ZaznajSpoznaj - a modifiable platform for accessibility and inclusion of visually-impaired elementary school children

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Abstract

The educational and IT communities have produced a number of e-learning products, ranging from support-oriented platforms for online courses and learning to educational games. However, there is still a growing need for inclusive and accessible learning products. To meet the need, we developed an accessible online web and mobile platform for educational games which are highly modifiable and applicative to any learning domain. The paper describes the platform, its agile development process, and first results of the platform's evaluation for the blind and visually impaired elementary school children.

1 Introduction

E-learning draws more and more attention each year, by increased inclusion of e-materials in primary and secondary schools, new IT products focusing on this field, and by the rising affordability of technology.

E-learning introduces a number of challenges. Existing educational materials may soon become outdated and do not evolve with new technologies. Moreover, the materials, especially the educational games, usually include fixed content, which cannot be modified by the user. When the product gradually becomes outdated, the educational process and the game content drift apart. Thus, the teacher is faced with a decision to either modify the educational process to include the game or stop using the game. Additionally, the source code of many projects is unavailable — either the code is private (not open-source), or even worse, is lost.

For students with disabilities, e-materials introduce additional difficulties. Although the technology itself usually provides accessibility options to be used by people with disabilities (e.g. Android, Windows and other OS accessibility features), these are rarely usable for a specific product to the full extent. For example, the OS built-in accessibility features may not be fully compatible with an e-learning application and games are not adapted for use by these students.

Within the ZaznajSpoznaj project, we are developing a novel platform for inclusive and accessible educational games that would overcome some of these difficulties. The project focuses on the blind and visually-impaired children by supporting them in their

elementary school learning process. The ZaznajSpoznaj platform offers a variety of repetitive games for memory and vision training, learning Braille and extending the typing skills. The games support accessibility for the blind and visually impaired and are developed to be extremely flexible and allow for modification of their content, thus offering teachers the possibility to adapt the games to several domains and modify them through time.

This paper presents the platform, which enables open-access to: developers with an open-source API for development; teachers who can modify the games in several aspects including content and visual appearance; and users who gain access to a growing community-based games database. The paper is structured as follows: the current state of related products is presented in Section 2. Further on, the ZaznajSpoznaj platform and its features are presented in Section 3, followed by a preliminary evaluation with visually impaired children in Section 4. We conclude the paper in Section 5.

2 Related work

Due to the increasing importance of e-learning there already exist approaches to make learning management systems (LMS) accessible for blind and visually impaired students [8]. In addition there are also various initiatives to make textbooks and other traditional learning materials accessible (e.g. [5], [2]). However, recent trends and developments introduce new challenges into learning processes in general and e-learning in particular. Two currently popular trends are mobile learning and game-based learning. The spread of mobile devices results in a greater demand to support mobile learning activities at every level of education. For example, research activities of Filho et al. address general aspects to make learning environments accessible on mobile devices, Ally et al.[1] are focused on the impact of mobile technology on learning processes, curriculum and education in general to make mobile learning beneficial. To foster mobile learning especially in developing countries the United Nations Educational, Scientific and Cultural Organization (UNESCO) published policy guidelines for mobile learning[10].

Despite all diverse learning concepts and modern technology, learning activities as such remain annoying to most students. To overcome motivational barriers, it proved beneficial to introduce game-based learning elements into the process. Depending on target groups, subject and learning objectives, different approaches can be applied. Especially elementary school children are likely to benefit from such approaches. For example, Leichtenstern et al.[4] use mobile devices to assign specific types of interaction within role plays. Görgü et al. [3] use mobile devices and augmented reality to motivate users for outdoor games. The approach of Schimanke et al. [9] focuses on the benefits of games to improve results of repetitive learning activities. The game-based approach also raises challenges related to accessibility and inclusion. Although some initiatives offer examples of web-based learning games [1][2] they lack the integration into a LMS and offer only limited opportunity for customization and personalization. In addition due to applied technology, they are not always available on standard mobile devices. Milne et al. [6, 7] present several examples for learning games for blind and

[1] http://allabilitiesplayground.net.au
[2] http://braillebug.afb.org

visually-impaired children on standard mobile devices. But so far their approaches offer only limited opportunities for customization and lack integration into a LMS.

Existing e-learning platforms and approaches do not provide sufficient support for game-based learning in general and are not suitable for visually-impaired children. In addition they do not support the Slovenian language and offer limited support for customization by teachers that are not IT-experts.

