Language Learning & Technology
ISSN 1094-3501

February 2018, Volume 22, Issue 1
pp. 119–136

ARTICLE

Interactive digital textbooks and engagement: A learning strategies framework

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Abstract

This mixed-methods study explored non-native English speaking students' learning processes and engagement as they used a customized interactive digital textbook housed on a mobile device. Think aloud protocols, surveys of anticipated and actual engagement with the digital textbook, reflective journals, and member checking constituted data collection. Participants included 13 students in a large U.S. university Business English class. This study responds to the call for further research on how interacting with digital textbooks and mobile devices may affect student reading behaviors and the learning process, using the cultures-of-use conceptual framework by Thorne (2003) as a lens for analysis. Results of a paired Wilcoxon signed-rank test found that participants entered the course with high expectations for the digital textbook and ratings remained high over the term, with only one area showing a significant decrease in engagement. Analysis of think aloud protocol and reflective journal data resulted in the creation of the Framework for Learning with Digital Resources. This framework of learning processes and strategies can be used by materials designers in creating digital textbooks and resources and by educators in supporting students as they move from using digital devices mainly for personal use to utilizing them effectively in their learning.

Keywords: *Language Learning Strategies, Reading, Multimodal Texts, Mobile Learning, English for Specific Purposes*

Language(s) Learned in this Study: *English*

APA Citation: Bikowski, D., & Casal, J. E. (2018). Interactive digital textbooks and engagement: A learning strategies framework. *Language Learning & Technology*, 22(1), 119–136. doi:10125/44584

Introduction

Digital textbooks are increasingly common for the teaching of English and other languages and across educational contexts as well as in content oriented courses. They are also commonly accessed through mobile digital devices (e.g., tablets, smartphones). In addition to increased affordability and portability, potential benefits include multimodality (Vaarala & Jalkanen, 2010), a more enjoyable learning process (Gu, Wu, & Xu, 2015), increased motivation (Huang, 2013), and, if implemented correctly, hypertextuality (DeStefano & LeFevre, 2007). Students need sufficient time, however, in learning to take advantage of these features (Chou, 2016), and concerns about the development and use of digital materials exist. Studies have shown that students prefer print textbooks over their digital counterparts (see Chou, 2016; Woody, Daniel, & Baker, 2010). Reasons for dissatisfaction include reading long texts on screens and consequent eye strain, limited notetaking features, technological difficulties, lack of sufficient learner training (Baek & Monaghan, 2013), inadequate teacher support (Gu et al., 2015), and difficulties comprehending online texts (Lam, Lam, Lam, & McNaught, 2009) or learning through digital texts (Daniel & Woody, 2013). The new skills required for learning with technology have led to increased discussions on *digital literacy* as a disposition (Gillen, 2014), particularly since many students are not sufficiently trained on learning in these media-rich environments.

Digital textbooks (also called e-textbooks or electronic textbooks) can be created through many tools, developed by large publishers or individual educators, and housed on devices or in the cloud. While many

are largely-static replicas of print counterparts, others are designed specifically for digital mediums and can thus integrate the affordances of mobile technology and a variety of digital resources into a single customized package. Thus, educators and writers of materials are increasingly able to create digital textbooks that are both interactive and customized to their educational context. As these textbooks can be specifically designed to target the course objectives, to deliver course content and text models, and with learner needs and broader cultural context in mind, they are an attractive option for English for specific purposes (ESP) courses. A customized interactive digital textbook which was created for university level Business English will be explored in this study.

The majority of research on digital textbooks explores those that are electronic versions of print texts (e.g., Chou, 2016; Huang, 2013; Lam et al., 2009), while relatively little research considers those that are customized (e.g., McFall, 2005) to the device or context; no research was found on the use of customized interactive digital textbooks with non-native English speaking (NNES) students. Survey studies of student satisfaction have revealed that the majority of student experiences are neutral or negative (e.g., Baek & Monaghan, 2013; Lam et al., 2009), and closer consideration suggests potentially negative changes in student learning behavior (e.g., Daniel & Woody, 2013) and a "crucial disjuncture … when moving from print to digital…" (Evans & Po, 2007, p. 56). Some may interpret these findings as calling for a return to print-based textbooks. Yet, it may be that students are ill-equipped for such learning, given that learner processes and strategies for digital texts are largely shaped outside the classroom, while their learning experiences are largely print-based within a classroom. As they transition to using their devices for academic in addition to personal purposes, students need to put forth extra "effort and involvement in productive learning activities," two key components of engagement that Kuh (2009, p. 6) identifies. While engagement can provide the motivation students need to navigate this new learning environment, the design of the digital textbook must also be considered, and it cannot be assumed that users will automatically become successful learners. As such, the importance of customizability becomes clear and learner training becomes crucial.

This exploratory study thus responds to the call for further research of digital textbooks as they support learning (Gu et al., 2015) and "how the conventions of readings shift when students interact with digital texts" (Evans & Po, 2007, p. 70), specifically with NNES students (Huang, 2013) developing disciplinary writing skills. It seeks to move beyond the examination of student perception or preference and explore students' learning processes, strategies (i.e., conscious employment of a learning process), and engagement as they use a customized interactive digital textbook. It is based on a broad application of the cultures-of-use conceptual framework of activity theory by Thorne (2003, 2016), which "provides a lens through which to explore, and potentially to pedagogically address, tool socialization and its variabilities and consistencies" (Thorne, 2016, p. 188). The framework also suggests that learners' limited exposure to digital text mediums and limited use of mobile digital devices in educational contexts may affect how they engage with such materials for learning.

