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A Quantitative Features Analysis of Recommended No- and Low-Cost Preschool e-Books

Howard P. Parette · Craig Blum · Katie Luthin

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Abstract In recent years, recommended e-books have drawn increasing attention from early childhood education professionals. This study applied a quantitative descriptive features analysis of cost (n = 70) and no-cost (n = 60) e-books recommended by the Texas Computer Education Association. While t-tests revealed no statistically significant differences between features of cost and no-cost e-books, certain features were present in cost e-books that occurred more frequently. In discussing the implications, emphasis is placed on connecting use of e-books to planned activities having specific learning objectives, targeted instructional strategies, and consideration of universal design for learning principles.

Keywords Early childhood education · e-Books · Technology · Preschool · Universal design for learning · Scaffolding · iPads · Instructional strategies

The National Association for the Education of Young Children (NAEYC) and Fred Rogers Center (2012) recently adopted its position statement on technology integration in early childhood settings. In summarizing existing research related to technology and media in the lives of young children, several findings noted included that (a) developmentally appropriate technology can enhance children's cognitive and social abilities; and (b) technology integration is effective when integrated into the integrated into the classroom, curriculum, and children's routines. These two findings have immense implications for early childhood education professionals regarding the role of technology used in instructional settings. As succinctly noted by Parette et al. (2013), a key challenge regarding use of current technologies in classrooms, is "how to use technologies effectively and efficiently to support learning experiences for young children" (p. 7).

One technology that has received increasing attention and use by early childhood education professionals in today's classrooms is the electronic book (e-book). Generally, an e-book is a book-length publication having text, images, animations, audio, text highlighting, text-to-speech, and/or other features and which has been composed in or converted to a digital format for display on a computer screen or handheld device (e.g., tablet, smart phone). However, to make decisions regarding use of an e-book in a planned classroom activity, the early childhood education professional must know what features are present (de Jong and Bus 2003) if it is to be connected to specific instructional strategies and assessment approaches (Parette et al. 2013).

The subsequent sections present an overview of what is known about e-books followed by a description of the efforts of a state professional organization to evaluate e-books and post their recommendations regarding e-books having utility in instructional settings. A quantitative features analysis of recommended preschool e-books and findings are then described, followed by a discussion of the implications of the features analysis, i.e., its relevance to instructional strategies and assessment approaches, for early childhood education professionals.

e-Book as Tools for Learning

In the past few years there has been noticeable increase in use of personalized technologies in early childhood classrooms, particularly apps developed for use on the tablet and smart phone. Additionally, e-books now have a strong

H. P. Parette · C. Blum · K. Luthin (✉)
Illinois State University, Normal, IL, USA
e-mail: cblum@ilstu.edu

presence among the array of instructional technology options that can be used in the preschool classroom. Growing popularity of e-books has been noted in recent years (Buckleitner 2011; Zucker et al. 2009). Unfortunately, as is the case with many current instructional technologies, the research base related to the e-book's effectiveness as a learning tool is markedly deficient (Luthin et al. 2013).

Current Status of e-Books

While earlier reviews of the value of e-books were skeptical (de Jong and Bus 2003), more recent reviews of features and use of e-books (Buckleitner 2011; Felvégi and Matthew 2012; Pearman and Chang 2010) have suggested the value of these technologies with regard to increasing emergent literacy skills. E-books have also been shown to hold promise among children who are at risk (Shamir and Korat 2013; Shamir et al. 2012), a population of diverse learners that is increasingly served in today's twenty first century classroom settings.

According to Wood et al. (2010), e-books can benefit children's literacy development by enabling children to: (a) enjoy a text and interact with its associated story; (b) read for meaning and enjoy stories when paired with focused talk; (c) develop an understanding of print when text is highlighted; (d) develop their own narratives linked to screen images; (e) understand icons, navigational features, and hot spots; and (f) collaborate with others. These investigators suggested that the e-book encourages children to talk about the story being read and develops their understanding of a story, interacting with the text, and making predictions.

