# Identifying characteristics of innovative and less innovative teachers, and opportunities to enhance their digital academic practice, in science and engineering

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## Abbreviations

| | |
|---|---|
| ADD | Academic and Digital Development |
| BOLD | Blended and Online Learning Development |
| CoSE | College of Science and Engineering |
| CPD | Continuing Professional Development |
| GTA | Graduate Teaching Assistant |
| GUSTTO | Glasgow University's Teaching Tips Online |
| LEADS | Learning Enhancement and Academic Development Service |
| MALT | Moodle Active Learning and Teaching |
| MOOC | Massive Open Online course |
| PGCAP | Postgraduate Certificate in Academic Practice |
| TEL | Technology-Enhanced Learning |
| VLE | Virtual Learning Environment |

## Abstract

This study was undertaken in the context of my role in providing Academic and Digital Development (ADD) support to the College of Science and Engineering (CoSE) at the University of Glasgow. Given this emphasis on academic development, as a basis for enhancing student learning, the work seeks to identify the characteristics of innovative versus less innovative teaching staff, external influencing factors on teachers' ability to innovate, and methods of continuing professional development (CPD) that may be employed to encourage greater innovation in all teachers.

This work assumes that engaging in teaching innovation is a positive action, in terms of constructively influencing students' performance and teachers' experiences. This is supported by the literature which implicitly equates innovative teaching with 'good' teaching, resulting in an enhanced student experience and optimised learning outcomes. Technology-enhanced learning (TEL) was used as a lens with which to examine teaching innovation, given the increased emphasis on blended and online learning within the University of Glasgow, its direct relevance to my role in the Learning Enhancement and Academic Development Services (LEADS), and recognition within the sector of TEL as core knowledge for UK Higher Education.

The study adopted a mixed-methods, sequential explanatory methodology in the form of a questionnaire administered to teaching staff, followed by two focus groups; one with self-professed early adopters of teaching innovation and one with teachers who considered themselves early majority.

The study revealed quantitative and qualitative differences between the two groups in terms of their engagement with TEL teaching innovation. The biggest barrier to engaging in TEL teaching innovation for both groups was time. Informal meetings and events, giving academics the opportunity to make serendipitous discoveries and share good practice, was suggested as the most useful form of CPD for promoting teaching innovation, while the Postgraduate Certificate in Academic Practice was also seen to be enabling in terms of innovation diffusion.

The findings were discussed in relation to institutional strategy and the extant literature, and the work concludes with an action plan for CoSE and the institution to encourage and support teaching innovation (the additional intended learning outcome to be agreed with supervisors).

# 1 Introduction and literature review

## 1.1 Context

Technology-enhanced learning (TEL) is playing an increasingly important role in facilitating pedagogical innovation in higher education (Laurillard 2008, Gordon 2014). Blended learning offers learners increased flexibility, as well as promoting an enhanced student experience and improved learning outcomes (Garrison and Kanuka 2004). Students increasingly expect to use TEL (Beetham 2014), and the 'use and value of appropriate learning technologies' is recognised as core knowledge for educators in UK higher education (Higher Education Academy 2011, Almpanis 2015). My work has focused on supporting staff transitions to blended and online distance learning, as well as effective use of TEL in the classroom. This has recently been achieved through the Enhancement Themes project on Transitions to Blended Learning (Adekola, Dale et al. 2017a, Adekola, Dale et al. 2017b, Adekola, Dale et al. 2017c) as well as the Blended and Online Learning Development (BOLD) project (University of Glasgow 2017). Both projects considered capacity building within the institution to support the move towards increased use of TEL. I also co-led courses on TEL within the Postgraduate Certificate in Academic Practice (PGCAP), and there is evidence to show that this formal approach to academic development has been successful in changing teachers' attitudes and behaviours (Jaap and Dale 2016). Given the difficulty in persuading the reluctant majority to engage with TEL (Hixon, Buckenmeyer et al. 2012), I focused this project on staff engagement with TEL teaching innovation opportunities, and explored how this related to intrinsic teacher characteristics as well as external enablers and barriers. The ultimate aim was to identify approaches to academic development that would encourage more teachers to engage with teaching innovation, using TEL as a lens. The College of Science and Engineering (CoSE) provided a context for the research, relevant to my role as an Academic and Digital Development contact for CoSE within the Learning Enhancement and Academic Development Service (LEADS).

## 1.2 Literature review methodology

This literature review explores the published evidence as a basis for:

- Defining the concept of 'innovative teaching', particularly as it relates to engagement in TEL
- Identifying intrinsic teacher characteristics associated with innovation
- Identifying external factors that act as enablers or barriers to innovation
- Identifying suitable strategies, including CPD opportunities, to encourage teachers to be more innovative.

In addition to Google Scholar, the Professional Development Collection database was searched, which has access to over 500 peer reviewed education journals and over 200 educational reports. The following keyword search terms were used to retrieve appropriate literature:

- teach* AND innov*
- teach* AND innov* AND (online OR blended OR e-learning OR elearning)
- "early adopters" AND (learn* OR teach*)
- teach* innov* science and engineering
- teach* innov* academic development
- teach* innov* academic development e-learning

In terms of inclusion criteria, an emphasis was placed on peer-reviewed publications, and included literature reviews as well as evidence-based empirical work. Conducting the above searches resulted in literature that was scanned for additional relevant studies. Literature was deemed relevant if it alluded to attitudes and characteristics of teachers engaging in professional development connected to learning and teaching across different education sectors, worldwide. Other literature was considered relevant if it related to teachers' attitudes to, or adoption of, e-learning, including blended and online distance learning. Generic literature on innovation was also included, relating to the marketing of innovations and adoption of new technologies or products more broadly. Other literature related to innovative teaching in higher education generally, as well as the diffusion of e-learning innovations institutionally. Most cited literature was published during the last 15 years; however, given the slow adoption of teaching innovation in the context of TEL, some cited literature was older.

## 1.3 Defining the concept of teaching innovation

A systematic review of 396 publications, resulting in assessment of 37 evidence-based research papers, revealed that most researchers follow Janssen's (2003) definition of teaching innovation; "…a three-stage process: (a) intentional idea generation, (b) idea promotion, and (c) idea realization" (Thurlings, Evers et al. 2015, p.440-441). Novotn (2002) defined an innovative teacher simply as "one who implements change to his/her own job" (no page number). Lunde and Wilhite (1996, p.156) defined the term teaching innovation as "… a construct, comprised of a cluster of qualities including effective interaction with learners, openness to change, persistence, reflective practice, specificity of approach, and discipline-embedded pedagogy". Such definitions are vague at best, and while they acknowledge agency on the part of the teacher, none refer to the process of teaching or supporting student learning.

For the purposes of initiating this study, I conceptualised teaching innovation in the context of TEL as teachers seeing the potential for new technologies to enhance the quality of their students' learning, and engaging with TEL and reflecting on the outcome. On the basis of the literature review, it was assumed that this may be facilitated through internal motivation, contextual enablers and the provision of appropriate academic development opportunities.

### 1.3.1 Early adopters versus mainstream majority

In the context of TEL, it is reasonable to equate innovative teachers with the 'early adopters' as discussed in the literature around innovation diffusion, also referred to as the 'usual suspects' (Smith and Oliver 2000). Citing the work of Rogers (2003), Hixon et al. (2012) outlined five categories of adopters: the innovators and early adopters who are quick to embrace change and take risks, the more conservative early majority and late majority, and finally the risk-averse laggards who are most skeptical and the last (if ever) to adopt an innovation. These groups are mirrored in Slinn's (2010, cited by Fresen 2011) technology adoption curve, as indicated in Table 1:

| | | | | | |
|---|---|---|---|---|---|
| **Rogers (2003)** | Innovators (2.5%) | Early adopters (13.5%) | Early majority (34%) | Late majority (34%) | Laggards (16%) |
| **Slinn (2010)** | Technology enthusiasts | Visionaries | Pragmatists | Conservatives | Sceptics |

*Table 1: Categories of technology adoption*

Early adopters were conceptualised as 'lone rangers' by Taylor (1998), who considered this group insufficient to bring about paradigm change in universities, thereby highlighting a need for less innovative teachers to be encouraged to adopt innovative practices. This highlights the need to understand how to support *all* teachers to engage with teaching innovation.

## 1.4 The need for teaching innovation in STEM subjects

Citing several empirical studies, one literature review (Carberry and Baker, 2018) argued that engineering education has traditionally neglected to promote active, student-centred learning, with problem-solving elements being restricted to mathematical solutions rather than real-life applications. Student-centred learning was argued to be critical in advancing a successful 'culture' of engineering for societal good. Very little literature was available regarding the characteristics of science and innovation teachers in higher education. Citing several studies by Henderson and colleagues, Besterfield-Sacre et al. (2014) argued that efforts to promote teaching innovation in STEM staff should focus less on individual teachers and more on the institutional enablers and barriers such as resources and incentives. Citing King (2012) and Fairweather (2008), Carberry and Baker argued that those wishing to adopt student-centred methods of teaching and learning may be deterred by a research-intensive university culture that places a lesser value on teaching. Support and recognition for teaching innovation, such as active learning and engaging pedagogies, were also recommended as a result of a wide consultation of engineering educators across the United States (Besterfield-Sacre, Cox et al. 2014, citing ASEE, 2009). This study therefore seeks to examine the influence of intrinsic teacher characteristics, as well as contextual factors, on CoSE teachers' engagement with innovation opportunities, with a view to identifying academic development

opportunities that encourage teachers to adopt innovative, active learning strategies.

## 1.5 Teacher characteristics associated with innovation

Individual characteristics associated with teaching innovation in the wider literature include self-efficacy, risk-taking, previous engagement in TEL, use and conceptions of e-learning, and digital knowledge and skills. These characteristics are explored in turn, and form the basis of the intrinsic teacher factors examined in this study.

### 1.5.1 Self-efficacy

Self-efficacy is considered essential to teacher development in the use of technology to foster a student-centred approach to teaching (Ertmer and Ottenbreit-Leftwich 2010). Self-efficacy, specifically in teaching with technology, was associated with constructivist pedagogical beliefs and a higher value placed on the use of technology in a study of North American teachers, based on 152 survey response and eight follow-up interviews and teaching observations (Hsu 2016).

### 1.5.2 Risk taking versus conservativism

Citing Geoghegan (1995), Wilson and Stacey (2004) compared early adopters versus mainstream majority teachers and noted that the former are risk-takers who engage in interdisciplinary interaction, while the latter are conservatives who operate within their own discipline. A survey of 310 educators at one North American institution, and associated focus group, revealed that innovative teachers have the persistence to overcome barriers put in their way, seeing them as opportunities, while non-innovators see barriers as limitations (Lunde and Wilhite 1996). The same study also showed that persisters had more teaching awards and used active learning strategies more in their teaching, and that innovative teachers were risk-takers and reflective about their teaching.

### 1.5.3 Previous engagement with TEL

There is evidence to show that teachers' beliefs (or conceptions) about TEL, and their behavior (practice) in using it, can change through engagement with e-learning. In a longitudinal multiple case study, Scott (2016) demonstrated that teachers either change their beliefs, then their practices, or vice versa. This was

typically stimulated by a dissonance associated with lack of student engagement (either with traditional or innovative teaching), accompanied by reflection and remedial action on the part of the teacher. Prestridge (2017) made a similar claim in relation to maths and science teachers engaging in gamification of learning using technology, whose 'ICT pedagogies' evolved over time. Therefore, it is also relevant to consider teachers' previous engagement with developmental opportunities relating to TEL.

### 1.5.4 Use and conceptions of e-learning

The link between teachers' approach to teaching, and students' approaches to learning, has long been evident. The phenomenographic study by Trigwell, Prosser et al. (1999) revealed that an information transmission teacher-focused (ITTF) approach to teaching encouraged surface learning, while a conceptual change student-focused (CCSF) approach to teaching encouraged deep learning. There is also evidence that teachers have different conceptions about e-learning, and that these can influence the way they use technology to engage their learners. For example, González (2012) identified five approaches to e-teaching from an phenomenographic study with 18 teachers about their use of a virtual learning environment (VLE). These ranged from 'lower level' to 'higher level' e-learning use, articulated as:

A. An information focused strategy, providing easy access to core content and administrative information
B. An information focused strategy, providing up-to-date, quality learning resources at point of need [essentially, providing additional learning objects and media at student point of need, for additional clarification and explanation]
C. A communication-focused strategy, using forums for announcements and simple Q&As
D. A communication-focused strategy, using forums to engage students in deep thinking though discussion
E. A collaboration-focused strategy, using the online space to facilitate knowledge construction

González associated information-focused e-teaching strategies (A-B) with information-transmission teacher-focused (ITTF) approaches to teaching, and communication and collaboration focused strategies (C-E) with conceptual change student-focused (CCSF) approaches to teaching.

In a similar phenomenographic study of 19 teachers, Ellis et al. (2009) demonstrated a correlation between conceptions of learning technologies, and approaches to designing blended learning. Conceptions included 'fragmented' views of learning technology use (as tools for access or information delivery) versus 'cohesive' use (to enable active learning opportunities or knowledge construction). Approaches to designing blended learning were 'unintegrated' (using technology for pragmatic ends or as an add-on) versus 'integrated' (to encourage active learning or develop applied understanding).

