Research in Learning Technology
Vol. 32, 2024

ASSOCIATION FOR LEARNING TECHNOLOGY ALT

ORIGINAL RESEARCH ARTICLE

Students' experiences of educational technology use to facilitate university learning: factors influencing their mediation of learning

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(Received: 5 July 2023; final version received 19 April 2024; Published: 10 September 2024)

The ability to design effective technology-enhanced learning (TEL) experiences is a critical skill for university teachers. However, challenges endure on how best to develop university teachers in research-intensive universities to design TEL experiences that meet student, professional, and employer expectations. Having a greater insight of the varying ways students use educational technology in their learning benefits university teachers' TEL design skills. To develop this insight, a qualitative case study comprising differentiated interview strategy was conducted to explore students' use of educational technology for their university learning. This research drew on phenomenographic and sociocultural theoretical perspectives and analysis techniques to investigate university students' experiences of educational technology use.

The analysis of the research data collected found a variance in the way students used educational technology for their university learning with three distinct dispositions identified. This study identified that students' varied dispositions influenced their educational technology use and were mediated by the task and social contexts of their learning. These findings aim to support university teachers further develop their TEL experience design skills.

Keywords: learning dispositions; higher education; learning design; learning contexts; social contexts

Introduction

The rapid pace of technological change and the COVID-19 pandemic pivot to online teaching has impacted on university teachers' practice and continues to challenge the engrained beliefs and traditions of teaching and assessment practices (Goodyear, 2022).

As a result, university teachers are compelled to rethink the way they design and facilitate technology-enhanced learning (TEL) experiences. As part of the design process, they have to disentangle and test assumptions about students' digital capabilities that encompass digital literacy, information literacy, and academic literacy skills in these times of digital flux in higher education (De Nito et al., 2023; Jisc, 2022a; Wuyckens et al., 2022).

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Citation: Research in Learning Technology 2024, **32**: 3193 - http://dx.doi.org/10.25304/rlt.v32.3193
(page number not for citation purpose)

Results from the 2022 Jisc Digital Insights Survey identified that most students were comfortable with using technology and confident in trying out new technology. However, many students reported their digital learning experiences were not motivating and engaging and the opportunities in their course to develop digital skills for their future career were limited (Jisc, 2022b).

Whilst the expectation that university teachers use educational technology effectively in their teaching (Advance HE, 2023), university teachers report that they want more and better digital teaching support and training in both TEL methods and tools (Jisc, 2022b).

UK universities have invested heavily in educational technology for teaching purposes and increased the number of specialist TEL staff. However, the literature continues to report that further work is required to meet learners, professional, statutory, and regulatory bodies, and employer demands (Markauskaite et al., 2023).

To aid the design of the research study a literature review was conducted.

Literature review

Reviews of educational technology research in higher education contexts conclude that most studies have either been pragmatic, concentrate on applications of new technology and the pursuit of evidence of improved learning outcomes, or focus on matters of practical implementation and design (Bennett & Oliver, 2011; Gunn & Steel, 2012). Very few of these studies provide in-depth accounts of the everyday ordinary use of educational technology to facilitate university learning (Selwyn, 2011).

A closer look at the literature reveals that many studies have been conducted in online and distance learning contexts over campus-based classroom contexts and much more in teaching-focussed university contexts than research-intensive university contexts (Ellis & Goodyear, 2010).

Phenomenographic student approaches to learning research have played a major role in bridging the gap between theory and practice of university learning and teaching (Ramsden, 2003). This body of literature has identified that a student's approach to learning is a response to an educational context which is influenced by prior learning experiences, their perceptions of the learning context, their own conceptions of university learning, and academic performance. In these studies, differences in the outcomes between learners as well as the learning processes they employed were reported (Marton & Säljö, 1976; Marton et al., 1993; Prosser & Trigwell, 1999).

This research has had an impact on the higher education research field and professional development programmes for university teachers (Åkerlind, 2023). However, much of this early research was conducted prior to the ubiquitous access to educational technology in higher education and does not explore the complexities this TEL educational context presents to learners.

