Interactive E-Texts and Students: A Scoping Review

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Abstract

The purpose of this article is to explore the scope of available evidence regarding the use of interactive e-texts and their relationship to student learning experiences in post-secondary education. Following the framework of Arksey and O'Malley, this scoping review identified and reported on 33 articles. Study characteristics are presented alongside four themes that were found across the included articles: (1) the effect of interactive e-texts on student learning experiences; (2) the relationship between interactive e-texts and academic performance; (3) factors influencing student adoption and experience of interactive e-texts; and (4) roles, responsibilities, and recommendations. While the adoption of interactive e-texts is becoming increasingly common in post-secondary education, their effect on student learning experiences remains complex. This review emphasizes the importance of user-friendliness, affordability, accessibility, portability, and the role of educators. Using interactive e-texts shows promise, though future research should explore how barriers might be minimized and benefits might be maximized to have the strongest impact on student learning experiences.

Keywords: interactive e-text, student experience, scoping review, post-secondary education

Résumé

L'objectif de cet article était d'explorer l'étendue des connaissances disponibles sur l'utilisation des documents numériques interactifs et leur relation avec les expériences d'apprentissage des étudiants à l'enseignement supérieur. Suivant le cadre de l'étude d'Arksey et O'Malley (2005), cet examen de l'étendue des connaissances nous a permis de repérer et d'analyser 33 articles. Les caractéristiques de l'étude sont présentées selon quatre thèmes retrouvés dans les articles consultés : (1) l'impact des documents numériques interactifs sur les expériences d'apprentissage des étudiants; (2) la relation entre les documents numériques interactifs et les résultats scolaires; (3) les facteurs influençant l'adoption des documents numériques interactifs et les expériences d'utilisation par les étudiants; et (4) les rôles, les responsabilités et les recommandations. Tandis que l'utilisation des documents numériques interactifs devient de plus en plus fréquente au postsecondaire, leur impact

sur les expériences d'apprentissage des étudiants demeure complexe. Cet article souligne l'importance de la convivialité, du coût, de l'accessibilité, de la portabilité et du rôle des enseignants. Puisque l'utilisation de documents numériques interactifs est prometteuse, de futures recherches devraient explorer comment les obstacles pourraient être réduits au minimum et les avantages maximisés pour permettre le meilleur impact possible sur les expériences d'apprentissage des étudiants.

Mots-clés : documents numériques interactifs, expérience étudiante, étendue des connaissances, éducation postsecondaire

Introduction

Technology is changing the landscape of post-secondary education by influencing both the ways in which students learn and engage with content, and the kinds of content students engage with (Tretinjak et al., 2014). Providing students with the opportunity to choose how they want to engage with course material has long been established as vital to promoting self-directed learning, which is critical for knowledge improvement (Knowles, 1975). Research has shown that teaching strategies that are active and engaging provide post-secondary students with the necessary tools to self-learn (Pratt et al., 2006). Traditional authoritarian paradigms of teaching that focus on memorization and repetition through static course materials are not meeting the needs of the modern post-secondary student (Pratt et al., 2019; Skiba & Barton, 2006). As such, high-quality post-secondary programs should include interactive teaching and learning opportunities for students (Haworth & Conrad, 1997).

Advances in technology such as online learning resources, multi-media platforms and digital textbooks now enable students to choose when, where, and how to study, facilitating individualized and effective engagement with course material (Numer & Spencer, 2015; Tretinjak et al., 2014; van Dusen, 1996). For example, students reported course learning was more interesting and effective when social media and interactive technology were used to deliver and support course content (Tretinjak et al., 2014). Student engagement with course material both in and outside of the classroom was also reported to improve when using bring-your-own-device technology (Numer & Spencer, 2015). The present learning environment is a blend of the physical campus and online learning mediums (Percival & Muirhead, 2009). As a result, it is crucial that educators adapt to the changing technology-informed environment by seeking out innovative methods to use technology to promote holistic engagement with course materials (Numer & Spencer, 2015; van Dusen, 1996).

The use of technology in post-secondary education is becoming increasingly diverse, with various teaching and learning technologies widely available. In particular, digital textbooks, or e-textbooks, have been gaining traction and growing in popularity (Chulkov & VanAlstine, 2013). E-texts are often less expensive than traditional print textbooks and alleviate the burden of carrying around heavy books. E-texts, like other technologies, have been explored as a cost-effective way to engage students in post-secondary contexts (Tremblay, 2010). Potential benefits of e-texts include the ability to search and annotate within text and to integrate media that supports student accessibility needs and a

variety of learning styles (Chulkov & VanAlstine, 2013). For educators and institutions, the use of e-texts provides significant advantages over the use of traditional print textbooks in that they are easier to update and keep current and allow for the tailoring of content to the specific needs of the instructor, course, or students (Chulkov & VanAlstine, 2013).

Despite the potential benefits of e-text usage, challenges have also been identified. Evidence suggests that some students have expressed a lack of comfort and familiarity in using e-texts and there are technological challenges regarding the need to access the internet (Chulkov & VanAlstine, 2013). The ease of navigating e-text features and formats has also been noted as a potential challenge, as the difficulty of navigating e-text platforms, compounded with students' technical abilities, may impede usability (Stone & Baker-Eveleth, 2013). When students are provided with traditional textbook and e-text versions of the same text, factors influencing student adoption of one format over the other include ease of purchasing, student personal preferences, and the ability to keep the book after the semester (Chulkov & VanAlstine, 2013; Daniel & Woody, 2013; Shepperd et al., 2008).

