British Journal of Educational Technology *Vol 50 No 3 2019* 956–971
doi:10.1111/bjet.12770

Where is the "theory" within the field of educational technology research?

Khe Foon Hew, Min Lan, Ying Tang, Chengyuan Jia and Chung Kwan Lo

Khe Foon Hew is an Associate Professor of Information Technology in Education at the University of Hong Kong. His research investigates the use of educational technology in K-12 and university settings, and computer-mediated communication with a particular focus on social media applications. Min Lan is a final year PhD candidate of Information Technology in Education at the University of Hong Kong. Min's research interests lie in the area of technology-enhanced learning, particularly in the area of online learning. Ying Tang is a final year PhD candidate of Information Technology in Education at the University of Hong Kong. She is interested in the use of computer-mediated communication for teaching and learning. Chengyuan Jia is a PhD student of Information Technology in Education at the University of Hong Kong. Her research interest lies in the area of technology-enhanced language learning. Chung Kwan Lo holds a doctorate degree in Information Technology in Education from the University of Hong Kong. His research investigates the use of educational technology in school and higher education settings. Address for correspondence: Khe Foon Hew, Faculty of Education, The University of Hong Kong, Room 112 Runme Shaw Building, Pokfulam Road, Hong Kong, Hong Kong. Email: kfhew@hku.hk

Abstract

Critics often characterise the study of educational technology as under-theorised. To test this assertion and to determine the extent of this criticism, the present paper reports an in-depth analysis of the 503 most recent empirical articles published in three selected education-technology-related journals (Computers & Education; Learning, Media and Technology; and British Journal of Educational Technology). These journals were selected because they publish studies related to all education settings rather than focusing on only a certain segment such as higher education; they have broad geographical catchment; and they were the most highly ranked journals in terms of their 2017 journal citation impact factor. The present paper examines how explicitly existing theory was identified in previous research, how theories were applied and how often these theories were advanced in education technology research. In the majority of cases, explicit engagement with theory was absent. Many studies either were wholly bereft of theories or made vague use of theory. Where theory was explicit, the articles were more likely to use theory to conceptualise the research, to inform the data collection or analysis process and to discuss the results. Very few articles reported findings that help us to learn something new about a particular theory (ie, little evidence of theory advancement).

Introduction

"Theories are an important, but neglected area in research in educational technology." (Issroff & Scanlon, 2002)

Within the last decade, research within the field of educational technology has grown substantially in importance. There are myriad reasons for this, the most obvious of which is probably the substantial investment by many governments in information and communication technology

Practitioner Notes

What is already known about this topic

- Educational technology research has grown substantially in importance.
- Yet educational technology research is often criticised as methodologically weak and under-theorised.

What this paper adds

- Provides an in-depth analysis of the 503 most recent empirical studies.
- Examines how explicitly theory is identified and applied and how often it is advanced.

Implications for practice

- Researchers should develop more "middle-range" theories.
- Researchers need to be more explicit about the theories that underpin their studies.

(ICT) resources, such as computers, software and the Internet, to facilitate learning both within and beyond school (OECD, 2010). Many policymakers have implemented nationwide master-plans with the assumption that investment in ICT can lead to higher levels of learning and innovation (Han & Makino, 2013). Naturally, these policymakers will be concerned with research questions such as whether access to ICT really helps students learn, or how ICT can best be used to enhance learning (Yuen & Hew, 2018). Addressing these research questions would help justify the large financial investments spent on integrating ICT into education systems.

However, the field of educational technology research is often characterised by critics as methodologically weak (Bulfin, Henderson, Johnson, & Selwyn, 2014) and under-theorised (Jones & Czerniewicz, 2011; Markauskaite & Reimann, 2014). The word "under-theorisation" can have multiple meanings. In the context of this paper, it means "a lack of existing theory to frame or inform an empirical research study." The rationale for our study is largely motivated by Bennett and Oliver's (2011) assertion that most research on educational technology research focuses on "matters of practical implementation and design, largely driven by 'common sense' assumptions about what technology can achieve" (p. 179) but pays scant attention to existing theories that might be used to frame and inform research. It is important for the existing theories that frame empirical research to be made explicit because they can help generalise findings across a variety of contexts so that researchers can build knowledge together (Jones & Czerniewicz, 2011).

In this paper, we are mainly concerned about: (1) how often researchers make use of existing theories to frame or inform research (such as to conceptualise the research, to inform the data collection or analysis, and/or to discuss or explain the research findings), and (2) how often existing theories are advanced in education technology research (such as whether the findings challenge the underlying rationales supporting a theory or add or subtract elements from a theoretical construct).

Too often, authors try to justify their research by merely stating that "there is little research in this area." Such statements, however, are increasingly seen as weak justifications for conducting research, as eloquently reported by Grant and Pollock (2011, p. 874):

> Just because a gap exists does not necessarily make the study interesting or worthwhile. Many authors write the introduction by stating that there is a gap but end there without clearly noting why filling this

particular gap is important and interesting, or *why this contributes to our enhanced understanding of the particular phenomenon.*

The use of theory is imperative to enhancing our understanding of a certain phenomenon or element. First, a theory provides a useful basis to describe, explain and predict the phenomena it relates to (Mueller & Urbach, 2017). For example, theories can explain how and why a particular use of teaching material could contribute to students' learning experience and behaviours (Issroff & Scanlon, 2002). Second, studies that utilise a theory and then show refinements to the theory are usually considered exemplars of high-quality research (Straub, 2009). May (1993) describes the importance of theory in the following way:

> The idea of theory, or the ability to explain and understand the findings of research within a conceptual framework which makes "sense" of the data, is the mark of a mature discipline. (p. 20)

Third, the use of theory can increase a researcher's success of generalising the findings to other contexts (Jones & Czerniewicz, 2011; Moore, 1991). Moore (1991), eg, argues,

> Research that is not grounded in theory is wasteful. It might solve an immediate problem, but it doesn't fulfil its promise. Relating it to theory, however, increases its ability to solve other problems in different times and different places. (p. 2)

Given the pivotal role of theory and the persistent criticism that there is little explicit use of theory to conceptualise research (Tight, 2004), this paper makes a valuable contribution by discussing what and how *existing* theories are applied in empirical educational technology research.

