



# **The Use of Web and Mobile Applications in Language Learning**

Mukhtar Mohamed ST20149677

BSc (Hons) Degree in Software Engineering

Cardiff Metropolitan University

## Declaration

I declare that all of this work is my individual work and that all information gathered from other sources has been acknowledged and referenced. This dissertation is submitted in partial fulfilment of the requirements of Cardiff Metropolitan University for the Degree of Bachelor of Science with Honours.

Supervisor: Ana Calderon

Signed: MUKHTAR MOHAMED 13/05/21

## Abstract

In this report you will find the evolution of the Internet and the World Wide Web (WWW). You will also find the development of language learning, its theories and how those theories have evolved as time went on. The report also includes a review of a study that was carried out to observe and evaluate the effect and impact mobile and web applications and technology in general have on language learning. The report will also include a review of existing web and mobile language learning applications and the categories these applications fall into. The report will also focus on evaluating the development of a prototype that will help students to learn the Arabic alphabet, its software design and the use of rapid application development as its software methodology to develop the prototype. Towards the end of the report you will find an evaluation of the prototype along with limitations that have been discovered and suggestions for further improvements to be made in the future. The report will also include a conclusion which will discuss a summary of how the research project went overall, future directions for theories of language learning and its knock-on effect on the development of web and mobile applications used or made for the purpose of language learning.

## Acknowledgement

I would first like to express gratitude and thanks to Allah (God) for granting me the ability, motivation and guidance to pursue this research project and the degree as a whole. I would secondly like to express my utmost appreciation to my mother and family who raised me, nurtured me, supported me and motivated me which resulted in love for education and pursuing it to the highest degree possible. I would thirdly

like to thank my supervisor Ana Calderon for going above and beyond to provide me the support and guidance I needed to carry out this research project during the pandemic at a time where more support was needed than ever. Finally, I would like to thank my peers and other lecturers for supporting me throughout my studies in university.

## Table of Contents

<b>Declaration .....</b>	<b>2</b>
<b>Abstract .....</b>	<b>2</b>
<b>Acknowledgement.....</b>	<b>2</b>
<b>Figures .....</b>	<b>4</b>
<b>Introduction.....</b>	<b>6</b>
<b>Motivation .....</b>	<b>7</b>
<b>Aims .....</b>	<b>8</b>
<b>Objectives .....</b>	<b>8</b>
<b>Literature Review .....</b>	<b>9</b>
<b>The Internet.....</b>	<b>9</b>
<b>The Relationship Between Language and Culture .....</b>	<b>10</b>
<b>Theoretical Approaches Towards Language Learning .....</b>	<b>12</b>
<b>Study - Technology-Enhanced Intercultural Language Instruction (TEILI).....</b>	<b>14</b>
<b>Review of Existing Language Learning Applications .....</b>	<b>15</b>
<b>Software Methodology.....</b>	<b>20</b>
<b>SDLC – Software Development Life Cycle.....</b>	<b>20</b>
<b>RAD – Rapid App Development .....</b>	<b>21</b>
<b>Arabic 4 U Application .....</b>	<b>24</b>
Home Page.....	24
Learn Page .....	28
Quiz Game.....	33
<b>Evaluation.....</b>	<b>40</b>
<b>Limitations .....</b>	<b>40</b>
<b>Future Work .....</b>	<b>41</b>
<b>Conclusion .....</b>	<b>42</b>
<b>Bibliography.....</b>	<b>43</b>
<b>Ethics Form .....</b>	<b>45</b>

## Figures

Figure 1 - Diagram of Byram's Intercultural Communicative Education Model (Byram, 1997, 2012 & Byram et al., 2002) (Chen and Yang, 2014) .....	11
Figure 2 – Classification of Mobile Apps (Gangaiamaran and Pasupathi, 2017).....	16
Figure 3 – Apps for Primary Learners (Gangaiamaran and Pasupathi, 2017).....	16
Figure 4 – Apps for Secondary Learners (Gangaiamaran and Pasupathi, 2017) ....	18
Figure 5 – Apps for Tertiary Learners (Gangaiamaran and Pasupathi, 2017) .....	18
Figure 6 - Software Development Life Cycle (Javatpoint, 2021).....	21
Figure 7 – Home Page (Desktop Version) .....	24
Figure 8 – Home Page (Mobile Version) .....	25
Figure 9 – Code snippet of navbar-collapse bootstrap CSS class .....	26
Figure 10 – Navbar collapses and is revealed by clicking the burger icon in the top-right hand corner .....	27
Figure 11 = Code snippet of CSS used to style hover feature for buttons .....	27
Figure 12 – Hover feature activated .....	27
Figure 13 – Code snippet of active class .....	28
Figure 14 – The purpose of the activate class is to show which page the user is currently on .....	28
Figure 15 – Phase 1 of the Learn Page .....	29
Figure 16 – CSS code to align the table in the centre of the page.....	29
Figure 17 – curved-edges class to create grey curved tiles for each letter .....	30
Figure 18 – Phase 2 of Learn Page .....	30
Figure 19 – JavaScript code to play the audio once its clicked.....	31
Figure 20 – the onclick attribute is used within each tile to active the audio once clicked. ....	31
Figure 21 – JavaScript code snippet that allows audio to be played several times without delay .....	32
Figure 22 – CSS code snippet to implement hover feature for tiles on Learn Page .	32
Figure 23 – Hover feature implemented on the tiles in the Learn Page .....	32
Figure 24 – Quiz Game Home Page .....	33
Figure 25 – Screenshot of the Quiz Game .....	34
Figure 26 – Screenshot of the End Page .....	34
Figure 27 – CSS flexbox-layout code snippet .....	35
Figure 28 – Snippet of HTML code Quiz Game Page.....	36
Figure 29 – Snippet of CSS code for Quiz Game Page .....	36
Figure 30 – Snippet of JavaScript code to store questions as objects within an array .....	37
Figure 31 – Array that is used to store the questions that are about to eb displayed	37
Figure 32 – Questions from the questions array being stored into the availableQuestions array using the spread operator.....	38
Figure 33 – Snippet of JavaScript code to increment the score when the correct answer is selected .....	38
Figure 34 – Constants that store the 10 points for each correct answer and the maximum number of question in the quiz .....	38
Figure 35 – If statement used to initiate the score to be incremented .....	38
Figure 36 – Snippet of JavaScript used to validate answer selected by the user .....	39
Figure 37 – CSS correct and incorrect classes .....	39

Figure 38 – Snippet of JavaScript code used to create delay between select answer and new question being displayed .....	39
Figure 39 – Red verification for incorrect answer.....	39
Figure 40 – Green verification for correct answer.....	39
Figure 41 – Snippet of JavaScript code to update the progress bar each time a question is completed .....	40
Figure 42 – CSS styling for the progress bar .....	40
Figure 43 – Progress bar in the quiz game page .....	40

## Introduction

One of the most important life skills that has played a key role in the survival and maintenance of mankind throughout history is the skill of communication. Through communication, people express their feelings, concerns, brilliant ideas and are able to connect with each other. Due to the human nature to want to socialise, there are many different ways in which people communicate with each other. People communicate with each other through media such as videos and pictures, through verbal and non-verbal exchange. (Corporate Finance Institute, 2021)

The type of communication that stands out the most and is the most complex in its nature is the verbal exchange whereby people speak to each other through the medium of languages. The great number of different languages, the ability to speak and learn more than one language and communicate with others using it, is from one of the great signs within the Muslim faith that shows God exists as it is mentioned the Quran, whereby God says:

“And from His signs is the creation of the heavens and the earth, and the diversity of your languages and colours. Surely in this are signs for those of sound knowledge.”  
(Quran 30:22)

Communication plays a massive positive role in many aspects of life ranging from work, education, socialising and entertainment and many other aspects. One example we can use is the positive effect good communication has in bringing about success of organisation in the workplace. Owen Hargie (Hargie, 2016) discovered through his research on this topic that the following benefits are obtained:

- “increased productivity
- higher quality of services and products
- greater levels of trust, engagement and commitment
- more staff suggestions and higher levels of creativity
- greater employee job satisfaction and morale
- better workplace relationships
- more acceptance of change
- decreased absenteeism
- reduced staff turnover
- less industrial unrest and fewer strikes
- reduced costs.” (Hargie, 2016)

and many other positive effects like the ones listed above are found in other aspects of life.

Due to the great importance of learning languages to communicate, we find parents and guardians teaching their children and helping them to utter the first words in the mother-tongue that they use to communicate. Also, children are taught their mother tongue, universal languages like English and the recognised language of the place they live in within schools. Students are also encouraged to learn modern foreign languages that will allow them to communicate and connect with others around the world. With the advancements of technology, the development of the World Wide Web, mobile and web applications have paved the way to gain access to a massive amount educational resources at a person's fingertips. The applications created that are used for language learning have generated the possibility to learn, apply and practice language skills (Rosell-Aguilar, 2018). The aim of this research project is to review and evaluate applications that assist in language learning, the impact they have on language learning and to create a prototype that can teach people the Arabic alphabet.