Not surprisingly, e-books have been known to offer increased interactive opportunities for young children, thereby increasing engagement (de Jong and Bus 2002). This is especially true when e-books are used with an iPad. Vaala (2012) has noted that "Perhaps the most powerful characteristic of the iPad as a learning tool is its power to motivate and engage students. Underlying each area of skill development is the sheer magnetism between child and iPad" (para 8). Supporting engagement of young children using iPads paired with e-books in instructional settings represents a key underpinning of UDL and developmentally appropriate practice (National Association for the Education of Young Children 2009; Parette et al. 2013). If the assumption is made that e-books are indeed engaging, and that young children are interested in them given the increasing presence and use of technologies in their lives, the question then arises regarding what this means for the education community. Guernsey (2011) observed that, "The most pressing question may be not *if*, but *how* [emphasis added] teachers…should use e-books" (para 24). She also commented on the importance of *intentionality* when using e-books in instructional settings for young children.

Based on the limited studies available and the varying evaluative blog posts made by family members who use e-books with their children, it may be that e-books support the delivery of instruction in different ways than traditional books (Roskos et al. 2011). But from an instructional perspective, promise can only be realized when e-books are *meaningfully* connected to planned classroom activities (Parette et al. 2013). The conceptual framework for technology integration proposed by Parette and Blum (2013) holds great promise for making decisions about e-books that would be purposefully used in a planned classroom activity. But an important element of successfully integrating technology into a planned classroom activity hinges on understanding an e-book's features. Without such understanding, specific instructional strategies and assessment approaches to evaluate student learning can sometimes be difficult to identify. So the question then becomes, 'How can early childhood education professionals find e-books that have been evaluated by features?'

Texas Computer Education Association Web Site

One professional organization that has assumed a leadership role in making recommendations regarding the pedagogical usefulness of apps and e-books is the Texas Computer Education Association (TCEA n.d.; http://www.tcea.org/), a member-based organization devoted to the use of technology in education and which is affiliated with International Society for Technology in Education (ISTE). Using TCEA members who are experts in the field, the organization has conducted an internal review of apps, including e-book apps, used in early childhood education.

Expert member reviews culminated in a compilation of apps and e-books at the TCEA Web site, organized by age level, content area, and specific curricular purpose, that is available to practitioners for both the iPad (http://www.tcea.org/ipad;) and iPod (http://tinyurl.com/8mwzavc) (Note: All preschool books listed on the iPod site are also available for the iPad). The TCEA Web site includes a range of categories related to apps and e-books for each category.

Examples of these categories include; language arts (literacy skills, poetry, vocabulary); mathematics (addition, subtraction, division); and *interactive books* (picture books, chapter books, rhyming books). The Web site chart does not include specific information about e-books, or apps, but a general description can be found on the iTunes Web site (TCEA n.d.; http://www.tcea.org/).

While such recommendations are helpful, they do little other than provide an indexing of available e-books for

consideration by early childhood education professionals. Educational decision making related to technology integration in early childhood education should not be made on such limited information (Parette and Blum 2013).

Purpose

The purpose of this study was to apply a quantitative descriptive features analysis to the TCEA recommendations regarding preschool e-book apps. We chose the TCEA Web site for this evaluation because of the thorough process used by TCEA, and the potential practical uses of database for early childhood education professionals. This evaluation is not intended as a judgment on other databases, on TCEA, or any other similar organizations.

Additionally, the study examined the differences between cost versus no-cost apps in the TCEA recommendations for preschool e-books. Cost of resources in early childhood education is always of concern, particularly in light of the limited budgets available to teachers for purchase of technologies to support their curriculum (Gillis et al. 2012). Understanding the benefits, if any, obtained by purchasing an e-book is an important consideration in the educational decision making process. Finally, the study examined the presence or absence of particular features present in cost and no-cost e-books. Community preschools and public preschools often struggle with both significant budget constraints and the expectation that they conform to new and evolving educational standards. Information about how to screen for quality and make the most cost effective decisions when purchasing e-books has never been more critical.