An important caveat

It is important to note that the present study focuses on whether and how researchers use existing theories when they conduct empirical studies. The emphasis here is on *empirical* papers rather than other types of articles, such as literature review studies and conceptual papers. Although the analysis of non-empirical papers can also tell us about theory in the field, we focus on empirical papers largely to answer the question raised by Markauskaite and Reimann (2014): "What is the role of theory in data-driven research?" (p. 386). The research questions guiding the present study are as follows:

1 How explicitly is existing theory identified in empirical educational technology research?
2 How is existing theory applied in empirical research?
3 To what extent is existing theory being advanced in empirical research?
4 Are certain research methods more likely to engage with theory?

The remainder of this paper is organised as follows. First, the notion of theory is briefly discussed. Second, we explain our methodology in choosing the three top-ranked SSCI indexed educational technology journals. Third, the findings regarding the theorisation of educational technology research are explored. Finally, some conclusions and implications of the study are discussed.

Theory in education technology research

It is appropriate to explain how we operationalise the key term "theory" in the current study. For the purpose of this paper, we follow Malone's (1985) conceptualisation of theory as either *explanatory* ("Y because of X") or *design* ("to achieve Y, do X"). Although there may be other classifications of theories, these two types of theories (explanatory and design) are widely recognised as the two major kinds (Reigeluth & Carr-Chellman, 2009). Explanatory or descriptive theories

are defined as "suppositions which explain, or seek to explain, something" (Blaxter, Hughes, & Tight, 2001, p. 205). Explanatory theories usually describe the factors or reasons affecting a phenomenon, such as a human behaviour. An example of explanatory theory is the cognitive load theory (Sweller, 1988) which explains how three different types of loads produced by learning tasks (intrinsic, extraneous and germane) can impede students' ability to process information.

Design theories are concerned with how things should be designed to achieve certain goals (Reigeluth & Carr-Chellman, 2009; Simon, 1996). Design theory helps people create something, while explanatory theory explains why phenomena are the way they are. In the field of learning and instruction, design theories typically refer to methods of instruction used to achieve certain learning outcomes (Reigeluth, 1999). An example of an instructional design theory is the elaboration theory, which posits that subject content should be sequenced from simple to complex using a "zoom lens" analogy (see Reigeluth, 1992 for more details).

Method

The aforementioned research questions (see Introduction) are addressed through an in-depth analysis of the most recently published empirical articles in selected education-technology-related journals over the last 2 years (2017–18). We define "education-technology-related journals" as those that publish articles examining the application of ICT resources (eg, software, networks, tools) in formal and informal education at all levels. Three journals, *Computers & Education* (CAE), *Learning, Media and Technology* (LMT) and the *British Journal of Educational Technology* (BJET), were selected for the following four reasons:

1 The three journals are the most highly ranked education-technology-related journals according to their 2017 journal citation impact factor (CAE = 4.538, LMT = 3.175, BJET = 2.729).
2 The three journals publish papers related to all education settings rather than focusing solely on a certain setting, such as higher education.
3 They are three of the four prominent educational technology journals (ie, CAE, BJET, LMT and the *Australasian Journal of Educational Technology* (AJET)) that are used by other researchers searching for education-technology-related empirical articles or authors (see Bulfin, Henderson, & Johnson, 2013; Bulfin *et al.*, 2014). However, we dropped AJET from our study because it focuses solely on higher education settings.
4 The three journals have broad geographical catchment, with authors from many parts of the world (Bulfin *et al.*, 2014).

As of November 1, 2018, we downloaded and read all of the articles from the journals' official websites. *Computers & Education* allowed us to access all of the December 2018 issues. After excluding non-empirical papers (eg, literature review studies, conceptual papers) from the data corpus, we were left with 503 empirical articles: 311 from *Computers & Education*, 32 from *Learning, Media and Technology* and 160 from the *British Journal of Educational Technology*.

To answer the first research question (How explicitly is existing theory identified in empirical educational technology research?) and the second (How is existing theory applied in the empirical research?), we developed a codebook with references to previous relevant studies (Ashwin, 2012; Tight, 2004). Table 1 summarises the coding scheme used in the current study. To determine the extent to which theory is explicitly applied in education technology research (research question 1), we drew upon Tight's (2004) work and devised the following simple "theoretical explicitness" scale.

