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Understanding academics' adoption of learning technologies: A systematic review

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ABSTRACT

Learning technologies are implemented in higher education institutions to enhance teaching and meet external challenges and demands. The adoption of the technologies by academics, however, frequently falls short of organisational aspirations. Academics respond in different and sometimes unpredictable ways. To advance understanding of factors influencing adoption, we systematically reviewed literature regarding academics' adoption of learning technologies. One hundred and thirty-one articles met the inclusion criteria and were analysed. The findings suggest that adoption is a complex process that is influenced by the learning technology, academics, context and strategies. To advance our understanding of learning technology adoption, we call for studies that challenge the current research assumption and address methodological issues. To facilitate staff adoption, we identify a list of effective strategies derived from the literature.

1. Introduction

Learning technologies are introduced and implemented across higher education institutions with the aim to improve and transform educational practice (Schneckenberg, 2009). The vision for transformations in teaching, however, often fails to be achieved (Britten & Craig, 2006; Dahlstrom, Brooks, & Bichsel, 2014). Academics do not necessarily adopt learning technologies in ways that transform teaching (Kirkup & Kirkwood, 2005) and institutional efforts to innovate are reported to fall short of intent (Porter & Graham, 2016). Given that learning technologies are widespread within higher education but underused, it is important that institutional leaders and those who are charged to facilitate staff adoption understand the process by which learning technologies are (or are not) adopted.

There are, to date, three clusters of literature reviews relevant to the adoption of learning technologies by academics (Table 1). The cross-sector reviews explored the adoption of innovations in organisational contexts (Frambach & Schillewaert, 2002; Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004). They used comprehensive search strategies, identified a range of factors pertaining to adoption, and provided avenues for exploring adoption of innovations in specific organisational contexts. However, learning technology was not a specific focus for these reviews.

A further group of reviews situated the issue of adoption in education. They contrasted theoretical perspectives (Keller, 2005) and accentuated to a greater or lesser degree on teachers in the adoption process (Dusick, 1998; Straub, 2009). They, however, did not follow systematic procedures and tended to draw on a limited range of theories.

A final group of reviews examined adoption within higher education. They followed systematic process and investigated the

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Table 1
Existing literature reviews.

Context	Author & Year	Focus of Review	Data	Search Strategy
General organisations	Frambach and Schillewaert (2002)	Factors related to innovation adoption	Unknown	Unknown
	Greenhalgh et al. (2004)	Means to spread and sustain innovations	495 (empirical & conceptual)	database search & purposive reference list check
	Wisdom, Chor, Hoagwood, and Horwitz (2014)	Theories and constructs of innovation adoption	20 (empirical & conceptual)	database search & purposive reference list check
Education in general	Dusick (1998)	Social cognitive factors in teachers' use of instructional technologies	Unknown	Unknown
	Keller (2005)	Theories on virtual learning environment implementation	Unknown	Unknown
	Straub (2009)	Teachers' computing adoption process	Unknown	Unknown
Higher education	Bland et al. (2000)	Medical curriculum innovations	57 (empirical & conceptual)	Reference lists check & database search till findings become repetitive
	Smith (2012)	Diffusion of learning and teaching innovations	89 (empirical & conceptual)	Database search
	Brown (2014)	Instructors' use of online tools in face-to-face teaching	58 (empirical)	Database search

adoption of a range of educational innovations (Smith, 2012). Although they contributed to the understanding of how innovations take place within higher education, the broad and disparate scope of the reviews means that they did not fully explain the adoption of learning technologies by academics.

In this review, we explore the adoption of learning technologies by academics within higher education. We aim to develop a framework that integrates current scholarly knowledge and informs practice and future research. The review encompasses a range of theoretical and methodological approaches in an effort to identify commonalities and nuance in the field with important theoretical and practical implications. We seek to answer the following questions:

1. What influences the adoption of learning technologies by academics in higher education?
2. What are the directions of future research that may advance the adoption of learning technologies by academics?

Throughout the review, we view learning technologies as an umbrella term that captures a broad range of information communication technologies that are used to support learning, teaching and assessment (Deepwell, 2017; Kirkwood & Price, 2014). We conceptualise adoption as a micro-perspective on change: it describes the process in which the individual integrates learning technologies into their educational practice (Straub, 2009).

2. The review process

Our review process aligns with the meta-narrative approach developed by Greenhalgh et al. (2004) when they explored how innovations diffuse in service organisations. Meta-narrative reviews are systematic, theory-driven interpretative techniques designed to 'help make sense of heterogeneous evidence about complex interventions applied in diverse contexts' (Greenhalgh, Wong, Westhorp, & Pawson, 2011, p. 2). The primary purpose of this approach is to engage in thinking and reflection on current scholarly conversation in order to explain why and how certain intervention works, rather than producing an estimate of effect size through a series of quality checking procedures (Greenhalgh et al., 2011). By the nature of the approach, the output of the review is formative: it intends to inform future research and practice rather than validating causality (Greenhalgh et al., 2005).

Prior to beginning the review, we formed a review panel. The panel met regularly and decided the scope of the initial review and the search strategy. The panel then supervised a research assistant to test and refine the search strategy over a ten-week period. After seven iterations and modifications, with reference to search strategies used by other reviews (Singh & Hardaker, 2014; Smith, 2012), the search strategy below was used. We did not restrict the search by the term 'technology' but expanded it to capture types of innovative teaching practice that use learning technologies. Similarly, we included search terms such as 'diffusion', 'dissemination' and 'implementation' because many studies that used these terms fall into our conceptualisation of 'adoption'.

> *Search strategy*: (diffus* OR disseminat* OR implement* OR adopt*) AND (innovat*) AND (tertiary OR "higher education" OR universit*) AND (learn* OR teach* OR educat*)

