but on content, not on why they were learning it …'*).

This drew the observation that the teaching/ learning style 'dictated' by the traditional arrangement,

'… might be more efficient in terms of covering content – skills and processes. But at what cost? The students worked individually, losing the effectiveness of social skills development, collaboration … so they lost a lot as well.'

A repeated comment was that challenges were limited; the students in the school present few behavioural problems. Also, the school supports teachers well through the specialist approaches mentioned. Both of these factors reduced teaching challenges during the project. However, each teacher commented on the way the intervention created another layer of challenge for them. Many had taught in their 'A' configuration for many years; the change created a professional challenge in terms of re-orienting their teaching style: *'It was hard to adjust, and the big change did cause disruptions.'* This was the case for all the intervention teachers, regardless if they moved from traditional, to innovative or the opposite, in term 3: *'I had to rethink how I taught. It was very different.'* Similarly, each teacher commented that students were equally familiar with the 'A' set up, and there was a consistent need to support students' adaptation to the quite different spatial arrangements: *'I had to rethink what parameters I needed to set for the students, what rules for furniture use I had to put into place.'* Students missed the familiarity of the 'A' configuration, but quickly adapted. There were a number of comments expressed that provided evidence this change was harder for students going from more innovative furniture arrangements to the traditional, as comparted to the reverse.

Each teacher expressed having low- to mid-level pedagogic difficulties with changes in furniture during the 'intervention' term; this was not as extensive for the 'reverse' participant (traditional to innovative to traditional). Those innovative-to-traditional difficulties are summarised in teacher comments such as:

'The more traditional room increased my workload … I lost the efficiency of students working collaboratively …'

'I had to learn to not move, to feed information to my students.'

'Students had to learn to not move, to rely only on the colleagues close by.'

'It changed the way they learned. It may have improved content knowledge, but decreased the ability to engage in active learning strategies … they were fed information.'

A result of the traditional seating arrangement was a reduction of student capacity to form groups to work on projects. Another workload challenge during the intervention for some teachers was a need for more preparation:

'I found I had to do more work to prepare individual students to work … this was different, because in the other space the students would problem solve this between each other …'

Commonalities were evident in terms of how furniture was manipulated:

- Teachers tended to keep the overall arrangement intact during each term.
- In the innovative, flexible furniture spaces, it was common for changes to be made during lessons to suit particular needs but were mostly returned at the end of that day/focus.
- Changes were made for the primary purpose of improving student learning, as opposed to adjusting to suit a teacher's pedagogy.
- The 'traditional' setting was consistently seen as 'filling' the space, thus not allowing any modification.

In summary, during the intervention all teachers expressed disruption to established teaching patterns, and noticed changes in how students learned. The difficulties (and disadvantages) teachers experienced appeared greater for those going from innovative to traditional arrangements. The change created additional workload for teachers; it was apparent they undertook to minimise the impact of the change on students by consciously adapting teaching approaches and re-designing learning activities. A consistent theme was significant student agency in using furniture as part of their learning; during the intervention, students and teachers noted a reduction in opportunities to do this when moving to a traditional setting – the opposite was noted for the students moving to an innovative setting.

What does this mean?

Phase One has found that teachers do change pedagogies in various ways according to furniture arrangements, but with a one-term intervention students at this school do not change in terms of their perceptions of their cognitive or behavioural engagement.

The findings show:

- Students have what we might call 'resilient engagement' with their learning. By this, we mean that instructional policies initiated by the school over time, and teachers' response to those policies in terms of practice, result in a high level of sustained engagement by students. This is so embedded and effective, it is argued that the intervention for one term (changes to furniture) makes little difference to that engagement.
- Despite this, 93% of students feel furniture does have an impact on their overall learning.
- A range of furniture options in each classroom are important as students are actively selecting furniture to accommodate their individual physical and/or learning needs, with comfort and flexibility being two critical characteristics for selection of furniture by students.