### 1.5.5 Digital knowledge and skills

Knowledge and skills in using ICT are recognised to be important for effective use of TEL (Ertmer and Ottenbreit-Leftwich 2010). Zhu, Wang et al. (2013) associated teaching innovation with a series of 'competencies':

- Learning competency (actively learning about new teaching methods)
- Social competency (sharing teaching problems with others)
- Technological competency (using current learning technologies)
- Educational competency (having sufficient knowledge about one's own discipline)
- Innovative teaching performance (designing student-centred learning opportunities)

However, with the exception of example statements, these competencies were not further articulated. In a phenomenological study of interviews with 16 teachers, Bennett (2014) aligned the experiences of 'digital practitioners' with Sharpe and Beetham's (2010) tiered model of student digital literacies, citing this as a mechanism for learning from early adopters. Bennett associated the lowest level (access), with new ways of working. At the next level (skills), teachers demonstrate an awareness of the need for technological skills. At the penultimate level (practice), TEL is used appropriately for specific pedagogical

needs rather than for its own sake. At the top level (attributes), engagement with TEL becomes 'normalised' academic practice. Thus, Bennett argued that to be a digital practitioner, it is necessary to have access to technologies, have the digital skills to know how technologies work, to use them for pedagogical gain rather for their own sake, and to integrate digital teaching strategies into regular academic practice.

## 1.6 External influencing factors

McGeown (1980) argued that teaching innovation is influenced by contextual factors such as the school environment. The teaching environment reflects the organisational climate, which may include the views and support of colleagues and management. The attitudes and skills of students themselves may also influence teachers' ability to engage in innovative practice.

### 1.6.1 Organisational climate

The organisational climate is a strong influencing factor in terms of enabling teachers to innovate using technology (Ertmer and Ottenbreit-Leftwich 2010). Academic workload appears to be one of the most significant factors in teachers' ability to innovate with TEL (Al-Senaidi, Lin et al. 2009, Brown 2016, Hsu 2016). Barriers identified in a mixed-methods study of 152 North American teachers included a lack of time to implement TEL solutions as well as a lack of technical support (Hsu 2016).

In a study of interviews with 'excellent teachers' and early adopters, Jacobsen (2001) outlined workload, fear of failure of using technology, an underhand institutional agenda, disproportionate time and effort versus perceived benefits for student learning, lack of experience of using TEL, inadequate infrastructure, annual review processes that do not value teaching, and lack of recognition for TEL expertise as negatively impacting other teachers' ability to innovate. In a survey of 100 teachers in Oman, institutional barriers included a lack of time, equipment and institutional support (Al-Senaidi, Lin et al. 2009).

Reflecting on the outcomes of a literature review and two research projects, Fresen (2011) reported barriers such as inadequate infrastructure, lack of coordinated planning for technology, TEL use not being rewarded or recognised,

TEL not being a financial priority for the institution, or a lack of institutional vision.

### 1.6.2 Student influences on teachers' ability to innovate using TEL

Students' lack of computer skills or online learning confidence were identified as a barrier to teacher engagement with TEL (Muilenburg and Berge 2005, Hsu 2016). Student buy-in is essential for harnessing the potential of technology for teaching innovation (Brown 2016).

## 1.7 Approaches to professional development for teaching innovation

Richter, Kunter et al. (2011) distinguished between formal and informal approaches to staff development. Almost half of UK institutions offer a specific module on TEL as part of their postgraduate certificates in academic practice (Almpanis 2015).

Experience of using TEL, accompanied with reflection, promotes effective use of TEL. A study of the digital logs of 94 teachers in secondary education noted that teachers learned through experimenting with new techniques, reflecting on their practice, experiencing discord or friction, making a concerted effort not to revert to 'old ways', and getting ideas from others through reading or interaction (Bakkenes, Vermunt et al. 2010). A phenomenographic study of 15 teachers incorporating semi-structured interviews and diaries revealed that teachers learned through 'doing', interacting with students and other teachers, by reading and by thinking, although this tended to be spontaneous rather than planned (van Eekelen, Boshuizen et al. 2005). Hands-on experience and reflection was also emphasised in a case study of three teachers' use of TEL, who learned to adopt student-centred approaches (Prestridge 2017). Other studies that emphasise the importance of 'hands on' training suggest starting with teachers contributing to – or designing – a Massive Open Online course (MOOC) (Almpanis 2015, Bartoletti 2016).

Other informal approaches to staff development in TEL include partnership working with staff, e.g. through the Carpe Diem approach to learning design (Salmon, Jones et al. 2008, Salmon and Wright 2014). A Faculty Learning Community based around Garrison's Community of Inquiry model was observed to engage staff in blended learning (Vaughan and Garrison 2006). Open, social

learning communities provide opportunities for educators already in good standing to further enhance their digital teaching practice (Nerantzi 2015).

Given the role of early adopters in leading innovation, it is not surprising that recent efforts to promote wider engagement with digital education have sought to harness their expertise and enthusiasm. In Turkey, a one-to-one mentoring scheme was successful in improving teachers' technical competence (Filiz, Yurdakul et al. 2013). Hixon et al. (2012) promoted a mentoring programme for staff engaged with distance education, where teachers were paired with another in a different discipline. The early years of the programme successfully recruited the early adopters/early majority, while the later year of the programme saw less enthusiastic engagement by the reluctant majority and laggards.

Based on the literature review, and as a means of advancing engagement with teaching innovation and student-centred TEL, my study sought to answer the following research questions:

- How do science and engineering teachers in higher education construe the concept of 'innovative teaching'?
- Which intrinsic teacher characteristics are associated with successful engagement in teaching innovation and TEL in science and engineering?
- What extrinsic factors, indicative of the organisational climate, influence science and engineering teachers' engagement in teaching innovation and TEL?
- Are there differences between teachers' responses in relation to their self-identification as an innovator/early adopter versus early/late majority?
- What methods of academic development may be used to best support innovative and less-innovative teachers?

# 2 Methodology

## 2.1 Mixed-methods case study

Following guidance of Crotty (1998) and Cousin (2009a), the underpinning epistemology of this study is constructionist. The research was interpretivist in that it sought to capture the self-reported attitudes and experiences of individuals and how they learn and construct meaning. The methodology was a mixed-methods case study of teaching innovation in a single college (CoSE), consistent with "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence" (Robson 2002, p.178, citing Yin (1981)). A sequential explanatory approach (Jones, Torres et al. 2013) comprised a questionnaire and focus groups. The questionnaire was administered first to gain an overall view of staff experiences, and the focus groups were used to explore insights and compare different types of adopter.

Given that quantitative and qualitative methods were used, I used Coughlan, Cronin et al. (2007) and Ryan, Coughlan et al. (2007) as guides to enhance credibility and trustworthiness, in that I have sought to be transparent about the literature review, research questions, theoretical framework, methodology, sampling, analyses undertaken, findings and discussion.

## 2.2 Survey

The key benefit of survey research is that it can be used to gather large amounts of standardised, quantitative data very quickly from a large number of participants; it also permits statistical analysis to look for relationships between factors (Cohen, Manion et al. 2007b).

### 2.2.1 Design of the pilot questionnaire

Based on the literature review, I designed a pilot questionnaire to capture the following data:

- Demographics
- Intrinsic factors:
    - Approach to teaching
    - Use of (underpinned by conceptions) of e-learning

    - Digital knowledge and skills (digital practitionership)
    - Confidence in performing specific TEL tasks
    - Self-efficacy
    - Risk-taking versus conservativism
- Extrinsic factors: A series of items representing organisational climate (school/college/institutional culture) including enablers and barriers.

#### *2.2.1.1 Demographics*

This section of the questionnaire sought to identify categorical data such as:

- Years of teaching experience
- Teaching role
- Gender
- School

#### *2.2.1.2 Perception of self as early adopter or mainstream majority*

Using the language of Rogers (2003) as referenced in Hixon et al. (2012), this section invited participants to identify themselves as one of five types: innovator, early adopter, early majority, late majority or laggard. Participants were asked to justify their answer.

#### *2.2.1.3 Self-efficacy*

Initially, Bandura's (1990) teacher's self-efficacy scale was reviewed as it is relevant to learning and teaching. However, it does assume that teachers have the autonomy to override restrictions such as class size and resources. Therefore, items were selected from Emmer and Hickman's (1991) teacher efficacy questionnaire which focused more on learning and teaching processes. Each item was attributed a 1-5 Likert scale, resulting in ordinal data.

#### *2.2.1.4 Risk-taking versus conservativism*

This section was informed by the Kirton Adaptation-Innovation Inventory (Bobic, Davis et al. 1999). While it provides a diagnostic tool for distinguishing between individuals who are primarily adapters of good practice versus true innovators, it is a generic instrument unrelated to teaching. I reworded the statements for application to learning and teaching, as indicated in Table 2.

| **Bobic, Davis et al. (1999)**<br>*Choose from each of the following pairs which best describes you…* | **New questionnaire items** |
|---|---|
| ☐ Solutions sought by tried and true methods<br>☐ Use unproven ideas in seeking solutions | When I encounter difficulties in learning and teaching:<br>☐ I seek solutions based on tried and tested methods<br>☐ I seek solutions based on unproven ideas |
| ☐ When involved in a project, I am still considerate of others<br>☐ When involved in a project, I forget that other people are involved and should be consulted | *When involved in a teaching-related project:*<br>☐ I am considerate of all other group members<br>☐ I forget that other people are involved and probably should be consulted |
| ☐ Prefer to work within established rules<br>☐ If rules don't fit, bend them a bit | When faced with challenges in teaching administration:<br>☐ I stick to established rules and guidelines<br>☐ I bend the rules to find a working solution |
| ☐ Can maintain high accuracy for long periods of work<br>☐ Work best for short bursts of activity | *When assessing student work:*<br>☐ I can maintain high accuracy for long periods of time<br>☐ I work best for short bursts of high intensity |
| ☐ Command of general knowledge<br>☐ Command of specialized knowledge | *In relation to learning and teaching:*<br>☐ I have a strong command of general pedagogical literature<br>☐ I have a strong command of specialised pedagogical literature |
| ☐ Interested in solving problems<br>☐ Interested in finding problems to solve | *As a teacher in higher education:*<br>☐ I am interested in solving problems<br>☐ I am interesting in finding problems to solve |

*Table 2: Adaptation of Kirton Adaption-Innovation Inventory for the questionnaire*

The original instrument asked respondents to choose one possible answer for each item. Each new questionnaire item was given a score of 1 (conservative) versus 2 (risk-taking); a higher aggregate score was associated with increased risk-taking.

#### *2.2.1.5 Previous engagement with teaching innovation opportunities*

This section asked participants to state whether they have applied for, or been successful, in a range of opportunities for teaching innovation, such as internally

or externally funded projects, or awards for teaching excellence. Each item contributed ordinal scale data (not applied/applied/successful). An aggregate score was generated to represent the degree to which individuals had engaged in TEL teaching innovation.

#### *2.2.1.6 Approaches to teaching*

This section was informed by Trigwell and Prosser's (2004) Approaches to Teaching Inventory, to measure the extent to which teachers take a conceptual change, student-focused (CCSF ) approach as opposed to an information-transmission, teacher-focused (ITTF) approach to teaching. Each item was attributed a 1-5 Likert scale, resulting in ordinal data. Aggregate scores for CCSF and ITTF approaches indicate the level to which teachers adopt one approach over the other.

#### *2.2.1.7 Conceptions of, and approaches to, e-teaching*

Informed by Gonzalez (2012), this section explored the extent to which teachers use a virtual learning environment (VLE) for administration as opposed to promoting active learning through collaboration and construction of knowledge, resulting in categorical data. A higher aggregate score was interpreted as representing the extent to which teachers' use the VLE in different ways.

#### *2.2.1.8 Digital practitioner elements*

Informed by Bennett's (2014) digital practitioner framework, this section looked at participants' access to equipment and resources, digital skills, digital teaching practice, and attributes (attitudes towards TEL). Each item was attributed a 1-5 Likert scale value, resulting in ordinal data. An aggregate score was generated to represent the degree to which individuals may be considered successful digital practitioners.

#### *2.2.1.9 Enablers*

Based on the literature review, a series of statements were devised to measure the impact of the institutional climate, such as recognition for engagement in TEL, and provision of resources and support. Each item was attributed a 1-5 Likert scale, resulting in ordinal data.

#### *2.2.1.10 Barriers*

Enablers were reworded as equivalent barriers. Again, these largely represent institutional climate factors in the literature (Al-Senaidi, Lin et al. 2009, Hsu 2016). Each item was attributed a 1-5 Likert scale, resulting in ordinal data.

#### *2.2.1.11 Learning preferences*

This section asked participants to rate the usefulness of different CPD opportunities, identified through personal experience of engaging in self-directed informal learning, professional communities, events internal and external to the institution, and opportunities for formal learning and recognition. Each item was attributed a 1-5 Likert scale, including an option for 'Not used', resulting in ordinal data.