Table 1: Coding scheme

Category	*Remark*	*Definition or example*
Theory explicitness	1 Explicit	Theory is clearly used and one or more theories are explicitly identified.
	2 Vague	Theories are only vaguely identified.
	3 No evidence	The presentation and discussion of the study are devoid of any theory.
Theoretical perspective	Extracted from the study	For example, cognitive load theory, self-determination theory.
Theory application	1 To conceptualise the research	For example, using the cognitive load theory to develop the purpose of the research or propose the research questions.
	2 To inform data collection or analysis	For example, using constructs from the self-determination theory to develop a questionnaire; using critical theory perspectives to analyse the data).
	3 To discuss the research outcomes	For example, using theory to explore or explain the findings.
Theory advancement	This category was rated as a yes/no dichotomous variable to address the following question: Do the findings help us learn something *new* about a particular theory?	For example, do the findings add or subtract factors or elements from a theoretical construct?
		For example, do the findings explain how additional factors or elements may affect the relationships between the variables?
		For example, do the findings challenge the underlying rationales supporting accepted theories?
Research method	• Descriptive study • Correlational study • Comparison study • Other study (eg, data mining) • Mixed	This refers to the process or procedure used to collect and analyse data. The classifications were adopted from Ross and Morrison (1995).

- Explicit: Theory is clearly used and one or more theories are explicitly identified.
- Vague: Theories are only vaguely identified. For example, an article utilised the "self-efficacy scale" as a data collection instrument but did not explicitly identify or describe the theory underlying the self-efficacy constructs.
- No evidence: The presentation and discussion of the study are devoid of any theory.

To examine how existing theories are applied in educational technology research (research question 2), we adopted and revised Ashwin's (2012) categorisation of the ways theory was used to conceptualise the research object, analyse the data and discuss the research outcomes. The following working codes were applied in the data analysis. Each subcategory was rated as a yes/no dichotomous variable: either theory was used to conceptualise the research, or it was not.

- To conceptualise the research (eg, using self-regulated learning theory to develop the purpose

of the research or propose research questions).
- To inform data collection or analysis (eg, using constructs from self-determination theory to develop a questionnaire).
- To discuss the research outcomes (eg, using theory to explore or explain the findings).

To examine the extent to which theory is being advanced in the research (research question 3), we read each article and determined whether or not the findings help us learn something *new* about a particular theory. This may take several forms, which include but are not limited to whether the findings add or subtract factors or elements from a theoretical construct, whether the findings explain how additional factors or elements may affect the relationships between the variables and whether the findings challenge the underlying rationales supporting accepted theories (Whetten, 1989).

To investigate whether certain research methods are more likely to engage with theory (research question 4), we classified the methods used in the educational technology articles into one of the following categories, which were adapted from Ross and Morrison (1995):

1 Descriptive study: to describe the situations or conditions found in a particular context (this usually refers to qualitative case study, ethnography). In descriptive studies, a researcher may use qualitative data sources (observations, research journals, interviews), quantitative sources (frequency counts, percentages, descriptive statistics) or both.
2 Correlational study: to examine the relationships among variables (eg, Pearson correlation, regression, structural equation modelling).
3 Comparison study: to test causal effects (eg, experiments, quasi-experiments).
4 Other study: to investigate research objects using a data mining or machine learning method (eg, clustering analysis).
5 Mixed: a combination of multiple methods.

The authors randomly selected 52 articles (around 10% of the total reviewed papers) and coded them independently. The overall Cohen's kappa value was 0.74, indicating substantial agreement (Cohen, 1960).

Results

RQ1: How explicitly is existing theory identified in educational technology research?

Out of the 503 studies, more than 40% (N = 209) were wholly a-theoretical (ie, did not make any reference to a theory) (see Table 2). Approximately one-quarter (N = 120) of the articles vaguely described the theories that they used. Nearly 35% (N = 174) of the studies explicitly described the theories that they used.

More than 183 theories were identified. The majority (N = 148) were theories that are frequently found in other fields, such as psychology (eg, self-regulated learning, self-determination theory). Fewer (N = 35) were specific to the field of educational technology, such as technological pedagogical and content knowledge (TPACK) and cognitive theory of multimedia learning. Table 3 describes some of the most frequently used theories identified in the articles.

RQ2: How is existing theory applied in educational technology research?

Compared to vague theory studies, explicit theory studies were more likely to utilise theory to conceptualise the research (33.00%, N = 166 in the explicit group vs. 10.34%, N = 52 in the vague group) (see Figure 1) to inform data collection or analysis (29.03%, N = 146 in the explicit

Table 2: Summary of the reviewed empirical articles (N = 503)

	Explicit	*Vague*	*No evidence*
Number of studies	174 (34.59%)	120 (23.86%)	209 (41.55%)
Theory			
Edu-tech-specific	66 (13.12%)	34 (6.76%)	N.A.
Other fields	108 (21.47%)	86 (17.10%)	
Conceptualisation			
Yes	166 (33.00%)	52 (10.34%)	N.A.
No	8 (1.59%)	68 (13.52%)	
Data collection and analysis			
Yes	146 (29.03%)	67 (13.32%)	N.A.
No	28 (5.57%)	53 (10.54%)	
Research outcome discussion			
Yes	142 (28.23%)	58 (11.53%)	N.A.
No	32 (6.36%)	62 (12.33%)	
Advancement			
Yes	57 (11.33%)	20 (3.98%)	N.A.
No	117 (23.26%)	100 (19.88%)	
Research methods			
Descriptive	62 (12.33%)	28 (5.57%)	93 (18.49%)
Correlational	47 (9.34%)	18 (3.58%)	19 (3.78%)
Comparison	41 (8.15%)	42 (8.35%)	63 (12.52%)
Others	6 (1.19%)	4 (0.80%)	9 (1.78%)
Mixed	18 (3.58%)	28 (5.57%)	25 (4.97%)

N.A. = Not applicable because no theory was evident in these studies (*N* = 209, 41.55%).

group vs. 13.32%, *N* = 67 in the vague group) and to discuss the research outcomes (28.23%, *N* = 142 in the explicit group vs. 11.53%, *N* = 58 in the vague group). In other words, the studies that did not explicitly describe a theory were less likely to apply theories to conceptualise the research design, to inform data collection or analysis or to discuss the results.