More recent student approaches to learning research identified the distinct variation in students' conceptions of TEL environments and how the introduction of digital tools, methods, and resources added further complexity to student learning (Ellis, 2016; Ellis & Goodyear, 2010; González, 2010; Mubarak & Khan, 2022).

Although this valuable research has explored the inextricable link between the quality of teaching in TEL environments and the quality of students' learning there are limited studies conducted in university classroom contexts.

Citation: Research in Learning Technology 2024, **32**: 3193 - http://dx.doi.org/10.25304/rlt.v32.3193

Sociocultural studies conducted in educational technology mediated learning and teaching classroom contexts have been primarily focussed on primary and secondary classroom contexts. This research identified how cognitive development is enhanced through the supportive intervention of more knowledgeable others and that this 'learning with instruction' in formal learning environments can expand and extend learning with the right kind of support (Hennessy & Deaney, 2009; Hennessy et al., 2005; Mercer, 1995, 2008).

Whereas guided instruction may be effective in primary and secondary classrooms, it may have limitations in university classrooms where students are encouraged to make their own discoveries and develop as self-directed independent learners (Bakker, 2018).

Sociocultural research identified ways whereby schoolteachers and their students co-constructed knowledge using talk and educational technology to complete learning tasks and where TEL is seen as an additional tool to the teaching technique repertoire (Deaney et al., 2006; Littleton & Mercer, 2013). This research provides research potential in higher education classroom settings.

An English study found that schoolteachers' beliefs on how effective educational technology could be to facilitate learning were affected by what they perceived as educational need and their knowledge of educational technology affordances. When this was congruent, then the assimilation of technology into their ongoing teaching practices and the established curriculum occurred (Hennessy et al., 2005).

Whilst other studies conducted with university students in Australia echo these findings, additional studies to more completely understand student educational technology use in UK university classroom contexts are required (Ellis & Goodyear, 2010; Woo et al., 2008).

Method

Considering the literature reviewed, a case study synthesising insights offered by phenomenographic and sociocultural perspectives was designed to sensitively explore the connections between the process of learning and how students approach and experience learning in TEL classroom contexts.

To shape the design of the study, two research questions were formulated:

- What are the variances in thinking underpinning university students' educational technology use?
- How do students use educational technology to facilitate their university learning in classroom contexts?

Participants and recruitment

The case study occurred over an 18-month period within the natural environment of a School of Chemistry at a research-intensive English University. To develop multi-layered understandings, the researcher was immersed in the life of the school, its lecture theatres, and classrooms, where relationships with academic staff and undergraduate students were developed.

Using purposeful sampling, alumni with a postgraduate certificate in academic practice were invited to participate in the research. Bryn, a motivated university

teacher skilled in promoting TEL pedagogy, offered to open their classroom for the research. A volunteer sample of 15 first-year Chemistry students enrolled in a compulsory first-year module participated in the study.

The learning context

The Chemistry module in this study comprised lectures, laboratory sessions, and problem-based learning (PBL) workshops. In the PBL workshops, each group of six students engaged in 'real-world' small group assessed tasks that required them to think and act like a professional Chemist. The researcher attended four lectures and subsequently generalised interviews were conducted with 15 students. Four PBL workshops were attended where the same group of six students (Team A) were observed during each workshop. Contextualised interviews were conducted immediately after each of these workshops. These six students participated in both generalised and contextualised interviews of the study.

Instruments

A qualitative interview strategy was developed incorporating generalised student interviews and contextualised student interviews. The generalised interview was anchored in the phenomenographic in-depth interview tradition which helped the design, conducting of, and analysis of these interviews (Ellis & Goodyear, 2010; González, 2010). The contextualised interview was grounded in the sociocultural tradition of the post-lesson contextual interview where specific concrete lesson events and commentaries of specific classroom practice of the informants are accessed during this type of interview (Deaney et al., 2006; Hennessy et al., 2005). Table 1 outlines in more detail the research methods and purpose of the study.

Table 1. Research method and purpose of use.

