

## Combining the Dimensions of Written and Digital Media in a NFC-based Non-linear Adventure Game for Children

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### Abstract:

*In many countries, people are worried about kids' reading habits. Furthermore, many people thinks TVs and games takes hours away from reading and decreases not only kids reading skills, but especially their imagination. We can not claim that such phenomena does not exist, but games are the new form of storytelling and social interaction for younger generations. Literature, imagination and finally learning itself has always been about storytelling and social interaction. We should use that fact to build motivation around literacy and reading. This paper describes a Near Field Communication (NFC) based multiplayer mixed reality game "The Literature Race" that motivates the children to find information about books, apply that information in teams to solve the challenges in the game and finally get familiar with libraries. According to our pilot studies the game concept is engaging and motivating.*

**Keywords:** NFC, games based learning, reading, library, children

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### 1. Introduction

In many countries, people are worried about kids reading habits. Furthermore, many people thinks TVs and games takes hours away from reading and decreases not only kids reading skills, but especially their imagination (e.g. Greenfield 2009). We can not claim that such phenomena does not exist, but games are the new form of storytelling and social

interaction for younger generations. Literature, imagination and finally learning itself has always been about storytelling and social interaction.

This paper describes a Near Field Communication (NFC) based multiplayer mixed reality game “The Literature Race” that motivates the children to find information about books, apply that information in teams to solve the challenges in the game and finally get familiar with libraries. The game is developed and designed by teachers and students at Satakunta University of Applied Sciences (Finland) in co-operation with Luvia municipality library (Finland).

The game is targeted for children aged 11-15 with aims to get children familiar with literacy and libraries. However, there are several other hidden objective behind the game design: 1) it requires and teaches team work, 2) because kids are walking in the library, they get some physical exercise and 3) solving the tasks requires learning new knowledge e.g. in history, geography and biology.

Applying NFC and RFID in game design has been studied e.g. in social mobile games with educational dimensions, with shared social experience and physical interaction between players (e.g. Nandwani, Coulton & Edwards, 2011; Garrido, Miraz, Ruiz & Gomez-Nieto 2011). Furthermore, location based NFC games and location aware NFC UIs allow users to play games in mixed reality in that they can interact with both real and virtual objects within that location (e.g. Rashid, Coulton, Edwards & Bamford 2006; Broll, Graebisch, Holleis & Wagner 2010; Vajk, Coulton, Bamford & Edwards 2008; Sánchez, Cortés, Riekkilä & Oja 2011). In these environment NFC and RFID are used to extend mobile devices into game controllers.

In our study we connect the object with NFC into game controller (mobile phone), but not only because of the object. The key is to connect the textual content of the object into game controller in order to control the storytelling. In other words, in our approach we are connecting content into stories with NFC.

## **2. Research procedure**

Empirical experiments were done in Luvia municipality in September 2013 involving 15 fifth grade pupils (11-12 years old) in one group and in May 2014 involving 31 fifth grade pupils in two groups. The research procedure for all groups was following: Classes/groups were divided into 4-5 pupils teams and each team received one Nexus tablet. Pupils get a brief 3 minute instruction for the game play. Further instructions and support was provided when needed. No identities were written down, nor any other notes that makes recognizing the person possible. Playing time was approximately 40 minutes. Researchers and librarians were allowed to assist pupils during the game play only in verbal way, i.e. they were not allowed to play the game.

Researchers observed during the gameplay and interviewed after the gameplay the following themes: 1) what was the user experience including the first impressions? 2) What was difficult, what was easy or boring and what kind of social activities occurs during the game play? 3) What was the experienced educational usefulness and was learning fun?

The additional research questions were a) how the players adopted the gameplay, b) if the user interface was informative enough, c) if they had learned something about the library and d) how they felt using the tablet as a book scanner.

### 3. The Literature Race - Game concept

The game is designed for mobile devices, the current version particularly for Android Nexus tablets. Android was technically the easiest platform to start with and it has NFC support but we tried to keep it as customizable as possible. The game can be played as a single player game but suits actually even better for group working. If played in 3-5 member group, one can hold the tablet and deal with the book scanning (figure 1), while the others can actively find books and search information on the library computers. The non-linear story will always be different, i.e. chain of books will never be the same. The Literature Race is designed to combine the digital dimension of media to the written world of books. The mission is to help children to get familiar with library and furthermore, to find interesting books that they can read afterwards. The gameplay is kept straightforward: the focus is on searching books and scanning the correct ones.