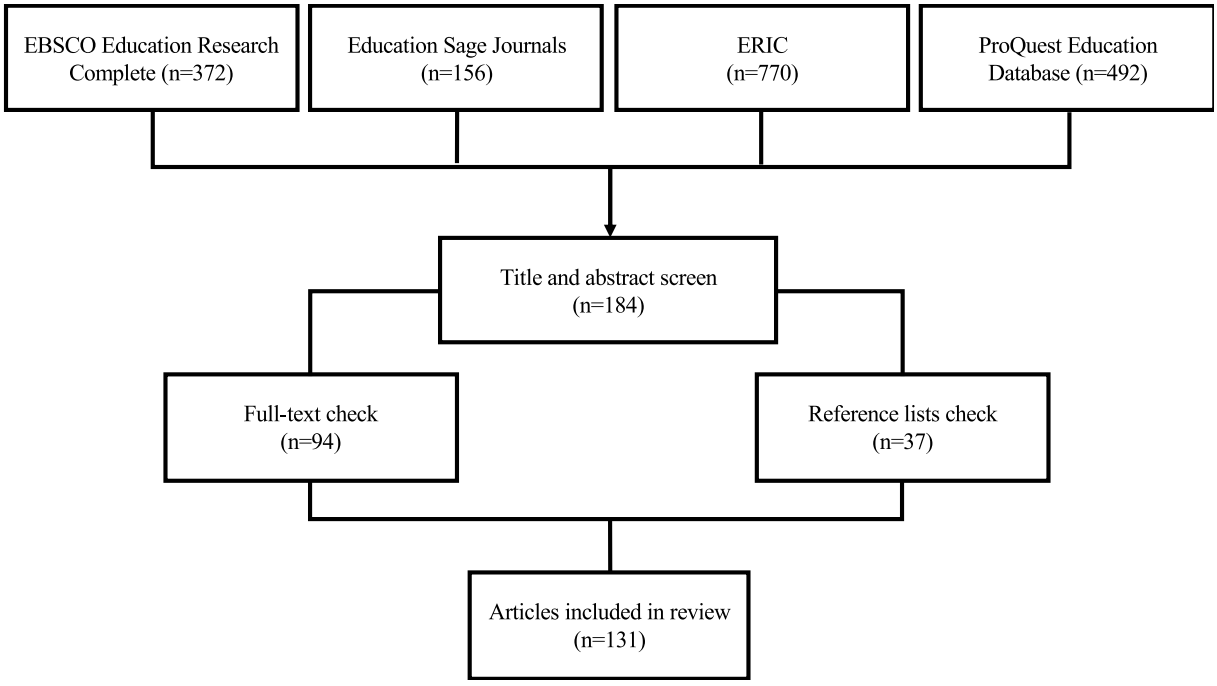

Fig. 1. Literature search procedure.

We applied the search strategy to identify articles from four electronic databases: EBSCO Education Research Complete, Education Sage Journals, ERIC and ProQuest Education Database. The search was conducted in December 2018 and was limited to full-text, peer-reviewed journal articles, written in English. We did not specify a publication date during the database search phase as we intended to capture as many relevant articles as possible. Secondary search of references of identified records was also undertaken.

In addition to empirical studies, we included conceptual and review papers because we aimed to synthesise primary and secondary data and knowledge expertise to gain insights into the adoption of learning technologies by academics.

For each article, we screened the title and abstract for relevance and, if relevant, assessed the full text. To be included in the review, articles had to (a) focus on higher education, (b) relate to learning technology, (c) capture the process of adoption, and (d) include the perspectives of institutions and/or academics.

We recorded information on authorship, year of publication, publication title, type of technology, type of research, country and region, research site, level of analysis and key findings in a spreadsheet.

We applied the inductive thematic analysis at the semantic level to code the findings from reviewed articles (Braun & Clarke, 2006). After the initial coding, we combined the codes into sub-themes and then further integrated the sub-themes to form overarching themes. In cases where certain sub-themes overlapped or did not have sufficient data to support them, they were aggregated into new sub-themes.

3. Results

3.1. Overview

The initial database search identified 1790 articles. Title and abstract screening identified 184 articles for full text review, of which 94 articles met inclusion criteria. Checking of reference lists of the 184 articles identified 37 more articles that met the inclusion criteria. In total 131 articles were included in the review. Fig. 1 shows the literature search procedure.

The included articles (n = 131) consisted of nine conceptual papers, eight review papers and 114 empirical studies. In terms of methods, the empirical studies included qualitative (n = 53), quantitative (n = 32) and mixed-methods (n = 15). There were 14 studies that used case study approach or were reflective account but did not provide details on data collection and analysis. In terms of the time periods, the empirical studies included 104 cross-sectional studies and ten studies that collected data at multiple time points, including seven longitudinal studies and three participatory or design-based studies.

The included articles covered 68 academic sources. Twenty-five journals contributed two or more articles. Five journals — *The British Journal of Educational Technology*, *Computers and Education*, *Research in Learning Technology*, *Australasian Journal of Educational Technology*, and *Educational Technology and Society* — contributed nearly a third (31.3%, 41/131) of the articles.

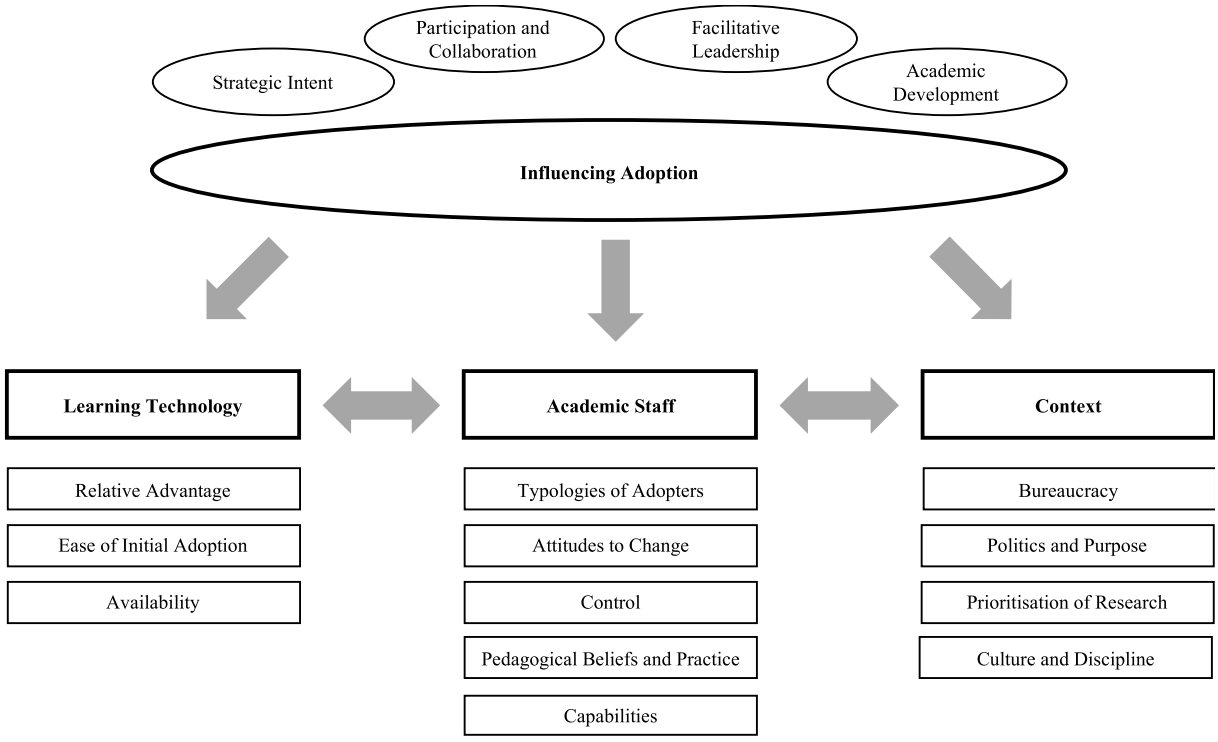

Fig. 2. Framework for the adoption of learning technologies by academics.

With regard to research site, one hundred studies collected data from higher education institutions in one country, seven studies collected data across different countries, and seven studies did not indicate the context of data collection. Most frequent locations of research were the United States (21%, 28/131), the United Kingdom (15%, 20/131) and Australia (11%, 14/131).

A variety of vocabularies were used to describe learning technology including: ICT (Information Communication Technology), e-learning, LMS (Learning Management Systems), online, flexible, distance or blended learning, classroom technologies and references to specific technologies such as Mobile learning, MOOC or portfolio systems.