## Motivation

The motivational drive to conduct this research project stems from my passion for learning languages, specifically the Arabic language as I have been studying the Arabic language for over 10 years, delving deeper and deeper into Arabic grammar, morphology, eloquence and literature. The more I learn the Arabic language, the more I fall in love with it. I have also been voluntarily teaching Arabic in the evenings and weekends for the past 5 years. The teaching aspect is one of the main driving factors as I found that many students whom I have taught how to read Arabic alphabet struggled to learn it and easily forget it. This led to me discovering that by using the method of repetition coupled with quizzes to test their knowledge would help the students to memorise the letters. Also, by setting various activities based on these two techniques inspired me to create a prototype that allows the students to click on each letter to hear how it's pronounced as many times as they like. Once they feel like they have mastered the Arabic alphabet, they have a go at a quiz that

puts their knowledge to the test. If my students alone were to have access to something like this outside of lesson time, it would definitely improve the comprehension and ability to read, memorise and recall the Arabic alphabet.

## Aims

The aim of this project is to create a prototype that helps students to master the Arabic alphabet. This prototype can really help students who struggle to learn the Arabic alphabet. Research will be carried out to discover and evaluate language learning theories, the evolution of the internet, the use of mobile and web applications for the purpose of language learning. The aim of this project is also to look at the effect web and mobile applications have on improving the language learning education and reviewing existing mobile language learning apps.

## Objectives

The objectives of this research project will be to:

- Critically review academic literature regarding the evolution of the Internet, language learning theories and its advancements, the use of web apps in language learning and their impact and language learning apps that exist in the current market.
- To design and create a prototype that helps students to master the Arabic alphabet.
- To conclude and evaluate the findings within my research.

## Literature Review

### The Internet

When defining the internet, it is observed that it consists of a global network, providing communication and access to information via a large collection of networks that are private, public, business, academic and government owned. Agencies such as the Internet Assigned Numbers Authority (or IANA) govern the internet by establishing universal protocols that the world abides by. Another term that is used interchangeably for the internet is the World Wide Web. However, they are not the same as the World Wide Web is one of the services communicated over the internet and it does not refer to the global communication system, including hardware and infrastructure (Techopedia, 2021).

Technology and Computing experienced a drastic transformation starting from the 1960s through the 1980s and has continued on that journey at an exponential rate until now. Originally, the computer was merely seen as a device that exists for the sole purpose of calculations, however over time it evolved to become a means of communication to the point where today the process of information transfer and communication via long distances instantaneously has become something that is familiar and known by necessity and has been taken for granted by many of this generation. For many individuals all over the world it has become very easy to communicate or access media and information online at their fingertips, making this an essential factor of computer technology as opposed to the 1960s, computers were very expensive and rare. Also, using a computer for communication was seen as something not possible. During this time, transferring information between computers involved someone carrying the information physically in the form of magnetic tape or punch cards. As for the development and popularisation of network technology, the internet played a massive role, which placed computers at the centre of a new communications medium. Between the late 1960s and the 1990s, the Internet grew from a single experimental network serving a dozen sites in the United States to a globe-spanning system linking millions of computers. Before the creation of the internet, its predecessor was created which was called ARPANET which was created by the US Department of Defence's Advanced Research Projects Agency (ARPA) (Abbate, 2003).

## The Relationship Between Language and Culture

Experts of theoretical approaches to foreign language learning have identified that there is a strong relationship between language and culture and when language “is used in contexts of communication, it is bound up with culture in multiple and complex ways” (Kramsch, 1998).

One of the well-established and recognised councils for teaching of foreign languages called the American Council on the Teaching of Foreign languages developed and supported that the following points be applied in foreign language teaching:

- Communication
- Culture
- Connection
- Comparison
- Community (ACTFL, 1996).

Each of these five focus points have unique and distinguishing factors.

Communication is the foundation and the main purpose for language learning. When learning a foreign language, understanding it in its cultural context whilst comparing it to the native language of the person its cultural context will help in creating a more open mind with higher tolerance to other cultures and the learner will be able to recognise the interdependent relationships between the native language and the foreign language. Connection gives learners access to details regarding the foreign language and its language from a variety of perspectives. Comparison increases the understanding of the language and its components along with the cultural aspects by comparing the foreign language to the native language. Community creates an environment and an atmosphere that learners can use to practise the language in an international setting beyond the classroom (Chen and Yang, 2014).

Over the years, researchers and experts from all over the world have developed and propositioned intercultural communicative education models. However, one of the most extensive and significant intercultural communicative educations models that has been suggested is Michael Byram’s model due to its encompassing, all-

inclusive, linguistic and intercultural competence and its objectives are realistic, well-defined and ethical (Byram, 1997) (Chen and Yang, 2014).

Byram's model is made up of five components. Byram placed critical cultural awareness in the centre acting as the core due to its direct relationship to the other components which are:

- Knowledge
- Intercultural attitudes
- Interpreting and relating skills
- Discovery and interaction skills (Chen and Yang, 2014).

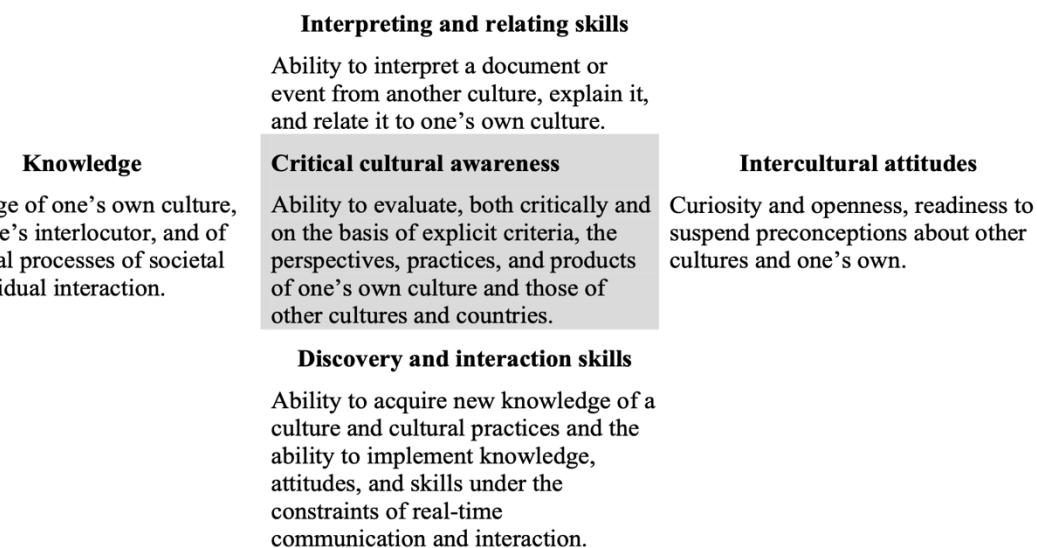


Figure 1 - Diagram of Byram's Intercultural Communicative Education Model (Byram, 1997, 2012 & Byram et al., 2002) (Chen and Yang, 2014)

The combination of accurate teaching of language studies and intercultural elements will allow students to acquire the skills and competency needed for communication with others via the language/languages they have learnt and the most important part of implementing Byram's model is the steps the teachers take to reach these aims and objectives. Byram's model is only a blueprint that shows the connection between intercultural communication and foreign language teaching; teachers must develop and use the best teaching strategies alongside Byram's model to create the best solution for their context (Byram, 1997 & Byram et al., 2002) (Chen and Yang, 2014).

## Theoretical Approaches Towards Language Learning

When a language is learnt in a closed environment like a classroom and that language is not spoken in the city and society where the teaching is taking place, that language is referred to as a foreign language. Learning foreign languages has many benefits as it will allow individuals to interact and communicate with people from different countries and societies. It will allow individuals to become more open minded as they discover other cultures and perspectives, developing intercultural understandings and better understanding of one's own culture and language as many comparisons will be made between languages (Moeller and Theresa Catalano, 2015).

Experts in language studies have come to the conclusion that there are two distinct ways in which an individual can pick up a language. The first method is known as acquisition whereby individuals learn the first and second languages naturally as a result of their environment without formal teaching methods like a classroom. The second method is known as learning whereby the language is learnt via formal study such as a classroom etc (Moeller and Theresa Catalano, 2015).

The theoretical approaches to language learning have evolved significantly overtime due to extensive research and experiences which have allowed the scientific and theoretical knowledge foundations to expand regarding how an individual learns a foreign language. The original traditional method of learning a foreign language involved students carrying out exercises that involve repeating or imitating new pieces of information. Based on behaviourist theories of learning and structural linguistics, the amount and the quality were the determining factors in successfully learning a language. A well-established method of teaching that involved mimetic activity and was frequently used in 1950s was a method known as audio-lingual approach (ALM).

the ALM approach consisted of an instructor that would be the authority figure in the class and the instructor would get students to carry out activities and tasks involving repetition and imitation until the students reach a level whereby they can automatically respond to the instructor, believing that the students would develop the ability to automatically use the appropriate terms and phrases without the need of

rigorous thinking when conversing with others via the foreign language that they are learning. However, the first language interrupted the expected results of the ALM approach as the students experienced the foreign language was taking the position of their first language which resulted in errors. In 1959, Noam Chomsky reviewed B.F. Skinner's work on verbal behaviour and this drastically changed the perspective of many with regards to language learning. Chomsky came to the conclusion that language learning is not a set of habits but it is a rule-governed activity. Chomsky also argued that methods such as ALM, structural linguistics and behaviourist psychology would negatively affect the creativity of the student and that by looking at language learning as rule-governed activity, the creativity would come from the student deeply processing the meaning. Chomsky claimed that children have an innate ability to figure out and discover the rules and grammar of a language (Chomsky and Skinner, 1959) (Moeller and Theresa Catalano, 2015).

