Technology enhanced learning environments in higher education: A cross-discipline study on teacher and student perceptions

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Abstract

Teacher and student perceptions of using technology enhanced learning (TEL) in higher education have received growing attention, particularly during COVID-19, however existing studies are mainly discipline-specific. This study adopts a holistic cross-disciplinary approach. It compares teacher and student perceptions on defining TEL, promotors and barriers for its use, and solutions offered for better use of TEL in the future. Both qualitative and quantitative data were collected from an Australian university. A total of 75 teachers and 48 students completed an online survey, and of these participants, 24 teachers and 29 students participated in follow-up focus group interviews that included Kahoot! surveys. Quantitative results show that teacher and student perceptions on TEL were generally aligned except that self-reported technology savviness and confidence was rated higher than how students and staff rated each other. Qualitative analyses reveal that both teachers and students identified the main promoters for TEL as being: modern and expected in higher education, while being equalising, efficient, engaging, authentic, collaborative and flexible. The common barriers for using TEL were identified as fear, time, organisational culture, knowledge and technical/support issues, along with the perceived pitfalls of distraction, and superficial student learning. Solutions offered for TEL in the future from staff focused on the institution and a desire for strategic, pedagogical and holistic approaches, while students focussed on the accessibility, flexibility and collaborative potential of TEL. This cross-discipline pre-COVID-19 study of TEL perceptions offered by teachers and students has contributed to knowledge in this area by identifying barriers and solutions for TEL common to all disciplines that have the potential to be applied to whole of institution strategic approaches for the more effective use of TEL in teaching and learning in higher education. Student accessibility to TEL and the development of pedagogically sound digital learning resources bringing together educational developers and discipline experts are of particular relevance during and post-COVID-19.

Keywords

Introduction

With the pervasive integration of technology into higher education, particularly in post-COVID-19 settings, technology-enhanced learning (TEL) environments continue to evolve rapidly. Differing teacher and student perceptions of using TEL have received growing attention partly because of the diverse ways in which TEL has been implemented and adapted. However, most previous studies are discipline specific. There is a need to explore teacher and student perceptions at a whole of institution level, considering that universities are adopting institution-wide TEL benchmarks and frameworks such as those produced by The Australasian Council on Open, Distance and e-Learning (ACODE, 2014; 2019). This study fills this gap by comparing teacher and student perceptions on defining TEL, identifying promotors and barriers for use, and providing solutions for more effective use of TEL in the future.

TEL – Differing definitions and perceptions between teachers and students

TEL is an umbrella term that encompasses a range of curriculum models that involve applying technology to support learning, to enhance the learner's experience (Kehrwald & McCallum, 2015). However, there is a lack of consensus on precisely what is meant by TEL (Bayne, 2015; Castañeda & Selwyn, 2018; Gregory & Lodge, 2015; Kirkwood & Price, 2014), although it is suggested that the use of TEL implies that something in the learning is improved. This lack of consensus is often attributed to how TEL is articulated and valued across different teacher communities, as well as between teachers and students, particularly as it replaces the outmoded term 'e-learning' (Kirkwood & Price, 2014, Chen, 2017; Pihlajamaa et al., 2016). For example, some students consider that TEL has value when linked explicitly to assessment support (Peart, 2017). In contrast, teachers declare that their purpose for using TEL in higher education is based on efficiencies and engagement (Flavell, 2019). Better articulation of what is meant by TEL from the teacher and student viewpoints is required to understand what benefits it achieves (Kirkwood & Price, 2014).

Although more empirical research is needed to confirm the arguments supporting the 'digital natives' versus the 'digital immigrants' (Kennedy, 2008), it is clear that how the vast majority of the students in universities approach TEL is different to that of their teachers (Underwood, 2007; Prensky, 2001). How teachers use technology has been widely studied (McKnight et al., 2016) however, their acceptance of technology (Teo & Zhou, 2017) and both their conceptions of and approaches to the use of technology are understudied (Englund et al., 2017).

Previous studies (Josefsson et al., 2018) have identified the promoters of TEL adoption for teachers to be: collegial discussions with peers; increased automation to decrease administrative load; support to implement technology; flexible learning and increased access to resources; and technology savvy students. On the other hand, barriers to implementation of TEL for teachers include insufficient funding; inexperience with digital tools; lack of discussions among other discipline members; unclear return on time investment (Josefsson et al., 2018) and many of these are subsumed under the banner of academic work load (Gregory & Lodge, 2015). In addition, a teacher's pedagogical beliefs can act as both a promotor and barrier (Tondeur et al., 2017).

Students also exhibit a continuum of technological expertise and have significant differences in expertise within their cohorts (Helsper & Eynon, 2010; Šorgo et al., 2017). Students indicate a variety of reasons why TEL is useful for them, including improving the logistics of studying; such as flexibility in when and where to work; time-saving reviewing; replaying and revising material; collaboration; and cost savings of electronic resources (Henderson et al., 2015). However, students also have negative engagements with technology including distraction (e.g., social media as a

source of procrastination and other student use of digital devices); disruption (technology failing to function properly); difficulty (e.g., inconsistent design of technology and physical issues); and detriment (e.g., 'Death by PowerPoint' and diminished engagement of teacher) (Selwyn, 2016).