Generalised interview	1) Elicit student accounts of their learning strategies, beliefs, and values in a variety of classroom learning contexts involving educational technology use. 2) Capture the variety and range of patterns of generalised learning strategies, beliefs, and values that inform the participation of a group of students in a university classroom. 3) Elicit a full range of students' university learning experiences which feature educational technology use.
Contextualised interview	1) Elicit student accounts of the learning strategies, beliefs, and values in relation to learning in a PBL classroom learning context involving educational technology use in a small group.

Ethical considerations

To ensure complete confidentiality, all informants identified in this paper have been provided with a pseudonym which reflects their cultural and linguistic heritage without compromising their anonymity.

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Permission for research was approved by the Research Ethics Committee in a UK School of Education. Permission from the Head of the School of Chemistry and the module convenor was also approved.

All informants were assured of confidentiality and signed the participant consent form that provided background information on the research project, its purpose, and details about their participation in the project.

Processes and procedures of data analysis

The process for analysing the interview data entailed a close listening to the audio recordings, a detailed reading of all written transcripts, a collation of common questions, and a further close reading and highlighting of key responses to questions. This was iterative with explicit decisions made at each stage so that confidence in the authenticity, credibility, and trustworthiness of accounts and of the interpretations of those accounts could be examined and tested. The interview transcripts analysis used a combination of inductive and deductive approaches through successive repeated readings and sweeps through the data where themes and patterns were identified and a category system developed (Silverman, 2021).

To minimise the gap and inconsistencies in the discourse of the informants, interview data from generalised and contextualised interviews was merged.

Results

The analysis of the data identified that influences of educational technology on student learning are mediated by students' disposition towards learning and the task and social contexts of their learning.

These findings were developed through analysis of 19 generalised student interviews with 15 students and 11 contextualised student interviews with 6 students over an 18-month period. Four students were interviewed more than once.

A conceptual model was developed to illustrate how influences of educational technology on learning are mediated by student dispositions as well as the tasks and social contexts of learning. Figure 1 presents the different variables at play when students used educational technology to facilitate their university learning.

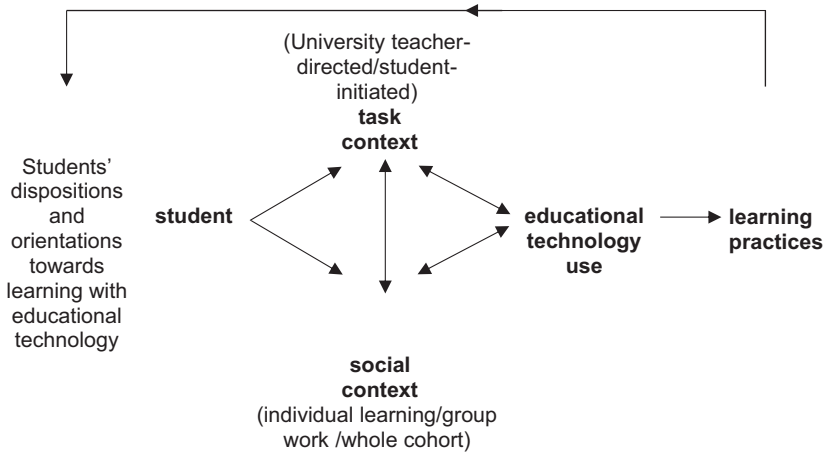

Figure 1. Factors influencing the mediation of learning by educational technology.

Student dispositions

Three clear dispositions towards university learning using educational technology were identified as outlined in Table 2. All students adapted to their new learning context and found innovative and practical ways to incorporate educational technology into different aspects of their university learning.

Table 2. Student dispositions to educational technology use.

1) Pioneer	Genuine enthusiasts who voiced their discontent with the institution and their university teachers' efforts. Felt educational technology use on their degree was not adequate for their learning and future professional needs.
2) Compliant	Expressed satisfaction with the educational technology options provided. Were content to work within the 'institutionally endorsed' sphere.
3) Sceptic	Were critical about what they saw as a 'forced' use of educational technology with minimal support given. Identified themselves as being competent but reticent educational technology users.

The three dispositions identified will now be discussed.