Literature Review

Digital Textbooks in the Classroom

Research on digital textbooks has focused more heavily on classes for native-English speaking (NES) students, but findings provide important considerations for NNES students as well. Most studies focus on preferences and utilize surveys, with many finding that students prefer print to digital textbooks. Baek and Monaghan (2013) found that only 34% of the over 600 NES students surveyed indicated feeling satisfied with their publisher-created digital textbook. Older students were more likely to report positive opinions, perhaps due to younger students' use of computers for entertainment over academic purposes. The authors advocate the use of faculty-created customized digital textbooks. Working with 12 NNES students, Lam et al. (2009) found that participants who used publisher-created digital textbooks for extended periods expressed more negative opinions than those who used them for shorter times. Measuring students' perceptions initially and over time can thus provide more in-depth information.

Other research moves beyond surveys and focuses on students' learning and experiences. Daniel and Woody (2013) found no differences in NES students' learning (measured through quiz scores) when using print versus digital textbooks, though students using the digital textbooks were shown to require more time for reading and to spend more time on a range of non-academic activities than they did while reading print-based versions of the same text. The authors question the efficacy of asking students to learn with the same devices they utilize for personal use without providing sufficient training. Yet, while Daniel and Woody point out the draw that the technology can have on students' attention, others have noted students' difficulties in engaging with these technologies. Evans and Po (2007) found that their 12 NES undergraduate participants were "unable to engage with digital texts" largely due to "their previous interactions with technology" (p. 70). Similarly, McFall (2005) found that many features of the customized digital textbook were challenging and unfamiliar, and therefore not utilized by the 33 undergraduate NES participants. The author underscores the importance of design and customization in learning with digital textbooks, noting that training must include critical reading skills. Training in this area is particularly salient given that each new online reading experience potentially requires a different set of skills and strategies (Leu et al., 2011).

Customization is critical with disciplinary writing and learning in ESP, which is a pragmatic, needs-based approach to language teaching and learning within specific contexts (Belcher, 2009) such as Business English. This customization is increasingly occurring via technology (e.g., authentic videos and texts, communication with professionals). Technology offers students many affordances, meaning it offers a "'match' between something in the environment … and the learner" (van Lier, 2004, p. 96). With these new environments, however, comes the need for new learning strategies.

NNES students cannot necessarily rely on familiar strategies as they read and learn with digital textbooks (Chou, 2012). Reading on a screen introduces new challenges (e.g., distinct annotation procedures, eye-strain) to what many find an already daunting task. As of yet, no studies have outlined the processes and strategies these students utilize as they engage in this new context. Research into processes learners use in other learning contexts has moved beyond surveys and added cognitive-based methods such as think aloud protocols (TAPs), which are useful for understanding problem solving and cognitive functions while using technology-based learning tools (e.g., Okuyama & Igarashi, 2007; Sun, 2003; Vinther, 2005) and during second language reading (Brown & Rodgers, 2002).

Evolving Pedagogical Practices and Training

The inconclusive findings about digital textbooks may be surprising, considering the prominence of digital texts in society and educator expectations, but they also highlight the gap between their societal (e.g., social media) and educational uses (e.g., digital textbooks, learning management systems). Following the work of Kessler, Bikowski, and Boggs (2012) we can reframe this gap as an opportunity, a space wherein tools, pedagogical practices, and use can "co-evolve" (p. 105) for successful learning. Kessler et al. explain that changes in a developing tool or use require new or revised pedagogies, broadly suggesting that successful pedagogical practices are conceived with tools and student usage patterns in mind. Likewise, there is little reason to expect that the ways we use technology in our everyday lives are optimized for or even compatible with learning; learners may require training for learning and need to be engaged in the learning process.

Hubbard (2004) distinguishes between operational and learning competence in his discussion of training. Learners may struggle and resist, as Thorne (2003) finds in computer-mediated communication contexts, or ignore technologies they do not perceive as useful, as Conole, de Laat, Dillon, and Darby (2008) find. Instructors may need to make deliberate efforts to foster learning relationships between students and their digital textbooks and devices. Hubbard (2004) supports this view in arguing that effective training develops learner awareness of the connection between learning objectives and technology-based resources. A component of this connection is engagement, which can be the path for students as they expand their use from solely personal to academic. How students expect the digital textbook to affect their engagement, compared to how they reflect on its actual impact, has not been measured.

Theoretical Framework

In his cultures-of-use conceptual framework, Thorne (2003, 2016) highlights the importance of tools and how their use (including for learning) is determined by society: "The design of the tool as well as the habitual patterns of its use influence the purposes to which it is put and methods by which it is used" (Lantolf, Thorne, & Poehner, 2015, p. 209). The way a tool (or *artifact*) is used leads to a *culture-of-use*; for example, a tablet can fit into a personal or academic culture-of-use. Thorne (2003) found that a learner's prior artifact-mediated activity can either facilitate or constrain their future learning activity. These cultural artifacts become empowered within specific contexts. As such, critical, academic engagement with a mediating learning artifact may lead to increased feelings of engagement and positive educational outcomes, but these cannot be expected to arise naturally and can benefit from teacher guidance and peer discussions.

The studies discussed above track digital texts or textbooks in distinct contexts, but one similarity is that training users for learning competence with such resources does not occupy a central role. Even though Lam et al. (2009) include limited training in their study, the focus appears to be on operational competence. While learners in these studies may have begun with, developed, or even been trained for capacity to use digital texts or textbooks (e.g., navigation features, functionality of notetaking tools), there is little evidence that they were trained to learn from them (e.g., previewing, notetaking strategies). As such, a poorly developed academic culture-of-use surrounding these texts and a lack of learning strategies may have represented a learning barrier and discouraged learner engagement. Participants were placed in innovative learning environments, but they were not necessarily fully prepared to succeed.

