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Author(s)	Thompson Long, Bonnie; Hall, Tony; Hogan, Michael; Harney, Owen; Doukoulos, Theodoros; Murray, Chita
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Using a Collective Intelligence Scenario-Based Design approach to develop a collaboration ecosystem supporting the authorship of pedagogically valuable e-books for children

Bonnie Thompson Long
National University of Ireland, Galway
Bonnie.long@nuigalway.ie

Tony Hall
National University of Ireland, Galway
Tony.hall@nuigalway.ie

Michael Hogan
National University of Ireland, Galway
Michael.hogan@nuigalway.ie

Owen Harney
National University of Ireland, Galway
harneyowen@gmail.com

Theodoros Doukoulos
Q-Tales Project Programmer
douoht@gmail.com

Chita Murray
National University of Ireland, Galway
chitamurray@gmail.com

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Abstract

Literacy is a universal public good, essential to the overall, effective functioning of civil society through its foundational contribution to personal well-being and active citizenship. The extant research shows that literacy is ideally and optimally developed in childhood.

This paper reports research into the conceptualisation and design of an e-book ecosystem: Q-Tales, to support the collaborative and mobile, authoring and sharing of interactive, pedagogical narratives in the form of children's educational e-books. The research reported here enumerates and examines the use of Collective Intelligence (CI) methodology, combined with user story methods, in providing a structured, systematic process for collaborative elicitation and prioritisation of user requirements for the creation of the Q-Tales ecosystem. The paper concludes with reflections on the potential of CI as a methodology for the collaborative and inclusive design of innovative computing to augment literacy through interactive storytelling technologies.

Keywords: Literacy, technology, education technology, e-books for children, Collective Intelligence

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Introduction

The development and promotion of literacy skills in children is of paramount importance. This paper describes how we engaged stakeholders in the design of an innovative on-line platform for the creation of e-books for children in the context of a European Innovation Project, Q-Tales. A primary goal in developing the platform was to design an ecosystem that would allow for the creation of e-books that are pedagogically valuable and enhance children's literacy skills. The production of a complex, quality e-book for children requires a team that includes authors, graphic designers, narrators, music and sound effects artists, editors and curators. All these creative services (and others, directly or indirectly, related to electronic and legacy publishing) are provided mainly by freelance artists and small companies. Q-Tales has created a unique web and mobile children's book platform, through which e-book and app creators will be able to exhibit their work, and find partners and collaborate in creating e-books for children. Everyone involved in creating, publishing or buying content will be able to take part in the Q-Tales platform, which can be accessed and used via registration by authors, illustrators, voice artists, musicians, publishers, parents, children and educators.

The Q-Tales project has as its major objective the enhancement of literacy skills in children. All our design efforts within the project are focused on this goal. There is a need for e-book designers and e-book creators to make increasingly well-informed decisions by engaging with expert stakeholders and studying the needs of users (Colombo, Landoni, & Rubegni, 2012). In addition to the development of a pedagogical framework to guide the design of children's e-books (see Thompson Long, Hall, Hogan, & Papastamatiou, In Press), the authors of this paper were tasked with engaging expert stakeholders in order to investigate system user needs for the Q-Tales platform. We used collective intelligence and user story

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methodologies to identify key user needs. Through the use of these methodologies, during a one day workshop, participants identified 72 barriers to literacy skill development that were organised into 8 categories, and a total of 265 solutions in response to these barriers. User stories highlighted 79 categories of user needs in the areas of story creation, interaction design, and learning/assessment tool needs. Design solutions were evaluated according to their feasibility and impact by the Q-Tales consortium to generate a final set for software implementation in the Q-Tales platform.

Broad Literacy Context

Literacy remains a highly significant priority on national and international educational policy and research agendas. Publication of the most recent data of the Programme for International Student Assessment PISA 2012 (Organisation for Economic Co-operation and Development, 2014) highlights the imperative to continue to focus intensively, strategically and systemically on improving and supporting literacy, in particular the encouragement of reading among young people. The development and promotion of key literacy skills among children and young people – from the earliest stages in their education - is of paramount importance. International data highlight how difficult it is to redress literacy difficulties in adulthood. In particular, UNESCO noted the difficulty in reversing current, problematic statistics in adult illiteracy and underscored the importance of childhood literacy development: "The number of illiterate adults remains stubbornly high at 774 million, a fall of 12% since 1990 but just 1% since 2000. It is projected only to fall to 743 million by 2015...Universal literacy is fundamental to social and economic progress. Literacy skills are best developed in childhood" (United Nations Educational Scientific and Cultural Organization, 2014, p. 4).

Defining Literacy

The definition of literacy employed by PISA focuses predominantly on the concept of *reading literacy*, which is construed as: "understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, to develop one's knowledge and potential, and to participate in society" (Organisation for Economic Co-operation and Development, 2013). Since PISA 2009, and for the two successive, most recent PISA assessments (2012, 2015), *engagement in reading* has become a key focus of the definition of reading literacy. The definition in use in the current, ongoing PISA assessment (2015) encompasses text in both traditional print and innovative digital formats. In Ireland, one of a number of EU-27 countries with a nationwide school-based literacy policy, literacy is broadly and inclusively defined as going beyond a print-centric focus to encompass speech, communications media and new technology. Here the focus is on "the capacity to read, understand and critically appreciate various forms of communication including spoken language, printed text, broadcast media, and digital media" (Department of Education and Skills, 2011, p. 8).

There are several key aspects to literacy and the development of literacy that are outlined in key policy and research on this issue. UNESCO has found that "Engagement in everyday reading activities helps sustain literacy skills" (United Nations Educational Scientific and Cultural Organization, 2014, p. 73). Furthermore, it has been shown (UNESCO, 2014) that children who engage in reading for pleasure generally perform better at school, thereby highlighting the importance of this activity for young people's general education and lifelong learning as they progress towards and enter adulthood.

Key factors influencing literacy development

Learning to read is a complex and multifaceted skill that changes as it is acquired (Snow, 2008). Literacy develops in stages, and is linked fundamentally to children's language

development (Sulzby, 1985; Chall, 1996; Whitehurst & Lonigan, 1998). One of the most important ways parents and carers can support children's emergent literacy development and chances of school success is through the practice of reading directly to children (Amulya, 2015). Pre-school aged children who engage in regular interactive book reading with a parent or caregiver are more successful in language growth, emergent literacy and reading achievement, regardless of the socioeconomic level of the family or the parents' level of education (Bus, van Ijzendoorn, & Pellegrini, 1995).

Spending time with children in one-on-one conversation; providing them writing materials; supporting their dramatic play; and demonstrating the uses of literacy and maintaining a playful atmosphere around literacy activities are some of the ways parents can promote a literacy-rich environment in the home (Snow et al, 1999). Other areas of family functioning that can influence reading development include the valorisation of literacy by parents and the value placed on it at home; parental expectations for academic achievement; availability and use of reading materials in the home; and opportunities for verbal interaction (Hess & Holloway, 1983).

