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Digital transformation of higher education in Australia: Understanding affordance dynamics in E-Textbook engagement and use

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ABSTRACT

This paper addresses digital transformation in higher education by exploring the engagement and use of e-textbooks through an affordance theory lens. Drawing on the insights from in-depth interviews (n = 18), focus group discussions (n = 15), a pilot survey (n = 83) and the main survey (n = 344) in Australia, we developed and validated an affordance actualisation model for the engagement and use of e-textbooks. The partial least squares (PLS) technique was used to validate the dimensions of affordance actualisation and its relationship with e-textbooks engagement and affordance effect. The findings indicate the efficacy of the two affordance constructs, as well as the significant mediating effect of engagement. An important lesson for the e-textbook industry is that firms need to consider affordance actualisation dimensions (i.e., portability, accessibility, searchability, highlighting, copying, browsing, hedonic and utilitarian value) when enhancing digital engagement and use of e-textbooks.

1. Introduction

Digital transformation presents organisations with the opportunity of a new digital business model, enabling them to offer their services in a distributed space and using an anytime anywhere mode to their clients. As a result, there are both opportunities and challenges that require innovation and new organisation and leadership dynamics (Jackson, 2019; Schwarzmüller et al., 2018). Krishnamurthy (2020) outlines how the COVID-19 pandemic has accelerated digital transformation in the higher education sector, as institutions transform their traditional teaching platforms to digital platforms. Krishnamurthy (2020) also identifies several issues that institutions must address as they navigate through this digital transformation; one of these is the "transformation of the student". This issue recognises the cognitive shift that students will undertake as the learning environment pivots from a personal interactive one, to one mediated by technology. Considering this and the broader challenges of digital transformation, there is a need for higher education institutions to define new areas of competency and create innovations for online learning that can encompass the needs of all stakeholders (Bond et al., 2018; Hilderbrandt, 2019).

Textbooks are an important resource in learning contexts. As higher education learning platforms transition to digital platforms, e-textbooks will form an integral part of these platforms. It is well understood that e-textbooks offer distinct advantages for students (and at lower costs), however, student preferences for digital media vis-à-vis traditional media are not well understood (D'Ambra et al., 2020). In order for digital transformation to be successful in meeting the needs of students and other stakeholders, this paper adopts an affordance theory view of evaluating how well e-textbooks support learning in a digital context.

In a recent study, Volkoff and Strong (2018) note the surge in interest in the use of affordance theory to investigate the IT artefact and its deployment. They recognise that, along with the growth of the use of affordance theory, there have been issues and difficulties with applying the original theory from ecological psychology to information systems (IS). In addressing these issues, they provide clear definitions and guidelines for future research utilising an affordance theory lens. In considering future affordance theory studies in the IS domain, they suggest the opportunity for more quantitative techniques to study affordances and their actualisation. In response to this call, this study extends the use of research into e-textbooks through an affordance theory lens, with the aim to make a contribution to developing quantitative approaches to the study of affordance theory as part of the digital

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transformation of education (Bresciani et al., 2021; Dong & Wang, 2018; Ferraris et al., 2020; Nelson et al., 2017; Panigrahi et al., 2018; Pee, 2018; Wang et al., 2020).

Interestingly, textbooks are a significant resource used by students. The wide adoption of smart devices (smartphones, tablets, e-readers and lightweight laptops) has been accompanied by the emergence of e-textbooks (Chang, 2016). Studies have shown that although e-textbooks do offer distinct advantages over print textbooks, and at much lower costs, the uptake of e-textbooks has been slow and student preferences for either medium are not well understood (D'Ambra et al., 2013). As part of the digital transformation of the learning technology, smart devices offer the readers of e-textbooks the added functionality of accessing multiple information resources such as online dictionaries, online encyclopedias, and other useful information resources (Bond et al., 2018; Elves, 2012; Rai & Selnes, 2019; Usoro, 2014). By enabling web access while reading e-textbooks, the reading and study experience is enhanced, allowing students to resolve questions and thereby enhance the reading experience. This new context of reading and studying takes the content of textbooks beyond the boundary of print textbooks, to an information system capable of resolving information need as it arises in the process of reading (D'Ambra et al., 2013).

This paper adopts the approach that e-textbooks, and the smart readers on which they are stored and read, are IT artefacts (Elves, 2012). e-Textbooks are an application that can be executed on smart devices. As part of our evaluation of e-textbooks from an affordance perspective as a digital resource, we explore student engagement with e-textbooks as a mediating factor. The contributions of this paper are threefold: first, we present a nomological model exploring the causal relationships between three constructs: affordance actualisation, engagement with e-textbooks, and affordance effect; second, we use an affordance lens to assess student perceptions of how e-textbooks support learning; third, a general contribution to quantitative approaches to the study of affordance theory is made. The paper is structured as follows: first we consider the literature in the domains of affordance theory, student engagement and e-textbooks; second, the methodological approach we followed is outlined in detail; third, we report the results; fourth we outline a summary of our findings and, finally, the discussion and conclusion are presented.

2. Literature review

2.1. Affordance theory

A significant body of literature offering extensive overviews of the history and development of affordance theory is available (Fayard & Weeks, 2014; Majchrzak & Markus, 2012; Markus & Silver, 2008; Robey et al., 2013; Volkoff & Strong, 2018). The concept of affordance has evolved and been appropriated by a number of disciplines, including information systems (IS). The concept of "affordance" was first discussed by Gibson (1979) when he proposed that "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill" and affordance was defined as an "opportunity for action offered by the real world" (p.127) as part of his work on ecological psychology.

Norman (1988) is responsible for developing the human–computer interaction (HCI) perspective of affordance. In considering the interaction between humans and objects, he recognised both an object's intended use (real affordances) and the affordances perceived by the user (perceived affordances). HCI focuses on how different visual cues in IT artefact design support real affordances of the artefact (Norman, 1999; O'Brien & Toms, 2008). An important distinction between Gibson's and Norman's view of affordance relating to an object is that Norman's is about the usability of the object, while Gibson's is about the usefulness (Volkoff & Strong, 2018).

In this paper, we adopt Gibson's perspective of affordance in line with current IS research (Hartson, 2003; Leonardi, 2011; Markus & Silver, 2008; Volkoff & Strong, 2018). Ecological psychologists have agreed on the following understanding of affordance: "An affordance is a property of the relationship (between the user and the artefact) and is defined as an opportunity for action." In reconciling opposing views of constructivism and realism on the social impact of technology, Hutchby (2001, p.448) argues that "affordances are functional and relational aspects which frame, while not determining, the possibilities for agentic action in relation to an object." Further, Hutchby argues that users enter into relationships with objects and that in the relationships, objects are "read" by the users and users produce readings of objects which best suit the purpose they have in mind for the object. Affordances are functional in the sense that they are enabling factors in a user's attempt to engage in an activity: reading a book, photocopying a document, sheltering from a storm. Certain objects, environments or artefacts have affordances that enable the particular activity, while others do not. The relational affordance of an object may be different between species or between users. Therefore, realists argue that an affordance exists in the domain of the real (Volkoff & Strong, 2018).