Pioneer approach to educational technology use

'Pioneer' users (five students) talked distinctively about how they were independently shaping their own learning experiences by employing a range of institutionally endorsed and non-institutionally endorsed educational technology applications. They used a range of tools beyond what was required of them and found innovative ways of organising and managing their day-to-day study requirements.

Sam talked about how he took ownership of his learning and developed his own personalised digital revision materials building on the resources his university teachers had provided him. He amalgamated resources in a way that made sense to him and helped him with his learning. This was something he developed through trial and error and refined over time.

> I use (Microsoft) OneNote on my laptop which is great because you can pull all sorts of different bits together, stuff from ChemDraw that I might have needed to draw a mechanism for, or slides from PowerPoint, or images or recordings. Anything, you can pull it all together along with my typed-up notes. So then when it then comes to revision, I have every single bit of information that I've gathered over the semester all in one place and then I can type up or I've occasionally made podcasts, you know, spoken it, because I sometimes find that I learn best when I'm explaining something, but it's all there in one place and I suppose yeah part of that is when watching those lectures again, I can either be scribbling them down, scribbling notes or typing them straight up.

'Pioneer' users were independent and autonomous learners who were not reliant on their university teachers to provide more technology use. They experimented with a wide range of educational technology tools to facilitate their university learning. They used the university-endorsed technology extensively and used non-institutionally

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endorsed technology to satisfy their interests and learning dispositions, preferences, and needs. This included curating digital images and diagrams, academic publications, audio recordings, video, and animation to create their own study resources for both teacher-designated tasks (TDT) and student-initiated tasks (SIT).

'Pioneers' negotiated task boundaries and how they could engage with the task. They negotiated with their peers in group work. They recounted agile engagement in their educational technology-mediated university learning experiences which is represented in Figure 2.

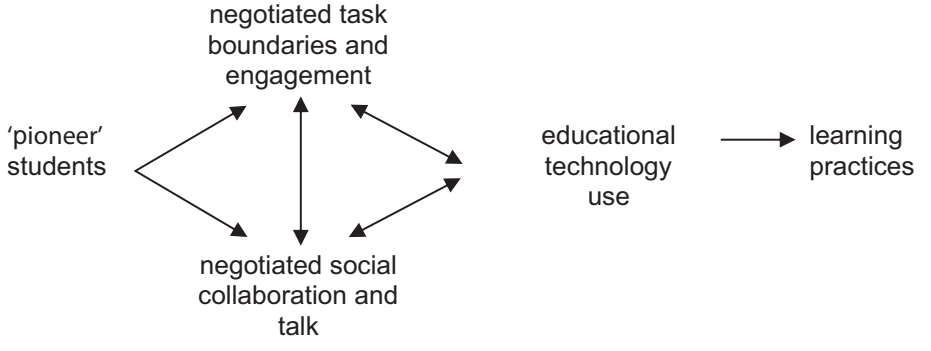

Figure 2. Agile engagement in educational technology-mediated learning.

Compliant approach to educational technology use

'Compliant' users (eight students) were open to the idea of using educational technology as an integral part of their university studies. However, they were also happy to use a combination of traditional educational technology tools such as paper and pen. Over time they mastered the specific tools made available to them but were reliant on their teachers guidance and hesitant to go beyond the institutional provision. They incorporated educational technology into their day-to-day university learning as required.

Gulwant was interested in mastering the institutionally endorsed educational technology to manage her learning.

> I have the Blackboard app. So that's a university app. So it gives me a notification every time a new lecture has gone up or if there's any like – because we have assessed labs every week. So, our reports, like our grades, will go up on there. So, I think that's really important. I check that every day, five times a day.

They were users of social media but were not completely convinced of their usefulness for study purposes. They would use them if necessary but had their reservations. They looked to their university teachers for guidance on what tools they should use.

They were also happy to keep their personal lives separate from their study lives and found the merging of the two uncomfortable. For example, receiving notifications for both social and study purposes in Facebook or WhatsApp was challenging. Active users of these media found the increase in the number of notifications difficult to juggle and having the two spheres of their life on the one application confusing.