3.2. Themes

Thematic analysis of included articles identified four themes with 16 subthemes, which have been organised into a conceptual framework (Fig. 2). The four themes were: The Learning Technology (relating to the nature of a technology), Academic Staff (relating to the individuals who may utilise a learning technology), Context (cultural and situational sub-themes as instrumental in adoption), and Influencing Adoption (strategies and actions effected by stakeholders in an effort to influence adoption or diffusion). For each theme, the profile of studies that contributed to the theme and the key theories underlying the theme are described, followed by the subthemes that constitute the theme. The number in brackets that follow each subtheme indicates the articles that contributed to the subtheme.

3.3. The learning technology

Forty-five articles referred to the attributes of technology influencing adoption (Appendix A). These included two conceptual papers, eight review papers and 35 empirical studies, including 13 qualitative studies, 16 quantitative studies, four mixed-methods studies and two case studies.

Diffusion of Innovation Theory (Rogers, 1995) and Technology Acceptance Model (Davis, 1989) provide the theoretical foundation for this theme. These models share common ground. Moore and Benbasat (1991) combine the two theoretical models to identify the ease of use, visibility, result demonstrability, relative advantage, compatibility and trialability as the innovation-attributes that are associated with adoption. A recent systematic review supports the notion that attributes such as the ease of use, visibility, and result demonstrability are associated with adoption (Kapoor, Dwivedi, & Williams, 2014).

Three subthemes were identified within the reviewed articles, they relate to the attributes of learning technology and include: relative advantage, ease of initial adoption and availability.

3.3.1. Relative advantage ($n = 18$)

Relative advantage describes the extent to which an innovation is perceived as useful and superior to alternatives. Consistent with general innovation research, the included articles showed that relative advantage is associated with the adoption of a range of learning technologies, including IT applications, web-based instructions and LMSs (T. Buchanan, Sainter, & Saunders, 2013; Coskunçay & Özkan, 2013; Sayadian, Mukundan, & Baki, 2009). When academics can demonstrate the relative advantage of a learning technology to themselves and others, adoption is reinforced (Agbonlahor, 2006).

3.3.2. Ease of initial adoption ($n = 17$)

Ease of adoption describes the amount of effort it takes to adopt a learning technology. This issue is captured by different terms, such as complexity, trialability and compatibility (Usluel, Askar, & Bas, 2008). While the complexity of a technology increases the difficulty of adoption (Kardasz, 2013), trialability and compatibility, which describe how a technology interacts with an individual's initial learning and use, ease the adoption process (Chan, Borja, Welch, & Batiuk, 2016). Being able to try-out and experiment (trialability) provides learning opportunities for academics, which facilitates sense-making and adoption; when an individual finds that a technology fits the existing practice (compatibility), adoption is more likely to occur (Coskunçay & Özkan, 2013).

3.3.3. Availability ($n = 30$)

Adoption is also influenced by the availability of a technology and the infrastructure it depends on (Andersson & Grönlund, 2009). The lack of computers (Sahin & Thompson, 2006), discipline-related media (Groves & Zemel, 2000), and software and the internet (Handal, MacNish, & Petocz, 2013) hinders the adoption process. In particular, the lack of quality technological infrastructure on which learning technologies depend is commonly reported as a barrier for adoption (Brill & Galloway, 2007). The importance of technological infrastructure points to the fact that learning technologies are seldom implemented in isolation. Instead, they operate within the institution-wide learning ecosystems, and their adoption depends on the integration with existing technologies (S. Brown, 2014).

3.4. The academic staff

This theme describes how individual differences in academic staff influence adoption. The theme was identified in 68 articles, including 57 empirical studies, three conceptual papers, and eight review papers. The empirical studies included 27 qualitative studies, 17 quantitative studies, ten mixed-methods studies and three case studies.

Theories underpinning this theme focus on individuals, such as motivation theories (Gagné & Deci, 2005; Vallerand, 1997), socio-cognitive theories (Bandura, 1977) and Concerns-based Adoption Model (Hall, 2010). These theories recognise that adoption

varies between individuals, influenced by their intrinsic characteristics rather than the technology per se (Kulviwat, Bruner, & Neelankavil, 2014). One of the subthemes was the approach of describing typologies of adopters. The five other subthemes were all descriptors of characteristics which are proposed to vary within individuals and be predictive of adoption.

3.4.1. Typologies of adopters (n = 21)

Studies describing types of adopters conclude that there are differences between academics. Within innovation diffusion research, adopters are classified into innovators, early adopters, early majority, late majority and laggards based on their speed of adoption (Rogers, 1995). Studies in higher education further show that the differences not only lie in the speed of adoption (Heilesen & Josephsen, 2008; Sahin & Thompson, 2006) but are represented by academics' demographic information (e.g. age and gender, Adams, 2002), conception of elearning (Stein, Shephard, & Harris, 2011), actual adoption behaviour (Trentin, 2008), and their roles and the way they approach the roles (Gilbert & Kelly, 2005). Other research that focused on the stages of individual adoption rather than the groups of adopters reached similar findings: when learning technologies are introduced, academics may be at different adoption stages with different levels of concerns (Foulger & Williams, 2007; Lin & Cantoni, 2018). These patterns are influenced by the following subthemes, which describe individual differences as antecedents of adoption.

3.4.2. Attitudes towards change (n = 24)

Attitudes to change, positive or negative, may influence technology adoption. Positive attitudes including enjoyment (Alshammari, Ali, & Rosli, 2016) and excitement (West, Waddoups, & Graham, 2007) have been reported to facilitate adoption. Negative attitudes, such as fear and risk aversion (Birch & Burnett, 2009; Bryant, Coombs, & Pazio, 2014), are commonly identified as barriers to adoption. It remains unknown how modifiable attitudes may be.

3.4.3. Control (n = 7)

Control refers to the extent that people feel they can make decisions about how they perform their roles (Frese, Garst, & Fay, 2007). Adoption of learning technology may be accompanied by the feeling of loss of control. For example, D. R. Johnson (2013) found that the implementation of learning technologies undermined academics' control over their teaching practice, either by not involving them in the decision-making process or by imposing irrelevant pedagogical change to disciplinary teaching. The loss of control also occurs in academics' interaction with students, where technologies afford greater student agency and shift the instructor-student relationship (M. G. Brown, 2016). The feeling of loss of control creates reluctance for adoption (Singh & Hardaker, 2014).

3.4.4. Pedagogical beliefs and practice (n = 20)

The degree to which learning technologies are aligned to pedagogical beliefs, that is how academics view teaching (Ertmer, 2005), influences adoption. Constructivist beliefs, that teaching is a process of facilitating knowledge construction rather than transmitting information, have been found to facilitate the adoption of learning technologies (Zhen, Garthwait, & Pratt, 2008). Beliefs about the role of technology in teaching are also associated with adoption (King & Boyatt, 2015). If academics believe that the learning technology enables students to learn new skills, prepares them for future careers, or encourages collaboration, they are likely to adopt it; if a technology is perceived as misaligned to pedagogy, academics are unlikely to incorporate it (Handal et al., 2013).

Pedagogical practice differs from beliefs as it refers to previous practice. Studies report that previous practice often serves as the frame of reference which aids the sense-making during the adoption process. When learning technologies contradict previous teaching practice academics may experience difficulties in adoption (Blin & Munro, 2008; Kirkup & Kirkwood, 2005). Overall, this subtheme suggests that the consistency between the technology and existing pedagogical beliefs and practice shapes the adoption.

