

# Games for Learning Old and Special Alphabets – The Case Study of Gamifying *Mrežnik*

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## Abstract

This paper presents many different custom made web games which are created for learning the Glagolitic script, the sign language, and the Braille alphabet. These games were created within *The Croatian Web Dictionary Project – Mrežnik* where the author works on gamifying dictionary content. The games for learning the Glagolitic script, sign language, and Braille alphabet will be connected to the entries *glagoljica* (the Glagolitic script), *brajica* (Braille alphabet), and the subentry *znakovni jezik* (sign language) of the entry *jezik* (language) in *Mrežnik*. In the paper, each of these games will be presented by stating the game type, mechanics, and gamification elements such as scoring, leaderboards, levels, and badges, etc. The position of these games in the structure of *Mrežnik* will be shown and the reception of the published games through Facebook likes and shares will be presented. For Glagolitic games, a statistical analysis will also be given to show how many players have completed the game, submitted their results, and replayed the game. At the end of the paper technology used for creating, testing, and publishing these games will also be analyzed.<sup>1</sup>

## 1 Introduction

Games have evolved as a new media and are being more and more used in everyday life. What makes a game more engaging than other media is its interactivity with the player. In a game, content is constantly changing based on players reactions in the physical world. With dynamic content and unlimited ability to do different things in the virtual world, games can be used as a powerful tool for educational purposes (Gros, 2007). Some contents in which educational games occur are mili-

tary schools, driving schools, and hospitals which are using virtual simulation to simulate real-life situations. There are also a lot of websites and applications for learning foreign languages such as Duolingo and Memrise. Online dictionaries such as Merriam-Webster and The Free Dictionary have some games for learning definitions, grammar, spelling, etc. The popularity of games for educational purposes in all fields can be attributed to new trends such as e-learning, gamification and game-based learning (Strmečki et al., 2015). The purpose of e-learning methods and techniques is to improve the quality of the class, communication between teachers, instructors, students, and other participants in the learning process, and to allow easier exchange and access to learning material (SRCE, 2016). There is no unique definition of gamification. One of the most quoted papers on gamification (Deterding et al., 2011) *From Game Design Elements to Gamefulness: Defining Gamification* defines gamification as a process which uses the existing game elements in situations which are not considered as a game. Gamification elements, which include scoring, ranking, levels, rewards, ect., are abstracted from many different games. Research has been conducted on the use of gamification mostly in the field of computer science (Ortiz et al., 2016). A study conducted by professor of management Traci Sitzmann (2011) at *Colorado Denver Business School* demonstrates that staff which completed their training with the help of video games learned more facts and accomplished more skills and long-term knowledge than staff that was trained in a less interactive environment. However, there were many critical points about using gamification elements such as leaderboards because some students don't do well when they are compared against others they know and scoring can sometimes be misused,

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misinterpreted or not implemented correctly. Sometimes assignments are not scored correctly or the games or systems automatically give scores to meaningless actions such as clicking the answers without reading the text (Armando et al., 2018). Gamification can also be used in combination with crowdsourcing where the community can play a certain game in which they solve or offer a solution for certain tasks. This type of gamification used through virtual games is called GWAP (Game with a Purpose) where the player is rewarded with entertainment rather than money (Venhuizen et al., 2013). GWAPs challenge players to score high on specifically designed tasks, thereby contributing their knowledge. GWAPs were successfully pioneered in NLP by initiatives such as ‘Phrase Detectives’ for anaphora resolution (Chamberlain et al., 2008) and ‘JeuxDeMots’ for term relation (Artignan et al., 2009). Venhuizen et al. (2013) have created a gaming platform *Wardrobe* ([wordrobe.org](http://wordrobe.org)) in which players answer multiple choice questions in which they guess if a certain word in a sentence is a noun or a verb or in another game, they must identify correct senses of a word. Players are through their virtual profile awarded with points and virtual achievements to keep them motivated. Player's answers are used for annotating the text. The amount of points the player gets depends on the agreement with fellow players. The working assumption is that the right sense of a word can be determined by the answers given by the players. The answer which has more selection or is selected by a more experienced player in a game is usually considered to be the correct one. However, that doesn't mean that this system of annotation is good because people tend to have wrong assumptions and make mistakes so in the end the overall data is checked by expert annotators. However, if most of the words are annotated correctly by non-expert annotators it makes the job of checking annotation much quicker for expert annotator (Venhuizen et al., 2013). This is one of the examples of using gamification in NLP.

