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Enhancing Children's Literacy Skills: Designing the Q-Tales ecosystem for children's e-book design and publication

Abstract

This article describes the conceptualisation and development of a pedagogical framework to support the design of e-books for children to enhance literacy development. It emerged from research undertaken within the Q-Tales international consortium project of the EU's Horizon 2020 Programme for Research and Innovation, where the aim was to facilitate key stakeholders to collaborate and participate in the online production and publication of high-quality, educational e-books for children. The pedagogical framework described here sought to answer the question; what concepts and principles undergird the effective design of pedagogically impactful e-books for children? It is grounded by the theoretical underpinnings of socio-constructivism, constructionism, and skill theory, and how they relate to children's literacy development. A framework describing different narrative forms and component features, key pedagogical activities appropriate for different stages of reading development, and design recommendations regarding the integration of multimedia into e-books are also central to the pedagogical framework. As well as informing the design of the Q-Tales infrastructure for children's e-book design and publication, we hope the guidelines and pedagogical activities enumerated here will be widely useful for those designing and developing digital, interactive narratives, particularly e-books to enhance children's emerging literacy.

Keywords

e-books, children's literacy, learning design, e-book design for children

Introduction

This article describes the conceptualisation and development of a pedagogical framework to support the design of e-books for children to enhance literacy development. As partners in an EU-funded project focused on the development of an online collaboration ecosystem for children's e-book designers, the authors were tasked with developing a pedagogical framework to direct and guide developers in creating e-books that would support children's literacy development.

The Q-Tales project developed out of an EU call to support the growth of small-to-medium enterprise (SME) ICT innovative Creative Industries (CORDIS, 2014). The goal of the call was to increase the competitiveness of the European creative industries by fostering exchanges between the creative industries SMEs and providers of ICT innovative solutions. Funded by the EU's Horizon 2020 Programme for Research and Innovation, an initiative aimed at securing Europe's global competitiveness (European Commission, 2016), Q-Tales has developed a collaboration ecosystem that will enable EU Creative small to medium enterprises to exchange multimedia content and create interactive e-books for children. Partners and stakeholders include European e-book publishers, storytellers, writers, illustrators, sound artists, educators, children, and parents.

An online system (Figure 1) has been designed that will allow authors, illustrators and multimedia app designers to collaborate together to create e-books for children.



Figure 1 Screenshot of the Q-Tales online system

The finished e-books will be curated according to reader ability level and educational value. The design will also incorporate a place where children can log on to the system and create their own e-books.

Literacy and narrative identity development

A key tenet of the Q-Tales e-book research reported here was the interdependence of literacy, identity and storytelling. Narrative and storytelling are fundamentally important in education (Egan, 1987; Zigo, 2001), culture and life. The Q-Tales pedagogical framework was predicated foundationally on the narrative concepts and theories of Bruner (1990; 2002; 2007), Schank (1990) and Egan (1989). According to Bruner (2007, 30:11), narrative is “about the most generic thing we have”. For Egan (1989) narrative and storytelling predominate as powerful educational processes, which help crucially to mediate learners’ identity development and lifelong literacy. Bruner went as far as to contend that the development of our foundational literacy and learning of syntactic structures and grammars in early life is determined by our inherent predisposition to make stories of our experiences in the world.

One of the most ubiquitous and powerful discourse forms in human communication is narrative. Narrative structure is even inherent in the praxis of social interaction before it achieves linguistic expression; it is a “push” to construct narrative that determines the order of priority in which grammatical forms are mastered by the young child. (Bruner, 1990, p. 77)

Therefore, through supporting and augmenting children’s storytelling, Q-Tales aimed to enhance and promote their narrative capacity and therewith their nascent and emergent literacy.

The pedagogical framework is grounded by the theoretical underpinnings of socio-constructivism (Vygotsky, 1978), constructionism (Papert, 1993), and skill theory (Fischer, 1980), and how they relate to children’s literacy development. Normal literacy developmental stages are outlined so as to give e-book developers a basic understanding of the literacy skills appropriate for each developmental group. These are categorised under three broad stages of literacy development: emergent reading, initial reading and reading to learn, based on Chall’s (1983) stages of reading development. A framework describing different narrative forms and component features, key pedagogical activities appropriate for different stages of reading

development, and design recommendations regarding the integration of multimedia into e-books are also central to the pedagogical framework.