3.4.5. Capabilities (n = 28)

The reviewed literature points to two types of capabilities that are associated with the adoption of learning technologies. Given that most learning technologies are dependent on basic ICT, the lack of ICT related capabilities has been commonly identified as a barrier to adoption (Chitiyo & Harmon, 2009). Conversely, academics with higher levels of internet skills have been found to use more advanced features within a LMS (T. Buchanan et al., 2013). Additionally, using innovative technologies often involves the redesign of teaching, which requires learning design capability. The lack of learning design skills has been reported to hinder the adoption process (Alghanmi, 2014; Alshammari et al., 2016).

3.5. The context

This theme relates to the context of adoption. The 76 articles that contributed to this theme included 64 empirical studies, six conceptual papers, and six review papers. The empirical studies included 33 qualitative studies, 14 quantitative studies, nine mixed-methods studies and eight cases studies.

Findings under this theme reflect research on how organisational structure and culture shape innovation adoption (Damanpour, 1991) and how the structural and cultural characteristics of higher education institutions set the context for educational change. The characteristics of higher education institutions may be captured by the term 'loosely coupled systems' (Weick, 1976). The term describes the components within an educational institution being responsive and attached to the system but retaining their own identities and separateness. The loose-coupling nature lowers the probability of responding to trivial changes; favours localised adaption; retains mutations and novel solutions; and leaves much space for self-determination by academics (Weick, 1976). We identified the following four sub-themes that constitute the context for adoption. They are bureaucracy, politics and purpose, prioritisation of research, and

culture and discipline.

3.5.1. Bureaucracy (n = 16)

Bureaucracy refers to the administrative processes and structures that govern an institution. The processes and structures establish the protocols and procedures by which learning technologies are adopted. Studies that took place at multiple institutions suggest that smaller institutions tend to adopt learning technologies more quickly than larger institutions (Nichols, 2008). Large institutions with rigid management frameworks describe delayed approval and restricted coordination, which created tensions in the adoption process (Maddux & Johnson, 2010).

The relative ineffectiveness of large institutions in facilitating adoption may be further explained by the central-peripheral tension (Clegg, 2003), which depicts the power relationships between the higher education institution and its departments. The literature confirms that academics tend to define their work based on their disciplines (Schneckenberg, 2009) and neglect central institutional policies (Habib & Johannesen, 2014). This suggests centrally-led implementation of learning technologies may be relatively ineffective within disciplines (Hardaker & Singh, 2011). When learning technologies are mandated top-down, academics may not adopt them in meaningful ways; when advice and guidance on adoption come from colleagues, adoption is genuine and effective (Nicolle & Lou, 2008; West et al., 2007).

3.5.2. Politics and purpose (n = 10)

The adoption of learning technologies is also a political process which involves differential interests and expectations. For instance, Hannon and Bretag (2010) found that learning technologies were viewed by academics as a way of delivering learning content and as tools for communication, but were portrayed as a bridge to global opportunities in institutional policies. Similarly, Dutton, Cheong, and Park (2004) found that the adoption of a virtual learning environment was driven by different political agendas and participated in by different stakeholders. These findings indicate that the contested and slow adoption is substantially shaped by the negotiation and reconciliation of different interests behind learning technologies.

3.5.3. Prioritisation of research (n = 40)

Current reward and recognition incentives in many higher education institutions seem to impede the adoption of learning technologies (Kirkup & Kirkwood, 2005; MacKeogh & Fox, 2009). Academic promotions are based on research productivity and impact (Schneckenberg, 2009), while teaching lacks official recognition (Alghanmi, 2014). The high priority of research and the low priority of teaching make the time and effort required for adoption a threat to research productivity, which may lead to negative responses (D. R. Johnson, 2013). For instance, Habib and Johannesen (2014) found that implemented learning technologies were viewed as authorised administrative procedures: they were rhetorically encouraged but rarely mentioned in performance reviews. The literature further suggests that although rewards and incentives have limited impact on enthusiastic early adopters (Birch & Burnett, 2009), they tend to drive emerging academics towards research and away from teaching (Schneckenberg, 2009).

The prioritisation of research is also associated with the lack of funds and time allocated to academics to support the adoption of learning technologies (Ensminger & Surry, 2008). As teaching tends to be considered a low priority, funds for teaching are tight (Handal et al., 2013) and short-term (Gunn, 2010), which is unlikely to sustain the adoption. The challenge of lack of time allocated to academics for adoption is compounded by the underestimation of the time and effort in adoption (Birch & Burnett, 2009; Chen, 2009). Studies confirm that additional time needs to be planned into the adoption process so that academics can adapt to new practices (M. G. Brown, 2016; West et al., 2007).

3.5.4. Culture and discipline (n = 44)

Culture represents institutional ethos and commitment (Southwell, Gannaway, Orrell, Chalmers, & Abraham, 2010). Academic culture values autonomy, the degree to which academics define their work practice independent of the university (Schneckenberg, 2009), and collegiality, the degree that academics tend to identify themselves with colleagues than with institutional leadership (McPherson & Nunes, 2006). These cultural characteristics define how communication takes place, what is valued and the degree of readiness individuals have to act during the adoption process.

The culture of autonomy and collegiality highlights the role of discipline in shaping communications in higher education and academics' practices. Academic discipline refers to the branch of knowledge that is researched and taught, and it has its own sub-cultures and practices (Becher & Trowler, 2001), which shape disciplinary communications and disciplinary identities (Hardaker & Singh, 2011). Studies suggest that academics' adoption of learning technologies is associated with their disciplines. For instance, the adoption rate of web-based learning was reported to vary across different academic units (Soffer, Nachmias, & Ram, 2010) and academics from hard and applied disciplines exhibited higher-order concerns and higher integration of technological innovations than those from other disciplines (Adams, 2002). Additionally, disciplinary boundaries also make the dissemination of grass-root innovative technologies difficult to sustain university-wide (Gunn, 2010).

3.6. Influencing adoption

This theme describes how institutional strategies can impact on the previous three themes and support the adoption by academics. Ninety-three articles referred to this theme, including six conceptual papers, seven review papers and 80 empirical studies. The empirical studies included 44 qualitative studies, 14 quantitative studies, 10 mixed-methods studies and 12 case studies.

Research on innovation-diffusion within organisations provides the theoretical basis for this theme. Organisational researchers

propose that diffusion is an interactive and recursive process in which actors negotiate the meaning of innovations and reconcile different interests (Fitzgerald, Ferlie, Wood, & Hawkins, 2002). Therefore, the key to innovation is the involvement of multiple actors within the organisation to facilitate the communication and collaboration via informal social networks (Ibarra, 1993) or to be led by change agents (D. A. Buchanan, Addicott, Fitzgerald, Ferlie, & Baeza, 2007).

In the review, we identified four sub-themes of strategic intent, participation and collaboration, facilitative leadership, and academic development.

3.6.1. Strategic intent (n = 47)

This subtheme identifies the need for strategic ambitions to go beyond simply having staff use learning technologies. Effective adoption requires a clear institutional strategy (McPherson & Nunes, 2006). However, institutional strategies with firm directions and a fixed vision may preclude alternative initiatives that address disciplinary and pedagogical needs (Hannan, 2005). Such strategies ignore contextual complexities, which hinders the adoption by academics. Instead, strategies that recognise the importance of context and allow personal or local adaptation enhance adoption (West et al., 2007). These strategies let academics redesign and redefine the technology and activate their sense making process (Heilesen & Josephsen, 2008).