Changing literacy requirements

Conventional reading usually begins as children enter formal schooling, between the ages of 5-7 (Snow et al., 1999). Over the course of the early years of schooling, children who learn to read successfully are able to identify printed words, read for meaning and read with fluency (Burns et al., 1999). As children reach the age of 8 or 9, they are increasingly expected to be able to read to learn new ideas and to gain new knowledge (Chall, 1983). At this stage of reading development, the texts read in school go beyond what the reader already knows and contain information that is beyond the reader's language and knowledge. Reading tasks

usually incorporate unfamiliar material and the reader's knowledge, language and vocabulary need to expand. Children who have not yet mastered the skills of the earlier stages of reading may fall behind in acquiring the knowledge that others are able to decode, infer and gain through their more advanced reading abilities (Indrisano & Chall, 1995).

At the later stages of reading development, reading instruction and curricula focus more strongly on reading comprehension and skills (Harlaar, Dale, & Plomin, 2007). An integral part of being able to comprehend reading at this level is vocabulary knowledge and being able to understand the meaning of words read in academic texts. Students need to be able to integrate new knowledge from texts with their prior background knowledge (Lawrence, White, & Snow, 2011). Langer (1999) defines the level of literacy needed by adolescents as "high literacy" (p. 1). Adolescents need literacy skills that go beyond the basic reading skills learned in earlier years of school. They also need "the ability to use language, content, and reasoning in ways that are appropriate for particular situations and disciplines/This notion of high literacy refers to understanding how reading, writing, language, content, and social appropriateness work together and using this knowledge in effective ways" (Langer, 1999, p. 1).

Literacy Technology Design

In the last twenty years, technology has emerged that creates new possibilities for storytelling, creativity and creative education. E-books are one such technology. Citing Cuban's classic critique of the historic hyperbole around non-bespoke technology in education, *Computers in the Classroom: Oversold and Underused* (2001), Plowman and Stephen (2003) pointed to the educational potential of novel computing, particularly where

novel digital—physical hybrid learning innovations can be designed, specifically to meet the user requirements of learners and educational stakeholders:

New technologies may lead to new concepts of play and learning in which ICT is much more than the "benign addition" referred to by Cuban (2001), especially as new ways are found of conceptualising ICT so that the term does not simply denote standard computers. 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).

Innovative technologies are emerging that potentially enable and promote innovative, engaging and creative possibilities for children's literacy development, particularly through the augmentation of conventional storytelling, including the traditional book, with the affordances of interactive, mobile and ubiquitous computing. However, long before the advent of mobile devices such as the e-reader and the tablet, children had been reading e-books. The Living Books CD-ROM books have been available since the early 1990s (Liebeskind, 2015a).

The National Literacy Trust's 2012 report on childrens' literacy attitudes and behaviours found for the first time that children reported reading more on computers and other electronic devices than in print form (Picton & Clark, 2015, p. 7). In the more recent 2014 survey, 88.6% of children and young people reported reading using technology (computer/laptop, tablet, e-reader or games console), with only 11.4% reporting that they read only on paper. E-reading devices have become increasingly accessible and affordable (Liebeskind , 2015). In a series of surveys dating back to January 2013, exploring how children and parents e-read, both independently and together, Liebeskind found that the

overall take-up of digital books is growing, with 93% of children aged 2–13 years engaging in e-reading at least once a week (2015b).

Technology, and good e-book design, can be used to provide scaffolds directly within digital text to support reading (MacArthur, Ferretti, Okolo, & Cavalier, 2001; Strangman & Dalton, 2005). Technology is increasingly being used to create customized scaffolded learning experiences for students with diverse needs (Dalton & Proctor, 2007; Coyne, 2001; Wehmeyer, Smith, Palmer, Davies, & Stock, 2004). Importantly, we view literacy abilities along a continuum and we appreciate the need for greater scaffolding and sensitivity to specific needs for some individuals compared with others. Scaffolding implies a socially and technically supported context whereby a tutor or interactive learning device enables a child to solve a problem, carry out a task, or achieve a goal that would be beyond his or her ability if unassisted.

There is a need for e-book designers and e-book creators to make increasingly well-informed decisions by engaging with expert stakeholders and studying the needs of users and evaluating the impact of e-book learning experiences on learning outcomes (Colombo & Landoni, 2014; Colombo et al., 2012; Colombo, Landoni, & Rubegni, 2014). Research in the learning sciences suggests that 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) made 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).

Developing technology and the need to involve stakeholders

With the advent of user centred design (UCD) (Norman & Draper, 1986), the top-down style of technology development gave way to users becoming a central part of the development process (Abras, Maloney-Krichmar, & Preece, 2004). UCD champions an "early focus on users and tasks, in order to understand the users, the tasks they perform, and the environment in which the tasks are performed" (Fox et al., 2008, p. 63).

New software is usually developed to meet a need or solve a problem (Pressman, 2005). Baetjer (1998, p. 85) described software development as a learning process. He stated:

> The process is a dialogue in which the knowledge that must become the software is brought together and embodied in the software. The process provides interaction between users and designers, between users and evolving tools, and between designers and evolving tools [technology]. It is an iterative process in which the evolving tool

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itself serves as the medium for communication, with each new round of the dialogue eliciting more useful knowledge from the people involved.

The development of software typically follows predictable steps that help to create timely, high quality results. This usually includes a generic process framework including the following steps: communication, planning, modelling, construction, and deployment (Pressman, 2005). During the communication step, future users of the proposed software are consulted to gather requirements for user needs. As noted by Cohn (2004), gathering software requirements can be challenging: getting the balance right between what users want and what developers can do, can be very difficult.

Cohn (2004) suggested user stories as a way to enhance communication between the stakeholders and the developers of a software system. Knowing who the user is and what problems they are trying to solve can help developers to design better software (Carroll, 2000). Central to our design work on the Q-tales project, we built upon existing approaches to developing user stories by combining collective intelligence methodologies (J. N. Warfield, 2006) with scenario-based design (Carroll, 2000) and agile user story (Cohn, 2004) methods. The remaining sections of this paper focus on our approach to developing user requirements; some of the key results from our stakeholder consultation and design work; and the way in which we have used these ideas to inform the design of our software and e-book design ecosystem.

The Q-Tales Collective Intelligence Design Process

We appreciate that only very well-designed technological solutions will have any beneficial impact on the enhancement of literacy skills in children. We appreciate that there are many barriers to the design and implementation of beneficial solutions. As part of the Q-

Tales platform design process, we used Collective Intelligence and user story methodologies to facilitate our thinking in relation to key user needs.

Methodology

The methodology used to gather user-level requirements is inspired by a scenario-based design (SBD) approach (Rosson & Carroll, 2002), but builds upon this approach by adding a Collective Intelligence (J. N. Warfield, 2006) and agile user story development (Cohn, 2004) approach. As such, the approach represents a new synthesis of methods developed specifically by Hogan (cf. Hogan & et al, In Press). The SBD framework (Rosson & Carroll, 2002) describes an iterative approach to interactive systems design and analysis, and encourages a reasoning process about people using technology and about finding trade-offs throughout development, including trade-offs between the potential impact of design decisions and the feasibility of the design options.