Some students mentioned that they were not sure if they could fully rely on the student-driven initiatives using social media for revision. They were unsure of the level of accuracy in these initiatives and were not fully convinced of their usefulness

for their learning. They felt more comfortable engaging with the university teacher-organised revision initiatives available on the VLE and the recommended textbooks.

Students recounted how they used technology socially for gaming or organising group events via Facebook, but they did not want to see these social media tools being integrated into their studies. They did not consistently voice an interest in taking educational technology initiatives themselves or discuss their experimentations with different educational technology.

Sceptic approach to educational technology use

'Sceptic' users (two students) found the regular reliance on educational technology as part of their university studies frustrating and at times overwhelming. Whilst they saw themselves as competent users, they found using educational technology for aspects of their studies problematic and a barrier to their learning.

They would comply with the minimum requirements by writing up their assignments using MS Word or submitting their work online but expressed their criticisms of other practices such as using Facebook for group work or the reliance of the teaching staff on using the VLE to communicate over face-to-face interactions or uploading materials digitally instead of handing out hard copies in class.

Stephen expressed a sense of bewilderment and clearly wanted more help and guidance. He was struggling with his studies and did not consider the TEL guidance provided adequate to support his learning.

> …and the Blackboard thing doesn't really help…it feels like I'm just – there's not really help with it. It's just information on the website and I just go on the website, and I try to gather information, but there's no real guidance to an extent unless I go to say the lecturer and he can guide me.

Most students interviewed were identified as being 'compliant' users who consistently recounted an acquiescent and receptive engagement with educational technology. Students identified as 'sceptic' users reluctantly complied with university TEL teacher-directed tasks and social engagement and saw them as a barrier to their learning. This engagement is represented in Figure 3.

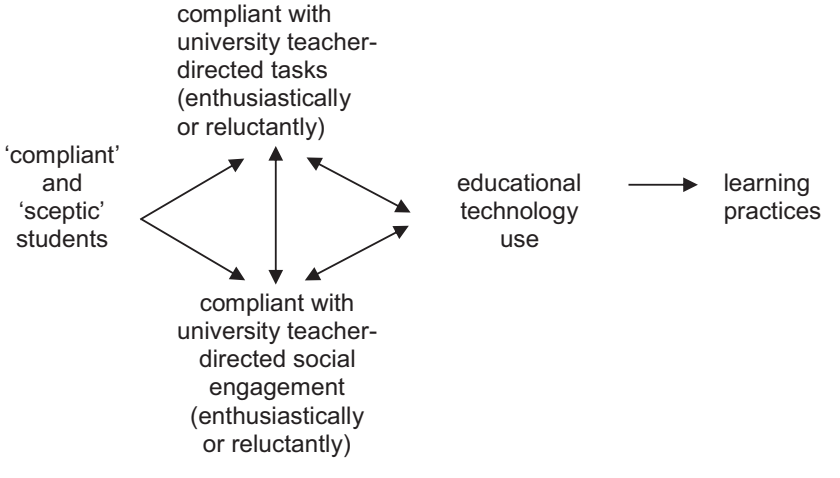

Figure 3. Acquiescent engagement in educational technology-mediated learning.

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Students' approaches to task and the social contexts

The focus in the analysis was on how the students construed the influence of educational technology on their learning. As the analysis developed, it became clear that for many students, the task context of learning was an important factor in influencing their use of educational technology. They also spoke about how the social context of learning influenced their educational technology use in relation to different facets of their learning. This analysis has been in encapsulated in Table 3 below.

Table 3. Students' approaches depending on the task and the social context

(1) Students' choices in educational technology use – task context	a) Structured task: teacher designated (e.g. VLE online quiz) b) Semi-structured task: some scope to adopt different task engagement (e.g., VLE group tool) c) Open-ended task: plenty of scope to engage with task in different ways (e.g. open education resources)
(2) Students' variation in educational technology use – social context	a) Individual learning: more freedom of choice (student-initiated task and tool) b) Group work: some freedom of choice but dependent on group membership c) Whole cohort: little freedom of choice (e.g., teacher-designated task and tool)

Task contexts of learning

A development in the analysis identified that there is more at play than students optimising their learning simply through educational technology use. Students tended to speak about technology use in relation to task contexts of their learning.