RQ3: To what extent is existing theory being advanced in the research?

In terms of theoretical advancement, few articles reported findings revealing new insights about a particular theory. Although both the vague and explicit groups yielded low numbers of articles that advanced theory, the explicit group showed a higher percentage (11.33%, *N* = 57) than the vague group (3.98%, *N* = 20). Some of the ways in which theory is advanced are described in Table 4. These include theory development, theory comprehension, theory challenge and new scale development that formulates and test new instruments to measure a theoretical construct.

RQ4: Are certain research methods more likely to engage with theory?

Overall, the descriptive method (36.38%, *N* = 183) and comparative method (29.03%, *N* = 146) were the two most predominant methods used in educational technology research. The descriptive method was more likely to show no evidence of theoretical engagement compared to other methods (see Figure 2), and the comparative method was also often used in theory-bereft studies (12.52%, *N* = 63). Interestingly, the correlational method, though only applied in a relatively small number of articles, was much more likely to show a higher proportion of explicit theoretical engagement.

Table 3: Some of the most frequently used theories

Theory	*Definition*	*Brief description*
Cognitive load theory	Cognitive load theory, which was outlined by Sweller (1988), focuses on the limited load on working memory when people receive instruction during academic learning tasks.	Three types of cognitive load were discussed: the extraneous cognitive load generated by how the information is presented to learners, the intrinsic cognitive load that instruction has an inherent difficulty associated with it and the germane cognitive load that dedicated to information processing, knowledge construction and the automation of schemas.
Technology acceptance model (derived primarily from the theory of reasoned action)	TAM is an information systems theory based primarily on Fishbein and Ajzen's (1975) theory of reasoned action, which explains how users come to accept and use a technology (Davis, 1986).	1. Technology acceptance model based on this theory: 2. TAM 1: perceived usefulness and perceived ease of use (Davis, 1989). 3. TAM 2: social influence and cognitive instrumental processes (Venkatesh & Davis, 2000). 4. TAM 3: the effects of trust and perceived risk on the system use were included (Venkatesh & Bala, 2008). 5. Unified theory of acceptance and the technology model (UTAUT) consisting of the constructs of performance expectancy, effort expectancy, social influence and facilitating conditions, were also commonly used (Venkatesh, Morris, Davis, & Davis, 2003).
Cognitive theory of multimedia learning	Cognitive theory of multimedia learning (CTML) based on dual-coding theory that there are two separate channels (ie, auditory and visual) for processing information.	Cognitively, the theory defines learning as an active process that filters, selects, organises and integrates information. The theory indicated the limitation of the capacity of each channel, as "people learn more deeply from words and pictures than from words alone" (Mayer, 2009, p. 47).
Social development theory	Social development theory stresses the foundation of social interaction for development (Vygotsky, 1978). Consciousness and cognition are the end product of socialisation and social behaviour. This is one of the foundations of constructivism.	The theory features three major themes: 1. social interaction: social interaction plays a fundamental role in the process of cognitive development. 2. the more knowledgeable other: anyone who has a better understanding or a higher ability level than the learner with respect to a task, process or concept. 3. the zone of proximal development: the distance between a student's ability to perform a task under adult guidance and/or with peer collaboration and the student's ability to solve the problem independently. According to Vygotsky (1978), learning occurs in this zone.

Table 3: Continued

Theory	Definition	Brief description
Self-determination theory	Self-determination theory (SDT) is a motivational theory that interprets universal and innate psychological needs: autonomy, relatedness and competence (Deci & Ryan, 1985).	The needs of autonomy, relatedness and competence are three major components of SDT. Autonomy refers to the freedom or perceived choice of an individual's action. Relatedness refers to feelings of connectedness with others. Competence refers to the perception of mastery of a pursuit (eg, learning something new).
Self-regulated learning theory	Self-regulated learning refers to "the processes whereby learners personally activate and sustain cognitions, affects and behaviours that are systematically oriented towards the attainment of personal goals" (Schunk & Zimmerman, 2011, p. 1).	Several perspectives of this theory exist, including 1. Zimmerman's cyclical phases (Zimmerman, 2000): forethought phase (eg, goal setting and strategic planning), performance phase (eg, self-monitor and self-control) and self-reflection phase (eg, self-evaluation and self-satisfaction) 2. Winne and Hadwin's SRL (Winne, 2011): task analysis (eg, goal setting and planning), self-control (eg, evaluate standard), self-monitor (eg, cognitive evaluation) and self-reflection. 3. Pintrich's SRL (Pintrich, 2000): motivation component (eg, value), cognitive and metacognitive strategy component (eg, rehearsal and elaboration) and resource management (eg, time management) In general, according to Puustinen and Pulkkinen (2001), these SRL theoretical perspectives consist of three major phases: preparatory phase, performance phase and appraisal phase.
Technological Pedagogical and Content Knowledge	Technological pedagogical and content knowledge (TPACK) explains the specific types of knowledge required by teachers for integrating technology in their teaching (Koehler & Mishra, 2009; Mishra & Koehler, 2006).	Three primary theoretical components make up the framework: content knowledge (CK), pedagogy knowledge (PK) and technology knowledge (TK). The interplay of the three components results to more knowledge requirement: pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK) and technological pedagogical content knowledge (TPACK).
Cognitive affective theory of learning with media	Cognitive affective theory of learning with media (CATLM) was grounded in the CTML but it expanded to media other than words and pictures, such as virtual reality (VR) and agent-based learning environment (Moreno, 2005).	In addition to the assumptions that in CTML (ie, dual-coding process, capacity limitation on each channel and active information process), CATLM also considered the dynamic process of long-term memory, the mediation function of self-regulated learning (eg, motivational beliefs, metacognition) to cognitive engagement and previous learning experience and ability.