E-books: new synergies of computing and storytelling

In the last twenty years, technology has emerged that creates new possibilities for storytelling, creativity and creative education. Plowman and Stephen (2003) point to the educational potential of novel computing:

New technologies may lead to new concepts of play and learning/These shifts in thinking may lead to technologies that can encompass participation by practitioners, parents and children in different learning spaces and promote discovery, delight, curiosity, creativity, self-expression and pleasure in learning (Plowman & Stephen, 2003, p. 160).

Digital media, interactive storytelling and e-books are ubiquitous in contemporary education, and consequently play an increasingly important role in the development of children's nascent and emergent literacy. Liebeskind (2015a) notes that children have been using electronic books (e-books) since the early 1990s, with the introduction of the Living Books CD-ROM books. The introduction of new technologies such as tablets, e-readers, smart phones and other mobile devices has seen a growth in the use of digital books for children (Kleeman, 2015). The National Literacy Trust's 2012 report on children's literacy attitudes and behaviours found that "...for the first time children reported reading more on computers and other electronic devices than in print form, confirming the central role of technology in young people's literacy lives" (Picton & Clark, 2015, p. 7). In the Trust's more recent 2014 survey, only 11.4% of children and young people report that they read only on paper, while 88.6% reported that they read using technology (computer/laptop, tablet, e-reader or games console).

E-reading devices have become increasingly accessible and affordable (Liebeskind, 2015a). "A 21st century child has two kinds of bookshelves: one with traditional printed books, plus a virtual bookshelf that is in the cloud" (Buckleitner, 2015, p. 3). In a series of surveys dating back to January 2013, exploring how children and parents e-read, both independently and together, Liebeskind has found that the overall take-up of digital books is growing, with 93% of kids 2–13 now e-reading at least once a week (2015b).

The advent of tablets and smartphones (especially, larger screen models) has moved the focus of e-book reading from desktop to mobile (Liebeskind, 2015a). Q-Tales aims to explore new possibilities for education and pedagogy when intuitive, elegant and easy-to-use technologies are combined with intrinsically powerful human forms of creativity, expressiveness and interpretation, principally narrative and storytelling. The emergence of new technology is helping to realise new contexts, opportunities and resources for creative and interactive storytelling, especially through the growing mobility and ubiquity of computer applications and devices that are "eminently easy to use" (Hall, 2012, p. 111). In a study of the use of e-books to support children's vocabulary, story comprehension and word reading, Korat (2010) found that technology can be used to support early literacy, and stated that "well-designed technology tools carefully chosen by parents and teachers can provide children with an additional efficient and enjoyable learning experience"(p. 30).

Where we were coming from, what we tried to do

As partners in an EU-funded project, Q-Tales, the authors were tasked with building a pedagogical framework to support developers of children's e-books in the creation of e-books that would support children's literacy development.

Knowing that many users of the Q-Tales platform might not have a background in children's literacy development, we wanted to create a framework that could be incorporated into the online Q-Tales platform in the form of information that could be accessed by the users of the platform. Our aim also was to give the software developers of the platform assistance in creating built-in interactivity, in the form of pedagogical mini-games that would enhance children's literacy skills. These games and interactive aspects could in turn be utilised by the e-book creators to add interactivity to their e-books to support children's literacy development.

A fundamental aspect of the Q-Tales platform is the curation of the finished e-books prior to making them available through the Q-Tales store. Once a book is completed, the creator completes a content categorisation step (genre, language, content category, literacy category and age range) and submits the book for curation. Different users of the platform are able to curate a book, presenting the opportunity to give any book a 'score' from the different perspectives of creator, experts, teachers, readers and parents. During the curation process, the books are evaluated based on appropriateness of reading/age level and genre as suggested by the creator, pedagogical appropriateness of interactive multimedia, quality of writing and quality of design. The same set of parameters is used by all curators, ensuring the books published via the Q-Tales platform are curated democratically, giving all users an interest in promoting the highest standards.

A focus on design quality in Q-tales implies an appreciation of aesthetics in the design of both learning materials and learning experiences. Robinson (2010) criticized what he calls the predominantly *anaesthetic* education systems of today, where passive, didactic approaches to teaching are privileged above *aesthetic* embodied and multi-sensorial dimensions of education, particularly the crucial affective aspects of learning. The goal of Q-Tales is to provide a collaborative ecosystem which affords key stakeholders – illustrators, storytellers, children, parents, educators, sound artists – assets and tools to develop collaboratively e-books with aesthetic elements, creative and literary effects. Further, it enables especially beautiful and interactive e-books, those with high aesthetic value, pedagogical relevance and impact, to be curated and valorised as such.