Interactive learning strategies are now well understood to encourage independent study through the use of computer technology and electronic media (Panitz, 1999). Interactive learning methods engage both the intellect and emotions of learners by deepening the relationship between the learner and the content as a form of active learning (Bonwell & Eison, 1991; Lease, 2016; Yale Poorvu Center for Teaching and Learning, 2018). The benefits and challenges of e-texts vary from student to student, institution to institution, and e-textbook to e-textbook. Analyses to date, however, have not differentiated between e-textbooks and interactive e-textbooks. Within e-textbooks, interactivity refers to students' ability to manipulate their text and engage with embedded media and interactive features (Baldwin, 2015). The ability to engage students and measure learning outcomes throughout the course can be a direct benefit of interactive e-textbooks (Baldwin, 2015). Despite the benefits of interactivity for student learning, e-texts have only recently begun incorporating interactive components to enhance students' experiences (Baldwin, 2015).

It remains unclear how interactivity relates to student adoption of and learning experiences with e-textbooks. To date, the scope of literature regarding the effectiveness of interactive e-textbooks in post-secondary classrooms has not been evaluated. Therefore, the purpose of this article is to explore the existing evidence regarding the use of interactive e-textbooks, and their relationship to student learning experiences in post-secondary education. Throughout this article, we will refer to interactive e-textbooks as *interactive*

e-texts, defined as electronic textbooks that have an embedded interactive component such as videos, audio, quizzes, tools, and/or learning modules that offer the potential to go beyond traditional textbooks by practising active learning, problem solving, critical thinking, and connecting to previous knowledge.

Methods

This study employed a scoping review design, which is used to assess the available "scope" of evidence or literature on a particular topic (Arksey & O'Malley, 2005). Scoping studies are useful for exploring the breadth of published literature on broad, emerging, complex, or understudied areas of interest (Arksey & O'Malley, 2005). Scoping reviews tend to explore breadth, rather than depth, and typically do not assess quality of evidence. Instead, they assess the availability of literature, and often identify gaps for future research (Arksey & O'Malley, 2005). For this review, we employed a rigorous scoping review methodology conducted in alignment with the Arksey and O'Malley (2005) staged framework, each stage of which is detailed below. Due to a noted shift from paper to digital textbooks in the post-secondary environment, the selected research question was: *What is known from the existing literature about the experiences of post-secondary students using interactive e-texts?* More specifically, we were interested in literature exploring interactive e-texts and their influence on the learning experiences of university students.

Identifying and Selecting Relevant Studies

Our search strategy was developed in consultation with a medical librarian at the Maritime SPOR Support Unit, and an Educational eLearning Developer from the Dalhousie University Center for Learning and Teaching. Our search strategy (visible as Table 1) included the following terms: interactive text*, e-text*, electronic text*, student, post-secondary, undergrad*, learning, and experience. The strategy identified studies from the ERIC, Scopus, CINAHL, MEDLINE and Academic Search Premier databases. Inclusion and exclusion criteria were developed iteratively as searches were conducted and familiarity with the literature was developed (Arksey & O'Malley, 2005). The iterative process continued through study selection, which occurred at progressive depth, beginning with title and abstract screening and progressing to full text screening (Arksey & O'Malley,

2005); studies were excluded by title or abstract if it could be determined that they did not meet inclusion criteria. Each study was screened by two reviewers for consensus at each level. A third person resolved all conflicts that could not be addressed by the two reviewers.

Table 1. Search strategy

1	TI ("interactive text*" OR "e-text*" OR "electronic text*" OR "digital text*" OR "online text*" OR "digital content" OR "digital learning object*") OR AB("interactive text*" OR "e-text*" OR "electronic text*" OR "digital text*" OR "online text*" OR "digital content" OR "digital learning object*")
2	TI(interactive N/2 ("e-book*" OR ebook* OR "electronic book" OR "digital book") OR AB(interactive N/2 ("e-book*" OR ebook* OR "electronic book" OR "digital book")
3	1 OR 2
4	TI (student* OR undergrad* OR university OR college OR postsecondary OR "post-secondary" OR learner*) OR AB(student* OR undergrad* OR university OR college OR postsecondary OR "post-secondary" OR learner*)
5	TI (learning OR outcome* OR experience* OR engage* OR comfort* OR confiden* OR attitude* OR percept* OR independ* OR participat* OR opinion* OR interact* OR competen* OR performance* OR achiev*) OR AB(learning OR outcome* OR experience* OR engage* OR comfort* OR confiden* OR attitude* OR percept* OR independ* OR participat* OR opinion* OR interact* OR competen* OR performance* OR achiev*)
6	3 AND 4 AND 5

We included studies published in English between January 1, 2008 and August 2, 2018 (when the search was conducted) that discussed any form of interactive e-text and outcomes relating to post-secondary student experiences. Given the ever-changing nature of technology, a period for inclusion was set at 10 years. Studies were included if they described interactive e-texts in relation to student learning experiences. We included studies focused on undergraduate, graduate, and professional student experiences, from post-secondary schools, in any jurisdiction, using any type of methodology. Studies were excluded if they were published prior to 2008, were focused on elementary, secondary, vocational, or trade schools, or did not have student experience as a primary outcome or phenomenon of interest. Studies were also excluded if they did not focus on the use of interactive e-texts, or the purpose of interactivity was to support students with identified disabilities or specific accessibility needs. Primarily, studies were excluded on the basis that the digital element was not integrated into an interactive textbook. Rather, many excluded studies explored educational technologies such as the use of virtual labs, learning platforms, learning management systems, augmented reality, print/paper textbooks with embedded digital mechanics,

massive online open classrooms, digital or interactive resources not integrated into the e-text (including online quizzes), e-libraries, e-readers, or video games.