The value of a cross-disciplinary approach in TEL research

Effective TEL implementation involves collaboration between cross-disciplinary teams, including education, pedagogy, computer science, design and media technology (Bälter, 2017; Donnelly, 2017). Specific disciplines within an institution may be limited by their own knowledge and research constraints, however if TEL is conceptualised in a team environment, various cross-disciplinary experts can collaborate to develop the best outcomes. Bälter (Bälter, 2017) also suggests that non-academic teachers may play an important role in effective TEL however, Thanaraj & Williams (Thanaraj, 2016) argue that it is the behaviour of academics that influences the learning of students, and a combined approach that values both academic and technical support for TEL is necessary, if it is to have a positive influence in student learning. Thus, a multi-disciplinary approach to TEL research has outcomes that are beneficial on two levels. Firstly, the benefits of sharing discipline-specific knowledge between disciplines, such as engineering academics offering solutions to biology academics for a science-related TEL activity. Secondly, the benefits of the inclusion of institutional professional staff in TEL research. For example, educationally trained professional support staff can assist teachers across disciplines to embed TEL practices that are pedagogically sound, or IT staff can provide solutions to teachers that ensures their TEL is robust within the scope of the institution's infrastructure or student's IT resources.

COVID-19 accelerated uptake of TEL innovation and blended learning, and while becoming the norm, still necessitated the identification and acknowledgment of the diversity in TEL practice in providing easy access to information, support and collaboration. Koehler and Mishra (Koehler and Mishra, 2009) suggest three core components of effective teaching with technology; content, pedagogy and technology, however there was limited time to implement these from either an individual or institutional level during the rapid shift to remote delivery necessitated by COVID-19. Koehler and Mishra proposed a Technological Pedagogical Content Knowledge (TPACK) model that illustrates the multifaceted nature of TEL and provides a foundation for professional development content. The TPACK model supports the earlier assertions regarding the need for cross-collaboration between disciplines. Whilst the teacher and students' differing perceptions of promoters and barriers for TEL have been studied, most studies are limited to their discipline area, thus more research is needed to understand these across different disciplines properly and in a way that is inclusive of both teaching and professional staff.

The primary purpose of this study was to apply a cross-disciplinary approach to explore the alignment between teacher and student perspectives of TEL in an Australian university, specifically, their perceptions on defining TEL, promotors and barriers for its use and solutions offered for better use of TEL in the future at their University. Our secondary aim was to consider our findings in the context of the current and post- COVID-19 higher education sector.

Research questions

1. How do teachers and students define TEL?
2. What factors promote positive perceptions and the use of TEL for teachers and students?
3. What factors are barriers to positive perceptions, and the use of TEL, for teachers and students?

4. What solutions can teachers and students propose for better TEL implementation at this University?
5. Was there a difference between teachers' and students' desire to use TEL, confidence in using TEL, and perceptions of each other's technology savviness? What factors influenced the teachers' and students' perceptions?

Methods

Procedure and materials

To answer these research questions, a mixed methods approach was adopted to collect data from both teachers and students across various disciplines at a small regional Australian university (35, 000 students) in Autumn Session 2018, prior to COVID-19. Invited to participate in the study were 'Teachers' (including both professional and academic members of the University staff), and students across all levels of undergraduate and post-graduate study. With University ethics approval (Protocol #2017/280), Phase I of the study consisted of an open email invitation to both teachers and students to complete an anonymous online survey on their perceptions of TEL at the University. Participants were then invited to self-nominate for Phase II consisting of a 1-hour focus group interviews for teachers and students. Within each Discipline at the University, separate focus groups were undertaken for teachers and students. To springboard discussions in the focus groups, participants were presented with a short quiz administered through the game-based learning platform Kahoot!. Before release, the questions in both phases were piloted with ten teacher members across different disciplines at the University and refined according to trial results and comments. Questions are described throughout the manuscript where relevant, the Kahoot! Survey tool was chosen as it has been proven to improve student engagement (Licorish, 2018) and each of the disciplines represented on our research team consisted experienced users of Kahoot!.

Instruments

The questions used in the online survey, focus groups, and Kahoot! survey fit into four broad themes: 1. Definition of TEL, 2. Promoters of TEL use 3. Barriers to TEL use, and 4. Solutions for TEL use in the future.

The online survey (Phase I) for teachers included 17 questions based on their role, campus, Faculty, years in role, how they define TEL, how supported they feel in implementing TEL, desire for TEL use, self-rated TEL savviness, method of obtaining TEL support, perceptions of pedagogical value and barriers of TEL use, and their perception of student TEL savviness. The teacher focus groups (Phase II) included 14 questions, starting with a discussion of what TEL means to the group members, and five Kahoot! questions asking them about if they have used Kahoot,, frequency of TEL use in lectures, whether they thought TEL helped their teaching, rating student enjoyment of using TEL in lectures, and whether they feel supported in using TEL. The remaining questions in the focus group aimed to draw discussion on perceptions of the pedagogical value of Kahoot! and TEL, value and barriers of TEL use, theirs and their students' desire to use TEL, suitability of TEL use across disciplines, how they use TEL outside of University, and how they would imagine a better future for TEL use at the University.

The online survey (Phase I) for students included 13 questions, asking about students' year of study, campus, how they define TEL, TEL successes and hindering in their learning, rating their confidence and desire in using TEL, and how savvy they thought their lecturers are, The student focus groups (Phase II) included 14 questions, starting with a discussion of what TEL means to the group members, and five Kahoot! questions asking them about if they have used Kahoot!, the number subjects that use TEL in lectures, whether they thought TEL helped their learning, rating

their enjoyment of using TEL in lectures, and whether they feel supported in using TEL. The remaining questions in the focus group aimed to draw discussion on perceptions of expectations of TEL in higher education, the learning value and barriers of TEL to their learning, their desire to use TEL, their perception of teacher willingness to use TEL, how they use TEL outside of University, and how they would imagine a better future for TEL use at the University. The full question set scan be provided upon request.

