

University of  
Chester

“bridgIT: An attempt to close female  
underrepresentation in IT using a prototype mobile  
application.

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# Abstract

The Information Technology (IT) industry is suffering of having low levels of females (Imafidon, 2022). This project aims on developing a high-fidelity prototype mobile app to increase awareness of IT as a career. It includes stories of successful females in IT, linking their achievements with positive outcomes on society. In addition to the use of gamification and humours elements. The high-fidelity (HIFI) prototype followed the usability industry standard recommendations of Knapp et al. (2016), which was tailored to be used by an individual instead of a team. In addition, the heuristic evaluation of Nielsen (2020) which was used a self-evaluation throughout the prototyping process. The app was tested by female students of non-computing background in the University of Chester. The results show that the use of gamification and humorous elements were promising in increasing the user engagement. The results are based on the participant's verbal constructive feedback following the testing sessions. However, the researcher relied also on their non-verbal cues for example their smiles and any detected signs of confusion. This clarified the aspects which can be improve the UX and usability of the app. There were also several points of self-criticism which can help future researchers or the researcher himself on developing future enhanced versions of the app. It is worth noting that the participants recommended that the use of this app in career pages of universities and career blogs can be promising.

**Keywords:** User Experience (UX), Design Sprint, Heuristic Evaluation, Gamification, Female role models.

# **Disclaimer**

This work is original and has not been previously submitted in support of any other course or qualification.

Signature: 

Date: 05/10/2023

## **Dedication**

To the next generation, I hope an enhanced version of this project would inspire you one day into considering IT as a career.

## Acknowledgments

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# **Chapter 1: Introduction**

## **1.1 Background:**

Diversity is essential in digital world to have products that suits the needs of everyone (Black History Month, 2023) . Miner et al. (2016), and Sax et al. (2017) illustrate that the current digital products lack the attention to females needs (Chapter 2.1.5). The reason behind this is the underrepresentation of females in the sector of IT (Information Technology) across different countries. Females represent only twenty-one percent of the IT work force and undergraduates in the United Kingdom (UK) and United States of America (US) (Beyer, 2014; Cheryan et al., 2022; The All-Party Parliamentary Group on Diversity and Inclusion in STEM, 2020). Likewise, they represent only thirty percent of the work force and undergraduates in Israel (Ben-David, 2022). Huston (2016), Layman et al. (2007) and Tang et al. (2008) claim that the reason behind this is that female tend to choose careers which can give a positive outcome on the society.

Imafidon (2022), states that this issue is making the digital world tailored to one gender only. The scope of the dissertation will not get into further details about why females does not choose IT. Therefore, the scope will be oriented on the User Experience (UX) and the usability side of the developed mobile applications designed to address the problem. There were previously published mobile applications attempting on solving this issue (Chapter 2.2.5). Consequently, they were constructively evaluated (Chapter 4.3; Appendix E; Appendix F) based on the heuristic evaluation of Nielsen (2022). As a result, the researcher has developed a high-fidelity (HIFI) prototype which aims to test three hypotheses (Chapter 3). The process of developing the app and testing was based on the usability industry standards of Knapp et al. (2016) and Nielsen (2020). The content of the app includes storyline of female role models in IT who made a difference for their society. In addition to adding gamification and humorous elements to increase the emotional user experience (Chapter 2.2.4).

## **1.2 Challenges:**

The project was undertaken by a male to address female problems. This required the researcher to be immersed in articles and books addressing the issue of female's underrepresentation in IT. Alongside, getting the feedback of the female supervisor to ensure that the design matches the desired target users (Chapter 4.5; Nickel et al., 2020). This was done with respect to the allowed time during the research process period. However, for future implications it would require more reading and understanding of female problems and the recruitment of a whole team of researchers. The research conducted by the researcher has shown that there are not abundant mobile applications with the same aim of this research (Chapter 2.2.5). The researcher did not have sufficient drawing and designing talents so there was a larger focus on improving the user journey and usability of the app.

Consequently, copyrighted GIFs and humour elements were used to improve the emotional user experience and the design (Chapter 2.2.5; Chapter 4.6). In addition, English is not the first language of the researcher. It is worth noting that the researcher apologises for any grammatical mistakes encountered in the dissertation. However, the researcher gathered the feedback and advice of the English Academic team in the University of Chester.

## **1.3 Summary of the dissertation outline:**

The dissertation is divided into six chapters; The first chapter has drawn an overview of the expected written content in the consequent chapters. It is followed by the literature review which will explain in brief the roots of the issue of underrepresentation of female in computing. In addition to a review of the usability and UX side of the project, alongside the usability industry standard on which the project is based on. Thirdly, the methodology chapter will explain the aspects of developing the project and how these aspects will be tested. In chapter 4, the journey of developing the mobile app will be explained in

details starting from the acquired skills which were developed during the MSc degree until the time of submitting this dissertation. Then the process of testing and analysing these aspects will be explained in a detailed view (Chapter 5). Finally, the results will be discussed and re-assessed for further improvement undertaken by other researchers or the researcher himself.

# **Chapter 2: Literature Review**

In the following chapter, the literature review will be divided into two main sections. Firstly, a brief about career choices and the issue of female's underrepresentation in IT. The second section will illustrate the UX and usability industry standards. At the end of the chapter there will be information about previous attempts of addressing the underrepresentation of females in IT using mobile applications. In academic writing it is suggested to write about a research question rather than a research topic to focus the scope on the research question (Ollhoff, 2017). As a result, the first main section (2.1) will only provide a brief on the issue of underrepresentation of women in IT. