DytectiveU: A Game to Train the Difficulties and the Strengths of Children with Dyslexia

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ABSTRACT

In this demo we present *DytectiveU*, a game with 35,000 exercises to train the cognitive abilities related to dyslexia. To personalize the exercises, the game takes into consideration 25 indicators grouped in performance measures, language skills, working memory, executive functions and perceptual processes. The main contribution of this approach is to train dyslexia from a holistic point of view addressing not only the difficulties in reading and writing but also other cognitive abilities that are related to dyslexia and/or contribute to create coping skills to overcome dyslexia. The game is available for Android, iOS and Web (PC/Mac).

Keywords

Dyslexia, Training Exercises, Serious Games, Cognitive Skills

Categories and Subject Descriptors

K.4.2 [**Computers and Society**]: Social Issues—*Assistive technologies for people with disabilities*

1. INTRODUCTION

Approximately 1 in 10 people has dyslexia, a disorder that leads to children who, despite conventional classroom experience, fail to attain the language skills of reading, writing, and spelling commensurate with their intellectual abilities [4]. Computer interventions to support dyslexia in Spanish mainly focus on training reading fluency but do not specifically focus on other cognitive skills that are related to dyslexia, such as visual spatial attention, working memory or auditory perception.

In this demo we present *DytectiveU*,[1] the first application to support 25 cognitive abilities related to dyslexia in order to train the difficulties but also to empower the strengths of children with dyslexia which are crucial to develop coping skills to overcome dyslexia.

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[1] Available for iOS, Android and Web at:
https://dytectiveu.org/
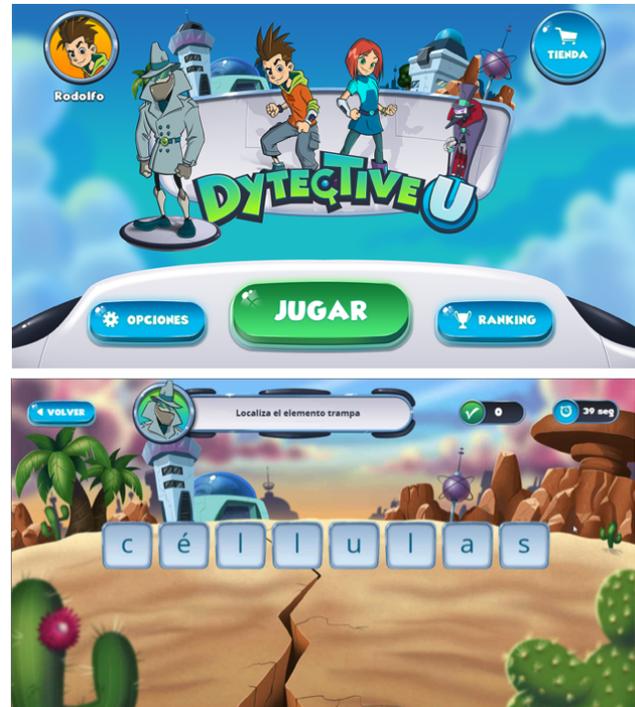
Figure 1: Characters of DytectiveU (up); and an example of an exercise targeting the executive function of activation and attention and the linguistic skills of phonological and lexical awareness (down).

2. RELATED WORK

In the mobile markets we found two scientifically validated apps. To support Spanish reading fluency we found *Galexia*,[2] with is composed of 24 sessions. It was evaluated with 46 participants (dyslexia and poor readers) showing significant improvements in reading skills between the pre-tests and post-tests [3].

To support the spelling there is *Piruletras (Dyseggxia)*,[3] with 5,000 exercises that integrate linguistic patterns found on errors written by people with dyslexia using a corpus of real errors [1]. The tool was evaluated with 48 children with diagnosed dyslexia showing significant improvements in their spelling performance after four weeks of use [2].