## 2 The Croatian Web Dictionary – *Mrežnik*

In the Institute of Croatian Language and Linguistics in Zagreb, the Croatian web dictionary called *Mrežnik* is compiled. *Mrežnik* will be the first web-born dictionary of Croatian. It is corpus-based (based on web corpora: *hrWaC*, *Riznica*

*Croatian language corpus*), written in TLex<sup>2</sup> and compiled using Sketch grammar and Word Sketches especially compiled within the *Mrežnik* project. Corpus and word sketches are searchable through Sketch Engine program for corpora managing. *Mrežnik* pays special attention to collocations and examples of word usage extracted from the corpus. It also has external links to different databases and web sites compiled at the Institute. So it contains much more content than digitized versions of paper dictionaries (such dictionaries exist for Croatian on web pages *Hrvatski jezični portal* and [rjecnik.hr](http://rjecnik.hr)). *Mrežnik* consists of three separate modules (the module for adult native speakers of Croatian, the module for elementary school children, and the module for foreigners learning Croatian). The three modules are connected by the fact that the data is coordinated and synchronized. However, each module functions as a separate dictionary compiled for a different target group. The module for adult native speakers of Croatian consists of 10,000 entries. The module for elementary school children consists of 3000 entries, and the module for foreigners consists of 1000 entries. Each dictionary module has a different dictionary grammar which is based on the specific needs of the dictionary user (Hudeček and Mihaljević, 2017). An additional content that is being developed for *Mrežnik* are games which are being placed as external links in certain entries of all three modules. Games compiled for children are e.g. games with fruit, animals, vegetables, professions, etc., games for non-native speakers of Croatian, i.e. foreigners learning Croatian, are e.g. games which help the foreigner produce correct verbal forms or use correct verbal aspect in Croatian, and games for adult native speakers are e.g. games for finding appropriate Croatian words for English loan words often used in Croatian as well as the presented games for learning old and special alphabets. Some of these games have already been published on the portal *Croatian in School* ([hrvatski.hr/](http://hrvatski.hr/)). This paper will focus on games compiled for learning the old script called Glagolitic and games for learning the sign language and Braille alphabet. These three scripts have been included in the *Croatian Orthographic Manual*, which will also be connected with *Mrežnik*. The structure of the entry *glagoljica* (Glagolitic script) in the module for adult native speakers of Croatian (this module includes children older than 14) is shown below:

<sup>2</sup> TLex (aka TshwaneLex) is a professional, feature-rich, fully internationalised, off-the-shelf software application

suite for compiling dictionaries or terminology lists. URL: <https://tshwanedje.com/tshwanelex/> (23.9.2019.)

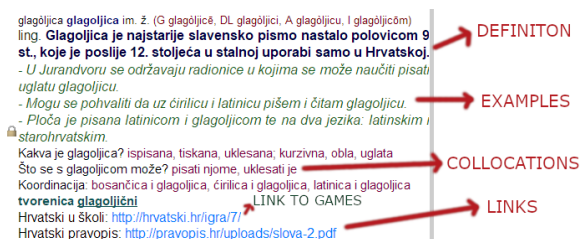


Figure 1: The structure of entry Glagolitic script displayed through TLex program