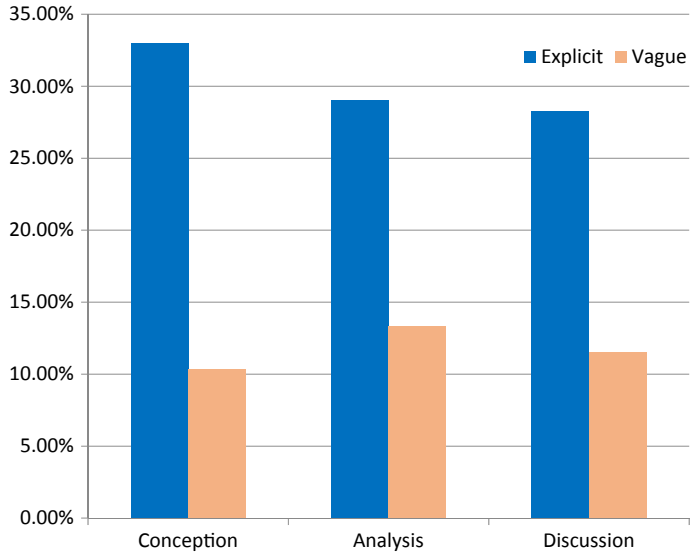

Figure 1: Study distribution of theoretical application
[Colour figure can be viewed at wileyonlinelibrary.com]

Table 4: Examples of theoretical advancement

Dimension	*Definition*	*Examples*
Theory development	Theory development through the addition of new dimensions or factors.	Add a new dimension: constructing a regulatory presence in the original community of inquiry theoretical perspective (Kilis & Yıldırım, 2018). A new theory: propose a causal theory to explain students' intention to exploit e-learning system functionalities (Moreno, Cavazotte, & Alves, 2017).
Theory comprehension	Studies that give a clearer demonstration or deeper understanding of how a theory functions, or how a theory may affect certain outcomes.	Findings deepen our understanding of the effects of the SRL (self-regulated learning). The results suggest that providing students with SRL support was helpful for low prior knowledge students to develop an adaptive learning strategy, with which they tend to master what they have learnt, improving their learning performance (Yang, Chen, & Cheng, 2018).
Theory challenge	Studies that question the validity of theories.	Findings challenge Hutt's theory (Hatzigianni, Gregoriadis, Karagiorgou, & Chatzigeorgiadou, 2018).
New scale development	Studies that use theoretical perspectives to develop and test new instruments to measure a theoretical construct.	Proposing a new objective measure of TPACK to supplement TPACK measures (Drummond & Sweeney, 2017).

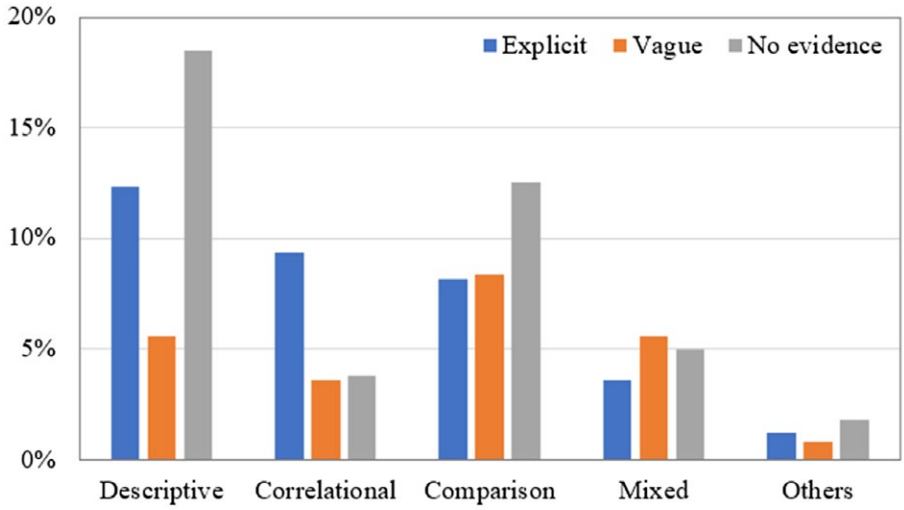

Figure 2: Study distribution of research method based on theoretical engagement level [Colour figure can be viewed at wileyonlinelibrary.com]

Discussion

In discussing the significance of the findings in this research, we return to two key questions: "How explicitly is existing theory identified in educational technology research?" and "How is existing theory applied in the research?" Based on our review, 41.55% (N = 209) of articles were atheoretical studies, and 23.86% (N = 120) articles made only vague references to theory. Only about 35% (N = 174) of studies showed explicit theoretical engagement. This suggests that the study of educational technology is under-theorised: to borrow May's (1993) expression, educational technology research does not appear to be a "mature discipline."