Taken together, these findings reveal that (a) reading and learning with digital textbooks is at least as challenging as learning with print texts, (b) the design of digital textbooks must be considered, (c) many learners are unsure of how to learn with them, and (d) training is therefore crucial. Previous efforts to utilize digital textbooks have not included conscious efforts to establish an academic culture-of-use surrounding the resource or digital device and have not capitalized on the opportunity that customization can provide in disciplinary contexts. As such, this exploratory study provides insights into the nature of NNES students' experiences with a customized interactive digital textbook after they have used the book for the course and undergone consistent training. Participants were in a university-level first-year Business English course; the digital textbook had gone through prior usability testing and was fully embedded within the curriculum. This study is driven by the following research questions:

1. To what extent do students report engagement (anticipated and actual) with the digital textbook, and what is the nature of that engagement as they are developing an academic culture-of-use?
2. What learning processes and strategies are part of students' developing academic culture-of-use as they are trained to use an interactive and customized digital textbook?

Methods and Materials

Setting and Participants

The context chosen for this study was a first-year 15-week Business English course in a large Midwestern U.S. university. This project-based course had a local non-profit organization focusing on environmental education as a client, with students researching collaboratively in small teams (of three to four people) and engaging in business genres (e.g., memos, progress reports, analytic reports). The overall goal of the course was to support students as they developed higher-level writing skills to help them succeed in business courses and their careers. This course was chosen since it required customized materials, collaboration, and technology use and offered students sufficient time to develop the strategies needed for learning with the digital textbook (Chou, 2016).

Participants were 13 fully-matriculated undergraduate students: their average age was 22 (range, 20–24); there were nine females and four males; their native languages were Mandarin Chinese (9), Arabic (2),

Japanese (1), and Dutch (1). All students owned a smartphone or a tablet. On average, participants felt very comfortable using their smartphone or tablet at the beginning of the course (M = 4.38/5.00, SD = 0.77) and used it for a variety of tasks: interacting in social media (M = 13.35 hours/week, SD = 15.34); reading digital books (M = 8.5 hours/week, SD = 9.86); reading the news (M = 4.35 hours/week, SD = 3.59); watching movies (M = 4.31 hours/week, SD = 3.25); studying, learning, or using educational apps (M = 4.15 hours/week, SD = 3.16); playing games (M = 3.54 hours/week, SD = 4.70); checking email (M = 2.65 hours/week, SD = 1.70); and shopping online (M = 1.92 hours/week, SD=1.79). Some participants also wrote digitally via personal blogs, news commentary, or product and media reviews. Seven of the 13 students had used a digital textbook created by a publisher; none reported using a customized digital textbook.

Digital Textbook Used for this Study

The digital textbook was created as an iBook due to this platform's features regarding stability, interactivity, and the affordances offered within the device (an iPad). Students who did not own an iPad were lent one during the term. For simplicity, the customized interactive digital textbook used in this study will be referred to as a *digital textbook*, with customized and interactive being understood. The digital textbook included course materials (e.g., syllabus, rubrics) as well as content chapters which explored issues related to professional writing (e.g., considering audience) and the course project (e.g., challenges facing non-profit organizations), with examples from students' home countries integrated when possible (e.g., relevant examples of non-profit organizations). Design principles followed in order to reduce cognitive load included having shorter readings (approximately 30 minutes) with bulleted material and sufficient white space; integrating learning tools and hyperlinks within and outside the iBook; and interspersing text with highly connected images, videos (open source or custom-made), and interactive content (e.g., self-assessment quizzes, links to Google Forms homework tasks). Guidelines followed regarding design from a learning perspective included allowing students to collaborate, maintain control, use previous experiences and knowledge, and give and receive feedback within the digital textbook and device (e.g., see Lim, Song, & Lee, 2012). The digital textbook underwent several iterations of usability testing, focusing on the attributes of learnability, effectiveness, and efficiency (see Kessler & Plakans, 2001; Lim et al., 2012). The book was used, tested (via student surveys, observations, and in-class discussions), and revised eight times prior to this study to maximize progress toward the course objectives.

Procedure and Analysis

A phased research design was used, following Vinther (2005). During Phase I (Weeks 1–2), all participants took an anticipated engagement survey and six participated in the first round of TAP. This information informed the reflective journals and training students received in Phase II (Weeks 3–10). Phase III (Weeks 11–15) included the survey of actual engagement, the final TAP, and member checking. This triangulation of data collection improved the credibility, dependability, and confirmability of qualitative and introspective data (Brown & Rogers, 2002).

Engagement Survey

Engagement with the digital textbook was measured via surveys (Week 1: anticipated; Week 11: actual). Handelsman, Briggs, Sullivan, and Towler's (2005) Student Course Engagement Questionnaire, created for college students, was modified and used (see Table 1). Based on theories of motivation and a multidimensional definition of engagement, this survey was tested for validity and reliability. It has been modified and used in other learning technology research, such as with studies of engagement within online learning (Dixson, 2010; Young & Bruce, 2011). An overall question and 15 items were included from the three factors (i.e., skills, emotion, and participation and interaction) that related to this study and to the definition of engagement utilized by Kuh (2009): effort and involvement. Three questions were re-worded slightly for relevance (similar to Dixson, 2010) or for clarity to NNES students, and one question was added about the digital environment. Participants rated the questions on a 5-point Likert scale, per Handelsman et al. (2005), and spaces for comments were included. Questions asked the extent to which participants

anticipated the digital textbook would (term initial) and then *actually did* (term final) influence them in various behaviors and feelings. General demographic and computer-use questions were also included.

Distributing the survey in Week 1 also allowed for the identification of potential participants for the TAPs. Potential participants were identified based on total time spent on two activities: hours/week reading digital books and hours/week studying, learning, or using educational apps. Of the 13 participants, the three with the lowest total hours, the three closest to the mean total hours (M = 12.65 hours/week), and the three with the highest total hours were invited. Of those nine, six agreed to participate in the TAPs: one from the lower three (3.5 hours/week), all three closest to the mean (11, 13, and 16 hours/week), and two from the upper three (23 and 33 hours/week). P1 (Participant 1), P2, P3, and P5 were native Chinese speakers, P4 Japanese, and P6 Dutch.