3 The ZaznajSpoznaj platform

Figure 1: A layout of available games on a mobile platform. The default layout includes instances of seven games which can be played offline. The classes which the user is enrolled in, are accessible in online mode.

The focus of the ZaznajSpoznaj platform is to provide a series of modifiable educational games which include concepts that can be applied to a number of learning domains. Since the project focuses on the blind and visually impaired, these games are divided into three related categories: memory training, vision training and ICT inclusion. The memory training section contains games such as a standard memory game and finding the correct subset of the shown items. There are also several variants of these games, e.g. finding exact sequences, inverted subsets etc. The vision training category includes games for pattern matching and its variations. The ICT inclusion category consists of two training activities for learning Braille and touch-typing. All games offer the user and their teacher a supportive environment to achieve the learning goals (see Figure 1).

The ZaznajSpoznaj platform offers these games as modifiable templates by providing a special interface for the teachers. A teacher can take a template, define the parameters of the game: the shown items, learning domain, and even the visual outlook of the game — which is important especially for the visually impaired. By modifying the template, teachers can create specific instances of the game for their students with specific needs.

Game templates can be further extended. All games communicate with the central ZaznajSpoznaj server hosting the ZaznajSpoznaj framework via an application pro-

gramming interface (API). Calls to the API give the templates the information the teacher entered to define their game instances. The game is then customised according to the given parameters of the specific instance based on the received information from the API. Moreover, each game for each student can be personalized. If a user suffers from a specific visual impairment, their personal preferences are adjusted accordingly (e.g. colors, text font, text size etc.) and the entire contents of the game displayed in this personalized manner. We believe that this is an important aspect that increases accessibility of the games.

The framework supports several user roles: administrator, teacher and student. Framework administrators have the ability to add users, create classes, define teachers for classes and upload new templates (for games) and media files (images, sounds).

Each class in the framework has at least one assigned teacher. Teachers can edit their class' information and create new games or applications from the available templates.

A user can be a teacher in one class and a student in another as this role is tied to individual classes. Students are the framework's regular users. They enroll (or are enrolled by teachers) in classes and participate in the activities the classes offer. Each user is able to specify specific preferences, including the level of visual impairment. This setting then tailors the visual display and behavior of the site and games, suitable for the user. The current list of style preferences contains the following possible states: default, blind, inverted colors, high contrast, protanopia, tritanopia and achromatopsia. It is up to the game template developers to determine how each of these is processed in the game itself. ZaznajSpoznaj platform also supports multiple languages. Each template can provide multilingual language files and a user can define their preferred language.

These features of the platform allow for involvement of the community to further expand the array of functionalities developed within the ZaznajSpoznaj project. The API is open to any potential developer who can create new games and offer them for use through the platform. The high customizability of both, the games and user preferences, is important for inclusion of users with various impairments. We expect to increase the number of options in the field of visual impairment and add support others conditions (e.g. ADHD, games for the elderly and others).

4 Preliminary evaluation

The ZaznajSpoznaj project is still under development. The developed features are however continuously evaluated by the staff at Zavod za slepo in slabovidno mladino Ljubljana (ZSSM), who is the leading partner in the project. Due to agile development, we are able to adjust the developed features according to results of their evaluation. Additionally, we performed a preliminary evaluation of the ZaznajSpoznaj platform with three visually impaired children. Each child was evaluated by a teacher who interviewed the child and accompanied by an observer who wrote down her observation. A child was presented with a game of finding a subset of displayed images, shown in Figure 3. Children started playing the game on the basic level, where the task was to find two images and if they successfully played the game, the difficulty was automatically increased by increasing the number of images to find. We evaluated children's interactions, their response to success and failure and understanding of instructions displayed

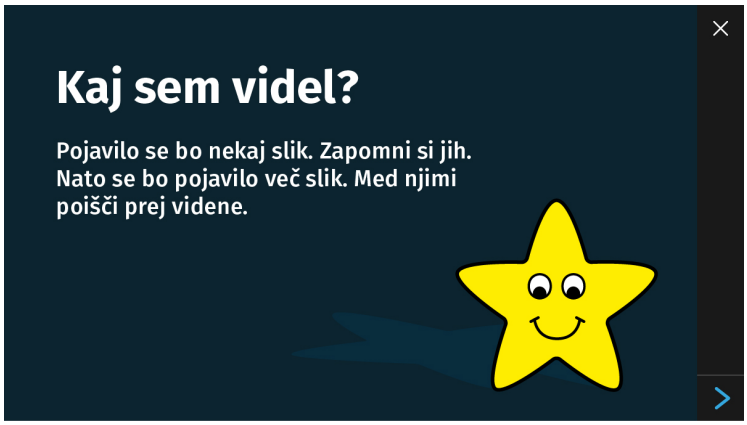

Figure 2: A layout with game instructions, accompanied by a star character which encourages the student throughout the playtime.

by the game.