Interpretation, Synthesis, and Reporting

Data from each article selected for analysis were extracted and charted (Arksey & O'Malley, 2005). Data were charted, using Microsoft Excel, by one research assistant and checked by a second. Arksey and O'Malley's (2005) descriptive-analytical approach to extraction was used as a framework for extracting and charting demographics and thematic data. Themes were developed and drafted by two reviewers through the iterative analysis process and thematic analysis procedures guided by the methods of Braun and Clarke (2006). Each reviewer conducted open inductive coding of the charted data to note and label key findings, trends, and commonalities. Reviewers then came together to discuss themes and trends, which were refined and finalized by the lead author.

Results

Search Outcome

Through the database search, a total of 3,209 studies were identified; 722 duplicates were removed, resulting in 2,487 studies screened. Screening at the title and abstract level resulted in the exclusion of 2,262 studies; 225 studies were thus assessed as full text. In total, 192 studies were excluded during full text screening, resulting in 33 articles selected for inclusion in this scoping review. This process is visible in Figure 1, while Table 2 presents a summary of the charting details. While 10 years of research were reviewed, the majority of studies (26) occurred in the most recent five years. Also, though studies were included from a variety of countries, including Argentina, China, Saudi Arabia, and Turkey, the majority (26) occurred in the United States of America and included a variety of university settings.
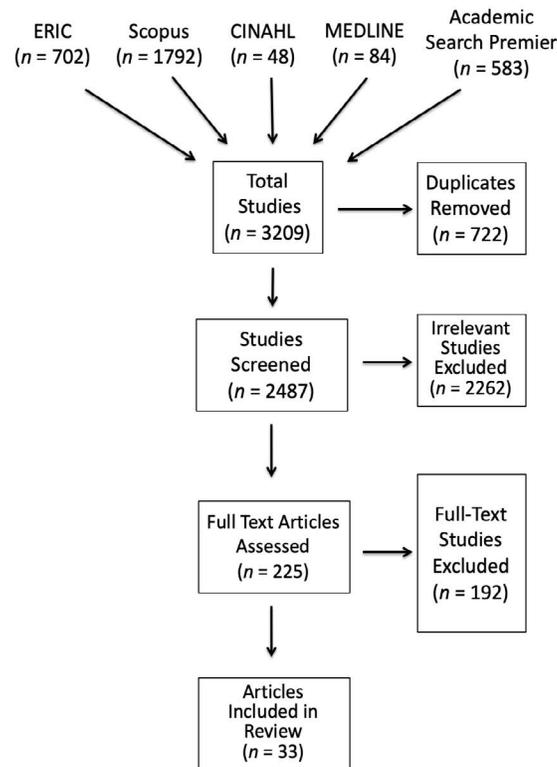
Figure 1. Search outcome

Studies also used a variety of research approaches, though the majority used quantitative (19) or mixed methods (13) techniques. Many studies (17) did not identify a theoretical framework; among those that applied theory, the most common included theories of acceptance (6), cognitive theory (4), and theories of innovation (2). The average sample size of the included studies was 353 students. Using a thematic analysis and a descriptive-analytical approach, four themes were developed and are presented below, referencing examples from the articles included in the review.

Table 2. Articles assessed for this study

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Alshaya & Oyaid (2017); Saudi Arabia.	To assess students' perceptions of the effectiveness of e-books and self-efficacy in their use.	Female university students of Princess Nourah University ($n = 44$).	Quantitative: Following a pilot survey of faculty members, questionnaires were conducted with students on e-book design, effectiveness, and self-efficacy.	Participants had necessary self-efficacy and competence to use interactive e-books, found them to be effective, and wanted to use them in the future.
Asensio, Barassi, Zambon & Mazza (2010); Argentina.	To test undergraduate students' performance while using an interactive textbook.	Undergraduate students in a course on chemical reaction engineering at University of Comahue, Argentina ($n =$ not specified).	Quantitative: To evaluate student experience with an interactive text using closed surveys and an evaluation test.	There was a significant degree of acceptance regarding the interactive text. Course grades were higher when using the e-textbook compared to students using a traditional textbook.
Baek & Monaghan (2013); United States.	To understand students' experiences using et-textbooks, and variables that impact their experiences, perceptions, and attitudes towards e-textbooks.	Students from five state university campuses from a total of 33 courses ($n = 662$).	Quantitative: Survey research design and sampling methodology. The questionnaire was available electronically on SurveyMonkey and consisted of 30 questions.	More than one-third of the students were satisfied with the e-textbook; more than half of the students felt that the e-textbook was easy-to-use; older students (22 or older) tended to have more positive experiences with the e-textbook than younger students; and students most liked the e-textbook's cost, accessibility, light weight, and keyword search features.
Birdsong, Chen, Tseng & Victornio (2015); United States.	To examine the implementation and effectiveness of online textbooks in three different undergraduate engineering courses.	Undergraduate students enrolled in three undergraduate engineering courses at California Polytechnic State University ($n = 220$).	Mixed methods: Analyzed student survey responses using both Likert and open-ended questions conducted at three time points in the academic quarter.	Online textbooks hold promise for improving student engagement and learning, increasing access, and decreasing cost. However, publishers have much work to do to gain the acceptance of students, who are rejecting online textbooks due to lack of perceived ease of use or usefulness.
Bolsen, Evans & Fleming (2016); United States.	To compare online and face-to-face approaches to teaching a university level course.	Students enrolled in an introduction to American Government course at Georgia State University ($n = 1,542$).	Quantitative: Quasi-experimental design. Students were placed in one of four conditions: Traditional (traditional textbook and lecture) Breakout (traditional textbook and group discussions), Blended (e-textbook and two lectures), and Online (e-textbook, two lectures, and online assignments). Students completed pre and post-tests and exit surveys.	Found that mode of course delivery is significantly related to student academic engagement and performance. Students enrolled in sections that were assigned the interactive online textbook rated their textbook as significantly more beneficial to their learning experiences than students who were assigned the traditional paper textbook.