Another theoretical approach that came about was known as the interactionists approach which focused on combining the children's innate ability in acquiring a language with the linguistic environment. Interactionists held the view that the language must shift in accordance the learner's ability. One of the advocates for the interactionists approach, Long held the view that if the input of the language being learnt is made easy, linguistic and extralinguistic hints are applied and that the interactional structure of the dialogue is modified, all of these steps would allow the language being learnt easily to become more comprehensible and understandable. Long came to this conclusion due to his observation that the students who apply these methods when learning a new language adjust their words and phrases whilst interacting with others and they negotiate the meaning and by this, their comprehension of the language they're learning increases and grows. Long also held the view that the comprehension of a language being learnt cannot increase and become enhanced by mere input and output (Long, 1985) (Moeller and Theresa Catalano, 2015).

In most recent times, specialist researching in this field have deduced the following contemporary theoretical approaches to language learning:

- Universal Grammar
- Autonomous Induction
- Associative-Cognitive CREED
- Skill Acquisition
- Input Processing
- Processability
- Concept- Oriented Approach
- Interaction Framework
- Vygotskian Sociocultural Theory (VanPatten and Williams, 2008) (Moeller and Theresa Catalano, 2015).

Exploring and reviewing literature on the theoretical approaches towards language learning is vital towards this research project because these theories have direct impact on the design of web and mobile applications that are tailored towards language learning. As these theories evolve and are implemented within the language learning education sector this will allow the web and mobile applications to evolve and adapt to suit the style of learning and teaching at its current time and the future.

### **Study - Technology-Enhanced Intercultural Language Instruction (TEILI)**

A study carried out by the Professor Shu Ching Yang and Dr Jen Jun Chen at National Sun Yat-sen University involved implementing TEILI to improve English language learning. The study consisted of a one-year course that included 3 projects that involved language activities using TEILI. The study shows that the students enjoyed learning English as a second language through these intercultural projects. One project within the study that the students gave a high score of satisfaction and gave very positive feedback about was the E-pal project which consisted of students

from different cultures communicating via instant messaging. The E-pal project allowed to students to put their English language skills to the test and engage in live conversation allowing them to practice in an authentic learning context with people from different backgrounds from all over the world. The study also included the utilisation of a weblog-assisted teaching model that allowed students to overcome the lack of experience with intercultural projects. More than 93% of the students expressed that the weblog-assisted teaching method was helpful in their projects and all the students who took part in the study preferred TEILI to traditional classroom style teaching. (Chen and Yang, 2014).

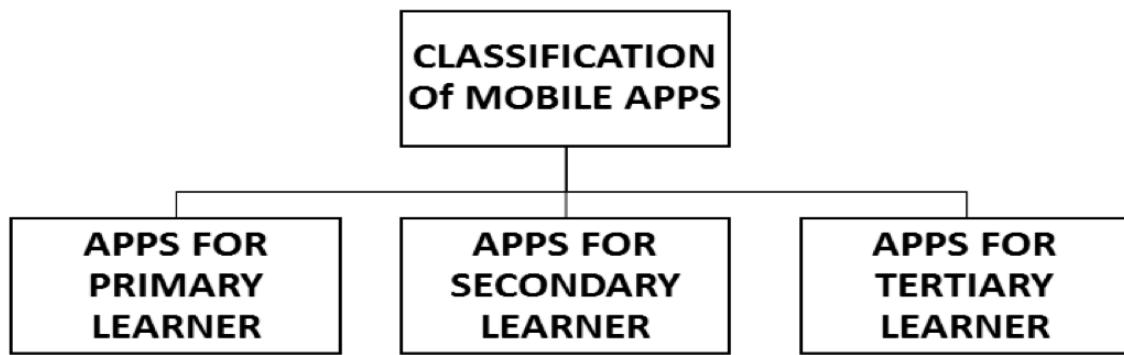
One of the things that really stood out about this study is the combination between real life teaching and the use of technology to aid and assist in foreign language learning which resulted in excellent positive feedback from the students to the point where they expressed that no improvements should be made to the teaching model (Chen and Yang, 2014).

### Review of Existing Language Learning Applications

When looking specifically at the use of mobile technology to assist in language learning we find that there is a rapid increase in adoption for it in the language learning and education sector. “Mobile Assisted Language Learning (MALL) provides easy access for any learner without the constraints of both place and time. In Mobile Learning, devices like smartphones, iPod, tablet, laptop, iPad are implemented to scaffold language learning.” (Gangaiamaran and Pasupathi, 2017)

One of the reasons why I chose this paper is due to the detailed review on existing apps in the market that are used for language learning and which applications are most suitable for each user. Another reason for why I picked this paper was due to the lack of research done on this particular topic to this level of detail as Gangaiamaran and Pasupathi identified and expressed in this paper. They divided the different type of apps into 3 different categories; primary, secondary and tertiary. All three categories are based on age due to the average level of comprehension and understanding each age group has. The primary category is suitable for children aged 3-10, the secondary category is suitable for teenage children in secondary

school and the tertiary category is suitable for college/university students and adults (Gangaiamaran and Pasupathi, 2017)



*Figure 2 – Classification of Mobile Apps (Gangaiamaran and Pasupathi, 2017)*

Here below a list of few apps for the primary category:

**Table 1: Apps for Primary Level Learners**

LOGO	NAME OF THE APP	DEVICE	SKILL	PAID / UNPAID
	Pogg — Spelling & Verbs	iPhone and iPad	To Learn Spelling, Language and Vocabulary. [Special Education Like Autism and Speech Therapy Support]	Paid
	Speech with Milo Apps	iPhone, iPad, and iPod touch.	Enhance speaking skill.	Paid
	Phonetics Focus	iPhone, iPad, and iPod touch.	It offers various interactive activities to develop speaking skill.	Paid
	MindSnacks	iOS	It uses fun games to learn new English words.	Paid

*Figure 3 – Apps for Primary Learners (Gangaiamaran and Pasupathi, 2017)*

Due to the direct involvement of mobile technologies in our everyday lives, mobile and electronic devices are becoming a main part of our children's lives. Children use mobile and electronic devices for the purpose of interacting, watching videos and playing games. Professional instructors have experimented with the use of mobile devices in early learning to improve the learning of children which resulted in a

positive outcome and showed effective learning (Liu et al., 2014) (Gangaiamaran and Pasupathi, 2017). Researchers have identified that apps for learning have a great potential in improving early and primary level education. The apps in the figure 3 above have the following matters in common:

- “More social entertainment
- Round the clock availability
- Effective utilization of leisure hours
- Alternate modes of learning
- Fun and informal” (Gangaiamaran and Pasupathi, 2017).

Students in the primary category often learn languages by starting off with alphabet letters. They also learn through nursery rhymes, songs and animated stories. Majority of the learning involves images to help them learn and recognise new worlds whilst revising the words they have learnt. The mobile apps listed in figure 3 are designed to meet these needs. (Gangaiamaran and Pasupathi, 2017)

Here below is a list of a few apps in the secondary category:

Table 2: Apps for Secondary Learners

LOGO	NAME OF THE APP	SYSTEM	SKILL	PAID/UNPAID
	Rosetta Stone	iOS / Android	Vocabulary Acquisition	Free
	FluentU	iOS Android	Speaking, Vocabulary Acquisition.	Paid
	MindSnacks	iOS	Vocabulary Acquisition.	Paid
	Memrise	iOS /Android	Vocabulary	Free
	Open Language	iOS /Android	Speaking	Paid
	Busuu	iOS / Android	Speaking	Paid
	Duolingo	iOS /Android	Vocabulary	Free

Figure 4 – Apps for Secondary Learners (Gangaiamaran and Pasupathi, 2017)

Mobile apps for language learning can be one of the best ways in which students can adapt due to large amount of time the average secondary student spends on their mobile phone for recreational purposes, giving “Them active control of their learning in the palm of their hands” (Redd, 2011) (Gangaiamaran and Pasupathi, 2017). Bonnstette and VanOverbeke (2012) expressed that “The elementary classroom builds the basis for the content areas and the future success of students. From writing creative stories to fact mastery in mathematics, apps provide an engaging and interactive platform for learning.” (Gangaiamaran and Pasupathi, 2017)

Primary students discover the fundamentals of the language whereas secondary students progress to a more advanced level in language learning. Some of the language skills secondary students pick up are listening, speaking, reading, writing skills. They also pick up grammar, vocabulary and meanings, pronunciation, spellings and more (Gangaiamaran and Pasupathi, 2017).