Scenario-based design

Scenario-based design uses stories, or 'scenarios', at an early point in the development process to describe how a user might interact with a system. "A user interaction is a *sketch of use*. It is intended to vividly capture the essence of an interaction design, much as a two-dimensional, paper-and-pencil sketch captures the essence of a physical design" (Rosson & Carroll, 2002, p. 1032, italics in original). Instead of focussing on defining system operations, SBD, similar to other user-centred approaches, focusses on "how people will use a system to accomplish work tasks and other activities" (Rosson & Carroll, 2002, p. 1032).

According to Rosson and Carroll (2002) scenarios are stories that consist of:

- A setting or situation state;
- One or more actors with personal motivations, knowledge, and capabilities;

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- Various tools and objects that the actors encounter and manipulate; and
- A sequence of actions and events that lead to an outcome that includes the goals, plans and reactions of the people taking part.

User Stories

User stories can be derived from more complex scenarios and are also often used in the development of software. They are simple stories that describe a discrete and specific functionality that a user wants from the software (Cohn, 2004). User stories are similar to interaction design scenarios, but they are much less detailed. Typically they describe one user goal for the software design, and are written on cards (Jeffries, 2001). Scenarios and user stories are popular in interactive system design because they facilitate communication amongst members of the design team in relation to usage possibilities and the problems and issues that arise for different stakeholders. Simple scenarios are relatively easy to write and it takes only a little more effort to enrich the scenario with a rough sketch or storyboard. When designers are working through ideas, they often wish to make progress quickly, so that they can obtain feedback from stakeholders and the design team and continue to refine their ideas. Scenario and user story development provides a valuable source of data to work with in this context.

In the language we are using and the approach we adopt in the Q-tales project, we distinguish scenarios from user stories. Scenarios are more complex narratives including multiple interlinked events and outcomes, whereas user stories focus on a single event and outcome. In essence, more complex scenarios are analysed and broken down into a set of user stories that inform the design of technology for enhancing children's literacy skills. Importantly, scenario-based design can help to prevent rigid thinking patterns in relation to

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system design, and highlights that the design of an interactive system is an ill-defined problem. Ill-defined problems may evoke a solution-first problem-solving strategy, where designers generate and analyse solutions as a means of clarifying problems, goals, and allowable moves within a problem. Although solution-first problem-solving strategies are popular, commentators have noted that they are often problematic, as designers tend to generate solutions too quickly, before they have analysed what is already known about the problem and possible moves. Our collective intelligence analysis of barriers to literacy skill development in advance of user-story development helps to prevent this solution-first thinking. Notably, we recognise that ill-defined problems are ecologically situated in a complex field of influences, and solution-first thinking strategies may fail to respond to this problematic situation. Combining collective intelligence with scenario and user story development provides a rich context in which to ground the development of emergent solutions and iteratively refine and develop solutions in light of critical analysis and reflection.

Collective Intelligence

The Q-Tales partners conducted multiple collective intelligence scenario-based user design workshops across Europe; one each in Ireland, Italy and Poland. Each workshop began in the morning with a collective intelligence (CI) analysis of barriers to literacy skill development, followed by an analysis of options that may overcome these barriers. Based on Warfield's (1994) science of generic design, the CI process is a facilitated problem solving methodology that helps groups to develop outcomes that integrate contributions from individuals with diverse views, backgrounds, and perspectives. Established as a formal system of facilitation in 1980 after a developmental phase that started in 1974, CI was designed to assist groups in dealing with complex issues. The CI approach carefully delineates content and

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process roles, assigning to participants responsibility for contributing ideas and to the facilitator responsibility for choosing and implementing selected methodologies for generating, clarifying, structuring, interpreting, and amending ideas. Emphasis is given to balancing behavioural and technical demands of group work (Broome & Chen, 1992) while honouring design laws concerning variety, parsimony, and saliency (Ashby, 1958). CI has been applied in a variety of situations to accomplish many different goals, including assisting city councils in making budget cuts (Coke & Moore, 1981), developing instructional units (Sato, 1979), designing a national agenda for paediatric nursing (Feeg, 1988), creating computer-based information systems for organizations (Keever, 1989), improving the U.S. Department of Defense's acquisition process (Alberts, 1992), promoting world peace (Christakis, 1987), improving Tribal governance process in Native American communities (Broome & Cromer, 1991), and training facilitators (Broome & Fulbright, 1995). CI has also been recently used in a variety of basic science applications, for example, to design a national well-being measurement system (Hogan et al., 2015), to understand the adaptive functions of music listening (Groarke & Hogan, 2015), and to design a student-centred conceptualisation of critical thinking (Dwyer, Hogan, Harney & O'Reilly, 2014).

CI utilizes a carefully selected set of methodologies, matched to the phase of group interaction and the requirements of the situation. The most common methodologies are the nominal group technique, ideawriting, interpretive structural modelling, and field and profile representations. For the purposes of idea generation in our workshops, the ideawriting technique was used, along with categorisation or field representation of ideas.

Ideawriting (Warfield, 1994) is a method that utilizes relatively small groups of 4-6 persons each, formed by dividing a larger group into several working teams, for the purpose of

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developing ideas and exploring the meaning of those ideas through open discussion. Ideawriting involves five steps: (a) presentation of a stimulus question to participants; (b) silent generation of ideas in writing by each participant working alone; (c) exchange of written sheets of ideas among all group members, with opportunity for individuals to add ideas as they read others' papers; (e) discussion and clarification of unique ideas; and (f) an oral report of the ideas generated by each working group in a plenary session. In this plenary session, duplicate ideas across the working groups are eliminated from the set and new ideas (if any) are added; the resulting set of ideas is then ready for use in the next stage of the group's work.

In the current application of CI, workshop participants worked to develop scenario-based user needs, which involved profiling user needs in light of the barriers to literacy skill development and options to overcome these barriers, and high level scenarios of the use of the Q-Tales Platform. This included a separate focus on (1) story creation needs, (2) interaction design needs, and (3) learning/assessment tool needs. Idea writing was used for each cluster of needs. High level scenarios including multiple users were used to prompt thinking in relation to user needs. All the short user stories generated by participants were generated in the form:

As User Type _____, I want _____, so that I can _____.

After addressing each set of needs for the first set of scenarios, we introduced a second set of user scenarios for discussion and idea generation. The wants (or needs) generated by participants were then analysed and key categories of user needs identified. We also analysed the reasons for specified needs and used this analysis to advance our understanding of the scenarios and prospective use case models. The sections that follow provide details of the collective intelligence report from one pilot site.

Galway Workshop

The collective intelligence design workshop held in Galway, Ireland included 18 experts from the fields of education, psychology, and educational technology design. An overview of the Collective Intelligence workshop process can be seen in Figure 1. We began in the morning with a collective intelligence analysis of barriers to literacy skill development which had been generated by the participants prior to the workshop. This was followed by a collective intelligence analysis of options that may overcome these barriers. We then worked in the afternoon to develop user stories and interaction design ideas, which involved profiling user needs in light of the barriers and options and high level scenarios of Q-Tales platform usage.