### 2.2.2 Piloting of questionnaire

Piloting a questionnaire is essential to ensure content validity (that the question wording is clear to participants) as well as ascertaining that the survey produces analysable data that can answer the research questions and be reported in a meaningful way (Oppenheim 1992). Recognising the workload of CoSE staff, and the risk of compromising the number of returns for the actual study, I asked colleagues from LEADS ADD to pilot the questionnaire. The questionnaire was made available online via the Online Surveys platform in the last week of May 2018.

### 2.2.3 Changes to the questionnaire after piloting

The main feedback from pilot participants related to:

- the relevance of asking about gender; and
- the length of the questionnaire.

I therefore made the following changes:

- The gender question was omitted, given that the literature review did not reveal this to be important in the context of teaching innovation.
- The Approaches to Teaching section was omitted, given that this underpins conceptions of e-teaching, in the sense that teachers using the VLE in more student-centred innovative ways for discussion and creation

are likely to adopt a more conceptual change, student-focused approach to teaching.

- Enablers and barriers, which were more or less identical items expressed in opposite terms, were amalgamated under a single 'Contextual factors' question. Items were scored on a 5-point Likert scale from -2 to +2, depending on whether the contextual factor was considered to be a significant barrier, barrier, neutral, enabler or significant enabler. A total contextual factor score was calculated.

### 2.2.4 Implementation of live questionnaire with CoSE staff

With the permission of the Dean for Learning and Teaching in CoSE, the revised questionnaire was made available via the Online Surveys platform from 29th May 2018. Teachers were invited to participate via an email sent to CoSE Learning and Teaching Committee members, for forwarding to staff in each school, using snowball sampling (Cohen, Manion et al. 2007a). This resulted in a handful of responses, after which an email was sent directly to all CoSE teaching staff, with a reminder emailed a few days later. A newsletter item was also included in the 'internal university news' staff email bulletin. Thus, the questionnaire was intended to reach the whole CoSE population, rather than selecting a sample within CoSE. However, the CoSE population may be considered a purposive sample within the overall university teacher population (Cohen, Manion et al. 2007a). The questionnaire was closed on 22nd June 2018, after over a week of no further responses.

### 2.2.5 Visual exploration and statistical analysis of questionnaire data

The visualisation/statistical tool used was SPSS version 24.

#### *2.2.5.1 Visualisation*

Bar charts were generated alongside frequencies to explore the data. Scatterplots were generated to determine whether there was a linear relationship between variables.

#### *2.2.5.2 Data transformation*

The responses to each ordinal question set were added together to create an aggregate score; resulting in variables for Total self-efficacy, Total risk-taking

score, Total TEL engagement score, Total digital practice score, Total digital confidence score, and Total contextual factor score (barriers/enablers).

#### *2.2.5.3 Statistical analyses*

Statistically significant results were determined where $p<0.05$, and highly significant results were observed where $p<0.01$. Spearman's Rho was selected as the non-parametric test for correlation, given that the total scores were derived from ordinal data (Siegel and Castellan 1988). As advised by Pallant (2016 citing Cohen, 1988), a correlation of .1 to .29 represented a small positive correlation, .3 to .49 represented a medium positive correlation, and .5 to 1.0 represented a large positive correlation.

Between-group comparisons were conducted to compare the responses of innovators/early adopters versus early/late majority. The four groups were divided into two given the recognised differences between the first two categories and the second two categories (Wilson and Stacey 2004, Hixon, Buckenmeyer et al. 2012). The Chi-Square test was used to compare nominal data, and the Mann-Whitney U test was used to compare ordinal data.

## 2.3 Focus groups

Two focus groups were held, to represent innovative versus less innovative teachers, as identified by teachers themselves in the questionnaire (innovators/early adopters versus early/late majority respectively).

Focus groups capitalise on the interactions between participants (Kitzinger 1994, Gill, Stewart et al. 2008). Suited to exploring attitudes or experiences with groups of 4-8, they are useful for tapping into group norms and workplace cultures, and can comprise heterogeneous or homogeneous individuals (Kitzinger 1995). In this case, they were homogenous in that they purposively sampled either early adopters or early majority staff, and heterogeneous in that each group included staff from different schools.

Focus group prompts included:

- Why does this topic interest you? How is it relevant to your academic practice?

- What does the term ‘teaching innovation’ mean to you, particularly in the context of technology-enhanced learning (TEL)?
- How do you use learning technologies, such as Moodle, to support learning and teaching?
- What are the enablers to you engaging in TEL teaching innovation?
- What are the barriers to you engaging in TEL teaching innovation?
- What methods of CPD are most useful to you, to support you to become more innovative teachers?
- What can the school/college/institution do to better support you in terms of TEL teaching innovation?

The focus groups were semi-structured (Tong, Sainsbury et al. 2007), to provide a basis for comparison while allowing the participants’ responses to be explored in more detail. The focus groups were carried out by me rather than an independent party. While this allowed me full control over the questioning and directing of the focus group, it should be acknowledged that my role as ADD contact for CoSE could potentially have introduced a social desirability response bias (King and Bruner 2000).

The focus groups were audio-recorded, and transcribed by an external professional company. Detailed notes were taken during the focus groups. A general inductive approach (Thomas 2006) was adopted to identifying key themes. To enhance trustworthiness (Ryan, Coughlan et al. 2007), the transcripts, with annotations identifying themes, were circulated to participants for data validation purposes. One participant in the early majority group made additional comments for clarification. Anonymised interview quotes were added for authenticity to enhance credibility (Ryan, Coughlan et al. 2007).

## 2.4 Ethics

Ethical risks were addressed in accordance with the British Educational Research Association ethical guidelines (Hammersley and Traianou 2012), including the use of voluntary informed consent, openness and disclosure, giving participants the right to withdraw, minimising potential detriment from participation in research, and guaranteeing participant privacy. Thus, efforts were made to ‘do no harm’ as a consequence of the research (Cousin 2009b).

Ethical risks related to potential breaches of confidentiality; therefore, the questionnaire was completely anonymous. It was anticipated that this would allow participants to feel safe to provide information about their own characteristics and academic practice and boost the completion rate. The focus group was not anonymous, but transcripts were assigned anonymous identifiers to protect participants' identities, and any identifying information was removed.

Another significant risk in this project was the danger of participants considering themselves to be 'less innovative' in their teaching practice, which be potentially demotivating. Participants were reassured that no judgements were being made about their individual answers, as the main area of interest was in the aggregate data, and how all teachers could be adequately supported. In addition, participants were directed to sources of support such as the LEADS website.

The study was approved by the Ethics Committee for the College of Science and Engineering prior to data collection (#300170159).

# 3 Results

## 3.1 Questionnaire

Seventy questionnaires were returned, of which 68 were staff. Assuming a staff total of 380, as advised by CoSE HR, this represents an 18% response rate. It was not possible to calculate the overall Graduate Teaching Assistant (GTA) response rate, as HR were unable to confirm the number of GTAs appointed at the time the questionnaire was administered. Some of the responses included missing values; however, given the relatively low response rate, I retained all cases. Individual cases were omitted only at the point of analysis if the relevant variables included missing values.

### 3.1.1 Frequencies and qualitative data

Basic frequencies are presented in this section, to indicate CoSE staff responses overall. For each table, the modal value is in bold. Percentages were rounded up to the nearest integer and may therefore exceed 100 in total.

#### *3.1.1.1 School*

The number of responses from each school are shown in Table 3.

| School | Number of responses | Percentage of total response | Number of potential staff respondents | % of staff total in each school (excluding GTAs) |
|---|---|---|---|---|
| Chemistry | 14 | 20% | 40 | 35% |
| Computing Science | 8 (incl. 1 GTA) | 11% | 43 | 16% |
| Engineering | 18 | 26% | 121 | 15% |
| Geographical and Earth Sciences | 6 | 9% | 42 | 14% |
| Mathematics and Statistics | 10 | 14% | 59 | 17% |
| Physics and Astronomy | 10 (incl. 1 GTA) | 14% | 48 | 19% |
| Psychology | 4 | 6% | 28 | 14% |

*Table 3: Responses from different schools in CoSE*

Responses from each school were approximately equal with the exception of Chemistry, which was comparatively over-represented.

#### *3.1.1.2 Teaching role*

The number of responses representing each type of teaching role are shown in Table 4, including the number of Learning, Teaching and Scholarship (LTS) versus Research and Teaching (R&T) staff.

| **Role** | **Number of responses** | **Percentage of total response** | **Total number of LTS/ R&T** |
|---|---|---|---|
| GTA/demonstrator/ occasional tutor | 2 | 3 | |
| Lecturer on LTS contract | 13 | 19 | 19 |
| Senior lecturer on LTS contract | 4 | 6 | |
| Professor on LTS contract | 2 | 3 | |
| Lecturer on R&T contract | 25 | 36 | 46 |
| Senior lecturer on R&T contract | 8 | 11 | |
| Professor on R&T contract | 13 | 19 | |
| Other | 3 | 4 | |

*Table 4: Responses from different teaching roles*

Most respondents were on the Research and Teaching Track, comprising 66% of the returns.

#### *3.1.1.3 Years' teaching*

Participants had spent between 1 and 40 years' teaching; the mean being 13 years (see Figure 1) and the median being 10 years.

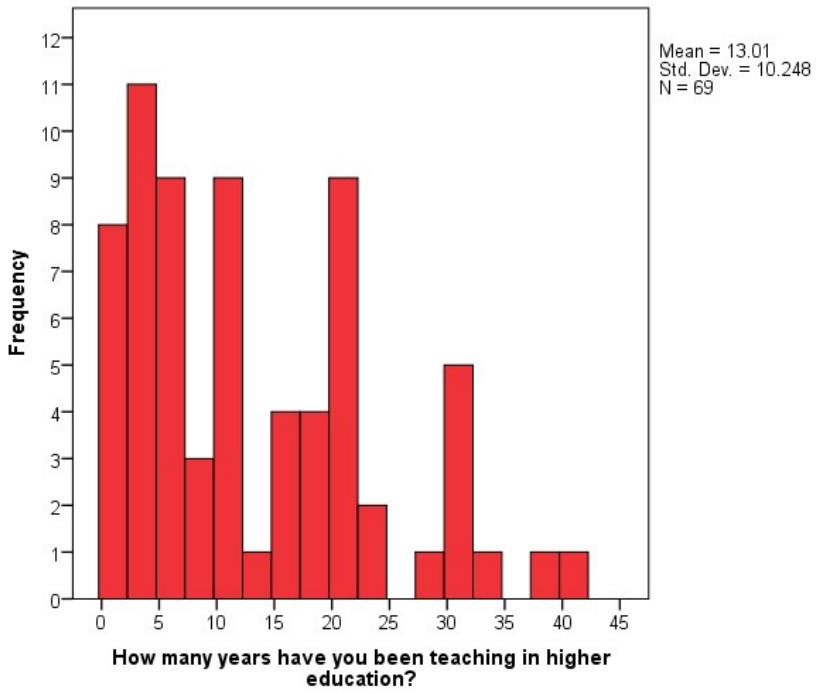


*Figure 1: Histogram of participants' number of years' teaching*

#### *3.1.1.4 Attitudes to technology adoption*

The types of adopter are shown in Table 5.

| Type of adopter | Number | Percentage of total response | Number of innovators/early adopters vs. early/late majority |
|---|---|---|---|
| Innovator or technology enthusiast | 3 | 4% | 19 |
| Early adopter or visionary | 16 | 23% | |
| Early majority or pragmatist | 34 | 49% | 51 |
| Late majority or conservative | 17 | 24% | |
| Laggard or sceptic | 0 | 0% | |

*Table 5: Responses from different types of technology adopter*

Most respondents were early/late majority, with no participants considering themselves to be laggards.

#### *3.1.1.5 Explanation for choice of stage of technology adoption*

Participants' explanations for their selection of stage of adopter are shown in Table 6.

| Thematic code | Innovator | Early adopter | Early majority | Late majority |
|---|---|---|---|---|
| Prefer someone else to try first | 0 | 2 | **6** | 3 |
| Not sure of benefits or need to see evidence of benefits | 0 | 2 | **8** | 1 |
| Time constraints, not a priority | 0 | 0 | **4** | 3 |
| More interested in pedagogy than technology | 0 | 1 | **2** | 0 |
| Track record of early technology adoption | 0 | **3** | 0 | 0 |
| Does not want to use 'buggy' tools | 0 | 0 | **2** | 1 |
| Takes a while to catch up, slow to adopt | 0 | 1 | **2** | 0 |
| Proactively seeks ways to use tech in teaching | 1 | **2** | 0 | 0 |
| Concentrates on easy-to-use rather than complex tech | 0 | 0 | 1 | **2** |
| Depends (on technology & duties) | 0 | 0 | **2** | 0 |
| Uses technology for teaching (including audio-visual) but not innovatively | 0 | 0 | **2** | 0 |
| Potentially detrimental to students | 0 | 0 | **2** | 0 |
| Considers themselves a 'digital native' | 0 | **1** | 0 | 0 |
| Technology itself not an innovation | 0 | 0 | **1** | 0 |
| Innovates at school level but not more widely | 0 | 0 | **1** | 0 |
| Does not suit large class size | 0 | 0 | **1** | 0 |
| Both innovator and sceptic | 0 | 0 | **1** | 0 |
| Moodle a poor introduction to TEL | 0 | 0 | 0 | **1** |
| Technology difficult to use | 0 | 0 | 0 | **1** |

*Table 6: Thematically coded responses for justification of chosen stage of adoption*

The early adopter responses reflect a track record of technology adoption, and a willingness to use technology to enhance learning and teaching. Early majority were more risk-averse in terms of waiting for others to experiment with innovations and generate evidence for their use.