### 3 Games for learning the Glagolitic script

The Glagolitic script (Croatian *glagoljica*) is the oldest known Slavic alphabet. It was created in the 9<sup>th</sup> century by Saint Cyril. The alphabet was created for Slavs in Moravia but was also used in Pannonia, Macedonia, Bulgaria, Bohemia, and Croatia (Damjanović, 2003). After the 12<sup>th</sup> century, it only survived in Croatia where it was actively used until the middle of the 19<sup>th</sup> century (Gadžijeva et al., 2014). Today the Glagolitic script is a symbol of national identity and is often used in Croatian art, design, subculture (e.g. Glagolitic tattoos are very popular), and marketing. Although the Glagolitic script is recognized in Croatia and mentioned in schools during history and Croatian language classes, most Croats cannot read or write in the Glagolitic script. Games developed for learning the Glagolitic script focus on recognizing each letter with its Latin equivalent. The two games that will be presented in this paper were created for the Institute of Croatian Language and Linguistics and are published online on 21<sup>st</sup> February of 2019 on the web site *Croatian in School* ([hrvatski.hr/](http://hrvatski.hr/)) and advertised on the Institute Facebook page, the day before the official proclamation of the *Day of Croatian Glagolitic Script and Glagoliticism* by the Croatian Parliament. The first game *Glagoljica pamtilica* (engl. *Glagolitic memory*) is a memory game in which the players have to match cards with Glagolitic and Latin letters ([hrvatski.hr/games/pamtilica-glagoljica/](http://hrvatski.hr/games/pamtilica-glagoljica/)). At the beginning of the game, the player can choose if he wants to turn on or off the colors for letters. If the player chooses to play with colors they will help him find pairs because the Glagolitic and Latin pairs have the same color. This was done to help the beginners to learn the Glagolitic script. Players who know the Glagolitic script can play without the assistance of colors for matching the pairs. The game also allows players to choose the level of difficulty of the game based on the number of

pairs they want to have (4, 8, 12). Player's results for each game are scored based on the number of tries and the time needed to finish the game. The player can submit his score to online leaderboards by using his written username with a certain emoticon. Emoticons will be displayed next to the username on leaderboards. If the player wins any of the first three places he gets a medal (bronze, silver or gold) and joyful music plays in the background. Leaderboards are different for different levels of difficulty.

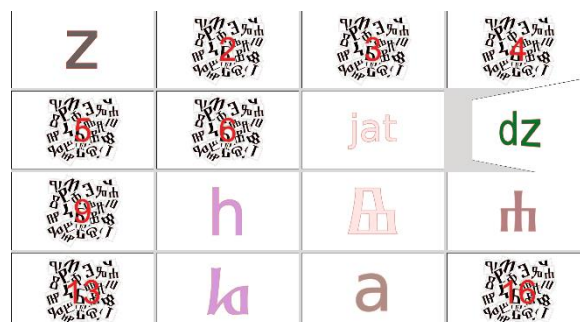


Figure 2: Example of a memory game in which the player connects Glagolitic and Latin letters

The next game *Znam glagoljicu* (engl. I know the Glagolitic script) is a quiz in which the player has 10 seconds to recognize the Glagolitic letter and choose one of the four given answers ([hrvatski.hr/games/kviz-glagoljica/](http://hrvatski.hr/games/kviz-glagoljica/)). The question is put for all the letters of the Glagolitic script but the order of the letters differs so the correct answer is never the same. The player can choose if he wants to play a game with the angular Glagolitic script, the script that was mostly used in Croatian history or the round Glagolitic script that was more used in Bulgaria than in Croatia. The player always gets feedback after each question. If the answer is correct the feedback will be given on how many points the player has gained on this question. If the player gives the wrong answer, he loses points and get feedback in the form of the correct answer. The quiz also allows players to submit their scores to online leaderboards similar to the previous game. Player's results for each game are scored based on the number of tries and the time needed to finish the game. If a player answers question quicker (e.g. 5 seconds for 20-second question) he gets additional points from remaining time left for answering a question (e.g. gets 15 points for answering a question in 5 seconds). With this type of a scoring system where there are more points, the results from players differ more.