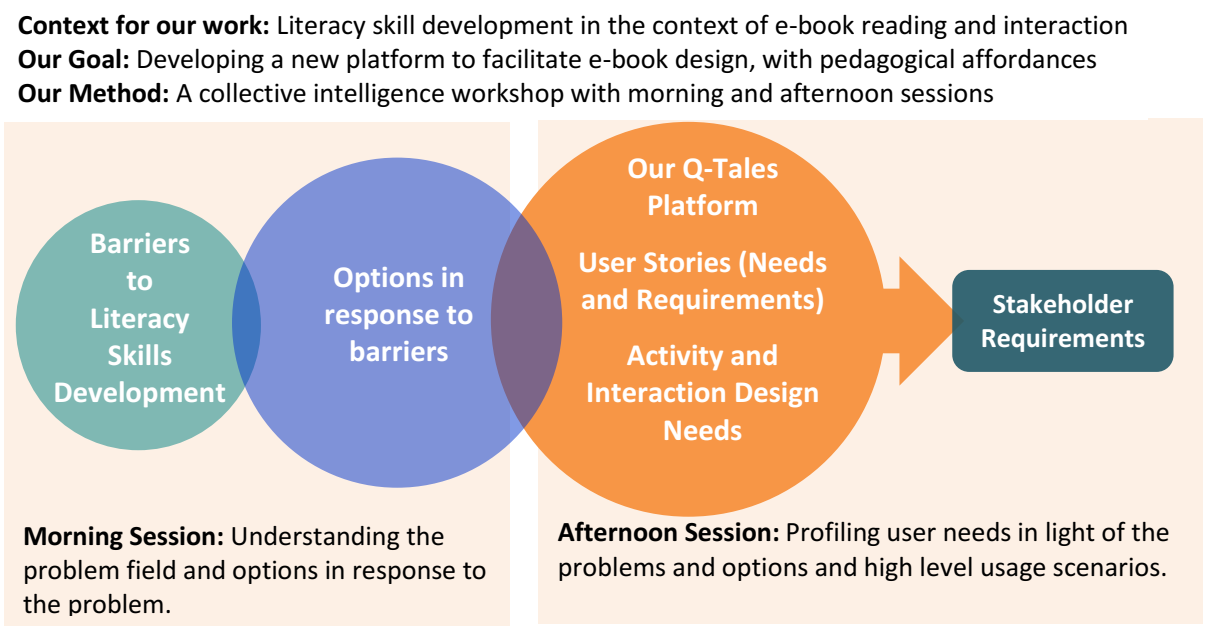

Figure 1: Overview of Collective Intelligence Workshop Process

Workshop Procedure

Prior to the workshop, participants were emailed and asked to generate five barrier statements in response to the question, "What are barriers to literacy skill development in

children?" Guidelines were provided for the writing of barrier statements. Barrier statements were collated and categorised so that they could be presented to participants when they arrived to the workshop. The categorised barrier statements were presented on display walls at the workshop venue and participants were divided into four sub-groups and asked to examine 2 categories. Groups were invited to add to their assigned categories of barriers if they felt key barriers remained which were not yet included. In the second part of the morning session, participants generated options in response to these barriers using the idea writing method.

In the afternoon session of the workshop, the initial options proposed by workshop participants opened the possibility space for creative thinking, whereby participants worked with specific usage scenarios and generated needs and requirements of users of the Q-Tales Platform, based on three scenarios. The scenarios involved hypothetical users including teachers, students, parents, book designers, and other stakeholders. Working this way in the afternoon, workshop participants generated an extensive range of 1) Story Creation needs, 2) Interaction Design needs, and 3) Learning/Assessment Tool needs.

Results:

Barriers to Literacy Skill Development

There were a total of 47 barriers returned by the participants prior to the workshop. Some of the statements included more than one barrier, so these were further broken down to create a total of 50 barriers. The individual barriers were then coded into 7 categories. During the first part of the workshop, participants added to and built upon these original barrier statements. At this stage, an 8th category, Technology, emerged from the participants' idea generation work. In total, at the end of the first stage of the workshop, there were 72 barrier

statements, falling under 8 categories. These categories, and the number of barriers in each category, can be seen in Figure 2.

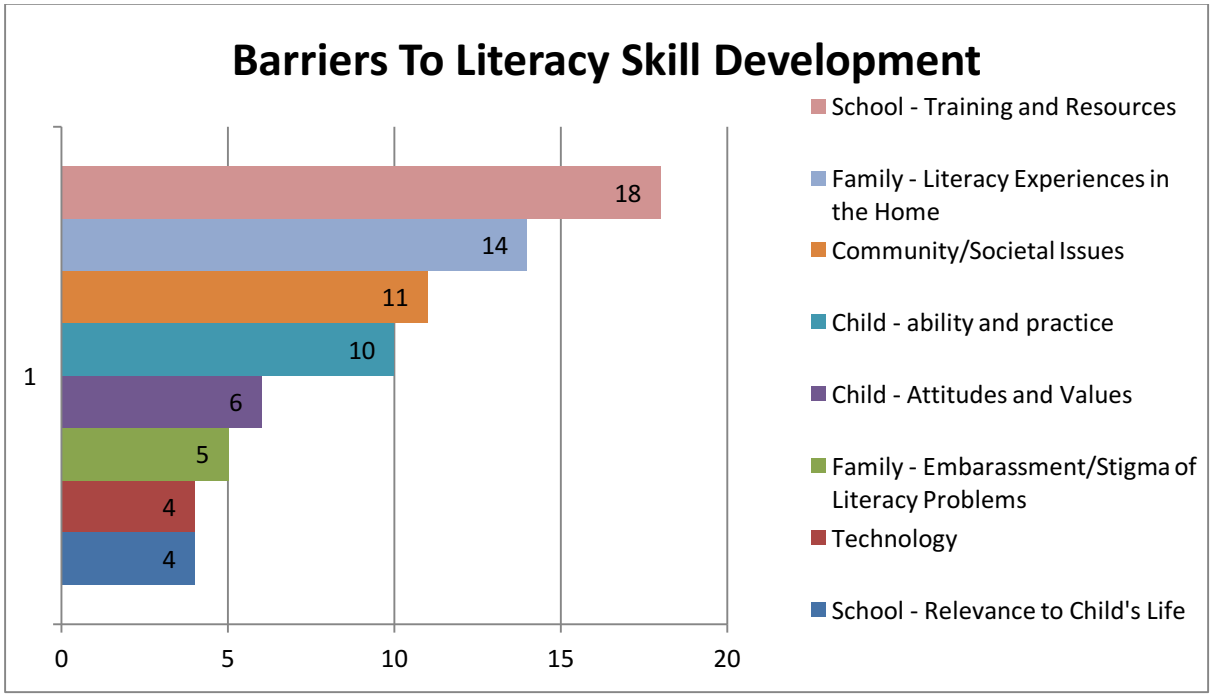

Figure 2: Barriers to Literacy Skill Development

Three barrier statements from each category are displayed in Table 1.