#### *3.1.1.6 Definition of concept of 'teaching innovation' in context of TEL*

The definitions are coded in Table 7 alongside the number of instances. As these did not appear to vary by stage of technology adoption, no distinction was made here. Some definitions included two or more aspects, e.g.

*"I would define it as using new technology, or using existing technology in new ways, for the purpose of improving student learning".*

| **Thematic code** | **n** |
|---|---|
| New technologies or tools | 19 |
| Enhancing student learning | 17 |
| New teaching methods, approaches or techniques | 16 |
| Using existing technologies in new ways | 8 |
| Doing something new or novel | 6 |
| Enhancing teaching | 5 |
| Bringing technology into traditional classroom teaching | 3 |
| Using TEL to resolve an issue, solution to a problem | 3 |
| Blended learning | 1 |
| Providing evidence of effectiveness | 1 |
| 'Don't know' | 1 |

*Table 7: Results of thematic analysis with regards to definition of innovative teaching with TEL*

The most common responses included reference to new technologies or tools (n=19), enhancing student learning (n=17) and using new teaching methods, techniques or approaches (n=16).

#### *3.1.1.7 Teacher self-efficacy*

| **Statement** | **%SD** | **%D** | **%N** | **%S** | **%SA** |
|---|---|---|---|---|---|
| When a student does better than usual, many times it is because I exerted a little extra effort | 3 | 17 | **46** | 30 | 3 |
| If one of my students could not do a class assignment, I would be able to accurately assess whether the assignment was at the correct level of difficulty | 4 | 7 | 32 | **45** | 12 |
| If a student masters a new concept quickly, it is probably because I knew the necessary steps in teaching that concept | 0 | 12 | **48** | 35 | 6 |
| If a student did not remember the information I gave in a previous lesson, I would know how to increase their retention in the next lesson | 0 | 19 | 37 | **40** | 4 |
| When I really try, I can get through to the most difficult students | 1 | 7 | 30 | **52** | 9 |
| If a student in my class becomes disruptive and noisy, I feel assured to know some techniques to redirect them quickly | 4 | 17 | 9 | **57** | 13 |
| When a student is having difficulty with a task, I am usually able to adjust to their level | 0 | 0 | 10 | **61** | 29 |

*Table 8: Overall frequencies for statements regarding teacher self-efficacy*

Distributions regarding the self-efficacy items were positively skewed; however, there were still a significant number of staff who were less confident about their abilities to teach effectively, with the exception of being able to adjust to the students' level of difficulty.

#### *3.1.1.8 Risk-taking versus conservativism*

| **Statement** | **% Conservative** | **% Risk-taking** |
|---|---|---|
| When I encounter difficulties in learning and teaching… | **88** | 12 |
| When involved in a teaching related project… | **91** | 9 |
| When faced with challenges in teaching… | 47 | **53** |
| When assessing student work… | 43 | **57** |
| In relation to learning and teaching… | **63** | 37 |
| As a teacher in higher education… | **84** | 16 |

*Table 9: Overall frequencies for conservative versus risk-taking teaching behaviours*

The responses indicated that most staff would adopt a conservative approach to different teaching scenarios, seeking solutions based on tried and tested methods (88%), being considerate of other group members (91%), interested in solving problems (84%) and having a strong command of general pedagogical literature (64%). However, just over half work best for short bursts of high intensity (57%) or bend the rules to find a working solution (53%).

#### *3.1.1.9 Previous engagement with teaching innovation opportunities*

Table 10 documents the participants' involvement with teaching innovation opportunities.

| | **% Not applied/ nominated** | **% Applied / nominated** | **% Awarded** |
|---|---|---|---|
| Blended & Online Learning Development project (BOLD) | **86** | 4 | 10 |
| Learning & Teaching Development Fund (LTDF) | **77** | 7 | 16 |
| Chancellor's Fund | **86** | 3 | 11 |
| College Teaching Excellence Award | **84** | 3 | 13 |
| Recognising Excellence in Teaching (RET) or equivalent scheme | **91** | 4 | 4 |
| L&T project funding at another HEI | **93** | 2 | 6 |
| L&T project funding from an external body | **87** | 0 | 13 |

*Table 10: Overall frequencies for engagement with teaching innovation opportunities*

The majority of respondents (between 77-93%) had at least applied for teaching innovation opportunities, with the highest rate of success observed in relation to LTDF projects.

#### *3.1.1.10 Use and conceptions of e-learning*

Table 11 documents the frequencies of different types of e-learning use.

| **Use of e-learning systems to:** | **% use** |
|---|---|
| … provide easy access to course materials and administrative information | 94 |
| … provide up-to-date, additional learning resources at point of need | 90 |
| … provide a space for student questions and staff announcements | 79 |
| … engage students in deep thinking through online discussions | 14 |
| … provide an online space for building knowledge | 40 |

*Table 11: Overall frequencies for varied use of e-learning systems*

E-learning systems were almost ubiquitously used for providing easy access to course materials (94%) and up-to-date additional learning resources (90%). The majority used e-learning for student questions and announcements (79%). Less than half (40%) claimed to use e-learning to enable students to build their knowledge online, and only 14% used online discussions to promote deep learning.

#### *3.1.1.11 Digital practitionership*

The frequencies for different aspects of digital practitionership are shown in Table 12.

| | | **%SD** | **%D** | **%N** | **%A** | **%SA** |
|---|---|---|---|---|---|---|
| Access | I have access to necessary hardware for engagement in TEL | 4 | 9 | 28 | **44** | 15 |
| | I have access to necessary software for engagement in TEL | 3 | 7 | **44** | 32 | 13 |
| | I have reliable access to wi-fi | 6 | 10 | 6 | **46** | 32 |
| | I have access to learning technology professionals who can support me in using TEL | 3 | 18 | **45** | 30 | 5 |
| Skills | I can manage the blurring of boundaries between private and work time | 13 | 24 | 24 | **32** | 7 |
| | I can teach myself to use new software (e.g. apps) | 0 | 3 | 13 | **53** | 31 |
| | I can teach myself to use new | 0 | 6 | 12 | **56** | 27 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | hardware (e.g. devices) | | | | | |
| | I can evaluate the suitability of digital content for my students | 0 | 6 | 22 | **62** | 10 |
| Practices | I design TEL activities to suit my students' learning needs | 8 | 6 | 37 | **43** | 6 |
| | I explore the capabilities of a technology for learning | 5 | 17 | 29 | **44** | 6 |
| | I evaluate my digital academic practice | 5 | 27 | 25 | **36** | 8 |
| | I reflect on innovations within my teaching practice | 3 | 15 | 22 | **46** | 13 |
| Attributes | I am confident in my attitude to TEL | 3 | 18 | 29 | **49** | 2 |
| | I am willing to invest time in exploring and evaluating TEL | 4 | 12 | 27 | **50** | 7 |
| | I am able to balance the risk of innovation with its potential for learning | 2 | 8 | 40 | **51** | 0 |
| | I am convinced of the potential of technology to enhance and transform learning | 0 | 10 | 34 | **43** | 13 |

*Table 12: Overall frequencies for different aspects of digital practitionership*

A positively skewed distribution was observed for most items; the ability to manage the blurring of boundaries between private and work time stands out as a skill that comparatively more participants struggle with.

#### *3.1.1.12 Confidence in using learning technology*

Table 13 documents the participants' level of confidence in performing digital education tasks.

| **Digital education task** | **% Not at all conf.** | **% Not very conf.** | **% Slightly conf.** | **% Conf.** | **%Very conf.** |
|---|---|---|---|---|---|
| Creating screen-casted mini-lectures (e.g. via Camtasia) | **44** | 21 | 15 | 10 | 10 |
| Creating audio podcasts for access via Moodle | **37** | 22 | 19 | 7 | 15 |
| Finding suitable external learning resources (e.g. YouTube videos) and integrating them into your teaching | 2 | 10 | 9 | 24 | **56** |
| Moderating online discussion forums in Moodle | 13 | 13 | **35** | 25 | 13 |
| Using an electronic voting system such as Socrative or YACRS in the classroom | 19 | **22** | 19 | 19 | 21 |

| | | | | | |
|---|---|---|---|---|---|
| Creating quizzes in Moodle for student learning and revision | 9 | 12 | 22 | 24 | **34** |
| Facilitating online peer review using Moodle Workshop or Aropä | **37** | 25 | 27 | 9 | 3 |
| Setting up assignment submission links in Moodle for students to submit their work online | 12 | 10 | 13 | 28 | **37** |
| Grading online and giving feedback on student work in Moodle | 18 | 10 | 21 | 25 | **27** |
| Using similarity checking software (e.g. Urkund or Turnitin) | 21 | 9 | 21 | **25** | **25** |

*Table 13: Overall frequencies for confidence in digital education tasks*

The differently shaped distributions show that comparatively more participants struggle with certain tasks; for example, creating screen-casted digital lectures or audio podcasts, or facilitating online peer view. Responses to some items are more divided; for example, grading and feeding back to students online, or using similarity checking software. A more positive response was observed in relation to finding and using learning resources such as video, and creating online quizzes.

#### *3.1.1.13 Contextual factors*

Participants' views of contextual factors as barriers or enablers is shown in Table 14.

| **Digital education task** | **% Sig. barrier** | **% Barrier** | **% No influence** | **% Enabler** | **% Sig. enabler** |
|---|---|---|---|---|---|
| Access to local learning technology support | 9 | 26 | **35** | 23 | 8 |
| Access to necessary equipment to engage with TEL | 7 | 15 | **42** | 23 | 12 |
| Reliability and robustness of technology in the classroom | 14 | 20 | **35** | 28 | 3 |
| Amount of time to experiment with TEL | **47** | 27 | 14 | 6 | 6 |
| Students' level of comfort using technology for learning | 3 | 21 | **38** | 32 | 6 |
| Level of support from head of school or management re: engaging with TEL | 9 | 11 | **56** | 21 | 3 |
| Level to which TEL is seen as an institutional priority | 8 | 12 | **62** | 18 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Colleagues attitude to, and support for, use of TEL | 7 | 14 | **56** | 23 | 0 |
| Presence of a community of practice of educators using TEL | 5 | 12 | **50** | 27 | 6 |
| Recognition and reward for engaging in TEL | 14 | 11 | **55** | 19 | 2 |

*Table 14: Overall frequencies for contextual factors (barriers and enablers)*

The amount of time to experiment with TEL was the biggest barrier, with 74% of participants rating it as a barrier. However, all factors were experienced as a barrier, neutral or an enabler by different participants.

#### *3.1.1.14 Usefulness of different CPD methods*

Table 15 documents perceived usefulness of different CPD methods.

| | | % Never used | % not at all useful | % Not very useful | % Somewhat useful | % Useful | % Extremely useful |
|---|---|---|---|---|---|---|---|
| Self-directed, informal learning | Reading relevant journal articles and book chapters | 11 | 9 | 9 | **30** | 23 | 17 |
| | Undertaking Massive Open Online Courses (MOOCs) on blended/online/innovative learning and teaching | **55** | 6 | 16 | 14 | 6 | 3 |
| | Learning informally from and with colleagues | 0 | 0 | 2 | 20 | **44** | 34 |
| Communities of practice | Joining an online learning technology community such as the Association for Learning Technology (ALT), or the Learner Experience Research Special Interest Group (ELESIG) | **59** | 6 | 13 | 14 | 6 | 2 |
| | Participating in a mentoring scheme, working with a more experienced teacher as a 'critical friend' | **42** | 6 | 11 | 9 | 23 | 8 |
| Events | Attending events hosted by external organisations such as ALT, ELESIG, the higher Education Academy (HEA) | **47** | 3 | 11 | 19 | 13 | 8 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Attending informal institutional CPD e.g. LEADS events, Learning and Teaching conference | **31** | 2 | 17 | 14 | 23 | 13 |
| Formal learning and recognition | Undertaking a credit-bearing postgraduate taught programme such as the PGCAP or MEd | **30** | 6 | 18 | 18 | 22 | 6 |
| | Applying for recognition of good practice, e.g. through Recognising Excellence in Teaching (RET) or fellowship of the Higher Education Academy (P/S/FHEA) | **59** | 6 | 14 | 11 | 6 | 3 |
| | Undertaking a research degree relating to learning and teaching in higher education | **74** | 8 | 5 | 8 | 3 | 2 |

*Table 15: Overall frequencies for usefulness of different CPD methods*

The most commonly used methods were meeting informally with colleagues (100%) and self-directed reading (89%), of which learning informally with colleagues was the most positively rated (98% useful). Least commonly used methods included undertaking a relevant research degree (26% use).