To evaluate the features of the early childhood e-books on the TCEA Web site we formed two research questions:

1. What are the e-book features available across cost and no-cost e-book apps from the TCEA Web site that are recommended for preschool children?
2. Is there a statistically significant difference for the percentage of occurrence of features identified between the cost and no-cost e-book apps on the TCEA Web site that are recommended for preschool children?

Method

Theoretical Framework

Given the importance of accountability in early childhood education (Diamond et al. 2013; Kostelnik et al. 2011; National Association for the Education of Young Children n.d. 2009; Sandall et al. 2005), classroom practitioners have an obligation to develop and deliver meaningful, outcomes-based learning experiences for all young children. Such experiences should be couched in careful planning, wherein learning standards and instructional objectives are clearly connected to classroom materials, instructional strategies, and assessment approaches. Since instructional technologies such as e-books have become more common classroom learning materials in twenty-first century early childhood settings (Blum and Parette 2013; Peurling 2012; Simon and Nemeth 2012), it is important to understand how these tools can support learning when used in developmentally appropriate ways that are linked to instructional strategies and assessment approaches. Compounding the challenge is the growing recognition of the importance of universal design for learning (UDL) principles and their connection to planning classroom activities (Blum and Parette, in press; Stockall et al. 2012). UDL assumes that classroom materials, instructional strategies, and assessment approaches consider multiple means of *representation* (i.e., means through which information and content is presented, including visual, auditory, kinesthetic, and tactile); *engagement* (i.e., means used to recruit children's interest, provide them with multiple options for sustaining their effort and persistence, and enhance their self-regulatory behavior); and *action and expression* (i.e., means by which young children can express what they have learned).

One current framework from which to view these connections and the role of e-books has been described by Parette and Blum (2013; see Fig. 1). In the EXPECT IT, PLAN IT, TEACH IT model of technology integration the use of e-books is situated within meaningful classroom activities for young children that have been planned by early childhood education professionals, and which consider UDL principles. This process involves selection of an instructional objective/benchmark connected to a state or common core standard (EXPECT IT). A planning phase then occurs wherein an e-book would be selected (TECH IT) based on the extent to which the book could be used to address the instructional objective/benchmark. Features of e-books may very well be important in this decision, and selection of any e-book would be couched in the availability of features known to have media research support.

While standards and benchmarks guide the educational planning process, the EXPECT, PLAN IT, TEACH IT model of technology integration is child-centered. Hence all aspects of planning for integration of e-books into an activity need to be centered on the children's developmental needs. As noted in Fig. 1, selection of the e-book would also hinge on the specific *instructional strategies* (ARRANGE IT; Blum and Parette 2013) that would be used with the e-book (e.g., modeling, prompting, guided discovery, scaffolding). When reflecting on a strategy it is essential that teachers consider

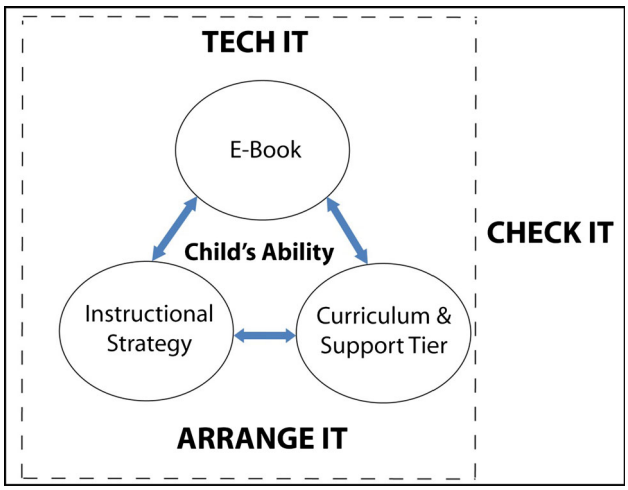

Fig. 1 Linkage among e-book selection, instructional strategy, and curriculum and support tier. Adapted from: Blum and Parette (2013, p. 56)

the features and nature of the e-book and how children respond to the e-book since some e-books may lend themselves to certain instructional strategies (Pearman and Chang 2010). One strategy is to let children explore a new e-book and observe their response to the e-book, thus allowing the teacher to have a better understanding of a needed instructional support to accomplish a given learning objective.

