Video-linked teaching: Designing and evaluating technology-rich classrooms for real-time collaboration

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A major 'state-of-the-art' video-linked teaching (VLT) project at Massey University encompasses the development of two purpose-designed rooms to support real-time teaching across two campuses. The intention is for these rooms to be used to establish a strong presence and sense of connection between teachers and students located at each site, offering the ability to teach two (or more) physically distanced classes synchronously with a focus on rich interaction and collaboration. This paper reports on the initial findings of a research project investigating how the VLT rooms have been used during the Semester 1, 2012 experimental pilot phase. It shares some of the experiences of the students and teachers involved and identifies a number of benefits and challenges of using such VLT rooms from pedagogical, physical space and technological perspectives. Finally, the paper reports how the preliminary findings from this research are informing the ongoing use of the facilities as well as the design and implementation of a wider range of teaching and learning spaces.

Keywords: Video linked teaching, video conferencing, synchronous, flexible, learning spaces

Background

Massey University's physical infrastructure is distributed across the North Island of New Zealand with three main locations in Albany (Auckland), Manawatu and Wellington. The distributed nature of Massey's campuses has meant that video conferencing (VC), amongst other methods, has become a key component in communication between departments and colleagues based on different sites. The relative availability of VC facilities for administrative purposes has encouraged staff within several disciplines to experiment with the service for teaching and learning. The College of Sciences, for example, has used VC to link classrooms in New Zealand and Singapore, as well as between campuses, for several years. The College of Business, and College of Humanities and Social Sciences have also used it for small group intercampus teaching, particularly at advanced undergraduate and postgraduate levels. An increased level of interest from all colleges in providing connected classes to larger groups of students across a wider range of courses was the major driver in the development of Massey's video-linked teaching project.

> Our strategy is to facilitate the implementation of [video-linked teaching] to enable collaborative partnerships by removing distance as a consideration from everyday activity (Tate, 2011, p. 4).

Institutional objectives of ongoing sustainability of multi-campus courses and increased intercampus connectivity encouraged the project to really explore "the power of *built pedagogy*" (Oblinger, 2006, p. 1.1) in the design and realisation of these teaching spaces (Hunt, Huijser, & Sankey, 2012; Keppell & Riddle, 2012; Neill & Etheridge, 2008). The project mirrors sector-wide growth in the use of real-time collaborative technologies (Bower, Kennedy, Dalgarno, & Lee, 2011). It has been suggested that "pedagogical innovation demands a space that enables exploration by both teacher and student" (Neill & Etheridge, 2008, p. 47) and this ethos of innovative teaching and active learning has underpinned the entire development process of VLT.

Throughout 2011, rooms were identified on each campus that would be suitable for the intended brief of delivering interactive video-linked classes for up to 50 students. Extended consultation with reference groups consisting of academic end-users, IT technical and support staff, and teaching consultants guided the design of VLT spaces. Three of the most important requirements consistently called for from the academic reference group were: reliability; availability of technical and teaching support; and usability. These became the 'pillars' of the project and to a large extent mediated other factors such as feature set and expense. When it became clear that budget constraints would significantly compromise the design and functionality of a three room build, a decision was made to construct just two spaces on the Albany and Manawatu campuses with an eye to adding a third room in Wellington at a later date. Existing VC infrastructure on the Wellington campus were used as part of the pilot to allow for three-way classes.

The consultation process established technical and pedagogical objectives for VLT classrooms (Tate, 2012). One of the primary technical goals was the creation of as seamless a connection between locations as possible. Clarity of audio and video, large displays to give remote participants more presence and décor intended to give the impression of linked classes being virtual extensions of one another were given high priority (see Figure 1). From a pedagogical perspective, the rooms needed to be flexible enough to accommodate a wide range of active approaches to teaching and learning. Furniture, multiple cameras, a variety of digital input sources and the ability for staff to easily manipulate these components were considered essential for creating an environment suitable for the delivery of rich, interactive classes across a video-link.

Construction began in late 2011 with a budget of almost NZ $1 million and continued following Prince 2 (Projects IN Controlled Environments) process-based project methodology through the experimental pilot phase in Semester 1, 2012.