Structure of the pedagogical framework

Our approach to the design of the pedagogical framework was team based. The authors of the framework are three academics from an Irish university. Two are education technologists and one is a developmental psychologist.

We began the process of creating the framework by each reviewing the literature in our particular area of expertise. Through a process of collaboration, we created a 'Big Wall' diagram incorporating the various areas of the literature we felt were relevant to the creation of the framework. From this, a structure for the framework emerged. We used Prezi to create a digital version of the 'Big Wall' schematic diagram which gave the team members access to the relevant literature. The pedagogical framework emerged over the course of six months through an iterative cycle of reading, discussion, refinement. The final report was a key deliverable that shaped the technology development work of the Q-tales consortium.

Central to the Q-Tales pedagogical framework is a focus on literacy skill development and engagement in reading. Our framework is grounded in developmental considerations derived from an analysis of the broad developmental psychology, education and educational technology literature. These considerations have shaped our ultimate activity- and design-focused pedagogical ontology. Figure 2 illustrates the broad component themes of the Q-Tales pedagogical framework.

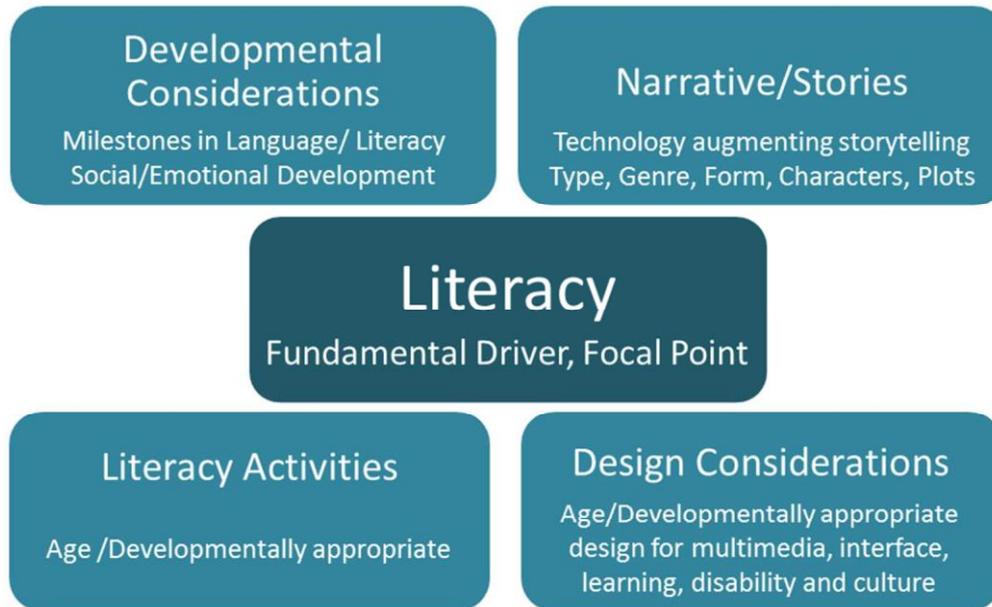


Figure 2 Q-Tales pedagogical framework

At a high level, the framework and ontology includes four themes: (1) Developmental considerations, (2) Literacy activities, (3) Narrative/Stories, and (4) Design considerations. Developmental considerations shape design thinking in the application of all other components of the framework.

Based on Chall's (1983) stages of reading development, and Sulzby's (Sulzby, 1985; Sulzby & Teale, 1987) emergent literacy skills, our pedagogical framework is structured in light of developmental considerations relevant to three broad age categories, that is, children aged 0 – 4, 5 – 8 and 9 – 16 years, based roughly on three broad stages of literacy development: (1) emergent reading, (2) initial reading, and (3) reading to learn. Furthermore, pedagogical literacy activities focus on four categories of literacy development: (1) code related skills, (2) comprehension, (3) cognitive and metacognitive skills, and (4) social/emotional interaction. A detailed version of our pedagogical framework document can be found online: http://www.q-tales.eu/portals/0/Deliverables/645588_D1.2_Pedagogical%20Framework.pdf. Below we provide a summary of some key details, focusing in particular on key literacy activities that e-book designers can use to support literacy development across different age-groups and reading levels, and some key design considerations that may shape e-book design for children.