Objects may offer multiple affordances in a single object–user view relationship. For example, a person may view a chair as offering a sitting affordance – however, they may also view it as offering a standing affordance to help reach something out of reach. In this example, both the associated goal and the actualising affordance are tied to the one actor; a resulting event or outcome in the actual domain is necessarily specific to the actor. While actual affordances exist within the actuality of a specific individual, we can refer to generic affordances in the real (the sitting affordance of a chair; the reading affordance of a book). This idea of a generic affordance allows for a structural range where actors exhibit a range in how the affordance is operationalised – actors can sit differently on a chair; a book is read differently by various readers.

Within the context of this paper, we propose the importing of the idea of affordances from ecological psychology to IS research in the context of individual goals and actions. We adopt the Volkoff and Strong (2013, p.823) definition of affordance:

> "The potential for behaviours associated with achieving an immediate concrete outcome and arising from the relation between an object *(*e.g.*, an IT artefact [such as a smart device on which an e-textbook can be read])* and a goal-directed actor or actors *[*e.g.*, a user of the smart device whose goal is to read]*."

The extant research aims to go some way in consolidating the issue of affordances in digital transformation perspectives (Benbunan-Fich, 2019; Liu et al., 2022). First, it offers the opportunity to identify the value proposition of IT artefacts through the awareness and actualisation of affordances by users of an object. Second, we propose two empirical constructs: affordance actualisation and affordance effect in a nomological model. We study the affordances by untangling the interaction between social actors (readers, users of e-textbooks and smart devices) and a material artefact (e-textbooks on a smart device). This is achieved by identifying affordances of e-textbooks and smart devices that are actualised by readers of e-textbooks, thereby enabling the understanding of what is valued by readers of e-textbooks. We do this by following Volkoff and Strong (2013), who state: "researchers seeking to identify affordances need to uncover the immediate concrete outcomes the actors experienced or expected to experience.".

2.2. Engagement

One of the objectives of this study is to evaluate the effectiveness of e-textbooks in supporting student learning. As we explore the affordances of e-textbooks, we also explore how these affordances support student learning. We draw on engagement theory to assess how the affordances of e-textbooks can support learning and improve student academic outcomes. With the wide adoption of digital learning management systems, students are developing skills for learning in the digital milieu. In parallel, more and more resources, including textbooks, are integrated into these digital environments (Osatuyi & Passerini, 2016).

Research studies (Barkley et al., 2014; Shulman, 2002) have demonstrated that student engagement, from both courses, related and an extra-curricular perspective, is a significant factor in the learning process and is necessary for retaining information as well as motivating learning (Wishart & Blease, 1999). In an analytics project, Junco and Clem (2015) built a predictive model of student success. They found that "time spent reading", one of the variables comprising an engagement index, was a strong predictor of final course outcomes. Osatuyi and Passerini (2016) provide two perspectives of engagement in student learning:

1. *"Activities that challenge and extend students' intellectual capacity to engage with academic activities allowing them the opportunity to synthesise concepts taught in class and give them the ability to critically analyse observation beyond the classroom."*
2. *"Activities that contribute to a student's educational experience beyond the classroom focusing on the students' non-academic social interaction." (p.511)*

As textbooks are an important resource in facilitating the learning of principles and concepts related to what is taught in class, our focus is on the first perspective.

The concept of engagement has been considered in a variety of research fields. Maslach et al. (2001) and Schaufeli and Bakker (2004) used engagement in work psychology research to explore employees' experience with a work activity. Schaufeli et al. (2002) extended this work by examining the dimensionality of the engagement construct in a study of tertiary students' experience of burnout and engagement in relation to their studies and academic performance.

Appleton et al. (2008) emphasise the myriad of definitions of engagement in the literature. This lack of clarity is confirmed in the IS literature, where engagement has been defined differently in several contexts. Jacques (1995), Webster and Ho (1997), and Webster and Ahuja (2006) all define engagement as the state of the user, whose attention and interest is fully captured and held in an intrinsically enjoyable experience. O'Brien and Toms (2008) and Rozendaal (2007) describe engagement as control, feedback and novelty, while Chou and Conley (2009), writing in a HCI context, consider engagement as users frequently engaging, actively and vividly becoming involved while using technology. More recently, Suh et al. (2017), in an IS gamification context, define engagement as "a state in which a user is deeply engaged with a gamified IS, which increases a user's continuous intention" (p.277). Syler and Baker (2016) use engagement analogous to the concept of flow.

Given this lack of clarity on a standard definition of engagement, we are guided by Schaufeli et al. (2002), who, in a cross-cultural study investigating engagement and burnout in university students, found that engagement is a multidimensional construct. This finding is confirmed by a *meta*-analysis of the construct by Appleton et al. (2008). The three dimensions are:

1. Vigour: defined as high levels of energy and mental resilience while working and the willingness and ability to invest effort in one's work.
2. Dedication: defined as a sense of significance, enthusiasm, inspiration, pride and challenge.
3. Absorption: being fully concentrated and happily engrossed in one's work, whereby time passes quickly, and one feels carried away by one's job.

To contrast the conceptualisation of flow from absorption (Csikszentmihalyi, 1990), we define absorption as "a more pervasive and persistent state of mind, as is the case with engagement" Schaufeli et al. (2002, p.29). However, flow focuses on short-term peak experiences.

2.3. e-Textbooks

Although the literature on e-textbooks and related technologies has been growing for the last decade (Ramaiah et al., 2005; Slater, 2010; Staiger, 2011; Yu et al., 2014), the sub-literature of e-textbook usage in higher education exploded only about a decade ago (Baron, 2015; Gerhart et al., 2015; Rodriguez et al., 2015; Valjataga & Fiedler, 2014). D'Ambra et al. (2013) provide a table summarising aspects of frequently cited research papers on the use of e-textbooks by faculty and students in academic environments. On reviewing the literature on e-textbook adoption and use by students in higher education, the following themes emerged: student preferences; perceived advantages of e-textbooks; behaviour; the digital milieu and content; information systems-based research. We consider each one of these themes below.

2.3.1. Preferences

Bookboon (2012) reports on an online survey of 10,000 students in eight countries (Denmark, Germany, India, Netherlands, Norway, Sweden, UK and US), reflecting on their experience with e-textbooks versus print textbooks. Overall, 58% preferred e-textbooks for their portability, ease of reading and cost, with the US leading, while Dutch students "never get tired of flipping real pages". Of all students preferring p-textbooks (print books) (42%), ease of reading and taking notes ranked high. Most German students refused to buy required textbooks, while almost half of the Swedish students realised that they needed only a few chapters.

Another online survey conducted by Baron (2015) collecting data from the US, Japan, Germany and Slovakia found a very significant preference for print for serious reading, for "light reading" respondents were not as concerned regarding format and media. Only 2% of respondents stated that they concentrated best using hard copy as opposed to electronic copy on smart devices (cell phone, tablet, e-reader or laptop). In a transaction log analysis using data from 127 UK university libraries, a survey of over 5,000 staff and students of the 127 universities, and data from focus groups, Nicholas et al. (2010) found that e-textbooks could be popular and widely used mainly for small "snippets of information and for fact finding". However, e-textbooks provided ease of access and convenience. DeNoyelles et al. (2015) found that e-textbook use has increased and become broader, demographically. Lower cost and convenience remain the top reasons students purchase e-textbooks, not the interactive features designed to enhance learning.