Our findings show that all three children, aged between 8 and 10, were excited to play the game. The game character provided valuable visual encouragement (as shown in Figure 2) but the children also needed verbal support while playing the game. This finding suggests that we should implement vocal encouragement into the games. Two children needed help after failing several attempts on a higher difficulty level, the third needed help already at the basic difficulty level. One child needed additional explanation of the game, while another suggested modifying the appearance of the game to his favourite colors.

5 Conclusion

The ZaznajSpoznaj project provides an open-source platform and a template standard for accessible and inclusive learning games. Even teachers without specific IT-knowledge can freely modify content and customize games according to the needs and preferences of visually-impaired school children. This way they can enrich and diversify the learning process and include motivating and accessible elements of game-based learning into inclusive learning scenarios.

Although we only performed an initial evaluation on target users of the platform, it has already shown positive acceptance of the ZaznajSpoznaj concept by teachers and school children. Therefore ZaznajSpoznaj can be considered a significant advancement in using ICT for inclusion of blind and visually impaired children.

We will base our future work on the results of our first evaluation stage. The next stage of evaluation will focus on the platform's interface and support for teachers to customize the games according to preferences and impairments of individual users. We further intend to evaluate the interface and to create and provide templates for new games with master students of the e-Learning course at the Faculty of computer and information science, University of Ljubljana. This will also help to extend the set of

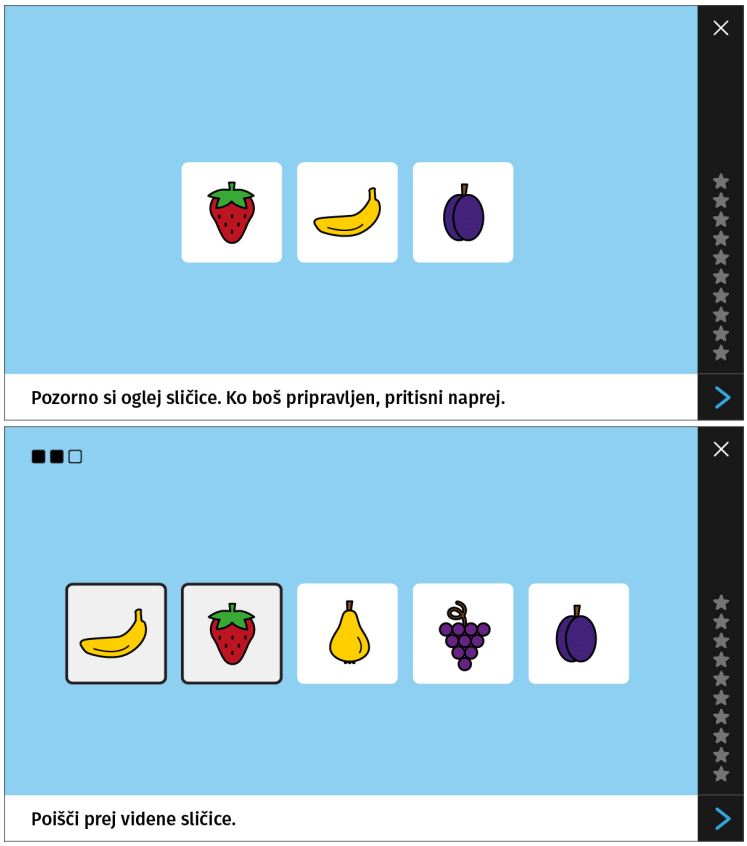

Figure 3: A screenshot of the game played during the evaluation. The user was asked to find the images (top), which are displayed as the subset of images (bottom). The number of images which need to be selected is indicated at the top left corner. The stars on the right side of the screen indicate the user's progress, which is tracked throughout the game.

available games for our primary target groups and introduce new domains of impairments (such as ADHD).

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