Additionally, e-books should be connected to thematic units and other curriculum sequencing considerations. Today's early childhood education settings are increasingly using a response to intervention (RtI) approach to meet the needs of all children. This requires multiple tiers of support, including core curriculum (for all students), differentiated instruction (for students at risk), and individualized instruction (for students with intensive learning problems or disabilities). How well students are responding to instruction within the curriculum may lead the teacher to add special instructional supports for some children to better meet their individual needs. For example, children identified as 'at-risk' may need the scanning option turned on or may need extra scaffolding to draw a connection to a theme. The connection made between each of these three components—e-book, instructional strategies, and curriculum tier/s of support—is inherently connected to assessment (Blum and Parette 2013; Meadan et al. 2013) to document the outcome of the planned activity (CHECK IT). The importance of understanding features of e-books in this study is viewed from the perspective of this theoretical framework.

Process of e-Book Recommendations Used by TCEA

The TCEA uses a review process adhering to the following approach (L. Gracey, personal correspondence, April 25, 2012). First, books were selected by TCEA staff by selected by examining weekly new releases featured at the iTunes Store. Second, each e-book app was reviewed by three different education professionals (from different subject areas and grade levels; one evaluator was an early childhood teacher) using a rubric. Evaluators were asked to spend at least 45 min on the e-book app, trying out its various features, and providing comments in a feedback section of the rubric using the rubric scale presented in Table 1.

Feedback in the comment sections by the expert reviewers was the most important part of the evaluation. Third, the evaluator reviews were then submitted to the Executive Director who collated the comments and scores. If an app scored a '3' by each of the evaluators, it was automatically listed on the TCEA recommended list. If an app scored an average between a '2' and a '3,' then two additional education professionals (from the grade level/content field for which the app was designed) examined the app and provided additional feedback to the Executive Director. Fourth, based on the evaluative feedback provided, the Executive Director made a determination whether the e-book was added to the recommended list.

Analysis of Features

Each e-book listed under the preschool column on a TCEA Google Doc (http://bit.ly/xur9mw) until April 25, 2012 ($n = 130$) was downloaded and evaluated by features (Luthin et al. 2012). Some of these e-book features have been described by Buckleitner (2011) in an analysis and exploration of e-books and their features, though additional features were also included in this study. The research team defined each feature with examples to enhance the accuracy of the features analysis (see Table 2).

Once features were defined, a graduate student on the research team systematically examined each e-book that was downloaded onto an iPad and identified features as they were observed in the e-book. A table of all e-books evaluated and features identified is archived on a wiki at http://bit.ly/V7yqBc. If a feature was identified at least once in an e-book it was coded as 'occurred.' If no such feature was available at any portion of an e-book, it was coded as 'not occurring.' Because of the diversity of the e-books in the sample, at times it was unclear if a feature should be identified or not. In those instances, the research team reviewed the definition as a group, reviewed the feature as a group, and used those opportunities to clarify a definition or the meaning of definition. If any refinements to definitions occurred during the process, those refinements were applied to the entire sample.

Results

E-books were grouped into two categories for further quantitative analysis: *free* ($n = 60$) and *cost* ($n = 70$). E-books having a cost included those that could be purchased for $.99, $1.99, $2.99, $3.99, and $4.99. Frequency of occurrence features from the sample were calculated for each of the two categories and converted to a percentage of occurrences within the category (e.g., the first category is author identification, so for a cost book the percentage is calculated by *n* of Cost books with Author Identification/ total cost books X 100, or 50/70 X 100). This permits a direct comparison of the categories since there were 10 more cost e-books in the sample. Differences were then calculated with all of these data and analyses being reported in Table 3. To analyze the overall mean difference percentage of occurrence of identified features between cost and no-cost groups an independent sample *t* test was used. This statistical procedure is appropriate given that it allows the comparison between two means of the cost and no-cost e-books. The findings based on these analyses are reported subsequently to address the two research questions.

e-Book Features Available Across Cost and No-Cost Recommended Apps

In using the TCEA rating system, expert raters produced a sample that had a great deal of similarity in the percentage of occurrence of features across cost and no-cost books. We will first describe the overall occurrence of features presented in Table 3.