When students were talking about task contexts of learning as a factor influencing their use of technology they tended to distinguish between the following:

- Teacher-designated tasks (TDT)
- Student-initiated tasks (SIT)

Students engaged with a range of both TDTs and SITs and talked about how they enacted these tasks using different educational technology. All 'pioneer' users and some 'compliant' users moved beyond the institutionally endorsed educational technology and used a range of non-institutionally endorsed educational technology as well.

Students talked about the VLE as the 'go-to' technology for their Chemistry module which included VLE tools such as groups, wiki, discussion forums, and quizzes. The module design gave them a purpose to log on and engage with their PBL tasks with their group.

Regardless of the flexibility in educational technology choice within the designated task, students were interested in what they could access, explore, or reflect on in the module VLE at their own pace and at convenient times and places.

Maggie's choice of Facebook Messenger for her PBL group work was unplanned and seemed easier to use than what was provided by the university teacher (TDT). However, this did not mean she used this application for all her group work.

> So we had to do a poster presentation and with that we actually did all of our research and everything separately and we all brought it together. That was actually by Facebook that we were messaging one another and we just found it was quite easy to do that and then we would sit or make sure that everyone's got it together and then actually in the PBL lesson, we'd put it together. So, we found that by doing the separate bits of research and sending it together to each other over Facebook, it was really beneficial to then kind of get everyone involved as well.

Susanna found that using Chemistry specialist software aided her conceptual understanding of new and difficult topic areas. Working independently, this tool helped her complete a module assessment (TDT) with confidence and revise for an exam (SIT).

> …in biology lessons we've used some software that helps draw proteins and then you can play with what you're given. So, you can have the structures given differently which really helps visualise what you're doing…. Well, it was easier to see like the 3D perspective and specifically for proteins, how they fold around one another. So, you could get more of a perspective on how it actually figures rather than just a picture on a 2D plane.

Both Maggie and Susannah recounted their educational technology use for specific learning tasks. They made these choices depending on how structured, semi-structured, or open-ended they perceived the tasks to be. These differences in structure are summarised in Figure 4.

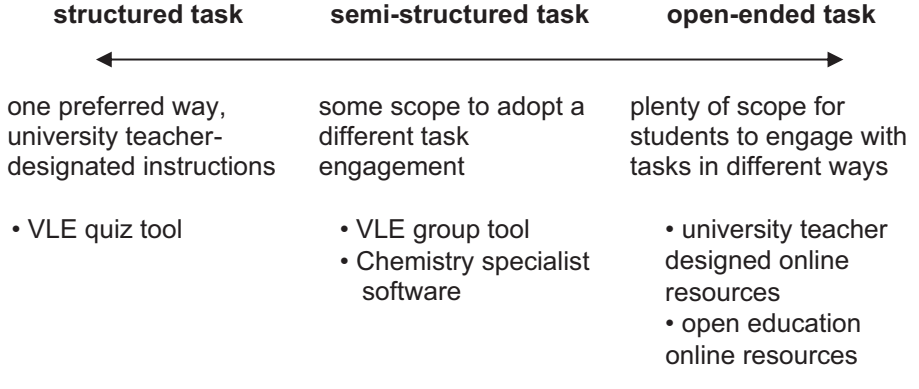

Figure 4. Degrees of structure in students' task contexts of learning.

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Social context of learning

It was evident from the data that some students, particularly 'pioneer' users, engaged with specific educational technology in different ways depending on who they were working with and what they were working on. These students construed different social contexts as influential on how and what educational technology they used to support their learning.

Figure 5 summarises the variation in use according to the social contexts of students' learning.