The same engagement survey was given during Week 11, but with verbs changed to the past tense. A Wilcoxon signed-rank test was used to compare participants' anticipated and actual feelings of engagement with the digital textbook. This non-parametric test was chosen given the non-normal distribution of the data set. The effect size (r) was calculated as the Z score divided by the square root of N minus any ties (Larson-Hall, 2010).

Think Aloud Protocols

This study used both *concurrent* (verbalizing thoughts during decision making) and *retrospective* (verbalizing thoughts after decision making but while they are still in short-term memory) TAPs (Kuusela & Paul, 2000) with material participants had not yet seen. The two types were used in order to minimize data collection concerns and given that researchers often utilize both (e.g., Chamot & Kupper, 1989; Charters, 2003). This study followed established guidelines for collecting data using TAPs, including participant training, task design, and researcher behavior (Ericsson & Simon, 1993). Retrospective TAP questions were informed by the notes taken during the concurrent TAP and by the possible strategies and processes identified in the literature. Sessions (ranged 30–45 minutes) were videotaped and transcribed. No participants appeared to have difficulties with the TAP.

The Phase I TAP analysis (Week 2) followed a two-cycle coding system (Miles, Huberman, & Saldaña, 2014), moving from provisional (initial summary of the data) to pattern coding (grouping provisional codes into themes). Codes were informed by learning and reading strategies used by second language learners (Chamot & Kupper, 1989; Grabe, 2009; Oxford, 1989), strategies and processes used by learners using technology (Okuyama & Igarashi, 2007; Sun, 2003; Vinther, 2005), and Hubbard's (2004) operational and learning competencies training framework. The coding scheme followed Gu's (2014) recommendation to be grounded in a theoretical framework but expanded to include more detail and examples. This coding scheme resulted in the Framework for Learning with Digital Resources (see Table 6) and was used to identify training needs (a 6-point training plan) during Phase II as well as the analysis of TAPs in Phase III.

The Phase III (Week 11) TAP was analyzed qualitatively according to the guidelines established by Charters (2003) and Gu (2014). A qualitative lens was chosen given the small sample size (six TAP participants) and the purpose of this study. Gu (2014) notes the importance of understanding students' motivations in using a strategy over simply obtaining quantitative tallies of presence or absence codes. TAP sessions were analyzed by coding each comment or behavior into the coding scheme created in Phase I (see Table 6). Two raters (one of the researchers and a research assistant) independently rated 25% of the videotaped TAP sessions. Given strong interrater reliability (96.25%), the two researchers completed the remaining coding. By the sixth and final TAP participant, Gu's (2014) recommendation to reach the point of data saturation was accomplished, and analysis demonstrated that the coding scheme was comprehensive.

Training and Implementation

The 6-point training plan carried out in Phase II (Weeks 3–10) was developed out of the coding scheme and framework developed in the Phase I TAP (see Table 6), which was itself influenced by Hubbard's (2004) competencies framework. Training was collaborative, student-centered, and adaptive, emphasizing

critical awareness of learning decisions and reflective practices. Each week, students engaged in a variety of brief activities designed to prepare them for learning with the digital textbook and to develop critical thinking skills (Sun, 2003). These activities can be broadly grouped according to purpose: introduction of features or strategies, implementation of behavior into personal practices, and reflection on effectiveness of behavior and needs. Tasks included brief demonstrations, classroom activities using the technology, personal reflective journals, and collaborative discussion of strategies with peers to develop their own metacognitive awareness (Chamot & Kupper, 1989). To emphasize peer learning, particular emphasis was placed on "collaborative debriefings" (Hubbard, 2004, p. 54) that created recurring spaces for learners to share and reflect on their strategies while thinking toward future activity.

Reflective Journals

Reflective Journals in Phase II (Weeks 3–10) allowed for the inclusion of a broader range of participants' experiences. Reflective journal topics were based on the coding scheme and the literature on engagement (Kuh, 2009) and digital literacy (Gillen, 2014). They included academic uses (notetaking, reading online, writing papers or assignments, and experiences with print vs. digital textbooks) and potential engagement (describing their learning experience with the digital textbook). The journal entries were analyzed and included in the results to provide more in-depth understanding to the engagement survey and to the TAPs (see Lam et al., 2009).

Member Checking

Member checking, also termed respondent validation (Phase III), allowed for increased participant perspectives and credibility in the analysis (Gu, 2014; Lincoln & Guba, 1985). Two of the six TAP participants chose to participate, spending approximately one hour each. Participants were shown the coding and asked to look for misrepresentations, errors, or inaccurate codes, and if they felt that the coding treated them with respect. The participants asked many questions and discussed the coding and project with the researcher; neither participant identified any areas of inaccuracies or errors in the coding, and thus no changes were made. The checking process added to the credibility of this study in that participants supported the data collected and its analysis.

Results

Overall, students (N = 13) were very satisfied (M = 4.33/5.00, SD = 0.72) with the digital textbook and strongly recommended that it be used for future courses (M = 4.27/5.00, SD = 1.16). Only one student did not recommend a digital textbook, commenting that they were difficult for notetaking and not motivating based on past experiences, although the same student expressed strong satisfaction (M = 5.0) for the digital textbook used for this class. In comparing digital to print textbooks, one reflective journal comment expressed a preference for this particular customized digital textbook but indicated that often there is no difference. Reasons (from reflective journals) for preferring this digital textbook over print textbooks included increased flexibility and learner control (e.g., *more flexible reading experience*), increased engagement and interest (e.g., *We truly are more connected to this book*), increased learning (e.g., *This iBook can make me understand more about the concept*), and ease of use and convenience. In addition to overall satisfaction with the digital textbook, the role of the digital textbook in their feelings of engagement to the course was measured.

Engagement

Participants' self-reported anticipated and actual engagement with the digital textbook and course was measured and then compared using a paired Wilcoxon signed-rank test (see Table 1).