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[2] Available for Android at: https://goo.gl/cfxiF8
[3] Available for iOS at: https://goo.gl/SPPNsQ

Language Skills	Performance Measures
Alphabetic Awareness	Reading Comprehension
Phonological Awareness	Reading Speed
Syllabic Awareness	Natural Spelling
Lexical Awareness	Arbitrary Spelling
Morphological Awareness	Writing Speed
Syntactic Awareness	Error Recognition
Semantic Awareness	Error Correction
Orthographic Awareness	
Prosodic Awareness	
Working Memory	**Executive Functions**
Visual (alphabetical)	Activation and attention
Auditory (phonology)	Sustained attention
Sequential (auditory)	Simultaneous attention
Sequential (visual)	

Perceptual Processes
Visual discrimination and categorization
 Auditory discrimination and categorization

Table 1: The 25 indicators used in DytectiveU for the personalizing of the exercises.

3. CONTENT DESIGN

Exercise Design. *DytectiveU* has 35,000 exercises that were manually created by linguists, psychologists and computer scientists using two language resources: (a) the linguistic pattern extracted from a corpus of errors made by people with dyslexia [1] using linguistic data mining; (b) language resources generated using natural language techniques. The exercises include all the linguistically motivated exercises validated in our previous work [2]. There are 54 types of exercises depending on the linguistic element and cognitive ability they target and 11 different interactions, *e.g.* find an element in whack a mole interaction, click over an element in a sentence, or delete a letter (see Figure 1, down).

Cognitive Abilities. Each of the exercises is tagged with three or more of the 18 cognitive abilities and 7 performance measures shown in Table 1.

Challenges. The tool is composed of 64 challenges (around 15-20 minutes long) that include a set of exercises. The set of exercises per challenge vary from child to child depending on their age and the personalization performed.

Personalization. For each exercise we gather a set of dependent variables (*number of clicks, hits, speed, accuracy* and *efficiency*) that are subsequently mapped with each of the cognitive abilities. Then, depending on the user performance per cognitive ability in comparison with the users of their age, we select subsequent challenge's exercises in order to strengthen the weakest cognitive skills and challenge the strongest cognitive skills with more difficult exercises.

Reports and Challenge Generation. The tool presents two type of reports: (i) and evaluation of the player compared to the percentile of the rest of players of the same age (see Figure 2), and (ii) the evolution of the player in time per cognitive skill. The measures used are *Accuracy* (percentage of correct exercises) and *Efficiency*, taking into account *Accuracy* and *Speed*.

There are two versions of *DytectiveU*, one for families
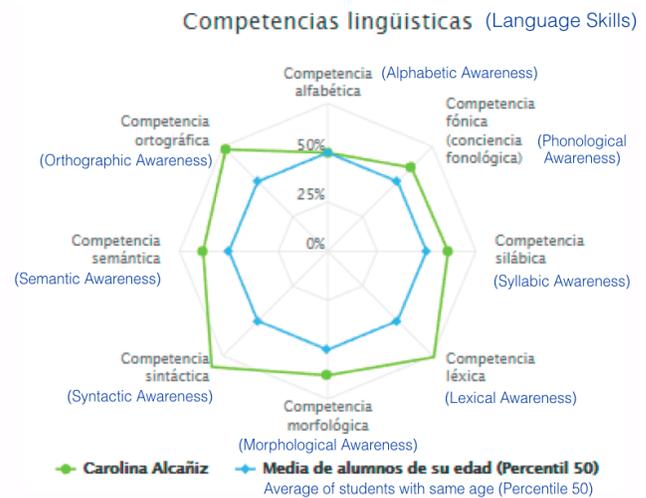
Figure 2: Example of an evaluation report of the language skills after playing a challenge. English translation in blue.

showing reports with performance measures only and *DytectiveU PRO* designed for professional therapists. *DytectiveU PRO* allows the therapist to access to more detailed reports (one per cognitive skill) and the manual personalization of the exercises.

4. PROOF OF CONCEPT AND FUTURE WORK

We accomplished a crowd-funding campaign to fund the development of *DytectiveU* and involved the contributors of the campaign in the creation process of the tool. We invited then to a Proof of Concept workshop in Madrid where 12 families with children with dyslexia -from 6 to 18 years old- and 6 professional therapists attended. The results of workshop were materialized in functionalities of the tool, such as the use of reports; some gamification strategies of the game; and the design of the characters (see Figure 1).

For future work we plan to carry out a longitudinal evaluation of *DytectiveU* in schools to measure the impact of the methodology on the performance of children with dyslexia.

5. REFERENCES

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