Here below are a few apps in the tertiary category:

Table 3: Apps for Tertiary Level Learners

LOGO	NAME OF THE APP	SYSTEM	SKILL	PAID/ UNPAID
	Sounds Right	iOS, iPad	Enhances the articulation and pronunciation of vowels and diphthongs.	Free
	WordBook XL – English Dictionary & Thesaurus for iPad	iPhone and iPad	Enhances the vocabulary acquisition.	Paid
	Speech Tutor	iPhone, iPad, and iPod touch.	It helps the learner in pronouncing specific letters and phonemes.	Paid
	English Podcast for Learners	Android	Nurture speaking, listening skills through audio.	Free
	Voxy	iOS and Android.	It connects learners with native English speakers to learn English and also through games.	Free
	English Listening and Speaking	iOS and Android.	By conversational stories and transcripts, along with word chain games it helps the learners to identify and assess pronunciation.	Free
	Exam Vocabulary Builder	iPhone, iPad, and iPod	Vocabulary Acquisition through illustrative sentences which helps Learners to understand how each word is used in context	Free

Figure 5 – Apps for Tertiary Learners (Gangaiamaran and Pasupathi, 2017)

For students in the tertiary category, just like the secondary students, they are well known for frequent usage of mobile and electronic devices, and they will pick up language skills such as listening, speaking, reading, writing skills. They also pick up grammar, vocabulary and meanings, pronunciation, spellings and more. The difference between the tertiary students and the secondary students is that the tertiary students are more used to independent learning on average. Researchers have discovered that tertiary students can use language learning apps to pick a new language by themselves and they feel more motivated to learn a new language through these mobile apps. Studies carried out by researchers of this topic have found that one of the language skills that are enhanced the most through mobile language learning apps are listening and vocabulary. (Gangaiamaran and Pasupathi, 2017)

## Software Methodology

### SDLC – Software Development Life Cycle

For my research project, I decided to create a prototype that allows beginner students to master the Arabic alphabet. To create this prototype, I first explored the Software Development Lifecycle (SDLC) and software methodologies which allowed me to perfectly plan how to turn my idea into a working prototype. SDLC can be defined as “A process followed for a software project, within a software organization. It consists of a detailed plan describing how to develop, maintain, replace and alter or enhance specific software. The life cycle defines a methodology for improving the quality of software and the overall development process. The SDLC aims to produce a high-quality software that meets or exceeds customer expectations, reaches completion within times and cost estimates.” (Javatpoint, 2021)

When researching the concept of SDLC, I came across the following popular SDLC models which are:

- “Waterfall Model”
- Iterative Model
- Spiral Model
- V-Model
- “Big Bang Model” (SDLC - Software Development Life Cycle - Javatpoint, 2021)

I also came across other similar methodologies like the Rapid App Development model (RAD) and Agile Model. After researching each model thoroughly, I came to the conclusion that the best model that is suitable for my project due to the shortage of time is the RAD model.

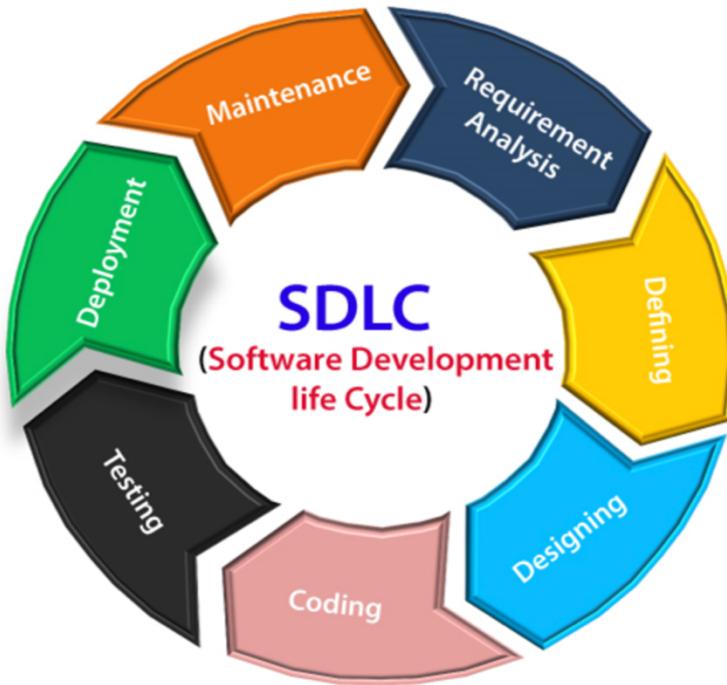


Figure 6 - Software Development Life Cycle (Javatpoint, 2021)

## RAD – Rapid App Development

Rapid application development (RAD) is an agile methodology that puts emphasis on developing applications at a rapid rate, which creates opportunities for continuous feedback, therefore resulting in multiple iterations based on that feedback. RAD focuses on creating Minimum Viable Products (MVP) based on the clients' requirements. RAD allows the clients to see what they have asked for in a short period of time and then give feedback on whether or not the requirements they gave are in line with the end result they expected. RAD has become really popular due to the competitive software market and greater demands for new software applications. RAD was first mentioned and presented by James Martin in 1991 as he recognised during his time that software has the ability to be updated and changed an infinite number of times based on design development models. RAD was a pioneer in software methodologies that led to the discovery of agile software methodology implemented by companies and organisations searching for methods that can keep up with the clients' requirements and the rapid growth of their business. Due to RAD concentrating on prototypes being produced at a rapid rate, iterations and release

cycles are based on user feedback which eliminates the need for strict planning which usually results in high costs especially when the clients are not satisfied with the finished result of that strict planning. The increase usage of RAD has resulted in an increase of low code/no code platforms being developed (Chien, 2021).

RAD allows customers to see a working prototype within a short period of time as opposed to more traditional SDLC models like the waterfall model which are more rigid. SDLC models like the waterfall model forces clients to sign a contract before the project starts and they may not see a working prototype for several months, resulting in complications regarding changes being made to the app due to new requirements that may arise. RAD therefore removes these complications by focusing on client satisfaction earlier on in the process, giving room for changes and improvements to be made as the client is involved throughout the development cycle (Chien, 2021).

RAD has 4 stages in its development cycle:

- “Define project requirements
- Prototype
- Rapid construction & feedback gathering
- Finalize product/implementation.” (Chien, 2021)

The RAD cycle begins with project requirements being decided by clients with the assistance of the development team. The project stakeholders discuss possible ways to tackle problems and issues that may occur and arise during the creation of the prototype. The project requirements that are discussed include aims, length of the project, pricing and budget allowing all project stakeholders to be on the same page, preventing mistakes that could result in high costs. Even though project requirements are set at the beginning of the project, RAD brings about the ability change the requirements at any time throughout the development process of the prototype (Chien, 2021).

Once project requirements are agreed upon by all project stakeholders, the developers work with the design team alongside the clients to begin the second stage which involves rapidly producing a final working prototype in line with requirements that were set beforehand. The prototype step will most likely be repeated more than once until the clients are satisfied. RAD involves the user testing and giving feedback on the prototype that exists as a live system, resulting in constant feedback as each version of the prototype is made, allowing the developers to improve the prototype in increments until requirements are met and the clients are satisfied. The Prototype stage allows all project stakeholders to communicate in an efficient way and identify the desired outcome. Due to many releases of the prototype, many errors and bugs are discovered earlier on the development cycle reducing the number of bugs that exist at the end of the development cycle (Chien, 2021).

The third stage is rapid construction and feedback gathering which involves developing the prototype and testing in its different forms. This stage converts the prototype into working software. This stage may also be repeated when the need arises. Majority of issues are resolved during the prototyping phase, allowing the developers to create a final version of working software that meets the client's expectation or exceeds it. Clients are heavily involved in this stage with their suggestions and any issues that arise during the later stage of the development cycle (Chien, 2021).

The last stage involves the developers pointing out technical debt whilst also optimising the working software to enhance its stability so that the product is ready to be launched. The code/software and its components are moved to a live production environment whilst undergoing rigorous testing to identify any remaining bugs. In this final stage, detailed documentation is compiled, and any remaining necessary tasks are completed, before the final product is handed over to the client. (Chien, 2021)

Due to time constraints, I was only able to complete the RAD cycle up until the prototype stage. However, I hope to complete the next following stages to create a working live application allowing many people to benefit from it.

## Arabic 4 U Application

In this section I shall be reviewing and commenting on the prototype I made called Arabic 4 U, its design and its implementation. I created this prototype using HTML, CSS, Bootstrap and JavaScript.

### Home Page

Arabic 4 U   Home   Learn   Quiz



Figure 7 – Home Page (Desktop Version)



# Arabic 4 U

**Have you always wanted to learn the Arabic language?**

**Look no further and begin right here with the Arabic alphabet!**

Let's get started!

Figure 8 – Home Page (Mobile Version)

As we can see in Figure 7 and 8, I have included the name of the prototype which is “Arabic 4 U” and placed it right in the centre. The reason why I chose that name is that the aim of this application is to make learning Arabic suitable for all types of people to the extent where the user feels like this app has been made to suit them specifically and their learning styles individually, allowing them to feel respected and important with the end goal being to obtain ultimate user satisfaction and experience. Also, to improve user experience, I have included a question which is “Have you always wanted to learn the Arabic Language” to capture the attention of the user, increasing user engagement. For those interested in learning the Arabic language I directed them to the first step to take by saying “Look no further and begin right here with the Arabic Alphabet” with a button underneath that says, “Let’s get started!” to encourage the user to go to the next page where they can begin their journey of learning the Arabic language. I carefully selected that photo in the background to give the user a vivid and colourful image their minds of learning Arabic, to also capture the user’s attention, increasing user engagement and improving the user’s experience. I put a lot of thought into the homepage as it’s the first page users come

into contact with. Great emphasis should be put on user experience (UX) due to the many advantages it brings to an application such as:

- Increasing customer acquisition and loyalty
- Maximizing revenue generation opportunities
- Optimising resources, development time and costs
- Obtain more insights from user engagement
- Reducing troubleshooting and associated costs (FAHM Technology Partners, 2021).