Table 1. *Anticipated and Actual Engagement with the Course Digital Textbook (N = 13)*

The digital textbook will encourage (encouraged) me to…	Anticipated Engagement		Actual Engagement			
	M	***SD***	***M***	***SD***	***Z***	***p***
Put forth effort	3.92	0.64	3.77	0.93	-0.59	.557
Do all the homework	4.23	0.60	3.85	0.90	-1.51	.132
Do all the assigned readings	3.62	0.96	4.15	1.14	-1.15	.250
Be organized	4.08	0.95	3.62	1.26	-1.04	.298
Take good notes	3.38	1.04	3.00	1.00	-0.88	.380
Come to class every day	3.85	0.69	3.38	1.12	-1.27	.206
Look up online answers to questions I have about the material	4.23	0.60	3.85	0.99	-1.41	.160
Apply course material to my life	3.85	0.80	3.85	1.21	-0.30	.763
Make the course interesting to me	4.31	0.63	3.77	1.30	-1.22	.223
Think about the course material between class meetings	3.92	0.95	3.62	1.39	-0.58	.564
Really desire to learn the material	3.77	0.83	3.62	1.12	-0.12	.903
Ask questions when I don't understand the instructor	3.92	0.76	3.23	0.73	-2.04	.041*
Have fun in class	3.69	0.75	3.77	1.17	-0.43	.666
Participate in class activities	4.38	0.65	4.23	1.01	-0.71	.480
Help classmates	3.92	0.76	3.31	1.03	-1.64	.101
The digital textbook will impact (impacted) how I feel about the course overall	4.00	0.71	4.16	0.55	-0.71	.480

Note. 1 = strongly disagree and 5 = strongly agree

*Significant at $p < .05$.

Participants entered the course with high expectations for the digital textbook, and ratings remained high over the term. The overall rating of how they anticipated it would impact their feelings about the course started strong (M = 4.00/5.00) and remained high for their actual experience (M = 4.16/5.00). No mean scores were below neutral (3.00) for any items. Highest scores were with the digital textbook encouraging them to participate in class activities (M = 4.38/5.00), making the course interesting (M = 4.31/5.00), and helping them do homework (M = 4.23/5.00). The engagement area scoring the lowest was in encouraging them to take good notes (M = 3.38/5.00). In fact, the only survey comments about features that did not contribute to engagement and learning were typing or taking notes with an iPad. Open-ended survey comments indicated that anticipated engagement scores were based on students' past experiences and expectations (e.g., *I like using electronic devices and I am used to it*, *I am a digital man*).

For actual engagement measured at the end of the term, participants' ratings remained high, though not quite as high as they had anticipated. The highest scores were for feeling that the digital textbook helped them participate in class activities (M = 4.23/5.00) and complete assigned readings (M = 4.15/5.00). One participant whose engagement increased commented, *I changed my mind [about the digital textbook]. It is the best way to help us study, it supports this class more, and it attracts us.* In only one engagement area did scores decrease significantly: asking questions when I don't understand the instructor (Z = -2.04, p = 0.041); the effect size was calculated as medium. For this item, almost every participant (10 out of 13)

scored it lower at the end of the term, while one participant scored it higher and two stayed the same. Engagement survey responses confirmed that few students (four of the 13) used the iPad for communication (e.g., texting, email, social media, etc.).

The nature of students' engagement was explored via survey comments, from which three roles emerged for the digital textbook (see Table 2). Participants noted roles for their digital textbook that ranged from pedagogical (i.e., learning facilitator and resource) to more personalized (i.e., motivator, relationship builder). Participants used the same device for class and personal use, with nine of the 13 noting that they used it to relax or for fun (e.g., games, videos). Participants recognized the distinct domains of use, with one student noting in her survey that academic work with her iPad was *different because it is my personal device*. Further, some reflected on transitioning from personal to academic use of a device, or as one student noted in their survey response, *turning the iPad into the learning tool instead of entertainment machine*. Many students commented on the responsibility of the individual learner in making this transition, noting that *the person himself can make these devices beneficial through his using*, or warning that *lots of students will go to social media or games in their smartphone during studying*. In spite of these concerns, one participant concluded that using these devices *the right way* means *to learn knowledge*, and all participants stated in their reflective journals that they appreciated having fun while learning. Enjoyment and engagement thus appeared to play a role in students' personal use of digital devices and for learning.

Table 2. *Student-Assigned Roles for the Course Digital Textbook (N = 13)*

Role	**Student Survey Comments: "The digital textbook…"**
Learning Facilitator and Resource	"is my tutor"
	"is my guider"
	"plays a big role to facilitate the studying and learning process inside and outside the class"
	"facilitates translation and taking notes"
	"offers tools such as translators, dictionaries, search engines, and research websites/articles"
	"has many videos, links and pictures that can help us understand"
Motivator	"makes reading and processing not become boring"
	"makes our class better and better"
	"helps my learning in a more dynamic way"
	"encourages me to learn"
	"encourages students to read and learn, because of its flexible features and functions"
	"is a good way to help those students who do not like reading books or finishing homework. The iBook is more fun than books because it is well organized and includes videos and pictures. It will draw students attention."
Relationship Builder	"is a friend"

Learning Processes and Strategies used in the Digital Learning Environment

The TAPs resulted in the development of the Framework for Learning with Digital Resources (see Table 6), which was divided into two main competencies identified by Hubbard (2004): operational and learning competencies. The following tables show the strategies and processes associated with operational competence (Table 3), learning competence for monitoring learning (Table 4), and learning competence for making connections (Table 5). This framework is comprehensive in that all observed learning processes and strategies are included, yet strategy use varied by individual. Examples of effective strategy use are included in the tables, while areas that at least some participants struggled with or were not observed follow

each table.