### 3.1.2 Between-group comparisons (innovators/early adopters versus early/late majority)

For the between-group comparisons between innovators/early adopters and early/late majority, only the p value is included, to indicate whether or not a significant difference was observed. Significant results are shown in shaded cells for emphasis. Graphs (not included for brevity) were generated to determine the direction of difference.

#### *3.1.2.1 Teacher self-efficacy*

The Mann-Whitney U test revealed no significant differences between the two groups in relation to the statements regarding teacher self-efficacy (Table 16).

| | Sig |
|---|---|
| When a student does better than usual, many times it is because I exerted a little extra effort | .806 |
| If one of my students could not do a class assignment, I would be able to accurately assess whether the assignment was at the correct level of difficulty | .891 |
| If a student masters a new concept quickly, it is probably because I knew the necessary steps in teaching that concept | .507 |

| | |
|---|---|
| If a student did not remember the information I gave in a previous lesson, I would know how to increase their retention in the next lesson | .948 |
| When I really try, I can get through to the most difficult students | .396 |
| If a student in my class becomes disruptive and noisy, I feel assured to know some techniques to redirect them quickly | .172 |
| When a student is having difficulty with a task, I am usually able to adjust to their level | .555 |

*Table 16: Between-group comparison in relation to teacher self-efficacy*

#### *3.1.2.2 Risk-taking versus conservatism*

The Chi-Square test revealed no significant differences between the two groups in relation to their preference for risk-taking versus conservatism (Table 17).

| | Sig |
|---|---|
| When I encounter difficulties in learning and teaching… | .524 |
| When involved in a teaching related project… | .536 |
| When faced with challenges in teaching… | .993 |
| When assessing student work… | .335 |
| In relation to learning and teaching… | .184 |
| As a teacher in higher education… | .478 |

*Table 17: Between-group comparison regarding risk-taking vs. conservativism*

#### *3.1.2.3 Previous engagement with TEL opportunities*

The Mann-Whitney U test revealed significant differences between the two groups in terms of College Teaching Awards (p=0.022) and participation in the Recognising Excellence in Teaching Scheme (p=0.026, Table 18). In both cases, innovators/early adopters were more successful than early/late majority at being nominated or awarded.

| | Sig |
|---|---|
| Blended & Online Learning Development project (BOLD) | .079 |
| Learning & Teaching Development Fund (LTDF) | .119 |
| Chancellor's Fund | .103 |
| College Teaching Excellence Award | .022 |
| Recognising Excellence in Teaching (RET) or equivalent scheme | .026 |
| L&T project funding at another HEI | .516 |
| L&T project funding from an external body | .704 |

*Table 18: Between-group comparison regarding TEL engagement opportunities*

#### *3.1.2.4 Use and conceptions of e-learning*

The Chi-Square test, examining each item separately, revealed no significant difference between the two groups apart from the use of e-learning to engage students in deep thinking through online discussions (p=0.020, Table 19). A

significantly higher proportion of innovators/early adopters used the VLE in this student-centred way, compared with early/late majority staff.

| Use of e-learning systems to: | Sig (1-sided) |
|---|---|
| … provide easy access to course materials and administrative information | .296 |
| … provide up-to-date, additional learning resources at point of need | .618 |
| … provide a space for student questions and staff announcements | .620 |
| … engage students in deep thinking through online discussions | .020 |
| … provide an online space for building knowledge | .149 |

*Table 19: Between-group comparison regarding e-learning use*

#### *3.1.2.5 Digital practitionership*

There were no significant differences between the two groups in terms of access. In relation to skills, there was a significant difference in terms of teaching themselves to use new software (p=0.027), with more innovators/early adopters agreeing with this statement. All statements related to practices and attributes (the higher levels of the digital practitioner framework) were rated significantly differently by the two groups (Table 20), with innovators/early adopters consistently more positive than early/late majority.

| | | Sig |
|---|---|---|
| Access | I have access to necessary hardware for engagement in TEL | .144 |
| | I have access to necessary software for engagement in TEL | .410 |
| | I have reliable access to wi-fi | .089 |
| | I have access to learning technology professionals who can support me in using TEL | .618 |
| Skills | I can manage the blurring of boundaries between private and work time | .389 |
| | I can teach myself to use new software (e.g. apps) | .027 |
| | I can teach myself to use new hardware (e.g. devices) | .068 |
| | I can evaluate the suitability of digital content for my students | .767 |
| Practices | I design TEL activities to suit my students' learning needs | .000 |
| | I explore the capabilities of a technology for learning | .004 |
| | I evaluate my digital academic practice | .013 |
| | I reflect on innovations within my teaching practice | .015 |
| Attributes (attitudes) | I am confident in my attitude to TEL | .037 |
| | I am willing to invest time in exploring and evaluating TEL | .004 |
| | I am able to balance the risk of innovation with its potential for learning | .043 |
| | I am convinced of the potential of technology to enhance and transform learning | .001 |

*Table 20: Between-group comparison regarding digital practitionership*

Significant differences between the two groups were observed in relation to all digital practices; designing TEL to suit student needs ($p<0.001$), exploring capabilities of a technology ($p=0.004$), evaluating digital academic practice ($p=0.013$) and reflecting on their own teaching innovations ($p=0.015$). Similarly, significant differences were observed in relation to all attributes; confidence towards TEL ($p=0.037$), willingness to invest time in TEL ($p=0.004$), balancing the risks with the potential of innovation ($p=0.043$) and being convinced of the potential of technology to transform learning ($p=0.001$).

#### *3.1.2.6 Confidence in using learning technologies*

Several significant differences were observed between the two groups (Table 21). Again, innovators/early adopters were consistently more positive in their responses than early/late majority.

| | Sig |
|---|---|
| Creating screen-casted mini-lectures (e.g. via Camtasia) | .023 |
| Creating audio podcasts for access via Moodle | .006 |
| Finding suitable external learning resources (e.g. YouTube videos) and integrating them into your teaching | .327 |
| Moderating online discussion forums in Moodle | .022 |
| Using an electronic voting system such as Socrative or YACRS in the classroom | .004 |
| Creating quizzes in Moodle for student learning and revision | .050 |
| Facilitating online peer review using Moodle Workshop or Aropä | .017 |
| Setting up assignment submission links in Moodle for students to submit their work online | .011 |
| Grading online and giving feedback on student work in Moodle | .234 |
| Using similarity checking software (e.g. Urkund or Turnitin) | .097 |

*Table 21: Between-group comparison regarding confidence in using technologies*

Significant differences were observed in relation to creating screen-casted lectures ($p=0.023$) and podcasts ($p=0.006$), moderating online forums ($p=0.022$), using an e-voting system ($p=0.004$), facilitating online peer review ($p=0.017$) and setting up assignment submission links ($p=0.011$).

#### *3.1.2.7 Contextual factors (barriers and enablers)*

The only significant difference between the two groups was in relation to the level of support from the head of school with regards to engaging with TEL

(p=0.004, Table 22), with more innovators/early adopters than early/late majority expressing a positive view.

| | Sig |
|---|---|
| Access to local learning technology support | .550 |
| Access to necessary equipment to engage with TEL | .191 |
| Reliability and robustness of technology in the classroom | .963 |
| Amount of time to experiment with TEL | .071 |
| Students' level of comfort using technology for learning | .332 |
| Level of support from head of school or management re: engaging with TEL | .004 |
| Level to which TEL is seen as an institutional priority | .135 |
| Colleagues attitude to, and support for, use of TEL | .405 |
| Presence of a community of practice of educators using TEL | .180 |
| Recognition and reward for engaging in TEL | .190 |

*Table 22: Between-group comparison regarding influence of contextual factors*

#### *3.1.2.8 Usefulness of different CPD methods*

Only two significant differences were observed between the two groups (Table 23), relating to attendance at informal institutional events (p=0.013) and external events (p=0.006). Again, innovators/early adopters were more positive.

| | | Sig |
|---|---|---|
| Self-directed, informal learning | Reading relevant journal articles and book chapters | .988 |
| | Undertaking Massive Open Online Courses (MOOCs) on blended/online/innovative learning and teaching | .274 |
| | Learning informally from and with colleagues | .352 |
| Communities of practice | Joining an online learning technology community such as the Association for Learning Technology (ALT), or the Learner Experience Research Special Interest Group (ELESIG) | .101 |
| | Participating in a mentoring scheme, working with a more experienced teacher as a 'critical friend' | .720 |
| Events | Attending events hosted by external organisations such as ALT, ELESIG, the higher Education Academy (HEA) | .013 |
| | Attending informal institutional CPD e.g. LEADS events, Learning and Teaching conference | .006 |
| Formal learning and recognition | Undertaking a credit-bearing postgraduate taught programme such as the PGCAP or MEd | .341 |
| | Applying for recognition of good practice, e.g. through Recognising Excellence in Teaching (RET) or fellowship of the Higher Education Academy (P/S/FHEA) | .284 |
| | Undertaking a research degree relating to learning and teaching in higher education | .372 |

*Table 23: Between-group comparison regarding usefulness of CPD*

### 3.1.3 Correlations between variables

The results of Spearman's Rho correlations between the aggregate scores, based on ordinal data, are shown in Table 24**Error! Reference source not found.**.

| Scale | Total self-efficacy | Total risk-taking | Total TEL engagement | Total e-learning use | Total digital practice | Total digital confidence | Total contextual enabler-barrier | Total CPD |
|---|---|---|---|---|---|---|---|---|
| Total self-efficacy | - | | | | | | | |
| Total risk-taking | -.078 | - | | | | | | |
| Total TEL engagement | .253* | .278 | - | | | | | |
| Total e-learning use | .141 | . | .248* | - | | | | |
| Total digital practice | .282* | .198 | .342** | .353** | - | | | |
| Total digital confidence | .334** | .003 | .390** | .178 | .587** | - | | |
| Total contextual enabler-barrier | .271* | .066 | -.062 | .222 | .373** | .187 | - | |
| Total CPD | .068 | .095 | .282* | .273* | .324* | .382** | .291* | - |

*p<0.05 (two-tailed), **p<0.01 (two tailed)

*Table 24: Correlations between aggregate scores per question set*

All significant correlations were positive. In terms of the relationship of self-efficacy to other variables, there was a medium highly significant correlation between digital confidence (.334**) and significant, small correlations with digital practice (.282*), contextual factors (.271*) and TEL engagement (.253*). In terms of TEL engagement, there was a highly significant medium correlation with digital confidence (.390**) and digital practice (.342**) and significant small correlations with CPD usefulness (.282*) and e-learning use (.248*). E-learning use had a medium, highly significant correlation with digital practice (.353**). Digital practice had a highly significant, large correlation with digital confidence (.587**), a highly significant medium correlation with contextual factors (.373**), and a significant medium correlation with CPD (.342*). There was a

highly significant medium correlation between digital confidence and CPD (.382**), and a significant small correlation between contextual factors and CPD (.291*). Risk-taking was not correlated with any other variable.

## 3.2 Focus groups

### 3.2.1 Response

Of the 18 participants who stated in the questionnaire that they were willing to participate in a focus group, eleven respondents agreed to participate. Of these, nine participants actually participated in the two focus groups. The breakdown of participants are shown in Table 25, Table 26 and Table 27.

| Stage of technology adoption | Number of participants |
|---|---|
| Innovator | 0 |
| Early adopter | 4 |
| Early majority | 5 |
| Late majority | 0 |
| Laggard | 0 |

*Table 25: Participation in focus group by stage of technology adoption*

| School | Number of participants |
|---|---|
| Chemistry | 3 |
| Computing Science | 2 |
| Engineering | 1 |
| Geographical and Earth Sciences | 1 |
| Mathematics and Statistics | 1 |
| Physics and Astronomy | 1 |
| Psychology | 0 |

*Table 26: Participation in focus group by school*

| Professional teaching role | Number of participants |
|---|---|
| Graduate Teaching Assistant | 0 |
| Lecturer | 8 |
| Senior Lecturer | 1 |
| Professor | 0 |
| Other | 0 |

*Table 27: Participation in focus group by role*

### 3.2.2 Findings

Qualitative differences between the two groups are summarised in Table 28.

| Early adopters | Early majority |
|---|---|
| Invest time to save their colleagues effort and time in using learning technologies | Minimise the amount of time invested in finding support and case studies for learning technology use |
| Look to systems developers for platform enhancements and new features | Look to a dedicated learning technology support service, including a local learning technologist, for using existing platforms |
| Make serendipitous discoveries through sporadic events | Like to be explicitly led to relevant information at specific events or online sources |
| Can see the potential for learning technology use across different disciplines | Prefer to be shown examples from their own or cognate disciplines |

*Table 28: Qualitative differences between early adopters and early majority staff as identified in the focus groups*

#### *3.2.2.1 Interest in the topic of research*

Early adopters were interested in technology enhanced learning because they taught in subjects that relied on technology, and because it offered them solutions to challenges such as large class sizes, or efficiencies in teaching administration.

