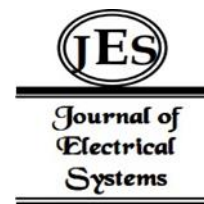


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## Designing a Web Application to Learn and Practice Vocabulary for Primary School Children



**Abstract:** - This paper presents a proposal of a web application to create hangman games for supporting the learning and practicing of vocabulary for different topics or disciplines, oriented to primary school children. The paper shows a comparative analysis of digital hangman games similar to the web application proposed, and describes their main features, such as: game description, instructions for the game, images and hints for the word to be guessed, different levels, user management, among others. The web application is planned to have two users: teachers (administrators) and students. Teachers will be able to create new categories of words, according to the topic or discipline they want, register words, clues, images and audio files, corresponding to each registered word. Students will have an interactive hangman game platform, where they will be able to play and enjoy with the categories of words created by their teachers, according to the topic or discipline desired. Students will have the possibility of learning and practicing new words and concepts in a ludic way, while improving their vocabulary.

**Keywords:** Hangman game, vocabulary, educational tool, web application, teaching-learning process.

### I. INTRODUCTION

Traditional methodologies no longer generate the same desire to learn. In some cases, these methodologies tend to demotivate students, so new and better strategies are needed to carry out the teaching-learning process of different disciplines. One of these new strategies is through the use of educational games, since with them students tend to continue playing and learning at the same time [1, 2].

The basic skills that are developed in most games are communication, adaptability, abstract thinking, among others. Based on the social theories of collaborative learning and the advantages that Information and Communication Technologies (ICT) bring to education, there is a need for students to acquire new skills and forms of development in our society. In order for ICTs to develop their great transformative potential, they must be integrated into the classroom or in a suitable place and become a cognitive instrument capable of improving intelligence and thus enhancing the adventure of learning [3].

Educational web tools are some of the most popular forms of educational technology used today to improve the quality of learning. Online web games should be considered as an important activity, as they provide a different way of acquiring knowledge, they provide recreation to the student, the games allow the participant's interest to be directed towards the area that is involved in the ludic activity [4]. These tools are designed to facilitate teaching and learning at any time and place, allowing students to access study materials and online learning resources [5].

Among the commonly used educational web games, we find the hangman game, which allows children, young people and adults to acquire new knowledge, and in particular to learn new words, expanding the vocabulary of its users and improving their spelling, as it allows the user to become familiar with the writing of the words used. There are several examples of the use of hangman games in education, which measure the effectiveness to learn or strengthen vocabulary in children or young learners [6, 7, 8, 9].

The work proposed in this paper is a web application that offers the creation of hangman games that allows teachers to create their own categories of words for hangman games, and students to play the hangman games with the set of words registered in each category, with the aim of reinforcing or learning new words and concepts of different topics or disciplines. One of the main features of the web application proposed is the possibility that teachers will

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have to add clues, images and audio files, corresponding to each registered word. The rest of the paper is organized as follows. Section II presents an analysis and comparison of the features of some existing similar web applications, such as game description, instructions for the game, images and hints for the word to be guessed, different levels, user management, among others. Section III describes the proposed web application, along with its modules, and some preliminary interfaces. Finally, conclusions and future work are presented in section IV.

## II. EXISTING TOOLS

The classic hangman game has evolved and there is a wide variety of platforms offering different experiences of learning. This section analyzes a series of online hangman games, identifying their features, strengths and limitations. A comparative analysis of the online hangman games evaluated is carried out at the end of the section. In addition, the educational impact and innovation of these platforms on vocabulary development is explored [10].

### A. *Rainbow Hangman*

It is an online game [11] that consists of two options: play the game and instructions. When playing the game, the alphabet is displayed on the interface so that the user can click on the letter that seems appropriate to guess; as the letters are selected on the keyboard, the correct letters turn green, these are those that appear in the word to be guessed; while the incorrect letters change to red, those that do not appear in the word to be guessed. The game consists of 10 lives and for each incorrect letter the hangman grows. If the word is guessed, there is the option to play the game again; on the other hand, if the user has finished with their 10 attempts, a message is displayed with the word that had to be guessed. The game does not have clues or images.