Operational Competence: Recognizing Features in the Digital Environment

Operational competence (Table 3) refers to students recognizing features and knowing how to operate the device, while learning competence (Table 4 and Table 5) identifies choices students make for effective learning using these affordances. Recognizing a link is a process that falls within operational competence; knowing when to follow (vs. skip) the link and return to the digital textbook is a strategy that relates to learning competence.

Table 3. *Operational Competence: Recognizing Features in the Digital Learning Environment*

Strategy or Process and Description	Examples of Effective Strategy Use
Recognizes or discovers the organization, features, and affordances of the digital learning environment Participant recognizes affordances (e.g., hypertextuality, navigational, highlighting, notetaking) or discovers through exploration and clicking; is successful at troubleshooting.	P1 recognized the links as customizing his learning experience through a model of "click, expand, and research." P1 appreciated the teacher-created captions in an authentic video and knew he could expand and pause the video as needed. P6 recognized recurring image-based visual cues that asked students to reflect on prior material or complete a homework assignment, stating "There's a question on the bottom here, so I should answer." P4 commented that though he had never used an iBook, during the course he taught himself to find features (e.g., the dictionary, links, digital table of contents) through discovery tapping.

By the end of the term, most participants exhibited behaviors consistent with strong operational competence. Behaviors needing further training included (a) accessing and utilizing advanced navigational digital textbook features, (b) noticing visual cues meant to prompt reflection, (c) resolving technical issues alone, and (d) accessing the digital textbook dictionary. Only one participant used the dictionary in the digital textbook. Two others used a browser-based dictionary on their smartphones rather than using the built-in iBook dictionary or the iPad's browser-based dictionary, either of which could have been navigated in their native language if desired. A behavior that was not observed was taking notes or highlighting text within the digital textbook, though retrospective TAP comments indicated that all participants knew how to do so, and the engagement survey and reflective journals indicated that six of the 13 participants did take notes in the digital textbook (the remaining students used their laptop, smartphone, or paper). Thus, while students know how to take notes in a digital textbook, many still do not prefer to do so. Similarly, only two participants reported in their reflective journals that they used the iPad to write academic material aside from what was embedded in the iBook with Google Forms; others preferred a laptop or desktop.

Learning Competence: Monitoring Learning in the Digital Environment

In addition to operational competence, learning competence was identified and explored. The Framework for Learning with Digital Resources divides monitoring learning into two aspects related to varying behaviors and planning learning (see Table 4). While some strategies are similar to those used with print-based materials, others are unique to this learning environment or are modifications of print-based strategies.

Strategy behavior varies according to project, individual, and task. For example, one participant (P2) was unprepared for the homework task even after interacting with the chapter content, showing that while he had clearly focused on the content, he had not connected it to his learning. Deciding when to interrupt reading and look up unknown words also falls into this learning competence. While three students looked up unknown words, the other three chose not to, even though the words were important for understanding

and the students stated they did not understand them. Plans for next learning steps ranged from academic (e.g., identifying which information to further explore and where) to personal (e.g., expressing interest in joining a partner organization activity).

Table 4. *Learning Competence: Monitoring Learning in the Digital Environment*

Strategy or Process and Description	**Examples of Effective Strategy Use**
Varies or adapts behavior depending on reading purpose, learning purpose, or affordances of the digital environment Participant navigates digital space making intentional choices (e.g., previewing, scanning, notetaking, accessing content, returning to task) that match their stated purpose.	P1 previewed chapter content, stating that he looks at headings and images in order to "get a general idea of how the parts are related and what it is talking about." P5 moved through the digital textbook intentionally (a) scanning for specific information ("I know I have homework, so I am trying to find it") and (b) skipping unnecessary information. P3 accessed links and previewed link content to determine if she would read them, deciding "I'll read this because I need to know more about this" and then returned to the digital textbook. P2 used his smartphone to support his digital learning by (a) looking up unknown words and (b) taking pictures of digital textbook content as a means of taking notes.
Plans next learning steps Participant expresses a plan for next steps after exploring digital content (e.g., task completion, information to look up).	P4 wanted to revisit content from a previous course, stating he "will have to use both" perspectives and listing specific sources (e.g., website, YouTube, guest speaker) beyond textbook content. P3 commented that the chapter content gave her the idea to administer a Google Survey via the iPad for her project. P1 commented that after interacting with chapter content he wanted to join partner organization activities and communicate further with the director to further his understanding.

Learning Competence: Making Connections in the Digital Environment

Making connections during learning consists of three components (see Table 5). Students make connections to construct meaning or resolve confusion by (a) connecting prior knowledge or experience and digital material, (b) connecting across ideas or digital material, and (c) finding connections that are personally motivating. Chapter content being directly related to students' project and home countries allows for great potential in this area.

While four of the six participants made numerous connections to build learning during the TAP, two students struggled. P5 made minimal connections due to her perception that she had sufficient background knowledge, limiting her ability to connect with and learn from the material. She was also unable to connect emotionally to the topic of philanthropy, stating *In my life I don't suffer*, and in another instance stating *I don't usually think this way* when asked by the digital text to consider an abstract question. Similarly, P2 struggled to use his prior experiences to understand content, saying it *cannot help me to understand this*, although his experiences seemed highly relevant to the researchers.