Figure 1. Searching the books in teams.

When the game begins, a video starts to play, in which a literature agent tells that there is a conspiracy against your library and you are only one to stop this by solving the code which is hidden into upcoming messages. The story is simple and it is presented in the very beginning. The player is ought to work as a helping hand of the library agent and save the library from a crisis. To complete the game, the player must find and scan 30 correct books.

In the starting video (figure 2), the player gets a tip for finding the first book. The tip is a word that should appear in the name of the first book, which will be scanned with the NFC

reader of the mobile device. If the word is, let's say, "world", the player can scan e.g. "Around the World in Eighty Days". After that, the name of the next book to be scanned should contain one of the words from the previous book's title, excluding the "world", which has already been used. The same word can't be used more than once, which prevents the player from looping and scanning the same books over and over again.



Figure 2. An instruction video.

After any mistake (scanning a wrong book, not finding a book fast enough or losing all the energy points) there will be shown a short video clip to explain that an error was made. Also the player will lose one life from a total of three lives. After playing for awhile, other videos will give the player cheering or if needed, some feedback about how to behave in library. The challenge in this kind of production is to build a manuscript flexible enough for non-linear gameplay. In the end, when the 30 books are found or all the lives have been lost, the player will get info about his/her score in the ending video. The game score consists of three elements:

1. How fast the player can find a correct book
2. How well the player obeyed library rules (e.g. no shouting or running)
3. How many books went correct

While the game is designed to be fun and cheer and lure the kids to come to the library, it's also chastening: the accelerometer of the tablet will pick up any running and the game will lower the score and notify the player not to run in the library. Also the microphone is harnessed: if the player or the group gets too loud, the score will go down a bit and a notification is given to keep the voice down.

When the player has found a book that is believed to be the correct one, he/she places it near the mobile device and the game reads the RFID-tag placed at the back of the book (figure 3). In the library of Luvia there is a RFID tag in every book, which is not the normal case in other libraries. Scanning the correct book will grant the player points and lead to searching the next book. While playing the Literature Race, the player/group will also get physical exercise imperceptibly: during one game, a player can walk 1-2 kilometers in the library.

There aren't many games available (that we know of) in the game industry that use NFC or RFID (Radio-Frequency Identification) in their core game play. Especially, there are not that many games which are designed and developed particularly for the libraries. One reason for this is that there are still not so many devices that support the NFC technology and libraries are not seen as a place for playing. We wanted to break these prejudices and develop a prototype game for one library, with whom we have worked before on this type of research. We decided to use NFC as our user-game-interaction interface, because we think there is great potential in it. Also one can go beyond the traditional "touch the screen and something might happen" interfacing with mobile games. With NFC technology player can truly interact with the game: the game reacts to your actual, physical actions. For the future versions, it's possible to modify the game to serve some additional purpose also. For example, if we want to teach the kids history, we could program the game to give history-related words and so on.



Figure 3. Scanning the books.

Playing the game in groups teaches the kids to manage roles in group work situations. There are different roles as mentioned earlier: the information seeker on the library computer,

the bookshelf agent searching the books and the leader, who handles the mobile device. These roles can be swapped during the game, which helps kids in learning the different tasks in library. It's also legal to ask help from a librarian. Because children have a natural appeal to games, the playing is fun and the situation is perfect to imperceptibly teach them group work. They learn more in groups and gather some good experience on team working for the future.

The game is currently being developed further, is now in pilot use and has been tested two times. In the next section, we'll go through the results gained so far.

#### **4. Results and Discussion**

Results discussed in this paper have been collected in two different trials. First trial was held in September 2013 (n=15) and second test was in May 2014 (n=31). Target group ages were between 11-12 years and total of 46 children played the game (three different classes). Game was tested in Luvia municipality library, in Finland and the players were fifth graders from local school.

Both testing events had same structure. At first short instructions were given about how to play the game and what is the goal of the game. Then the pupils were arranged to groups between 3 to 5 and they were given free playing time from 35 up to 45 minutes. After the groups had played enough short interview was held which was mostly about how the pupils adopted the gameplay and how they felt playing. Interviews also consisted free comments about the game. Some observations were also collected during the playing to get more detailed understanding how the pupils played the game.

Questions were formulated to find out players feelings as they played the game as well as to find bugs in the source code or wrong behaviors. We have to keep in mind that the game is still in beta phase when the tests were held. We also wanted to find out a) how the players adopted the gameplay, b) if the user interface was informative enough, c) if they had learned something about the library and d) how they felt using the tablet as a book scanner.