In the entire TCEA sample the top five ranks of the features analyzed in descending order are: (1) page turning, (2) cartoon and stylized drawing, (3) built-in audio narration, (4) page turning sounds, and, tied for the fifth rank is (5) instructions for e-book use *and* music. As depicted in Table 3, the top 5 ranking features had a range of 60–96.92 % of the e-books in the sample. Though not in the top five by rank, control of sound is at 53.08 % and scanning at 50 % indicting that they are quite common in the sample. These features tended to have an overall presence in the high quality books selected by the TCEA sample.

The bottom five ranking features in the TCEA sample in descending order are: (18) realistic illustrations, (19) Pull Tabs, (20) 3D with Perceived Depth, (21) Photograph, (22) 3D with Glasses. As noted in Table 3, the bottom 5 ranking features had a range of 0–3.85 % of the e-books in the sample. While not in the bottom five, Video was at 10 % and Motion-Based Input was at 6.15 %, indicating that they were less frequent in the sample. While these features are available in the larger population of e-books, some (e.g., 3D) are rare. Many of the e-books that were identified in the TCEA sample tended to be fictitious or did lend themselves well to the presentation of realistic photographs.

Differences in Percentage of Occurrence of Features

Using an SPSS statistical software package, independent sample *t*-tests were run to compare percentage differences between cost and no cost groups in the TCEA e-books sample. No significant difference was found ($t_{(44)} = .516$, $p = .608$) between percentage of cost e-books having the identified features ($M = 38.52$, $SD = 31.65$) and the percentage of no-cost e-books having the identified features ($M = 33.84$, $SD = 29.87$). This indicates that, while the two means appear different, there is enough overlapping variation between the two groups that this difference is most likely attributable to a chance outcome, rather than true differences. Hence we believe that the differences in this sample between cost and no-cost books are of little consequence.

Table 1 E-book evaluation rubric used by TCEA

3	2	1
Interesting to students; appropriate age level; enhanced interactivity (may include a quiz, a coloring page, a drawing page, etc.); includes "read to me" and "read by myself" with audio; voice for the audio is clear and easy to understand; able to create something within the e-book or select an alternative ending; no grammatical or spelling mistakes; story flows well; encourages students to actively use their imaginations; embraces a larger theme; if directions are given, they are clear and easy to understand; graphical elements strategically enhance the story	Of interest to some students; appropriate age level; more interactivity than simply clicking or turning a page; includes "read to me" and "read by myself: with audio; no grammatical or spelling mistakes; story is well written, but not perfect; if directions are given, they are clear and easy to understand; graphics are well-designed and appropriate to the story	Is of little interest to students; not appropriate content or story line for the age targeted; little or no interactivity; text only with no audio features; multiple grammatical and/or spelling mistakes; story is badly written; has a hidden agenda; app is difficult to use and provides no directions; graphics are missing, fuzzy, boring, or inappropriate

Table 2 Preschool e-Book feature definitions

Instructions for use	Instructions are present for use of e-book features
Page turning	Allows readers to turn pages either by depression of button or simple page swipe
Page turning sounds	Sounds are present when the pages are turned
Built-in audio narration	Option is present to listen to a narrator
Recording audio option	Readers can record voice in story
Control of sound	User can turn sounds on and off (such as narrator or music)
Language options	More than one language option is present
Scanning	Highlighting (or coloring) of words is present as story is being read
Interactive—games	Games are present that readers can manipulate with fingers
Interactive—hot spots	Spots (or graphics) are present that react when manipulated by touch
Animated	Characters (or graphics) are present that move on their own accord or can be manipulated by touch
Motion-based input	Graphics on the screen are affected when iPad is tilted
Video	Video is contained within the e-book
Music	Music is present anywhere in the e-book (even if only in the title page)
Illustrations-realistic	Drawings of real objects are present
Illustrations-cartoon and stylized	Non-realistic or semi-realistic drawings or paintings intended for satire, caricature, or humor are present
Illustrations-photographs	Real life photographs are present
Pull tabs	Tabs are present on the screen that display otherwise hidden features or cause a graphic to move
3-D with glasses	3-D effect is present that requires glasses to experience
3-D with perceived depth	3-D effect is present, though glasses are not required