Table 5. *Learning Competence: Making Connections While Learning in the Digital Environment*

Strategy or Process and Description	Examples of Effective Strategy Use
Makes connections between prior knowledge or experiences and digital material to construct meaning or resolve confusion Participant uses prior knowledge or experiences to guide their meaning-making process (e.g., through comparisons, exploration, considerations).	P4 uses prior knowledge to build meaning, stating, "Whatever article talks about, I have my opinion and I'm going to compare it." P1 connected past in-class experiences to digital textbook content, stating "Oh, this is related to constructivism and provides a real-world example and asks students to think about it…. It's a hard question." P2 linked information from marketing courses and partner organization needs to chapter content in order to inform data collection. P1 accessed past experiences in his country to explain abstract chapter content about corruption.
Makes connections across ideas or digital material to construct meaning or resolve confusion Participant connects ideas, particularly across media, (e.g., images, text, videos, links) in their meaning-making process.	P4 makes connections between several seasonal images, saying that the organization helps with "year round problems." P1 used chapter reflection questions to guide his navigation, "There is a question—it seems I need to watch the video to find the answer." P6 read chapter text to resolve confusion: "I'm a little confused about the picture, maybe it's discussed in the text." … "oh, they're talking about…"
Finds a personally motivating connection between own experiences and digital material Participant connects with content on an emotional or personal level and uses connection to motivate further learning or exploration.	P6 commented how much she liked seeing the "picture from my home country," in addition to pictures that caused her to reflect favorably on her own relationship with nature, her childhood and nature, and her hometown. P4 connected emotionally to chapter content and reflected on his past experiences donating money to disaster relief in his home country, commenting that his views have changed. P1 was motivated to act on a personal level to the topic after engaging with chapter content: "Maybe I will support this organization because I think they are helping people."

Discussion

Past research has shown that while digital textbooks are commonly used, many students find them challenging for learning (Baek & Monaghan, 2013; Lam et al., 2009), are "unable to engage" with them (Evans & Po, 2007, p. 70), and often prefer print texts (Chou, 2016; Woody et al., 2010). This study has responded to calls for research in this area, specifically how digital textbooks may support learning (Gu et al., 2015) and how students may vary their reading and learning habits in this environment (Evans & Po, 2007). The digital textbook used in this study offered the customization necessary for this ESP course.

Student Engagement with their Digital Textbook and Device

This study demonstrates that students can have high expectations and feel engaged throughout the term when using a customized interactive digital textbook. While students' experiences with the technology did not fully meet their expectations, they did report high overall satisfaction, and differences were not at a statistically significant level except in one area—asking the instructor questions. Students reported the

greatest levels of engagement in the digital textbook encouraging them to complete assigned readings (e.g., the device attracting their attention, the material being *fun*) and to participate in class (e.g., reacting to media, feeling the textbook supported their learning). These results are promising, given past findings that students often struggle with digital readings (Baek & Monaghan, 2013) and that increased time spent with a digital text can lead to decreased satisfaction (Lam et al., 2009). Key to this digital textbook helping students complete readings are customization and design features reducing eye strain. Also important is that students were familiar with digital devices and received considerable time with (Chou, 2016) and training on (Hubbard, 2004) learning in this environment.

It is interesting that any type of course material can encourage students to participate in class or impact students' feelings about a course as did this digital textbook. The engagement students reported was clearly linked to the three roles the digital textbook played: learning facilitator and resource, motivator, and relationship builder. Students' recognition of the human-like roles played by their devices supports Thorne's (2016) view that we can no longer conceptualize "artifacts and humans as distinctly independent from one another" (p. 189). While past research has identified increased motivation (e.g., Huang, 2013) and a more enjoyable learning process (e.g., Gu et al., 2015) as being benefits to digital textbooks, few studies have found that students view these digital devices as occupying personalized roles in learning environments. One explanation for this difference may be that past studies have explored digital textbooks that are frequently used with a computer and not paired to a mobile device or specific platform. In this study, however, the device was intricately linked to the digital textbook itself. These findings support Thorne's (2016) assertion that "digital environments and the human experience of activity form unified ecologies with agency distributed throughout the system" (p. 189). As technologies have evolved to be more interactive, customized, and engaging, users have given more agency and personality to their devices.

This study moves beyond an emphasis on the convenience of learning with digital devices and highlights the impact of the more personalized aspects they offer learners. Students studying with a mobile device may experience learning differently than when they study with a textbook or different technologies (e.g., computer). Other research has shown that people can develop feelings for technologies that are more personalized (e.g., Kidd & Breazeal, 2008). This study suggests that projected feelings and a sense of rapport play a role in learning with that device. *Device rapport*, then, must be considered as we develop materials using mobile technologies. Device rapport can be defined as a companion-like feeling that a user projects onto a personal mobile device and that in many ways mirrors a harmonious relationship. It can be the foundation on which a learner builds an academic culture-of-use or expands a personal culture-of-use.

Most students come to our classes with some type of rapport with a device and a personal culture-of-use with entertainment or social communication. They also enter courses with an academic culture-of-use with books and various online media. As digital textbooks and mobile learning increase, our responsibility will be to help students expand their academic culture-of-use to include learning with devices. The pathway to this expanded culture-of-use can be found in engagement, defined as effort and involvement (Kuh, 2009), with their device and learning. Measuring and monitoring student engagement allows for an understanding of student effort and involvement, but also provides insights into student achievement, given the strong correlation between high engagement and high achievement (Handelsman et al., 2005).

Engagement can be accelerated or decelerated based on the learner's disposition, which in Gillen's (2014) discussion of digital literacy includes (a) "flexibility—including recognition of change as a constant"; (b) "resilience in the face of setbacks" with a willingness to adapt; and (c) questioning technologies and resources critically (p. 154). Behaviors identified in the current study provide insight into the role of learner disposition. Flexibility and resilience can be recognized in a variety of strategies (e.g., varying behavior depending on learning purpose). Evaluation of technology was demonstrated when participants offered suggestions for the course digital textbook.

This study also provides insight into behaviors that indicate the development of an expanded culture-of-use that incorporates learning with digital devices. As students expand their culture-of-use, they are able to take advantage of specific functionalities for learning, monitor their learning in a hypertextual environment, and

draw connections between digital materials. Previous experience, as noted by Thorne (2003), also plays a role in the development of a culture-of-use. The interplay between students' experiences and their disposition can lead to increased or decreased rigidity and can affect how they engage with such materials for learning.