### B. *Hangman of Wordwall*

It is an online game [12], in which the user must guess the word from the image that the system provides. When selecting each letter in the game, a green figure or a red check mark is displayed, this will depend on whether the selected letter appears in the word to be guessed or if the letter does not appear in the word, respectively. The game has the letters of the alphabet counting those that have an accent; it should be noted that a stopwatch is displayed at the top left to visualize the time it takes a user to complete the game. At the end of the 20 games, a window is displayed showing the score that was obtained and how long it took to finish; the user also has the option to see the leaderboard, show the answers and start the game again.

### C. *Hangman of Ethical World*

It is an online game [13], where the aim is also to guess the correct word. This web application has 10 lives in each game for the user to guess the word; there is also a timer that will tell the user how many seconds it took to guess the word. The web application also has the possibility of enabling or disabling the sound of the game; a clue is provided to the user for each word to be guessed, so that the user can associate the clue with the word. At the end of the game, the remaining lives, points and the time it took to guess the word are shown in a table. It is possible to play again after finishing a game.

### D. *Hangman by Edudiver*

It is an online game [14], where multiple configuration options have been added to adapt the game to the characteristics of each player, so that it can be played at any age. The size of the word can be limited to make it easier to guess; the maximum number of errors can be changed to adjust the difficulty to the age or ability of the players. In the main interface there are three opportunities to guess the word. The game has a clue that informs the type of word to guess (adjective, adverb, conjunction, preposition, pronoun, noun or verb). In the upper right corner there is another clue about the theme to which the word belongs; these clues can be activated or deactivated. If the user guessed the correct word, there is the possibility to play again.

### E. *Cokitos Hangman*

It is an online game [15], which is based on a theme for young children. The interface has bright colors so that children are more interested in playing with it. It contains the letters of the alphabet. If the letter that is selected is in the word to be guessed, it will be colored green; on the other hand, if the letter is not in the word to be guessed, the drawing of the hangman automatically grows and the selected letters that are incorrect disappear. When the

game is finished, the user can play it again. This web application has the ability to play in full screen, enable or disable background sound, among other features.

#### F. Comparison table

This section compares the web applications evaluated, showing the features that were found. Table 1 shows a comparison of these features for the following web applications: G1) Rainbow Hangman, G2) Hangman of Wordwall, G3) Hangman of Ethical World, G4) Hangman by Edudiver, and G5) Cokitos Hangman. The tick indicates that the web application has the feature, while the cross indicates that the web application does not have it. A description of the features is presented after the table.

Table 1. Features of the analyzed web applications

| Features                | G1 | G2 | G3 | G4 | G5 |
|-------------------------|----|----|----|----|----|
| Game description        | ✓  | ✗  | ✓  | ✗  | ✗  |
| Images                  | ✗  | ✓  | ✗  | ✗  | ✗  |
| Instructions (tutorial) | ✓  | ✓  | ✓  | ✓  | ✓  |
| Hints or clues          | ✗  | ✗  | ✓  | ✗  | ✗  |
| Full screen             | ✗  | ✓  | ✗  | ✓  | ✓  |
| Different levels        | ✗  | ✓  | ✗  | ✗  | ✗  |
| Free to use             | ✓  | ✓  | ✓  | ✓  | ✓  |
| User management         | ✗  | ✓  | ✗  | ✗  | ✗  |
| Execution time          | ✗  | ✓  | ✓  | ✗  | ✗  |

*Game description.* This feature indicates that the web application contains a detailed explanation of the game as well as the rules, objectives, mechanics and any other relevant information about the game.

*Images.* This feature refers to the images that the web application provides as clues for the players.

*Instructions.* This feature indicates that the web application contains guidance and clarity on how to play the game effectively; it could contain a tutorial.