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Chaudhri, Cheng, Overtholtzher, Roschelle, Spaulding, Clark& Gunning (2013); United States.	To assess student use of artificial intelligence within an e-textbook and determine useful-ness of enhancements.	Students enrolled in an introductory biology course at a community college (*n* = 72).	Mixed Methods: Students were randomly assigned to one of three conditions, Full Inquire Biology group (e-text with all AI-features). Textbook group (traditional textbook) and ablated biology group (e-textbook that lacked AI features but had other e-text features). Used student surveys and homework and test scores.	Test results of students in the inquired biology group were higher than students within the other two groups using the same textbook. Students reported the interactive text to be motivating, engaging, and increase learning.
Coffin Murray & Perez (2011); United States.	Compare student perfor-mance in two sections of an online course, one using an e-textbook and the other using a paper-based textbook.	Students from a variety of majors enrolled in an infor-mation technology literacy course (n = not specified).	Quantitative: Compared student per-formance on course assessment.	There was no significant difference in student performance.
Daniel & Woody (2013); United States.	Examine differences in learning and differential usage that result from using a variety of print and electronic textbook modes in both lab and more naturalistic con-ditions.	University students in an introductory psychology course (*n* = 298).	Quantitative: Recorded quiz scores, reading time, motivation, and percep-tions of textbook features.	Students performed similarly on a quiz across all conditions; reading times were higher for elec-tronic text in the lab and even greater at home; and students reading electronic text at home reported higher levels of multitasking.
DeNoyelles & Seilhamer (2013); United States.	Understand how instructors and learners are integrating e-text-books to revolutionize learning spaces.	Students in 84 courses at the University of Central Florida (*n* = 933).	Mixed methods: A university-wide student survey was distributed to students.	In a university setting without an e-textbook initiative, e-textbook use is relatively low, and the features are not being effectively utilized by stu-dents or instructors. In any university that offers e-textbooks, instructor development is critical.
Dobler (2015); United States.	To better understand issues surrounding the use of e-textbooks for teaching and learning.	Pre-service teachers in a language arts methods course (*n* = 56).	Mixed methods: Students received a print and e-textbook for the course and asked to complete a pre and post-reading questionnaire, share e-notes, and participate in a follow-up focus group.	Some participants described an increase in cogni-tive engagement due to the ability to both utilize e-textbook features and engage with media, in ad-dition to text. Others found the process of reading an e-textbook challenging because of distractions on their device, eyestrain, and a feeling of being overwhelmed with choices. Overall the preser-vice teachers expressed a preference for choice between using print, electronic format, or both.

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Dwyer & Davidson (2013); United States.	To examine student preferences for textbooks, reading, and learning.	Undergraduate students enrolled in a public speaking course at a larger state university in the Midwest (*n* = 321).	Quantitative: Online survey that consisted of three demographic items and 14 survey items.	Neither reading the paper textbook nor the e-textbook was a predictor of grade, but comfort in accessing the e-textbook through the online portal was associated with grade. Many students reported strong preferences for paper textbook usage and indicated several reasons for not liking or not using the e-textbook, such as inconvenience, eye strain, and difficulty taking notes.
Ebied & Rahman (2015); Saudi Arabia.	Examine the effect of interactive e-book on students' achievements.	Undergraduate students at Najran University registered in a computer in education course (*n* = 60).	Quantitative: Quasi-experimental study design. Students divided into experimental group (e-textbook) and control group (printed text).	Significant difference between groups, with greater academic achievement for the experimental group/students who studied using the e-textbook.
Feldstein, Martin, Hudson, Warren, Hilton & Wiley (2012); United States.	To describe how open-textbooks provide benefits to students.	Students enrolled in nine core courses at Virginia State University school of Business (*n* = 315).	Quantitative: University replaced traditional textbooks with an open-textbook format, a survey was sent to students enrolled in courses adopting the new format at the end of the semester.	Students enjoyed the open-textbook and preferred it to print resources, found it easy to read, enjoyed the interactive features, but did not find the videos contributed to their learning.
Huang, Chen & Ho (2014); China.	Analyze how presentation methods and concept maps interact with cognitive load and learning outcomes.	Undergraduate and graduate students in varying disciplines (*n* = 78).	Quantitative: Compared three presentation methods and used scales to measure cognitive load and learning outcomes.	Providing concept maps not only reduced learners' cognitive load but also enhanced their learning outcomes of cognition, affection, and psychomotor performance. Overall, video was superior to text and diagram interaction in terms of learning outcomes, and text and diagram interaction were superior to text and diagram without an interactive component.