Generally when the tests started most players were eager to start playing the game as they experienced the game to be exiting and new. This led to the outcome that instructions were listened poorly. But even though players did not listen the instructions so well they adopted the game quickly (table 1). Most of the players said that after the first book was scanned the gameplay was easy and straightforward. The whole game was build around storytelling with videos but most of the players skipped the videos immediately. They felt that watching videos was slowing them and they took the videos as a introductions or some additional game content which would not offer any value to the game. The videos were also considered weird and burdensome. Players who watched the videos on the other hand felt that the videos were bit entertaining and gave little instructions to the game. Videos might be also skipped because the volume must be kept down in the libraries and the players could not hear it clear enough. In next versions of our game videos must be replaced with non verbal animations, images or silent videos.

The usability was found good, extremely good if considered this to be in beta phase. In the testing session there were no show stoppers and all equipment worked as they should. Only major problems were in Finnish language when the game did not recognize

Scandinavian characters. Some players also felt that scanning the books RFID tag with the tablets' NFC reader was bit difficult. In the future we are going to add barcode scanner as a option in the game (current test devices did not have cameras at the back of the tablet which was the reason not to implement barcode scanner).

Generally pupils found the game somewhat entertaining and educational. Players opinion various quite much in how they found the game. Some of them found the game boring and did not want to play the game again. Some players on the other hand found the playing so entertaining that they liked the interviewing to stop in order to continue playing. Also the educational view of the game divided opinions. Some players were already familiar with the library before the tests and did not think that the game produced new information because of that. On the other hand players who have spent more time in library found the game more entertaining.

Question	Mean between 1 to 5 (1 being extremely negative and 5 being extremely positive, n = 46)
First impression about the game	4.4
How the game was adopted	4.1
Were the videos found entertaining	2.8
Usability of the menu	4.8
The functionality of the game	3.7
Instructions and symbols in the game	4.2
The functionality of the equipment	3.6
The usability of the equipment	4.0
Was the game entertaining	3.6
Was the game educational	3.2
How the players felt the game from easy to challenging	2.8

Table 1. Interview results.

In general pupils learned teamwork when they worked as a group. Usually one player searched books with library's search engine, one or two players tried to found correct books from the shelves and one handeled the tablet so that there would not be any sudden movements or loud noises because it would reduce points (figure 4). Players changed their roles in team occasionally to give everybody change to control the game. Also players found that the time had passed quickly. When asked how long they had played the usual answer was from 10 to 20 minutes and the reality was from 35 to 45 minutes. This gives an indication they have reached a Flow state (e.g. Csikszentmihalyi, 1991; Kiili & Ketamo, 2007).

Usually teams tried to sabotage other teams by coughing or speaking loud near other teams but there was also some teams who helped other teams. In general players were not so interested in their points or what was their position in score table. Teams just wanted to improve their own score.

Although players found library's search engine hard to use and finding the right book from the shelf difficult they did not ask help from the observers or library staff. When giving instructions to the game observers encourage players to ask advice if needed but they still wanted to learn how to find correct books by them selves. When the teams were roaming

between the shelves they found also interesting reading which they would like to loan and read later.



Figure 4. Searching books from the library's database.

In general the game tests were successful and the pupils found the game interesting and fun way to learn library's rules and the use of library's search engines. Some players found that scanning the books with NFC was bit arduous but still usable. Game it self was considered playable and entertaining a least when the library would improve it's internet connections and we would fix the discovered bugs and release finished version of the game.

## 5. Conclusions

Location and context aware games allow users to interact not only with objects within that location but also with knowledge inside the object. In the Literature Race, the story and gameplay is based on mixture of physical exercise, social interaction in real world, knowledge in databases and general understanding on literacy. From educational point of view, the main goal is to encourage children to visit libraries and find interesting readings. The game opens a new possibility to get familiar with libraries and books. Furthermore, walking around library as well as social interaction gives children necessary extra curricular activities.

According to observations and interviews, the game concept is excellent. The players faced a lot of technical challenges during the game play. In fact couple of teams lost their high scores because of network error. However, the observed gaming experience as well as interviewed user experience was very high. Most of the pilot players would like to come back and play the game, no matter if the bugs are fixed, but especially if the bugs will be fixed.

This kind of positive feedback from concept level prototype was promising. Future research will consist of user experience studies with school groups in Luvia library in fall 2013. According to these studies, the story, gameplay and UI will be improved.

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