93%

of students feel furniture impacts their learning

In relation to changes in teachers' pedagogies:

- While students at the school are highly engaged in both settings, teachers actively increase their workload to maintain student engagement in the 'alternative' furniture setting. The intervention term requires considerable re-thinking by them in order to continue the high level of instruction they expected of themselves. Ironically, for the project this 'change' in order to maintain levels/ quality of practice contributed to students' perceptions they remained engaged when working in a different furniture arrangement.
- Teachers 'carry the load' of inflexible furniture arrangements. They are required to work harder in traditional arrangements in order to maintain quality learning and student engagement. This carries a teacher well-being cost – overall they feel less effective, they are required to teach in ways they feel are 'not them', and they feel compelled to structure lessons in ways they believe are not as advantageous to the students as they would be in a more flexible setting.
- Teacher pedagogies are more student-centred when they are working with flexible furniture arrangements, and more teacher-centred when traditional groups of desks and chairs are installed. This difference is statistically significant within this sample, showing a clear difference based on the furniture provisions (given the controlled nature of other variables in the Single Subject Research Design A-B-A protocol).
- Teachers generally feel they have more impact and find it easier to build relationships and trust with their students when working with flexible furniture arrangements. They have to manage more relationship issues in their 'alternative' arrangement, as a result of helping students to adapt to the new setting.

Teachers workloads are negatively affected by inflexible furniture arrangements

What will we do next?

The 'no-result' findings from the intervention in terms of student engagement surprised the school's Spatial Learning Team and the university research team. It warrants, we all believe, more research to unpack what is actually happening. One explanation is given in this report (that the one-term intervention was not enough to disrupt the generally high levels of student engagement built over time; and that during the intervention teachers altered their pedagogy to maintain high engagement levels), but still leaves questions regarding the nature of student engagement in the school, and how furniture impacts those more nuanced activities by students.

In December 2019 the ECU/University of Melbourne research team met with the Vasse Spatial Learning team to discuss Phase Two activities. In January 2020 the university researchers workshopped the following research protocol.

Phase Two (2020-2021)

Two questions emerged from Phase One:

- What is the actual nature of students' engagement? And are the qualities of this engagement in line with the school's vision? In particular, the Spatial Learning Team seek to know if students are confident to take risks in their learning (not 'being safe' or 'taking the easy option'); if they approach learning in ways that encourage creative problem-solving; if they feel supported by peers and groups to improve their learning.
- Will teaching practices show the same trends when an inquiry-based learning model is applied across the whole school in 2020?

These questions lead us to use Phase Two to 'dig into' the construct of student engagement, and as a specific focus, the role furniture plays in this. Therefore, the questions that emerge are;

- Do these types of furniture impact risk-taking in learning?
- Do these types of furniture impact peer support in learning?
- Do these types of furniture impact creative thinking in learning?

As a matter of interest, and perhaps a useful framework for analysis and reporting, is that these issues loosely fall under the umbrella of 21st century learning skills (the 4Cs of collaboration, critical thinking, creativity, and communication).

It is proposed that Phase Two will replicate the Phase One research protocol, with the following adjustments;

1. To redesign the student survey to omit behavioural and cognitive engagement as dependent variables;
2. To include the three dependent variables of risk-taking, peer support for learning and creative thinking as a new measurement of student engagement in learning;
3. To reduce incidence of two measures:
   a. Student photo elicitation be reduced to once a term,
   b. Teacher mind frame survey reduced to a pre- and post-phase comparison;
4. To include three teacher-centred and three student-centred lessons for each class in the baseline phase (across terms 1 and 2) to allow for more reliable comparison to term 3 and 4 activities in the new inquiry learning model;
5. To use a flexible furniture control group; and
6. To 'partner' teacher participants to minimise furniture resourcing issues.

Research protocol

The change in dependent variable for student engagement requires a new type of measure, as the new constructs are all affective domain variables. Illustrated in Figure 10, this tool will address three dependent variables; risk taking, creative thinking, and peer support. It will manipulate the following variable to seek changes in those measures - furniture. The dependent variables carry some antecedent variables; established student practices in ILEs, student learning pre-dispositions in ILEs, established ILE and traditional furniture arrangements, and the school's overarching vision for learning. They also carry classroom culture and inquiry learning intervening variables.