How might we explain this finding? Anyon (1982) lamented the general inadequacy of educational research and identified two kinds of "naïve empiricism," which she considered the dominant paradigm of research in education:

> The first kind is the simple emphasis on collecting and processing data, and the building up of ad hoc generalisations that attempt to explain the data…Such explanations are only, in the most naïve way, merely descriptive of the relationships that they discuss. The second type emphasises the construction of sophisticated hypothetical-deductive systems based on the regularities that have been observed. These hypothetical-deductive systems are more complicated but still descriptive and not explanatory. (p. 34)

In other words, according to Anyon (1982), the first kind of naïve empiricism is concerned with data collection and analysis without anchoring or grounding the results in particular theoretical perspectives. The second kind of naïve empiricism, although seemingly more sophisticated, still relies primarily on empirically descriptive regularities rather than relevant theory to explain the results. In cases in which theory is mentioned, it is not used to explain a specific phenomenon but presented without adequate connections to the phenomenon under study.

Why is naïve empiricism prevalent in educational research? Although speculative, it is possible that there is strong pressure on researchers working in education to concentrate on identifying practices that work in the classroom (Tooley & Darby, 1998). Tight (2004) posits that "the demand for evidence-based practice gives relatively little priority to theory" (p. 406). Researchers in educational technology may pay more attention to the *practical* application of ICT in a particular

context rather than theory application or advancement. This appears to resonate with Bennett and Oliver's (2011) observation that most educational technology research focuses on matters of practical implementation.

We found a variety of theories being applied, explicitly or vaguely, in educational technology research. It is interesting that these theories may be placed within the context of one or more views that propel educational technology use (Anderson, 2016; Larreamendy-Joerns & Leinhardt, 2006). These views include the presentational view, the epistemic engagement view and the heutagogy view (Anderson, 2016). The presentational view focuses on theories that make discourse and visualisations explicit to learners, such as how to present images and words so that messages delivered through multiple channels do not interfere with learners' cognitive processing (Anderson, 2016; Larreamendy-Joerns & Leinhardt, 2006). An example is the cognitive theory of multimedia learning. The epistemic engagement view includes theories that stress learners' discovering and sharing of knowledge (Anderson, 2016). Such a view is closely associated with theories such as Vygotsky's social development theory that explain how social interaction influences a person's cognitive development through the zone of proximal development and the more knowledgeable other. The heutagogy view proposed by Hase and Kenyon (2007) focuses on the development of learner self-direction (Anderson, 2016). An example is self-regulated learning theory, which explains the different phases of learning to help learners independently monitor, adapt and evaluate their learning. It is also of note that other theoretical perspectives such as complexity theory (Anderson, 2016) are not evident in our data corpus.

We note that of the 183 theories, only 35 (approximately 19%) can be considered specific to educational technology, such as TPACK. The remaining 148 theories are largely drawn from the social sciences (Jones & Czerniewicz, 2011), such as sociology and psychology. Why do so many articles show explicit engagement with "other field" theories? One possible explanation is that educational technology is an eclectic field (Ely, 1983) that borrows heavily from other disciplines such as sociology, psychology and computer and information sciences (Jones & Czerniewicz, 2011). Consequently, to the extent that researchers of educational technology apply theoretical perspectives, these theories are likely to be drawn from other disciplines. This phenomenon presents both opportunities and challenges. On the one hand, drawing upon theoretical insights from other fields allows room for better interpretation of the findings. On the other hand, the sheer range of theories from various disciplinary sources presents a formidable challenge for any researcher attempting to outline a coherent theoretical stance on educational technology as a whole (Jones & Czerniewicz, 2011).

A majority of the explicit articles utilised theory to conceptualise the research objects, to collect and analyse the data and to discuss the findings. Few articles (only 77 out of 503 articles) reported findings that will help us learn something new about a particular theory. This suggests that many educational technology studies tend to focus on *theory exemplification* rather than theory advancement. Theory exemplification, in the words of Ashwin (2012), refers to using theory as "a way of highlighting particular issues about the relations between theory and data" (p. 952) instead of challenging or expanding the explanatory ability of a theory. For example, if a researcher uses constructs of the theory of reasoned action to analyse and discuss why people use smart mobile devices in education but does not add anything new to what we know about the theory itself, the researcher is engaging in theory exemplification. Although theory exemplification is not necessarily a problem, it means that there is nothing in the researcher's data that could lead to the advancement of the theory. The lack of theory advancement corresponds with what we have discussed about the need to develop theories specifically for educational technology research.

Interestingly, theory was more likely to be made explicit in correlational-based studies than in descriptive or comparative studies. Over 36% of the articles were descriptive studies, but more than half of these were a-theoretical studies. Similar to the articles that used the descriptive method, approximately 30% of all of the articles used the comparative research method (eg, experiments, quasi-experiments), yet many of the comparative-based studies made either no or vague references to theory. Descriptive studies tend to merely describe or illustrate certain phenomena within a particular context devoid of theoretical explanations. Comparative studies tend to focus on which method or intervention works better rather than to explicitly discuss the theoretical mechanisms that may cause the difference.

Although fewer studies used the correlational method (ie, less than 17%), more than half of them explicitly engaged with theory and contributed to theory advancement. One possible explanation is that the use of correlational methods, particularly multivariate techniques (eg, structural equation modelling or SEM), requires researchers to formulate a theoretical diagram (eg, arrows and boxes) comprising various theoretical constructs that can affect a dependent variable and to develop several hypotheses to test the various structural relationships. The *a priori* formulation of a theoretical diagram based on theories prompts researchers to explicitly identify the relevant theories that they used. Correlational methods such as SEM have the potential to advance theory (Violato & Hecker, 2007). However, using SEM requires researchers to have sophisticated statistical knowledge (Violato & Hecker, 2007). This knowledge may be beyond the comprehension of many educational technology researchers, as reported in Bulfin and colleagues' (2014) survey study of 462 academic researchers in the area of educational technology, which highlighted a preference among many researchers "for relatively basic forms of descriptive research" (p. 403). Basic forms of descriptive research include frequencies, means, standard deviations, comparing means (eg, *t* test), content analysis and narrative analysis. Many educational technology studies reported low levels of familiarity with advanced methods such as multivariate analysis.