Strategies and Processes for Effective Learning with Digital Resources

Analysis of student behavior and comments with their textbook and device resulted in the creation of the Framework for Learning with Digital Resources (see Table 6). This framework identifies key learning processes and strategies within operational competence (recognizing features in the learning environment) and learning competence (monitoring learning and making connections during learning) in this environment. Similar to findings by Conole et al. (2008), this framework indicates a "shift in the way in which students are working and suggest[s] a rich and complex inter-relationship between individuals and tools" (p. 521). Behaviors noted by Conole et al. but not observed as prevalently in this study included pervasive use (sharing resources with and seeking help from a peer community) and transferability (transferring technology skills to other learning situations). Students in this study did not use the iPad for communication with the instructor or teammates as often as they could have, most likely because they already had established patterns of communicating electronically via other means (e.g., a smartphone). While some participants transferred skills from their personal culture-of-use for digital devices, others failed to make key connections in this area. Further research can explore the ways in which students' prior knowledge and skills with the technology influence their learning processes and strategies in these areas.

Table 6. *Framework for Learning with Digital Resources*

Strategy or Process	Description
1. Operational Competence: Recognizes Features in the Digital Learning Environment	
Recognizes or discovers the organization, features, and affordances of the digital learning environment	Participant recognizes affordances (e.g., hypertextuality, navigational, highlighting, notetaking), or discovers through exploration and clicking; is successful at troubleshooting.
2. Learning Competence: Monitors Learning in the Digital Environment	
2a. Varies or adapts behavior depending on reading purpose, learning purpose, or affordances of the digital environment	Participant navigates digital space making intentional choices (e.g., previewing, scanning, notetaking, accessing content, returning to task) that match their stated purpose.
2b. Plans next learning steps	Participant expresses a plan for next steps after exploring digital content (e.g., task completion, information to look up).
3. Learning Competence: Makes Connections while Learning in the Digital Environment	
3a. Makes connections between prior knowledge or experiences and digital material to construct meaning or resolve confusion	Participant uses prior knowledge or experiences to guide their meaning-making process (e.g., through comparisons, exploration, considerations).
3b. Makes connections across ideas or digital material to construct meaning or resolve confusion	Participant connects ideas, particularly across media, (e.g., images, text, videos, links) in their meaning-making process.
3c. Finds a personally motivating connection between own experiences and digital material	Participant connects with content on an emotional or personal level and uses connection to motivate further learning or exploration.

The role of student agency while applying learning strategies with a digital textbook is key. Lack of feature use does not necessarily indicate a user limitation but can rather be an expression of autonomy. Faced with

device limitations related to typing, for example, some students developed creative notetaking strategies (e.g., taking pictures with their smartphone). Also crucial is making informed educational choices, such as choosing when to follow hyperlinks and how much information to read before returning to digital textbook content. Strong critical thinking skills allow students to establish what can be complex connections in the digital textbook, either across content or to their background knowledge or lives.

Student agency stems from their past experiences as well. Some are more *emergent* in their use of the digital textbook: they know how to use the technology for certain learning processes but somewhat regularly choose not to even when it would benefit their learning. They are at the threshold where operational competence merges into learning competence. Others are more *proficient*, meaning that they demonstrate a broader range of strategies and display more conscious choices over how they monitor their learning and connect with digital material. A deeper understanding of strategies and processes employed by more proficient users can be used for training those who are more emergent.

Pedagogical Implications and Future Research

Implications for teaching with digital textbooks and mobile technology fall into the interdependent categories of materials design and student training. The Framework for Learning with Digital Resources (see Table 6) developed out of this research can be used to provide guidance in these areas—with the understanding that learner strategies may vary depending on the digital resources being utilized, and the digital resource may well influence a user's cognition and learning (Thorne, 2016). Regarding materials design, digital textbooks are most effective and engaging when they are customized to the technology, course and students; interactive in exploiting the hypertextual, multimodal, and communicative affordances of the platform; and usability tested with the students and teachers, revising as needed. Training, then, supports students so that any "inherent imperfection" with the technology does not hamper learning (Okuyama & Igarashi, 2007, p. 54), and should be iterative, flexible, collaborative, reflective, and customized to the context and students. While usability testing allows materials designers to align the text with student expectations and preferred use, training allows educators to help students maximize learning and utilize affordances.

This exploratory research marks an important early step, but is somewhat limited in its generalizability due to the small number of participants with a narrow range of native languages. Future research can further explore students' development of an expanded academic culture-of-use with digital textbooks and devices, compare strategy use over time or across contexts, identify learner characteristics that may encourage more effective strategy use, or compare strategies and processes by students at different levels of proficiency in the second language or with the technology. The roles that students assign to their devices in the learning process can also be more fully understood, particularly as those roles relate to the device rapport students may experience.

Conclusion

This study has demonstrated that students can have high expectations and feel engaged throughout the term when using a customized interactive digital textbook. It has also identified the learning processes and strategies non-native speakers utilize as they learn with a digital textbook designed to maximize the affordances offered by current technologies. Our students are likely to encounter digital textbooks in some form at all levels of their educational experiences. Though many have substantial experience with devices and the digital environment, at least for their personal lives, they often are not fully prepared to learn in digital environments (Winke & Goertler, 2008). A pathway offered to support students as they expand personal device use to an academic culture-of-use is that of engagement between the class content, the student, and the device. This engagement can sustain students through training and lead to the increased time they need with the digital textbook in order to develop new strategies and processes, as well as determine which existing strategies should be transferred or modified for this environment. The Framework for Learning with Digital Resources offered in this study highlights strategies particularly effective in this

hypertextual, multimodal environment where students draw on a variety of print- and media-based resources. Teachers and designers need to incorporate flexibility in their materials and assignments so that students can choose among a variety of tools or strategies in order to customize learning for their specific disciplinary context and student goals within this co-evolving educational landscape.

Acknowledgements

The authors would like to thank the *LLT* editors and anonymous reviewers for their suggestions and comments on improving this paper. We would also like to thank the students who agreed to participate in this research.

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