For the navbar and buttons on the home and learn page, I decided to use bootstrap which is front-end open-source toolkit that allows you design and create responsive mobile-friendly websites and web-applications which a range of extra features such as Sass variables, responsive grid system and a wide-range of prebuilt components and JavaScript plugins. (Otto, 2021). By using bootstrap, I was able to rapidly produce the buttons and navbar which was in-line with the RAD software methodology approach I chose to produce this prototype. An example of how bootstrap aids in creating responsive mobile-friendly sites would be the collapsing navbar I implemented by using the navbar-collapse class.

```
<div class="collapse navbar-collapse" id="navbarSupportedContent">
```

Figure 9 – Code snippet of navbar-collapse bootstrap CSS class

For mobile devices, the user would click on the burger icon to reveal the navbar as we can see in figure 8 and 10 which prevents information cluster, creating a much cleaner look, therefore improving the user interface (UI) and UX.

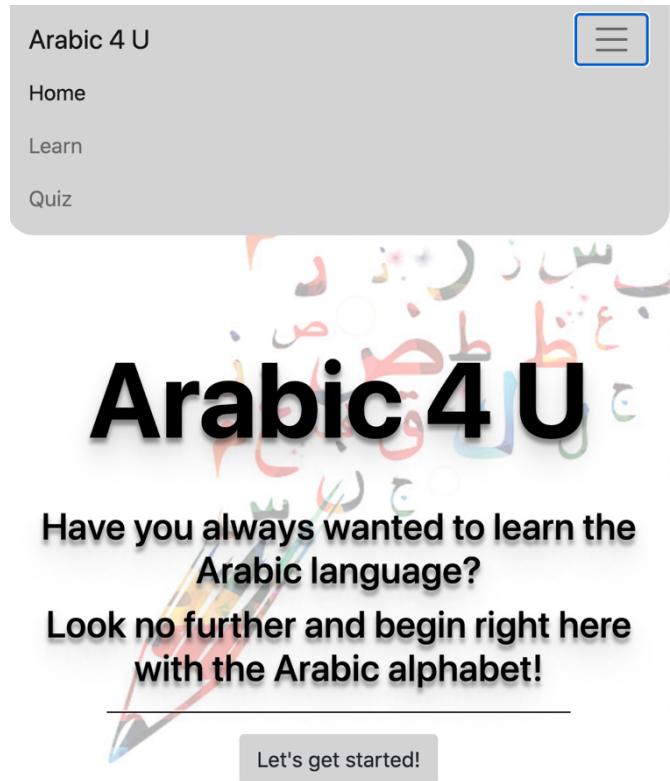


Figure 10 – Navbar collapses and is revealed by clicking the burger icon in the top-right hand corner

```
.button-style:hover {
  cursor: pointer;
  box-shadow: 0 0.4rem 1.4rem 0 rgba(86, 185, 235, 0.5);
  transform: translateY(-0.1rem);
  transition: transform 150ms;
}
```

Figure 11 = Code snippet of CSS used to style hover feature for buttons

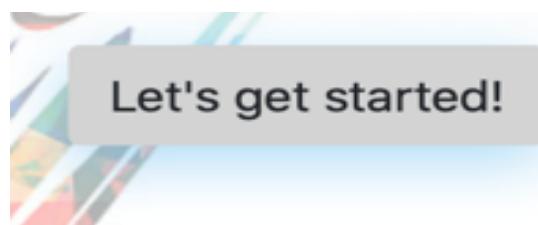


Figure 12 – Hover feature activated

Another feature that I have implemented in the prototype is the hover feature as we can see above in figure 11 and 12. The hover feature is activated with a faded

highlight behind the button when the user hovers over it. This feature again captures the attention of the user, improving the UI and UX.

Throughout the app, I have implemented consistency in the colours, font and theme as “usability and learnability improve when similar elements have consistent look and function in similar way” (Nikolov, 2017). Consistency simplifies how to use the app as the user adapts quickly to how the app works, improving the UI and UX.

```
<li class="nav-item active">
```

Figure 13 – Code snippet of active class

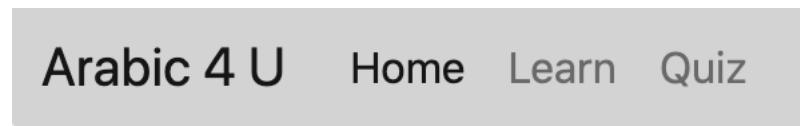


Figure 14 – The purpose of the activate class is to show which page the user is currently on

Another feature I have implemented in the navbar is the active class. This would be very useful in the later stages of development for the prototype as the number of pages in the app increase as it would allow the user to quickly recognise the current page they are on, making the navigation throughout the app a lot easier, therefore improving the UI and UX.

### Learn Page

One of the most challenging parts of creating this prototype was designing the learn page to become as user friendly and beneficial as possible and it went through more than one design phase.

## Phase 1

The screenshot shows a table of Arabic letters with their transliterations. The letters are arranged in three columns: the first column contains Alif, Thaa, Khaa, Raa, Sheen, Daa, Ghayn, Kaaf, Noon, and Laam Alif Hamzah Yaa; the second column contains Baa, Jeem, Daal, Zaa, Saad, Dhaa, Faa, Laam, Waaw, and a blank row for Laam Alif Hamzah Yaa; and the third column contains Taa, Haa, Thaal, Seen, Daad, Ayn, Qaaf, Meem, Haa, and a blank row for Laam Alif Hamzah Yaa. Below the table, there is a message encouraging users to take a quiz.

Do you feel like you have mastered the Arabic Alphabet?  
Put your knowledge to the test - play the quiz now!

Play the Quiz!

Figure 15 – Phase 1 of the Learn Page

as we can see in the figure 15, I decided to display the letters of the Arabic alphabet in the form of a table with no borders, with the transliteration underneath each letter to help the student pronounce the letter correctly. However, without no styling, the learn page is inconsistent with the general theme of the app.

## Phase 2

```
.center {
    margin-left: auto;
    margin-right: auto;
    margin-bottom: auto;
    margin-top: auto;
}
```

Figure 16 – CSS code to align the table in the centre of the page

```
.curved-edges {  
    border: 1px solid #ffffff;  
    border-radius: 25px;  
    background-color: #D3D3D3;  
}
```

Figure 17 – curved-edges class to create grey curved tiles for each letter

In phase 2, I begin to style the learn page in by centring the table and allowing each letter to be in line with the general theme of the app by increasing the size of the letters creating grey tiles with curved edges and each tile contains a letter of the Arabic alphabet. In order for me to create those tiles, I created a CSS class that allowed me to obtain the styling we can in figure 17 and 18.



Figure 18 – A section of Phase 2 of Learn Page

### *Phase 3*

After completing phase 2, I realised a common problem that many students have that I have experienced and seen in teaching the Arabic alphabet is that they forget how the letters are pronounced when they try to revise at home after the class. The transliteration at the bottom of the letter is not enough for them. In phase 3, I decided to record the sound of each letter and allow the user to click on each letter and hear how it is pronounced. I used the html audio element for each letter which accesses the sound of each letter from a folder called sounds that contains all of sounds of the letters being pronounced. Each audio has a unique ID attribute that is used within the JavaScript functionality. To create this functionality, I used JavaScript by creating a function called play(). The function play() consists of a variable called audio that uses getElementById which has letter as its parameter. The parameter, letter is where the ID attribute of each letter in the <audio> elements enters into the play() function. The variable called audio accesses the .play() HTML Media Element which plays the audio file for the ID attribute that has been clicked. The sound of each letter is activated by clicking each tile due to each tile having the onclick attribute set to activate the play() JavaScript function. The code for that we have mentioned here can be found in figure 19 and Figure 20.

```
<script>
|   function play(letter) {
|       var audio = document.getElementById(letter);
|       audio.currentTime = 0;
|       audio.play();
|
|   }
</script>
```

Figure 19 – JavaScript code to play the audio once its clicked

```
<div onclick="play('hamzah')" class="curved-edges">
```

Figure 20 – the onclick attribute is used within each tile to active the audio once clicked.

I noticed during phase three that if the student wants to click each tile to hear how the letter is pronounced, there is a delay if they click the tile a second time before they can hear the pronunciation again, which may affect the UI and UX. To resolve this, I set the current time of the audio variable to zero. This allows the user to repeat

the letter as many times as they like and each time they click the tile, they will hear the pronunciation of the letter without delay, improving the UI and UX.

```
audio.currentTime = 0;
```

Figure 21 – JavaScript code snippet that allows audio to be played several times without delay

I have decided to use inline JavaScript within the html file for the learn page to reduce the number of JavaScript files that are downloaded before the pages of the prototype are displayed (OXO Solutions, 2021).

Also, to remain as consistent as possible with theme I chose for this prototype, I implemented the hover feature for each tile due to its functionality resembling buttons as both the tiles and the buttons are clicked.

```
.curved-edges:hover {  
    cursor: pointer;  
    box-shadow: 0 0.4rem 1.4rem 0 rgba(86, 185, 235, 0.5);  
    transform: translateY(-0.1rem);  
    transition: transform 150ms;  
}
```

Figure 22 – CSS code snippet to implement hover feature for tiles on Learn Page



Figure 23 – Hover feature implemented on the tiles in the Learn Page

## Quiz Game

Once the students have used the learn page and reached a level where they feel like they have mastered the Arabic alphabet, I created a quiz game within the prototype so they can put their knowledge to the test. The quiz game consists of a home page that allows the users to start the game by clicking the play button. I have decided to use different colours to the general set theme of the app to make the user feel like they have entered a new area and dimension of the app.