3.6.2. Participation and collaboration (n = 48)

Facilitating the adoption of learning technologies requires staff participation and collaboration (Lisewski, 2004). Studies report that institutions need to involve academics in the planning and decision-making process (Ensminger & Surry, 2008; Uys, Nleya, & Molelu, 2004), as this allows them to use their expertise and local understanding to inform subsequent internal processes (Wolff, 2008) and, in turn, develops the feeling of ownership (Bryant et al., 2014; Samarawickrema & Stacey, 2007).

However, participation and collaboration needs to reach beyond formal channels such as committees, which are seen as an important indicator of staff involvement by senior management but seen as having minimal impact by academics outside these committees (Habib & Johannesen, 2014; Singh & Hardaker, 2017). Studies have demonstrated that adoption is facilitated by communication through informal networks by using champions (Owen & Demb, 2004) or initiating mentoring schemes (Keppell, O'Dwyer, Lyon, & Childs, 2010).

Students have also been identified as participants and collaborators in the adoption processes (Lashley, Cummings-Sauls, Bennett, & Lindshield, 2017). They are the recipients of academics' pedagogical practices, and their responses influence academics' adoption of learning technologies. For instance, Cook, Holley, and Andrew (2007) found that the inclusion of student voice encouraged the adoption as it helped academics integrate the technology in ways that enhanced student experience. The improvement of student performance has also been recommended to be powerful in promoting the adoption of learning technologies by academics (Porter & Graham, 2016).

3.6.3. Facilitative leadership (n = 43)

Leadership of senior management and heads of department, as well as by informal leaders influences adoption, as far as it is facilitative and enabling rather than directive and power-based. Senior management should lead the formulation of strategies and policies that establish institutional vision, allocate resources and redefine priorities (Blevins & Brill, 2017; Keengwe, Kidd, & Kyei-Blankson, 2009). These strategies and policies need to be long-term to shift cultural barriers (Barajas & Gannaway, 2007) and aligned with external policies to increase their legitimacy (Enderle, Southerland, & Grooms, 2013).

Although the strategic intent must be for flexibility in adoption and for wide participation and collaboration, these approaches may reduce the consistency and compliance at the programme, departmental or institutional levels (Swan, 2009). To counteract this effect, research recommends that institutions use mutually agreed benchmarks and indicators to guide local adaptations (Goeman, 2006). Senior management may lead the establishment of unified frameworks (Porter, Graham, Spring, & Welch, 2014) that can operate at the department and programme level (Birch & Burnett, 2009). Senior management can also connect learning technologies with aspects of teaching activities (Nichols, 2008) and clarify issues on security, data protection, and intellectual property (McPherson & Nunes, 2006). To support adoption, leaders need to coordinate changes across activities that are traditionally managed separately (Russell, 2009) and to translate learning technologies to local practices (Hannon, 2009).

In addition to leading the formulation of strategies and policies, senior management can use their political power to endorse learning technologies (S. Brown, 2014; De Freitas & Bandeira-de-Mello, 2012) by showing visible commitments (Ensminger & Surry, 2008) and sponsoring champions and informal leaders (Beastall & Walker, 2007).

Studies report that academic heads and departmental colleagues play a key role in influencing others. Academic heads are middle-level managers in higher education institutions, and they tend to focus more on collegiality rather than managerialism (Clegg & McAuley, 2005). They are the gatekeepers of adoption and their buy-in has a profound impact on the adoption by staff in the department (Ensminger & Surry, 2008; Hannan, 2005). Studies also report that informal leaders in the form of colleagues are an important source of support in marketing and translating innovations within departments (Enderle et al., 2013; Nicolle & Lou, 2008).

3.6.4. Academic development (n = 53)

The adoption of learning technologies is at least in part an academic development process (Nichols, 2008). To facilitate adoption, academic development opportunities need to address pedagogical, communication and technological capabilities (Barajas & Gannaway, 2007). In addition to developing expertise, research suggests that academics be exposed to new modes of teaching (Owen & Demb, 2004), where they work collaboratively with learning, media and graphic designers to develop curricula (Blouin et al., 2009; Uys et al., 2004). Russell (2009) goes a step further and advocates a move from individual teaching to team teaching. In terms of

academic development training and workshops, studies recommend sessions be designed in collaboration with academics so that they provide hands-on, authentic problem-based learning experience, which facilitates adoption (T. Johnson, Wisniewski, Kuhlemeyer, Isaacs, & Krzykowski, 2012; Tynan et al., 2010).

Additionally, research identifies the need for personalised learning and a focus not so much on the technology or teaching practice but on aspects of professional identity (Hardaker & Singh, 2011). To cultivate the commitment to and an identity of teaching, Owen and Demb (2004) advocate institutional showcase events to celebrate success and achievements in the area of learning and teaching. Other researchers, recognising the constraining and enabling influence of disciplinary perspectives, advocate framing learning technologies within the disciplines and using department-based models (Brzycki & Dudt, 2005) that align with disciplinary pedagogy and practice (Barajas & Gannaway, 2007; Handal et al., 2013). Similarly, communities of practice also provide valuable academic development opportunities (Latif, 2017). As a special form of networks, members of a community of practice not only have connections with each other but also share common interests and even similar professional identities (Wenger, Trayner, & De Laat, 2011). Within communities of practice, academics are active learners and practitioners rather than individuals needing to be trained: academics provide professional, pedagogical, technical and emotional support to each other during the adoption process (Wolff, 2008).

As most learning technologies involve basic ICT, support from IT staff is needed (Benchicou, Aichouni, & Nehari, 2010; Shea, Pickett, & Li, 2005). Studies have shown that simply providing centralised technical support does not work well. For instance, Barajas and Gannaway (2007) reported that, academics struggled to make sense of technical knowledge provided by IT staff that have purely technical roles; cross-departmental communication between IT staff and academics was difficult and slow; technical training was poorly designed; and tailoring support for academics was not regarded as important by IT staff. It seems that in order to facilitate the adoption, higher education institutions may need to reconsider the design of technical support to ensure that it is accessible for key audiences and to ensure that it supports understanding and adaptation of technologies for discipline-based pedagogical practices.

3.7. The association between themes and sub-themes

Of the articles reviewed, 40 explored issues within a single theme, 56 reported on issues that spanned two themes and 30 studies spanned three of the four main themes. Fifteen studies, predominantly review articles, addressed issues relating to all four themes. Table 2 shows the number of studies spanning two or more themes. In the paragraphs below, we describe the associations that are established or yet to be confirmed.

Thirty-one studies considered both academics and technologies. Pedagogical beliefs and relative advantage were both assessed in four studies and capabilities and ease of initial adoption were referred to in six studies. The most frequent co-description was of academics' skills and beliefs which were associated with perceptions of technologies, ease of use and/or availability which in turn were proposed to influence adoption (Sørebø, Halvari, Gulli, & Kristiansen, 2009).

Twenty-six studies examined aspects of technologies and context. The negative effect of research pressures on the use of learning technologies was the overriding message from these survey and interview studies (Ng'ambi & Bozalek, 2013b).