Early majority were either 'technophiles' in their personal life, or were interested in how TEL could engage students and better support large class sizes, or enhance their teaching practice. TEL was viewed by early majority staff to offer the opportunity for increased interaction between students and between students and teachers; however, it needed to be robust, reliable, and fully supported as otherwise there was an ethical risk to compromising the student experience.

#### *3.2.2.2 Definitions of TEL teaching innovation*

Early adopters considered themselves to be at the 'bleeding' edge rather than the 'cutting edge', and expressed some reluctance to adopt innovations where there was a risk of failure:

> *"There's a lot of blood, sweat and tears at that level too, to implement it, especially with large numbers. 'Cause you're at the stage where it has to work, otherwise you are in an awful*

*lot of trouble with 250 students where you messed up." (Early adopter #2).*

Teaching innovations were associated by early adopters with enhancing student learning. These need not be large innovations, but small-scale technology adoptions, or digital extensions of existing academic practice.

Early majority staff associated TEL teaching innovation with increasing student participation or engagement, or providing support that previously would not have been possible. Early majority staff also associated TEL innovation with using technology to address an existing learning or teaching issue, or with using technology to introduce efficiencies.

#### *3.2.2.3 How learning technologies were used by participants*

Early adopters considered that they were not using Moodle to its full potential. They largely used it as a file repository although they also mentioned enhanced use of multiple-choice questions via the Quiz activity, as well as using the Gradebook for online marking. One early adopter was using other TEL teaching innovations such as the flipped classroom approach, enabled through the use of videos uploaded to Moodle, as well as electronic voting systems such as Sli.do.

Early majority staff stressed the importance of not using technology for its own sake, and cited examples of established TEL use such as online assessment and marking, or doing online polls.

#### *3.2.2.4 Enablers, barriers and requested support for engaging in teaching innovation*

##### 3.2.2.4.1 Building relationships

For early adopters, the greatest enabler was the building of relationships with other innovators or early adopters across the university, including academics and learning technologists. Early adopters were intrinsically motivated to establish and sustain these relationships, which were largely cultivated through serendipitous discoveries at sporadic meetings such as the first year course coordinators network, as well as the CoSE teaching day. Early adopters noted that multi-disciplinary meetings such as these were useful because different subjects experienced similar issues concerning student learning experience, and technological issues and solutions:

> *"The first year course coordinators meeting … it's maybe once or twice a year. It's just an hour. So somebody will give a talk about how they … had a particular problem and they dealt with it, and there's coffee and a bit of cake too, and there's the opportunity to talk over a few issues. And again, it's an opportunity to make those contacts." (Early adopter #2)*

#### 3.2.2.4.2 Reliance on early adopters and established evidence

Although one early adopter was able to use their pioneering work for a Recognising Excellence in Teaching application, they all considered that they should receive greater recognition and reward for driving innovation and supporting colleagues to innovate their teaching.

Early majority staff were enabled to engage in TEL teaching innovation by seeing another colleague use the innovation in pedagogically effective ways to enhance student learning:

> *"For me the turning point was … I happened to attend one of those sessions where the lecturer was using YACRS … he knew how to do it, you know, using YACRS to … give instruction … their examples were spectacular. I've tried it in the past and for me it was just another means of doing multiple choice questions and if you do it for that reason it sucks." (Early majority #5)*

Early majority staff were also dependent on existing evidence that tried-and-tested technologies were effective. One early majority academic noted the importance of having colleagues in the school who had the time and funding to innovate, enabling them to generate evidence of a positive impact on the student learning experience.

#### 3.2.2.4.3 Time

Early adopters considered that the biggest barrier to adopting TEL teaching innovations was time:

> *"I think at the Teaching and Learning Conference you see lots of examples that are great and you think, how long did it take you to do that? … people talk about wee Camtasia videos … for a ten minute video it's hours and hours of work. When it's done it's done and it's great, but it takes a long time." (Early majority #3)*

Time was also identified as an issue by early majority academics, with workload and competing priorities such as research underpinning this concern.

#### 3.2.2.4.4 Technical support

There were some concerns expressed by early adopters that they were still waiting to hear back from Moodle developers about difficult experiences they had using specific features of Moodle, and requested refinements. Those professional relationships and personal contacts that were seen as enabling were viewed by early adopters as critically important for overcoming barriers.

The lack of a dedicated Moodle support service was seen as a barrier by early majority staff. They also valued technical support as an enabler, requesting dedicated support from college learning technologists, as well as platform-specific dedicated support (e.g. for Moodle) centrally. A guarantee from the institution as to the reliability of technologies was also considered an enabler.

#### 3.2.2.4.5 Range of supported technologies

A barrier identified by early adopters was the fact that the University has a limited range of supported learning technologies:

> *"There's a sense that we're constrained by what technology the university has blessed. That's the term that is used almost every day. Well we can't use that system 'cause it's not blessed." (Early adopter #1)*

Moodle itself was seen to be a barrier by early adopters, in term of its limited functionality, and the fact that it was considered slow and unreliable. Early majority staff also commented that some activities, such as forums, worked less well on Moodle than in external platforms.

#### 3.2.2.4.6 Funding

Early adopters also saw the availability of funding, which need not be significantly large, as an enabler in driving TEL teaching innovation, and requested additional funding opportunities, to enable teaching innovation.

> *"A little bit of money goes a long, long way at this level." (Early adopter #2)*

The absence of funding was seen as a barrier, in terms of the limited funding opportunities to innovate using TEL:

*"… when you talk of learning and teaching with technology you need funding. You need money to support your ideas. But I can't find any…" (Early adopter #3)*

#### 3.2.2.4.7 Student appreciation for TEL innovation

A positive response to TEL innovation from students was considered an effective enabler by early majority staff.

#### 3.2.2.4.8 Lack of transparent processes

The 'process' of introducing and sustaining innovations was not clear to early adopters.

#### 3.2.2.4.9 Reliable infrastructure

The absence of lecture recording equipment was viewed as a barrier by one early majority academic.

#### 3.2.2.4.10 Information about available technologies

One early majority academic noted lack of awareness about how to obtain software licenses.

#### 3.2.2.4.11 Evidence for TEL innovation

A gap in the availability of evidence of the impact of TEL innovation was viewed as a barrier by one early majority academic.

### *3.2.2.5 Useful methods of CPD*

#### 3.2.2.5.1 Peer support

Early adopters considered that they played a role in supporting 'secondary adopters'. Essentially this involved saving colleagues' time. There was some regret that this did not save the early adopters time; however, there was recognition that the secondary adopters could further refine the innovations and share the outcomes with early adopters. Early adopters considered that supporting others was about 'helping your mates'. There was satisfaction in this, but the process depended on goodwill and should not be formalised.

Early majority staff also noted the value of talking to colleagues in relation to changing their academic practice. One early majority academic also expressed a willingness to share good practice.

#### 3.2.2.5.2 LEADS-supported good practice

LEADS emails about CPD opportunities were seen by early adopters to be helpful in encouraging innovation. LEADS was also seen by early adopters as having the potential to sustain useful communities of practice that would otherwise lack momentum.

#### 3.2.2.5.3 LEADS events

Early majority academics noted that LEADS CPD events were useful, and more so if sessions were delivered by colleagues in their own college. They viewed the Learning and Teaching conference as an enabler in terms of showcasing what others were doing, and 'making' staff attend. Early majority staff also emphasised the value of small, practical CPD sessions, rather than longer events that incorporated more pedagogical theory. One academic suggested that a useful formula would be a three-step process including (1) raising awareness, (2) providing the opportunity for hands-on practice using a technology, and (3) supporting staff to go off on their own to use the technology in a pedagogically meaningful way. However, there was also evidence that using technology in itself was not effective in enhancing student learning, relating to the enabler of seeing a colleague using the technology in a pedagogically effective way.

#### 3.2.2.5.4 LEADS formal development opportunities

The PGCAP was also seen as an enabler to using TEL innovatively, according to one early majority academic:

> *"People who … do the PGCAP come back into their school and they bring these things back … I learned about YACRS because whoever was doing PGCAP at the time had heard about this and invited someone from the YACRS development team … to the school … that's how I became aware that this exists and roughly how it works." (Early majority #2)*

#### 3.2.2.5.5 LEADS visits to schools

Early majority staff requested that there should be a presentation, once a year, to CoSE staff about available technologies and support.

#### 3.2.2.5.6 TELT network

The TELT network was not considered effective by early adopters who viewed this form of communication as 'spam email'. None of the early majority had heard of the TELT network.

#### 3.2.2.5.7 GUSTTO

The GUSTTO teaching tips database was considered by early adopters as a good means of disseminating good practice by early adopters; however, not all early adopters were aware of its existence, and limitations in its functionality (such as the lack of alerts) were identified in promoting and sustaining connections.

#### 3.2.2.5.8 Online resources for access at point of need

Early majority staff were not aware of online advice and resources, and suggested that it would be helpful to be explicitly directed to these rather than having to check in regularly to the LEADS website to look for new content. They were not willing to spend too much time trying to find information, preferring case studies to be quick and easy to access:

> *"The key point is will it take more than three seconds to find what they need?" (Early majority #5)*

# 4 Discussion

## 4.1 How do science and engineering teachers in higher education construe the concept of 'innovative teaching'?

The study revealed multiple overlapping definitions of TEL teaching innovation; however, common responses included:

- Enhancing student learning
- Using new or existing technologies or tools to enhance teaching practice or introduce teaching efficiencies
- Using new technologies to implement innovation previously not considered possible
- Using new teaching approaches to enhance learning and teaching

Therefore, a new definition of teaching innovation, using TEL as a lens, can be offered:

> *TEL teaching innovation involves adopting new teaching approaches, or using existing technologies in new ways, or using new technologies, to enhance student learning and the experience of teachers.*

## 4.2 Which intrinsic teacher characteristics are associated with successful engagement in teaching innovation and TEL in science and engineering?

Engagement in teaching innovation opportunities was positively associated with digital confidence (in performing specific digital education tasks), digital practice (based on Bennett's 'digital practitioner' framework), perceived usefulness of CPD, self-efficacy, and use (and underpinning conceptions) of e-learning.

Therefore, all the intrinsic teacher characteristics examined in this study are positively related, with the exception of risk-taking, which was found not to be significantly correlated with any other factor. These findings support the arguments that teaching innovation, particularly in the context of TEL, is associated with self-efficacy (Ertmer and Ottenbreit-Leftwich 2010, Thurlings, Evers et al. 2015, Hsu 2016, Klaeijsen, Vermeulen et al. 2017), but refutes the argument that teaching innovation and risk-taking are correlated (Lunde and Wilhite 1996, Wilson and Stacey 2004, Ee, Seng et al. 2007). One reason for this

could be the limited variance in the data arising from the questionnaire offering only two choices per statement, as opposed to a 5-point Likert scale.

### 4.3 What extrinsic factors, indicative of the organisational climate, positively or negatively influence science and engineering teachers' engagement in teaching innovation and TEL?

The general frequency data (Table 14) showed that all contextual factors were experienced as barriers by at least some participants, which is perhaps reflective of their individual characteristics and each school's organisational climate. The most significant barrier overall was identified as the amount of time to engage with TEL (74%). A lack of time (or exhausted workload) has been identified as a significant barrier to staff engagement with TEL elsewhere (Jacobsen 2000, Al-Senaidi, Lin et al. 2009, Brown 2016). In terms of the organisational climate, some staff also appear to lack access to local learning technology support (35%), reliable classroom technology (34%), and recognition and reward (25%).

On the other hand, the most significant enablers appear to be student digital literacies (38%), access to necessary equipment (35%), a community of practice (33%), learning technology support (31%), and reliable classroom technology (31%).

Recognition and reward of teaching and teaching innovation, alongside improved physical and IT infrastructure, feature in the University's E-Learning and Learning and Teaching Strategies (University of Glasgow 2013, University of Glasgow 2015) but these enablers still require investment. The importance of organisational climate was also identified in subsequent work at the University of Glasgow (Adekola, Dale et al. 2017a), where an institutional framework for transitions into blended learning included the following as key considerations: institutional culture (to permit risk-taking and innovation), management and organisation (to reward innovation and support optimal workloads), and physical infrastructure (equipment and wi-fi). The new Digital Learning Strategy (VLE Development Board 2018) builds on previous recommendations and capability-building projects such as BOLD, to optimise the enablers and minimise the barriers to staff engaging in digital education to create transformative learning opportunities.

## 4.4 Are there differences between teachers' responses in relation to their self-identification as an innovator or early adopter versus early or late majority?

### 4.4.1 Defining innovative teaching

There was little difference in terms of how the two groups of staff defined innovative teaching. Both were concerned with using TEL to enhance student learning, and with seeing how TEL could introduce efficiencies to workload.

### 4.4.2 Personal characteristics

Quantitatively, there were no differences between the two groups in relation to their self-efficacy or risk-taking. This differs from the literature that states that innovators/early adopters are risk-takers (Wilson and Stacey 2004, Ee, Seng et al. 2007). The contrasting findings here may be due to a limited sample size or dichotomous question response limiting potential variation, as noted in section 4.2.