The Phase One teacher pedagogies data collection will remain the same in 2020. This is to explore if the current trends in pedagogy when comparing the two furniture arrangements (flexible and traditional) remain the same when the new whole-school inquiry learning model is introduced in the 2020 school year.

Consequently, the dependent variable for teachers will remain as pedagogy, but this is affected by the intervening variable of teachers' pre-dispositions to working with particular furniture arrangements and their existing expertise in ILE spaces.

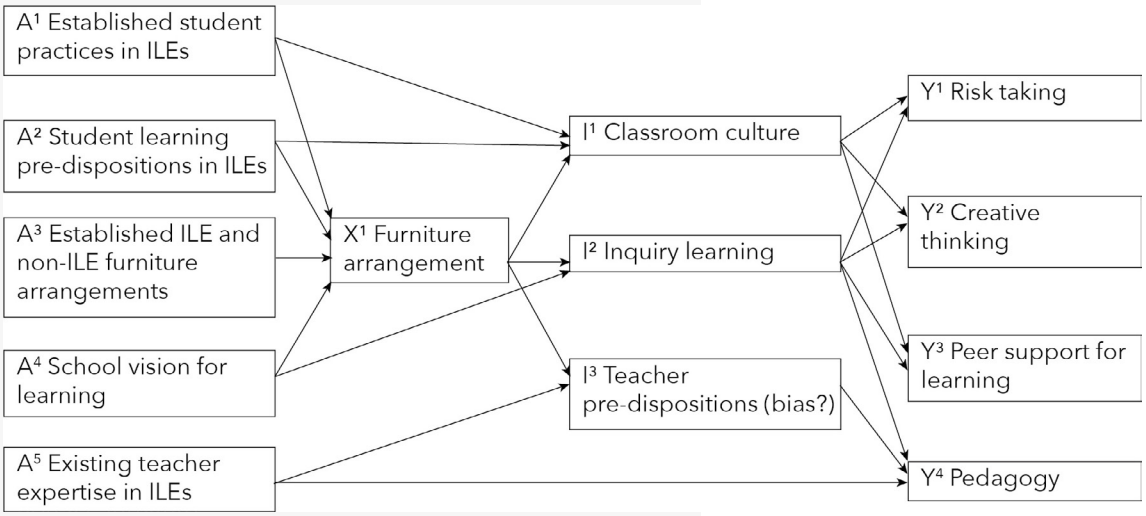


Figure 10. Mapping of variables for Phase Two (Y designates dependent variables, I intervening variables, X independent variable/s, and A antecedent variables)

An overview of the types and frequency of data collection are detailed in Table 4 below.

Table 4. Data collection frequencies comparing Phase One to Phase Two

Data Source	2019	2020
Student photo elicitation	3 x term	1 x term, in ILE only
Student survey	3 x term	3 x term
Teacher Mind Frame survey	1 x term	Pre- and post-Phase Two
Teacher observation metric	3 x term	6 x term 1 and 2 in total; 3 x terms 3 and 4 each
Teacher interview	1 x term	1 x term

These frequencies result in an adjusted timeline for Phase Two, shown below.

Implementation of this revised research plan is dependent on an amendment to relevant university ethics, permission from the school, and permission from the WA Education Department.

Table 5. Timeline of Data Collection for Phase Two

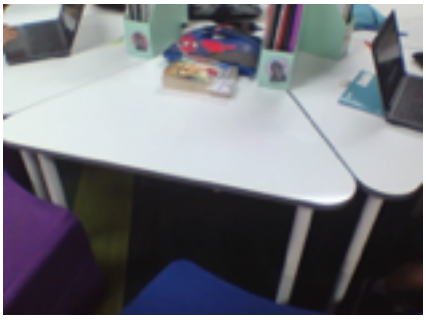
Term	Intervention Rooms		Control Room	
	Time	Data Collection	Time	Data Collection
1	Early	Survey pilot	Early	Survey pilot
		Teacher observation		Teacher observation
		Teacher mind frame survey		Teacher mind frame survey
	Mid	Student survey	Mid	Student survey
		Teacher observation		Teacher observation
		Photo elicitation		
	Late	Student survey	Late	Student survey
		Teacher observation		Teacher observation
		Teacher interview		Teacher interview
2	Early	Student survey	Early	Student survey
		Teacher observation		Teacher observation
	Mid	Student survey	Mid	Student survey
		Teacher observation		Teacher observation
		Photo elicitation		
	Late	Student survey	Late	Student survey
		Teacher observation		Teacher observation
		Teacher interview		Teacher interview

