

# Developing an AI-based spelling system for kids

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**Abstract:** In the field of education, poor spelling is a significant learning obstacle. To help overcome this barrier, this current study designed and developed a mobile-based system entitled: "Let's Spell" in order to help children boost their spelling skills by utilizing up-to-date technical tools necessary for learning. The system was developed by following the generic software systems development process. The main features used for the systems are "exercises" associated with "games-like learning state". Each game is based on the exercises on "Language Book" and is implemented using interactive voice recognition methods so that each letter in the set of letters and the names of various objects associated with the letter are expressed together aloud. Then the names will be called out to the children, who will in turn read it. If they get it right, they can go to the next level of the game, and in this way, they can continue to improve and succeed. On the other hand, if they get it wrong, a message will appear telling them to try again. In the event that they keep getting it wrong each time a help option is provided, a correction feature will be present to show them how to spell it correctly. Hence this contribute to the provision of a tool that will bring concentration on the practice of learning and enhanced confidence for the learners as well as improving the learning satisfaction.

**Keywords:** mobile application, voice recognition, Arabic language, Spelling game, Flutter, Text-to-speech, Speech-to-text, voice synthesis, voice recognition.

## 1. Introduction

Nowadays, technology has become a vital part of our children's lives. They are surrounded by technology wherever they go. It is almost impossible to find a child without a smartphone, a tablet, or an iPad in developed countries. Children are using these devices for many different purposes such as entertainment, education, games, and communication. Hence, the field of education seeks to develop and keep pace with this generation's developments by relying on technology and integrating it with education. Therefore, creating more attractive and effective environments for children to learn.

Technology helps teachers and students to enhance the education process, by not only depending on the traditional way of learning in school but also, learning from technologies that help to teach the students innovatively and effectively through human-computer interaction, such as voice recognition. Voice Recognition is the process of identifying and understanding voice signals of a user converted into text or commands for a program (Paul & George, 2013).

The aim of this study is to integrate voice recognition in education using interactive methods. Moreover, we are specifically focusing on teaching children how to spell. Spelling words is one of the most useful skills, helping children in all aspects of learning, such as reading and communicating. It also helps in building the foundation they need during their educational careers, even in their daily lives.

## 2. Problem definition

First-grade students tend to depend on adults such as teachers and parents to help them check their spelling exercises in (لغتي) book. However, adults' presence is not always guaranteed. Also, we found that although there are many applications to help students learn how to spell words in Arabic, they only give children two options either write the word or arrange letters but do not give them the option to spell by speaking. The objective of this work is thus to incorporate voice recognition with teaching Arabic spelling.

## 3. Literature review

In this section, we will review several related works similar to our application. Namely, we will review four similar applications: EduKittyABC, A+ Spelling test, Dictation, and Spelling Bug Hangman. Table 1 provides a comparative analysis of these applications in terms of five selected attributes: 1) voice recognition, which indicates whether the application supports voice recognition or not, 2) supports Arabic, 3) based on an educational book/curriculum, 4) IOS, and 5) Android.

**Table 1.** Comparative analysis of applications

Application	Voice recognition	Supports Arabic	Based on educational book	IOS	Android
EduKittyABC				√	
A+ Spelling test		√		√	
Dictation	√			√	√
Spelling Bug Hangman				√	√
Our proposed application (Let's Spell)	√	√	√	√	

EduKittyABC application teaches children English the alphabet and spelling by playing some games like ABC flashcards, tracing alphabet letters, catching flying letters, connecting upper case letters with lower case, spelling puzzle, and the alphabet song that is available on YouTube. The application contains a 3D guidance cat (App Store, 2019). In this application, children can spell the word by listening to a voice or seeing a picture. However, a disadvantage in this application is that it offers a limited free trial, and needs to be purchased later. In terms of the selected features for comparison, the application can be used in IOS systems only. It does not have voice recognition, does not support Arabic, it is not based on an educational book and is not available on Android.

A+ Spelling Test is another application that allows students, teachers or even parents to custom or create a list of words for children to spell: when the list is created the children can choose from any activity they want including: Practice it, Unscramble, Ace it and test. These activities are easy to use and can help children to learn how to spell correctly. Also, this app allows you to track their progress and send the result to their teachers through E-mail. The application requires IOS 8.0 or above, it's only compatible with iPhone, iPad and iPod touch (Dyslexiahelp.umich.edu, 2019). Some of the unique features of this application include the ability to share spelling lists with parents, students, and teachers, and the ability to backup spelling lists online. However, similar to the previous application, this application does not support voice recognition, nor is it based on an educational curriculum.