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Liberatore (2017); United States.	Evaluate usage of a new interactive e-textbook (zyBook) and related student outcomes.	Undergraduate students enrolled in a material and energy balances course at the University of Toledo (n = 100).	Mixed methods: Generated textbook data on student participation, quantitative web book participation data, and surveys measuring students' opinions.	Overall, 87% of the zyBook was read across all sections and students in the course. The average zyBook participation grades correlated with final course grades. Student surveys found strong support for almost all of the zyBook's features, especially the animations. Over 90% of students reported that they viewed at least one animation more than once. Finally, 87% of students found the zyBook to be a useful textbook for the course, which was higher than previous electronic books used for the course.
McDaniel & Daday (2018); United States.	Examine students' perceptions of e-texts for 100 and 200 level biology courses.	Undergraduate students enrolled in six 100 and 200 level biology courses (n = 2,152).	Quantitative: An online questionnaire was developed and administered in multiple sections of six 100 and 200 level biology courses.	Black students reported a significantly higher satisfaction with e-texts compared to white students; students with lower grade point averages significantly preferred the e-text; and the majority of students perceived the use of value-added technologies, such as e-homework, favourably.
Mills (2016); United States.	Determine how graduate pre-service teacher education students perceive the interactivity, engagement, and value of customized course e-texts.	Graduate students enrolled in a teacher certification program at a medium-sized mid-Southern regional university in the United States (n = 115).	Quantitative: Quasi-experimental study. Students were separated into a treatment (multi-touch e-book) and control (Kindle or PDF version of the same e-text, with no embedded videos or multi-touch components), and completed surveys on their experience.	Users of the multi-touch e-text reported a significantly more interactive and engaging experience with their text than the other e-text users. The experiment also revealed that students overwhelmingly preferred a free, customized open-access text for use in their course, no matter what e-text format was used.
Morris & Lambe (2017); United Kingdom.	To assess the role for multimedia interactive e-books in bioscience laboratory classes.	Second year students in a biomedical science undergraduate course at the University of Leeds (n = 39).	Mixed Methods: Experimental design that grouped students into a trial and control group. Data collection involved weekly surveys including quantitative and qualitative responses.	Students made extensive use of e-books and over 70% of students agreed that the e-books were beneficial for learning. Less than 40% of students, however, indicated a preference for e-books over traditional paper textbooks, and e-books had no statistically significant effect on assessment of marks.

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Nagra, Eng & Karrass (2013); United States.	Determine if interactive and embedded features within e-texts aid in learning mathematic concepts.	Students enrolled in an introductory statistics course or a service math course for elementary school teachers ($n = 83$).	Mixed methods: One section of the statistics course used a traditional text while the other used an e-textbook. The elementary school math course used both a traditional and an e-textbook. Used student pre and post-tests and focus groups.	E-textbook group had the highest average of all groups and the most interest in course content. The bundled group liked the e-textbook more than the traditional text. Students disliked reading from the e-textbook but enjoyed the interactive features.
Ngafeeson & Sun (2015); United States.	To examine the role of technology innovativeness (people's openness to new technology) in determining students' acceptance of e-textbooks.	Undergraduate college students enrolled in courses that adopt e-textbooks ($n = 158$).	Quantitative: One section of the class used traditional print textbooks; the second section used an e-textbook. A survey was implemented using 5-point Likert scale measure.	Their findings suggest that students' willingness to try new technology has a direct positive impact and indirect influence on intention to use e-textbooks. The amount of exposure to a given technology can moderate technology acceptance, adoption, and use.
Novak, Daday & McDaniel (2018); United States.	Explore student preferences with regard to using an e-text compared to printed materials.	Undergraduate biology students ($n = 1337$).	Quantitative: Online questionnaire, which included e-text cognitive load questions and questions about their preference and attitudes toward e-textbooks.	They established an instrument that discerns extraneous (EL) and intrinsic load. They also found that students do not strongly prefer e-texts to printed textbooks, and find reading off a screen and manipulating e-texts creates additional sources of EL.
O'Bannon, Skolits & Lubke (2017); United States.	Examine achievement when an interactive textbook is used in place of lectures, and the benefits and challenges of using an interactive text as an educational tool.	Pre-service teachers enrolled in a technology course at a large research-intensive university in the southeastern United States ($n = 57$).	Mixed methods: Pre and post-exam scores, online survey responses, blog posts, and focus group responses produced the data for this study.	There was a significant difference in the achievements of students who received instruction delivered through the use of the interactive textbook versus those who received lecture instruction. Additionally, participants indicated the interactive textbook provided a new way of learning, motivated them to learn, made learning more exciting, increased their attention toward instruction, was more efficient, and increased their interest in class.

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Peterson (2017); United States.	To explore how a modification of the Technology Acceptance Model (TAM) – assessing usability (ease of use) and perceived usefulness of specific features – affects overall use of electronic textbooks.	Undergraduate students enrolled in a general psychology course ($n = 100$).	Quantitative: Participants reported frequency of use, perceived usefulness and usability for each of the eight e-textbook features chosen for evaluation.	Advanced e-text features such as highlighting, annotating and linking to external information are among the least usable features available and thus less likely to be used. Results support the conclusion that usability of electronic textbooks must be improved before they will be a viable alternative to print textbooks.
Raynor & Iggulden (2008); United Kingdom.	Evaluate the effectiveness of using an online interactive e-book to deliver anatomy and physiology teaching.	Undergraduate and graduate university students ($n = 101$).	Mixed methods: Questionnaires, observations, and interviews.	Found that undergraduate students enjoyed the resource due to the interactive features but had technical difficulties; Graduate students enjoyed the resource and used to revise material; Lecturers felt this was an excellent resource.
Rickman, Von Holzen, Klute & Tobin (2009); United States.	Analyze the feasibility of a university to transition from rentals of traditional textbooks to rentals of e-textbooks.	University students in four selected courses that adopted e-textbooks at the University of Northwest Missouri State University ($n = \sim 500$).	Mixed methods: Observations, surveys, focus groups on student adoption, reading, and study habits.	The majority of students felt they read more with physical textbooks and did not see any changes in their study habits. Students enjoyed the ability to quickly retrieve information and the low cost, but nearly half of students still preferred physical textbooks.
Ryan (2008); United States.	Determine if e-textbooks were suitable as a primary course resource.	University students enrolled in three separate construction courses ($n = 225$).	Mixed methods: Online survey exploring student perceptions.	Overall, students enjoyed the e-textbook and the study supports e-textbooks as a primary course resource. Students had concerns on cost and re-sale, but enjoyed the interactive features, accessibility and transportability.
Sun, Flores & Tanguma (2012); United States.	Examine the relevant experiences of college students in terms of how the use of e-textbooks may enhance their learning.	Undergraduate students enrolled in several introductory statistics courses ($n = 137$).	Quantitative: A short online survey was sent to students during the semester with Likert-type questions.	E-textbooks are perceived as enhancers of student learning experiences in two complementing routes: (1) e-textbook helpfulness enhances students' learning outcomes directly and (2) student involvement plays an important mediating role between e-textbook helpfulness and learning outcome if students use e-textbooks in class.