Thirty studies examined both technologies and efforts to influence adoption. The message here is that the sub-themes within influence and the sub-themes within technology all contribute to adoption. Some studies (Porter & Graham, 2016), probably sensibly, imply that the relationship between influencing and adoption is mediated through the technological sub-themes but few studies set out to identify statistical or causal relationships.

Thirty-seven studies addressed factors relating to academics and their context. Sixteen studies alluded to the relationship between research pressure and academic culture and attitudes towards change. Research pressure was also linked with academics' capability, the implication being that time on research is time not available for learning about and using technologies (Wright, 2014).

Twenty-six studies examined aspects of influencers and academics. All included reference to the influencing sub-theme, academic development, associating it with improved capability and shifting attitudes towards change (M. G. Brown, 2016). The majority of studies did not include detailed follow-up data on the adoption of technologies as a result of an influencing intervention.

Finally, sixty studies included both influencers and context with seventeen reporting on research in more than one institution. On the whole, studies did not explicitly examine the relationship between contrasting influencing strategies, their impact on context and any consequential effect on adoption. For example, twenty-four studies reported on academic development (advocated for facilitating adoption) and research pressures (a contextual barrier to adoption). But no study examined academic development that specifically addressed research pressures. Studies were more effective in identifying strategies for not getting in the way of adoption than they were in identifying initiatives to ensure widespread and meaningful adoption.

Table 2
The number of studies spanning two (or more) themes.

	Learning Technology	Academic staff	Context	Influencing Adoption
Learning Technology (N = 45)	**6**			
Academic staff (N = 68)	31	**13**		
Context (N = 76)	26	37	**6**	
Influencing Adoption (N = 93)	30	26	60	**15**

Note: The diagonal shows the number of studies addressing a single theme. The remaining cells show the number of studies addressing each possible combination of two themes.

4. Discussion

Academics do not necessarily engage with innovative learning technologies to improve educational practice, not at least as their institutions would expect. This issue is common across the higher education sector and has been repeatedly reported in the research literature. To date, there have been numerous studies that explored the issue. However, there has not been a review that synthesised the current knowledge derived from multiple theoretical perspectives into a comprehensive framework. In this article, we provided one possible framework that explains the adoption of learning technologies by academics. The framework also allowed us to identify future research directions that may advance the knowledge and to provide a list of practical suggestions that may help higher education institutions develop effective strategies to facilitate adoption.

Our synthesis of the literature shows that individual adoption is shaped by a range of sub-themes that have been grouped under the following broad themes: the characteristics and availability of the technology, the variations in individual academics' attitudes, beliefs and capabilities, the situational dynamics, and the strategies used to align the technology, the individual and the context in the adoption process (Fig. 2).

The review described each sub-theme separately in an effort to answer the first research question "What influences the adoption of learning technologies by academics?' This provided a clearer exposition of a messy and complicated field. This review offered an advance on existing reviews as it considered the adoption of learning technologies within higher education, included more studies and captured multiple types of learning technologies. Therefore, we have been able to identify the commonalities in adoption across technological artefacts as they apply within an institution.

In the discussion that follows we consider the assumptions and scope of the reviewed literature and address methodological issues. We identify future research priorities in an effort to address the second research question "What are the directions of future research that may advance the knowledge and practice in this field?' Finally, we draw out some implications for practice.

4.1. The need to challenge assumptions

Our review suggests that the literature conceptualises the adoption of learning technologies based on three assumptions. They are: adoption is invariably positive; technologies are fixed, and; adoption is binary. Each is considered in turn below.

Learning technologies and their adoption are viewed as being desirable. This assumption shapes much of the research, for example, those who fail to adopt are categorised as laggards (Sahin & Thompson, 2006) or as not having the right competencies (Chitiyo & Harmon, 2009). It is very likely that conceiving non-adoption as failure is shaping the thinking throughout the field. Researchers may miss insights into the positive motivators, decision making and behaviours of those who do not utilise learning technologies in the way that others think they should. Future research could approach the adoption of learning technologies from a more neutral stance.

Not only were the learning technologies regarded as desirable, they were also perceived as fixed, tangible and unnegotiable. None of the literature referred to mechanisms for adjustments to the technologies although there was acknowledgement of the need for user adjustment and flexibility. Academics were implicitly regarded as agential in shaping their own use, the learning technology was recognised as being agential in enabling and restricting certain practices but academics were not considered to be agential in shaping the technology. This is also evident in the lack of participatory or design-based studies, which, by their nature, are about reshaping the tools, systems, processes and practice. There is a gap in our knowledge that relates to the impact of engaging academics during the adoption process. The gap could be met by drawing on established research on innovation co-creation (Mahr, Lievens, & Blazevic, 2014; Vargo, Maglio, & Akaka, 2008).

Finally, adoption was frequently assumed to be binary. Regarding adoption as something that an individual either does or does not do (Park, Lee, & Cheong, 2007; Sørebø et al., 2009) at a given point in time is insensitive to the ways academics can adopt a technology in qualitatively different ways. It misses the creativity and inventiveness of academics who continuously improve educational practice. Such an assumption overlooks the process of adoption and the path academics take to individually shaped adoption that serves their professional practice. As a further complexity, and with a few notable exceptions (Cook et al., 2007; Porter & Graham, 2016), the impact of adoption was assumed to follow the adoption and not established in detail. Such a view assumes that the adoption of technologies automatically stimulates improved educational practice and produces (institutionally) desired results. This is not a safe assumption. We recommend that future research recognises that adoption is multidimensional, occurs over time and has anticipated and unanticipated consequences.

4.2. Methodological issues

Our review suggests that there were two major methodological issues within the literature that limit our understanding. The first relates to measurement and the second to problems associated with single site, single study research.

A reliance on self-report data and thus an exposure to common method bias was evident in each theme (Conway & Lance, 2010). For example, no objective assessments were provided of relative advantage with respondents' pre- or early experience perceptions being taken as proxy indicators. Similarly, the measurement of adoption was, in many cases, less than robust with researchers frequently relying on self-reported adoption. Such studies are valuable but objective measures of adoption are likely to strengthen the impact of future research.

In conducting the review we were challenged by the range of definitions of similar variables and by the variability in how these were explored. It is likely that this is inevitable in a cross-disciplinary field. A related challenge was the prevalence of single site studies and the limited information provided on sites, methods and measurements. If researchers are to advance the field and if readers are to

Table 3
Strategies to facilitate the adoption of learning technologies organised by sub-themes identified in the review.