Dictation is an assistive technology (AT) resource that can help children who are struggling with writing. You can hear it referred to as the technology of "speech-to-text," "voice-to-text," "voice recognition," or "speech recognition." Instead of handwriting or keyboard writing, children can use dictation to write using their voices. This can be helpful for children with dysgraphia, dyslexia, and other learning disabilities that impair writing. The main advantage of this is that children with writing difficulties can have a hard time writing emails and assignments such as

essays and articles. In this regard, dictation software can help Dictation software is a powerful tool, but it is a skill to use it properly. Children need to learn commands. With some learning and attention problems, some elements of dictation can be challenging for children (Martin, n.d.). Additionally, this application does not support teaching Arabic spelling nor is it based on an educational curriculum.

Spelling Bug Hangman is an enjoyable way for 5-10 years old children to practice their spelling. It contains more than 100 words. Moreover, users can create their lists. Also, the app gives an option to play on your own, with friends, or parents. The app displays a picture and asks the user to guess the word by selecting letters from the on-screen keyboard (Search.bridgingapps.org, 2019). One of the interesting features of this application is that it allows multiplayer, so children can play with their friends or parents. The application is very useful, but it relies on the memory of children. The word does not appear to children unless they guess it correctly. Additionally, the application does not support voice recognition or the Arabic language.

Unlike related work, we propose to design and implement an application that: 1) incorporates voice recognition to simplify children's interaction with the interface, 2) supports teaching Arabic spelling, 3) is based on educational curriculum to help parents while teaching in school, and 4) supports both IOS and Android platforms.

## 4. Methodology

The overall methodology for the research consisted of four stages as outlined below.

**Stage 1:** Review of literature and previous works on the Let's spell application

**Stage 2:** Prior Questionnaire

We used a questionnaire to collect the results. The questionnaire targets all people who have/teach a child in the first grade of elementary school. Our sample size of this questionnaire was 445 participants, 7.4% represented males, and 92% represented the female. Our questionnaire contains 10 questions that lead to answer to our main points:

- Do you think that integrating technology with education has a role in motivating children?
- Do you prefer to have an application based on (لغتي) the first grade of the elementary school manual that listens and evaluates the child's spelling?
- Do you think this kind of application can save you time spent hearing and evaluating child spellings?
- Do you prefer the child to know the name of the letter or the sound of the letter?

The results of this questionnaire are provided in section 5.

**Stage 3:** Design and implementation of the application

The main purpose of our project is to create an application with Voice Recognition technology that will help students to improve the native language (Arabic) spelling skills interactively.

The optimal solution is to develop an application that makes students learn how to spell the words in the exercises from (لغتي) the book, by speaking to the application and making the application recognize their voices and interact with it and to check whether they are spelling the word in the right way or not. We conducted a comparative analysis among the related work and the proposed application as shown in Table 1.

The main features in LET'S SPELL application:

- apply interactive technology in education;
- transform the old boring spelling practice into a new and fun game;
- help kids become independent;

- fill the gap the parent may cause when they are busy;
- provide 24/7 access to practice.

#### Stage 4: Usability testing

In the usability testing phase, we survey whether the app and its segments match the predetermined prerequisites, moreover, ensure there are no errors and unreliable functions. This part will define the testing procedure utilized with assessing Let's Spell application. It applies unit testing, integrating testing, and system testing to assess system usefulness, including compatibility and usability testing. See section 7 for details.

## 5. Results of prior questionnaire

From this survey, we received 445 responses. The main idea of the application was described for people to understand the purpose of the survey. Figure 1 presents the questionnaire results for the four main questions. For the first question, the majority (92.8%) believed that integrating technology with education has a role in motivating children to learn. Additionally, 91% of the participants believed that if an application is to be designed, they prefer to have it based on an educational curriculum. 84% of the participants believe that our proposed application will save time spent on hearing and evaluating their kids spelling. Lastly, 77% of the participants believed that kids should learn the sound of the letter and not the name of the letter. The result of this questionnaire helped share the functional requirements of our system, which are detailed in the next section.