2.3.2. Behaviour

In a data mining project, Warner et al. (2015) mined 6.8 million log events between 2012 and 2014, from over 43,000 people worldwide interacting with "How To Think Like a Computer Scientist", a free interactive web-based textbook for learning computer programming (see https://interactivepython.org/). As part of their analysis, they compared engagement (use) patterns in three populations (high school students, college/university students and online website viewers). They report that people made extensive use of interactive components such as (1) executing code and answering multiple choice questions; (2) engaged for longer periods when taking high school or college/university courses; and (3) frequently viewed textbook sections out of order. Their study goes beyond adoption behaviour to one of actual usage and engagement behaviour.

McNeish et al. (2014) used focus groups (along with data from open-ended questions) to elucidate the characteristics that make students resist the complete replacement of p-textbooks with e-textbooks. Resistance to give up paper is a "typical reaction of the existing market to a disruptive technology." The authors suggest that e-content developers and publishers do not completely understand how students use p-textbooks to achieve academic success and therefore are not transferring the learning styles and processes that students use to e-textbooks. Roberts (2015) used levels of use as a framework to identify and analyse instructors' level of use rankings for e-textbook features.

2.3.3. Milieu and content

Pata et al. (2014) provide an extensive concept map of e-textbook properties and functions to explore novel applications in learning: e-textbook as an "artifact ecosystem" or as a "new socio-technical regime". Lee and Yau (2015) used findings in the literature and their interview results to identify four major IT-based challenges associated with e-textbooks: "standardising format of content, improving service reliability, improving quality and accuracy of content, and improving readability". They also developed "usage scenarios" for each of the challenges to provide solutions based on existing technologies such as cloud computing and others. Miller et al. (2013) used survey data of undergraduate students to estimate the determinants of e-textbook use. Their findings show that younger students from lower-income families, who went to larger high schools, were more likely to use e-textbooks. Additionally, use was higher among students in technically-oriented fields, especially in business, where competence in IT is required. The continued rise in college and university costs, along with a reduction in resistance from lecturers, add to the growth in the use of e-textbooks.

2.3.4. Information systems research on e-textbooks

Many quantitative studies of the use of e-textbooks in academic environments include theoretical intention-based models of technology acceptance. Hsiao and Tang (2014) assessed five such models: theory of planned behaviour (TPB); technology acceptance model (TAM); decomposed TPB model (DPTB); combined TAM and TPB (C-TAM-TPB); and the unified theory of acceptance and use of technology (UTAUT). They used the survey methodology and structural equation modelling (SEM) to assess the five models and found that UTAUT appeared to be the "best model in terms of the metrics of parsimonious fit and explanatory power"; C-TAM-TPB was superior to TAM or TPB alone. Stone et al. (2015) used the expectation-confirmation model (ECM) and included the constructs of e-textbook usability and its dimensions. Using nearly 650 responses from students in an American university who had previously used e-textbooks, the authors found that continuance intentions are driven by satisfaction and the perceived usefulness of e-textbooks. Furthermore, "students' expectation-confirmation and e-textbook usability positively influence both students' satisfaction and perceived usefulness and hence the intentions for continued e-textbook adoptions.".

D'Ambra et al. (2013) used the task-technology fit (TTF) model to structure and evaluate the adoption of e-textbooks by academics, while Gerhart et al. (2015) used TTF "to understand how students perceive their task of learning to fit with e-textbook technology and how that fit influences e-textbook usage and expected performance in their classes." Their findings showed that "four factors impact a student's perceived TTF: substitution, habit, hedonic motivation and facilitating conditions." Surprising, price value showed only a minor effect on e-textbook utilisation.

2.4. A commonality in findings

Although nearly all the literature reviewed acknowledges that students do read electronic text onscreen for pleasure (Cull, 2015) or for obtaining specific information (Nicholas et al., 2010), there is a near-universal preference for print, especially for serious reading (Baron, 2015), or for long-form and academic reading (Foasberg, 2014). Some 80% of students prefer printed text when reading for study (Cull, 2015). Reasons often given for print preference include the ability to highlight or underline text and write notes in the margins (Rodriguez et al., 2015). Many results state that students can focus or concentrate better with printed text than onscreen text; furthermore, comprehension and retention when reading print is greater than when reading e-text (Zabukovec & Vilar, 2015).

Mizrachi (2015) provides other reasons for print preference from student comments, including: "less eye strain and fatigue; advantages of the tactile aspects of holding, flipping and thumbing through a printed work; sustained concentration seems easier when reading in a linear progression than vertical scrolling; printed pages offer better memory cues." Finally, Millar and Schrier (2015) state that "the primary reason for their [student's] preference was because the students simply prefer print to digital.".

Despite the p-textbook preference for learning by the vast majority of students studied to date, nearly all would say that e-textbooks offer the following advantages over p-textbooks: easier accessibility; cost savings; ease of updating; ease of correcting errors; portability and weightlessness; internet connectivity for answering brief information needs (Pace, 2013).

If one provides an affordance lens to the literature review above, it is possible to identify a common theme and driver in the literature that clearly indicates that students' preferences for print textbooks or e-textbooks is based on the affordances offered by either medium. From our perspective, the themes that emerge in the literature are advantages and disadvantages, and preferences for either print textbooks or e-textbooks. We propose that these preferences and perceptions are based upon the perceived affordances of either medium. This then supports our further exploration of affordance theory in the context of the use of e-textbooks.

3. Research model

One of the objectives of this study is to contribute to the quantitative study of affordance theory within the domain of ubiquitous computing, with a focus on an individual artefact. We operationalise this objective through the nomological model illustrated in Fig. 1.

The development of the affordance actualisation model is driven by the applicable six principles for using affordance theory in IS research, as presented by Volkoff and Strong (2018). We define affordance using the definition provided by Strong et al. (2014): an affordance is *"the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor or actors."* This definition was developed to enable the study of affordance theory with groups of organisational actors engaging with complex objects. Although the focus of this study is individual users and a single generalised artefact, the definition is applicable: the affordance is the potential offered by the e-textbook and the smart device on which it is stored; the outcome is the reading and learning that arises from the relationship between the artefact and the goal-directed actor – the student.

Our model explains the relationship between affordance actualisation and affordance effect with the mediation of e-textbook engagement. One of our aims is to contribute to the development of quantitative techniques to study affordances and their actualisation. Our perspective is one of positivism, using affordance theory as a lens for exploring the interaction between e-textbooks read on smart devices and users, enabling the development and testing of the research model in Fig. 1. Bernhard et al. (2013), in a paper advancing the quantitative study of affordance theory, offer a causal framework of affordances as shown in Appendix 1. Our approach adopts two constructs from this model: affordance actualisation and affordance effect.