*Hints or clues.* This feature indicates that the web application contains additional information about the hidden word that the player needs to guess; the hints or clues help the player to get an idea of the word to be guessed.

*Full screen.* This feature refers to the functionality that allows the web application to be viewed in full screen on the web browser, (laptop, tablet or mobile phone).

*Different levels.* This feature indicates that the web application contains various levels of difficulty, this can be by the length of the word or the type of words displayed in the game.

*Free to use.* This feature usually involves providing players with unlimited and free access to the game with certain restrictions or limitations.

*User management.* This feature refers to the functionality that allows the web application to provide users with the facility to manage progress and interaction within the game.

*Execution time.* This feature refers to the optimization and efficiency in running the game, in order to provide a good gaming experience.

### III. PROPOSED WEB APPLICATION

This section presents the proposed web application. It describes the modules with the functionality that the web application will have, lists the most important use cases, and shows some of the interface prototypes created.

## A. Modules

The proposed web application will allow teachers to create new categories of words, the web application will generate hangman games from the categories created, and students will be able play the hangman games generated by the web application. The modules that will compose the web application are the following.

*Creating a category.* This module corresponds to the functionality that will allow teachers to create a new category in the web application. Teachers will be able to create categories to add words to them; hangman games will be created with the set of words added to a specific category. For example, teachers could create a category called *animals*, where they would probably add the words: *dog, cat, horse, mouse, rabbit, cow*, among others.

*Editing or deleting a category.* This module corresponds to the functionality that will allow teachers to edit the name of the category or delete it from the web application.

*Adding a word.* This module corresponds to the functionality that will allow teachers to add a new word to a specific category in the web application. Teachers will be able to add a word along with an associated image, a sound file and a clue. For example, for a category called *animals*, teachers would probably add a word “dog”, with an image of a dog, a sound file of a dog barking, and a clue to help guessing that word.

*Editing or deleting a word.* This module corresponds to the functionality that will allow teachers to edit or delete a word from the web application. Teachers will be able to modify the name of the word, its associated image, sound file and clue. It should be noted that it will also be possible to change the category of the word.

*Playing a hangman game.* This module corresponds to the functionality that will allow students to play a hangman game. Students will be able to select a category from the web application, which will generate a hangman game with eight random words from the selected category.

*Viewing results.* This module corresponds to the functionality that will allow students to view their results of all the hangman games played. There will also be a table with their scores.

*Responsive web design implementation.* This module refers to the functionality that will allow the web application to be displayed correctly and proportionately on any type of device.

*Database design.* This module refers to the functionality associated to the relational database, with its entities and attributes, making a representation through an entity-relationship diagram and a relational diagram.

## B. Design

The functionality of the web application was represented with use cases. The main use cases identified in the web application proposed are the following: *create category, view category, add word, view word, play hangman game, view score*. Table 2 shows the *create category* use case, Table 3 presents the *add word* use case, and Table 4 shows the *play hangman game* use case.

Table 2. Use case for creating a category

|                 |                                                                                                                                                                                                                                                                                                                                                            |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use case        | Create category.                                                                                                                                                                                                                                                                                                                                           |
| Description     | The teacher creates a category of words.                                                                                                                                                                                                                                                                                                                   |
| Actor           | The teacher.                                                                                                                                                                                                                                                                                                                                               |
| Precondition    | The teacher access the system and selects the option <i>create category</i> .                                                                                                                                                                                                                                                                              |
| Trigger         | Click on <i>create category</i> .                                                                                                                                                                                                                                                                                                                          |
| Normal sequence | <ol style="list-style-type: none"> <li>1. The system shows the page to create a new category with an input box to enter the name of the category and a button to upload an image, which will be associated to the category.</li> <li>2. The teacher inputs the name of the category.</li> <li>3. The teacher uploads an image for the category.</li> </ol> |

|                  |                                                                                                                                                                                                |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <p>4. The teacher clicks on the <i>create category</i> button.</p> <p>5. The system saves the category in the database, and shows a message indicating that the category has been created.</p> |
| Postcondition    | The system returns to the main page.                                                                                                                                                           |
| Alternative flow | <p>4a. The teacher clicks on the <i>cancel</i> button.</p> <p>5a. The system does not save the category in the database.</p>                                                                   |

