

Fill That Blank! An iOS-based Literacy Application

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Abstract— There are many existing software applications that claim to teach English literacy. However, these applications often cater to preschoolers, only teach vocabulary or phonetics and mostly focus on fundamental reading skills, and not comprehension. This project aims to develop an application that teaches 7-10 years old children comprehension of the English language. Research was conducted into existing applications and pedagogy leading to the elicitation of requirements specification and design. Our iOS app is designed as a tailored cloze activity (“fill-in-the-blanks”) in the context of a story. A usability study was conducted with 18 children in the target age group at two primary schools from different socio-economic areas. Overall response to the application was positive with high intuitiveness and engagement ratings. Future work includes refinements and can explore effectiveness of the app through a longer case study.

Keywords—*Child Computer Interaction (CCI), Digital Learning, Education, Literacy*

I. INTRODUCTION

Mobile devices have seen a large increase in both capabilities and popularity in recent years. With the arrival of digital e-books, and the introduction of tablets such as the iPad, teachers have begun to integrate these devices into their classroom activities [1]. At the same time, we find children are no longer part of the digital immigrants: they are digital natives [2]. It can be argued that they are more competent at managing technology than many adults.

As a consequence, many education-focused apps have appeared in the market. In the literacy category, these apps often cover areas such as alphabets, basic reading, phonetics and spelling, with very few addressing comprehension. Comprehension is defined as the ability to understand or extract meaning from text [3].

The goal of our project was to explore the design and development of a software application (app) for the iOS platform (iPad with Retina display tablet) that teaches comprehension of the English language. For example, rather than focusing on simply comprehending standalone words (e.g. “dog” and “bed”), our app emphasizes the comprehension of the language in the context of a sentence (e.g. while “the boy took his dog to the park” is correct, “the boy took his bed to the park” is incorrect.) Our app – named Fill That Blank! – is aimed at primary school-aged children. As such it was designed to be easy to learn, simple, and as intuitive as possible [4]. Through a usability study with children in NZ schools, we aimed to investigate the usability and effectiveness of our app

in engaging children’s attention and facilitating the acquisition or consolidation of comprehension skills respectively.

II. RELATED WORK

There is increasing evidence to support the potential of interactive technologies to benefit the educational sector. Efforts at introducing iPads in primary schools have concluded their ability to engage the previously unengaged students, share points across students easier and also make classes more creative [8]. However, we find that a predominant set of literacy based apps focus on early childhood education (pre-school) and apps focused on older age groups are rare.

A popular reading app format is e-Books. A common criticism of current literacy-based applications such as e-Books is that they are generally “watched” and not read [5]. With audio-to-text features, children often listen to the stories rather than learning to read. Another limitation is seen as their inability to promote interaction between children and parents/teachers [6].

Some popular iOS-based apps that focus on literacy include *Bookworm* [9] which attempts to assist children with building words to improve their vocabulary. Others, such as *iSpy Phonics* [10], aim to teach children phonics by matching the phonic sounds with letters. These applications were concerned with the recognition of the alphabet, or learning phonics; very few applications addressed comprehension or promoted the telling of stories [7].

Apps such as *Aesop’s Quest* [11] provide a short story for the user to read. At the end, they ask the user questions in order to evaluate their understanding of the text. This method does have merit, as it requires an understanding of the text if the user wishes to score well. However, a problem with this approach is that it becomes assessment focused. This might encourage readers to skim through the text or pick out key words in order to finish quickly and get a good score, rather than take their time to fully read through and comprehend the text [12].

Keeping these aspects in mind, we aimed to design a literacy app focused on imparting comprehension skills to school-aged children between 7-10 years old with varying levels of difficulty.

III. DESIGN AND IMPLEMENTATION

A classic literacy education and evaluation method is the cloze procedure [13]. This procedure is similar to sentence-completion exercises, as words are randomly deleted from a passage of text (“fill-in-the-blanks”). In an open cloze passage,

participants are asked to fill in an appropriate word in the deletion. In a closed cloze passage, participants are asked to select the correct word from a given list, often formed as the set of all deleted words from that passage.