The derivation of the scales for these constructs is outlined in the method section below. Here we discuss the theoretical derivation for explaining affordance effect behaviours. In their recent publication, Volkoff and Strong (2018) present six principles to guide the use of affordance theory in IS research. Principle two outlines the requirement to maintain the distinction between affordance and its actualisation. The distinction between affordances (as relating to potential actions) and actualisation, relates to specific actions taken by an actor. The unit of measurement in this study is the individual student (actor), and the survey instrument focused on specific actions taken in their use of e-textbooks accessed on smart devices. In terms of defining the actualised affordances construct, we draw on the well-accepted understanding that affordances relate to potential actions and the purpose they are meant to

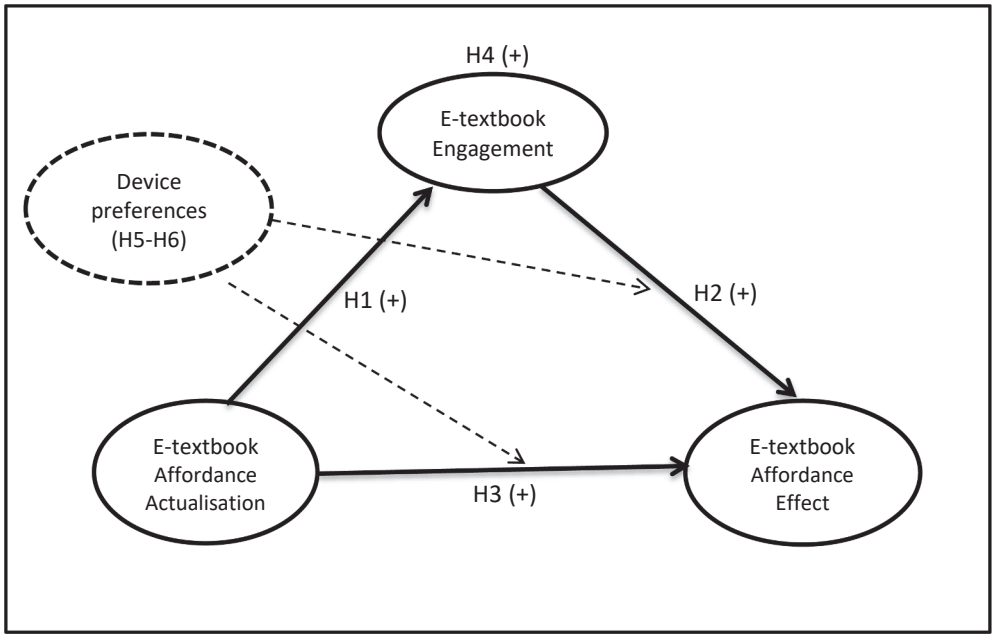

Fig. 1. Affordance actualisation structural model.

achieve. Actualisation relates to a particular individual actor and the specific action the actor will take or has taken. In our context, the actions taken include: transporting, accessing, searching, highlighting, copying, browsing and saving (value). These actions are affordances that have been derived as described in the method section below. In naming the actualised affordance, we are guided by Volkoff and Strong's third principle: *"focus on the action not the state or condition reached after taking the action."*.

As outlined above, we model engagement with three dimensions: vigour, dedication and absorption. The construct is formative. Schaufeli and Bakker et al. (2004) use engagement as a contrasting variable to burnout, investigating the relationship of the two variables with academic performance. In the current study, we propose that the actualisation of affordances of e-textbooks will enrich a student's study experience with the e-textbook, thereby affecting their level of engagement.

H1. *Affordance actualisation has a significant positive impact on e-textbook engagement.*

We model affordance actualisation as a reflective latent construct measured by its manifest affordances: transporting, accessing, searching, highlighting, copying, browsing, saving (value). The affordance effect is characterised by cognitive absorption and deep structure usage (Burton-Jones & Straub, 2006). After actualisation, the affordance leads to certain consequences, effects that are intended by the user and/or those by the original creator of the artefact as unintended effects (Markus & Silver, 2008).

H2. *e-Textbooks engagement has a significant positive impact on the affordance effect.*

Previous studies (as discussed above) investigating the impact of engagement in educational environments have proposed that there is a positive relationship between engagements and the dependent variable, with many of these studies drawing from the self-process model applied to education settings that indicate positive learning outcomes from higher levels of engagement (Appleton et al., 2008; Connell & Wellborn, 1991). We propose that e-textbook engagement will have a significant positive impact on the affordance effect.

H3. *Affordance actualisation has a significant positive impact on the affordance effect.*

3.1. Mediating effects of e-textbook engagement

e-Textbook engagement is a major driver of the positive affordance effect and, therefore, achieving high engagement is a key goal of e-textbook adoption across the world. This study identifies engagement as a mediator because, first, affordance actualisation (predictor) influences e-textbook engagement (mediator); second, engagement influences affordance effect, and affordance actualisation influences affordance effect. Finally, affordance actualisation influences the affordance effect in the absence of e-textbook engagement (Baron & Kenny, 1986). In addition, e-textbook engagement, as a mediator, plays the role of an "affective" attitude between "cognitive beliefs" (i.e., affordance actualisation) and "conative" construct (i.e., affordance effect) (Ajzen & Fishbein, 1980; Bhattacherjee & Premkumar, 2004). In e-textbook affordances, engagement is widely acknowledged to play a vital role between affordance actualisation and affordance effect to ensure its scalability. Thus, we put forward the hypothesis:

H4. *e-Textbook engagement mediates the relationship between affordance actualisation and affordance effects.*

3.2. Moderating effects of device preferences

Device preferences align content with reading platforms and their capabilities. The main way a device can help readers achieve affordance effects is by aligning its capabilities with various types of e-textbook content. Affordance actualisation and e-textbook engagement can influence affordance effects through the moderating role of a device preference. As device preference is a strategic choice by users (Mariani et al., 2019), it influences how to leverage the strategic uses of e-textbooks. This argument indicates that device preferences influence the relationship between affordance actualisation-affordance effects and engagement-affordance effects. A high level of actualisation of e-textbooks (e.g., portability, searchability, highlighting, value) could enable a reader to enjoy better affordance effects. In the absence of the right device, there is every possibility of declining performance in e-textbooks. Thus, we posit that e-textbooks will serve as a moderator of the relationship between affordance actualisation-affordance effects and

engagement-affordance effects:

H5. *Device preferences moderate the relationship between affordance actualisation-affordance effect.*

H6. *Device preferences moderate the relationship between e-textbook engagement and affordance effect.*

4. Methods

The study embraced a mixed-method approach to "compensate for the flaws, and leverage the strengths, of the various available methodologies" (Mangan et al., 2004, p.569). As such, first, it adopted qualitative techniques (in-depth interviews and focus group discussions) to explore affordance actualisation dimensions (Akter et al., 2020; Mariani & Nambisan, 2021). Second, it applied quantitative methods (i.e., online surveys) to confirm the research model and hypotheses (Ferraris et al., 2019; Mariani et al., 2021). Fig. 2 presents the process that was followed for the data collection of the study. Separate ethics approval was obtained for the interviews, focus group and the survey.

4.1. In-depth interviews

Eighteen undergraduate students who had used e-textbooks while attending a major university in Sydney were interviewed. All 18 were aged from 18 to 22 years. Eight of the interviewees were studying business and ten were studying other disciplines. Students read their e-textbooks on tablets, laptops and smartphones. The duration of the interviews ranged from 45 to 60 min. The interviews were transcribed and thematic analysis was used to analyse the data using the NVivo software program (Ferraris et al., 2019).