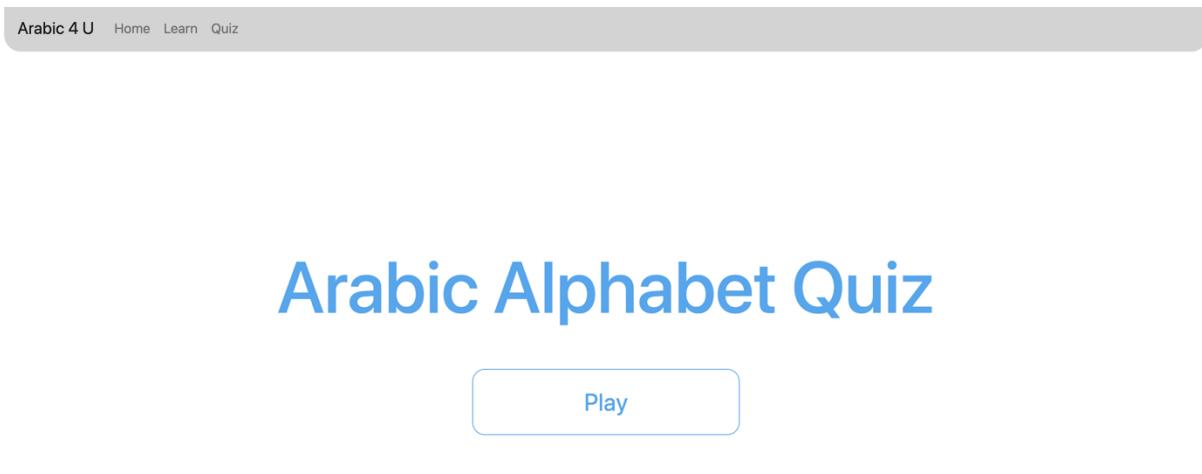


Figure 24 – Quiz Game Home Page

Once the user clicks play, they are then taken to another page which is the quiz. The quiz game consists of the user clicking play to listen carefully to the letter being read out loud, then they must choose one of the four options given to them. If they select the correct option, it will be highlighted in green and the user will get 10 points. If the user selects the wrong option, it will be highlighted red and they will get 0 points. The quiz consists of ten questions that are displayed one after each other in a random order. I have purposely removed the navbar to prevent the user from returning back to the learn page if they become stuck. This will force and encourage the user to completely rely on their memory and use active recall which will allow them to learn the Arabic alphabet in an effective and efficient way. Active recall involves your memory being actively stimulated to retrieve information (Brainscape Academy, 2021). I chose to design the quiz in this way as it is a technique that I use within the Arabic reading classes that I teach and it has produced amazing results whereby

students master the Arabic alphabet in a short amount of time. Even if the user gets a low mark at the end of the quiz they will have the option to play again until they achieve full marks.

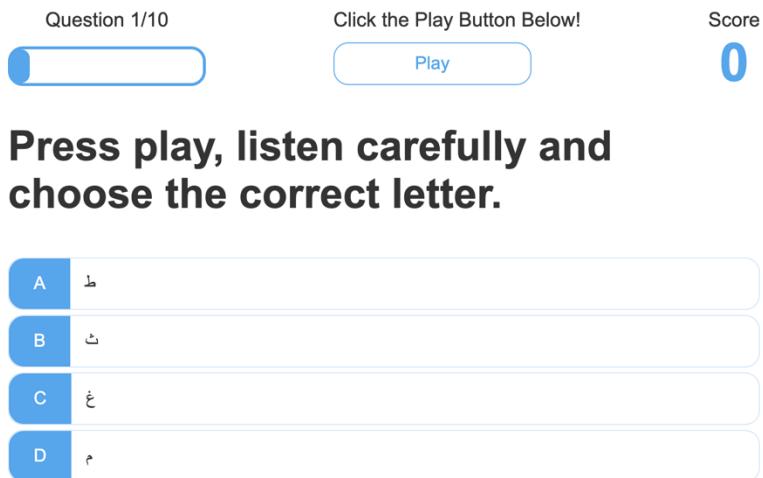


Figure 25 – Screenshot of the Quiz Game

## Total Score: 80 points

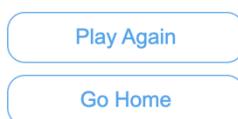


Figure 26 – Screenshot of the End Page

I have decided to place everything in the centre of the screen using CSS flexbox layout method which allows everything to remain in the centre even if the screen size decreases.

```
.container {
  width: 100vw;
  height: 100vh;
  display: flex;
  justify-content: center;
  align-items: center;
  max-width: 80rem;
  margin: 0 auto;
  padding: 2rem;
}

.container > * {
  width: 100%;
}

.flex-column {
  display: flex;
  flex-direction: column;
}

.flex-center {
  justify-content: center;
  align-items: center;
}

.justify-center {
  justify-content: center;
}

.text-center {
  text-align: center;
}
```

Figure 27 – CSS flexbox-layout code snippet

I have displayed each question on the quiz page with four options labelled A-D using nested div containers with each container and element containing the specific CSS class to style it. Each option has a data-attribute which is used within the JavaScript code to help identify and recognise the correct answer. I have also decided to implement the hover feature using CSS for each option that is being clicked which helps the user to clearly see which option they are choosing to answer each question.

```

<div class="container justify-center flex-column">
  <div id="game" class="justify-center flex-column">
    <div id="hud">
      <div id="hud-item">
        <p id="progressText" class="hud-prefix">
          Question
        </p>
        <div id="progressBar">
          <div id="progressBarFull"></div>
        </div>
      </div>
      <div id="hud-item">
        <p class="hud-prefix">Click the Play Button Below!</p>
        <br>
        <button class="btn" id='button-play'>Play</button>
      </div>
      <div id="hud-item">
        <p class="hud-prefix">
          Score
        </p>
        <h1 class="hud-main-text" id="score">
          0
        </h1>
      </div>
    </div>
    <h2 id="question">What is the answer to this question?</h2>
    <div class="choice-container">
      <p class="choice-prefix">A</p>
      <p class="choice-text" data-number="1">Choice 1</p>
    </div>
    <div class="choice-container">
      <p class="choice-prefix">B</p>
      <p class="choice-text" data-number="2">Choice 2</p>
    </div>
    <div class="choice-container">
      <p class="choice-prefix">C</p>
      <p class="choice-text" data-number="3">Choice 3</p>
    </div>
    <div class="choice-container">
      <p class="choice-prefix">D</p>
      <p class="choice-text" data-number="4">Choice 4</p>
    </div>
  </div>
</div>

```

Figure 28 – Snippet of HTML code Quiz Game Page

```

.choice-container {
  display: flex;
  margin-bottom: 0.5rem;
  width: 100%;
  font-size: 1.8rem;
  border: 0.1rem solid rgb(86, 165, 235, 0.25);
  border-radius: 15px;
  background-color: white;
  justify-content: center;
}

.choice-container:hover {
  cursor: pointer;
  box-shadow: 0 0.4rem 1.4rem 0 rgba(86, 185, 235, 0.5);
  transform: translateY(-0.1rem);
  transition: transform 150ms;
}

.choice-prefix {
  padding: 1.5rem 2.5rem;
  background-color: #56a5eb;
  color: white;
  border-bottom-left-radius: 15px;
  border-top-left-radius: 15px;
}

.choice-text {
  padding: 1.5rem;
  width: 100%;
}

```

Figure 29 – Snippet of CSS code for Quiz Game Page

The questions that are displayed on the webpage are stored in an array of objects called `questions` whereby each object contains four answer options, the correct answer and its sound file.

```
let questions = [
  {
    question: "Press play, listen carefully and choose the correct letter.",
    choice1: "س",
    choice2: "د",
    choice3: "ه",
    choice4: "ج",
    answer: 3,
    source: "sounds/taa.wav"
  },
  {
    question: "Press play, listen carefully and choose the correct letter.",
    choice1: "ع",
    choice2: "ل",
    choice3: "ه",
    choice4: "ج",
    answer: 4,
    source: "sounds/laam.wav"
  },
  {
    question: "Press play, listen carefully and choose the correct letter.",
    choice1: "ب",
    choice2: "د",
    choice3: "ه",
    choice4: "ف",
    answer: 3,
    source: "sounds/ghayn.wav"
  },
  {
    question: "Press play, listen carefully and choose the correct letter.",
    choice1: "ع",
    choice2: "د",
    choice3: "ه",
    choice4: "ف",
    answer: 1,
    source: "sounds/baa.wav"
  },
]
```

Figure 30 – Snippet of JavaScript code to store questions as objects within an array

I made sure that each question is displayed in random order by creating another array called `availableQuestions`. At the start of the quiz, that array has all of the objects from the `questions` array by using the spread operator that can be seen in figure (No.). The spread operator takes all of the elements in the `questions` array, spreads them out and then adds those elements into the `availableQuestions` array. Every question the user answers is removed from the `availableQuestions` array, allowing only the remaining questions to be displayed. This prevents previously answered questions from appearing more than once throughout the quiz.

```
let availableQuestions = [];
```