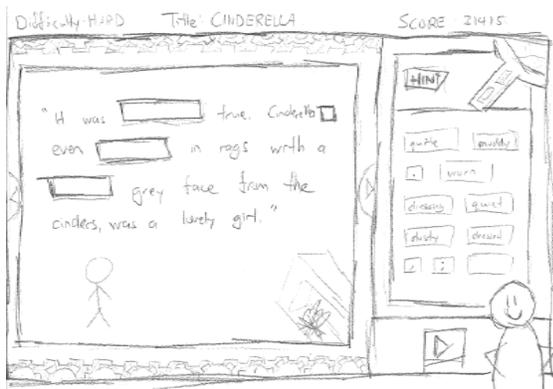


Figure 1. Top: Early Lo-Fi prototype
Bottom: Cloze passage (fill-in-the-blank) activity in the actual game

We decided to implement the app as a closed cloze passage within the context of a story, providing users with multiple options to select from. Upon opening the app, students were able to select a new game, continue a previous game, or view their high score. The book displayed a page on the screen at a time. Each page had 2-3 sentences, each with one word missing (a blank). On the side we included a list of options to select from. Figure 1 shows a hand-drawn early lo-fi prototype (top) and the actual cloze passage (bottom) in the final software application. By varying the number of options provided we were able to allow students to customize the passage into different difficulty levels such that the easy level had one correct and one incorrect option while medium and difficult levels had a greater number of incorrect options.

We allowed students to select from two different modes: (a) play mode (default): students would attempt the cloze passages as they read the story and (b) story mode: students could read the story at their own leisure without blanks to fill. The story mode became accessible after the student had completed the play mode at least once so that they couldn't access answers prior to attempting the cloze passages. Other features of the app included:

- Scoring: points are awarded for correct responses and deducted for incorrect responses, where incorrect responses led to half the points deducted as would be awarded for a correct response. This was done to discourage random guessing. The difficulty level also had a proportional bearing on the score earned and deducted.
- Back and Auto-Save: Touching the “Back” button, represented by the arrow, in the top-left corner will bring the user back to the cover view. Doing so automatically saves the current game, and so touching “Continue” from the cover screen will bring the user back to the page they were at and restore the game state.
- Hints: if the student chose to press the “Hint” button, it made the correct answer shake and blink momentarily.
- Certificates: The user receives a certificate upon completing a story. The certificates that have the best score for each story and each difficulty are displayed in the scores view. They can be used to see how well the user is doing, but their main role is to provide a clear goal for the user, in terms of a high score, to work towards.

The answer options include some extra words in order to discourage trial-and-error, as well as to test the reader's comprehension. For example, a sentence might be “It was the middle of the ____ so Alice went to the beach to sunbathe”, and possible words may be “night” and “day”. While both are grammatically correct, only “day” is correct when considering the context of the sentence. Research has shown that using words in context and placing emphasis on the intention behind the word, rather than solely the grammar, is a more effective way of teaching[15][16].

IV. USABILITY EVALUATION AND FINDINGS



Figure 2. Children evaluating *Fill-That-Blank* at school

We conducted a usability evaluation with 18 children within the target age range at two primary schools of different socio-economic backgrounds. Human ethics approval was obtained for all participants before evaluation was carried out. The evaluation was done in 10-15 minute sessions and consisted of three parts:

- Pre-evaluation Questionnaire: children were asked about their prior experience with touch devices and tablets.
- Evaluation Tasks: children were provided instructions to play the game through to completion, starting from the home view (Fig. 2). They were also given additional tasks along the way, such as muting the music. Their progress, comments and any difficulties they encountered were recorded.
- Post-evaluation Questionnaire: After completing the tasks assigned to them, children were asked to complete a questionnaire to give feedback on the user experience. A Likert scale was used to gather feedback on their level of satisfaction. Open ended questions were also provided to cover questions not suited for being measured with a scale. These include general questions to gauge comprehension of the story read during gameplay.

The post-questionnaire was conducted as a SUS evaluation [14]. SUS evaluation stands for System Usability Scale where the questions measure the intuitiveness and the usability of the application.

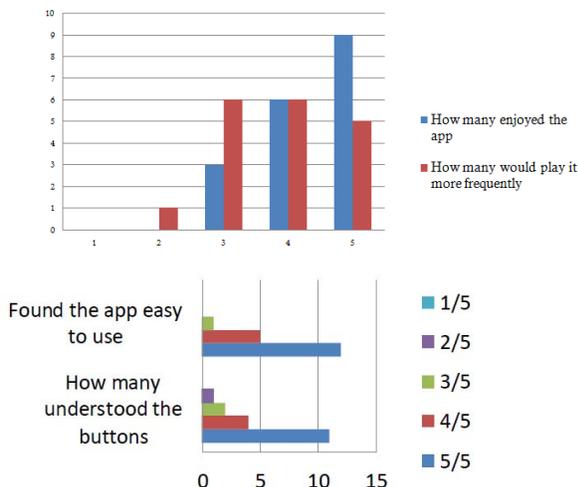


Figure 3. Usability evaluation findings: engagement (top) and intuitiveness (bottom)

A. Engagement

All participants had used touch devices before. Some usability issues were discovered after the evaluations. The most prominent of them was the drag and drop gesture. Despite our attempts to make the drag and drop more intuitive by adding animations, sound effects and even including instructions on a chalkboard in the game view during design, observations during the evaluations suggest it was still not as intuitive as tap and click. Many children attempted the tap and click, expecting that the word would go into the blank when they tapped it in the list instead of drag and drop.