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Sun & Flores (2013); United States.	Examine the role of technology savvy in terms of the experiences, skills and self-efficacy of students in using information technologies.	University students in an undergraduate statistics class at a southern university in the United States (n = 108).	Quantitative: A survey questionnaire was developed and administered electronically using an online survey website. The survey was anonymous and took less than ten minutes to complete.	Student experiences with e-textbooks vary significantly across technology veterans and novices. Results suggest a salient moderating effect of technology savvy on the relationships among e-textbook experiences. Technology savvy had a stronger effect than gender in this regard.
Turner & Webster (2017); United States.	Compare student performance and perceptions of a traditional, teaching-centered classroom to two different flipped courses: one using video lectures and one using a media-enhanced electronic textbook.	Male university students enrolled in an introductory electric power systems course (n = 27).	Mixed methods: Collected data on student use of features, student perceptions, quiz scores, and semi-structured interviews with instructors.	Little difference was found in student achievement between the course formats, there were strong negative reactions by students to unfamiliar instructional methods, and there was little difference in content coverage.
Usta & Guntepe (2017); Turkey.	Examine pre-service teachers' process in designing an e-textbook using the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model.	Sophomores in a material design and use education course at Giresun University (n = 54).	Qualitative: Special case study. Data were collected using a form that included eight open-ended questions and reflection reports where pre-service teachers expressed their opinions.	Although the pre-service teachers had problems in the development process of the e-books, they expressed positive views about their e-book, such as its being capable of creating an interactive learning environment.
Van Horne, Henze, Schuh, Colvin & Russell (2017); United States.	Determine whether an instructional video in a large, introductory biology class could promote students' adoption of an interactive e-textbook.	Undergraduate students from laboratory sections in an introductory biology class (n = 239).	Quantitative: Treatment group (viewed a video detailing the most beneficial ways to interact with an e-textbook) and control group. A pre- and post- test were administered to the participants in both groups.	The treatment group had higher overall satisfaction, on average, with the e-textbook than the control group but did not report using the interactive tools more often.

Authors (year); Country	Study Purpose	Population	Design/Methodology	Key Points
Van Horne, Russell & Schuh (2016); United States.	To assess the factors associated with time to students' first use of interactive e-text-book features and the relationship between frequency of tool usage and final course grades.	Primarily undergraduate students from eight courses that used an e-textbook (*n* = 274).	Quantitative: Data mining and sur-vival analysis following recording of student use of features.	The only tool that more than half of the par-ticipants used was highlighting. Students who purchased a print copy of the textbook had longer average times using notes and annotations. There was evidence that using the tools decreased as the semester progressed, and that students' self-re-ported reading behaviors and grade point average were predictive of the time to using the mark-up tools. An interaction between bookmark usage and amount of reading was positively associated with course grades.
Zhang, Dang & Amer (2016); United States.	To examine the impact of a large-scale blended and flipped class on students' intention to learn. Specifically, they examined the influence of students' computer self-efficacy and motiva-tion, as well as instructor characteristics and teach-ing method, on students' intention to learn.	Freshman level students in an introduction-to-com-puter-information-systems course at Northern Arizona University (*n* = 538).	Mixed methods: Survey of students and their written comments.	The model testing results showed that students' computer self-efficacy, motivation, and teaching method could significantly influence their inten-tion to learn in the blended and flipped environ-ment. Instructor characteristics were found to have no impact on intention to learn.

Theme 1: Interactive E-Texts Influence Student Learning Experiences

Overall, the reviewed articles indicate that students generally have more positive perceptions of interactive e-texts than negative or neutral perceptions. In many studies, students expressed a positive outlook toward the use of interactive e-texts and their associated features (Alshaya & Oyaid, 2017; Baek & Monaghan, 2013; Dobler, 2015; Feldstein et al., 2012; Liberatore, 2017; O'Bannon et al., 2017; Raynor & Iggulden, 2008; Ryan, 2008; Zhang et al., 2016). Some studies identified particular key features of interactive e-texts that positively affected student learning experiences including videos or animations (Baek & Monaghan, 2013; Huang et al., 2014; Liberatore, 2017; O'Bannon et al., 2017; Raynor & Iggulden, 2008; Zhang et al., 2016) and the use of interactive quizzes

(Baek & Monaghan, 2013; Feldstein et al., 2012; Ryan, 2008; Zhang et al., 2016). Other features of interactive e-texts that were identified as positively influencing student learning experiences include online note taking and sharing, as well as homework questions (Dobler, 2015; Raynor & Iggulden, 2008; Zhang et al., 2016).

Other reviewed articles suggested that student perceptions of interactive e-texts were related to learning experiences. In particular, perceived utility was highlighted by several studies as important, in that perceived usefulness of the interactive e-text was found to be related to both use and use intention, as well as learning experiences and outcomes (Birdsonget al., 2015; Ngafeeson & Sun, 2015; Peterson, 2017; Sun et al., 2012). Further, one study found that the more students read, the more they perceived the interactive e-text to be supportive of their learning (Van Horne et al., 2017).