Figure 31 – Array that is used to store the questions that are about to be displayed

```
availableQuestions = [...questions];
```

Figure 32 – Questions from the questions array being stored into the availableQuestions array using the spread operator

This quiz consists of ten questions and for each question the user answers correctly will receive ten points. However, if they choose the wrong option, they get 0 points.

```
//CONSTANTS  
const CORRECT_BONUS = 10;  
const MAX_QUESTIONS = 10;
```

Figure 34 – Constants that store the 10 points for each correct answer and the maximum number of question in the quiz

```
incrementScore = num => {  
    score += num;  
    scoreText.innerText = score;  
};  
  
startGame();
```

Figure 33 – Snippet of JavaScript code to increment the score when the correct answer is selected

```
if (classToApply === "correct") {  
    incrementScore(CORRECT_BONUS);  
}
```

Figure 35 – If statement used to initiate the score to be incremented

the correct option they chose will highlight in green and the incorrect option they choose

will highlight in red. I managed to do this by creating two CSS classes called correct and incorrect. Within each class I have the background colour to reflect the answer they have chosen. Those two classes are then used within the JavaScript code and one of them is activated depending on which answer the user selects (see figure 36). I have created a delay between choosing the answer and displaying the next question. To give the user enough time to take in the response to the answer they have chosen (see figure 37).

```

.correct {
    background-color: #28a745;
}

.incorrect {
    background-color: #dc3545;
}

```

Figure 37 – CSS correct and incorrect classes

```

choices.forEach(choice => {
    choice.addEventListener("click", e => {
        if (!acceptingAnswers) return;

        acceptingAnswers = false;
        const selectedChoice = e.target;
        const selectedAnswer = selectedChoice.dataset["number"];

        const classToApply =
            selectedAnswer === currentQuestion.answer ? "correct" : "incorrect";

        if (classToApply === "correct") {
            incrementScore(CORRECT_BONUS);
        }

        selectedChoice.parentElement.classList.add(classToApply);

        setTimeout(() => {
            selectedChoice.parentElement.classList.remove(classToApply);
            getNewQuestion();
        }, 1000);
    });
});

```

Figure 36 – Snippet of JavaScript used to validate answer selected by the user

```

setTimeout(() => {
    selectedChoice.parentElement.classList.remove(classToApply);
    getNewQuestion();
}, 1000);
});
});

```

Figure 38 – Snippet of JavaScript code used to create delay between select answer and new question being displayed

Question 1/10



Click the Play Button Below!

**Play**

Score  
**10**

**Press play, listen carefully and choose the correct letter.**

A	۱
B	۲
C	۳
D	۴

Figure 40 – Green verification for correct answer

Question 2/10



Click the Play Button Below!

**Play**

Score  
**10**

**Press play, listen carefully and choose the correct letter.**

A	۱
B	۲
C	۳
D	۴

Figure 39 – Red verification for incorrect answer

I have also included a progress bar towards the top left-hand corner allowing the students to clearly see their progress throughout the quiz. As they answer more

questions, the progress bar fills up in small increments. The purpose of the progress bar is help motivate them to complete the quiz.

```
//Update the progress bar  
progressBarFull.style.width = `${(questionCounter / MAX_QUESTIONS) * 100}%`;
```

Figure 41 – Snippet of JavaScript code to update the progress bar each time a question is completed

```
#progressBar {  
    width: 20rem;  
    height: 4rem;  
    border: 0.3rem solid #56a5eb;  
    border-radius: 15px;  
    margin-top: 1.5rem;  
}  
  
#progressBarFull {  
    height: 3.4rem;  
    background-color: #56a5eb;  
    width: 0%;  
    border-radius: 10px;  
}
```

Figure 42 – CSS styling for the progress bar

Question 1/10



Figure 43 – Progress bar in the quiz game page

## Evaluation

### Limitations

When evaluating the research project as a whole, I have recognised and identified limitations that exist within it. The main limitation that I have recognised is the analysis of this research project is deficient due it only focusing on the analysis of the prototype made rather than the analysis of the prototype along with its testing procedure, feedback given by volunteers who tested the prototype and results collected from the questionnaire filled out by the volunteer testers. If that type of in-depth analysis was carried out, then that would have provided a more complete analysis regarding the effectiveness of this prototype in improving the users experience in learning the Arabic alphabet which would directly reflect the effectiveness of web and mobile applications in improving language learning. The main reason for why this limitation exists is due to the time restrictions in which the project had to be completed.

## Future Work

Even though this project's aims and objectives were met and obtained, the evaluation of this research project has helped to identify and point out that many improvements can be made in the future. To improve the prototype itself, the verification of the answers and options selected within the quiz game could be improved. When the user selects the wrong answer, the option they chose becomes highlighted red, but it doesn't display the right answer, so the user will not know which answer is correct. To improve this, I would add a feature that allows the wrong option that is selected to be highlighted red and the correct option to be highlighted green simultaneously, allowing the user to see the correct answer.

Another way in which the prototype made can be improved is how the questions are displayed on the web page within the app. The questions along with the options, the correct answer and its audio file are hardcoded, stored as objects within an array and randomly selected to be displayed. As the user repeats the quiz many times, they will notice the same questions being repeated just in a different order each time they play the quiz. To improve this, I would use fetch API to make it more dynamic and to have a larger range of questions to be randomly selected and displayed.

Another in which this prototype could be improved is that I would create a feature that allows the user to store their high score and allow them to see a high score table of the highest marks along with the fastest time in which the quiz game was completed by the users, creating competition which will hopefully motivate them to learn and study.

As for other ways in which prototype can be improved, then it can include more games and quizzes that test the student's understanding and level of mastery from many different angles. One exercise I would create for them would involve building a bot using AI that plays the role of a teacher and listens to the student pronounce the letters displayed on the screen and then would verify with a green tick if its correct or a red cross if its incorrect whilst giving the user another chance to try again. I would also create another exercise which would involve creating a touch screen or mouse click feature that allows the user to draw the letter they can hear being pronounced on the screen and if it's correct, the screen would display a green tick and if its

incorrect then the screen would display a red cross giving the user another chance to try again.

## Conclusion

The research project has had a successful outcome overall as its set aims and objectives were met and obtained. Results of the research project has clearly shown that web applications play an important role in today's times in improving language learning and its presence in the language learning education sector is well respected and recognised. The ongoing advancements in developing new web and mobile applications for the purpose of language learning also shows promising results to improve the language learning education sector. However, the research carried out in this project brought to light some of the issues related to the use of web and mobile application in language learning and how experts in this area of research are looking to provide solutions to those issues. Within this research project, a thorough literature review was carried out on literature that exists on this area of research. A working prototype was created and was analysed and evaluated, which brought to light many positives of the prototype, its imitations and what would be implemented to improve it if the research project was to carry on.

## Bibliography

- Chien, C., 2021. *What is Rapid Application Development (RAD)?*. [online] Codebots. Available at: <<https://codebots.com/app-development/what-is-rapid-application-development-rad>> [Accessed 3 May 2021].
- www.javatpoint.com. 2021. *SDLC - Software Development Life Cycle - Javatpoint*. [online] Available at: <<https://www.javatpoint.com/software-engineering-software-development-life-cycle>> [Accessed 3 May 2021].
- Hargie, O., 2016. The Importance of Communication for Organisational Effectiveness. *Psicologia do Trabalho e das Organizações: Contributos*, pp.17-34.
- Rosell-Aguilar, F., 2018. Autonomous language learning through a mobile application: a user evaluation of thebusuuapp. *Computer Assisted Language Learning*, 31(8), pp.854-881.
- Corporate Finance Institute. 2021. *Communication - Importance of Good Communication Skills*. [online] Available at: <<https://corporatefinanceinstitute.com/resources/careers/soft-skills/communication/>> [Accessed 5 May 2021].
- Partners, F., 2021. *5 Benefits of integrating UI/UX Design to your process - FAHM Technology Partners*. [online] FAHM Technology Partners. Available at: <<https://www.fahmpartners.com/5-benefits-of-integrating-ui-ux-design-to-your-process/>> [Accessed 5 May 2021].
- Otto, M., 2021. *Bootstrap*. [online] Getbootstrap.com. Available at: <<https://getbootstrap.com/>> [Accessed 5 May 2021].
- Nikolov, A., 2017. *Design principle: Consistency*. [online] Medium. Available at: <<https://uxdesign.cc/design-principle-consistency-6b0cf7e7339f>> [Accessed 5 May 2021].
- OXO Solutions®. 2021. *What is Inline Javascript: How to Inline and Benefits of Using it?*. [online] Available at: <<https://oxosolutions.com/inline-small-javascript/>> [Accessed 10 May 2021].
- Brainscape Academy. 2021. *What is Active Recall? How to use it to ace your exams*. [online] Available at: <<https://www.brainscape.com/academy/active-recall-definition-studying/>> [Accessed 11 May 2021].
- Qur'an 30:22 (2007). translated by Dr. Muhammad Muhsin Khan, Dr Muhammad Taqi-ud-din Al-Hilail. Riyadh, Kingdom of Saudi Arabia: DARUSSALAM Publishers and Distributors.
- Chen, J. and Yang, S., 2014. Fostering Foreign Language Learning Through Technology-Enhanced intercultural Projects. *Language Learning and Technology*, 18(1), pp.57-75.