### 4.4.3 Digital practitionership

Differences in digital practice (Table 20) were interesting; while there were no differences in terms of access to support or equipment, and only one significant difference in relation to digital skills (learning to use new software), the statements relating to the higher two levels of digital practitionership – practices and attributes – were consistently statistically different. Designing TEL activities to suit their students' learning needs, exploring the capabilities of a technology for learning, evaluating their own digital practice, and reflecting on innovations in their teaching practice were all practices that innovators/early adopters agreed with more than early/late majority. Attributes such as confidence in their attitude to TEL, willingness to invest time to explore and evaluate TEL, the ability to balance the risk for innovation with its potential for learning, and being convinced of the potential of a technology to transform learning and teaching were similarly more positively rated by innovators/early adopters. These findings are also supported by the qualitative results from the focus groups, summarised in Table 28. This suggests that the early/late majority (for the most part) have still to reach the higher levels of practice and attributes, and that Bennett's (2014) digital practitioner framework is potentially useful in terms of scaffolding teachers' development through peer mentoring by early adopters.

### 4.4.4 Digital confidence and use (underpinned by conceptions) of e-learning

In terms of confidence in performing digital education tasks, it is perhaps not surprising that the two groups did not differ in terms of 'low' level e-learning use such as finding YouTube videos for use in teaching, creating quizzes in Moodle, grading online and giving feedback in Moodle, and using similarity checking software. These digital education tasks represent 'entry level' skills and are consistent with the information-focused strategies identified by González (2012). Setting up assignment links is a relatively straightforward task, but it is possible that the pioneer group are also more confident because early/late majority staff rely on them or others to do this less frequent task.

Still consistent with information-focused e-learning strategies, but more technically complex, tasks such as creating screen-casted lectures or audio podcasts appear to still be the domain of innovators/early adopters. Such activities are time-intensive, which the questionnaire and focus groups highlighted to be a significant difference between the two groups in that innovators/early adopters were more willing to invest time in TEL.

Facilitating online discussion and online peer review, both student-centred active learning tasks, and more consistent with communication and collaboration-focused strategies (González 2012), are also the domain of innovators/early adopters. Interestingly, while more innovators/early adopters claimed in the questionnaire to use e-learning to engage students in deep thinking through online discussions, they did not differ significantly in providing an online space for building knowledge. One potential explanation for this is the item wording; this may have been ambiguous, highlighting the importance of pre-piloting to ensure content validity (Oppenheim 1992) or it could be that in representing the highest level of e-learning use, neither were aware of what this practice actually entailed.

### 4.4.5 Enablers and barriers

The focus groups revealed that early adopters appear less reliant on learning technology support than the early majority, depending more on Information Services and systems developers for access to new software tools and system enhancements that can engage with directly. The early majority appear to be

dependent on dedicated Moodle support and learning technologists for using TEL, as well as their early adopter colleagues to establish evidence that TEL approaches work.

Barriers to early majority staff were around access to information about TEL platforms and support. Early adopters, on the other hand, were more concerned about the lack of funding opportunities to enable them to innovate. However, the amount of time associated with TEL innovation was a concern for both groups.

#### 4.4.6 Usefulness of CPD

In terms of useful CPD, both groups of staff in the focus groups recognised the value of learning from colleagues. However, while early adopters saw the potential of learning from colleagues from other disciplines, early majority staff preferred to learn from colleagues in their own or cognate disciplines. This comparison chimes with the literature; Wilson and Stacey (2004), citing Geoghegan (1995), similarly noted that early adopters engaged in interdisciplinary networks while mainstream majority worked within disciplinary networks.

### 4.5 What methods of academic development may be used to best support innovative and less-innovative teachers?

Given the innovator/early adopters' capacity for self-directed learning, serendipitous discovery and relationship building with enabling others, it is reasonable to conclude that from an academic development perspective, significantly more effort needs to be invested in developing the early/late majority group. However, the importance of the institution providing an enabling organisational climate, including funding and opportunities for calculated risk-taking, should not be underestimated.

The most useful method of CPD was learning informally with and from colleagues; all participants had used this approach, and only 2% considered it not very useful. This is consistent with the outcomes of a focus group study with online instructors by Schmidt, Tschida et al. (2016), who commented that conversations and one-to-one mentoring with colleagues were useful in furthering online teaching competence. A questionnaire study with 46 Finnish

lecturers also revealed that interaction and networking were important for motivating teachers to innovate. The sporadic, serendipitous nature of useful exchanges of good practice observed in the focus group with early majority staff is consistent with the outcome of van Eekelen, Boshuizen et al.'s (2005) study of higher education teachers self-regulation, which noted that most learning was spontaneous and non-planned and often in response to a problem.

The PGCAP was also considered to be a useful enabler for engaging in TEL innovation, particularly by majority staff. It was suggested that staff development around TEL should involve (1) raising awareness of what it possible with a technology for learning, before (2) allowing participants to try out the tool and then supporting them to actively explore its potential in an authentic context. It is worth noting that the PGCAP currently does this through the mandatory Course 1A, which is a general introduction to learning and teaching including TEL, and the elective Course 2C, which enables participants to evaluate a particular technology in their own context. This is congruent with Wilson and Stacey (2004)'s recommendation of tiered academic development, from awareness raising to limited practice to extensive practice. The PGCAP also satisfies Vogel's (2010, p.21) recommendation to "… to balance the advantages of a centralised provision and support for innovation with a respectful view of academic teachers as necessarily autonomous individuals whose learning needs are situated in their own practice". The innovation diffusion potential of the PGCAP could however be further exploited through showcase events.

While early adopters were able to see the potential of TEL applications from across disciplines, early majority staff prefer to see examples of good practice from their own or cognate disciplines, also noted by Wilson and Stacey (2004). Therefore, there is a need to increase opportunities for sharing good practice at school and college levels.

## 4.6 Limitations of the study

The survey had a response rate of 18%, which could indicate a response bias (Phillips, Reddy et al. 2016), with those more interested in teaching innovation and TEL responding. That there was over-representation of one school compared with others, and that 10% of respondents had been awarded BOLD funding, may

indicate that staff that I have directly supported in the past were more likely to complete the questionnaire. Therefore, the results should be interpreted with caution, and may represent an overestimated level of digital proficiency as well as potentially underestimating barriers to engaging in TEL teaching opportunities within the wider teacher population.

The study was also conducted as a case study of one college within a single institution. While it is reasonable to draw insights from this work to other colleges and schools, it is not possible to make generalisations from this study to other disciplines or institutions (Hodkinson and Hodkinson 2001).

# 5 Conclusions and implications for practice

## 5.1 Key lessons

This work has resulted in a new definition of teaching innovation in the context of TEL, produced by the research participants, in that it "involves adopting new teaching approaches, or using existing technologies in new ways, or using new technologies, to enhance student learning and the experience of teachers".

A positive correlation between engagement in TEL teaching opportunities and self-efficacy suggests that opportunities should be made available for staff to enhance their self-efficacy in this area. Increased self-efficacy is also associated with increased confidence in performing digital tasks, as well as a higher level of 'digital practitionership', and perceived value of CPD opportunities.

The form of CPD that participants valued most was informal engagement with colleagues; therefore, to promote the likelihood of serendipitous exchanges, LEADS should play a role in facilitating local learning communities as well as continuing to offer informal learning events and more formal learning opportunities such as the PGCAP.

The study revealed quantitative and qualitative differences between innovators/early adopters and early/late majority. While most effort should be invested in supporting the development of the majority, there is still a strong case to be made for an increasingly enabling organisational culture that provides systems support and funding for innovators/early adopters.

## 5.2 Action plan for the College of Science and Engineering to encourage and support TEL teaching innovation [additional agreed ILO]

I suggest the following recommendations to effectively support TEL teaching innovation across CoSE. While most involve direct support from LEADS, there is also a need for continued commitment and communication at the school, college and institutional levels.

In terms of supporting all staff:

- LEADS should build on the potential for innovation diffusion by helping PGCAP participants to further disseminate their work through showcase events and/or online resources.

- LEADS should work with CoSE to help sustain local communities of practice in partnership with academic colleagues. The aim should not be to act 'on' CoSE staff but to support and enable CoSE staff by undertaking some of the administrative load associated with maintaining local learning communities, and facilitating connections and the building of relationships that are critical to the sharing of good practice. This could, for example, be supported by LEADS College contacts.
- The institution should more clearly highlight potential funding opportunities, internally and externally, acknowledging that teaching innovation can take place in incremental steps, with appropriately sized funds being made available to support small or large-scale innovation.

In terms of supporting the early/late majority:

- The PGCAP clearly has a role to play in enabling staff to engage in TEL teaching innovation in a supported way, and this formal education strand should continue as anticipated, augmented by informal learning opportunities offered by LEADS such as CPD workshops and the annual Learning and Teaching conference.
- An annual presentation to each school, by LEADS in partnership with CoSE staff, should take place to highlight development opportunities, as well as novel applications of learning technologies, and available resources that exist online to promote good practice. As discussed at a How To Moodle meeting (31/7/18), this could include resources such as How To Moodle (www.gla.ac.uk/howtomoodle), Moodle Active Learning and Teaching (MALT) and GUSTTO (teachingtips.gla.ac.uk).

In terms of supporting the innovators/early adopters:

- The institution has a role to play in recognising and rewarding early adopters for promoting TEL innovation and supporting the secondary adopters. However, the early adopter role should not be formalised.
- The Digital Learning Environment strategy (VLE Development Board 2018), should be promoted more widely and embedded in practice such that requests for enhancements to existing learning technologies, or the

trialing of new learning technologies (subject to the limits imposed by the recent General Data Protection Regulation), can be better supported. If it is not possible to accommodate requested enhancements, the reasoning should be more clearly and quickly communicated to teaching staff.

## 5.3 Implications for my practice

For my own practice, I see myself continuing to formally support academic development through the PGCAP, as well as informally supporting staff through facilitating connections between staff within individual schools and CoSE, and cross-disciplinarily across the institution. This includes proactively working with staff in schools to capitalise on opportunities for networking, and sharing of good practice within and between schools.

## 5.4 Future work

Future work should extend this research to other colleges across the university, as well as longitudinal research within individual schools and CoSE to assess the impact of ongoing academic development activities.

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# 7 Appendix: Questionnaire distributed to teaching staff in CoSE

## Consent: Identifying characteristics of innovative and less innovative teachers, and opportunities to enhance their digital academic practice, in science and engineering

**Researcher:**

Dr Vicki Dale (Principal Investigator). I am primarily undertaking this research for my dissertation as a participant on the MEd Learning and Teaching in Higher Education; however, it will also inform my work in terms of how I can best support CoSE staff as a college contact within the Learning Enhancement and Academic Development Service.

**Supervisors:**

- Dr Jason Bohan, Senior Lecturer, School of Psychology
- Dr Michael McEwan, Senior Academic and Digital Development Adviser, LEADS

*You are being invited to take part in a research project. Before you decide, it is important for you to understand why this work is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Please ask me (vicki.dale@glasgow.ac.uk) if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.*
*Thank you for reading this.*

**About the project and its purpose**

This study seeks to identify characteristics of teachers that engage in technology-enhanced learning (TEL) related academic development and teaching innovation opportunities, and those that do not. This is to inform my work as the LEADS academic contact for the College of Science and Engineering. As well as identifying those characteristics, I seek to understand how teachers may be influenced by contextual enablers or barriers, such as by students and the institution.

**Whatever your views or experiences of teaching innovation and technology-enhanced learning, I would really welcome your input into this study.** I hope to use the findings to inform the provision of academic development around technology-enhanced learning, in order to provide a service to best support you within your professional context, being aware of contextual enablers and barriers that I hope will have emerged from the study. It is my aim to support you as best as I can, acknowledging your competing duties and complex role within the institution.

**Why have I been chosen?**

As a teacher in the College of Science and Engineering, you have been identified as a key stakeholder in relation to teaching innovation and technology-enhanced learning.

**Do I have to take part?**

It is up to you to decide whether to take part. As a learner (for example on the PGCAP), the decision not to participate will not affect your grades in any way. Similarly, as a colleague, withdrawing from the research or deciding not to participate will not jeopardise your relationship with the researchers in any way.

**What will happen to me if I take part?**

The survey should take 10-15 minutes to complete.

You may also be invited to attend a focus group discussion with colleagues that should last approximately 45-60 minutes.

**Will my taking part in this study be kept confidential?**

**Please note that the survey is completely anonymous unless you list your email address. For the purposes of data analysis, this identifier will be separated from the survey data.**

By completing this survey, you are giving your informed consent for the data to be used in this study. The data will be aggregated so that **my focus as a researcher will be on trends and general patterns within the data, and not on individual anonymous responses**. Similarly, by participating in the focus group, you will be giving your informed consent for me to analyse the data.

Please be assured that when it comes to representing and statistically analysing the survey data, and thematically analysing the focus group data, I will be aggregating the responses to look for general trends and patterns in the data. I will not be examining the responses from individual teachers. The only caveat to this would be, for example, if an individual was to make explicit reference to practices within their own school; however, all efforts will be made to ensure that any quotes will be appropriately de-identified.