Table 3. Use case for adding a word to a category

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use case         | Add word.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Description      | The teacher adds a word to a specific category.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Actor            | The teacher.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Precondition     | The teacher access the system and selects the option <i>add word</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Trigger          | Click on <i>add word</i> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Normal sequence  | <p>1. The system shows the page to add a word, with a list box to choose the category, an input box to enter the name of the word, a button to upload an image, a button to upload a sound file, and an input box to enter a clue.</p> <p>2. The teacher selects the category from the list box.</p> <p>3. The teacher inputs the name of the word.</p> <p>4. The teacher uploads an image for the word.</p> <p>5. The teacher uploads a sound file for the word.</p> <p>6. The teacher inputs the clue for the word.</p> <p>7. The teacher clicks on the <i>add word</i> button.</p> <p>8. The system saves the word in the database, and shows a message indicating that the word has been added to the category chosen.</p> |
| Postcondition    | The system returns to the main page.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Alternative flow | <p>7a. The teacher clicks on the <i>cancel</i> button.</p> <p>8a. The system does not save the word in the database.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |

Table 4. Use case for playing a hangman game

|                 |                                                                                                                                                                                                |
|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Use case        | Play a hangman game.                                                                                                                                                                           |
| Description     | The student plays a hangman game with a selected category.                                                                                                                                     |
| Actor           | The student.                                                                                                                                                                                   |
| Precondition    | The student access the system and selects a category to play.                                                                                                                                  |
| Trigger         | Click on a category.                                                                                                                                                                           |
| Normal sequence | <p><i>For each of the eight words that compose a hangman game:</i></p> <p>1. The system shows the spaces for the word to be guessed, along with the associated image, sound file and clue.</p> |

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  | <p>2. The system displays the board of letters of the alphabet.</p> <p>3. The student selects a letter from the board in order to try to guess the word presented by the system (if the letter is contained in the word to be guessed it will turn green; if the letter is not contained in the word to be guessed it will turn red).</p> <p>4. The system turns the letter in the board to color green and writes the letter in the corresponding space, indicating that the letter is contained in the word to be guessed.</p> <p><i>Steps 3 and 4 and repeated until the word is guessed.</i></p> <p>5. The system displays a message indicating that the student has guessed the word.</p> <p>6. The student clicks on the <i>next</i> button to move to the following word to be guessed.</p> <p>7. The system shows the following word to be guessed.</p> |
| Postcondition    | The system returns to the page with the categories.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Alternative flow | <p>4a. The system turns the letter in the board to color red, indicating that the letter is not contained in the word to be guessed.</p> <p>5a. The system displays a message indicating that the student has not guessed the word.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

The other uses cases identified in the design stage were elaborated in a similar way. The use cases give a clear idea of the steps to be followed to develop a specific transaction or functionality of the web application.

### C. Interface prototypes

The design of the web application interface was represented through prototypes, which will allow greater clarity to start the development of the web application. The preliminary prototypes are shown in this section: the first five figures represent the interface for the functionality of the hangman games for students, in which it is shown how students play a hangman game; the last two figures illustrate some of the functionality for teachers.

Figure 1 shows the prototype for the initial page of the web application, which has initially six green buttons with the categories available in the web application: animals, countries, anatomy, English, chemistry, and colors. The student will be able to select one of the categories presented; each category will take the student to a hangman game with a set of eight random words corresponding to the selected category. The left panel of this interface has a menu with three options: home, games, and sign out.