Table 1: Examples of Barrier Statements generated by workshop participants

Barrier Categories	Sample Barrier Statements
Child - Attitudes and Values	• Lack of motivation • Lack of a sense of self-efficacy in relation to reading and writing • Negative attitude in relation to reading
Child - ability and	• Failure to practice reading/literacy skills

practice	• Lack of learning experiences with more academic and specialist language in secondary school subjects • Poor language - oral language, vocabulary knowledge, comprehension
Family - Literacy Experiences in the Home	• Absence of culture of reading and writing for meaning and for pleasure • Limited exposure to the modelling of literacy-rich behaviours (parents, siblings, peers who read) • Limited access to a range of reading material
Family - Embarrassment/Stigma of Literacy Problems	• Embarrassment and resistance to admitting to literacy problems (parents and/or child). • Inability to cope with fear of failure on the part of the child • Hostility to 'special treatment' in a classroom setting
School - Relevance to Child's Life	• Lack of relevance of materials to child's real world literacy experiences • Failure to engage the identities and cultural practices of all learners into school literacy practices • Failure to integrate out of school literacy practices within schools
School - Training and Resources	• Inadequate education - instruction and feedback • Failure of teachers to recognise literacy problems early • Failure to see beyond traditional teaching methods
Community/Societal	• Lack of role models in the community, actually seeing

Issues	people reading • Shortage of volunteer literacy programmes, adult mentoring and community programmes to foster reading • Lack of investment in junior classes: Class numbers too high to give individual attention
Technology	• Currently one-way: Kids can't tell stories based on their interests to anyone (and family) • Unappealing to the child • Hardware too hard/not available: Too expensive? Training for teachers & family/kids? (not accessible)

A number of significant barriers to literacy skill development emerged. Workshop participants noted that children can experience a lack of a sense of self-efficacy in relation to reading and writing (see Schunk & Zimmerman, 2007; Zimmerman & Bandura, 1994), and difficulties with attention, memory, comprehension, and the ongoing practice of reading skills. They felt that there may also be a lack of relevance of school materials to a child's real world literacy experiences. Other barriers included inadequate resources, training for teachers, and instruction to foster reading skills both in the school and home environments; limited experience with print and reading material during early development (see Burns et al., 1999; Snow et al., 1999); and an inadequate array of literacy-promoting material in the home (see Snow et al., 1999).

Also highlighted was the potential embarrassment and resistance to admitting to literacy problems both on the part of parents and children; an inability to cope with fear of

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failure on the part of the child; and hostility to 'special treatment' in a classroom setting. On a cultural level, it was noted that barriers to literacy included the potential devaluing of literature within civil society; an increasingly image-focused media; a shortage of volunteer literacy programmes, adult mentoring and community programmes to foster reading; and too few role models in the community, where children would actually see people reading (see Purcell-Gates, 1996).

In relation to technology, one barrier identified is that the delivery of literacy initiatives is often one-way, for example, children cannot always tell stories based on their interests and experience. This act of creating and constructing a story may be a powerful route to literacy skill development (Cassell, 2004). Also, workshop participants noted that technology may reinforce the reduction of physical interaction and engagement in the reading experience. Technology may also be unappealing to the child, inaccessible or too expensive for them to access.

Options to overcome barriers

While these and other barriers highlighted many challenges to literacy skill development, during the next stage of the workshop, our expert working group collectively identified 265 options that could help to overcome these barriers. The number of options generated for each barrier category can be seen in Figure 3.

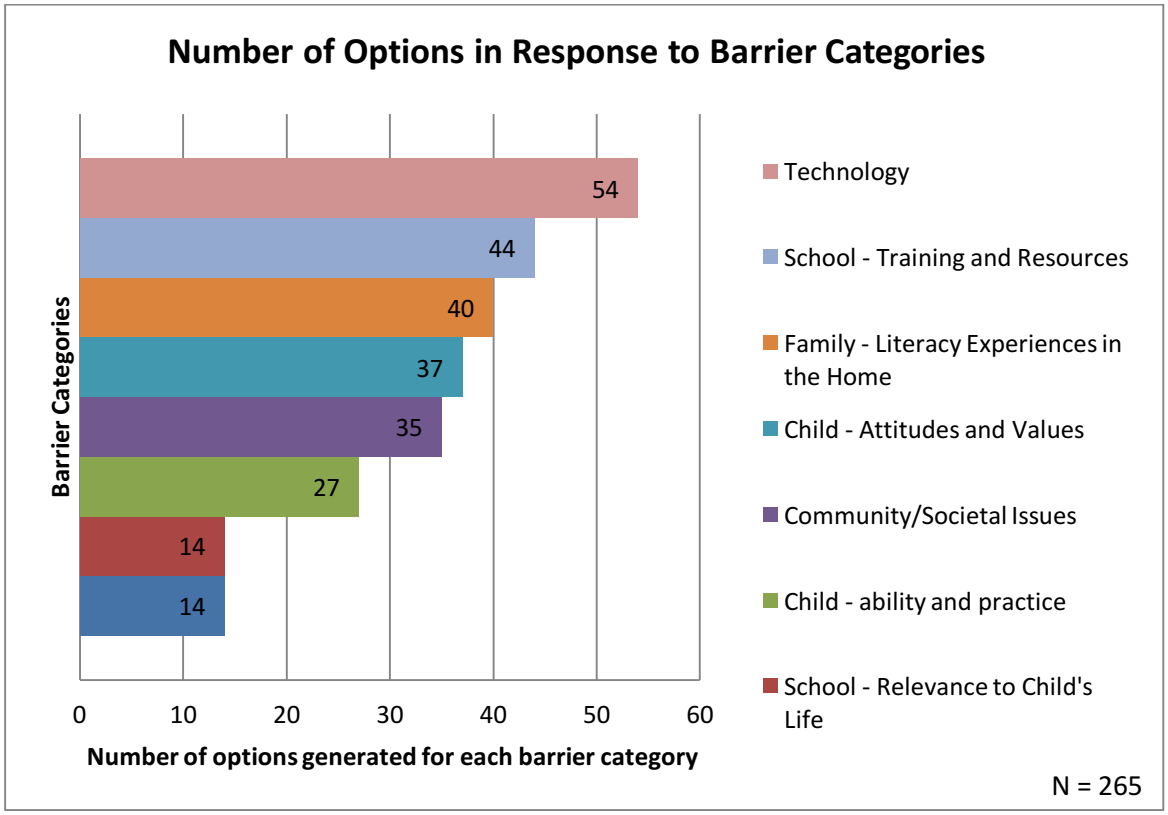


Figure 3: Number of options in response to each barrier category

A sample of these options, along with sample barriers from the corresponding category, can be seen in Figure 4.

Figure 4: Sample of proposed options to overcome barriers to literacy development

User Stories and Specific Q-Tales Platform User Needs

The initial options proposed by workshop participants opened the possibility space for creative thinking about specific usage scenarios and key needs and requirements of users of the Q-Tales Platform. A sample scenario read by workshop participants can be seen in Figure 5.