Participants

75 teachers and 48 students across all five disciplines and other divisions in the University, including the central University Learning and Teaching unit and the library, participated in the online survey in Phase I (Table 1). 'Teachers' also included their professional support staff. Of all participants, , 26 teacher and 29 students voluntarily attended follow-up discipline-specific focus groups in Phase II. A list of the teacher and student discipline affiliations can be found in Table 1.

Table 1:

Discipline representation in Phase I (online survey) and Phase II (focus group) of the study

	Phase I		Phase II	
Discipline	**Teacher (n)**	**Students (n)**	**Teacher (n)**	**Students (n)**
SMAH	17	13	8	4
SOC	9	13	6	9
BUS	8	5	3	1
EIS	8	7	1	4
LHA	19	9	3	5
LTC/Library	12	n/a	5	6
Other/Not specified	2	1	n/a	n/a
Total	75	48	26	29

Discipline acronyms: SMAH = Science, Medicine and Health, SOC = Social Sciences, BUS = Business, EIS = Engineering and Information Sciences (includes physics and maths), LHA = Law, Humanities and the Arts, LTC = Learning, Teaching & Curriculum.

The Phase I teacher respondent's years of service in their current role ranged from two months to 32 years (Table 2), with an average of 6.45 years (SD = 6). Phase I student participants' years of study at the university varies from 1 to 4 years and additionally includes postgraduate students (Table 3).

Analysis

The first four research questions were answered by qualitative data analysis. Coding of the qualitative data from the online survey and focus groups was undertaken by 4 co-investigators. Thematic analysis and constant comparison (Braun, 2006) were used to analyse the qualitative data. Research question 5 was answered by quantitative analyses. The participants' responses to the close-ended questions in the online survey and Kahoot! quiz were analysed quantitatively

using IBM SPSS Statistics software Version 25. Independent samples t-tests were performed to compare the teachers' and students' perceptions of the use of TEL, including a desire to use TEL, confidence in using TEL, helpfulness of TEL to learning, and the other stakeholders' technology capability. One-way ANOVAs were used to examine the effect of background factors (i.e., discipline, years of study/service) on the participants' perceptions.

Table 2:

The teacher participants' years of service

Years of Service	n	Percent
0 to 3	32	42.7
4 to 8	24	32
9 to 15	13	17.3
16 to 19	4	5.3
20+	2	2.7
Total	75	100

Table 3:

The student participants' years of study

Years of Study	n	Percent
1	14	29.2
2	10	20.8
3	13	27.1
4	8	16.7
Postgraduate	3	6.3
Total	48	100

Results

Teacher and student definition of TEL

In the online survey and focus group interviews, teachers and students were asked to describe what TEL means to them. Teachers and students agreed that TEL is the use of technology that helps students to achieve learning outcomes, independence, and to interact and engage with their studies. When teachers and students were prompted to give examples of TEL in their teaching or learning, the responses were very similar. Their responses covered learning platforms, lecture recordings, discipline-specific software, document sharing, virtual and augmented reality, video conferencing, presentation software, social media, videos, interactive tools, infrastructure and research tools.

Both teachers and students believe TEL enriches and transforms the student learning experience, supplements and clarifies their class material, creates new opportunities, enables them to assess their own competence, aligns with the diverse learning styles of students whilst providing flexibility.

Sample of Teacher comments included:

> "supplement class material"

> "have great flexibility".

Likewise, students also appreciated the use of TEL:

> "enhance(ing) understanding, … making learning practical….more easily recalled"

> "practice activities immediately tell you whether you are right or wrong."

The students' definition of TEL diverged from that of teachers in that students were much more focussed on the practical benefits of TEL in providing accessibility to resources. Although teachers specifically mention TEL in providing flexibility and supplementing class material, students focused more on the advantages and efficiencies that incorporating TEL can bring to learning in the context of fitting studies in with family life and work commitments.

Student comment on TEL :

> "access … resources from wherever I am. I …need to be flexible with my employers."

Teacher and student perceptions on promotors of TEL use

The participants' responses to the online survey and Kahoot! quiz were analysed separately. Coding of the qualitative data from the Phase I online survey questions and from the Phase II focus group interview questions revealed several practical and pedagogically driven promoters for TEL use that were aligned between students and teacher. Any misalignments in results between teacher and students are stated specifically within each sub-theme.

The practical promoters identified by teachers and students for the use of TEL were:

- expectation for modern learning and teaching programs,
- equalizing learning for students,
- provision of efficient learning and teaching,
- enhanced competitive pressure in higher education.

The pedagogical promoters identified by teachers and students for the use of TEL were:

- enhanced engagement,
- authentic learning,
- enhanced feedback,
- fostering collaborative learning,
- provision of flexible learning.

The first practical promoter of TEL use was that it is modern and expected. It was expected that the University would provide students with up-to-date technology and resources that are highly relevant in the contemporary digital world and the society in which students live.

Teachers commented that:

"Pressure from students" and "Meeting the expectations for 21st century learners …"

While one student commented: "[Lecturers] should be able to keep in touch with technology."