Conclusion

In summing up this paper, we return to the initial issue that prompted this study: the claim by critics that educational technology research is often under-theorised. To examine this assertion and to determine the extent of this criticism, the present paper examined the 503 most recent empirical articles published in 3 selected education-technology-related journals (ie, *Computers & Education*, *Learning, Media and Technology*, and the *British Journal of Educational Technology*). The results revealed that explicit engagement with theory is absent in the majority of previous studies. Many studies were either wholly a-theoretical or made only vague mention or use of theory. Where theory was explicit, the studies were more likely to use theory to conceptualise the research, to inform the data collection or analysis process and to discuss the results. Very few articles reported findings that will help us learn something new that could advance a particular theory. In conclusion, it appears that critics' characterisation of educational technology research as under-theorised is valid.

What, then, are some implications of the present findings for educational technology research? One implication is that researchers in the field of educational technology are encouraged to develop more "middle-range theories" (Morgan & Wildemuth, 2009) that can both explain empirical findings in a concrete way and demonstrate the ability to frame a variety of research topics in the field to conceptualise the research design, inform data manipulation and interpret the results. In addition, it is important for researchers to be more explicit about the theories that underpin their studies. Even though a-theoretical studies could describe how a technological tool

was applied and its effect on student outcomes (eg, learning or motivation), explicit theoretical engagement can expand the research to a broader level, helping us better understand the reasons and mechanisms behind the phenomenon.

Several limitations of this study must be acknowledged. First, our analysis could only focus on what the authors presented in their articles. The absence of certain theories did not necessarily imply that those theories have not been thought of by the authors in the reviewed studies. Instead, it only indicated that the authors did not explicitly name the theories in their articles. Second, the articles were selected from three highly ranked journals in the educational technology field. Our results may be biased by the high-quality articles in this field, which may have a higher level of explicit theoretical engagement. Third, these articles were published in recent years (ie, 2017 and 2018). Further research could use a longer search period (eg, 5 years) to include more articles so that researchers can investigate whether theoretical engagement changed in the educational technology field. Fourth, the present study focused on whether and how researchers used existing theories in *empirical* studies. Further research could analyse non-empirical papers, such as conceptual papers, to determine what they can tell us about theory in the field.

Statements on open data, ethics and conflict of interest

All of the data are available in the journals (*Computers & Education*, *Learning, Media and Technology* and the *British Journal of Educational Technology*).

We declare that no human participants were involved in this study.

We declare no conflict of interest concerning this study.

References

Anderson, T. (2016). Theories for learning with emerging technologies. In G. Veletsianos (Ed.), *Emergence and innovation in digital learning: Foundations and applications* (pp. 35–50). Edmonton, Canada: Athabasca University Press.

Anyon, J. (1982). Adequate social science, curriculum investigations, and theory. *Theory into Practice*, *21*(1), 34–37.

Ashwin, P. (2012). How often are theories developed through empirical research into higher education? *Studies in Higher Education*, *37*(8), 941–955.

Bennett, S., & Oliver, M. (2011). Talking back to theory: The missed opportunities in learning technology research. *Research in Learning Technology*, *19*(3), 179–189.

Blaxter, L., Hughes, C., & Tight, M. (2001). *How to research* (2nd ed.). Buckingham, UK: Open University Press.

Bulfin, S., Henderson, M., & Johnson, N. (2013). Examining the use of theory within educational technology and media research. *Learning, Media and Technology*, *38*(3), 337–344.

Bulfin, S., Henderson, M., Johnson, N. F., & Selwyn, N. (2014). Methodological capacity within the field of "educational technology" research: An initial investigation. *British Journal of Educational Technology*, *45*(3), 403–414.

Cohen, J. (1960). A coefficient of agreement for nominal scales. *Educational and Psychological Measurement*, *20*, 37–46.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–340.

Davis, F. D. (1986). A technology acceptance model for empirically testing new end-user information systems: Theory and results (Unpublished doctoral dissertation). MIT Sloan School of Management, Cambridge, MA.

Deci, E., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Springer Science & Business Media.

Drummond, A., & Sweeney, T. (2017). Can an objective measure of technological pedagogical content knowledge (TPACK) supplement existing TPACK measures? *British Journal of Educational Technology*, *48*(4), 928–939.

Ely, D. P. (1983). The definition of educational technology: An emerging stability. *Educational Considerations*, *10*(2), 2–4.

Fishbein, M. A., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Reading, MA: Addison-Wesley.

Grant, A. M., & Pollock, T. G. (2011). Publishing in AMJ—Part 3: Setting the hook. *Academy of Management Journal*, *54*(5), 873–879.

Han, S., & Makino, A. (2013). Learning cities in East Asia: Japan, the Republic of Korea and China. *International Review of Education*, *59*(4), 443–468.

Hase, S., & Kenyon, C. (2007). Heutagogy: A child of complexity theory. *Complicity: An International Journal of Complexity and Education*, *4*(1), 111–119.

Hatzigianni, M., Gregoriadis, A., Karagiorgou, I., & Chatzigeorgiadou, S. (2018). Using tablets in free play: The implementation of the digital play framework in Greece. *British Journal of Educational Technology*, *49*(5), 928–942.

Issroff, K., & Scanlon, E. (2002). Educational technology: The influence of theory. *Journal of Interactive Media in Education*, *6*, 1–13.

