Designing a gamified reading app with pupils in elementary school

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Abstract. Playing games on mobile devices has become an integral part of younger generations’ lives. Mobile games foster, among other things, deep concentration. This paper reports on design guidelines derived from observations of six elementary school pupils’ engagement over a six-week period during an after-school reading club program. Each meeting consisted of three activities as well as reading text on the Microsoft immersive reader on an iPad, and playing a competitive reading game app, ‘Henry rennt’, which are both designed to support reading. Pupils were engaged in informal conversation with the researchers about both applications, and the authors informally observed the pupils’ engagement with the apps and each other. Patterns of engagement and comments from pupils informed the design of a new reading app. This work reports these general patterns and concludes with new research areas to pursue as a result, including the impact of: social setting on playing, in-game teaching with avatars on engagement, and speed as a measurement of skill mastery. Finally, the applicability of children’s engagement patterns is validated with adult students of German as a second language who used the app.

Keywords: serious games, literacy games, elementary educational games, child-centered design.

1. Introduction

The motivational power of games was discovered by educational systems in the 1960s by a teaching movement known as Back to the Basics, when pupils were getting poor scores in exams. The movement highlighted that reading and writing skills are the basics of communication, and should be taught through

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interaction rather than memorization (Hankin & Sachs, 2002). Integration of mobile devices into educational systems is reported to have a positive impact on pupils’ learning curves (Major, Hassler, & Hennessy, 2017). Since digital games are based on interactivity and decision making to achieve various goals, they have an additional edge over educational books (Yannakakis & Togelius, 2018). According to the LEO (Level-One) study 2018 held by the Ministry of Education in the Federal Republic of Germany, 6.2 million German speakers could not read or write, representing more than 12% of the German population (Davis, 2019). This group of people is left behind by traditional schooling and could be supported by serious games encouraging motivation and practice. Creating effective learning games for elementary schools may be one solution. In games, fun in its varied facets is a strong motivator (Ismail & Ibrahim, 2018), and best explored by involving pupils during the design phase (Langridge, Smith, Smithers, & Southgate, 2017; Nesset & Large, 2004; Sykes & Federoff, 2006). By integrating observations of elementary school pupils’ engagement with good apps, insights into motivating factors can result in design guidelines for more effective games across different age groups.

2. Observing elementary school pupils’ engagement with reading apps

A reading club was established in an elementary day-school one afternoon per week for 2 hours. Six pupils of different genders between ages 8-9 in second grade with elementary German language reading skills participated for 6 weeks. Each session included reading with the immersive reader and playing the literacy game ‘Henry rennt’ (Berkling, Fawaz, Zundel, & Abdennadher, 2019). The immersive reader provides customization options for fonts, sizes, and colors, as well as live focus, pictionary, and part-of-speech highlighting. The game provides the task of finding words to be capitalized in a running game with an emotional avatar. Together, the apps cover a wide spectrum of approaches to the presentation of text material to students for reading practice. Both applications were well received by the pupils. Based on the observations, the authors compiled the following design guidelines for engaging game design specifically for reading games:

- formatting reading texts should be customizable to provide freedom while reading;

3. Parental permission required for biometrical data collection resulted in few volunteers.
4. https://azure.microsoft.com/en-us/services/cognitive-services/immersive-reader/
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- supporting reading comprehension with pictures is an important facilitator;
- sentences should be kept short to support beginning readers;
- games need a simple, short tutorial;
- an accompanying emotional avatar is an important factor for engagement;
- rewards are expected and are not replaceable by the emotional avatar; and
- customization of the character is important to connect the user with the game.

3. Application toward game design

‘Phingu and the magic book’, was designed as an example of how to implement these guidelines in a game (see Figure 1). The game presents a maze to be navigated by Phingu with the help of three tutorial skill-dependent avatars. The student has to read, understand, and complete sentences in order to progress through the maze and levels with increasing difficulty. Table 1 summarizes the game features developed.

Table 1. Guideline and design decisions

| Guideline                               | Adaptation                                                                 |
|-----------------------------------------|-----------------------------------------------------------------------------|
| Customizable text format                | This is left to future work to display the magic books that will be unlocked with each level. |
| Picture-supported reading comprehension | The answers of the passwords are presented as pictures above each sentence. |
| Short sentences                         | Riddle sentences contain a maximum of six words.                             |
| Simple, short tutorial                  | Three distinct skill-based avatars/monsters were added to the game, are associated with by the user, and explain the concept of each of the three types of orthographic principles. |
| Emotional avatar as company             | After each victory, celebratory music is played and Avatars always show reactions after each user’s entry. |
| Rewards                                 | Correct passwords result in prizes in each of the three categories and are displayed with diamonds of the same color-coding as the skill-based avatars. |
| Avatar customization                    | The users can change the customs of the main Avatar before starting the game. |
Figure 1. Scenes from ‘Phingu and the magic book’, including the login page, the maze, the interactive reading and comprehension quiz that can open the gate if correct but also provides a teaching opportunity in case of problems related to the use of the avatar, and the personalization of the avatar.

4. Applicability of design guidelines for adult students

To evaluate the engagement for adults, ten exchange pupils from the German University in Cairo evaluated the game from the perspective of German as a second language for level A2 on the Common European Framework of Reference for languages (CEFR) scale, which level is somewhat comparable to elementary pupils’ reading and writing skills. The average time of guessing the correct words was approximately equal to 34.07 seconds. The average score was 65, which meant the average number of words solved was 13 out of 24. 70% of the students used the one hint offered in-game to help with spelling rules. Table 2 below explores the speed of answering for repeated words. Students tended to get faster during the game, indicating a memorization process.

Table 2. Time taken to submit correct words by trial for example repeating words

| User | Repeated words | Times | 1st visit (seconds) | 2nd visit (seconds) | 3rd visit (seconds) | Average time (seconds) |
|------|----------------|-------|--------------------|--------------------|--------------------|------------------------|
| 1    | Suppe          | 2     | 11                 | 5                  | -                  | 8                      |
|      | Wasser         | 2     | 7                  | 5                  | -                  | 7                      |
|      | Lieder         | 3     | 8                  | 15                 | 9                  | 11                     |
| 2    | Wiese          | 3     | 8                  | 5                  | 3                  | 6                      |
|      | Waffel         | 2     | 6                  | 7                  | -                  | 6                      |
|      | Messer         | 2     | 6                  | 3                  | -                  | 5                      |
In addition to the game analytics, results from informal interviews with the students can be summarized as follows:

- the avatar tutorials provided a learning event;
- the skill-based avatars supported pattern acquisition of orthographic principles;
- playing the game in a social environment resulted in longer time engagement; and
- the game seems to support understanding and memorizing of new words.

5. Conclusions and future work

The presented work showed that a number of guidelines developed based on elementary school pupils’ engagement observations can be applied to literacy game design and is generalizable across age groups. Observing pupils’ engagement with digital reading material and literacy games informed design decisions for a new application in a structured manner and resulted in new leads for further research.

For adult language learners, a qualitative evaluation indicates that playing multiple times improves skill, which supports previous findings for children in similar applications (Berkling et al., 2019). Observations motivate further need to study how social environments during play can boost engagement time, and the effect of emotional bonds with avatars in learning environments. Avatars as teachers seemed to be effective in teaching adult learners’ new concepts.

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5. Social environment for playing games as a major engagement factor has been observed in classroom setting, for children and with adults.
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