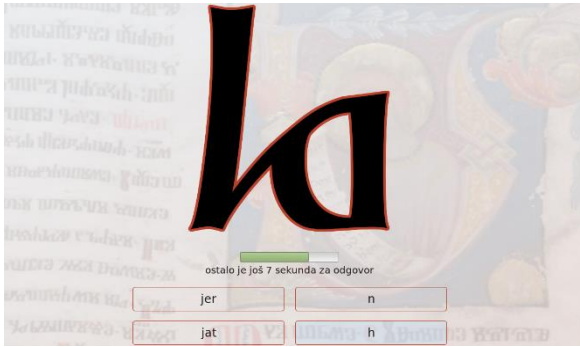


Figure 3: Example of a quiz with a time limit for guessing the Glagolitic letter

The third Glagolitic content present on the site *Croatian in School* is not a game but a web application used to facilitate the learning of writing the Glagolitic letters ([hrvatski.hr/games/crtanje-glagoljica/](http://hrvatski.hr/games/crtanje-glagoljica/)). The user can choose a certain Latin letter for which he will receive a virtual canvas for drawing which displays same Glagolitic letters with reduced opacity. On the canvas, there are some arrows that show directions in which he must drag the mouse or finger on a touchscreen to write the letter correctly. The mentioned game types for learning the Glagolitic alphabet could also be used for learning other alphabets like the Greek alphabet or Chinese or Japanese symbols.

### 3.1 Analyzing game reception

All three mentioned interactive Glagolitic contents published on the site *Croatian in School* were well received on the Facebook page of the Institute of Croatian Language and Linguistics. They currently have 559 likes (187 on the original post, 372 on the shared post) and 106 shares of the post<sup>3</sup>. The post about these games is among the most popular posts on the Facebook page reaching more than 16,546 people, only outnumbered by posts on the mobile language advice application that has reached more than 39,623 people, the post about official proclamation of the *Day of the Croatian Glagolitic Script and Glagoliticism* by the Croatian Parliament which has reached 17,701 people and the post about a Croatian language quiz for preparing high school seniors for the state exam in the Croatian language which has reached 26,810 people. The analysis of the database containing the results of the players that have finished the games and submitted their results shows that currently there is a total of 758 submitted results for the memory game and 378 submitted results

for the quizzes. This means that these games have been played many times and by many users. Some of the recorded results were submitted by the same player since the player used the same username for each new round of the game thus showing that he liked the game and enjoyed playing it more than once. In Glagolitic quizzes, there are 195 unique usernames and 107 of those users have submitted their quiz results more than once. Out of those 107 users, 71 of them even submitted results more than twice. The maximum number of times a certain user submitted his score in quizzes is currently 22. In memory games, there are 279 unique usernames. 148 have submitted their results more than once, and 79 of them have submitted results more than twice. The maximum number of times a certain user submitted his score in the memory game is currently 22 times. These games have also been presented on the television show *School hours* on Croatian Radiotelevision Two ([skolski.hrt.hr/emisije/1070/jezicne-igrice](http://skolski.hrt.hr/emisije/1070/jezicne-igrice)).

## 4 Games for learning Braille alphabet and sign language

In addition to different ancient alphabets, the other special letters and symbols that are an important part of human culture and knowledge are the ones made for people with certain disabilities. Braille is a writing system used by people who are visually impaired. It is traditionally written with embossed paper. Braille symbols are formed within units of space known as braille cells. A full braille cell consists of six raised dots arranged in two parallel vertical columns of three dots. 63 combinations are possible using one or more of these six dots. Cells can be used to represent a letter of the alphabet, number, punctuation, part of a word or even the whole word. The braille system was created by Louis Braille, a Frenchman who lost his sight in 1824 as a result of a childhood accident. It is still the most popular writing system for visually impaired people today although its usage has decreased because of the development of screen readers (Wiazowski, 2014). However, it is still largely present in the paper format. There is no substitute for the ability to read, and therefore no digital alternative can replace the braille alphabet completely. Visually impaired people learn braille letters by touch so creating a computer game for them is pointless since it is a visual media. However, teachers, parents, and others who are not visually impaired tend to read braille by sight rather

<sup>3</sup> Games for learning Glagolitic script. URL: <https://www.facebook.com/ihjj.hr/photo/a.687321037952455/2715935941757611/?type=3&theater> (21. 6. 2019.)

tos/a.687321037952455/2715935941757611/?type=3&theater (21. 6. 2019.)



than by touch. Since some people who are not blind will want to learn braille it is good for them to know how to read the system and explain it to a person who is learning it. That is the reason why braille alphabet was included in the *Croatian Orthography Manual* (Jozić et. al, 2013: 125).