Teachers and students both perceived that TEL was equalizing. TEL enhances equity for students in accessing resources, providing more opportunities for engagement with the learning material at a time and place that suit the student's lifestyle and other commitments. TEL can also offer the means for students who prefer to interact with the material and their peers online rather than face-to-face, the opportunity to contribute, and engage in their coursework. There was greater emphasis from students on the benefit TEL can provide for those students who are under financial stress.

Teachers believed TEL was important for:

"Accessibility" and "Benefits students who have difficulty speaking up in class"

Students believed:

"It's a leveller …there are some students … who don't have a lot of resources."

Teachers and students recognised that TEL could provide efficiencies in both teaching and learning, by catering to different learning preferences, and using TEL can promote more self-directed learning for students. Teacher responses focussed more on efficiencies in coordinating subjects with large student numbers (i.e. for marking assessments, communicating and providing feedback), whereas some students perceived other efficiencies as actually being lazy, for example lecturers putting up a long video during a lecture.

Efficiencies achieved from the teachers' perspective were:

"time saving (e.g. Marking, ability to reach large groups)"

"looking for ways to work more efficiently"

From the students' perceptive were:

"Helps explain difficult concepts"

"Lecturers who put on videos that are a bit too long … they're being a bit lazy."

As competition between Universities increases, there is an expectation from teachers that institutions will provide a modern, technology rich experience for them and their students. There was only one mention from a student in a focus group about competition and they believed that a competitive edge this University has is the availability of resources and teachers to assist them with their learning compared to larger other Universities.

Teachers believed there was a need for:

"Keeping up to date with other universities"

"Keeping abreast of best practice and international standards of delivery."

A student thought:

> "in a competitive environment [a larger university] people do hide resources."

Teachers and students concurred that a considerable pedagogical motivator for using TEL in their class was that it promotes student engagement in the subject material, and can provide a mode of engagement for the more reserved students to participate in discussions and activities in which they would otherwise have not engaged. Students expressed a desire to be more engaged in class and appreciated that TEL can provide opportunities to do so. TEL can also bring students back in to focus if their minds have wandered during a lecture.

Teachers thought TEL can engage students as follows:

> "[kahoot!]: an anonymous way to contribute"

> "keeps …students more attentive"

Students found TEL engaging because it:

> "keeps people awake, brings them back into focus… ready to continue learning"

> "iclickers have inspired me to study….. in order to get questions correct"

Teachers and students alike believed that technology is authentic and very much a part of our world, and that Universities should be preparing students with a skillset for the technology they are likely to encounter in their future careers. Technology also offers an opportunity for self-paced independent learning which are qualities sought from employers. It was also expected that the University would provide students with digital literacies to take with them into the workforce.

Teacher comments on the value of TEL in the University setting included:

> "get students ready for the workforce where they will be using technology"

> "builds student independence and autonomy….key attributes valued by employers"

Student comments were:

> "Helps giving you the skills for …..the workforce."

> "technology …being more used nowadays in… the workforce"

The opportunity to provide feedback were reported by teachers and students to be a pedagogical promoter for using TEL, and they valued the feedback that activities such as real time interactive quizzes can give them on students' level of understanding of the subject content. TEL allows for feedback to be given quickly, as a formative means to show students' gaps in knowledge or misconceptions that a teacher can utilise in class design. Teachers considered that taking action on the feedback was crucial. A perception unique to students was that they valued the opportunity to see feedback on how they are progressing in comparison to the rest of their cohort, as this can provide some reassurance if they know that others are at the same point as they are.

Teachers believed TEL can provide:

> "[kahoot!] quick snapshot of entire class … "

> "use it to gather some information … before you started … a bit of a pre-test"

"What should we do with the [feedback] data …? That's what needs to be pushed more"

Student comments included:

"lecturer could see what the people in the lecture knew and what they did not know"

"[kahoot!] helpful for students …to see where they are at against the cohort …"

TEL was understood to be a powerful collaboration tool by teachers and students. There were a variety of new opportunities for collaboration made possible by TEL that would not have been possible without it. Teachers and students described collaborations and exchanges between: teacher and students; students and their peers; and students and employees in the workforce.

According to teachers, TEL improves collaboration by:

"allows different types of interactions between teachers & students & student to student"

"Creates new opportunities that weren't possible before (eg: interactive videos with people working in the field)"

According to students, TEL:

"makes … easier … communicate with lecturer, tutor and teacher"

"you can always check the forums to see what everyone else has to say"

For teachers, TEL offers the opportunity for flexible delivery of subjects and resources and a broader scope of learning opportunities for their students. This flexibility of learning opportunities caters to the variety of learning styles of students. Students, on the other hand, valued the flexibility in delivery and resources with respect to fitting study in with their other commitments.

From the teacher perspective TEL gives:

"flexible access to resources"

"more flexible learning opportunities"

Whereas a student commented:

"Echo 360 (INC.), has allowed for my learning to be more flexible with my schedule"

Teacher and student perceptions on barriers for TEL use

Through the coding of the qualitative data from the open-ended Phase I online surveys and from the Phase II focus group interviews, barriers that teachers or students reported as preventing them from using or considering using TEL in the classroom were:

• fear and time burden of incorporating TEL and lack of technical knowledge

• institutional culture and infrastructure and support for TEL

• distraction of TEL and prospect of superficial learning using technology with no pedagogical/contextual justification and the value of face-to-face teaching

In terms of fear, this includes fear of change, fear of failure (technology failure), lack of confidence, privacy concerns and cost. Among teachers, there was a fear of lack of recognition

from their school or institution for the time spent learning and developing TEL resources. Lack of technical knowledge and lack of digital literacy were barriers for teacher and students in implementing, or using TEL, respectively. From the teacher perspective only, lack of knowledge on where to get support for TEL was an issue. Sustainability of TEL, pace of change of technology, IT control (fear of SPAM, security concerns), and lack of a fail-safe if technology does not work, were also concerns from teachers. Some perceptions unique to students were that they feared losing face-to-face teaching and expected that what they are paying for in an on-campus course is the opportunity to interact with their peers and academics, and some were limited in their use of TEL by financial constraints.

