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

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Activity Report Phase Two

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

2021

Plans to Pedagogy: Vasse Primary School

beparta™

Vasse Primary School
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Executive Summary

Phase Two of this project, conducted during the 2021 academic year, repeated an A-B-A withdrawal design to rotate (across terms 2, 3, and 4) the furniture in 4 primary school classrooms from innovative to traditional furniture arrangements[1] A fifth classroom with innovative furniture was used as a control. Three-weekly repeated measures were taken across the terms of: (1) characteristics impact students' engagement, namely creative thinking, peer support and risk taking, (2) teachers' observed actions in their classrooms, and (3) photographs by students of their preferred furniture item/s, with annotations explaining this preference. Once-a-term measures included (4) structured teacher interviews to unpack observation data, and pre-post measures included (5) a Teacher Mind Frame survey to explore teachers' judgements of their impact.

The aim of this phase of the study was to dive deeper into students' engagement, which was consistently high across Phase One of the study in 2019. Specifically, the school wanted to know what characteristics were impacting engagement, with a focus on how creative thinking, peer support for learning and risk taking changed between flexible and traditional furniture arrangements. A second aim was to determine if any changes to teacher pedagogies was seen between the differing furniture arrangements, and if trends identified in teachers' pedagogies in Phase One were consistent across Phase Two.

Statistical, visual and thematical analyses were applied to broadly examine the data. In summary, Phase Two of the study found that:
- When asked to rate how furniture assisted their learning, there is a statistically significant difference that shows students feel flexible furniture more positively impacts their ability to take risks, support peers, and be creative.
- Regardless of engagement levels, 97% of students feel furniture impacts their learning.

- Teachers alter how they teach according to the furniture arrangement, with more student-centred approaches being used in flexible or innovative furniture arrangements.
- Teacher-centred approaches increase in traditional arrangements.
- Teachers' interviews showed they can teach 'efficiently' in traditional spaces, but they feel students are less engaged in these spaces.

The Phase Two data indicate that flexible furniture enhances teaching and learning. Innovative arrangements support students' ability to engage in learning in the way that is desired by the inquiry-based, student-centred model of learning at Vasse Primary. Teachers are able to teach in a way that is more aligned with the inquiry model when working in flexible furniture arrangements. This Phase of the study, coupled with the Phase One findings, gives robust data to identify that furniture plays a role in enhancing teaching and engagement in learning.

* National measures to combat the COVID pandemic closed schools and cancelled researcher travel and accessibility to Western Australian schools for all of 2020. It significantly limited access during 2021, and the school's post-pandemic restructuring needs were understandably their priority into 2022. As a result, Phase 2, scheduled for 2020, required more than two years to complete, thus this report's issuing date in early 2023.

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1   Innovative furniture arrangements were characterised by multiple styles of tables and seats, storage solutions and other portable items, 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.

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

To reiterate from the Phase 1 report, Vasse Primary School, working with Beparta™, has consistently reflected on the alignment of engagement and furniture. Their experimentation with teacher and student use of furniture over several years created a need for evidence to support their belief this was having a positive effect on student engagement. The resulting research hosted by Edith Cowan University in collaboration with The University of Melbourne[1] has been driven by two 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?*

This Activity Report summarises findings from the second of three Phases of this research. The first (see Morris & Imms, 2019) established the nature of the relationship between the school's furniture, student engagement and teacher pedagogies. Phase 2, the focus of this report, explores nuances of those findings. Phase 3 will be determined by the school's spatial learning team, but will leverage these findings back into teacher practice at Vasse in a very practical way.

What were we trying to do?

The first year of the study found that students' behavioural and cognitive engagement remained high during the year, regardless of the furniture in their classroom. However, teachers were forced to work noticeably harder to maintain that level of engagement when using (what they decided were) traditional furniture arrangements.

The second year of the study sought to understand the nature of students' engagement. Based on qualitative data from this study and other anecdotal evidence, the school's spatial learning team decided three key characteristics of engagement should be explored in relation to furniture arrangements:

1. Creative thinking: Do students approach learning in ways that encourage creative problem-solving?
2. Peer support for learning: Do students feel supported by peers and groups in their learning?
3. Risk taking: Are students confident to take risks in their learning (i.e., to not be 'safe' or take the easy option)?

How did we do it?

Based on the shift in focus for measuring engagement, a new student engagement survey was designed around the three target characteristics. The new survey focussed on these three areas using items adapted from existing instrumentation, but also asked some specific questions about furniture in relation to these areas (e.g., 'the furniture in my classroom helps me to work effectively with other students' to explore furniture and peer support). It also asked students to respond to one generic statement: The furniture in my classroom supports my learning. The survey mapping is shown in Table 1. The other student measure, photographs with annotation, remained the same[1].

Based on emerging trends from the 2019 data, the teacher data collection also remained the same in 2021 (repeated measures observations, the Teacher Mind Frames Survey, and the teacher interviews). There were two changes, however. In 2019, teachers completed the Teacher Mind Frames Survey each term. For 2021 it was decided a pre-post approach (that is, only two measures) would minimise interruption to heavy workloads.