Activities and design to support literacy development

The Q-tales pedagogical framework documents a broad range of over 100 pedagogical activities, across three stages of reading ability and four domains of literacy skill, that e-book authors might want to incorporate into their stories to enhance children's literacy development. Based on the suggestions for literacy skill development in the literature (Lawrence, White, & Snow, 2011; Snow, Burns, & Griffin, 1999), programs and apps designed to support children's literacy development were surveyed to ascertain the types of activities and mini games that should be developed for inclusion in the Q-Tales platform. This information was presented to the Q-Tales platform designers as a table depicting the types of literacy apps available to support different types of literacy skills at the different developmental stages. A sample of some of these suggestions, in the categories of code-related skills and comprehension skills, are presented in Table 1.

| Code related skills: language and vocabulary development, phonological awareness , relationship of speech to print, phonemic awareness, story grammar, text structure, letter naming and writing, decoding | | |
|---|--|--|
| Reading Level | Literacy skills | Example Apps (Reading Rockets, 2015) |
| Emergent reading (0-4) | <ul style="list-style-type: none"> Finding all the objects or words on a page that begin with a certain letter (sound) Rhyming games using the words in the story Grouping objects according to how their names begin (letter, sound) Games that pronounce each phoneme and highlights each letter | Alphabytes: helps children learn their letters, the sounds letters make, how to write both upper and lower case letters, and how to spell a few words. |
| | | Bob Books #1-Reading Magic - teaches the sounds that letters make and how to combine them to make short words. |
| Beginning reading (5-8) | <ul style="list-style-type: none"> Games that allow children to find all occurrences of a letter in a small amount of text Build sight vocabulary by playing games such as concentration (find two matching words) Identify and match the initial sounds in words, Segment and produce the initial sound, then the final and middle sounds | Bob Books #2 - Reading Magic HD: interactive book app that uses spelling, repetition, and phonics to build beginning reading skills. |
| | | Word Wagon: helps children learn about letters, phonics, and spelling. Can be set to one of four progressively harder levels: letters, phonics, and spelling of short and long words. |
| Reading to Learn (9-16) | <ul style="list-style-type: none"> Activities that work with roots, prefixes, and suffixes in order to learn how to take words apart to infer their meanings Activities that emphasize specialized academic vocabulary in the text | Bluster: A word matching game. Match rhyming words, prefixes and suffixes, synonyms, homophones, adjectives, and more. |
| | | Chicktionary: a chicken themed spelling and vocabulary-building word game. Children create as many words as possible out of a given set of letters. |
| Comprehension: understanding words, sentences, ideas: including vocabulary growth, grammar and syntax, and conceptual knowledge | | |
| Emergent reading (0-4) | <ul style="list-style-type: none"> Ask questions to help children think about or reflect on vocabulary words, plot, or characters Listen to an audio recording of a book, then have the child draw a picture of their favourite part of the book | Learn With Homer: A learn-to-read app that incorporates drawing, voice recording, stories, songs, along with more traditional phonics exercises. |
| Beginning reading (5-8) | <ul style="list-style-type: none"> Activities that ask children to summarize before and after chapters are read Activities that ask questions that will help children think about the meaning of what is read Provide background knowledge and vocabulary children need to understand the text they will read | Aesop's Quest: based on Aesop's Fables, a learning game where the child must remember elements of a story to complete a level. |
| Reading to learn (9-16) | <ul style="list-style-type: none"> Identify the main idea and supporting details of a text Summarize major points and discuss details Activities/questions to activate students' prior | e Skills Minimod Reading For Details: helps the student build mastery in the essential reading comprehension skill of Reading for Details. |

| | | |
|--|---|--|
| | <p>knowledge and build curiosity about the topic.</p> <ul style="list-style-type: none"> Activities using graphic organisers that help readers focus on concepts and how they are related to other concepts, such as maps, webs, graphs, charts, frames, or clusters | <p>Popplet: a productivity app & mind mapping tool. Use the app to begin structuring the writing process.</p> |
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Table 1 Activities to support Literacy Development across three age-levels

Figure 3 shows an example of a literacy game developed by the programmers based on the above activities. Authors can choose to include these literacy enhancing games, which can be modified to fit the book’s content, as they create their book.



Figure 3 Prototype literacy game

The term e-book covers a range of media, from digitized print books with no interactivity to books that combine multimedia (such as sound, motion, voiceover, animations and graphics) with interactivity. Some research has shown that multimedia elements incorporated into e-books that do not support the story line can be distracting to children instead of enhancing their literacy development (Labbo & Kuhn, 2000). Interactive features in particular have been shown to negatively affect story comprehension, especially in disadvantaged children (Takacs, Swart, & Bus, 2015) and younger children who are not yet conventional readers (Bus, Takacs, & Kegel, 2015). Other research has shown that when multimedia elements are used correctly in e-book design, they can support children’s literacy development (de Jong & Bus, 2003; Korat, 2010). The Q-Tales pedagogical framework aims to guide e-book designers in the creation of interactive multimedia stories that support children’s literacy development.