Teachers stated:

> "I'm a discipline expert, not a technology expert"

> "restricted access…by IMTS…using free software"

Whereas students commented:

> "Face to face will always beat technology"

> "I do not own a laptop or a mobile phone plan that has much data per month"

A viewpoint offered by teachers, but not students, was that University culture is a barrier for TEL use. The casualisation and high turnover of teachers were considered a barrier for teachers in implementing TEL, because the time involved in re-training teachers would be significant and teachers on fixed term contracts may not see the benefit of investing the time in TEL. Institutional and disciplinary cultures with a research-driven focus were barriers for teachers where time spent in research is prioritised and more formally recognised over teaching. There is also uncertainty among teachers in who should take ownership of TEL development for teaching, is it the academic's role, or the professional/technical teacher member's role? Both teachers and students reported that issues with infrastructure on campus were a barrier to using TEL. Additional barriers for using TEL from the teachers' perspective, were limited funding and limited elbow support. There were also some frustrations from teachers that some learning platforms and common teaching areas were not consistent across the University. For students, problems with Wi-Fi on campus and their own equipment were a barrier with TEL, particularly running out of battery on their laptops.

According to teachers:

> "Culture of the university ….research is going to win out every time"

> "I'm on a fixed term contract…time spent on implementation might not be worthwhile"

Whereas for students:

> "some projectors … fail to work"

> "Low battery, lack of internet"

Distraction was the most commonly reported pedagogical barrier for using technology in the classroom from both the teacher and student perspectives. For teachers, the challenges of setting up technology were a distractor, taking them away from getting on with their subject content, as was teaching to a class where students were preoccupied with their devices and disengaged. Students also perceived that their technology buzzing around them was a barrier to their learning,

and even though they recognised it was within their control to turn off their devices or distractors, many students left them on. A problem only mentioned by students at distance campuses, was that the technology glitches experienced when connecting to the main campus were a distraction and barrier for their learning. In addition, there was a concern among teachers and students that TEL could result in superficial rather than deep learning of content and may shortcut the skills that are required for their future careers. Traditional methods of learning and teaching were considered by some to be superior to TEL for achieving a deeper level of learning and understanding.

Teachers thought TEL can be distracting because:

> "You have to detach them [students] from constantly checking social media"

> "bad technology broadens the gap (developing skills/learning)"

Students concurred with teachers on the distractions of TEL:

> "When teachers experience technical difficulties and muck around for 30 min trying to log in"

> "can actually detract from the quality of the discussion … everyone is having a screen up in front of them as a kind of barrier"

Teachers and students believed that technology used for technology's sake was detrimental to learning, and that TEL was most successful when used in the appropriate context. Additionally, the overwhelming view from teachers and students was that face-to-face teaching is highly valued and is integral to success in learning. Students in particular held very strong views about the value of face-to-face learning at University. They believed that face-to-face delivery is pivotal to the on-campus University experience and to their learning, and desired the opportunity to interact with their teachers and peers.

Teacher comments included:

> "TEL has to be appropriate in the scenario"

> "I did a peer review on a painting class…it's not applicable there [digital technology]."

Student comments included:

> "I pay a lot of money to come to university, I want to see teachers face to face"

> "If students simply wanted a whole bunch of online subjects they would have enrolled in an online university not xxx [this one]"

Solutions offered by teachers and students for better TEL in the future

In the focus groups, we investigated the solutions teachers and students offered to envisage a better future for TEL at the University, if given unlimited funding and resources. The solutions offered did not align between teachers and students. The teacher responses centred on the need for a more streamlined, strategic, holistic, accepted and pedagogically sound approach in the implementation and support of TEL. Working together with a clearly defined and well-supported purpose was a common theme echoed among teachers in their responses. Students' vision for the future was that the institution would prioritise the compulsory recording of all lectures, and have TEL strategies that continue to expand accessibility to free learning resources, efficiencies in the classroom, and have recognition of the financial constraints faced by students who may not have access to their

own devices and/or internet connection off campus. Although face to face learning remains important to students, they would still like the option to choose to 'Skype in' to a tutorial, and experience learning in virtual and augmented realities to enhance, but not replace, their face-to-face learning. Students would like to be considered as partners to teachers in developing online resources, and as partners with other universities so they can experience other teaching styles and expand their peer-to-peer learning.

Example Teacher responses included:

> "needs to be more clarity and guidance about … strategic alignment"

> "…collaboration between … faculties (disciplines) to ensure support and integration of technologies"

Example student responses included:

> "compulsory recording of lectures - this is the most important technology of them all."

> "I want the options. You want the option to come in [to campus] if you want to."

> "cooperation between teachers and student … Students have the ability to create online content"

Desire and confidence to use TEL, a teacher and student comparison

Research question 5 asked if there is any difference between the teachers and the students in their perceptions on the TEL use, correlations of the teachers' responses to relevant items and of the students', and what factors influenced the teachers' and students' perceptions. This question was answered by quantitative analyses. The participants' quantitative responses to the online survey and Kahoot! quiz were analysed separately.