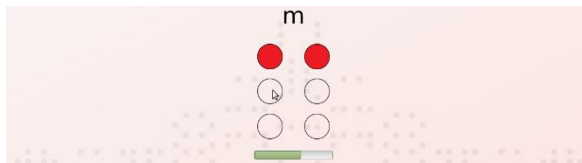


Figure 4: Example of the game in which the player has to press the correct cells to get a certain letter in the Braille alphabet

The game for learning braille is not yet publically available. It is currently stored on GitLab repository, but it can be accessed through this link: [bit.ly/2XYHHO1](https://bit.ly/2XYHHO1). In the game, each player gets a certain symbol and six empty braille cells. The player has 15 seconds to click on certain braille cells to get the symbol. He can use a hint to know how many cells need to be click on, he can also unselect a cell if he thinks it is not a part of the symbol. The player always gets feedback for his answers. If he answers incorrectly or runs out of time the right answer will be displayed. The symbols are displayed in random order and they include Croatian alphabet, punctuation, and symbols for mathematical operations. The plan is to officially publish this game on 15<sup>th</sup> October, i.e. on the White Cane Safety Day. Because the game has not been published at the time of writing of this paper, there is no way to evaluate its success yet. The game for learning the sign language alphabet is similar to the quiz game for learning the Glagolitic script. Sign language is a language in which communication is done by using hands and sometimes the movement of other body parts. It is unclear how many sign languages currently exist in the world. Each country generally has its own, native sign language, and some have more than one (Lewis et al., 2013). The game for learning the sign language alphabet only covers the Croatian language. The game is available through this link: [ihjj.hr/znakovni](https://ihjj.hr/znakovni). It was officially published on 23<sup>rd</sup> September 2019, the International Day of Sign Languages. The initial reaction to the game was positive with 337 likes, comments and shares and 321 results submitted to leaderboards. The players can choose if they want to learn one or two hand alphabet. For each question, the player has 10 seconds to answer and he always gets a feedback for his answers.

## 5 Technology used for creating the games

All of the mentioned games were created for web browsers. They have a responsive design so they can be played even on mobile devices. Game logic and animations were programmed by using jQuery language. Questions, answers, and additional question data were stored in JSON format. Development of these games started on GitLab repositories which allow distributed but private storing of digital files which can be accessed and modified through various computers. GitLab also has a version control system the author could experiment easily while developing games without the fear of spoiling the final product. GitLab also allows users to generate a preview for the websites so they can send private links to testers or publishers. Since there was no database present on the server, the scores and players usernames for games are stored on Google Sheets. The website in the background reads, sorts, and displays data from the sheets so players don't notice that the data is stored elsewhere. One thing these games have to implement in the future is social play in which you can challenge individual opponents through social networks such as Facebook.

## 6 Conclusion

Game design is constantly evolving so we can expect more educational games in the area of language learning and lexicography. In the paper, some examples of games for learning special alphabets are presented and it is shown how they are incorporated within a dictionary project and received by users. These types of games could be applied for other special alphabets of other languages. The compilation of games for *Mrežnik* is still in progress and many different games for learning grammar, definitions, spelling, etc. are being developed. By gamifying the Croatian dictionary and grammar we can interest children and teenagers but also help foreigners learn Croatian language and culture and popularise language contents. Research on the influence of gamified content on non-native speakers learning Croatian is still in progress within the *Mrežnik* project.

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