In a study of children’s user experience with e-books, Colombo and Landoni (2014) found that the interactive and multimedia enrichments in interactive e-books can have a positive effect on children’s e-reading experience, causing them to spend more time reading and interacting with the story. “E-books with a better reading experience might motivate children – reluctant readers especially...to read more, with all the benefits that this entails in terms of literacy and educational attainments” (Colombo & Landoni, 2014, p. 142). They also found that children’s e-reading experience is greatly enhanced by the multimedia and interactive

features of e-books “provided that they give a meaningful contribution to the storyline” (p. 143).

A core focus of the Q-Tales pedagogical framework is to facilitate e-book creators in their design thinking, particularly around design issues that influence the literacy development of children. In general, when designing e-books to enhance children’s literacy, it is important to include multimedia that supports the child’s understanding of the storyline. Multimedia storybooks that contain multimedia effects that are congruent with and support the storyline have been termed ‘considerate’ storybooks, those that include multimedia effects that are incongruent with or incidental to the story have been termed ‘inconsiderate’ (Labbo & Kuhn, 2000). Including multimedia assets that do not support the storyline can confuse children and actually impair their comprehension of the story (Labbo & Kuhn, 2000).

De Jong and Bus (2003) make a distinction between the different kinds of multimedia storybooks, which they label as ‘talking books’ (those with a minimum of multimedia and interactivity), ‘living books’, which include multimedia combined with minimal interactivity, and ‘interactive books’, stories that combine multimedia with interactivity (p. 158). Of the three types of multimedia storybooks, ‘interactive books’ have been shown to provide the most support for story understanding (de Jong & Bus, 2003). Multimedia storybooks can serve as an electronic scaffold which provides children access to stories that may be beyond their reading level (de Jong & Bus, 2003; Labbo & Kuhn, 2000). Research shows that written text together with synchronised narration, multimedia elements such as animated pictures and sound effects that relate to the storyline, and the inclusion of an interactive dictionary that provides meaning of rare words, can support children’s literacy development (Korat, 2010).

The pedagogical value of an e-book is influenced by the design of the book and a number of design considerations are important for e-book creators to keep in mind. The following are suggestions made in the pedagogical framework which we felt were the most pertinent e-book design considerations to make available to users of the Q-Tales platform.

Multimedia Elements essential for children’s e-book design:

- Include multimedia that supports the child’s understanding of the storyline (Labbo & Kuhn, 2000; Shamir & Korat, 2006)
- Animations “should be carefully crafted as logical and engaging story components” so that they support the child’s engagement and understanding of the story (Labbo & Kuhn, 2000, p. 207)
- Written text should be synchronised with narration (Colombo & Landoni, 2014; Korat, 2010; Shamir & Korat, 2006)
- Integrate text nearby the relevant graphic on the screen (Phadung, Suksakulchai and Kaewprapan, 2012)
- Pictures and corresponding text should display together and should be clearly related (Clark & Mayer, 2011)
- Use simple and relatively large fonts that are clearly legible on the screen (Phadung et al., 2012; Shamir & Korat, 2006)
- Narration should be spoken in a friendly human voice, using age-appropriate language (Phadung et al., 2012; Shamir & Korat, 2006)
- Text that can be highlighted in sentences, phrases or words, along with narration, should be available options (de Jong & Bus, 2003; Korat, 2010).

- When clicked, interactive text can display the syllabicated form of the word, and pronunciation of the word and the separate syllables (Korat, 2010)
- While text is highlighting, other multimedia should not be active (de Jong & Bus, 2003).
- Printed text should not be placed over graphics (de Jong & Bus, 2003)