Term	Intervention Rooms		Control Room	
	Time	Data Collection	Time	Data Collection
3	Early	Survey pilot	Early	Survey pilot
		Teacher observation		Teacher observation
		Teacher mind frame survey		Teacher mind frame survey
	Mid	Student survey	Mid	Student survey
		Teacher observation		Teacher observation
		Photo elicitation		
	Late	Student survey	Late	Student survey
		Teacher observation		Teacher observation
		Teacher interview		Teacher interview
4	Early	Student survey	Early	Student survey
		Teacher observation		Teacher observation
	Mid	Student survey	Mid	Student survey
		Teacher observation		Teacher observation
		Photo elicitation		
	Late	Student survey	Late	Student survey
		Teacher observation		Teacher observation
		Teacher mind frame survey		Teacher mind frame survey
		Teacher interview		Teacher interview

Appendix A: Photographic examples of furniture items taken by participating students

High table with adjustable stools

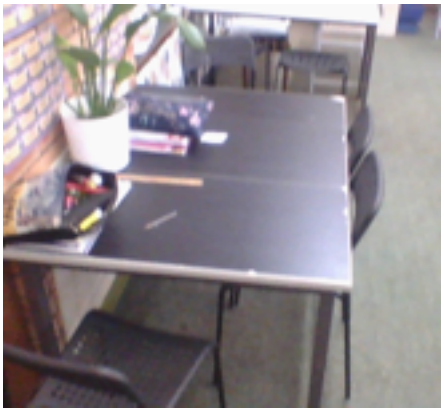
Circular table



Equilateral table with soft seating

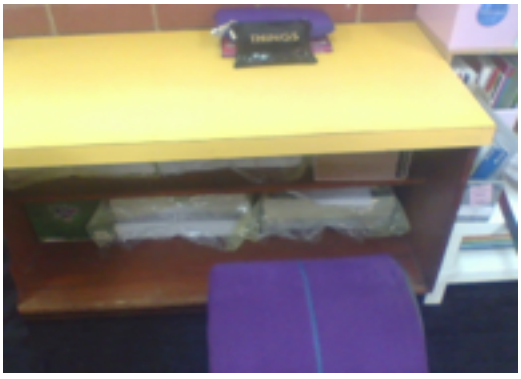
Ottomans and soft seating

Rectangular table with soft seating

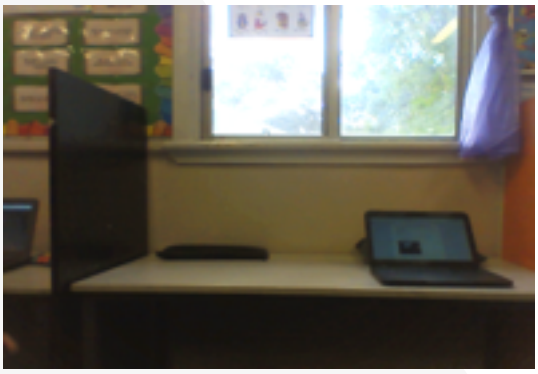


Traditional table and chairs

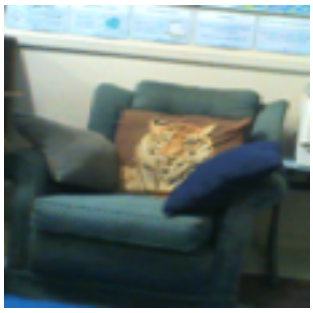
Wobble stool



Wide desk or bench

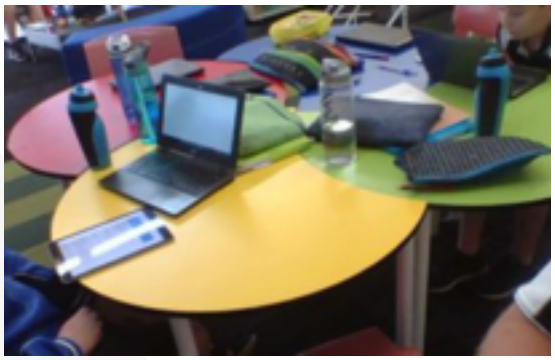


Carrel desk



Armchairs

Equilateral table with hard seating



Interlocking desks

Padded caddy
(left: detail; right: as a seat at an equilateral table)

Fitball

Appendix B: Codes for furniture characteristics

Code	Definition
Comfort	Item supports student comfort or helps them to feel physically relaxed while learning.
Flexibility	Item allows for flexible ways of working; for example, the ability to sit or stand, or to adjust seat height.
Height	Item is high off the ground; for example, high tables or stools.
Movement	Item allows the student to move while working on or at it; for example, wobble stools and fitballs.
Colour	Item is bright and colourful.
Portable	Item can be easily moved around the learning environment.
Writeable surface	The working surface of the item can be drawn on; for example, whiteboard surface on desks.
Cave	Item allows student to feel like they are in a cave environment; for example, working under a table where there is less light and a cosy space.
Storage	Item allows student to store their possessions through trays or shelves.
Fun	Students perceive the item allows them to have fun while learning; often this was associated with movement.

Appendix C: Codes for students' perceived benefits from their chosen furniture item

Code	Definition
Aids concentration	Supports students' concentration on their own work by minimising distractions from peers or the surrounding environment.
Supports comfort and safety	Supports students to feel comfortable or relaxed while learning. Refers to both physical comfort but also emotional security.