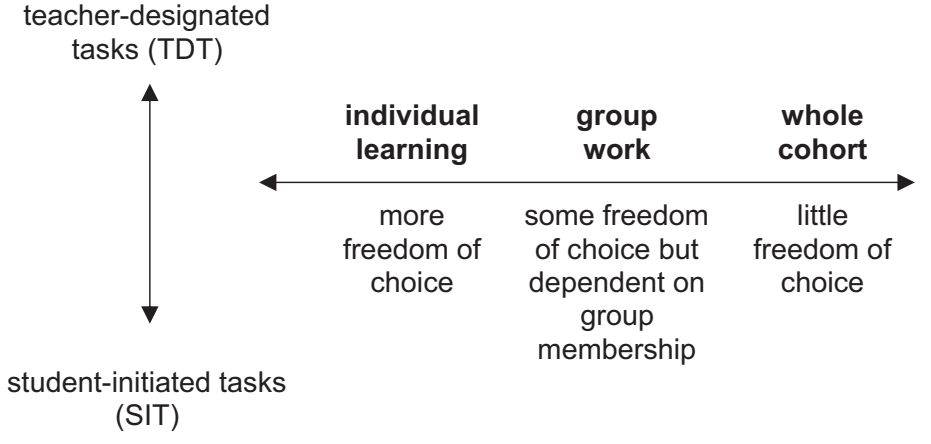

Figure 5. Students' variation in educational technology use depending on social context.

Interactions between task and social contexts of learning

Students' interview accounts showed how interactions between task and social contexts related to students educational technology use in ways that influenced different facets of their learning. They recounted the different ways they engaged with TDTs and SITs. All 'pioneer' users and some 'compliant' users engaged with a range of non-institutionally endorsed educational technology. Maggie, a 'pioneer' user recounted her use of Facebook Messenger over the recommended tool for PBL group work tasks (TDT) and Sam used OneNote over the VLE to support his specific learning needs for module revision (SIT).

Students' choices and decisions around educational technology use were unique, often opportunistic, and contingent on the social and tasks contexts they were faced with. This might be understood as pointing to a highly skilled and adaptive expertise cultivated by students. They adapted their educational technology use in different contexts to enhance their learning.

Sophie, a mature student with children, devised creative ways to support her individual learning.

> It's not always practical to be able to sit and revise as most students would. So being able to like listen to my notes and obviously I don't live on campus. So, it would be nice to listen to my notes in the car. I can put my Dictaphone notes, convert them onto my iPad and play them through my stereo of the car.

However, for Nareem educational technology in the classroom provided him with the opportunity to access relevant scientific information in a speedy manner which facilitated his PBL group work.

> Well one of the main things that technology plays is fast access to information, especially in PBL when most of the time we're talking to each other and we're at a table and we need to get information to discuss very quickly, and with technology, that allows us to be able to do that.

Sam who was tasked with a specific role within the PBL group, worked efficiently during the workshop to support the group task completion.

> I was able to import the text for the second question into a word processing app that I've got. So, I was able to go through that and make some changes from there, highlight some differences. It's quite useful to have different tabs open with the different documents. So, I'd got the problem open once. I was then able to open another tab and do a bit of research on this CAD laser system which obviously you'd really struggle to do with a piece of paper with a problem on.

'Pioneer' users shared successful learning experiences using a range of educational technology during their individual learning and their PBL group work. This was not the case for all students. 'Sceptic' users revealed both successful and unsuccessful individual learning stories; they did not reveal any stories of successful learning while working with peers in PBL group work.

Discussion

The findings of this modest case study identified three dispositions ('pioneer', 'compliant', and 'sceptic') which reflected the variances in thinking underpinning university students' educational technology use. These students responded to their TEL experiences differently and approached their learning in a variety of ways as identified in other student approaches to learning studies (Ellis, 2016; Ellis & Goodyear, 2010; González, 2010).

The results found that most students successfully used educational technology to come to terms with new and challenging concepts in their discipline and complete the required individual and group TEL tasks in their Chemistry module.

However, this was not the case for all students. Some 'compliant' and both 'sceptic' users reported that they would have benefited from more explicit instruction for teacher-designated individual and group TEL tasks. The type of support they sought from their university teachers encompassed digital, information, and academic literacies guidance as well as explicit task instructions and scaffolding as has been discussed in other literature (Bakker, 2018; De Nito et al., 2023; Jisc, 2022a; Wuyckens et al., 2022).