Independent samples t-tests were performed to compare the teachers' and students' perceptions on TEL use, particularly their desire and confidence to use TEL and perception of each other's savviness. Descriptive results of the participants' responses to the online survey are shown in Table 4.

Results show that there was no significant difference between the teachers ($M = 6.12$, $SD = 1.06$) and the students ($M = 6.08$, $SD = 0.87$) in their desire to use TEL in the classroom, $t (121) = -.19$, $p = 0.85$, $d = 0.04$. The results suggest that both teachers and students had a strong desire to use TEL to facilitate their teaching and learning. However, the students' confidence for their proficiency in using TEL in classroom activities ($M = 5.96$, $SD = 1.01$) was significantly higher than the teacher's perceptions about students' TEL savviness ($M = 5.29$, $SD = 1.15$), $t (121) = -2.38$, $p = .02$, $d = 0.4$. Likewise, the teachers' confidence about their tech skills ($M = 5.41$, $SD = 1.01$) were significantly higher than the students' perception about their teachers' TEL savviness ($M = 4.79$, $SD = 1.15$), $t (121) = 2.32$, $p = .02$, $d = 0.4$. Cohen's d suggests that the effect size was small. The results suggest that teachers are more confident in using TEL than their students perceived.

Independent-samples t-tests were also conducted to compare teachers' and students' confidence about their proficiency in using TEL, and their perceptions of each other's technology savviness/skills. Results show that there was a significant difference in the scores for teachers ($M = 5.41$, $SD = 1.42$) and students ($M = 5.98$, $SD = 1.01$); $t (121) = 2.32$, $p = .02$, $d = 0.4$. Cohen's d suggests that the effect size was small. Results of also show the teachers' ratings for students' TEL

savviness (M = 5.29, SD = 1.15) were significantly higher than students' ratings for teachers' TEL savviness (M = 4.79, SD = 1.13); t (121) = -2.38, p = .02, d = 0.4. Cohen's d suggests that the effect size was small. The results suggest that the teachers believed that their students were more proficient in using TEL than the other way around.

Table 4:

TEL perceptions and self-rated confidence proficiency and tech-savviness

		n	Mean	Std. Deviation	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Desire to use TEL in the classroom	Teacher	75	6.12	1.174	5.85	6.39	1	7
	Students	48	6.08	.871	5.83	6.34	4	7
I am proficient in using TEL	Teacher	75	5.41	1.415	5.09	5.74	1	7
	Students	48	5.96	1.010	5.67	6.25	3	7
Students are Tech-savvy	Teacher	75	5.29	1.148	5.03	5.56	2	7
Teachers are Tech-savvy	Students	48	4.79	1.129	4.46	5.12	2	7

Pearson correlation coefficients were calculated to examine the correlations between teachers' perceptions about the support received, their desire and confidence to use TEL, and students' savviness. Results are shown in Table 5.

Table 5:

Correlations between teacher perceptions

	Pearson Correlations (n =75)			
	1	**2**	**3**	**4**
1. I feel supported in implementing TEL in my teaching	1			
2. I feel that I am proficient in using TEL	.20	1		
3. Students are tech-savvy	.23*	.12	1	
4. I want to use TEL in my teaching practice	.34**	.43**	.18	1

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

As Table 5 shows, that teachers' desire to use TEL was strongly correlated with their perception of support received in implementing TEL (r=.34, p<.01) and confidence of their own tech savviness (r =.43, p<.01). The results suggest that the teachers who felt supported in implementing TEL or those who was proficient in using TEL had a strong desire to use TEL in their teaching practice. The teachers' perception of the support received in using TEL is correlated with their perceptions about students' tech savvies (r=.23 , p<.05). The result suggests that teachers felt more supported in implementing TEL when their students are tech-savvy.

Pearson correlation coefficients were also performed to measure the correlations between students' perceptions about their desire and confidence to use TEL, and teachers' savviness, and helpfulness of TEL. The results are presented in Table 6.

Table 6:
Correlations between student perceptions for the four statements

	Pearson Correlations (n =48)			
	1	**2**	**3**	**4**
1. I want to use TEL in the classroom	1			
2. I am confident in participating in TEL activities in my class	.68**	1		
3. TEL helps with my learning in the classroom	.86**	.59**	1	
4. University lecturers/tutors are technology savvy	.08	.272	.09	1

** Correlation is significant at the 0.01 level (2-tailed).
As Table 6 shows, the students' desire to use TEL in the classroom was strongly correlated with their confidence in participating in TEL activities (r = 0.68, p < 0.01) and their belief about helpfulness of TEL (r = 0.86, p < 0.01). The students' confidence in participating in TEL activities was also strongly correlated with their perceptions of the helpfulness of TEL (r = 0.59, p< 0.01). This result suggests that students who were confident in participating TEL activities perhaps were more likely to find that TEL was helpful to their classroom learning.
One-way ANOVAs were performed to examine whether the teachers' and students' perceptions of TEL varied with their disciplinary affiliation and years of study/experience. The results show that neither discipline affiliation nor years of study/experience had a significant effect on their perceptions.