Specific Features Having at Least a 10 % Difference

There were seven features wherein cost e-books exceeded the percentage of occurrence by 10 % over no-cost e-books, including (a) Author Identification, (b) Instructions for Use, (c) Page Turning Sound, (d) Built-in Audio Narration, (e) Language Options, (f) Video, and (g) Stylized Drawings. There were no features of the no-cost e-books that meet or exceeded the 10 % threshold for occurring more frequently than cost e-books in the sample. There were four instances where the no-cost e-books in the TCEA sample did exceed the percentage of occurrence, including (a) Music, (b) Motion-based Input, (c) Scanning, and (d) Recording Audio Options. All of the features that met the 10 % threshold were features that were present more frequently in the cost e-book category.

Discussion

In this study there were no statistically significant differences in the presence of certain features when comparing cost versus no-cost e-books. There are two important implications that can be drawn from this finding. First, even though no overall statistical differences were found, it does not mean that differences are present that have important implications for purchasing these apps for use in early childhood programs. In our descriptive review there are seven features (described above) that indicated a 10–18 % higher frequency in cost e-books. These features represent an overall quality indicator of the presence of features that may be more expensive for app developers to program (e.g., language options or built-in audio narration). Increasingly, purchasers of apps are recognizing that there are limitations to 'no-cost' apps. Notably, all app development comes at a cost; it is just a question of who is paying for them and what is required in return for downloading them without payment. Hence, the reason that some e-books have a cost to the consumer while others do not is complicated, and features that each has available is most likely related to the financial structure of the app developer (e.g., for profit, non-for profit, connected to other resources created by developer). Some free apps or e-books may have limited use or be of limited educational value. Others may only be 'introductory' in which a developer hopes that the consumer buy more or sends advertisements to the individual who downloaded the app or e-book. Because of these potential issues, early childhood education professionals who are using e-books need to be discriminating consumers when downloading a free e-book or app.

A second important implication relates to the nature of the TCEA sample itself. While TCEA reviewers screened e-books for quality, they are *not* representative of all e-books. The goal of the TCEA reviewer was to select meaningful high quality e-books for young children. As indicated by the results, at least by features, TCEA appears to have accomplished its goal. Further, one would expect that, in a valid screened sample selected using quality

Table 3 Analysis of cost versus no-cost e-books by features

Features	Total (n = 130)		Cost (n = 70)		No cost (n = 60)		Difference (%)
	n	%	n	%	n	%	
Author identified	81	62.30	50	70.42	31	51.67	18.75*
Instructions for use	78	60.00	46	65.71	32	53.33	12.38*
Page turning	126	96.92	70	100	56	93.33	6.67
Page turning sounds	36	27.69	23	32.86	13	21.67	11.19*
Built-in audio narration	119	91.53	68	97.14	51	85.00	12.14*
Recording audio option	19	14.61	9	12.86	10	16.67	−3.81**
Control of sound	69	53.08	39	55.71	30	50.00	5.71
Language options	26	20.00	21	30	5	8.33	21.67*
Scanning	65	50.00	34	48.57	31	51.67	−3.1**
Interactive							
Games	50	38.46	25	35.71	25	41.67	−5.96
Hot spots	44	33.85	24	34.29	20	33.33	0.96
Animated	48	36.92	26	37.14	22	36.67	0.47
Motion-based input	8	6.15	3	4.29	5	8.33	−4.04**
Video	13	10.00	11	15.71	2	3.33	12.38*
Music	78	60.00	39	55.71	39	65.00	−9.29**
Illustrations							
Realistic	5	3.85	3	4.29	2	3.33	0.96
Stylized drawings	53	40.78	32	45.71	21	35.00	10.71*
Cartoon and stylized drawings	120	92.31	67	95.71	53	88.33	7.38
Photograph	1	.77	1	1.43	0	0	1.43
Pull Tabs	2	1.58	2	2.86	0	0	2.86
3D with glasses	0	0	0	0	0	0	0
3D with perceived depth	2	1.54	2	2.86	0	0	2.86
3D stated but depth difficult to perceive	45	34.62	26	37.14	19	31.67	5.47