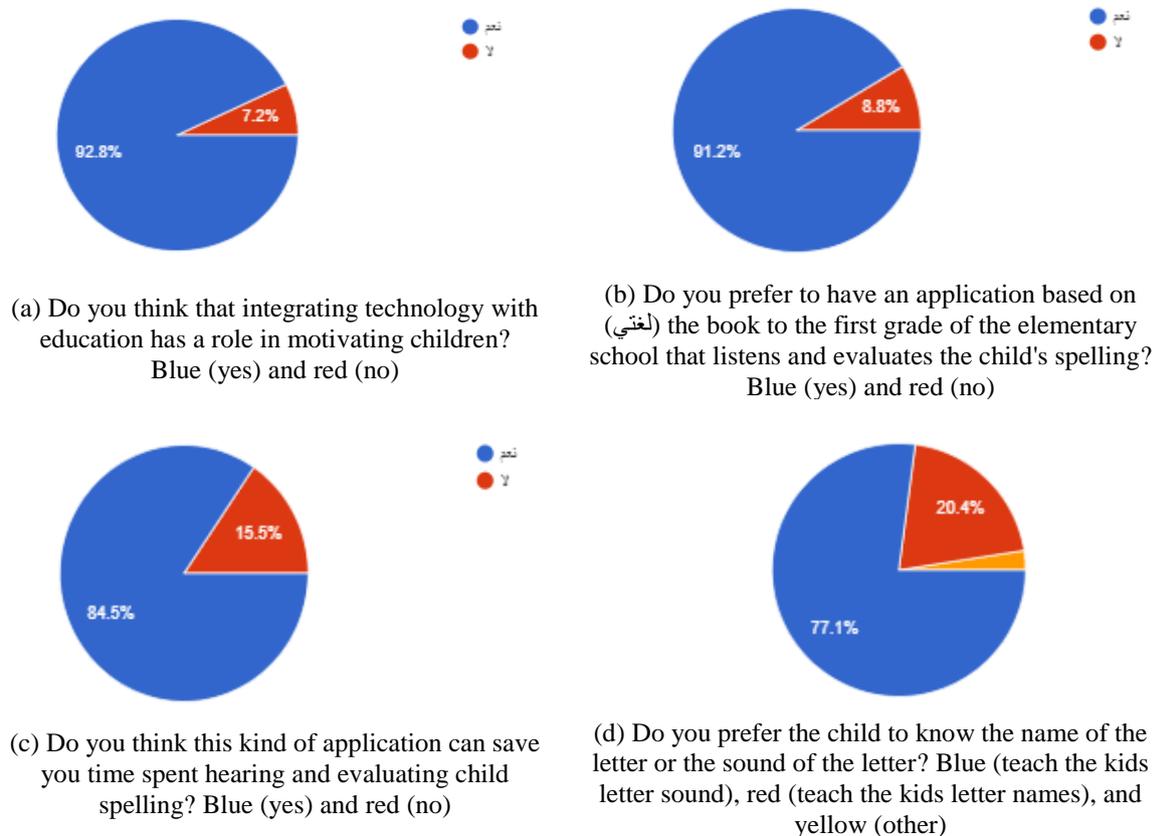


Figure 1. Questionnaire Results

## 6. Design and implementation of the application

### 6.1. Design of the application

In the design phase, we have specified the functional and non-functional requirements of the system. We have also designed the user interface of our application.

#### 6.1.1. Functional requirements

The functional requirements describe what the application is supposed to do and how the application should interact and respond to the user's voice, the main functional requirements are:

1. users should be able to choose from any section they want to try and practice on;
2. keep checking after every time the user tries to spell and correct if there's a mistake;
3. display the total achievements the user has achieved while using the app and keep it saved even if the application is not used.

#### 6.1.2. Non-functional requirements

1. usability: the application should be useful to achieve the goal of knowing how to spell correctly;
2. simplicity: the application is easy to use by first graders; they just need to follow the instructions of the game;
3. performance: the application's response time and displaying the results will be immediate.

#### 6.1.3. Interface & description of application

This section explores the Interface & Description of Application as following (as show in Figure 2):

- Let's Spell application starts with a simple yet fun and visually appealing page that displays the name of the application and a start button;
- the next interface is the unit's page. It displays the letters units in accordance with (لغتي) the book;
- after choosing the wanted unit a set of letters will appear just as they are displayed in the book. And an option to go back to the previous page;
- a letter page appears when choosing a letter, displaying examples of words that include that letter. Along with returning to the previous page option, there is an option to return to the start page;
- when choosing a word, the next interface shows a picture of the word and the sound of the picture. There are two options: the first to try to say the word; the second is a help option that replays the sound of the picture. If the child pronounces it correctly, this page appears with an enforcement statement and a clapping voice.



Figure 2. Interface of application

## 6.2. Implementation of the application

The application was implemented using Flutter. Flutter is an open source SDK created by Google. It was selected because it supports developing applications for IOS, Android, and other platforms as well. Here, we highlight the main plugins we used to develop voice recognition and voice synthesis in our application.

- **Voice synthesis:** Flutter has the Text-to-Speech plugin which enables the application to utter any word given to it in a text format. This means that children can listen to the word that they need to spell. This is achieved using the *speak()* method in this plugin, which is responsible for converting the text to speech. The Text-to-speech plugin in Flutter supports the Arabic language.
- **Voice recognition:** Flutter has the speech-to-text plugin which is used to convert the voice input into text. In this plugin, the *resultListener()* method is used for receiving the speech and convert it to text. We compare the speech result with the saved word using *contains()* method. This method compares each letter in the first word by each letter in the second word. If the two words are identical, the result will be successful. In this case, we play clamping mp3 sound using the audio player plugin.