The teacher interview questions remained the same except for the 'engagement' items. The school's spatial learning team felt a sound general understanding of their students' engagement was built in 2019. As 2021 focused on nuances of that engagement, this required the re-working of the engagement-focus teacher interview questions. A mapping of the 2019 and 2021 interview questions is provided in Table 2.

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1   The measures that remain consistent can be found in Appendix A.

Table 1. Survey mapping for 2021 student survey

Survey dimension	Original survey attribution	Adapted version for student survey
Creative thinking	Research team developed based on Ovbiagbonhia, Kollöffel & den Brok's (2019)[1] work on creative self-efficacy and innovation competence	1. I keep an open mind when learning 2. I enjoy thinking about complex problems 3. I like to come up with new or different solutions to a problem, not just the obvious answer 4. I enjoy it when learning challenges my thinking 5. I can easily connect different ideas when learning
Peer support for learning	Direct from Carter et al, (2012)[2] in a validated Student Engagement Instrument - Elementary tool	1. Other students care about me 2. Students at my school are there for me when I need them 3. Other students like me the way I am 4. I enjoy talking to students here 5. Students here respect what I have to say 6. I have friends at school
Risk taking	Adapted from Chell & Athayde's (2009)[3] risk propensity scale in the Youth Innovation Skills Measurement Tool as the original scale is for adolescents	1. When I make choices I want to be as sure as possible what the consequences will be for me 2. I want my school work to provide me with chances to show that I can overcome problems 3. I would not take a risk on a class activity if it would spoil my chances of getting good grades at school 4. I am afraid of failing at tests or assessments
Furniture and learning	Research team developed specifically for this project	1. The furniture in my classroom helps me to work with other students (peer support) 2. The furniture in my classroom makes me feel isolated or lonely (peer support) 3. The furniture in my classroom gives me space to solve complex problems (creative thinking) 4. The furniture in my classroom supports me to be creative (creative thinking) 5. The furniture in my classroom helps me to solve problems outside my comfort zone (risk taking) 6. The furniture in my classroom helps me to try a range of solutions when working out problems (risk taking) 7. The furniture in my classroom supports my learning (general)

1   Ovbiagbonhia, A. R., Kollöffel, B. & den Brok, P. (2019). Educating for innovation: Students' perceptions of the learning environment and their own innovative competence. *Learning Environments Research, 22,* 387-407.

2   Carter, C., Reschly, A. L., Lovelace, M. D., Appleton, J. J., & Thompson, D. (2012) Measuring student engagement among elementary students: Pilot of the Elementary Student Engagement Instrument. School Psychology Quarterly, 27, 61–73.

3   Chell, E. & Athayde, R. (2009). The identification and measurement of innovative characteristics in young people: Development of the youth innovation skills measurement tool. National Endowment for Science, Technology and the Arts.

Table 2. Teacher interview questions, 2019 and 2021 (condensed)

Interview dimension	Phase 1 question/s	Phase 2 question/s
Perceptions of my teaching	What do you feel you did well? What were the challenges? Do you feel you did all you wanted to, or needed to?	Repeated
Perceptions of student engagement	*Student behaviour* Were your students… a. On task? b. Settled or disruptive? *Thinking and learning* a. Were your students focused? b. Did effective learning happen? *Emotional characteristics* Were your students…. a. Generally happy? b. Balanced emotionally? c. Settled emotionally?	*Risk taking* Were your students… a. Taking risks in their learning? b. Letting assessment drive choices? *Creative thinking* Were your students… a. Looking for different solutions? b. Enjoying challenges of complex problems? *Peer support* Were your students… a. Settled as a group? b. Co-operating in learning?
Furniture	Did you make any changes to the furniture? Were any changes intentional? Did the furniture assist or detract from your teaching? Did the furniture assist or detract from student learning?	Repeated

Figure 1. Examples of a traditional (left) and flexible (right) furniture arrangement as defined by the school

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. Table 3 shows the difference in mean scores across students' experience when they changed furniture arrangements (note: the table includes only Years 5 and 6 data), with there being only slightly higher scores on all three scales in the flexible furniture arrangements. To confirm that none of the three scales experienced statistically significant change throughout the year, Wilcoxon signed ranks tests were conducted to compare responses to the survey between traditional and flexible furniture arrangements. These tests identified no significant statistical change.

Overall, students were most positive about having peer support for their learning, irrespective of the furniture in their classroom. In general, they felt they had good relationships with other students, they felt cared for and respected. Having a good peer network is essential to supporting the collaborative, inquiry-based learning approach being implemented by the school.

They were least comfortable with taking risks in their learning, irrespective of the furniture arrangement. However, responses to the survey suggested that flexible furniture assists students to take risks in their learning, with a mean score of 2.93 (SD = 1.05) in traditional arrangements and 3.97 (SD = .896) in flexible arrangements (Table 4).

Table 3. Range and mean scores for student scales across differing furniture arrangements

Scale	Furniture Arrangement	N	Minimum	Maximum	Mean	Standard Deviation
Creative thinking	Traditional	105	2	5	3.59	.730
	Flexible	230	1	5	3.61	.864
Peer support for learning	Traditional	106	1	5	4.06	.865
	Flexible	232	1	5	4.13	.838
Risk taking	Traditional	106	2	5	3.42	.550
	Flexible	232	2	5	3.47	.550

Table 4. Range and mean scores for student scales across differing furniture arrangements

Scale	Furniture Arrangement	N	Minimum	Maximum	Mean	Standard Deviation
Furniture to assist creative thinking	Traditional	105	1	5	3.15	1.17
	Flexible	229	1	5	4.21	.829
Furniture to assist peer support for learning	Traditional	105	1	5	3.33	1.12
	Flexible	230	2	5	4.36	.801
Furniture to assist risk taking	Traditional	105	1	5	2.93	.1.05
	Flexible	230	1	5	3.97	.896

Table 4 shows students' responses to the scales that ask specifically about furniture and the three characteristics of engagement that are the focus of this Phase. Students' responses to the items about how furniture assisted their learning showed they felt that flexible furniture was positively impacting their ability to take risks, support peers, and be creative.

Again, Wilcoxon signed ranks tests were conducted to explore statistical significance for the items related to furniture and learning. When responding to the items about furniture specifically, these tests showed significance. Specifically:

- The test showed a significant difference between traditional (mean rank = 44.82) and flexible (mean rank = 31.72) furniture on how furniture assists risk taking. It was statistically significant, T = 571.00, z = -5.44 (corrected for ties), N -Ties = 20, p < .001, two-tailed.

- The test showed a significant difference between traditional (mean rank = 28.73) and flexible (mean rank = 46.06) furniture on how furniture assists peer support for learning. It was statistically significant, T = 431.00, z = -6.232 (corrected for ties), N -Ties = 19, p < .001, two-tailed.

- The test showed a significant difference between traditional (mean rank = 31.72) and flexible (mean rank = 45.44) furniture on how furniture assists creative thinking. It was statistically significant, T = 571.00, z = -5.496 (corrected for ties), N -Ties = 20, p < .001, two-tailed.

As the Wilcoxon tests shown above suggested there may be a link between furniture and their learning, we also explore how the generic furniture item responses correlated with responses on the three scales. Spearman's rho correlation found:

- There was a positive but very weak correlation between 'The furniture in my classroom supports my learning' and risk taking, rs = .169, p < .01, two-tailed, N = 335.

- There was a positive but weak correlation between 'The furniture in my classroom supports my learning' and peer support for learning, rs = .339, p < .001, two-tailed, N = 335.

- There was a positive but weak correlation between 'The furniture in my classroom supports my learning' and creative thinking, rs = .304, p < .001, two-tailed, N = 335.

This analysis suggests while risk taking, peer support and creative thinking remain fairly consistent over time (and are likely influenced by other factors), students see furniture as playing a role in supporting how they engage in these behaviours in their learning.

Photo elicitation data

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.

The photo elicitation data confirmed Phase 1 results that students do actively select furniture based on their needs. Figure 2 shows the furniture items most frequently selected as students' favourite places to work.

Soft seating remained a favourite item, and was most commonly noted in the addition of office style chairs as one option for seating. Office chairs were frequently selected by students because

they have wheels, back support, and cushioned seats. High tables continued to be popular, as well as circular tables.

Equilateral tables were not as popular as they were in 2019, nor did we see the inclusion of wobble stools or padded caddies in the furniture selected by students. However, students enjoyed using wobble boards at the high tables in order 'to get any jitters out' and more frequently reported moving from sitting to standing at high tables.

Furniture choice

- High table with adjustable stool
- Circular table
- Ottomans and soft seating
- Traditional table and chairs
- Wide desk or bench
- Armchairs and couches
- Fitball or wobble board
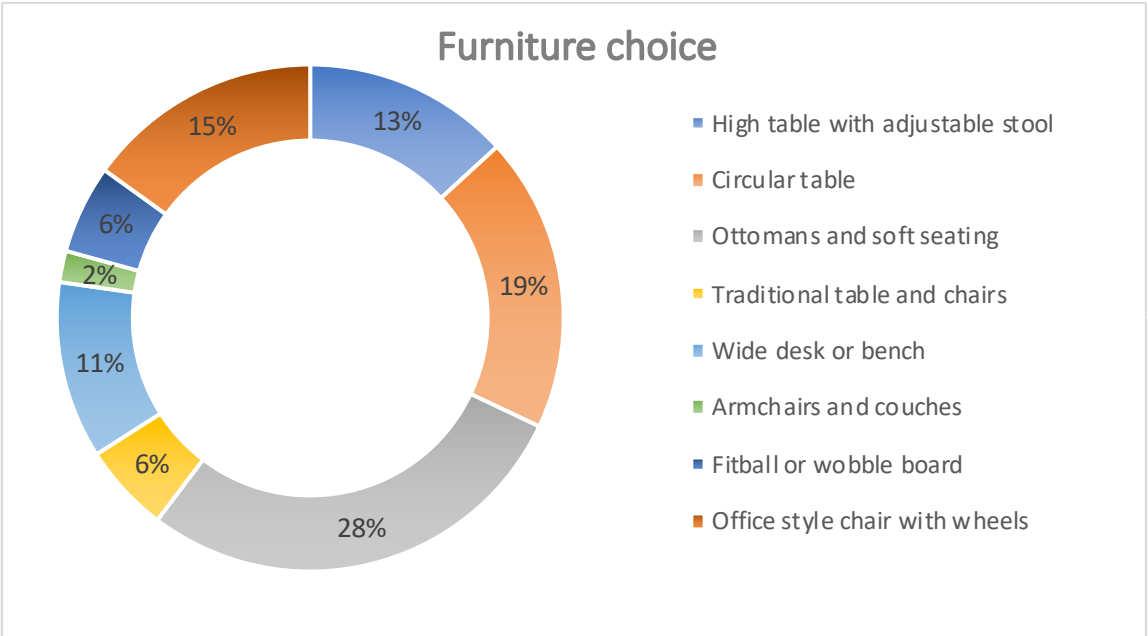- Office style chair with wheels