Figure 2 illustrates the interface of the hangman game for the *animals* category. The central panel contains the hangman game for the selected category. On the left side, there is an image associated with the word that the student must guess; additionally, there is a red text with the clue, which is an aid for the student to guess the word; in this case, the text “has a very long neck” is presented. On the right side, there is the board with the letters of the alphabet; it should be noted that the proposed web application has the vowels with accents and the vowels without accents, this is intended to promote better spelling in children, since if the word has an accent, the accented vowel must be selected. On the right side, at the top, the number of lives that the student has to guess the word is shown, which are marked with a heart; there is also the score that the student has, which depends on the number of words guessed; there is a stopwatch to count the time that the student took to finish the eight words that are presented in the game. At the bottom of the interface it is the number of the word that the student is trying to guess (one out of eight), a button to listen to the audio with the pronunciation of the word, and a button to enter in full screen mode.

Once the hangman game has started, the student has to try to guess the first word presented through the image and clue provided. Figure 3 illustrates that the student has already selected 12 letters on the board: the letters A, I, J and

R appear in green, because they are part of the word that the student has to guess, they have already been placed in the corresponding spaces of the word to be guessed; the letters A (with accent), C, E, I, K, S, T and V appear in red, as they are not part of the word to be guessed. The current number of lives is two, this is because for each letter selected on the board and not found in the word, one life is taken. When the student has guessed the word or has lost all their lives, the web application will show the next word to be guessed, and this will continue for the remaining words contained in each hangman game.

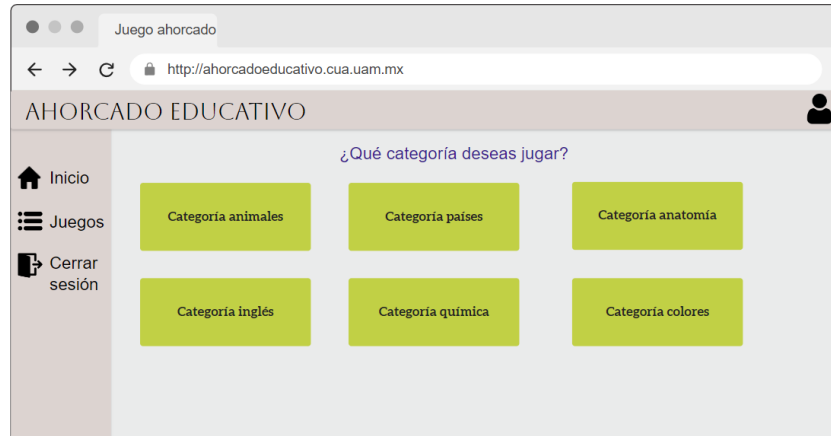


Figure 1. Interface with the categories of the web application.



Figure 2. Hangman game with the first word to be guessed.

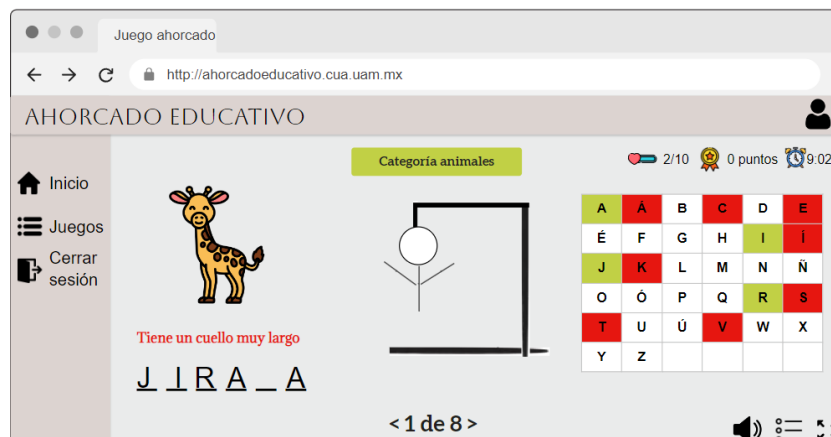


Figure 3. Hangman game with five letters found.