Anonymous (survey) or anonymised (focus group) data will be stored in accordance with the 1998 Data Protection Act and the 2018 General Data Protection Regulation, in a password-protected drive of a university server, and/or in a locked cabinet in an office at the University of Glasgow when not in use. De-identified data will be securely stored on the Enlighten database for 10 years for research integrity purposes.

**What will happen to the results of the research study?**

I seek to make the results of my study available to stakeholders within LEADS, and CoSE (reporting to the Dean for L&T and the appropriate L&T committee), as

well as the wider university (e.g. through the Learning and Teaching conference), and the sector at large (e.g. peer-reviewed journal article and/or conference presentation). The emphasis will be placed on general trends within the data and implications for our academic development provision within LEADS, to offer you the best service we can. You may contact me for a summary of outcomes after the end of the project (end of August 2018).

**Who is organising and funding the research?**

Funding will be sought from the Chancellors Fund to transcribe the focus groups. Refreshments for focus groups (tea/coffee) will be supplied by LEADS.

**Who has reviewed the study?**

This project has been reviewed by the College of Science and Engineering Research Ethics Committee, and is being carried out with the permission of the Dean for Learning and Teaching in the College of Science and Engineering, Professor John Davies.

**Contact for Further Information**

For more information about this project, please contact Dr Vicki Dale at vicki.dale@glasgow.ac.uk, telephone 0141 330 5675. If participants have any concerns regarding the conduct of the project, they can contact the project supervisors above and/or College Ethics Officer Dr Christoph Scheepers at christoph.scheepers@glasgow.ac.uk.

**Please agree to the following statements to begin the survey:**

- I confirm that I have read and understand the Plain Language Statement (above) and have had the opportunity to ask questions.
- I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason.
- I also understand that in any instances where a dependent relationship is involved, my choice to participate or not, or to withdraw from the study, will have no effect on my grades/assessment/employment.
- I have been assured that my data will be held in accordance with the 1998 Data Protection Act and the 2018 General Data Protection Regulation, i.e. that electronic data will be stored securely on a University of Glasgow server, and that paper copies of any transcripts will be stored in a locked office cabinet in an office at the University of Glasgow when not in use.
- I consent to any de-identified data being securely archived for at least 10 years on the Library's Enlighten database for the purposes of research integrity.

Q1. ☐ I agree to the statements above.

Q2. ☐ OPTIONAL: I consent to any de-identified data being made available for reuse by other researchers via the Library's Enlighten database.

## About you

Q3. What school are you primarily based in?

- ○ Chemistry
- ○ Computing Science
- ○ Engineering
- ○ Geographical and Earth Sciences
- ○ Mathematics and Statistics
- ○ Physics and Astronomy
- ○ Psychology

Q4. What is your current teaching role?

- ○ Graduate teaching assistant / demonstrator / occasional tutor
- ○ Lecturer on LTS contract
- ○ Lecturer on R&T contract
- ○ Senior Lecturer on LTS contract
- ○ Senior Lecturer on R&T contract
- ○ Professor on LTS contract
- ○ Professor on R&T contract
- ○ Other (Please specify)…….

Q5. How many years have you been teaching in higher education?

…….

## Personal characteristics

Q6. When it comes to teaching innovation, including the use of technology-enhanced learning, would you describe yourself as:

- ○ Innovator or technology enthusiast (the first to adopt an innovation)
- ○ Early adopter or visionary (an early adopter of innovation)
- ○ Early majority or pragmatist (slightly slower to adopt an innovation)
- ○ Late majority or conservative (much slower to adopt an innovation)
- ○ Laggard or sceptic (the last to adopt an innovation)

Please explain your answer

……

Q7. Please rate the following statements where SD=Strongly disagree, D=Disagree, N=Neither Agree nor Disagree, A=Agree, SA=Strongly Agree

| | SD | D | N | A | SA |
|---|---|---|---|---|---|
| When a student does better than usual, many times it is because I exerted a little extra effort | ○ | ○ | ○ | ○ | ○ |
| If one of my students could not do a class assignment, I would be able to accurately assess whether the assignment was at the correct level of difficulty | ○ | ○ | ○ | ○ | ○ |
| If a student masters a new concept quickly, it is probably because I knew the necessary steps in teaching that concept | ○ | ○ | ○ | ○ | ○ |
| If a student did not remember the information I gave in a previous lesson, I would know how to increase their retention in the next lesson | ○ | ○ | ○ | ○ | ○ |
| When I really try, I can get through to the most difficult students | ○ | ○ | ○ | ○ | ○ |
| If a student in my class becomes disruptive and noisy, I feel assured to know some techniques to redirect them quickly | ○ | ○ | ○ | ○ | ○ |
| When a student is having difficulty with a task, I am usually able to adjust to their level | ○ | ○ | ○ | ○ | ○ |

Q8. When I encounter difficulties in learning and teaching:

○ I seek solutions based on tried and tested methods
○ I seek solutions based on unproven ideas

Q9. When involved in a teaching-related project [reverse-coded]:

○ I forget that other people are involved and probably should be consulted
○ I am considerate of all other group members

Q10. When faced with challenges in teaching administration:

○ I stick to established rules and guidelines
○ I bend the rules to find a working solution

Q11. When assessing student work [reverse-coded]:

○ I work best for short bursts of high intensity
○ I can maintain high accuracy for long periods of time

Q12. In relation to learning and teaching:

○ I have a strong command of general pedagogical literature
○ I have a strong command of specialised pedagogical literature

Q13. As a teacher in higher education [reverse-coded]:

○ I am interesting in finding problems to solve
○ I am interested in solving problems

## Engagement with teaching innovation and technology-enhanced learning (TEL)

Q14. How would you define the concept of 'teaching innovation' in the context of technology-enhanced learning?

……

Q15. To what extent have you applied or been successful for the following teaching innovation opportunities (either as an individual or part of a team)?

| | Not applied or nominated | Applied or nominated | Successfully awarded |
|---|---|---|---|
| Blended and Online Learning Development (BOLD) project | ○ | ○ | ○ |
| Learning and Teaching Development Fund (LTDF) | ○ | ○ | ○ |
| Chancellor's fund | ○ | ○ | ○ |
| College Teaching Excellence Awards | ○ | ○ | ○ |
| Recognising Excellence in Teaching (RET) scheme or equivalent recognition at another higher education institution | ○ | ○ | ○ |
| L&T project funding at another higher education institution | ○ | ○ | ○ |
| L&T project funding from an external body e.g. Higher Education Academy, Jisc, EU | ○ | ○ | ○ |

## Digital teaching practice

Q16. Which of the following describe your use of e-learning systems? (Please select all that apply):

☐ To provide easy access to course materials and administrative information
☐ To provide up-to-date, additional learning resources at point of need
☐ To provide a space for student questions and staff announcements
☐ To engage students in deep thinking through online discussions
☐ To provide an online space for building knowledge

Q17. Please rate the following statements where SD=Strongly disagree, D=Disagree, N=Neither Agree nor Disagree, A=Agree, SA=Strongly Agree

| | SD | D | N | A | SA |
|---|---|---|---|---|---|
| I have access to necessary hardware for engagement in TEL | ○ | ○ | ○ | ○ | ○ |
| I have access to necessary software for engagement in TEL | ○ | ○ | ○ | ○ | ○ |
| I have reliable access to wi-fi | ○ | ○ | ○ | ○ | ○ |
| I have access to learning technology professionals who can support me in using TEL | ○ | ○ | ○ | ○ | ○ |
| I can manage the blurring of boundaries between private and work time | ○ | ○ | ○ | ○ | ○ |
| I can teach myself to use new software (e.g. apps) | ○ | ○ | ○ | ○ | ○ |
| I can teach myself to use new hardware (e.g. devices) | ○ | ○ | ○ | ○ | ○ |
| I can evaluate the suitability of digital content for my students | ○ | ○ | ○ | ○ | ○ |
| I design TEL activities to suit my students' learning needs | ○ | ○ | ○ | ○ | ○ |
| I explore the capabilities of a technology for learning | ○ | ○ | ○ | ○ | ○ |
| I evaluate my digital academic practice | ○ | ○ | ○ | ○ | ○ |
| I reflect on innovations within my teaching practice | ○ | ○ | ○ | ○ | ○ |
| I am confident in my attitude to TEL | ○ | ○ | ○ | ○ | ○ |
| I am willing to invest time in exploring and evaluating TEL | ○ | ○ | ○ | ○ | ○ |
| I am able to balance the risk of innovation with its potential for learning | ○ | ○ | ○ | ○ | ○ |
| I am convinced of the potential of technology to enhance and transform learning | ○ | ○ | ○ | ○ | ○ |

Q18. Please rate the following statements on a scale of 1-5 where 1=Not at all confident, 2=Not very confident, 3=Slightly confident, 4=Confident and 5=Very confident:

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Creating screen-casted mini-lectures (e.g. via Camtasia) | ○ | ○ | ○ | ○ | ○ |
| Creating audio podcasts for access via Moodle | ○ | ○ | ○ | ○ | ○ |
| Finding suitable external learning resources (e.g. YouTube videos) and integrating them into your teaching | ○ | ○ | ○ | ○ | ○ |
| Moderating online discussion forums in Moodle | ○ | ○ | ○ | ○ | ○ |
| Using an electronic voting system such as Socrative or YACRS in the classroom | ○ | ○ | ○ | ○ | ○ |
| Creating quizzes in Moodle for student learning and revision | ○ | ○ | ○ | ○ | ○ |
| Facilitating online peer review using Moodle Workshop or Aropä | ○ | ○ | ○ | ○ | ○ |
| Setting up assignment submission links in Moodle for students to submit their work online | ○ | ○ | ○ | ○ | ○ |
| Grading online and giving feedback on student work in Moodle | ○ | ○ | ○ | ○ | ○ |
| Using similarity checking software (e.g. Urkund or Turnitin) | ○ | ○ | ○ | ○ | ○ |

## Contextual influences

Q19. Please rate the following contextual factors where -2=Significant barrier, -1=Barrier, 0=No influence, +1=Enabler, +2=Significant enabler:

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Access to necessary equipment to engage with technology-enhanced learning (TEL) | ○ | ○ | ○ | ○ | ○ |
| Access to local learning technology support | ○ | ○ | ○ | ○ | ○ |
| Reliability and robustness of technology in the classroom | ○ | ○ | ○ | ○ | ○ |
| Amount of time to experiment with TEL | ○ | ○ | ○ | ○ | ○ |
| Students' level of comfort using technology for learning | ○ | ○ | ○ | ○ | ○ |
| Level of support from head of school re: engaging with TEL | ○ | ○ | ○ | ○ | ○ |
| Level to which TEL is seen as an institutional priority | ○ | ○ | ○ | ○ | ○ |
| Colleagues' attitude to, and support for, use of TEL | ○ | ○ | ○ | ○ | ○ |
| Presence of a community of practice of educators using TEL | ○ | ○ | ○ | ○ | ○ |
| Recognition and reward for engaging in TEL | ○ | ○ | ○ | ○ | ○ |

## Learning preferences

Q20. How useful are the following types of learning to you, in terms of advancing your academic practice in TEL and teaching innovation (1=Not at all useful, 2=Not very useful, 3=Somewhat useful, 4=Useful 5=Extremely useful):

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Independently reading relevant journal articles and book chapters on learning and teaching | ○ | ○ | ○ | ○ | ○ |
| Undertaking Massive Open Online Courses (MOOCs) about learning and teaching | ○ | ○ | ○ | ○ | ○ |
| Learning informally from and with colleagues about learning and teaching | ○ | ○ | ○ | ○ | ○ |
| Joining an online learning technology community such as the Association for Learning Technology (ALT) | ○ | ○ | ○ | ○ | ○ |
| Participating in a mentoring scheme, working with a more experienced teacher as a 'critical friend' | ○ | ○ | ○ | ○ | ○ |
| Attending events hosted by external organisations such as the Higher Education Academy (HEA) | ○ | ○ | ○ | ○ | ○ |
| Attending informal institutional CPD e.g. LEADS events, UofG Learning and Teaching conference | ○ | ○ | ○ | ○ | ○ |
| Undertaking a credit-bearing postgraduate taught programme such as the PGCAP or MEd | ○ | ○ | ○ | ○ | ○ |
| Applying for recognition of good practice, e.g. through Recognising Excellence in Teaching (RET) or fellowship of the Higher Education Academy (P/S/FHEA) | ○ | ○ | ○ | ○ | ○ |
| Undertaking a research degree relating to learning and teaching in higher education | ○ | ○ | ○ | ○ | ○ |

## Follow-up focus group

Q21. Would you be willing to be contacted to take part in a focus group with around 4-8 teachers to discuss your views on teaching innovation, and using technology-enhanced learning, in more detail? The focus group will last up to 60 minutes. Any information provided here will be detached from the other data you have provided which will be kept anonymised/de-identified.

- ○ Yes
- ○ No

If yes, please provide your email address. Please note that your email address will be detached from the survey data, during analysis, to preserve your confidentiality.

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## Thank you

Thank you for taking the time to participate in this study. The analysed results will be made available via the College and School learning and teaching committees in due course. In the meantime, please feel free to contact the researcher vicki.dale@glasgow.ac.uk, if you have any questions.