## 7. Testing

This section incorporates a description of the testing process which includes preparations, goals, target participants and test environment. Furthermore, we provide a list of the main functionalities of the system and the correct way to execute fundamental tasks through the system. Additionally, testing methods used to test the system and the result of the methods used are presented.

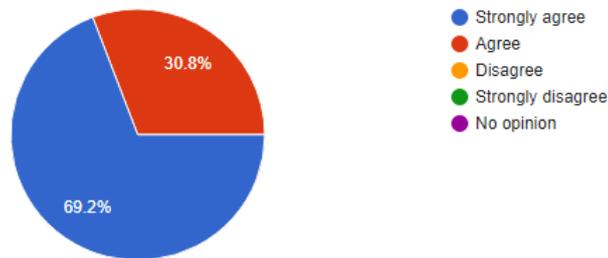
### 7.1. Usability testing

Usability testing is an approach that assesses how easy to use interfaces are and how the user can interact and use the system to achieve his goals in an efficient and effective way. As defined by Nielsen (2003), usability is defined by five quality components which are:

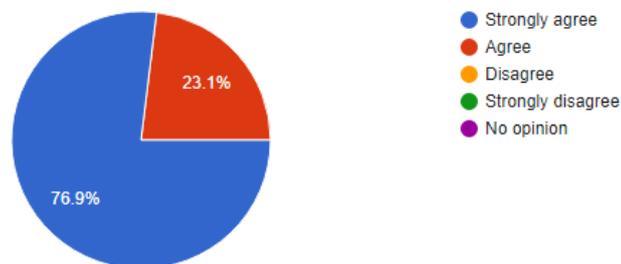
- **Learnability:** How easy is it for users to accomplish basic tasks the first time they encounter the design?
- **Efficiency:** Once users have learned the design, how quickly can they perform tasks?
- **Memorability:** When users return to the design after a period of not using it, how easily can they reestablish proficiency?
- **Errors:** How many errors do users make, how severe are these errors, and how easily can they recover from the errors?

- Satisfaction: How pleasant is it to use the design?

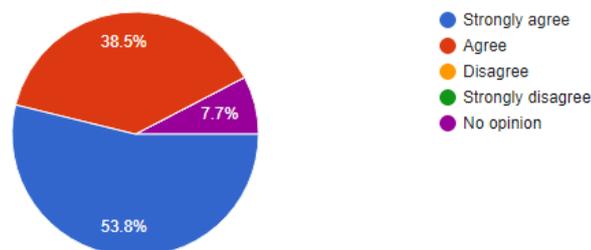
Below are the results of the questionnaire we made in order to measure the usability test of our system based on five quality components:



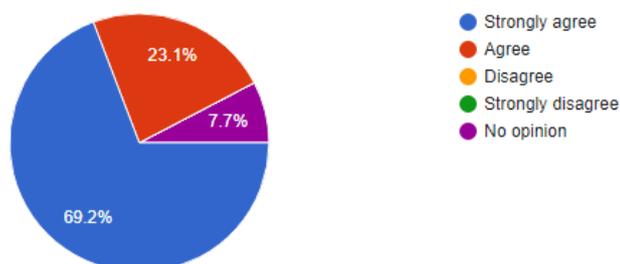
**Figure 3.** Learnability : Let’s spell application is easy to use when you use it for first time



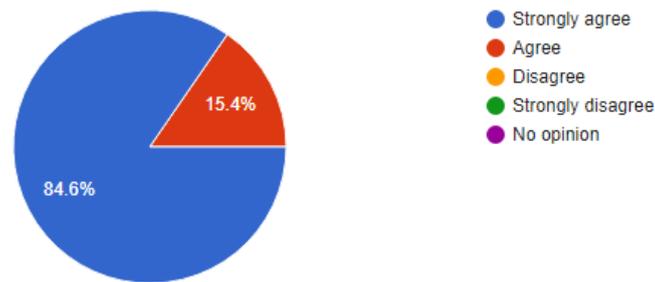
**Figure 4.** Efficiency: once you learned the design Let’s spell application, you quickly perform?



**Figure 5.** Memorability: when you return to the Let’s spell application design after a period of not using it, it is easy you can reestablish proficiency



**Figure 6.** Errors Let’s spell application helps you avoid and recover any errors



**Figure 7.** Satisfaction: How pleasant is it to use the Let's spell Application design

## 8. Conclusion & future work

This study described the design and implementation of Let's Spell application. The main contribution of this work is that it utilizes voice recognition to teach kids spelling. This work can be further improved by incorporating additional technologies to aid kids in their learning. For example, personalized learning techniques can be adopted to customize the words that appear to each child based on his/her needs and learning pace.

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