13%, 19%, 28%, 6%, 11%, 2%, 6%, 15%

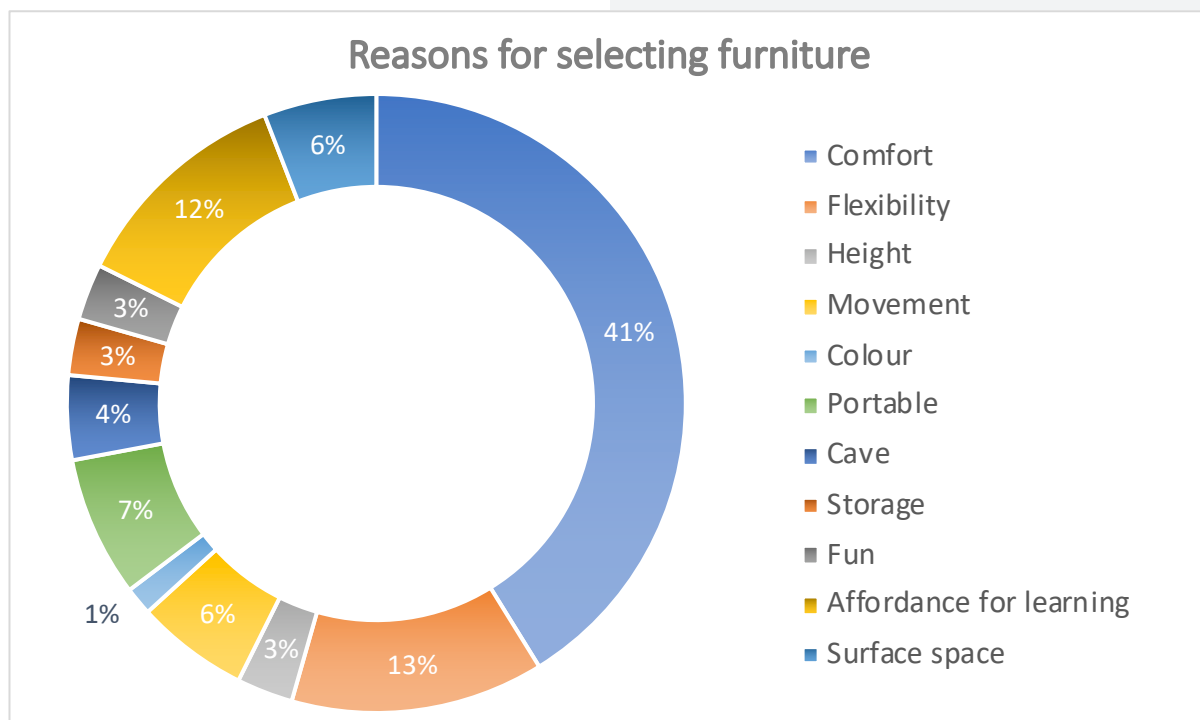*Figure 2. Primary students' most preferred furniture items*

Figure 3. Beneficial characteristics of furniture items as indicated by primary students

Figure 3 shows the reasons for students' selection of their preferred furniture item.

The three most common reasons were:
1. They support comfort (41% of students): 'The chair is soft and squishy and I can change positions when I'm uncomfortable.'

2. They have flexibility (13% of students): 'You can sit down and [or] stand up and still be able to work.' (in relation to high table with stool)

3. They have affordances for learning (12% of students): 'That there is only a max of two people sitting here which makes for less talk which results in focus.'

Affordance for learning (12%) and working space (6%) were two new reasons provided – with affordance for learning being identified when students listed furniture as having a specific characteristic that benefitted their learning, and working space being identified as either the quality or amount of space at a particular location (e.g., 'It has a nice amount of work space').

Selecting an item of furniture because of its writeable surface was the only reason listed in 2019 that was not seen again in the 2021 data.
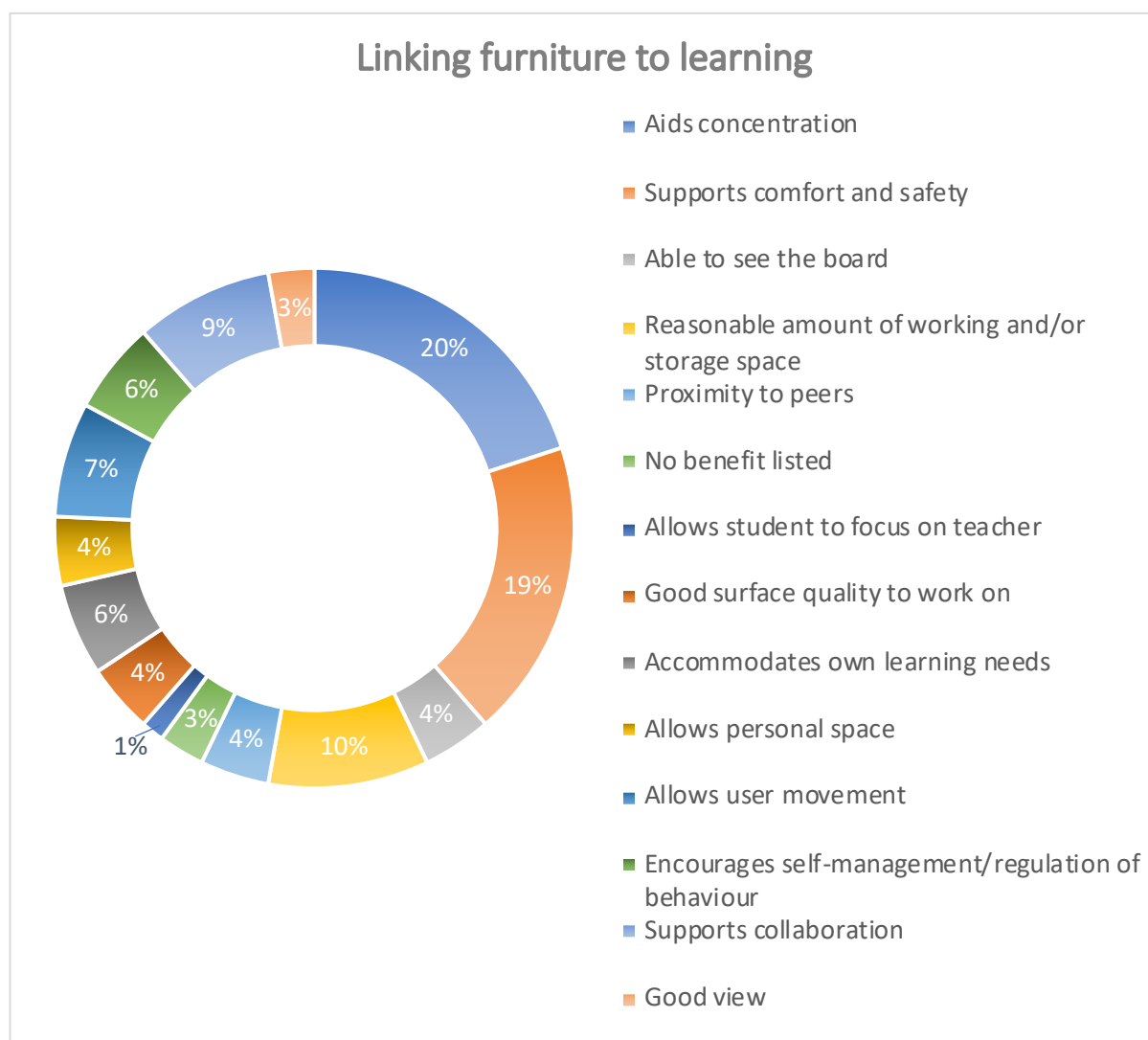
Linking furniture to learning

- Aids concentration
- Supports comfort and safety
- Able to see the board
- Reasonable amount of working and/or storage space
- Proximity to peers
- No benefit listed
- Allows student to focus on teacher
- Good surface quality to work on
- Accommodates own learning needs
- Allows personal space
- Allows user movement
- Encourages self-management/regulation of behaviour
- Supports collaboration
- Good view

Chart values: 20%, 19%, 4%, 10%, 4%, 3%, 1%, 4%, 6%, 4%, 7%, 6%, 9%, 3%

Figure 4. How students feel flexible furniture helps them to learn better

Figure 4 shows how students perceive furniture to link to their learning.

The three most common links to learning were:
1. Aids concentration (20% of students): 'I focus better on the couch than other furniture it help me throw [sic] maths and English because my friend can help me.'

2. Supports comfort and safety (19% of students): '…it helps better because my back is more supported.'

3. Working/storage space (10% of students): 'I have lots of room to work and put my things.'

Proximity to the 'front' of the classroom was the only link not to re-emerge in the 2021 data.

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

Teacher observation data

As in 2019, this question was addressed by repeated measures of teacher observations, which provided direct objective measures of what was seen to occur in the classrooms. Interviews conducted at the end of each term with the participating teachers unpacked these observations, and the Teacher Mind Frames survey provided an indication of participants' attitudes to teaching.

A total of 21 observations were conducted, with 12 observations occurring in flexible furniture arrangements and 9 observations in the traditional arrangement setting. The figures below show the average amount of time (as a percentage) that teachers spent in more teacher or more student focus modes, using a range of pedagogical strategies, conducting learning activities with various group sizes, and using a range of activity types to support student learning.

The trends in observation data remained consistent across 2021. Figure 5 shows teachers tended to use more teacher-centred practices when working in traditional furniture arrangements, and conversely, were more student-centred in flexible furniture arrangements. This trend was statistically significant, with Mann-Whitney U tests showing teachers are more student-centred in flexible spaces, $U = 13.50$, $z = -4.80$, $p < .001$ (ILE: Mean Rank = 199.5, n = 12; Traditional: Mean Rank = 139.5, n = 9); as well as being more teacher-centred in traditional furniture arrangements, (ILE: Mean Rank = 150, n = 12; Traditional: Mean Rank = 171, n = 9), $U = 18$, $z = -5.12$, $p < .001$.
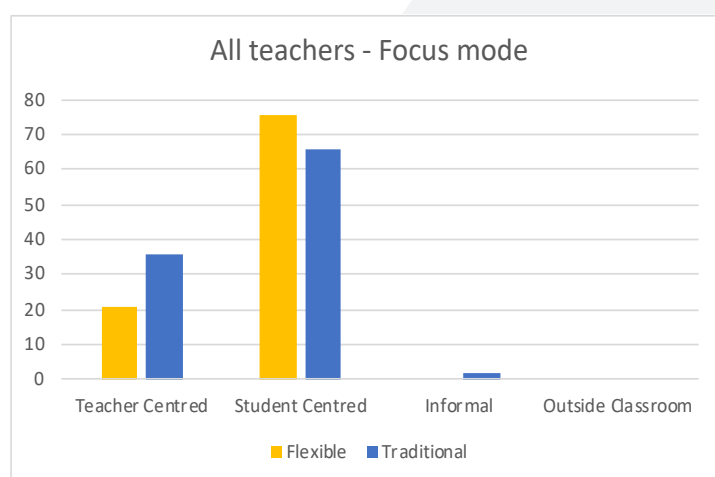

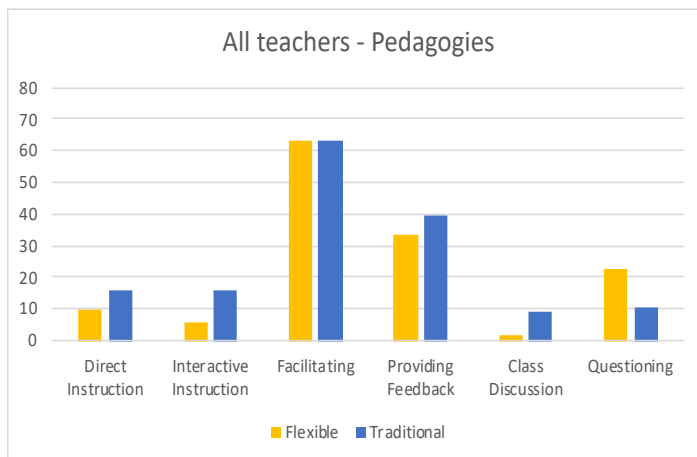*Figure 5. Comparison of mean times for focus mode in flexible and traditional furniture arrangements*

Figure 6. Comparison of mean times for teacher pedagogies in flexible and traditional furniture arrangements

Figure 7. Comparison of mean times for learning activities in flexible and traditional furniture arrangements

Figure 6 shows mean scores for the pedagogies used by teachers across both flexible and traditional furniture arrangements. Visually, the data show more instruction and class discussion when working with traditional furniture, an emphasis on facilitating regardless of furniture (to be expected given the inquiry learning focus), and higher amounts of questioning happening in flexible furniture settings.

There was a statistically significant difference between furniture arrangements in terms of direct instruction; teachers did more direct instruction in traditional spaces (ILE: Mean Rank = 153, n = 12; Traditional: Mean Rank = 172.5, n = 9), U = 19.5, z = -5.22, $p < .001$. The same result was found for interactive instruction (ILE: Mean Rank = 132.5, n = 12; Traditional: Mean Rank = 152.5, n = 9), U = 0.5, z = -3.80, $p < .001$. As anticipated, there was also a significant result that suggests flexible furniture arrangements support more frequent questioning (ILE: Mean Rank = 200.5, n = 12; Traditional: Mean Rank = 121.5, n = 9), U = 14.5, z = -4.87, $p < .001$, but also for providing feedback (ILE: Mean Rank = 181, n = 12; Traditional: Mean Rank = 145.5, n = 9), U = 5, z = -3.48, $p < .001$. Conversely, traditional furniture arrangements supported more whole class discussion (ILE: Mean Rank = 129.5, n = 12; Traditional: Mean Rank = 164.5, n = 9), U = 11.5, z = -4.65, $p < .001$.

Figure 7 shows the types of learning activities being conducted in each setting. There appears to be more creative activity happening in flexible spaces, but statistical testing showed there was no significant difference (ILE: Mean Rank = 150, n = 12; Traditional: Mean Rank = 110, n = 9), U = 36, z = -1.30, $p = .201$.

Last, Figure 8 describes the types of learning communities observed in both settings, with mean scores showing more whole class work happening in traditional and a more even spread of group sizes happening in flexible arrangements. There was no significant difference between the flexible and traditional furniture on any of these measures.

All teachers - Learning communities

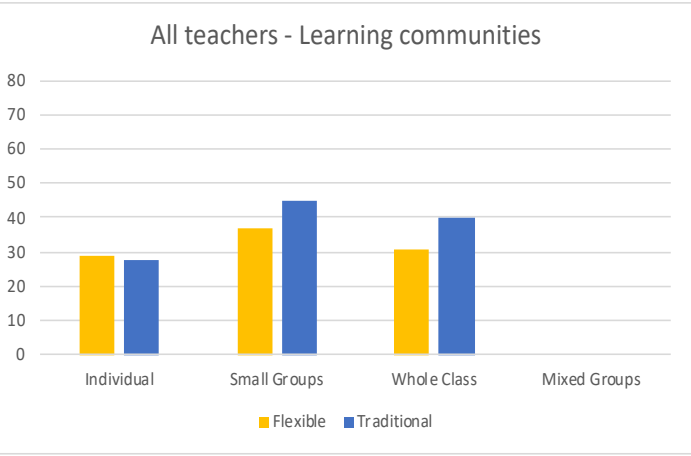|	Flexible	Traditional
Individual	29	28
Small Groups	37	45
Whole Class	31	40
Mixed Groups		

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

Teacher Mind Frames survey data

While the observation data show the amount of time teachers spent engaging in different activities or practices, it did not measure how teachers felt they were performing over the year. In 2021, the Teacher Mind Frames (TMF) survey was conducted at the start and the end of the intervention period (start of term 2 and end of term 4) to score teachers' own judgements of their quality in relation to Hattie's high impact teaching strategies. Table 5 outlines the results from the 2021 data. The results show that teachers perceive they are improving the quality of their teaching over the course of the year, except for (1) engaging in equal amounts of dialogue and monologue, and (2) collaborating with peers. These two mind frames also decreased in 2019 data.

There was no statistically significant change to any of the mind frames between the pre and post occasions (which was different to 2019 where there was a significant change to relationships and trust), but the teacher interview data did suggest their relationships with students did change when they moved into traditional furniture arrangements.

Table 5. Mean scores for Teacher Mind Frames

Teacher Mind Frames	Pre-test (n = 3)		Post-test (n = 4)	
	Mean	Standard Deviation	Mean	Standard Deviation
I focus on learning and the language of learning	5.00	.707	5.06	.556
I see assessment as informing my impact and next steps	4.20	0.748	4.60	1.020
I build relationships and trust	4.75	.433	4.75	.901
I engage as much in dialogue as monologue	5.58	.493	4.88	.484
I am an evaluator of my impact	4.33	.850	4.69	.845
I am a change agent	4.08	.954	4.88	.927
I collaborate with my peers	4.17	1.143	3.94	.827
I give and help students understand feedback	4.40	.611	4.90	.889
Overall Mean and SD	4.56	.742	4.71	.806

Teacher interview data

The opinions about interview questions 1 and 3 ('my teaching' and 'use of furniture') expressed during the Phase 2 teacher interviews were consistent with those provided during the Phase 1 interviews. This was anticipated – the same questions were used, but this consistency across years with four of the five 2021 participants being new to the research, indicated robustness of these findings. The consistent findings, were:

- Teachers were more teacher-focused when in traditional furniture arrangements (with more instruction, and more whole class work).

- Teachers were more student-centred when in flexible furniture arrangements (where they also engaged in more questioning).

- The tightness of 32 chairs and tables meant restricted movement by the teacher.

- Teachers again made the point that they were required to work harder in a traditional furniture arrangement: (1) They felt they had more focus on managing student behaviour and not on the learning, (2) They believed the traditional furniture arrangement allowed them to teach 'efficiently' due to easier surveillance, but at the cost of not engaging in quality teaching/learning, (3) They felt disengaged from the students due the need to differ in use of the space – for example, increased use of 'front of the room' and less circulation.

However, to address the 'deeper dive' into student engagement, Phase 2 interviews used new items for this second dimension (see Table 2).

Risk taking

Teachers consistently referred to students in the flexible environments moving to a favoured space to do their work; 'they just go off and do it'. Embedded in this was a capacity and willingness to take risks – undertaking tasks without supervision and pro-actively making decisions about their learning direction. They spoke of students 'challenging themselves', identifying what in a topic interested them, 'finding out the information for themselves and not needing to be spoon fed'. This was not the case for every student, but still a characteristic more common in the flexible compared to traditional furniture arrangements.

Flexible settings, one teacher reflected, allowed students to create and occupy a 'safe space', one that provided them licence to take risks. To her/him, it was clear in the traditional setting students 'backed off' creative approaches, they 'slowed back', they lost interest. Students reacted to having a teacher easily accessible by relying on her/his opinion, rather than working it out for themselves. But that accessibility benefit 'lost its shine'

Creative thinking

The teachers often spoke of creative thinking within the concept of deep learning – some students 'enjoy complex thinking', look for 'deeper meaning', they try to 'take their thinking to higher levels'. In the traditional setting some teachers felt the students lost the 'freedom to move away from whatever was distracting them'. They lost autonomy, producing work they felt was required, compared to following avenues of investigation closer to their own wishes and interests.

Peer support
In the more flexible environments students still grouped according to a need to gravitate to those with whom they felt safe and competent to work with, but were more likely to help others 'beyond their tight friendship groups – they were more supportive'. Flexible environments, one teacher said, bred tolerance – students with learning or social difficulties were allowed by others to 'have their own space'. These 'spaces' disappeared in the traditional layout. Social issues arose in the traditional setting according to one teacher – the blame was placed on an inability for students to remove themselves from difficult situations. Similarly, what was a common support action in the flexible environments ('when a kid has a problem, others would show them what to do') disappeared, the students, one teacher said, simply withdrew. They 'stayed put in their seats, they weren't interested in each other'.

Overall comments
There was no sense of dichotomies being expressed by teachers as they reflected on comparison between the terms with flexible and traditional arrangements. There were few polarised analyses - 'in the traditional students did X, in the flexible they did Y'. Teachers recognised there were many factors that influenced any perceived changes in student engagement. But what was evident in the teacher comments was a trend towards less and more movement, less and more student interactions with each other, less and more group work blended with increased independent thinking. This trend consistently favoured the flexible environments. The message was of the flexible furniture arrangements correlating with these qualities, but not exclusively; the furniture assisted more favourable actions by students, it acted as a licence to be creative collaborative risk takers. But like Phase 1 data on engagement, for strong students the creative, risk-taking collaborative skills were so well embedded they remained despite the change in furniture. However, they required more effort.   This was consistent with Phase 1 data, where engagement levels remained high, but was 'harder work' in the more traditional settings. This contrasted to students experiencing social and learning challenges; the common viewpoint was that the flexible arrangements – for many students – provided students capacity to identify safe spaces, to seek support from trusted colleagues, and to develop, ownership of their learning.

Another consistency across the Phase 2 interview data concerned student agency. In traditional settings, the teacher's wishes (as perceived by the students) dominated their preferred learning strategies. In the flexible environments students had increased opportunity to make choices about spaces and work approaches. The greater freedom students experienced came with an implied trust by the teacher in their decision-making capacity. This was in comparison to the traditional setting where students, one teacher said, saw themselves as 'all being the same'.

Another was that the traditional arrangement aided 'efficient' teaching ('I was a well-oiled machine') but this came at the cost of connection with the students. Surveillance and control became a focus, a contrast to the flexible arrangement.

Overall, there was a sense of teachers using the experimentation of Phase 2 to reflect on their own teaching and the nature of their students' learning. Consistently, teachers identified greater control in traditional settings but that came at the expense of student autonomy and agency. They consistently lamented this loss of independent thinking, and identified an increase in social problems and loss of interest in learning in the traditional setting.

What does this mean?

Consistent in the students' data was the link between furniture and learning. In 2021, 97% of students feel furniture impacts their learning, up from 93% in Phase One. Again, students mostly made links between furniture providing comfort and aiding their concentration.

Given the new focus on creative thinking, peer support for learning and risk taking in learning, there were also new findings from the students' data:

• Most notably, students specifically identify that flexible furniture positively impacts their ability to engage better than traditional furniture, and there is a statistically significant difference between how they feel furniture 'works' in the flexible arrangement compared to the traditional.
• Students actively select furniture to support their learning, most commonly for their comfort, but also because its flexibility and affordances for their learning.

Teachers' comments in the interviews supported the finding that flexible furniture increased students' engagement in terms of the focus characteristics:

• In regard to students' creative thinking, teachers noted the main change between traditional and flexible furniture arrangements lay in the way they undertook tasks. Teachers consistently noted students became less adventurous in the traditional setting. They relied more on teacher guidance and approval and exhibited reduced autonomy. Teachers noted they produced work that lacked spontaneity. Of interest, and ironically, the only teacher to identify a positive impact on creative thinking in the traditional furniture term was when they took the students outside the classroom to ignite creativity. Given these perceptions of differences, it is reasonable to say furniture arrangements influenced creative thinking; the more flexible arrangements facilitated greater autonomy, experimentation, and lateral thinking.

Students feel flexible furniture impacts their ability to engage in learning

- Regarding peer support, teachers felt this was reduced in the traditional arrangements; students found it harder to self-identify groups, they fought for ownership of a 'space' in the classroom because all the spaces were the same (i.e., the same desk/chair rather than students knowing each other's preferences). It limited movement between individuals, fostered exclusivity, and these led to a loss of collaborative support. Given these perceptions, it is reasonable to say the furniture arrangements influenced peer support, with flexible arrangements allowing students more options for working together, and they fostered more collaborative practices.
- In regards to risk-taking, in the flexible environment the students appeared more willing to 'find a space and have a go'. They challenged themselves. They required less supervision and a greater willingness to make independent decisions. Given these perceptions, it is reasonable to say the flexible furniture arrangements positively influenced risk taking, with traditional arrangements correlating to greater student dependence on teacher decision making.

Teachers feel students' autonomy is increased in flexible furniture arrangements

What will we do next?

The research has been put on pause from 2022 as we determine the right time and way to move forward with Phase Three of the research. Phases One and Two have given us robust evidence that furniture is making an impact on students and teachers, and that both teachers and students are identifying specific affordances (or barriers) of certain furniture items and arrangements in relation to learning.

Consequently, Phase Three aims to explore the process of putting furniture into classrooms, and if it is feasible for teachers to be more engaged in having furniture designed/made to meet specific students in their classes. Phase Three asks:

- Is it possible for teachers to co-design furniture for specific students' needs?

- Is it possible for furniture designers to meet this need quickly and efficiently?

- Is it possible to evaluate if that bespoke furniture makes a difference to the student?

This next phase of research is entering into a new era of teachers being actively involved in carefully considered purposeful furniture, that is, furniture that meets a specific learning need.

Appendix A: Repeated measures that were consistent across 2019 and 2021

The following measures remained consistent from 2019 to 2021 data collection:

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].
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.

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.*