* Features that have 10% or greater difference between cost and no-cost e-books. ** Negative integers mean that the no-cost percentage of occurrence value was greater than a cost e-book percentage of occurrence value.

indicators, there would be limited differences between no-cost and cost e-books. This study provides indirect support that the TCEA rating (or similar) process can be used to help identify quality e-books for potential purchase by an early childhood program. One possibility is that early childhood programs could form a user group (Parette et al. 2012) to rate apps for quality using the TCEA process combined with a features analysis. Using this evaluative process would likely help an early childhood program make meaningful purchasing decisions about e-books, and more effectively consider the value added of any e-book, regardless of cost. Further, some features may be related to the type of e-book under evaluation. The TCEA sample included mostly fictional stories for young children. While this was not intentional, it may be coincidental that most of the high quality e-books are in this genre. It is also possible that this is simply the majority of e-books available to young children, or that there was some type of selection bias in the process of TCEA evaluation. Because we know so little about e-books, it is difficult to determine which of these possibilities exist. Examination of the larger population of e-books, study of different genres, exploring how app developers make choices are all important areas for future study.

Selecting an e-Book in Practice

As our sophistication increases with regard to effective practices for technology integration in twenty-first century early childhood classrooms, education professionals will continually be challenged to connect instructional technologies, instructional strategies, and assessment approaches (Parette et al. 2013; Roskos et al. 2011). While e-books certainly can maintain a presence in today's classrooms *without* a specific connection to learning standards and benchmarks (e.g., unsupervised reading on iPad during Literacy Center), in order to harness the potential of

e-books there *should* be a specific learning objective and instructional strategy associated with use of an e-book (Blum and Parette 2013; Pearman and Chang 2010). Far too often education professionals use apps and other technological innovations as 'edutainment,' i.e., entertainment in which educational value is of secondary importance. While it is not problematic for education to be engaging and entertaining, the primary objective of the use of any app or e-book needs to be associated with a learning outcome. As noted by Roskos et al. (2011), a major challenge of integrating e-books into the curriculum is how to effectively use them.

This challenge of effective use of e-books is compounded with the growing interest in UDL principles and how these principles are applied to instructional approaches in early childhood settings (Bertling et al. n.d.; Conn-Powers et al. 2006; Darragh 2007; Lieber et al. 2008; Parette et al. 2013). Two of the three UDL principles—multiple means of representation and multiple means of engagement—are *teacher* issues in designing planned classroom activities that may include e-books. Clearly, many e-books enable content (i.e., a story) to be represented in several ways such as text, audio narration, and animation. Additionally, the features of many e-books, such as those identified in this study, engage children's interest with the features and the reading or literacy content (Chiong et al. 2012; Grimshaw et al. 2007), though they may not necessarily result in literacy skill acquisition that is much different from outcomes when using traditional books (Labbo and Kuhn 2000; Chiong et al. 2012). Thus, the issue of *effectiveness* of features in an instructional planned activity is unclear (Chiong et al. 2012), which may prove to be problematic as frameworks for integrating today's technologies increasingly place emphasis on connecting use of technologies such as e-books to assessment (Meadan et al. 2013).

The following vignette illustrates how an e-book is selected based on each of the foregoing considerations.