Theme 2: Relationship bBetween Interactive E-Texts and Academic Performance

While individual student outcomes and academic performance falls outside the purpose of this review, the relationship between academic performance and student learning experience is important and was highlighted by many of the included studies. Based on those studies, the relationship between interactive e-texts and academic performance is complex. Several studies reported a positive relationship between interactive e-texts and student learning, noting interactive features relate to improved attention, comprehension, motivation, excitement, and academic outcomes (Bolsen et al., 2016; Dobler, 2015; Feldstein et al., 2012; Huang et al., 2014; Nagra et al., 2013; O'Bannon et al., 2017). Several studies compared traditional textbooks and e-texts, and found higher academic achievement using e-texts (Asensio et al., 2010; Chaudhri et al., 2013; Ebied & Rahman, 2015; O'Bannon et al., 2017). Two studies indicated that interactive e-text use was associated with increased reading (Liberatore, 2017; Nagra et al., 2013).

In contrast, other studies indicated a less significant relationship between interactive e-text use and academic performance. A few studies noted no significant impact on student performance when comparing interactive e-texts and traditional textbooks (Coffin Murray & Pérez, 2011; Daniel & Woody, 2013; Dobler, 2015; Morris & Lambe, 2017; Turner & Webster, 2017). Similarly, while two studies noted above found that students read more when using an interactive e-text, two other studies found students read more

with a traditional textbook (Dwyer & Davidson, 2013; Rickman et al., 2009). Finally, the complexity of this relationship was noted in two additional studies; in one study, student comfort was associated with academic achievement (Dwyer & Davidson, 2013), while the other found that interactive e-text use was associated with improved engagement but decreased learning outcome expectations (Sun et al., 2012).

Theme 3: Factors Influencing Student Adoption and Experience of Interactive E-Texts

Through this review, several factors were identified as important in influencing student adoption and experience using interactive e-texts, including affordability, accessibility, and portability. Several studies highlighted cost to students as particularly important for student adoption and experience, noting that e-texts tend to cost students less than traditional print textbooks (deNoyelles & Seilhamer, 2013; Dobler, 2015; Rickman et al., 2009). Studies have also described a shift in student perceptions around cost and an increasing demand for no- or low-cost options (Mills, 2016; Ryan, 2008). Interestingly, one study found a majority of students would not be willing to pay more for a print text-book (McDaniel & Daday, 2018), while the opposite was found in another study; that is, students were willing to spend more for a print textbook (Novak et al., 2018).

Accessibility and portability were highlighted as significant benefits to using interactive e-texts, which were viewed as more convenient to access in comparison to tra-ditional textbooks and less physically burdensome (Dobler, 2015; O'Bannon et al., 2017; Raynor & Iggulden, 2008; Rickman et al., 2009; Ryan, 2008; Zhang et al., 2016). Some studies reported that students enjoyed the format and interface of interactive e-texts. Instead of large blocks of text, these e-texts tended to have images and activities inter-spersed, could present course material in more relevant and applicable ways, and were better able to summarize content (Feldstein et al., 2012; Liberatore, 2017; Ryan, 2008).

Despite the benefits presented in some studies, other studies noted barriers to adoption or negative aspects of student experience using interactive e-texts. Most often, these barriers related to a preference for reading from a traditional text or paper, some-times due to eye strain caused by reading from a screen (Baek & Monaghan, 2013; de-Noyelles & Seilhamer, 2013; Dobler, 2015; Dwyer & Davidson, 2013; Morris & Lambe, 2017; Nagra et al., 2013). Similarly, other studies indicated that, for this reason, students

would also purchase a print copy or print electronic documents (McDaniel & Daday, 2018; Novak et al., 2018; Peterson, 2017; Van Horne et al., 2017).

Other barriers to positive student experiences using interactive e-texts included technical difficulties and some confusing interfaces. Some studies reported challenges with technology as negatively affecting student experience, including personal user challenges with technology and internet speed and accessibility (Birdsong et al., 2015; Morris & Lambe, 2017; Raynor & Iggulden, 2008). Some articles noted student challenges or a distaste toward the format or interface of interactive e-text features, such as excessive module length; others reported underutilization of interactive e-text features due to lack of familiarity, usability, and disparities between books, formats, and systems (deNoyelles & Seilhamer, 2013; Peterson, 2017; Van Horne et al., 2016). Finally, one study noted that the use of interactive e-texts resulted in students perceiving an excess of potential distractions on their personal computers (Dwyer & Davidson, 2013).

Theme 4: Roles, Responsibilities, and Recommendations

Many of the studies noted the critical role and responsibility of educators in the effective development and implementation of interactive e-texts that support student adoption and positive learning experiences. Regarding educators, studies highlighted the need for educator training to ensure they are comfortable with the technology and therefore able to demonstrate its use (Dobler, 2015; Ebied & Rahman, 2015; Van Horne et al., 2017). Several studies also noted the importance of educators presenting a rationale for e-text use and actively engaging students in the use of the technology (Dobler, 2015; Sun et al., 2012; Van Horne et al., 2017; Zhang et al., 2016). Additional studies noted that incorporating interactive e-texts requires educator flexibility and creativity, and that educators should be willing to customize the use of technology based on student needs (Sun & Flores, 2013; Usta & Güntepe, 2017). A few studies also commented on the role of educational institutions and publishing companies, emphasizing that the implementation of interactive e-texts should be supported by educational benefits and financial support (deNoyelles & Seilhamer, 2013; Nagra et al., 2013; Ngafeeson & Sun, 2015). Other articles suggested educational institutions should work with publishing companies on cost and accessibility of interactive e-texts (deNoyelles & Seilhamer, 2013; Dwyer & Davidson, 2013).

Several of the articles also discussed recommendations for interactive e-text development and implementation to support student learning experiences. Several articles mentioned how additional research and development is required to implement user-friendly features that will be strategically adopted by students (Huang et al., 2014; Peterson, 2017). Two authors emphasized that the development and use of interactive e-texts should be driven by educational benefits as opposed to cost benefits (Coffin Murray & Pérez, 2011; Nagra et al., 2013). Authors of articles had conflicting views regarding whether e-texts should be universally adopted or adopted alongside traditional texts (Asensio et al., 2010; Morris & Lambe, 2017). One article suggested the importance of including students in the development and improvement of interactive e-text features (Nagra et al., 2013).