Scenario 1: Hannah and **Peter** are **mother** and **son**. They have recently purchased an **iPad**. Hannah wants an educational app for the device, to help encourage Peter's **literacy development, reading and creativity**. She wants a technology that will enable her and Peter, who is eight years old, to **create stories together**. Peter loves sitting with her to read together, talk about and make up different stories and characters, and when he learns new words. She wants a technology that will help them both to **create fun and interactive stories**, where **text: vocabulary and sentences** can be combined with **images, sounds and music**. Peter wants something **fun**. He wants a technology that will support him to create stories with **moving images, pictures, animations** - where he can see his **stories come to life**. He also wants a technology where he can **record** his own **voice** and **narrate stories** and **perform characters' dialogue and voices**. Hannah and Peter also want to see other multimedia stories and they want to be able to choose from a **menu of characters and media resources** so they do not have to start from a blank page. They want a technology that is **visually appealing** and **easy-to-use**, and they want to **share** their **stories and books** with other parents and children online. Hannah and Peter download the Q-Tales app to their iPad. They see that there are different genres, landscapes, scenes and characters available that they can use to create story templates. They can then add interactive features to these templates including ready-made media from the Q-Tales website, or they can add their own self-generated content within the templates. Uploading their finished book to the Q-Tales website, they can share the final version of their story online with other users, children and parents.

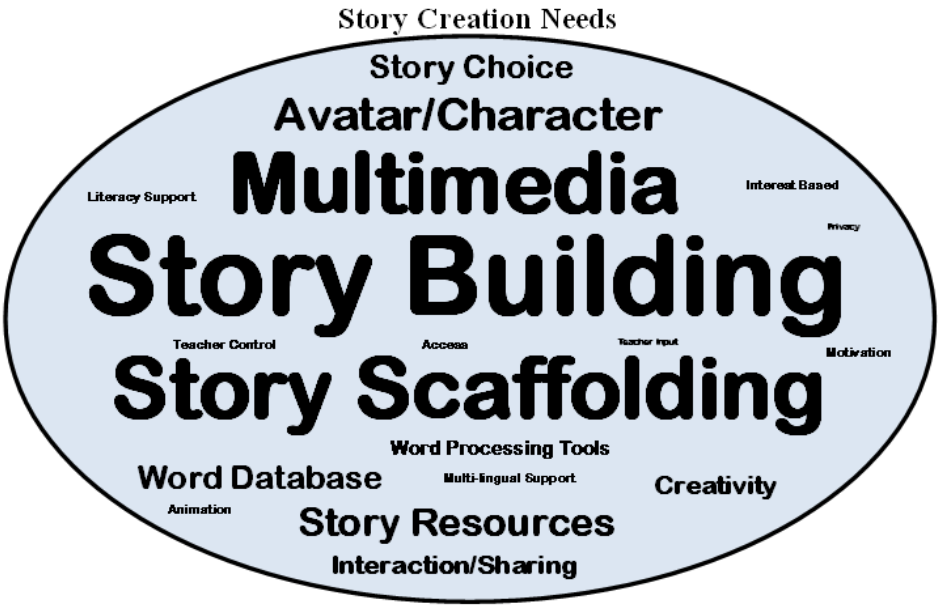
Figure 5: Sample scenario

Building on the barriers to literacy skill development, and the options to overcome these barriers, workshop participants generated an extensive range of 1) Story Creation needs, 2) Interaction Design needs, and 3) Learning/Assessment Tool needs in response to specific scenarios.

Story Creation Needs

A total of 93 story creation needs were generated by the participants. These needs were coded and organised into 20 categories. These categories are presented in Figure 6 as a word cloud, to demonstrate graphically the frequency of needs suggested by the workshop

participants in each category: the larger the word, the greater the number of items in that category. The legend beneath the word cloud gives an actual frequency count for items coded to each category.



Frequency of story creation needs categories represented in diagram:									
Story building	17	Story resources	6	Creativity	4	Animation	2	Motivation	2
Story scaffolding	13	Word database	5	Word processing tools	3	Multi-lingual support	2	Teacher input	1
Multimedia	13	Story choice	5	Access	2	Interest based	2	Privacy	1
Avatar/character	7	Interaction/Sharing	4	Teacher control	2	Literacy support	2		

Figure 6: Story Creation Needs Categories by frequency

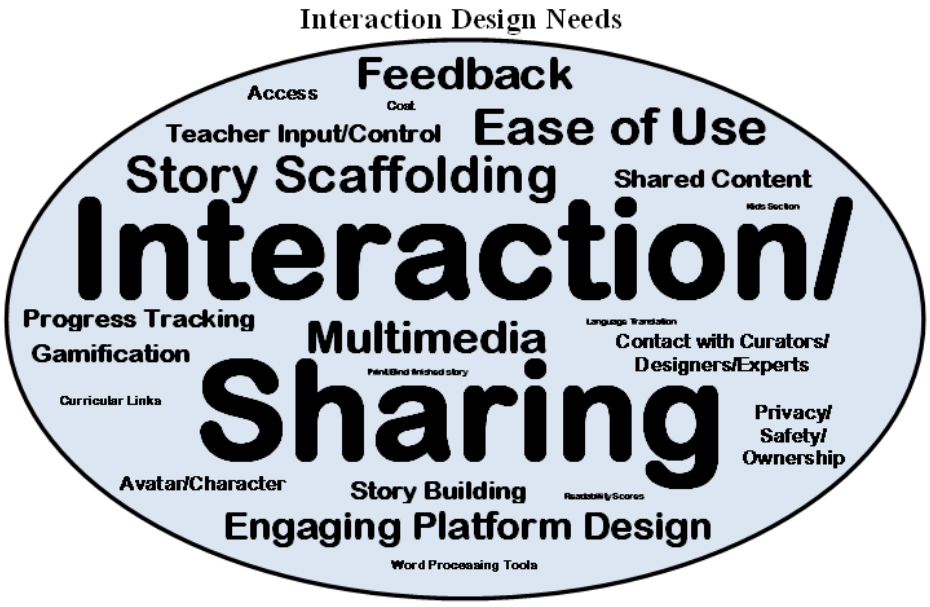
The top five categories in Story Creation Needs were *story building*, *multimedia*, *story scaffolding*, *avatar/character* and *story resources*. *Story building* needs included tools and options that give children story ideas and help them to create their own stories. One participant suggested "A bank of story ideas to help students get their stories started." Others suggested "Online idea prompts/beginning of story" and "Give the ending – students have to develop the story." Many participants also suggested that scaffolding should be structured into the Q-Tales platform, such as "To be [able] to access a template that is relevant to a topic", "A place to get help with my story when I get stuck," and "Ready-made story-boarding

templates." *Multimedia* also featured highly in the story creations needs section. Participants suggested the need for "Students to create multimedia texts." Multimedia mentioned by participants under this category included "Selection of sound effects," "Audio clips," "The facility to embed photo/video/audio/text" and "To record voiceover and sound effects."