Independent sample t-tests based on the survey data administered within Kahoot! Phase II, shows no significant difference between the teacher and students in their experience of using TEL (e.g., use of Kahoot!, frequency of use, benefits, enjoyment, and support of TEL in any form). One-way ANOVA shows that the discipline had a significant effect on both groups' perceptions about "How supported they felt when implementing (for teacher) or using (for students) TEL", F (5, 45) = 3.31, p = 0.013. Bonferroni corrections show that students (M = 3.25, SD = 0.75) and teacher (M= 1.80, SD = 1.10) in the EIS discipline felt less supported than those in another. There was no significant difference among students and teacher in other disciplines.

Discussion

Definitions of TEL

This study explored the definitions of TEL by teachers and students across all disciplines of an Australian University. In line with the work of Stein, Shepherd & Harris (Stein, Shepherd & Harris, 2011), teachers and students defined TEL as a tool to support student learning and facilitate interaction. Students in particular described TEL as a collaborative enterprise, in terms of facilitating teacher to student, and student-to-student interaction which may extend an expansive geographical distance, but also collaborative in terms of teachers and students and being co-producers of technologically supported learning content. Partnering with students in curricula design is a global trend with many reports attesting to the positive outcomes for both teachers and students regarding their engagement and learning (Cook-Sather et al., 2014; Hubbard et al., 2017). In agreeance with Timmis and Williams (2013), partnering with students in the co-design of TEL resources provides opportunities for authentic forms of student enquiry and research whilst engaging in learning with a shared purpose. Our study highlights the desire from students, to be involved as co-producers of learning content and a resulting shift in the conceptualisation of the teacher-student relationship towards a more reciprocal model (Bovill, 2013). Other institutions may want to consider the value of the student voice when developing strategic guidelines for the adoption of TEL across their Faculties. TEL may also offer opportunities (i.e. engaging with anonymous polls) for more introverted students to contribute to and engage in learning, producing a richer student voice than what may be achieved by purely face to face environments.

Additionally teachers and students describe that TEL supports students in becoming self-regulated learners, with the ultimate goal in education - to have students become masters of their own learning (Zimmerman, 1990). Self-regulated learners are likely to have been well placed to cope with the rapid shift to the more isolated environment during COVID-19 (Alghamdi, 2021) and self-regulated learning may require more explicit development in students and teachers as these lifelong skills become more applicable in the post-pandemic higher education sector (Petronzi, 2020) and workplaces. There are several models that explain the process that underpins self-regulated learning. McMahon and Oliver (2001) outline a model including roles of both affective (self-concept, motivation, volition control strategies) and cognitive (metacognition, self-monitoring, strategy formation) aspects of self-regulation. These factors need careful consideration when designing and utilising TEL environments aimed at promoting student's self-regulation of their learning. A point of divergence in the conceptualisation of TEL in our study was the students heightened focus on TEL as a tool for accessibility to resources to ensure equity for student learning. However, one of the barriers to the inclusion of TEL proposed by teachers   was their experience with unreliable and costly infrastructure. This continues to highlight a teacher's struggle with embedding TEL that truly supports, equitably, the learning of all students. Additionally, students continue to seek technology that can equalise student-learning opportunities and alleviate the increasing cost of higher education.

Many student experiences during the COVID-19 pandemic, even in more developed nations, such as Australia, highlighted the struggle to have equitable access to computers, the internet and other important TEL infrastructure. This is further exacerbated by the now wide spread acceptance of work from home protocols which puts the student in competition for these resources within households. This needs consideration as providers expand their use of TEL and models of online learning to reach students across the globe at a pace unseen before the pandemic. Although the shift to remote learning during COVID-19 was an emergency rather than permanent situation, it is likely to lead to a revolution in higher education. Recent studies on student or teacher perspectives

of online learning have affirmed the positive attributes of TEL in higher education such as flexibility and convenience (Rapanta, 2020, Hill 2020), however there are few studies that address this issue from a cross-discipline perspective. Future studies could use our findings as a baseline data to investigate the dynamic changes of teacher and student TEL perspectives post COVID-19.

Promoters and barriers of TEL, with solutions

This study explored the promoters and barriers to the effective use of TEL by both teacher and students across several disciplines at an Australian University. Not surprisingly, a number of shared and divergent concepts emerged, and there was a significant difference between self-reported technology savviness and confidence of teachers and students, compared to how they rated each other's technological savviness and confidence. This misalignment could be evidence of the 'digital divide' that may still exist between teacher and students in higher education (Alexander, 2017). Our study showed no significant difference in participant's responses relative to age or experience or discipline context. This finding is surprising but may have been impacted by the relatively small sample size across some disciplines and experience levels, and potential bias if, for example, teachers or students chose to participate in the study due to their interest in technology to assist with their learning.

Nevertheless, this study contributes to a more shared understanding of what drives both teachers and students in their use of technology in education, with a mutual notion on the power of TEL for engaging students in authentic, collaborative and flexible learning. Teachers and students agreed that in the competitive higher education climate at the time of the study, expanding TEL is an assumed part of modern education. Interestingly both teachers and students were strong in their opinion of the importance of face-to-face learning opportunities, with TEL being a supportive aspect in blended learning. The challenge is that educators who have been comfortable and competent in traditional face-to-face teaching often find themselves thrust into new modes of online or blended teaching with limited technical or professional preparation. Their current pedagogical understanding is often not transferable to the new mode of teaching (Stacey, 2007), however online learning has now been forced upon all educators during COVID-19. Clearly, there is a need for continual upskilling of educators to effectively deliver teaching in the shift to an increasingly online or blended approach in post-COVID-19 higher education globally. Institutions are also recognising that team based, cross-discipline approaches to learning and teaching are required in our higher education digital landscape to provide support for teachers by connecting them with professional staff such as TEL specialists, learning engineers and educational developers who can provide sound pedagogical approaches in the adoption of TEL (Bälter, 2017; Donnelly, 2017). Sound pedagogical approaches in online learning should now be considered as an essential component of lesson planning for all teaching given that many courses will have at least some component delivered online post COVID-19. For universities to be competitive in the future, investment must be made to ensure both the face to face and online modes of delivery are high quality, and that pedagogies are addressed for both modes of delivery in teacher professional development (Rapanta, 2020). We propose that professional development tailored to meet future needs of higher education could consist of upskilling of teachers in sound online pedagogical practices, the provision of real time elbow IT support for online synchronous and asynchronous learning for teachers and students, and a cross-discipline model of learning design that can incorporate the learnings from both discipline-specific academic experts and education designers in a transparent process that is strategically aligned with the university's visions and goals. Institutions would benefit from ensuring sound investment in, for example, the Wi-Fi technology, hardware and software available for teachers and students.