Able to see the board	Location or physical characteristics of the item allow students good sight lines to the board or teacher's working space.
Reasonable amount of working space and/or storage space	Students have adequate room to spread their work out on a surface without disrupting others. This includes having storage for pencil cases or other items so they don't minimise available working space.
Proximity to peers	Supports students to be physically closer to peers, regardless of whether they are working collaboratively or independently.
No benefit listed	Student perceived no benefit from furniture in the classroom.
Allows students to focus on teacher	Supports students to see, hear or track teachers within the learning environment.
Good surface quality to work on	Supports students to work more easily with both traditional and digital technologies.
Accommodates own learning needs	Supports students to manage their individual needs; for example, accommodating back pain through seat selection, height through settings that don't cramp students, or using portable furniture to get closer to whiteboards to accommodate vision impairment.

Code	Definition
Accommodates own learning needs	Supports students to manage their individual needs; for example, accommodating back pain through seat selection, height through settings that don't cramp students, or using portable furniture to get closer to whiteboards to accommodate vision impairment.
Allows personal space	Supports independent learning by allowing students to move away from groups and have adequate space to work on their own.
Allows user movement	Supports students to physically move while they are learning; for example, wobbling on a stool or bouncing on an ottoman.
Proximity to 'front' of classroom	Item supports learning by its position in the learning environment, namely, being close to the students' perceived 'front' of the classroom.
Encourages self-management of behaviour	Supports students to manage their own behavioural needs; including physical needs (often movement) or intellectual needs (often minimising distraction through relaxed colours or limiting their view of the whole learning environment by facing walls).
Supports collaboration	Supports students to work collaboratively with their peers.
Good view	Supports students' learning needs (view of teacher, peers, resources) or mental health (view out a window) by providing visual access to desired stimuli.
Supports student mindfulness	Supports students to be more aware of their engagement in their immediate learning experience.
Proximity to ICT or required resources	Item supports learning by its position in the learning environment, namely, being close to charging points for digital devices, bookshelves for print resources and proximity to other resources like word walls.