Figure 1: VLT room, Turitea campus, Manawatu

Experimental pilot phase: Semester 1, 2012

A small group consisting of three undergraduate cohorts of Massey University students along with their lecturers participated in the experimental pilot phase of the VLT project:

- Course A: Taught weekly between the Manawatu VLT room and a standard video conferencing room in Wellington (3 lecturers, approximately 20 students)
- Course B: Taught weekly between the Manawatu and Albany VLT rooms (2 lecturers, approximately 15 students)
- Course C: Taught weekly between the Manawatu and Albany VLT rooms (2 lecturers, approximately 30 students)

Teaching usage for the semester totalled 66 hours across 25 live classes. It should be noted that construction and testing was still happening around scheduled classes, and several components of the final build such as interactive whiteboards, document cameras and room presets were not available. Course A was also constricted by the lack of a VLT facility in Wellington, requiring a simplified connection via a standard VC facility.

The project had technical and teaching support funding built-in and this proved to be invaluable through what

had the potential to be a very trying semester of teaching in untested and incomplete facilities. IT technical support was on-hand to assist with set up prior to the start of a class and remained on-site for the duration of classes to ensure a swift response should any technical issues arise. Despite the unfinished nature of the rooms during the pilot semester not one dropout of connection occurred during classes. The conferencing technology that the rooms are based on has continued to be a solid platform and inspires confidence in those that use it.

Academic support has proven to be of value through both the design and implementation phases of the pilot. A teaching consultant assigned to the project has been involved in assisting staff in the design of VLT classes, as well as liaising with technical staff on the implementation of user presets and evaluating the technical build's application. Presets were based on observations of classes, lecturer feedback and a broader knowledge of the requirements that different teaching styles bring to the layout of a classroom. They enable teachers to tap a single button to call up layouts for specific teaching styles. Presets can be further customised and fine-tuned.

An academic development model proposed by Steel and Andrews (2012) for technology-enriched learning spaces has influenced the ongoing teaching support that is being provided to VLT users. On-demand web-based and mobile resources, planning materials and guides have been produced (see Figure 2). These resources, along with one-to-one consultations, monthly hands-on professional development sessions and heuristic opportunities for academics to review and re-imagine their VLT classes, will enable teaching staff to more fully exploit the interactive and collaborative potential that the rooms offer. Pre-set guides, room planning documentation and 'visual planners' have also proved valuable aids in the design of VLT lessons.
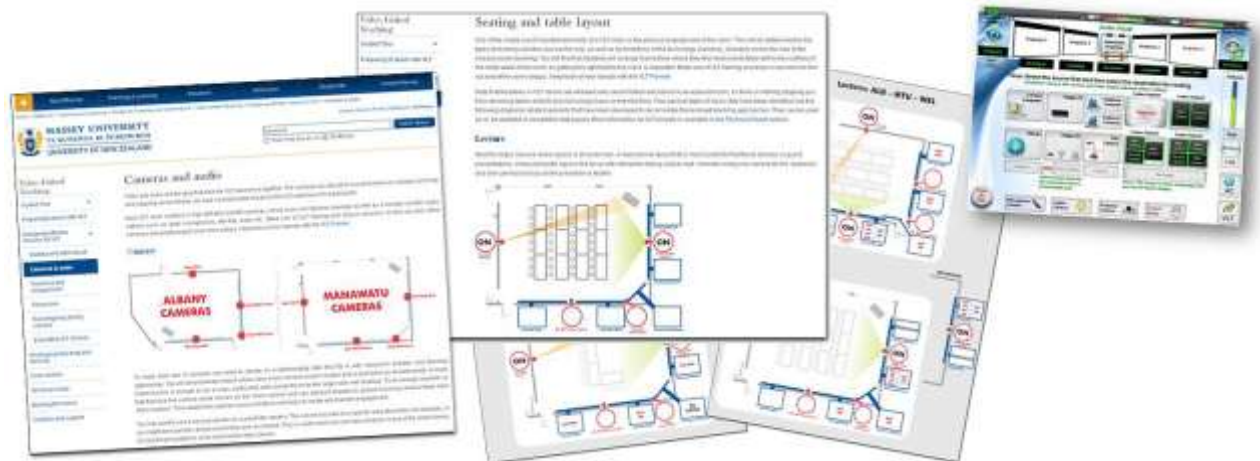

Figure 2: VLT support materials

Initial results

A formal evaluation of the Semester 1 pilot was undertaken, utilising a mixed methods approach. Ethical approval for the evaluation was obtained from the Massey University Human Ethics Committee. Quantitative data from an anonymous student questionnaire were collected alongside in-depth qualitative data gathered through student focus groups and staff interviews, including the lecturers and teaching consultant involved in the experimental pilot phase. Findings presented here draw on student questionnaire data and staff interview data that were collected after the completion of the semester. The questionnaire asked students to rate the importance of multiple factors relating to technical considerations, physical considerations and those related to teaching and learning. While the survey evaluation is based on a relatively small sample of students (n=17) with a response rate close to 30%, the data collected (coupled with insights from staff) provide some useful feedback on the initial implementation and use of VLT at Massey. The results are presented below.

Table 1: Which paper were you studying in semester 1?

Course A	35%
Course B	18%
Course C	47%

Table 1 reports the response rate from each of the three experimental courses. The majority of the respondents (47%) were from Course C, taught between the Manawatu and Albany campuses.

Table 2: How would you rate yourself as a technology user?

Very inexperienced	12%
Inexperienced	0%
Neither experienced nor inexperienced	23%
Experienced	47%
Very experienced	18%

The level of experience as a technology user is reported in Table 2. The majority of students (65%) self-reported that they were experienced or very experienced at using technology.
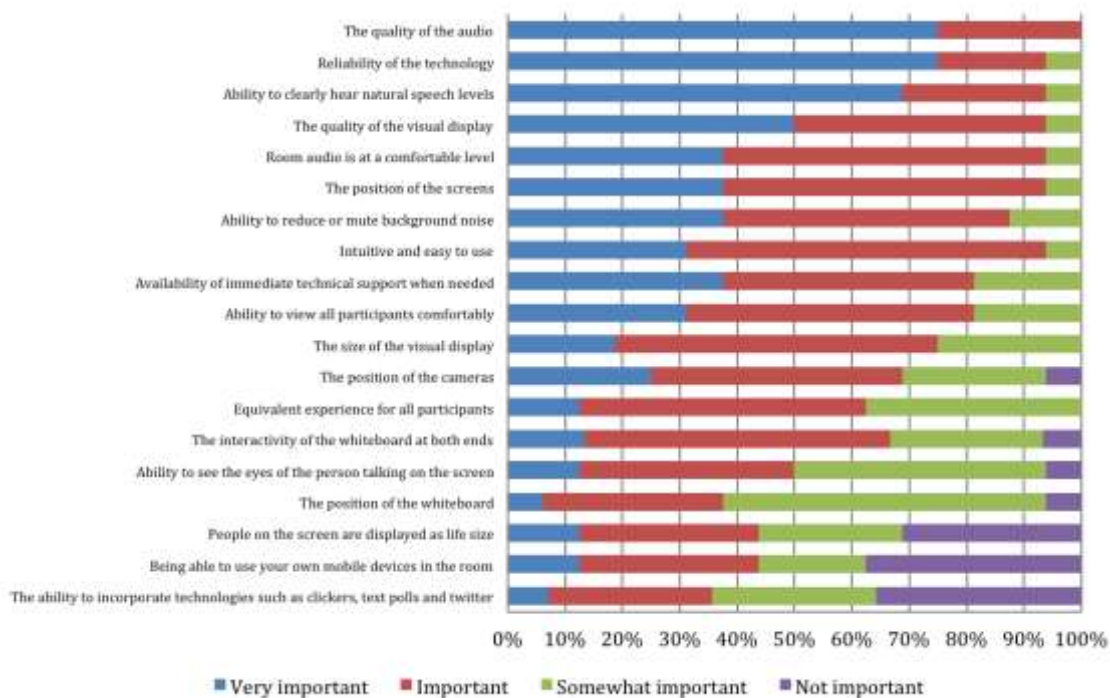

Figure 3: How important do you consider the following technical considerations?

Figure 3 reports a range of technical considerations students perceived as important in the effective use of the rooms. Notably, the most important features were the quality of the audio and reliability of the technology. The importance placed on these technical considerations was echoed in comments made by teaching and support staff as the following comments indicate:

> … you didn't get that delay that you get on the video conference and it's much more real time and you can hear everything well and … I think that worked really well for us. (Course A, Lecturer3)

> I mean obviously the goal is to make it as user friendly as possible so that, you know, staff can come in and be able to operate the room without having to have technical support there, but at the moment it's, it's at such a stage, you know, it's at a trial stage and, … it was reassuring just to know that there's that support because you've got students turning up, they're expecting to have a

class and it doesn't look good, it looks pretty unprofessional when there's all of these problems that crop up instead, not that there were any problems particularly. (Course A, Lecturer2)

And make sure you've got the technical sort of support there backing it up to make it successful otherwise there would be lots of wasted time, down time for students, breaks in their learning and you know, I don't think it would work at all. (Teaching Consultant)
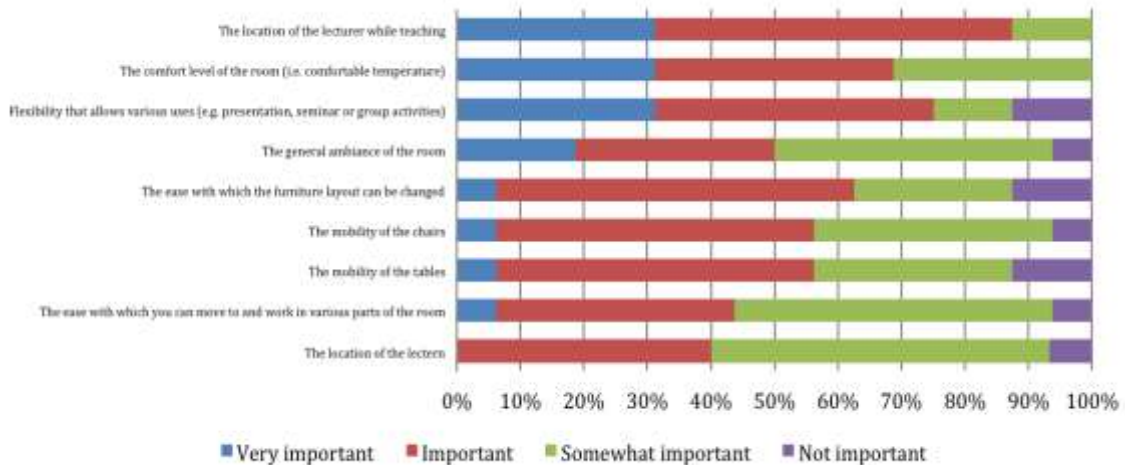

Figure 4: How important do you consider the following physical considerations?

Figure 4 presents the relative perceived importance of different physical considerations. It shows that the locality of the teacher was rated as the most important consideration over and above the comfort level and mobility of the furniture. Staff were also aware of the importance of where they placed themselves when teaching as the following comments demonstrate:

> … the teaching spot is quite decentred, it moved elsewhere, and that's what creates a dynamic VLT room … it becomes far more fluid in the VLT space. (Course C, Lecturer1).

> You've got to be aware; you have to … you have to keep thinking, oh no I really need to be looking at Albany as well. (Course B, Lecturer)

> And where to stand and we'd figured out that we sort of stand on the side and sort of, then we can see both, look at both the screens, it depended on which screen was up too, in the VLT, so if you had to big screen up … on the side wall you tended to look to the side wall because it was a bigger screen, it showed more of the class. But that wasn't where they actually were, you had to turn and face the back wall to speak to the students that were in [the other room]. (Course A, Lecturer2)
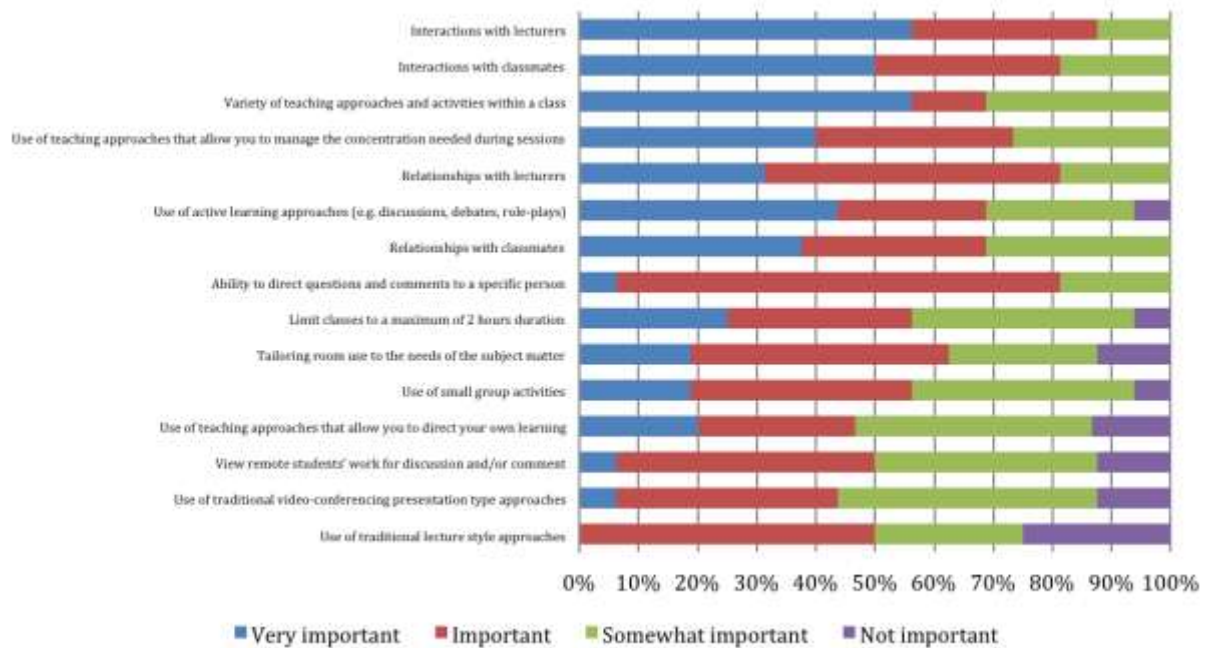
Figure 5: How important do you consider the following teaching and learning considerations?

The relative importance of a number of teaching and learning considerations from students' perspectives are reported in Figure 5. The interactivity of the VLT rooms coupled with the use of a variety of teaching approaches were perceived to be the most important considerations. Staff also spoke of the importance of interaction and teaching approaches that supported this:

> And then the other thing is we were able to use it for group work so one of the speakers we had did the presentation and then in each of the rooms they did group work around what they had done and then the other thing that we have been doing is doing mock presentations because the students have to do their final presentations in a couple of weeks and so they've been able to present to a wider group and that's been good as well. So it's not, it's not a stand and deliver content type lecture. (Course A, Lecturer3)

> … it was important to get interaction and discussion going… it was really, really important. (Course B, Lecturer)

> [What] Lecturer2 and I realised very early on was that him and me were really important in, in trying to model the interaction in the room … and the more that we could move the kind of locus of activity backwards and forwards between us, the more we could animate the whole room as a single room. (Course C, Lecturer1).

Discussion

It needs to be noted that all three pilot classes were team taught, with academic staff facilitating in each location for the majority of sessions. This approach is not necessarily a model for future use of VLT and some classes may well 'rotate' the physical location of a single teacher through co-taught courses or utilise tutors to facilitate remote locations. Focus group feedback indicates that students are wary of the potential for 'remote' teaching, but enjoy the increased intimacy that the rooms have brought to their learning experience and have pointed out the contrast to other classes held in more 'authoritarian' teaching spaces. Students appreciate the opportunity to develop closer relationships with their teachers, the subject matter and the learning process itself. With these general observations in mind, the following section reflects on the findings in terms of technology, physical space and teaching and learning considerations.

Technology considerations
The overwhelming presence of technology is the first thing that confronts participants in VLT classes. Student survey responses showed a very heavy emphasis on the audio capabilities of the rooms, with four out of the top

seven technical considerations being audio-based (quality of audio, ability to hear natural speech levels, room audio at comfortable level, ability to reduce or mute background noise) compared to only two visual concerns (quality of the visual display, position of displays). The importance of high quality audio was also highlighted by staff teaching these courses. These findings were perhaps surprising given the visual nature of the rooms, with each containing five displays and four cameras. One of the major technical goals for the rooms based on user-group consultations was to create as much of a 'physical' presence for virtual/remote participants as possible. This was achieved through creating an 'audience' wall in each room with two large (3m) displays designed to project participants as close to life-size as possible. The student response to this was rather mixed, with over 50% of students responding that displaying life-size participants is only somewhat important or not important. This could signal that the audio qualities of the rooms require more work, but on the basis of these data the visual connection with staff and peers is of much less importance than the ability to hear and speak to them clearly.

Furthermore, students showed a relative lack of interest in using technology such as clickers and mobile devices within VLT classrooms, with over 60% saying this was only somewhat or not important. Along with the emphasis on audio qualities of the rooms, this finding would perhaps suggest that students see these spaces as more suited to conversational and discursive teaching approaches.

Physical considerations

Student responses to the physical aspects of VLT rooms demonstrate the importance they place on their teachers. The overwhelming consideration for students (almost 90% important or very important) was the location of lecturers whilst teaching in the VLT rooms. This point captures the criticality of lecturers staying 'in shot' and in a position where all participants in class feel as though they are being addressed equally. Feedback from staff indicates they, too, were aware of the importance of where they stood and how this could change the learning experience for students, particularly in the other room. Switching position mid-class has proven to fundamentally alter the dynamics of a class, with drops in student engagement in one or several locations noted by teaching staff. It is interesting to note the relative lack of importance ascribed to the visual display mentioned above when compared with this finding, which seems to suggest that certain visual aspects are important (i.e. clear and direct view of the teacher), albeit indirectly.

Flexibility that allows for various teaching activities was also highly rated, but it is notable that students did not really link the mobility of furniture, or indeed themselves, with this statement. Lecturers have reported how the flexible physical nature of the rooms (space, furniture, displays) seems to disappear once a video-link is established and classes begin. Moving students and furniture around rooms during class requires repositioning of cameras, the tweaking of VC data sources (in the case of Course A) and the shifting of content on displays. It is disruptive and potentially counter-productive, increasing the potential for technical problems. Although flexibility of the physical space and furniture was considered a key component in the design and implementation of the rooms, VC technology (on the Wellington campus) has impacted upon this flexibility. Student responses may reflect the way staff have tended to 'set and forget' the physical space to mitigate these issues.

The issue of comfort level can mostly be explained by the lack of air conditioning in the Manawatu VLT room and is something that is currently being addressed. Temperature and lack of airflow was noticeable throughout the semester and significantly impacted student engagement towards the end of classes. Air conditioning is now considered an essential requirement of VLT rooms, which was originally beyond the initial budget.

Teaching and learning considerations

It is perhaps unsurprising that students' most important considerations were about interaction, as this is what the spaces have been designed to facilitate. Interaction with lecturers (almost 90% important or very important) topped the responses to this question, closely followed by interaction with classmates. It clearly demonstrates the need for teaching staff to devote plenty of time to student discussion and questions, and to make the most of the huge potential the rooms offer in this regard. There are important space and timetabling implications in terms of which courses and lecturers are allocated access to the facilities in the future, as the rooms were explicitly designed to avoid the problem of teachers using VC for passive forms of teaching and learning.

Students have also highlighted the importance of a variety of teaching approaches and activities. Consistent with the original goals of the project, they do not want to be talked at: students want interactive, engaging classes. Traditional lecture-style approaches and presentations are of much less importance to participants, and on the basis of these findings they do not rate highly with students. Interviews with staff also support these views highlighting that interaction is very important and that the VLT spaces are not well suited to a stand and deliver lecture-type approach.

Conclusion

In conclusion, the technical and physical flexibility of these spaces offer staff a multitude of parameters that need to be selected prior to teaching. One of the emergent findings is that the technical knowledge required by lecturers to run successful VLT classes is largely overshadowed by the pedagogical skills and lesson planning that staff need to develop. The technical design of the rooms, one-touch user presets and presence of IT technical support has helped to make VLT a relatively user-friendly experience. Initial findings suggest that the onus has now been put on to lecturers to develop suitable teaching methodologies and to employ them effectively in these technology immersive classrooms.

A second emergent point (from the wider study) is that supporting academic staff through this development process will be important to the ongoing success and viability of the technology from a pedagogical perspective. Professional development sessions offering hands-on experience are being offered monthly, and are designed to encourage staff to re-think and adapt their teaching methodologies for truly interactive forms of learning.

Final analysis of qualitative data from the Semester 1 pilot is currently underway, with a full report due before the end of the year. It is anticipated that survey feedback from students will continue to be collected over the coming year in order to form a more complete picture of the student perspective of learning in these spaces and to inform the ongoing technical and teaching development for VLT.

Finally, a positive and consistent theme that runs through the questionnaire data is the value students place on their teachers and their interactions with them. They enjoy being engaged in their learning and having the opportunity to develop closer relationships with academic staff. In this sense, the VLT rooms can be used to 'flip' the traditional classroom, although the effectiveness of this depends on a number of factors which include technology, physical space and pedagogical considerations. That said, the VLT project at Massey was designed to bridge the physical space between groups of students across campuses and so far they appear to be successful in breaking down the metaphorical distance between lecturers and students. There is emerging evidence to suggest that when used appropriately, VLT is paving the way for less transmissive teaching approaches and a more interactive and egalitarian classroom.

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