4.2. Focus groups

The population for the focus groups was drawn from a convenience sample of undergraduate and postgraduate students of a major research university in Sydney, Australia. Two approaches to recruiting students were adopted: notices were placed on the learning management system for a number of courses as well as on the "free food group" social media pages for the university. To be eligible to participate in the focus groups, students were required to have used e-textbooks for at least one semester. A shopping voucher of $40 was provided to each participant as compensation for their time. In total, fifteen students were recruited and each attended one of three focus groups.

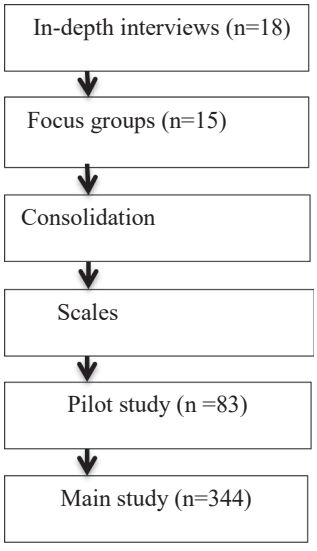

Fig. 2. Data collection activities.

Focus group participants represented various disciplines, including business, social science, engineering and medicine. The approach in the focus groups was semi-structured and questions focused on: e-textbook use, usefulness, quality, system quality, fit for purpose, functionality and devices on which they are read, value, perceptions of learning, and learning outcomes. The timing of each group ranged from 45 to 60 min. Each focus group discussion was recorded and transcribed by a commercial transcription service, resulting in a document of 13,229 words. The transcribed discussions were the artefact used for the initial coding. The age of focus group participants ranged from 18 to 40 years, with nine males and six females. There were 10 undergraduates and five postgraduates, all with experience of using e-textbooks for a period of between 1 and 5 years. Participants were drawn from several faculties in the university: business (5), engineering (2), medicine (2), science (2), optometry (1), arts and social sciences (1), two did not disclose their faculty.

For the in-depth interviews and the focus group discussions, thematic analysis was used to analyse the transcripts of the focus groups, and axial and open codes were derived. To facilitate the derivation of the codes, the results from the two data sets (interviews and focus groups) were consolidated. The statements from the transcribed interviews and focus groups, being the latent manifestations of the open codes, were mapped against the open codes. The thematic analysis followed the method prescribed by Braun and Clarke (2006) and Hossain et al. (2019). As part of the thematic analysis, we explored recurrent patterns that identified eight affordance actualisation dimensions (i.e., portability, accessibility, searchability, highlighting, copying, browsing, hedonic value and utilitarian value). Fig. 3 shows the eight themes of affordance actualisation from qualitative interviews, which are consistent with the findings of the literature review. Candidate scale items were then adapted and confirmed by consultation among the researchers.

4.3. Pilot study

The survey instrument was tested in a pilot study. The pilot study was conducted at two major universities – one in Sydney and the other in a regional centre of Australia. The purpose of the pilot was to test the validity of the scales derived from earlier stages in the method. A convenience sample of 185 postgraduate students was identified. They were invited to complete the online survey via. Of the sample, 167 respondents attempted the survey and, of these, 101 had used e-textbooks. Of the 101 responses, 83 were usable. None of the respondents in the pilot had been involved in the earlier phases of the data collection process. The data from the pilot was not included in the final analysis. Factor loadings for scales were calculated with the aim of identifying any ambiguities or structural issues with the scales. Refinements were undertaken, including dropping off items and rewording.

4.4. Main study

The main study was conducted across the campuses of the two universities. The incentive for taking part was entry into a draw to win one of five $200 pre-paid charge cards. On one campus, a notification informing students of the survey (and the link to the online survey) was placed on the student portal for one month. At the other campus, students were invited to participate via posts on the learning management system. A total of 631 responses were received and, of those, 344 were usable.

5. Results

Table 1 provides the descriptive statistics of the sample. The sample is representative of a university student population, with 78% of respondents aged between 18 and 25 years. To participate in the survey, respondents must have used e-textbooks. All respondents had used at least one e-textbook over the last two years, with 52% having used four

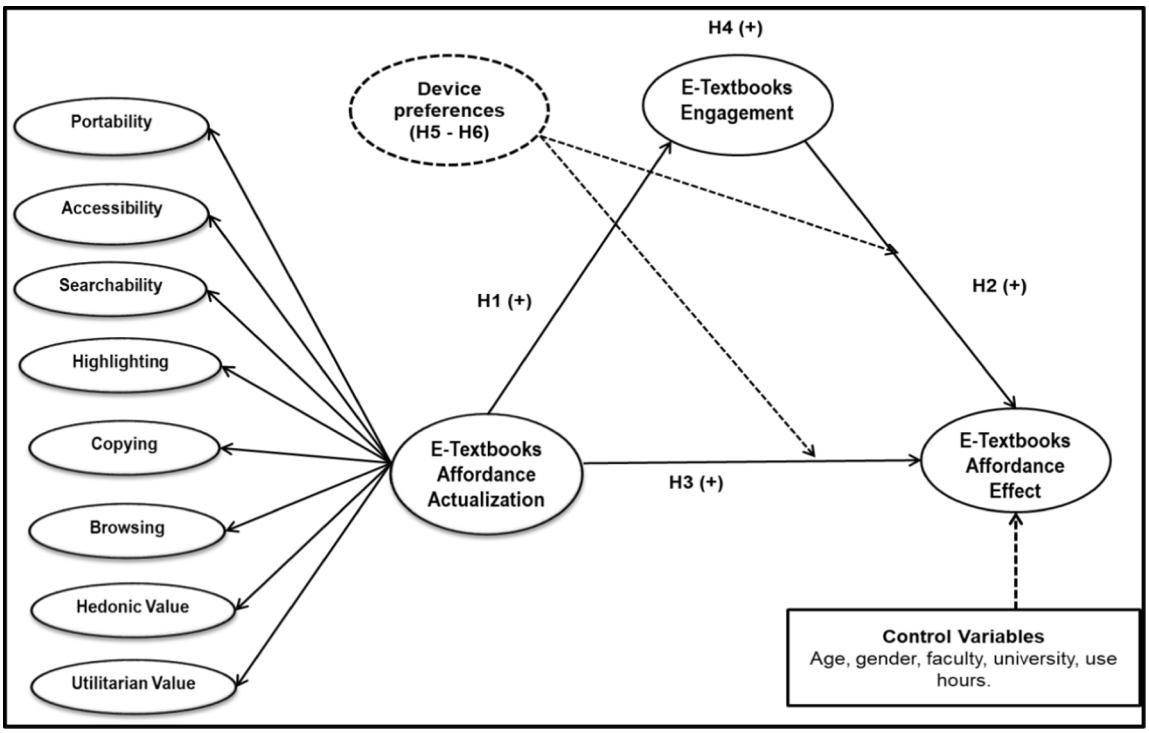

Fig. 3. The measurement model.

or more. Device use is indicative of IT usage on a daily basis, with 77% using a smart device for five hours or more per day. The majority of students owned a laptop computer (94%) and a smartphone (97%); therefore, it is reasonable to assume that access to devices is not an issue for this sample. Students preferred to read their e-textbooks on laptops, followed by tablets, with low preferences for reading on phones and e-readers.