ACTFL. (1996). *Standards for foreign language learning: Preparing for the 21<sup>st</sup> Century*. Lawrence, KS: Allen.

Byram, M., Gribkova, B., & Starkey, H. (2002). *Developing the intercultural dimension in language teaching. A practical introduction for teachers*. Strasbourg, France: Council of Europe Publishing, Language Policy Division

Kramsch, C. (1998). Language and culture. Oxford, UK: Oxford University Press.

Byram, M. (1997). Teaching and assessing intercultural communicative competence. Clevedon, UK: Multilingual Matters.

Chomsky, N. and Skinner, B.F., 1959. Verbal behavior. *Language*, 35, pp.26-58.

Long, M.H., 1985. Input and second language acquisition theory. Gass, S., Madden, C. (Eds.), *Input in Second Language Acquisition*. Newbury House, Rowley, MA, pp. 377–393.

VanPatten, B., Williams, J. (Eds.), 2008. *Theories in Second Language Acquisition: An Introduction*. Routledge Taylor & Francis Group, New York.

Gangaiamaran, R. and Pasupathi, M., 2017. Review on Use of Mobile Apps for Language Learning. *International Journal of Applied Engineering Research*, 12(21), pp.11242-11251.

Liu, M., Scordino, R., Geurtz, R., Navarrete, C., Ko, Y., & Lim, M., 2014, “A look at Research on mobile learning in K-12 education from 2007 to the present,” *Journal of research on Technology in Education*, 46(4), pp. 325–372.

Techopedia.com. 2021. What is the Internet? - Definition from Techopedia. [online] Available at: <<https://www.techopedia.com/definition/2419/internet>> [Accessed 30 April 2021].

Redd, J., 2011, “Supporting vocabulary growth of high school students: An analysis of the potential of a mobile learning device and gaming app,” Ph.D. thesis, Iowa State University, IOWA.

# Ethics Form

## PART ONE

1A: GENERAL INFORMATION	
Name of applicant:	Mukhtar Abdirahman Mohamed
Supervisor (if student project):	Ana Calderon
School / Unit:	Cardiff's School of Technologies
Student number (if applicable):	ST20149677
Programme enrolled on (if applicable):	Bsc Software Engineering
Project Title: If using a working title, it should convey what the project is about	The Use of Web Applications For Language Learning
Expected start date of data collection:	N/A
Approximate duration of data collection:	N/A
Funding Body (if applicable):	
Other researcher(s) working on the project: If your collaborators are external to Cardiff Met, include details of the organisation they represent	N/A
Will the study involve NHS patients or staff? If yes, attach a copy of your NHS application to this form	No
Will the study involve human samples and/or human cell lines?	No

1B: Does your project fall entirely within one of the following categories:	
Desk based, involving only documents and not involving the collection of data from participants	Yes <input checked="" type="radio"/> No <input type="radio"/>
Laboratory based, not involving human participants, human samples, animals or animal derived material	Yes <input checked="" type="radio"/> No <input type="radio"/>
Practice based not involving human participants (eg curatorial, practice audit)	Yes <input checked="" type="radio"/> No <input type="radio"/>
Answering YES to any of these questions indicates that the project does not include any participants and you will not therefore be collecting participant data. If this is the case, please provide a short (150 words) non-technical summary of the project, complete the Declaration at the bottom of the form and forward this form to your School Ethics Committee (or equivalent). No further information regarding your project is required and you do not need to complete any more sections of this form.	
If you have answered NO to all of these questions, please proceed to 1C.	
Provide a non-technical summary of the project below:	

1C: Does your project fall entirely within one of the following categories:	
Compulsory projects in professional practice (eg Initial Teacher Education)	Yes <input checked="" type="radio"/> No <input type="radio"/>

A project for which NHS approval has been obtained NB If this is the case, please ensure that you submit copies of the following with this form: <ul style="list-style-type: none"> <li>• any questionnaires to be used</li> <li>• participant consent / asset form and withdrawal form</li> <li>• participant information sheets</li> </ul>	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
A project which is not compulsory in professional practice and has gained external ethics approval from a body other than the NHS. NB If this is the case, please ensure that you submit a copy of the approved ethics application with this form.	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
<p>If you have answered <b>YES</b> to any of these questions, please provide a short (150 words) non-technical summary of the project and <b>complete the rest of Part One of this form</b>. You do not need to complete Part Two.</p> <p>Forward your completed form, along with any additional documents required (as indicated above) to your School Ethics Committee (or equivalent).</p> <p>If you have answered <b>NO</b> to all of these questions, please complete the rest of this form including Part Two.</p> <p>Provide a non-technical summary of the project below:</p> <hr/>	

<b>1D: DATA COLLECTION AND STORAGE</b>	
What types of data will you collect or create?	
I will be collecting secondary data.	
How will you manage access to and security of the data?	
I will be accessing this data by reading journals, research papers online and I will be storing this data in my documents folder.	
Will the data collected be subject to the data retention protocols of any of the following bodies?	
<ul style="list-style-type: none"> <li>• Human Tissue Authority (HTA)</li> <li>• Health and Care Research Wales (HCRW)</li> <li>• Applications involving the NHS which will be submitted via IRAS</li> </ul>	
<p>Yes <input type="checkbox"/></p> <p>For any project which is subject to the data retention protocols of an external body listed, you must develop a data storage plan to be submitted alongside this document for consideration by your School or Unit Ethics Panel.</p>	
<p>No <input checked="" type="checkbox"/></p> <p>Please confirm that the data collected will be stored in a manner which complies with Cardiff Met requirements via one of the following statements.</p>	
<p><b>STATEMENT 1: FOR STUDENTS ON TAUGHT COURSES</b></p> <p>I confirm that any non-anonymised data related to research participants will only be stored on OneDrive, or by agreement with supervising staff, on Figshare, and that all data held elsewhere will be deleted, unless it is anonymised.</p>	
<p><b>STATEMENT 2: FOR STAFF APPLYING ON BEHALF OF STUDENTS ON TAUGHT COURSES</b></p> <p>I confirm that all students covered by this application are aware of their obligation to ensure that non-anonymised data related to research participants must only be stored on their</p>	

Cardiff Met student OneDrive account and that all data held elsewhere must be deleted, unless it is anonymised.	
<b>STATEMENT 3: FOR RESEARCH STUDENTS AND STAFF</b> I confirm that any non-anonymised data related to research participants will be stored in a secure manner (using a platform such as OneDrive or FigShare) and that all data held elsewhere will be deleted unless it is anonymised.	<input checked="" type="checkbox"/>

**DECLARATION:**

I confirm that this project conforms with the [Cardiff Met Research Integrity & Governance Framework](#)

I confirm that I will abide by the Cardiff Met requirements regarding confidentiality and anonymity when conducting this project.

**STUDENTS:** I confirm that I will not disclose any information about this project without the prior approval of my supervisor.

Signature of the applicant: MUKHTAR ABDIRAHMAN MOHAMED	Date: 2/12/2020
---	-----------------

**FOR STUDENT PROJECTS ONLY**

Name of supervisor:	Date:
---------------------	-------

Signature of supervisor:
--------------------------

**Research Ethics Committee use only**

Decision reached: <a href="#">Click here to enter text.</a>	
Project reference number: <a href="#">Click here to enter text.</a>	
Name: <a href="#">Click here to enter text.</a>	Date: <a href="#">Click here to enter a date.</a>
Details of any conditions upon which approval is dependant: <a href="#">Click here to enter text.</a>	

**PART TWO**

If you haven't already done so elsewhere on this form, in the box below, provide a short (150 words), non-technical summary of the project.	
For my research project, I will be exploring the topic of mobile-web applications that are used for language learning. I will be exploring the effectiveness of these apps and if they really do help people learn new languages. I will be exploring research conducted on these topics and evaluating the conclusions previous researchers have come to and have expressed in their research papers and journals. I will also look at the current apps that have been created for language learning and comparing them against each other. I will be creating an application that can be used to learn the Arabic alphabet.	

**A RESEARCH DESIGN**

A1 Will you be using an approved protocol in your project?	Yes / No
--	----------

A2 If yes, please state the name and code of the approved protocol to be used<sup>1</sup>

A3 Describe the research design to be used in your project

In this section, include details (as appropriate) of:

- Research method(s);
- Sample and sampling;
- Participants including recruitment methods, activities to be undertaken, time commitment, details of any proposed payments;
- Analytical techniques

If your project does involve the use of an approved protocol, much less details will be required but you should indicate which areas of the project are covered by the protocol.

A4 Will the project involve deceptive or covert research?

Yes / No

A5 If yes, give a rationale for the use of deceptive or covert research

A6 Will the project have security sensitive implications? Yes / No

A7 If yes, please explain what they are and the measures that are proposed to address them

## B PREVIOUS EXPERIENCE

B1 What previous experience of research involving human participants relevant to this project do you have?

None

## B2 Student project only

What previous experience of research involving human participants relevant to this project does your supervisor have?

Enterprise Project module leader at undergraduate level. Past experience of undertaking research for undergraduate and postgraduate qualifications. Past experience of supervising student projects at undergraduate and postgraduate level.

## C POTENTIAL RISKS

C1 What potential risks do you foresee?

Include details of risks to the participants, the researcher and the project as a whole.

None

C2 How will you deal with the potential risks?

N/A