Some of the members of Team A (comprising three 'pioneer', two 'compliant', and one 'sceptic' users) reported that they negotiated the different educational technology options they had at their disposal to complete specific group tasks in their PBL sessions. They reported how they co-constructed knowledge to expand and

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extend their PBL task outputs mediated through talk and educational technology use. These results echo findings revealed in school TEL classroom context studies discussed earlier (Hennessy & Deaney, 2009; Hennessy et al., 2005; Mercer, 2008).

From the results, 'compliant' and 'sceptic' users in this study could have benefited from more explicit guidance on how to effectively collaborate, participate, and communicate with peers when engaged in TEL group work. This type of 'digital capabilities' guidance could encourage more productive TEL group work practices, increase group dynamics in PBL sessions, and hopefully minimise group friction as identified by some 'pioneer' users (Beetham, 2020; Jisc, 2022a).

The findings confirm that the variety of ways in which students used educational technology to facilitate their learning was shaped by the nature of the task (either teacher-designated or student-initiated tasks) and the social contexts in which these tasks were undertaken (either individual or group work). Further research in higher education classroom contexts needs to be conducted to meet the learning needs of a growing diversity of students in a generative artificial intelligence learning environment.

In line with other studies, some students were disappointed by the difference they perceived between their own personal use of educational technology and the uses adopted by their university teachers. They felt that some university teachers' educational technology use did not always meet their expectations (Jisc, 2022b). To reduce the mismatch between students expectations and university teacher approaches, institutional support to design effective TEL environments that match the learning dispositions of their students is still required (Beetham & Sharpe, 2020).

Of course, the study findings need to be seen against a number of limitations. Firstly, the sample came from one school of Chemistry in an English research-intensive university and so it does not claim to be generalisable. Secondly, the sample size of 15 students could be considered small; however, this is not unusual in phenomenographic research. Thirdly, the ways these first-year undergraduate students described their educational technology use in this study did not reflect an exhaustive range of the possible educational technology uses.

Conclusion

University students and teachers have different levels of TEL competencies and capabilities. This research reports that whilst some students have cohesive conceptions of TEL and use educational technology effectively in their studies, others seek clearer guidance from their university teachers. However, there are both students and university teachers who struggle with incorporating educational technology into their practice even if they are proficient users of technology (González et al., 2023; Selwyn, 2014).

An important conclusion from the research is that educational technology alone cannot resolve the learning and teaching challenges that teachers and their students face in university classrooms. It was clear from the results that educational technology use tends to have its most successful effects on learning and teaching through considered interaction with social and task contexts of that learning and teaching. University teachers when designing tasks need to consider what educational technology they want their students to use and how they expect them to use them. By providing students explicit advice, guidance, and options when working

independently and in groups, additional complexities that TEL environments produce are alleviated.

The differentiated interview strategy employed in this study contributes to the articulation of the student voice. These insights can spur university teachers to capture and examine closer their own students' dispositions and educational technology use to enhance their students learning experiences in TEL environments.

This research presents a nuanced description of how educational technology was used to promote learning with the aim to support university teachers in professional development contexts. A great deal can be learnt from how students' engage with TEL experiences regardless of their pedagogical and technological awareness (Jisc, 2022b).

To ensure that future professional development does not contribute to work overload, online communities of practice, peer support, and dissemination of TEL experiences may be more fruitful than traditional formats such as workshops and seminars. Systematic guidance on curriculum development and learning design will help university teachers build stronger concepts and learn through discussion on how to imagine, plan, and evaluate their TEL designs (González et al., 2023; Goodyear, 2022, Laurillard et al., 2018).

Acknowledgements

The author is grateful for the opportunity of developing this work with past and present postgraduate certificate in higher education (PGCHE) participants. This article has benefited from comments by Dr Charles Crook as well as from feedback from reviewers and editors. The author gladly acknowledges their contribution.

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Citation: Research in Learning Technology 2024, **32**: 3193 - http://dx.doi.org/10.25304/rlt.v32.3193