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A FRAMEWORK FOR THE CREATION OF MOBILE EDUCATIONAL GAMES FOR DYSLEXIC CHILDREN

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ABSTRACT

Dyslexia is a reading disability that can, in some cases, be cured. The most frequent treatment for dyslexia consists on repeatedly performing certain word exercises. Because most dyslexic patients are young children, most applications for word training are games. The development of such games is costly and it involves different parts (developers, psychologists, etc.). In this paper, we analyze and review the advantages of mobile devices in education and healthcare and present a framework for the creation of games for vocabulary training on mobile devices. The main goal of the framework is to enable the reusability of features typically present in applications for dyslexia training. The main advantage is the rapid development of such games by reducing the dependency of collaboration between developers and experts in the field. We also demonstrate the usage of our framework in the creation of a simple game called ReadPoker.

KEYWORDS

Dyslexia, educational games, mobile games, legaframework

1. INTRODUCTION

Dyslexia is a term used to describe a learning disability that hinders affected people from both, reading fluently and comprehending what they read. This disability is often treated by repeatedly solving reading and writing tasks. A big challenge, particularly when treating dyslexic children, is to keep them motivated in order for them to continue practicing. Because of their motivational power, games are often used to treat dyslexic children.

The development of such games is often complex, mainly due to the knowledge gap between the different stakeholders involved in the creation of the game. Another challenge is to keep the balance between entertainment and learning features. Games created without the involvement of experts in the field, are likely to tend towards “fun”, leaving the “seriousness” of the game aside. Most of the existing games, however, are simple word puzzles that fail to produce player’s immersion, as they lack a game story, among other game features. Additionally, most games target desktop platforms, despite the fact that dyslexia is often diagnosed in early ages, when children’s motoric skills are not yet fully operational.

We propose a framework for the creation of mobile educational games for dyslexic children. The purpose of the framework is to allow the construction of games for dyslexic children by reusing features and content usually present in such games. The framework is constructed in such a way, that entertainment and educational features are decoupled from each other. It also allows developers and experts in the field of dyslexia to work independently on a common game project, which suggests less communication overhead.

The contribution of this paper is twofold: first we introduce the framework and its main components, and then we describe how it can be used to create a game with relatively little effort.

2. THEORETICAL BACKGROUND

2.1 Dyslexia

Dyslexia is characterized by difficulties with accurate and / or fluent word recognition and by poor spelling and decoding abilities (Shaywitz, 2005). Three types of dyslexia have been identified. The so-called trauma dyslexia is a type of dyslexia caused by a serious illness or brain injury. The primary dyslexia is another kind of dyslexia caused by a dysfunction of the brain. This dysfunction is however caused by genetic factors and does not change with age. The third type of dyslexia is called secondary or developmental dyslexia. Patients of this kind of dyslexia usually present standard IQ levels and sensory abilities but still suffer from deficits in reading (Démonet, 2004). The only known way to improve this condition is continuous practice.

2.2 Mobile Games for Education

Several researchers (Gee 2008, Prensky 2008) have discussed how the experience delivered by games can contribute to our everyday learning. Games are mainly used in education because of their ability to motivate and engage learners. As they offer more interactivity and immersion capabilities than other instructional media, learners may sometimes not even perceive playing as a learning activity. Indeed, this is the goal of most educational games, despite the criticisms in (Papert, 1998).

Games also result advantageous due to the fact that they allow abstract concepts learned in a classroom to be contextualized. Learners can then apply the concepts in concrete situations rather than simply reading or hearing about them. This contextualization takes place without the risks or impossibilities of real life. Further, games allow situations to be repeated immediately in the exact same way as much as needed.

Mobile devices can be beneficial in the context of education for different reasons. First, their multi-touch capabilities favor collaborative problem solving, which enhances learning (Wang, 2009). Additionally, the fact that mobile devices can be used in different environments suggests better opportunities for students to apply learned concepts outside of the classroom. Mobile devices offer a more direct way of interaction and usually highly intuitive user interfaces, enabling their usage by younger children.

3. RELATED WORK

There exist several approaches that try to improve the problems based on developmental dyslexia. A teaching approach that has gained acceptance in the last decade is known as the *multisensory approach*. It relies on connecting the written form of words with related visual and acoustic elements. It is the most effective teaching method for children with learning difficulties (Ohene-Djan et al., 2008).

(Merzenich et al., 1996; Tallal et al., 1996) showed how a computer game that stretches or slows down word phonemes can help dyslexic players improve reading by developing learner's auditory discrimination and phonological awareness. (Kujala et al., 2001) showed how students with dyslexia who received audiovisual training improved their reading skills by matching sound patterns to their visual representation. (Shaffer et al., 2001) showed how a computer tool could evoke and reinforce certain brainwaves causing a significant improvement in student's motor control, as well as language and reading skills.