Sub-themes	Strategies to facilitate academics' adoption
1. Relative advantage	- Render the advantages of the new technology explicit, obvious and experienced - Provide hard, persuasive and visible evidence
2. Ease of initial adoption	- Make the initial experience very positive - Don't release anything that will frustrate: watch out for bugs - Provide a safe place to experiment - Provide immediate expert support
3. Availability	- Provide technically easy access with minimum steps - Provide reliable access that is integrated with existing IT infrastructures
4. Typologies of adopters	- Recognise diversity and allow for levels and rates of adoption - Design training and support that caters for diversity
5. Attitudes to change	- Assess, recognise and accommodate the disruptions to the status quo - Gather concerns and address them - Address the emotions that are associated with change and adoption - Recognise staff may become overwhelmed, anxious and defensive - Make learning safe
6. Control	- Give academics as much choice and control as possible. - A take-it-or-leave approach to training and technology use does not work - Academic-led opportunities are likely to lead to adoption
7. Pedagogical beliefs and practice	- Recognise that teaching is performed in multiple ways - Align the technology with existing thinking and practice: use familiar language - Replicate the previous practice in the new
8. Capabilities	- Do not assume digital literacy - Include learning design tips and sample cases - Recognise the limited background knowledge and the cognitive load - Make sure that learning is achievable
9. Bureaucracy	- Actively disseminate knowledge across the institution - Develop systems for listening and responding to grassroot concerns - Bring academic departments on board – aim for ownership not just buy-in - Have open and honest conversations that explain and clarify
10. Policies and purpose	- Recognise different interests and drivers behind the learning technology - Be clear on the purpose and express it in terms of staff and student benefit - Develop policies that allow for flexibility in implementation and which devolve decision making down -Determine minimal acceptable levels of adoption and make non-performance uncomfortable - Incentivise local leaders and role models and accommodate workload implications
11. Prioritisation of research	- Provide role-model adopters who are successful researchers - Ensure expectations of time required are accurate, communicated and afforded - Establish sustainable mechanisms that recognise and reward teaching excellence - Encourage and use research into large scale adoption initiatives - Recognise the important role of professional staff and teaching assistants
12. Culture and discipline	- Use local champions to explain the change and influence their peers - Design discipline-based initial training and support that addresses micro-cultures - Promote cross-disciplinary conversations that trigger the rethinking of pedagogy
13. Strategic intent	- Collaborate with the disciplines to formulate institutional strategies on learning technology - Align learning technologies and their adoption with the strategy - Allow flexibility and contextualisation of the strategy at disciplinary level - Monitor progress and evaluate impact
14. Participation and collaboration	- Involve a diverse range of academics throughout beginning with the initial decision-making stage - Do not involve a few – use networks to involve as many academics as possible - Collect and respond to student voice and feedback - Collect and respond to the voice of professional staff
15. Facilitative leadership	- Senior leadership shows visible commitment to learning technologies - Obtain buy-in and collaborate with academic heads and departmental champions
16. Academic Development	- Ensure that academic development regimes are evidence-based and informed by constructivist, social and affect-based models of learning - Provide a rich support regime so staff can efficiently learn what they want to learn when they want to learn it and with minimum risk - Minimise technical jargon - Provide for long term progressive development and so support staff as they move from rudimentary adoption to enriched pedagogies

have confidence that research findings are transferable across institutions and technologies, then full details need to be provided in research reports. As an example, recent research has recognised the different challenges brought about by mandated and bottom-up initiatives (Ng'ambi & Bozalek, 2013a). Although these differences seem fundamental, many articles did not provide sufficient details for a full exploration and review. To gain additional insights into how factors within sub themes shape the adoption of learning technologies under different conditions, we recommend that future research provide details of the study and its context. We recommend studies that explicitly and systematically compare institutions, disciplines, academic development methods, strategies or technologies.

Although we reviewed 91 articles that addressed more than one theme, the literature did not allow us to firmly establish the relationships between themes or their sub-themes. This provides ample scope for future research. Evident in some articles was the assumption of unidirectional causality, with the learning technology, the adopter or the context being interpreted as determining adoption behaviours. Other researchers alluded to the multi-directional influences between technologies, adopters and context and their shaping of adoption outcomes. However, few studies took a longitudinal and holistic approach. Thus the majority of studies were insensitive to potential dynamic and reciprocal influences of technologies, adopters and contexts as they evolved over time. There is a gap in our knowledge that could be filled by longitudinal studies.

The methodological implication here is not that researchers do not know how to conduct robust, theoretically informed and fulsome studies. This review suggests that researchers have been conducting opportunistic small-scale studies which may be locally valuable but cannot contribute substantially to helping institutions and their staff become fluent and fluid adopters. It appears that despite devoting substantial resources to learning technologies and despite recognising that their aspirations are not being realised, higher education institutions are not investing in investigations that would shed light on this problem.

4.3. Implications for higher education institutions

The review provides messages for institutional leaders on the importance of a clear expression of strategic intent supplemented by established decision making mechanisms and support.

A frequently reported finding related to the importance of positive proximal social and disciplinary cultures which engaged staff in decision making. The influential role of champions and middle managers was similarly noted. The review provided limited insight into how to bring such climates about, however, it could be inferred that institutions should resource professional development for middle managers, heads of department and local champions in order to build skills in facilitative leadership and change management. Senior leaders could also expect, measure and incentivise leadership, positive role-modelling, influence and impact.

One paradox within the literature is that while no institution purchases a technology with the ambition of taking academics away from their research, there appears to be a widespread belief that this is what technologies do. This may be a problem that is recognised but not addressed in the literature. However, if institutional leaders have evidence that a technology saves time and demonstrate this relative advantage, they should speak directly to the voiced concerns of many academics.

A further paradox is that institutions attempt to promote learning technologies without regard for the recognised and evidenced practices in innovation adoption and change management. Higher education institutions have expertise in leadership, management, change, disciplinary requirements, academic development, learning and teaching. All these perspectives could inform the adoption but they do not seem to have been utilised in shaping the interventions reported in most of the studies. Such concerted efforts would not only increase the impact of a new learning technology but also provide valuable insights for researchers.

4.4. Implications for developing effective adoption strategies

We are mindful of the need to address the interests of potential users of systematic reviews (Green, Taylor, Buckley, & Hean, 2016). We imagine that the users of the review will be academic developers, champions and middle managers. We recommend that efforts to support staff adoption should recognise the emotional and attitudinal consequences of introducing new technologies, be informed by best practices in learning design and change management, recognise diversity in ways technologies can be used by academics, and gather and share hard evidence to guide individual and collective decision making. In Table 3, we identify positive strategies in relation to each subtheme, which would be expected to facilitate the adoption of learning technologies by academics.

5. Conclusions

Universities implement new learning technologies but academics do not adopt the technologies as readily and in ways their institutions anticipate they should. We unpack this problem by reviewing extant research in the adoption of learning technologies in higher education. One hundred and thirty-one articles were reviewed. Findings show that adoption is a complex process that is influenced by the learning technology, academics, context and strategies. We identify multiple avenues for future research, challenging assumptions and noting methodological advances that could enhance understanding. Most notably we call for studies that capture the dynamics of adoption and change processes.

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CRediT authorship contribution statement

Qian Liu: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing - original draft, Writing - review & editing, Project administration. **Susan Geertshuis:** Conceptualization, Methodology, Validation, Formal analysis, Writing - original draft, Writing - review & editing, Funding acquisition. **Rebecca Grainger:** Conceptualization, Methodology, Writing - review & editing.

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Appendices

Appendix A

Included articles (n = 131) mapped by the themes.