The *avatar/character* category had to do with suggestions regarding the use of avatars or characters in the user interface, as well as the ability to create or design one's own characters, or to choose from stock characters provided on the platform. Suggestions included "Selection of options re avatars, characters", "A programme that creates an avatar based on my descriptions", and "To use some copyright-free yet interesting characters." Finally, the *story resources* category included suggestions such as "To be able to add to the resources already available", access to "Copyright free images, music, sound effects," and access to a "Bank of photos."

Interaction Design Needs

Participants were also asked to generate interaction design needs they considered important for the Q-Tales platform. A total of 104 interaction design needs were identified. These were coded and categorised into 22 categories, illustrated in Figure 7.



Frequency of interaction design needs categories represented in diagram:							
Interaction/Sharing	25	Gamification	4	Avatar/character	3	Kids section	1
Ease of use	8	Progress tracking	4	Contact with curators/designers/experts	3	Language translation	1
Story scaffolding	8	Shared content	4	Privacy/safety/ownership	3	Print/bind finished story	1
Multimedia	7	Story building	4	Cost	2	Readability scores	1
Feedback	7	Teacher input/control	4	Curricular links	2		
Engaging platform design	6	Access	3	Word processing tools	2		

Figure 7: Interaction design needs categories and frequencies

The interaction design needs most frequently mentioned by participants fell under the categories of interaction/sharing, story scaffolding, ease-of-use/usability of the platform, multimedia and feedback.

Participants mentioned interaction or sharing with others most frequently in this category of needs. This interaction included sharing with others through story sharing and idea sharing. They thought it would be important for students using the platform in an educational setting to share with their parents, their teachers and with each other. They also thought children using the platform ought "To be able to share my stories/read others stories." They felt that users of the platform should be able to "Collaborate in a group or a shared story" and that users should be able "to comment on finished stories [of] others."

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Story scaffolding also ranked high with the workshop participants in the interaction design needs category. They suggested the use of templates, wireframes and narrative structures to assist users of the platform to create their stories. They stated that the platform should include a "Clear workflow path/checklist," and that guidelines should be included for forms of writing, such as "…Sonnets, Novellas, Limericks, etc." The third most frequently mentioned interaction design need was *ease of use*. They felt that the platform should be "A friendly, easy-to-use technology that is intuitive," and "A tool which is suited to my ability."

The use of multimedia elements such as images, music and sound was also mentioned frequently in the interaction design needs category. Participants suggested the need to "Be able to use my own music", "…download/include my own photos/music" and the need to have "Access to a wide variety of multimodal resources." The category of feedback included the ability to get feedback "…from users – teachers, students, others" using the platform. Participants also suggested that there should be "A range of ways to give feedback (written, oral, visual)" and that there should be some way for teachers using the platform with their students to "…see how other teachers assess/give feedback."

Learning/Assessment Tool Needs

Finally, participants were asked to generate needs to do with learning/assessment tools. Participants generated 165 Learning/Assessment tool needs, which were categorised into 36 categories, shown in Figure 8.

Frequency of learning/assessment tool needs categories represented in diagram:							
Curricular links	21	Gamification	6	Story topic choice	2	Literacy support through games	1
Interaction/Sharing	15	Personal relevance	5	Teacher training	2	Multicultural	1
Literacy development	14	Access	5	Story scaffolding	2	Student choice of finished e-books	1
Engaging platform design	12	Interactive assessment	5	Ranking of finished stories	2	Searchable stories	1
Progress tracking	11	Story building	3	Story collaboration	2	Personal storage	1
Story resources	9	Teacher input/control	3	Metacognition	2	Student independence	1
Feedback	9	Multimedia	3	Technical support	2	Self-assessment facility	1
Privacy/safety/ownership	8	Shared creative space	2	Content creation	2	Age appropriate tools	1
Ease of use	6	Avatar/character	2	Creativity	1	Print final story	1

Figure 8: Learning/Assessment tool needs categories

The largest category in the learning assessment tool needs was curricular links. Some of the needs mentioned by participants in this area included “To use media to help bring relevance to English/historical context”, “To be able to use the website to fit with my lesson objectives” and “To practice using the new vocabulary in our history text book.” Interaction and sharing also figured high in this category of needs. Participants stated that users should be

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able “To share the story with my friends”, to “Facilitate interactive story circles,” and “To know how I can create a page within this platform to upload and share my students writing.”

Engaging platform design suggestions dealt with the need to create a platform that would provide “A colourful, game-like experience”, a “Stable online platform with technical support” and “A technology interface that is user-friendly.” Participants also suggested an interface design that included “Software with multiple pathways, differentiated”, and “A platform that is not device specific.”

Participants also suggested needs dealing with progress tracking. Some wanted “To be able to use this website to assess progress”, while others suggested that the platform should be able “…to provide for portfolios to be created.” Finally, the need for “Assessment embedded (like Khan Academy)” was also mentioned.

It is important to note that some needs were mentioned across more than one needs category. These included Interaction/Sharing, Story Scaffolding and the use of Multimedia. In summary, the most frequently cited needs across the three needs categories are presented in Figure 9.

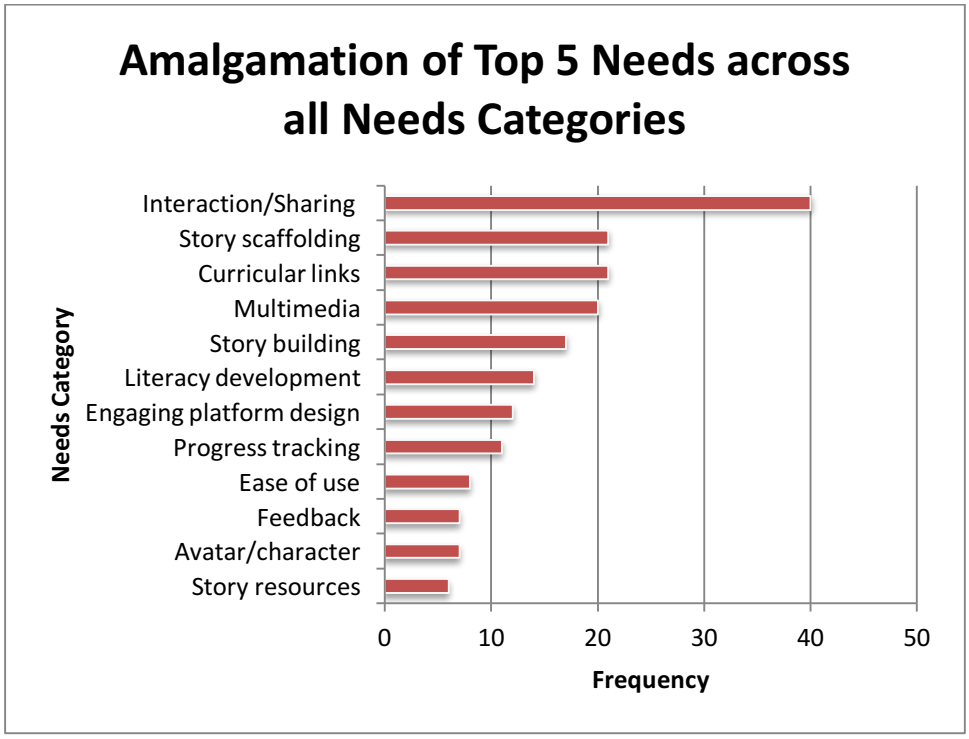

Figure 9: Amalgamation of top 5 categories across the three needs categories

Overall, the results of our collective intelligence workshop highlight a wide range of programmable user needs and requirements that align with pedagogical priorities and affordances identified in the mainstream educational, psychology, learning sciences and design-based research literature.