5.1. Non-response bias and common method variance

The study addressed the issues of common method variance (CMV) as follows: (1) a comparison of the differences between the first 25% responses with the last 25% responses using a paired *t*-test – no evidence of non-response bias was found (Akter et al., 2017; Stanko et al., 2012); (2) a comparison of the profiles of the respondents (university type and faculty affiliation) – the results did not provide any evidence of non-response bias; (3) the introduction of negative items to ensure the reliability of scale and establish psychological distance through the separation of exogenous and endogenous constructs; and (4) the questionnaire was revised, including the wording, scale, structure and the re-ordering of confusing items, based on the findings of a pre-test with over 50 respondents.

To address the issue of statistical validity, we followed the guidelines of Podsakoff and Organ (1986) and applied Harman's single-factor test; the results did not find any factor with>30% of the variance. However, acknowledging the limitation of this technique in identifying small CMV (Lindell & Whitney, 2001), we used the marker variable technique to detect significant CMV (Malhotra et al., 2006) by introducing a weakly-related item in the SEM model. The findings did not provide any evidence of a significant relationship between the marker variable and other variables in the model, as the correlation coefficient was 0.086, with an average significance of 0.273 ($p > 0.05$).

5.2. Data analysis

The study applied the partial least squares (PLS) approach for structural equation modelling (SEM) using the repeated indicator approach proposed by Wetzels et al. (2009) and Becker et al. (2012). Using SmartPLS 3 (Ringle et al., 2015), the study estimated a higher-order reflective affordance actualisation model by repeatedly using the measurement items of portability, accessing, searching, highlighting, copying, browsing, hedonic value and utilitarian value. We opted for PLS-SEM because the objective of the study is to develop a new theory by exploring various dimensions of affordances. Additionally, PLS-SEM is suitable for higher-order modelling because it captures complex concepts in relatively simple abstractions (Afraz et al., 2021; Ferraris et al., 2021; Polites et al., 2011). Using a path weighting scheme for the inside approximation and a nonparametric bootstrapping (Chin, 1998; Efron, 1993; Tenenhaus et al., 2005), we estimated the measurement and structural model with 5,000 subsamples to obtain the statistical significance for the level of t-statistics (Hair et al., 2017).

5.3. Measurement model

The objective of the measurement model (illustrated in Fig. 3) analysis is to ensure reliability, convergent validity and discriminant validity through the identification of the correct indicators for the constructs. The findings in Table 2 show adequate reliability of the scales since all the loadings of the first-order model exceed 0.80, except one item of access, which is 0.735. These results are supported by composite reliability (CR) and average variance extracted (AVE), with all the first-order constructs exceeding 0.80 and 0.50 minimum threshold levels. To measure formative control variables, we used factor weighting to measure the reliability of the scale and estimated variance inflation factor (VIF) to check collinearity. To calculate the discriminant validity of all the constructs, we estimated $\sqrt{AVE}$ in the diagonals in Table 3, which adequately exceed the correlation coefficients (Chin, 2010; Fornell & Larcker, 1981). These findings are also confirmed by cross-loadings, which indicate that items of respective constructs are significantly correlated to them than to the others. In Table 4, the findings show the relationship between the hierarchical affordance actualisation construct and its sub-dimensions, as well as the hierarchical engagement construct. Since the model is reflective-reflective

Table 1
Descriptive statistics.

Variable and category	Frequency	Percent	Mean
Gender			
Male	152	44%	
Female	192	56%	
Age			
18–25	268	78%	
26–33	38	11%	
34–41	16	5%	
42–49	13	4%	
50 +	9	2%	
Number of e-textbooks used in last two years			
1	33	10%	
2	77	22%	
3	54	16%	
4	40	11%	
5	20	6%	
6	120	35%	
Device preference for reading e-textbooks			
(scale 1 – 7)			4.7
Tablet			3.0
Phone			5.4
Laptop			3.9
e-Reader			
Device ownership			
Desktop computer	172	50%	
Laptop	323	94%	
Tablet	199	58%	
Smartphone	334	97%	
e-Reader	63	18%	
Hours per day device use			
< 1	3	1%	
1 – 2	13	4%	
3 – 4	63	18%	
5 – 6	115	34%	
7 – 8	63	18%	
> 8	87	25%	
Number of years enrolled			
1	125	36%	
2	79	23%	
3	75	22%	
4	44	13%	
> 5	21	6%	
Enrolment			
Full-time	298	87%	
Part-time	43	13%	
Other	3		
Faculty			
Commerce/business	169	49%	
Engineering	57	17%	
Arts/social sciences	45	13%	
Science	26	7%	
Law	20	6%	
Medicine	14	4%	
Fine arts	4	1%	
Other	9	3%	
University			
Capital city	235	69%	
Regional	109	31%	

(Mode-A), affordance actualisation was manifested by its eight first-order dimensions; that is – portability (36%), accessing (48%), searching (42%), highlighting (44%), copying (38%), browsing (55%), hedonic value (46%) and utilitarian value (37%). Similarly, engagement was reflected by three sub-dimensions: vigour (96%), dedication (95%) and absorption (94%). According to the recent guidelines by Sarstedt et al. (2019), both the higher-order affordance actualisation and engagement constructs met the reliability (CR > 0.70, AVE > 0.50) and validity (HTMT < 0.90) criteria.

5.4. Structural model

The findings of the structural model are reported in Table 5 which presents the path coefficients (β) and the coefficient of determination (R^2). The findings provide a standardised path coefficient of 0.591 from affordance actualisation (AFAC) to engagement (ENGA) (H1), 0.622, from ENGA to affordance effect (AFEF) (H2) and 0.214 from AFAC to AFEF (H3). All these path coefficients are significant at $p < 0.05$, thus supporting H1–H3 (Chin, 2010). In Table 5 and illustrated in Fig. 4, we also evaluated the main model (m) with the interaction model (i) using an incremental F-test to investigate whether the inclusion of a moderating variable (i.e., device preferences) (DEPR) significantly enhances the R^2 for affordance effect (AFEF). The findings confirm a superior prediction power of the interaction model, which is reflected in AFEF ($\Delta R^2 = 0.032$, $f^2 = 0.085$, $p < 0.01$). According to the guidelines of Cohen (1988), the size of the moderating effect is small ($f^2 > 0.02$) but significant at $p < 0.05$. Similarly, we investigated the impact of control variables (COVA) on AFEF. However, the results show an insignificant impact of COVA as the R^2 change is very small after including this construct in the model.

In order to estimate the mediating effects of e-textbook engagement between affordance actualisation and affordance effects, we applied the

Table 2
Measurement model: Assessment of first-order, reflective model.