Additionally the identification of key barriers to TEL use, and the articulated solutions, show that teachers focus on the institution and a need for strategic and pedagogically driven approaches, whereas unsurprisingly the students focus more on accessibility and costs. However, the students also focus on the collaborative power of TEL and their potential role as co-creators of content. Higher education providers have had to take bolder steps, or leaps, into TEL in light of online learning during the COVID-19 pandemic and many have partnered with students in this endeavour and models developed (Green, 2020 & Whelehan, 2020). However, the pace at which some of this transformation has had to occur means that now we need to enhance our partnerships with students in the co-creation, review and optimisation of this content. As Ntem and colleagues (2020) have stated, a review of student-teacher partnerships in a virtual environment has led to a re-conceptualisation of values, such as respect, reciprocity and shared responsibility, to ensure an effective partnership is achieved.

For many students and teachers, the financial toll of COVID-19 in terms of reduced or lost work for them and/or their family, or illness due to COVID-19, amplifies the importance of institutions providing accessible and affordable education such as provision of laptops for students and flexibility in payment of course fees. Border closures and the need to care for family members have driven or kept many international students offshore from their enrolled institution, resulting in a greater need for an understanding of the challenges, including access to technology, students may face in their country. For example, Abushammala and colleagues (Abushammala, 2021) reported that nearly 40% of their students surveyed in Oman were either unsure of or lacked computer skills, and 35% did not have a webcam. This potentially limits the student's ability to participate completely and equitably in an online learning environment, increasing the risk of feeling isolated, disengaged and hampering learning. We may also see an increase in international and regional enrolments more broadly in higher education as online course offerings are likely to remain and/or grow post COVID-19, making these considerations even more important. Currently, institutions also need to be well equipped to instantly switch to teaching remotely to domestic and international students, if outbreaks of COVID-19 re-occur. Institutions, their staff and their students need to have the agility to act quickly and responsibly.

The current and post-COVID-19 higher education sector may also draw on TEL resources more heavily such as interactive software, videos and animations to retain knowledge that could be lost at their institutions in the face of casual staff lay-offs, redundancies and merging of Faculties occurring across many institutions. To ensure that TEL resources are pedagogically sound and of high quality, a cross discipline approach that brings together educational developers in addition to subject content experts should be the strategic approach in the future to best meet the needs of students in both the blended and online environments. Post-COVID-19 we are likely to see various institutional strategies to deal with vaccinated, unvaccinated, and vulnerable students, and this is where TEL may be able to offer accessibility for many students who may not be able to attend face to face classes. We also must draw attention to the limitations of online learning and TEL in replicating the face to face environment, particularly in terms of practical based activities, engagement, social interaction, increase in workloads and successful group work. For example, 50% of students in health related coursework were either dissatisfied or very dissatisfied with the arrangement of lab classes during COVID-19 (Abushammala, 2021), and 42.9% of students surveyed reported they felt difficulties while doing group projects or assignments through distance education and the lack of socialization (Adnan, 2020). 29% of respondents in the Australian student experience survey (Martin, 2020) noted dissatisfaction with the level of peer engagement during online learning during COVID-19. We need to find creative solutions to keep students engaged online with their peers, particularly for those who are unwilling to use their webcam or do not have access to one.

Conclusion

This holistic cross-discipline study of TEL perceptions of teachers and students has contributed to knowledge in this area by identifying barriers and solutions for TEL common to all disciplines that have the potential to be applied to whole of institution strategic approaches for the effective use of TEL in teaching and learning in higher education. The results of this study have informed our institution's recent 'TEL issues paper' which was purposed to better enable and support academics in the use of technologies for teaching and learning, and may also be useful for other higher education institutions who would like a whole of institution approach. Our cross-discipline approach will benefit all disciplines as TEL solutions and innovations are shared and efficiencies are found, which is particularly relevant as we see cuts across the higher education sector and more reliance on digital modes of delivery post COVID-19. Our awareness of the misaligned perceptions between teacher and student of each other's technology savviness and confidence can also be helpful in overcoming and preventing barriers that may arise in TEL use between teacher and student. The unique insights from teachers and students on how to provide a better future for TEL at our institution may result in more targeted approaches to succeed in meeting their needs. This pre-COVID-19 snapshot of TEL at our institution may also provide a valuable reference point for future studies of how teacher and student perceptions may have changed in the rapid temporary shift to fully remote learning in 2020 for nearly all of the institution's subjects, and which of our findings remain, or are more relevant, in the post-COVID-19 higher education sector

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