Despite some interesting findings in the field, (Torgesen, 2001) points out that typical school interventions for children with reading disabilities *stabilize* the degree of reading failure instead of *normalizing* the learner's reading skills. This is mainly due to insufficient budgets and overcrowded classrooms. While automatic adaptivity of software tools could help overcome the problem, (Ohene-Djan et al., 2008) remark the lack of learning technologies able to even identify learner weaknesses.

The industry faces similar problems. Most games for vocabulary training save budget on pedagogical insight and present tasks such as correcting wrongly written words or finding words in clouds of letters. Based on today's studies, this is not recommended anymore because of the risk that learners memorize incorrect spellings of words. According to (Naegele, 2001) and (Meumann, 1914) children learn words more effectively when they are shown the correct spelling of words from the beginning.

4. LEGAFRAMEWORK

The goals of the *LegaFramework* are to simplify the development and ensure the quality of games for vocabulary training by reusing available components. As an example, game assessment strategies are given to developers, who can therefore focus on game-specific features such as the logic of the game, user interface, etc. The framework is based on iOS and supports iPhone and iPad development. It consists of four different modules: *Content*, *Style*, *Adaptivity* and *Assessment*. Figure 1 illustrates the different modules and their interaction.

The *Content* module provides an abstract interface to content elements, such as words. Words are represented in four different ways. The first one is the regular written form of the word (e.g. "Coffee"). The second is a representation in which the core difficulty of the word is blanked out (e.g. "Coff__"). Furthermore, a word is represented by an image and its spoken representation. Each word is further categorized into a problem group, such as "words with double vowels".

The *Style* module is responsible for displaying content in a suitable way for dyslexic children. It uses the *Andika* font that was developed for high legibility and uniqueness of each letter, which makes it easier for dyslexics to read. It further ensures the appropriate dimensions of labels and images, such that users can interact with them. The Framework foregoes any configuration here to guarantee that developers won't use ineffective fonts, font-sizes or inconsistent images.

The *Adaptivity* module takes care of adjusting the game's difficulty to the player. Developers can configure when the game will automatically change to a more or less difficult situation by mapping player skills to difficulty levels. Currently, the framework knows three different difficulties that are: 1) word and image are displayed, 2) the word is displayed with blanked core difficulty together with the image and 3) only the image is displayed. As adaptivity strategy the framework uses simple counting of correct and wrong solutions.

The *Assessment* module stores every solved task and calculates player skills. Developers interact with the *Assessment* module by specifying the event type (correct or wrong answer events) and the corresponding content related to it (task, word, etc.). These results not only serve as input for the *Adaptivity* module but can also be displayed in the form of a table, as shown in Figure 1. This information is useful for therapists and / or parents in order to see the player's progress and to analyze what problem group they have the most difficulties with.

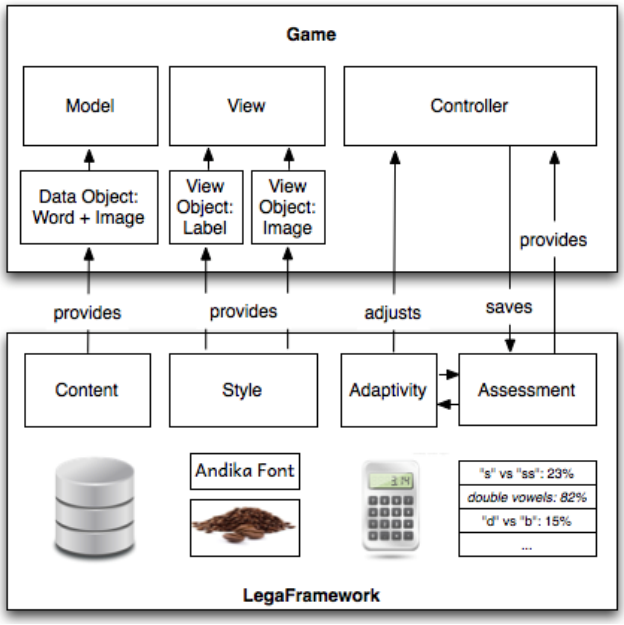

Figure 1. Model of LegaFramework's modules and its interaction with a game

5. CREATION OF A GAME USING LEGAFRAMEWORK

To assess the usage of our framework, we made use of it in the creation of a simple game we called *ReadPoker*. In this game, the player receives five cards that show either words, images, or both. In order to win, the player must select the appropriate cards depending on the current task. As an example, the player may be asked to select every card with double vowels. Figure 2 (left) illustrates the main interface of the game.

LegaFramework's content component is used to fill the cards with content, and the Style component to generate the corresponding view objects out of the content objects. As illustrated in Figure 2 (center), the Content module generates the word and image objects and the Style module provides an appropriate representation for them, which can be added into the game directly.