Reflective constructs	Items	Loadings	CR	AVE
Portability	PORT1	0.873	0.881	0.712
(PORT)	PORT2	0.845		
	PORT3	0.813		
Accessing	ACCS1	0.937	0.908	0.769
(ACCS)	ACCS2	0.942		
	ACCS3	0.735		
Searching	SEAR1	0.884	0.946	0.855
	SEAR2	0.951		
(SEAR)	SEAR3	0.938		
	HIGH1	0.917	0.913	0.778
	HIGH2	0.901		
	HIGH3	0.826		
Copying	COPY1	0.937	0.965	0.901
(COPY)	COPY2	0.949		
	COPY3	0.962		
Browsing	BROW1	0.857	0.847	0.651
(BROW)	BROW2	0.755		
	BROW3	0.866		
Hedonic value	HEVL1	0.939	0.957	0.882
(HEVL)	HEVL2	0.940		
	HEVL3	0.938		
Utilitarian value	UTVL1	0.939	0.967	0.908
(UTVL)	UTVL2	0.960		
	UTVL3	0.960		
Vigour	VIGO1	0.843	0.948	0.784
(VIGO)	VIGO2	0.888		
	VIGO3	0.945		
	VIGO4	0.927		
	VIGO5	0.818		
Dedication	DEDI1	0.915	0.958	0.883
(DEDI)	DEDI2	0.949		
	DEDI3	0.955		
Absorption	ABSO1	0.888	0.955	0.841
(ABSO)	ABSO2	0.919		
	ABSO3	0.935		
	ABSO4	0.925		
Affordance effect	AFEF1	0.913	0.934	0.740
(AFEF)	AFEF2	0.899		
	AFEF3	0.823		
	AFEF4	0.867		
	AFEF5	0.795		
Formative construct	Items	Weights	t-value	VIF
Device preferences	DEPR1	0.467	4.836	1.14
(DEPR)	DEPR2	0.493	6.033	1.12
	DEPR3	0.464	5.242	1.01
	DEPR4	0.194	1.907	1.20
Control variables	AGE	0.153	0.366	1.039
(COVA)	GEN	−0.130	0.294	1.022
	FAC	−0.612	1.310	1.060
	UNI	0.796	1.699	1.029
	HOUR	0.173	0.451	1.027

Table 3
Correlations and AVEs*.

	PORT	ACCS	SEAR	HIGH	COPY	BROW	HEVL	UTVL	VIGO	DEDI	ABSO	AFEF	COVA	DEPR
Portability (PORT)	**0.843***													
Accessing (ACCS)	0.68	**0.877***												
Searching (SEAR)	0.34	0.34	**0.925***											
Highlighting (HIGH)	0.21	0.34	0.35	**0.882***										
Copying (COPY)	0.28	0.30	0.29	0.32	**0.949***									
Browsing (BROW)	0.38	0.38	0.57	0.44	0.48	**0.807***								
Hedonic value (HEVL)	0.23	0.32	0.29	0.46	0.27	0.41	**0.939***							
Utilitarian value (UTVL)	0.24	0.37	0.25	0.30	0.30	0.29	0.39	**0.953***						
Vigour (VIGO)	0.21	0.32	0.22	0.47	0.26	0.38	0.47	0.39	**0.884***					
Dedication (DEDI)	0.18	0.31	0.24	0.45	0.25	0.33	0.43	0.36	0.47	**0.940***				
Absorption (ABSO)	0.15	0.28	0.11	0.41	0.20	0.27	0.40	0.34	0.42	0.45	**0.917***			
Affordance effect (AFEF)	0.19	0.28	0.27	0.47	0.29	0.43	0.48	0.32	0.41	0.44	0.48	**0.860***		
Control variables (COVA)	0.19	0.14	0.16	0.16	−0.02	0.05	0.04	−0.03	0.06	0.05	0.04	0.06	**N/A**	
Device preferences (DEPR)	0.12	0.24	0.20	0.37	0.26	0.32	0.46	0.28	0.49	0.46	0.48	0.54	**N/A**	**N/A**

* Square root of AVE on the diagonals.

Table 4
Higher-order model.

Models	Latent constructs	β	t-stat
Affordance actualisation (AFAC)	Portability (PORT)	0.603	12.830
	Accessing (ACCS)	0.693	18.252
	Searching (SEAR)	0.647	15.950
	Highlighting (HIGH)	0.661	20.505
	Copying (COPY)	0.613	13.900
	Browsing (BROW)	0.743	27.739
	Hedonic value (HEVL)	0.680	17.152
	Utilitarian value (UTVL)	0.606	13.774
e-Textbook engagement (ENGA)	Vigour (VIGO)	0.956	148.610
	Dedication (DEDI)	0.947	177.793
	Absorption (ABSO)	0.936	115.658

bootstrapped-based sampling distribution effects with a 95% of confidence interval using the guidelines of Preacher and Hayes (2008) and Hayes et al. (2011). The indirect effect is 0.367, which is the product of the path coefficients from AFAC to ENGA and from ENGA to AFEF significant at $p < 0.01$ (Table 4). The results show the significant partial mediating effect of e-textbook engagement between affordance actualisation and affordance effects (Hair et al., 2017).

Overall, the model explained around 35% of the variance for e-textbook engagement and 59% of the variance for affordance effects. As hypothesised, the results confirm that affordance actualisation has a significant direct impact on affordance effects and indirect impact through e-textbook engagement. e-Textbook engagement was found as a significant partial mediator between AFAC and AFEF ($\beta = 0.367$, t-value = 10.39), as outlined in Table 6. The study also calculated Stone–Geisser's Q^2 value as part of nomological validity, which confirmed adequate predictive validity of the research model as they varied between 0.24 and 0.41.

6. Summary of findings

Drawing on affordance theory, this study investigated the research question: How does affordance actualisation influence e-textbook engagement and affordance effects? To answer this research question: (1) we explored the components of affordance actualisation by developing a hierarchical model and then (2) modelled its impact on e-textbook engagement and affordance effects. The findings, based on 344 university students in Australia, confirm all the proposed hypotheses. More specifically, the findings show that portability (36%), accessing (48%), searching (42%), highlighting (44%), copying (38%), browsing (55%), hedonic value (46%) and utilitarian value (37%) are key components of e-textbooks actualisation. The higher-order affordance actualisation construct was proven to be a significant predictor of e-textbook engagement ($\beta = 0.591$) and affordance effect ($\beta = 0.214$). Similarly, e-textbook engagement was found to be a significant predictor of affordance effect ($\beta = 0.622$), with an overall $R^2 = 0.590$.

7. Discussion and conclusion

This paper contributes towards the call for quantitative approaches to investigating affordance theory and e-books adoption and use (Bernhard et al., 2013; Volkoff & Strong, 2018; Wang et al., 2018). We adopted a methodology that utilises qualitative techniques to develop scales for affordance actualisation and affordance effect, and then tested these scales in a quantitative causal model. To the best of our knowledge, this is the first attempt at such an analysis. The context of our study

Table 5
Results of structural model.