Most children enjoyed the high-score mechanism, a lot of them wanting to go back to attempt to beat it. Some of the kids

finished the book and went through it again on a different difficulty.

The results from the questionnaires as well as comments from the participants during the evaluation indicated that it was an enjoyable experience, with all participants rating it a 3 or higher on a scale out of 5. A majority of participants reported that they would want to use it more frequently (Fig. 3). In particular, participants were eager to replay the game, either to try a harder difficulty or to improve their score. Upon being asked whether they wanted “Fill That Blank!” at school, 94% of the participating students agreed.

B. Effectiveness

Most participants were able to answer questions about the story they had read as a part of gameplay afterwards. For example, in response to the question “*What happened to Tommy at the end of the book?*” several children answered very well. The participants were asked if they had learned any new words upon completing the tasks. The majority of them claimed that they didn’t, and that the content was too easy. This may also be the reason why many children did not use the ‘hint’ feature. However, despite the perceived easy content, many children failed to achieve a perfect score. This indicates that two areas of the app can be improved – the content difficulty and adding feedback for incorrect answers such as the reason why it was incorrect.

While some indication of comprehension through the gameplay was evident, an in-depth study will need to be conducted to assess the long-term effectiveness of the app in supporting literacy, particularly comprehension, in a classroom setting.

V. DISCUSSION

An important consideration is the level of textual complexity suitable for children aged 7-10. One well-known readability metric is the Lexile scale, a quantitative measurement based on word frequency and sentence length. The scale ranges from 0 Lexile (L) to 2000L, with 0L and below rated as being for beginner readers. One problem that results from using a quantitative measurement is it fails to account for multiple levels of meaning or the maturity of the themes [17]. For example, “Library Mouse” is a 32 page children’s book about a mouse that likes to read and write. This book has a Lexile measure of 830L. In comparison, “The Hunger Games”, a 384 page book set in a dystopian future that explores philosophy, romance and death, has a Lexile measure of 810L [18]. Another criticism of the Lexile framework is that unlike other readability formulas, the formula is not freely available for use. In a more general sense, readability metrics are often criticized as being inconsistent and unreliable [19] as they do not take into account context or complexity. As such, content used in “Fill That Blank!” is not rated with a readability score.

Recent exploration of iPad use and learning shows that a clear concept of a game in an app is generally expected by children between 6-8 years old [20]. This includes a clear purpose, process, and way to improve by winning or mastering a level besides being highly interactive (over and above visual

and audio features) [20]. Our study supports this observation as participating children were definitely interested in the idea of high score and reattempted gameplay in an effort to better their score. Similarly, the interactive nature of our app was generally highly appreciated by the children.

Other research in this area includes studies of use of iPads in: learning literacy in early years (3-7 years old) with parents [21]; amongst 5-8 years old children with disabilities [22]; and amongst 5 (or nearly 5) years old children in 'Prep' school settings [23]. While not focusing on the same age group or scenarios as our study, some findings from these studies are generally useful for this field of inquiry, including: the popularity of interactive mobile devices (such as the iPad) has pervaded the arena of education with teachers and researchers exploring best ways of design, develop, and use latest technologies to support and enhance traditional learning subjects. In general, while preliminary findings – such as ours – support the potential of iPads to support learning, more in-depth research needs to be conducted in this area to draw strong conclusions about the effectiveness of literacy apps/games amongst 7-10 year olds in school settings.

VI. CONCLUSION

We designed and developed an iOS application "Fill That Blank!" aimed at helping children aged 7-10 with comprehension skills. It was designed as a cloze passage activity where children were required to select correct words from the given options to fill in the blanks in the sentence while maintaining the correct grammatical and contextual meaning.

Overall, the feedback from the usability evaluation was positive, with high intuitiveness and engagement ratings. A strength pointed out by an educator is the extensibility of the application's functionality – adding appropriate content would allow it to be used as an educational tool for different subjects, or different age groups – such as adults learning English as a second language. Several participants expressed a desire to be creative with the story, which is a very viable idea. Allowing creativity with selecting answers would help improve writing ability, which is another important area of literacy. While concrete conclusions about effectiveness cannot be made without a longer-term evaluation, the usability evaluation suggested high level of engagement and better appreciation from students. In the future, we would like to evaluate the app over a longer time to assess the effectiveness of the app as a comprehension improvement tool.

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