> Mrs. Jones decides that her planned activity will focus on a Language Arts standard, 'Recognize key ideas and details in stories.' Her specific learning objective for the planned classroom activity is for students to 'ask and answer questions about books heard and read aloud.' Once this decision is made, she begins the activity planning process which is couched in consideration of UDL principles. Initially, she decides on an e-book that will allow the story content to be *represented* in multiple ways—both using sound, pictures, and with text. Mrs. Jones has a number of free and cost e-books on her classroom iPad, though she needs an e-book that can be used (a) in a small group during Literacy Center, and (b) jointly with an instructional strategy (i.e., guided discovery, such that she can ask questions and scaffold children's learning using the features of the e-book). A $3.99 book that supports both of these priorities is *Moo, Baa, La La La* (http://www.goodreads.com/book/show/4600.Moo_Baa_La_La_La_). This book has an array of features that afford Mrs. Jones flexibility in its use, including scanning and highlighting of text, text-to-speech, animal 'hot spots' that move and say sounds on touch, and a pull tab. Students can opt to have an adult narrator read the text, or students can opt to read it themselves. With either choice, students can touch words and pictures at any time whereon sounds or words are spoken. The features of *Moo, Baa, La La* afford multiple means of *engagement* for children given that the teacher can use guided discovery in a small group setting during Literacy Center to allow children choices throughout the reading of the book (e.g., touching words and having them pronounced; touching animals that respond with movement and making noises) while also allowing her to ask questions regarding sounds that animals make both before and after a page is read. She can also employ modeling of sounds and scaffold their learning. Children will also have opportunities for multiple means of *action and expression* making sounds of the animals presented in the story (sheep, rhinoceros, dog, pig, cow, cat, duck, horse) in response to Mrs. Jones' questions. To assess children's learning she creates a check sheet listing key sounds made by animals, with columns for students' names allowing her to place a check by each animal sound for students in the small learning group as he or she correctly pronounces a sound. Since she has an iPad, she also has the option of using the camera feature to capture video of children responding to questions about animal sounds.

Conclusion

Given the increasing presence of e-books in today's education marketplace, greater attention must be focused how they may be effectively used to support learning among young children. As our sophistication changes with regard to effective practices of technology integration in twenty first century early childhood classrooms, teachers will continually be challenged to connect instructional technologies, instructional strategies, and assessment approaches (Blum and Parette 2013; Parette et al. 2013).

Despite the innovative characteristics of e-books and apps, it is unclear whether multimedia research and best

practices are consistently considered by developers who design these technologies. Principles of multimedia design are well-known (Mayer, 2001, 2005), and Mayer (2003) suggests that multimedia features used in combination may 'prime' cognitive processes for active learning. Lack of such understanding, and the presence (or absence) of important features that support learning in e-books, calls attention to the current practice of arbitrarily selecting e-books. Earlier work with CD-ROM storybooks suggested that most multimedia effects present in electronic books are 'inconsistent' with the main aspects of a story (Korat and Shamir 2004; Labbo and Kuhn 2000). These concerns point to a need for early childhood professionals to evaluate apps and e-books systematically before large-scale purchase for a program.

There is also the issue of cost and the need to understand which e-books may result in the best educational outcomes for children (Shuler 2012). Teachers are typically provided with small budgets for classroom expenditures on technology and materials (Judge 2006; Parette et al. 2013), and when there are multiple iPads in a classroom, an app that may appear to be of relatively small cost must be installed on multiple iPads, thus increasing the cost outlay.

Limitations

There are several limitations to this evaluation of the TCEA e-book sample. First, the sample is a screened sample and is not representative of the plethora of e-books available for young children. We strongly discourage anyone from drawing any conclusions about the larger sample of e-books available for young children. Second, this process has not been replicated by an early childhood program. While we are aware of many programs using some kind of evaluative procedures to screen e-books or apps, we are aware of the need for replication. More investigation is needed to on how to select e-books and connect it to a technology integration model as described in the discussion.

Most e-books support UDL principles, and, when used thoughtfully in the classroom, can be powerful learning supports in planned classroom activities. The many features of e-books, such as those examined in this study, provide for multiple means of representation and engagement from the teacher's perspective when designing planned classroom activities, while allowing for multiple means of action and expression by children within planned activities. When tied to effective early childhood technology integration models and evidence-based practice, e-books hold a great deal of promise in the early childhood classroom.

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