Presentation of Needs to the Q-Tales Consortium

In May, 2015, the Q-Tales consortium met in London to present the user needs generated in the workshops held across Europe. During this step in the process, a dialogue between the software development team and collective intelligence team ensued, in an attempt to get the balance right between what users want and what developers can do, which as Cohn (2004) noted, can be very difficult. The needs generated in each of the workshops were amalgamated into a spreadsheet by the consortium director and over two days of discussion,

developers, coders and other team members went through the list to rank the needs in order to decide what was feasible to code in the first iteration of the Q-Tales platform. The needs were ranked as: High Impact and Feasible, High Impact but Less Feasible, Less Impact and not Feasible, and Less Impact and Feasible. The needs that were deemed high impact and feasible were targeted for incorporation into the initial platform design. Those deemed as high impact but less feasible were tagged for possible incorporation into the platform at future phases of development.

Conclusion

As noted previously, the Q-Tales project has as its major goal the enhancement of literacy skills in children. The collective intelligence of our stakeholders was used to inform priority design issues, constraints and requirements. As a result of the design process thus far, we appreciate the many design challenges and risks involved in the creation of an e-book platform for children, including:

1. The challenge of translating pedagogical principles and specific needs and activities into a usable set of templates, activities, and design structures for e-book designers.
2. Aligning a potentially complex set of pedagogical framework ideas with a curation strategy that is relatively easy to manage and sustain.
3. Creating a technology design strategy that allows for different pedagogical innovations to be introduced at different phases of the Platform design process.
4. Prioritizing key pedagogical innovations as the primary starting point in the Platform design process.
5. Designing the usability of the Platform such that it addresses and facilities intuitively the diverse user requirements of multiple types of users.

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Moving forward, we are optimistic that we can embrace these challenges and design a platform environment that responds directly to the needs of users and results in the design of a new generation of e-books that foster and accelerate the development of literacy skills in children in a fun and engaging way.

At this point in the technology design process, the appropriation of CI methodologies, along with user story methods, has enabled the Q-tales design consortium to elicit and prioritise – in a principled and systematic fashion - key system user constraints and requirements. As the Q-Tales platform serves a dual purpose, both as an educational and curatorial system, whereby e-books are not only authored but also evaluated, the design work for the initial Q-Tales system has entailed engaging with a wide range of stakeholders, representing a diverse array of end-user needs and requirements. CI, augmented with user story methods, has supported the Q-Tales design consortium to engage critically with these manifold requirements and develop a nascent e-book ecosystem that embodies the key design requirements emerging from the systematic collaboration with key stakeholders while concomitantly honouring fundamental design laws concerning variety, parsimony and saliency (Ashby, 1958).

The Q-Tales Authoring Tool offers an easy-to-use interface with powerful and sophisticated authoring features which can be used to create e-books that can be, with a single click, published for many different digital platforms (iOS, Android, Windows and Mac OS). The authoring interface makes use of pedagogical mini games, gamification techniques and a curation mechanism to create and share quality e-books. The Q-tales Authoring Tool (Figure 10) is not intended only for professionals, but also for parents, teachers and other adults, who want to create e-books for, or with their children/pupils.

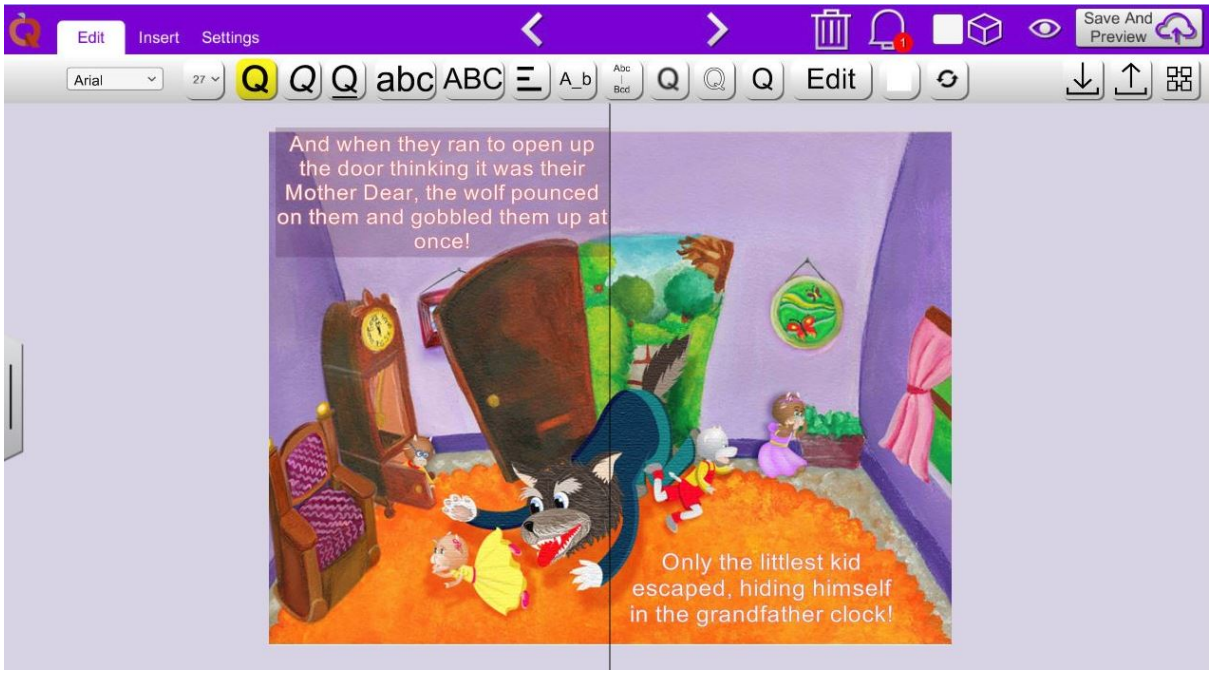

Figure 10: Q-Tales authoring tool

The limitations of the design-based research work at this juncture are, that although a detailed and rich set of user constraints and needs have been identified and prioritised, the initial conceptual design and technological implementation are still at an early, formative stage in development, and the initial design work has been undertaken with a purposive, relatively small user group and intensive but small number of workshops. The integrated use of CI and user story methods has enabled the Q-Tales project consortium to conceptualise and design a system. However, further design and evaluation are warranted – again using CI and user story methods – to develop and refine further the Q-Tales e-book ecosystem. Notwithstanding, from our initial experience exploring and employing this methodology, collective intelligence, augmented by user story methods, has much to commend it as a generative and inclusive, systematic design approach to the conceptualisation and development of innovative technologies to support children's literacy development and enhancement.

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