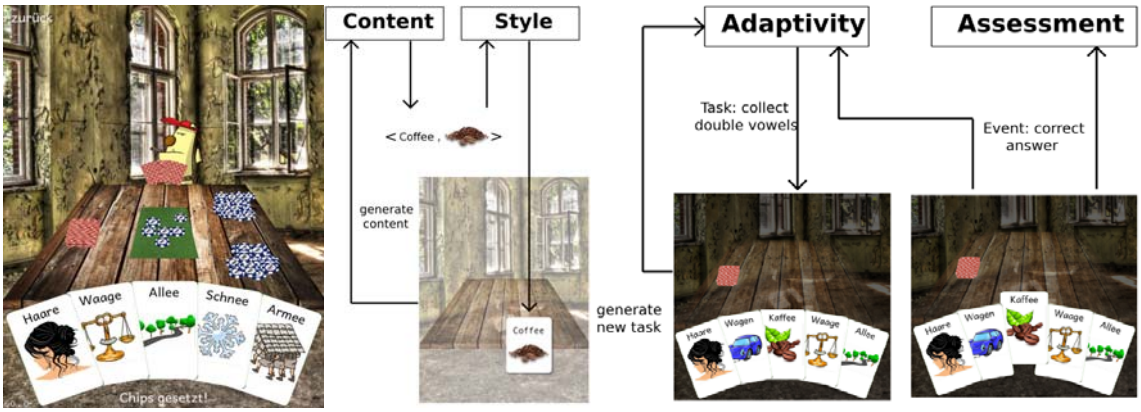

Figure 2. (Left) ReadPoker main interface. (Center) Content generation and representation. (Right) Communication between Game and Adaptivity and Assessment modules

The Adaptivity and Assessment modules are used to provide behavior to the game. The Adaptivity module is responsible for generating new Tasks according to the player skills. A player with low skills will get easier tasks such as collecting double vowels on cards where words and images are fully visible. The more chips a player wins, the higher the probability that new tasks will include words with blanked letters.

The Assessment module receives game events such as correct or wrong answer events and groups this data in a meaningful way in order to determine players' skills. This is illustrated by Figure 2 (right).

6. CONCLUSION

We showed in this work how game developers could add learning features and content to games for dyslexic children without going through the hassle of understanding the problem domain. Based on our experience in the field and interviews with experts, we were able to identify major components needed for such games and integrated them in a framework, from where they can be reused. We demonstrated how the framework enables the creation of a compelling mobile game without major effort.

Tablet devices provide a more direct way of interaction, allowing children even without computer experience to interact with objects on the screen by literally touching them. Additionally, mobile devices do not enforce a usage at home and can be used simultaneously by more than one user. This suggests better opportunities for collaborative playing, and it also facilitates its usage in the context of a therapy.

While reusing existing components enables game creators to save time, this comes at the cost of a reduced flexibility when realizing game specific features. In order to refine the abstractions used by the framework, we are currently planning to use it in the creation of more complex games.

REFERENCES

Démonet, J., Taylor, M. and Chaix, Y., 2004. Developmental Dyslexia. The Lancet 363, 1451-1460.

Gee J., 2008. What Video Games Have to Teach us About Learning and Literacy. St. Martin's Press

Kujala, T., Karma, K., Ceponiene, R., Belitz, S., Turkkila, P., Tervaniemi, M., & Näätänen, R. (2001). Plastic neural changes and reading improvement caused by audiovisual training in reading-impaired children. Proceedings of the National Academy of Sciences, 98(18), 10509– 10514.

Shaywitz, S. and Bennett A., 2005. Dyslexia (Specific Reading Disability). Biol Psychiatry 2005;57:1301–1309.

Naegele, I., 2001. Schulschwierigkeiten in Lesen, Rechtschreibung und Rechnen. BELTZ Taschenbuch.

Meumann, E., 1914. Experimentelle Pädagogik und ihre psychologischen Grundlagen. Verlag von Wilhelm Engelmann.

Merzenich, M. Fast ForWord: Training children to improve their fundamental acoustic speech reception abilities.

Ohene-Djan, J. and Begum, R. 2008. Multisensory Games for Dyslexic Children, pp. 1040-1041, IEEE International Conference on Advanced Learning Technologies.

Prensky M. (2007). Digital Game-Based Learning. Minneapolis: Paragon House.

Papert, S. Does Easy Do It? Children, Games, and Learning. Game Developer, 5(6):1–5, 1998.

Shaffer, R. J., Jacokes, L. E., Cassily, J. F., Greenspan, S. I., Tuchman, R. F., & Stemmer, P. J., Jr. (2001). Effect of Interactive Metranome training on children with ADHD. American Journal of Occupational Therapy, 55, 155–162.

Tallal, P., Miller, S., Bedi, G., Byma, G., Wang, X., Nagarajan, S., Schreiner, C., Jenkins, W., & Merzenich, M. (1996). Language comprehension in language-learning impaired children improved with acoustically modified speech. Science, 271(5245), 81–84.

Torgesen, J., 2001. The theory and practice of intervention: comparing outcomes from prevention and remediation studies, Dyslexia: Theory and Good Practice, (pp. 185 – 202).

Wang, A., Ofsdahl, T. & Mørch-Storstein, O. (2009). Collaborative Learning Through Games -- Characteristics, Model, and Taxonomy.