Author & year	Learning Technology (n = 45)			Academics (n = 68)					Context (n = 76)				Influencing adoption (n = 93)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Conceptual																
Errington (2004)							x					x			x	x
Johnson (2000)										x				x		
Lackie (1999)			x								x		x			
Maddux and Johnson (2010)			x										x			x
Schneckenberg (2009)											x	x				
Selwyn (2007)									x	x						
Somekh (1998)							x						x	x		x
Wagner, Hassanein, and Head (2008)														x	x	x
Zhang (2010)							x		x			x				
Review																
Alshammari et al. (2016)	x	x			x		x	x							x	
Andersson and Grönlund (2009)		x	x		x			x		x	x					x
Bagarukayo and Kalema (2015)			x					x								
Brown (2016)	x	x	x	x	x		x	x	x		x			x	x	x
Dusick (1998)			x		x		x	x			x					x
Keller (2005)	x	x	x				x	x	x			x		x		x
Reid, Ledger, Kilminster, and Fuller (2015)	x	x	x		x	x		x		x	x		x	x		x
Singh and Hardaker (2014)			x		x	x					x		x	x	x	
Mixed-methods																
Barker, Jeffery, Jhangiani, and Veletsianos (2018)				x												
Blackburn (2017)								x					x			
Blevins and Brill (2017)					x								x	x		
Blin and Munro (2008)							x	x		x						
Coskunçay and Özkan (2013)	x	x						x				x				
Drent and Meelissen (2008)					x		x	x							x	
Dutton et al. (2004)			x	x			x	x		x		x	x			
Forsyth, Pizzica, Laxton, and Mahony (2010)												x	x	x		x
Habib and Johannesen (2014)										x		x	x	x	x	x
Kenny (2004)												x	x	x	x	
*Kirkup and Kirkwood (2005)			x				x				x	x				
*Lashley et al. (2017)													x	x	x	
Latif (2017)											x	x		x		x
Nicolle and Lou (2008)				x											x	x
Wright (2014)	x							x			x					
Qualitative																
Alghanmi (2014)			x				x				x	x		x	x	x
Annabi and Muller (2016)				x												
Barton (2013)											x	x		x		
Bell and Bell (2005)									x							x
Birch and Burnett (2009)					x						x				x	x
Bottomley, Spratt, and Rice (1999)			x		x			x			x		x		x	x
Brill and Galloway (2007)			x													
Brown (2014)													x	x	x	

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(*continued*)

Author & year	Learning Technology (n = 45)			Academics (n = 68)					Context (n = 76)				Influencing adoption (n = 93)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Bryant et al. (2014)					x											
Carmichael (2015)																x
Chitiyo and Harmon (2009)			x					x			x				x	x
De Freitas and Bandeira-de-Mello (2012)															x	
*Enderle et al. (2013)												x	x		x	
Flavin (2012)							x					x				
Gilbert and Kelly (2005)				x												
Goeman (2006)													x			
Graham, Woodfield, and Harrison (2013)				x									x			
Gunn (2010)										x	x			x	x	
Handal et al. (2013)			x			x	x				x	x			x	x
Hannon (2009)													x	x		
Hannon and Bretag (2010)										x						
Hardaker and Singh (2011)									x			x	x		x	x
Hora and Holden (2013)							x					x	x	x		
Islam, Beer, and Slack (2015)					x	x	x				x					x
Johnson (2013)					x	x			x		x	x				x
Johnson et al. (2011)														x		x
Kardasz (2013)	x	x					x							x		x
Keengwe et al. (2009)			x								x		x		x	x
Keppell et al. (2010)														x		
King and Boyatt (2015)					x						x	x		x		
Lin and Cantoni (2018)				x	x											
Lisewski (2004)											x	x	x	x		x
Lwoga (2012)			x					x						x	x	x
MacKeogh and Fox (2009)					x			x	x		x		x			x
Martins and Nunes (2016)									x					x		
McMurray (2001)											x	x	x	x	x	
McPherson and Nunes (2006)												x	x		x	x
*Mtebe and Raphael (2017)			x		x								x			
Nichols (2008)									x			x	x		x	x
Owen and Demb (2004)													x	x	x	x
Porter et al. (2014)			x								x		x	x		x
Rambe and Nel (2015)				x												
Russell (2009)					x			x			x	x		x	x	x
Samarawickrema and Stacey (2007)	x	x			x						x	x	x			x
Schneckenberg (2010)								x			x				x	x
Singh and Hardaker (2017)												x		x	x	
Steel and Hudson (2001)									x	x	x					
Stein et al. (2011)				x												x
Stensaker, Maassen, Borgan, Oftebro, and Karseth (2007)											x					x
*Svensson (2003)							x					x				x
*Swan (2009)									x				x	x		
Tshabalala, Ndeya-Ndereya, and van der Merwe (2014)			x					x					x			
West et al. (2007)		x			x						x	x	x	x		
Quantitative																
Adams (2002)				x								x				
Agbonlahor (2006)	x	x	x													x
Al-Samarraie, Teng, Alzahrani, and Alalwan (2017)	x															
Al-Senaidi, Lin, and Poirot (2009)			x		x			x			x				x	
Ansah and Johnson (2003)				x												
Benchicou et al. (2010)													x		x	
Buchanan et al. (2013)	x							x			x					
Chan et al. (2016)		x														
Chen (2009)											x					
Davis, Strand, Alexander, and Hussain (1982)	x	x			x										x	
Ensminger and Surry (2008)								x	x		x				x	
Foulger and Williams (2007)				x										x		
Groves and Zemel (2000)bib_&Zemel_2000			x											x		
Li and Lindner (2007)			x	x												
Loogma, Kruusvall, and Ümarik (2012)								x								
Ng'ambi and Bozalek (2013b)	x		x		x			x	x		x	x				
Park et al. (2007)	x	x														
Porter and Graham (2016)			x	x									x	x	x	x
Sahin and Thompson (2006)			x	x	x			x				x			x	x
Sahin and Thompson (2007)												x		x		

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(*continued*)

Author & year	Learning Technology (n = 45)			Academics (n = 68)					Context (n = 76)				Influencing adoption (n = 93)			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Sánchez-Mena et al. (2017)	x	x		x												
Sayadian et al. (2009)	x	x														
Shea et al. (2005)											x	x		x	x	x
*Soffer et al. (2010)												x				
Sørebø et al. (2009)	x					x		x				x				
Tabata and Johnsrud (2008)				x												
Usluel et al. (2008)	x	x														
Wolff (2008)												x		x		x
Zhen et al. (2008)							x	x								
Zhou and Xu (2007)				x												
Zhu (2015)												x	x	x	x	
Zhu and Engels (2014)												x	x		x	
Case-study																
Barajas and Gannaway (2007)												x	x	x	x	x
Beastall and Walker (2007)													x	x		x
Brzycki and Dudt (2005)			x						x		x	x	x	x	x	x
Cook et al. (2007)												x		x	x	
Heilesen and Josephsen (2008)				x			x									
Salmon (2005)													x	x	x	
Littlejohn and Cameron (1999)			x								x		x	x		x
Sharpe, Greg, and Richard (2006)													x	x		x
Stiles and Yorke (2007)						x			x				x			x
Trentin (2008)				x												
Tynan et al. (2010)																x
Uys et al. (2004)											x		x	x	x	x
Uys (2010)												x	x			x
Ward, West, Peat, and Atkinson (2010)												x	x			

Note: * refers to longitudinal studies. The numbers refer to the subtheme. 1 Relative advantage; 2 Ease of Initial adoption, 3 Availability, 4 Typologies of adopter; 5 Attitudes towards change; 6 Control; 7 Pedagogical beliefs and practice; 8 Capabilities; 9 Bureaucracy; 10 Politics and purpose; 11 Prioritisation of research; 12 Culture and discipline; 13 Strategic intent; 14 Participation and collaboration; 15 Facilitative leadership; and 16 Academic development.

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