Jones, C., & Czerniewicz, L. (2011). Theory in learning technology. *Research in Learning Technology*, *19*(3), 173–177.

Kilis, S., & Yıldırım, Z. (2018). Investigation of community of inquiry framework in regard to self-regulation, metacognition and motivation. *Computers & Education*, *126*, 53–64.

Koehler, M., & Mishra, P. (2009). What is technological pedagogical content knowledge (TPACK)? *Contemporary Issues in Technology and Teacher Education*, *9*(1), 60–70.

Larreamendy-Joerns, J., & Leinhardt, G. (2006). Going the distance with online education. *Review of Educational Research*, *76*(4), 567–605.

Malone, T. W. (1985). Designing organizational interfaces. In L. Borman, R. Smith (Eds.), *Proceedings of the CHI'85 Conference on Human Factors in Computing Systems* (pp. 66–71). New York, NY: ACM Press.

Markauskaite, L., & Reimann, P. (2014). Editorial: e-Research for education: Applied, methodological and critical perspectives. *British Journal of Educational Technology*, *45*(3), 385–391.

May, T. (1993). *Social research: Issues, methods and process*. Buckingham, UK: Open University Press.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge, NY: Cambridge University Press.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.

Moore, M. G. (1991). Editorial: Distance education theory. *The American Journal of Distance Education*, *5*(3), 1–6.

Moreno, R. (2005). Instructional technology: Promise and pitfalls. In L. PytlikZillig, M. Bodvarsson, & R. Bruning (Eds.), *Technology-based education: Bringing researchers and practitioners together* (pp. 1–19). Greenwich, CT: Information Age Publishing.

Moreno, V., Cavazotte, F., & Alves, I. (2017). Explaining university students' effective use of e-learning platforms. *British Journal of Educational Technology*, *48*(4), 995–1009.

Morgan, C., & Wildemuth, B. M. (2009). Questions related to theory. In *Applications of social research methods to questions in information and library science* (pp. 40–50). Westport, CT: Libraries Unlimited.

Mueller, B., & Urbach, N. (2017). Understanding the why, what, and how of theories in IS research. *Communications of the Association for Information Systems*, *41*(17), 349–388.

OECD. (2010). *Are the new millennium learners making the grade?: Technology use and educational performance in PISA 2006*. Paris, France: OECD Publishing.

Pintrich, P. R. (2000). Multiple goals, multiple pathways: The role of goal orientation in learning and achievement. *Journal of Educational Psychology*, *92*(3), 544–555.

Puustinen, M., & Pulkkinen, L. (2001). Models of self-regulated learning: A review. *Scandinavian Journal of Educational Research*, *45*(3), 269–286.

Reigeluth, C. M. (1992). Elaborating the elaboration theory. *Educational Technology Research & Development*, *40*(3), 80–86.
Reigeluth, C. M. (1999). What is instructional design theory and how is it changing? In C. M. Reigeluth (Ed.), *Instructional design theories and models: A new paradigm of instructional theory* (pp. 5–29). Hillsdale, NJ: Lawrence Erlbaum Associates.
Reigeluth, C. M., & Carr-Chellman, A. (2009). Understanding instructional theory. In C. M. Reigeluth & A. Carr-Chellman (Eds.), *Instructional-design theories and models, volume iii: Building a common knowledge base* (p. 3–26). New York, NY: Routledge.
Ross, S. M., & Morrison, G. R. (1995). *Getting started in instructional technology research*. Washington, DC: Association for Educational Communications and Technology.
Schunk, D. H., & Zimmerman, B. J. (2011). Self-regulated learning and performance: an introduction and an overview. In D. H. Schunk & B. J. Zimmerman (Eds.), *Handbook of self-regulation of learning and performance* (pp. 15–26). New York, NY: Routledge.
Simon, H. (1996). *The sciences of the artificial* (3rd ed.). Cambridge, MA: MIT Press.
Straub, D. W. (2009). Editor's comments: Why top journals accept your paper. *MIS Quarterly*, *33*(3), iii–x.
Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, *12*(2), 257–285.
Tight, M. (2004). Research into higher education: An a-theoretical community of practice? *Higher Education Research & Development*, *23*(4), 395–411.
Tooley, J., & Darby, D. (1998). *Educational research—A critique*. London, UK: Office for Standards in Education.
Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, *39*(2), 273–315.
Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204.
Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, *27*(3), 425–478.
Violato, C., & Hecker, K. G. (2007). How to use structural equation modeling in medical education research: A brief guide. *Teaching and Learning in Medicine*, *19*(4), 362–371.
Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. In M. Cole, V. John-Steiner, S. Scribner, & E. Souberman (Eds.), Cambridge, MA: Harvard University Press.
Whetten, D. A. (1989). What constitutes a theoretical contribution? *Academy of Management Review*, *14*(4), 490–495.
Winne, P. H. (2011). A cognitive and metacognitive analysis of self-regulated learning. In D. H. Schunk & B. Zimmerman (Eds.), *Handbook of self-regulation of learning and performance* (pp. 15–32). New York, NY: Routledge.
Yang, T. C., Chen, M. C., & Chen, S. Y. (2018). The influences of self-regulated learning support and prior knowledge on improving learning performance. *Computers & Education*, *126*, 37–52.
Yuen, A. H., & Hew, T. K. F. (2018). Information and communication technology in educational policies in the Asian region. In J. Voogt, G. Knezek, R. Christensen, & K. W. Lai (Eds.), *Handbook of information technology in primary and secondary education* (pp. 1–20). Cham, Switzerland: Springer.
Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Amsterdam, Netherlands: Elsevier.