Interface Design Elements

- Allow children to control the multimedia and interact with characters (Colombo & Landoni, 2014; Phadung et al., 2012; Shamir & Korat, 2006)
- Navigation buttons should be provided: right pointing arrow for forward, left pointing arrow for back (Shamir & Shlafer, 2011)
- Provide interactive hypermedia elements (hotspot) activation aligned with text and a dictionary option that allows repeated action by children (Korat, 2010; Phadung et al., 2012)
- Hotspots may be related to text or graphics (Korat, 2010)
- More than 5 hotspots on a screen can be distracting for children (Korat, 2010)
- Hotspots should combine multimedia and multi-sensory options such as text, voices, pictures and animations and should be placed on words and objects appropriate for the child's skill and age level (Shamir & Shlafer, 2011)
- Include an interactive dictionary (de Jong & Bus, 2003)
 - An interactive dictionary can provide both oral and visual (image) explanations of a word (Korat, 2010)
 - Effective interactive dictionary format: Explanations for difficult words appear on the screen after the entire page has been read by the narrator. With its appearance on the screen, the word is clearly pronounced by the narrator; concurrently, pictures supporting the word's meaning appear on the screen. (Shamir & Shlafer, 2011)
 - Choices can be provided for the user to "Read story only", "Read story with dictionary" and "Read and Interact" in order to minimise distractions when desired (Shamir & Korat, 2006)
- Design clickable items that look clickable and consider the distinction between clickable and non-clickable items, ensuring distinctions are clear and meaningful (Phadung et al., 2012)
- Provide immediate feedback showing that children's actions have had some effect (Phadung et al., 2012)
- Providing interactive features suitable to the motor skills of children. For example, one-click interfaces are easier than dragging or double clicking/tapping (Phadung et al., 2012)
- Touch screens are good for young children because they have difficulty targeting small objects on the screen, but it is important to appropriately space out items for this reason (Chiasson & Gutwin, 2005; Phadung et al., 2012)

- An animated figure at the beginning of the story can be used to introduce the different operational modes (de Jong & Bus, 2003; Shamir & Korat, 2006)

More thoroughgoing design thinking coupled with careful selection of developmentally appropriate literacy activities can serve to enhance the reading and learning experience of children reading e-books. Technology is increasingly being used to create customized scaffolded learning experiences for students with diverse needs (Pisha & Coyne, 2001; Wehmeyer, Smith, Palmer, Davies, & Stock, 2004; Dalton & Proctor, 2007). Bus, Takacs, & Kegel hold that “multimedia books that provide intensive, closely monitored, and individualized scaffolding may be especially effective in turning a putative “risk” group into a successful group” (2015, p. 91). Ongoing experimental work is needed to evaluate the pedagogical impact of various design decisions in this regard. Developing increasingly sophisticated pedagogical frameworks that support the design and evaluation of e-book literacy experiences in an important first step.

Conclusions

The growing ubiquity of e-books in children’s education creates significant possibilities to deploy and use new technologies to enhance children’s creativity with narrative and storytelling, and concomitantly their nascent and emerging literacy. In this paper, we have presented the Q-Tales pedagogical framework, which has been used to conceptualise the development of an infrastructure or ‘ecosystem’ that enables key stakeholders -- children, parents, illustrators, educators, storytellers, writers, sound artists -- to collaborate virtually to design, produce and publish high-quality, pedagogical impactful e-books. There is a very considerable role for a wide set of stakeholders to engage collaboratively in the production and publication of educational e-books, which synergise high-quality multimedia content and interactivity with proven pedagogical literacy strategies and techniques. Indeed, the development of considerate storybooks necessitates this kind of synergistic collaboration between learner, educator, storyteller and multimedia artists. In this highly dynamic emerging area of educational technology design, there exists the imperative for critical review and reflection on what constitutes the best approach to the principled, systematic design of e-books for children’s literacy.

The pedagogical framework reported here has emerged through the critical interrogation and synthesis of two key literatures pertaining to e-book design – a review both of relevant learning concepts and theories, and the state-of-the-art in terms of extant, latest e-book technology, and the embodiment of theory as practical features and affordances. This paper has sought to outline some key principles and guidelines for the systematic design of e-books to promote children’s literacy development. Furthermore, through specific reference to examples of current, salient features and techniques employed in a range of relevant e-book apps, infrastructures and technologies, the paper illustrates many possible, useful ideas for those designing and developing educational e-books to enhance and promote children’s literacy development. This pedagogical framework has informed and guided the development of the multi-collaborative Q-Tales platform which enables key stakeholders to design, produce and publish high-quality educational e-books for children. A detailed version of the pedagogical framework document is freely available online. We share the result of our wider-ranging synthesis of design principles and guidelines in the hope that the pedagogical framework enumerated here will have wide practical use for other literacy researchers designing and developing e-books to promote and enhance children’s nascent and emerging literacy. We furthermore hope that Q-Tales will help to lay the groundwork in policy and research in the development of children’s literacy skills through technology-enhanced learning.

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