Main effects model	Path coefficients (β)	Standard error	*t*-statistic	R^2	f^2
AFAC → ENGAG	0.591	0.044	13.254	0.349	*n.a.*
ENGAG → AFEF	0.622	0.044	14.373	0.590	
AFAC → AFEF	0.214	0.046	4.783	0.590	
Interaction model	**Path coefficients (β)**	**Standard error**	***t*-statistic**	R^2	$f^2 = \frac{R_i^2 - R_m^2}{1 - R_i^2}$
DEPR → AFEF	0.187	0.044	4.212	0.622	***=0.085***
ENGA*DEPR AFEF	−0.082	0.026	3.094		*(Here, i = interaction model, m = main effect model)*
AFAC*DEPR AFEF	−0.060	0.02	2.670		
Control model	**Path coefficients (β)**	**Standard error**	***t*-statistic**	R^2	$f^2 = \frac{R_c^2 - R_m^2}{1 - R_c^2}$
COVA AFEF	−0.002	0.06	0.03	0.592	***=0.004***
					(Here, c = model with control variables, model, m = main effect model)

is the use of e-textbooks by tertiary students in Australia. e-Textbooks are a significant resource used by students, as well as an emerging information technology that fits the current trend of moving much of learning content online (Ferraris et al., 2020). The extant literature on e-textbooks indicates that current students prefer print textbooks but, at the same time, appreciate the attributes of e-textbooks that enable them to read and study any place and any time. A significant theme emerging from the extant literature is that of the advantages and disadvantages of both media (print and digital). This perception by students of the advantages and disadvantages (as well as preferences) of the media, lends itself to an affordance perspective. Users do perceive e-textbooks as offering several affordances that enable studying in certain contexts that otherwise would not be convenient or possible with print textbooks. This justifies the affordance lens that was used in this study. Our analysis does uncover affordances of e-textbooks that have a positive effect on study outcomes: portability, accessing, searching, highlighting, copying, browsing, hedonic value, and utilitarian value (cost). These affordances are not new in the broad context of textbooks; however, they do indicate the affordances of e-textbooks that students find valuable and that contribute to their learning.

Using the principles of Volkoff and Strong (2018) and the theoretical approaches of Bernhard et al. (2013), we theorise affordance actualisation and affordance effect. In this study, affordance actualisation is the usage of the eight affordances listed above. We theorise the affordance effect as a consequence of affordance actualisation and measure affordance effect as the effect on students' perceived academic performance. We also extend affordance theory by positioning engagement as a significant construct in educational contexts (Liu et al., 2022; Wang et al., 2018). Our findings on e-textbook engagement indicate that the actualisation of affordances of e-textbooks will have a positive effect on the construct affordance effect as well as having a mediating effect on the dependent variable. Our results indicate that e-textbook engagement is a partial mediator between affordance actualisation and affordance effect, demonstrating that engagement with e-textbooks and their platforms can improve learning outcomes for students. Extending this stream of research (e.g., Gerhart et al., 2015; D'Ambra et al., 2020), our findings on e-textbook engagement reflect that students' perceptions of the degree of vigour (mental resilience), dedication (enthusiasm) and absorption (concentration) will holistically influence the perception between e-textbook affordance actualisation and e-textbook affordance effects.

A key practical benefit of this study is that e-textbook developers can focus on the following properties: portability, accessing, searching, highlighting, copying, browsing, hedonic value, and utilitarian value (cost) in designing and marketing e-textbooks. These affordances indicate that e-textbooks should be developed for a broad range of academic activities, including multimedia enhancements, video slide modules and interactive value-cocreating activities that are particularly relevant in an increasingly digitized service industry such as higher education (Mariani & Borghi, 2019). According to Rai and Selnes (2019, p.8) "Schools and

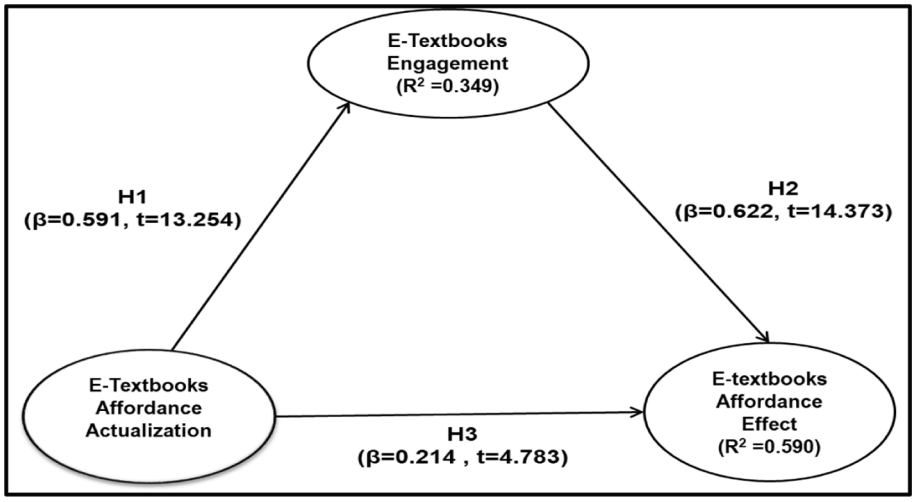

Fig. 4. Main effects model.

Table 6
Results of the mediation testing.

	Direct effect	95% C.I.	t-value	Significance ($p < 0.05$)	Indirect effect	95% C.I.	t-value	Significance ($p < 0.05$)
AFAC- AFEF	0.214	0.13–0.31	4.704	0.000	0.367	0.30–0.44	10.39	0.00

universities need to set precise goals for what students should learn and must develop a clear understanding of how the different set of learning activities contribute to achieve the learning objectives. When this is clear, managers can search for digital learning technologies that fit the different sets of learning activities; this will improve their students' actual learning." Our findings indicate that the actualisation of e-textbook affordances and their effects are largely dependent on digital engagement perceptions of e-textbooks by consumers. Furthermore, our findings on the moderating effects of device preferences suggest that the type of device influences the relationship between perceived affordance actualisation and perceived affordance effect. Our findings show that students preferred smart devices with a screen size larger than that of a smartphone (e.g., tablets, laptops and desktops). This finding might help e-textbook developers to recommend optimum screen sizes to improve the learning process. Overall, digital transformation of the higher education sector can make a significant difference in a post-COVID era if e-textbook designers focus on various affordance actualisation properties, strong engagement and learning outcomes.

8. Limitations and future research

The work reported in this paper is exploratory and requires further validation. The constructs and related scales need to be tested to a greater extent so that the scales can be used with confidence in future research. As the context of the study is e-textbooks, the approach and constructs should be applied in other contexts, thereby testing the robustness and efficacy of the constructs and approaches. Theoretically, our research findings can pave the way for exploring task-technology fit, usability, and expectation-confirmation theories in the digital transformation of the higher education context. Methodologically, experiments can be conducted using various features of e-textbook to understand more of the embedded causality of digital learning technology use and engagement.

CRediT authorship contribution statement

John D'Ambra: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Shahriar Akter:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Marcello Mariani:** Writing – review & editing, Writing – original draft, Validation, Project administration, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1

The framework from Bernhard et al. (2013, p.7) illustrated by e-textbooks and e-readers:

Construct	Dimensions	Description
Object	Properties with causal potential to incur effects	An object employed by an individual in goal-directed activity
User	Goal	An individual who employs an object to perform a goal-directed activity
	Expertise	
Information about affordance	Symbolic expressions	The communicative possibilities of an object for a user
	External information	Information about affordances from a source other than the object itself
Affordance perception	Degree of correct/false perception	The perception of a possibility for goal-oriented action afforded by an object for a user
Affordance actualisation	Cognitive absorption	The actualisation of a possibility for goal-oriented action afforded by an object for a user
	Deep structure usage	
Actualisation effort	Cognitive load	The degree of difficulty related to actualising an affordance
Effect	Positive/negative use effects	The outcomes attributed to the actualisation of an affordance

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