Many articles discussed the need for future research in this field. The most frequent recommendation was that larger and more diverse samples are needed to produce more generalizable results (Baek & Monaghan, 2013; Birdsong et al., 2015; Chaudhri et al., 2013; Dwyer & Davidson, 2013; Ryan, 2008; Sun & Flores, 2013; Sun et al., 2012; Zhang et al., 2016). Several other articles noted the need for future research to attempt to disentangle how multiple variables and features relate to observed outcomes of interactive e-text use (deNoyelles & Seilhamer, 2013; Mills, 2016). Other studies emphasized the need for future research to explore the relationship between interactive e-text use and academic performance or learning outcomes further (Daniel & Woody, 2013; Liberatore, 2017; McDaniel & Daday, 2018). Finally, one article noted the need for future interactive e-text research to focus on diverse learners and issues related to accessibility (Raynor & Iggulden, 2008).

Discussion

This scoping review of 33 articles explored what is known about post-secondary student learning experiences using interactive e-texts. Four themes were developed through reviewing the existing literature. The first theme discusses how interactive e-texts influence student learning experiences, with studies generally describing more positive than negative or neutral experiences using interactive e-texts. They also highlight user-friendly format and the importance of features that promote interactivity and engagement. Relatedly, the third theme identifies factors influencing student adoption and learning experiences. Price, accessibility, and portability seem particularly important for student experiences, while eye-strain and technological challenges were seen as common barriers. Similar barriers and facilitators to

e-text adoption have been noted previously (Foote & Rupp-Serrano, 2010; Jamali et al., 2009; Marques de Oliveira, 2012; Shelburne, 2009; Stone & Baker-Eveleth, 2013; Tremblay, 2010).

While it was not the intention of this review to explore the impact of interactive e-texts on individual student-level outcomes or academic performance, it is clear that academic performance and student learning experiences are intertwined. This insight formed the second theme noted from the studies included in this review. The articles included in the review describe this relationship as complex and conflicting with a lack of consensus on how the use of interactive e-texts may affect learning outcomes. Previous literature on the impact of e-texts on student learning experiences and academic outcomes are mixed; there is a need to investigate this area further (Rockinson-Szapkiw et al., 2011; Shepperd et al., 2008; Siebenbruner, 2011; Simon, 2002).

The final theme that emerged related to roles, responsibilities, and recommendations. In particular, the important role of the educator in successful implementation of interactive e-texts was highlighted in the articles. Studies in our review emphasize educator comfort level with technology, willingness to be flexible, and their role in engagement and student motivation. Similarly, professors' personal preferences, comfort levels, and use of technology in class have been shown to influence student engagement with e-texts (Doering et al., 2012; Records et al., 2015; Yager & Szabo, 2011). Studies also noted the important role of educational institutions and publishing companies, particularly regarding accessibility. Finally, recommendations for future work was a theme seen across studies, with articles noting the importance of a better understanding of the student experience and use of specific features in order to reduce barriers and improve student learning experiences.

A primary outcome of scoping reviews is to identify gaps in the literature (Arksey & O'Malley, 2005). From the studies included in this review, we identified three gaps. First, the majority of the articles included in this review were from the United States. The findings of this review are therefore likely more representative of the post-secondary education system in the United States. This also indicates a gap in the literature, in that research should be conducted in other settings. As a team of Canadian researchers, we would like to highlight that no Canadian research was included in this review, indicating a gap in the literature that warrants further study in Canada. Additionally, a majority of the studies in this review were either quantitative or used mixed methods approaches that emphasized quantitative results. More qualitative research is needed to understand the experiences of students better, particularly regarding the barriers they face, and what could be done to facilitate adoption

and implementation of interactive e-texts that positively affect student experiences. Lastly, the majority of articles included in this review studied a single course in a single setting. Future research should explore adoption of interactive e-texts across contexts including multiple courses, using longitudinal designs, and exploring unit or university-wide adoption.

Strengths of this review include the variety of literature pulled together from a variety of settings and disciplines. Through the literature included in this review, we are beginning to distinguish between digital and electronic textbooks and interactive e-texts and are better able to understand student learning experiences using interactive e-texts. Through this review we have also begun to identify key features and factors relating to interactive e-text and student experiences. Additionally, this work was conducted by a research team with a growing body of work in educational research, the scholarship of teaching and learning, and technology and education. A limitation of this work is its inability to draw conclusions in this complex field of varied research, or to make specific recommendations on any particular feature of interactive e-texts. Future research could begin to unpack the features and factors identified here to dive more deeply, particularly in under-researched contexts. Additionally, given the ever-changing nature of technology, articles might have been excluded from our review based on rapidly advancing and highly variable use of terminology. Finally, one restriction of scoping reviews is that they do not include quality assessment, so we are unable to comment on the quality of the research summarized here (Arksey & O'Malley, 2005).

Conclusion

The adoption of interactive e-texts is becoming increasingly common in post-secondary education, but the relationship between interactive e-text use and student learning experiences remains complex and warrants further research. The results of this review emphasize the importance of user-friendliness, low cost, accessibility, portability, and the role of the educator. While there appears to be more positive experiences associated with interactive e-texts, there are negative experiences and barriers reported as well, which require further investigation. There is a need for research in the Canadian context, qualitative research, and longitudinal research that crosses e-text settings and courses over time. Overall, the use of interactive e-texts shows promise in the post-secondary education setting. Future research should explore the student learning experience in more depth, such that barriers might be minimized, and benefits might be maximized.

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