The eighth word of this hangman game is shown in Figure 4, in which the student has already guessed the word “PEZ”, after having selected six letters on the board: the letters E, P and Z appear in green, because they conform the word that the student had to guess, they have already been placed in the corresponding spaces of the word to be guessed; the letters E (with accent), I and S appear in red, as they are not part of the word to be guessed. Given that the hangman game is composed of eight random words for the category selected, after having guessed the eighth word, the web application will show the message displayed in Figure 5, in which the student is notified that the game is completed, it also shows the points obtained, the time taken to complete the game and three links: one that shows the list of winners, one to show the answers of the current game, and one to start the game again.

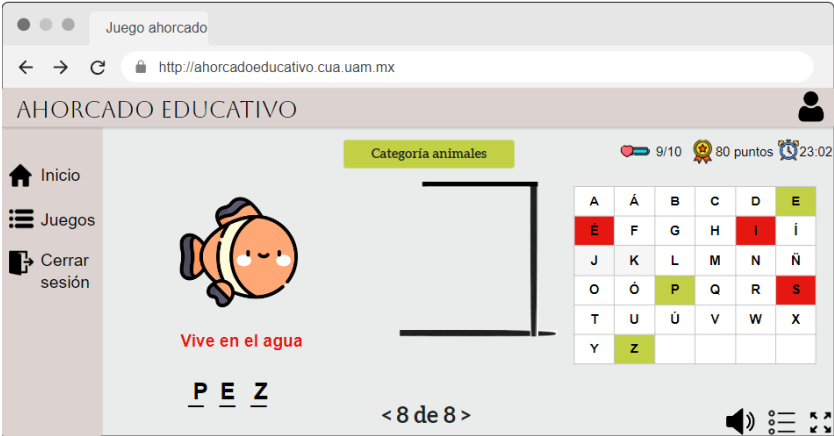


Figure 4. Hangman game with the eighth word to be guessed.



Figure 5. Interface for the hangman game completed.

Figure 6 shows the users registered in the web application, which displays a table with ID, name, surname, email, role (student or teacher) and actions to visualize the information, edit it and delete it. Figure 7 shows how a teacher can register new words in a specific category. In this case, the interface shows the category of animals, in which the teacher has to register the word to be added to the category, along with an image, an audio file and a clue, so that this information is incorporated into the category and is available when a student plays a hangman game with that category. Additionally, a teacher can modify or delete the information provided: word, image, sound file and clue. Finally, a teacher can also register new categories of words, which allows to create hangman games for particular topics or disciplines, as it was shown in Figure 1 of this section, where the following categories were already registered in the web application: countries, anatomy, English, chemistry, among others.





Figure 6. Interface with the list of registered users.



Figure 7. Interface to register new words for a specific category.

#### IV. CONCLUSIONS AND FUTURE WORK

This paper presented a proposal of a web application to create hangman games, with the aim of supporting the learning and practicing of vocabulary for different topics or disciplines, oriented to primary school children. The web application will have two users: teachers (administrators) and students. Teachers will be able to create new categories of words, according to the topic or discipline they want, register words, clues, images and audio files, corresponding to each registered word. Students will have an interactive hangman game platform, where they will be able to play and enjoy with the categories of words created by their teachers, according to the topic or discipline desired. The modules of the proposed web application with their functionality were described, and some use cases and interface prototypes were shown.

The paper also showed a comparative analysis of digital hangman games similar to the proposed web application, and described their main features, such as: game description, instructions for the game, images and hints for the word to be guessed, different levels, user management, among others. A comparative table was presented with the features of the web tools analyzed, which showed that none of the web tools evaluated had all the relevant functionality, specially the possibility of allowing to create new categories of words. This also allowed to determine the functionality that the proposed web application will have.

Further work is needed to complete the development of the web application for both users: teachers and students. The web application for hangman games will be evaluated by teachers and students in four aspects: functionality, usability, design and didactic features. It is also planned to put the system on a web server so that teachers and students can use it to create and play their own hangman games.

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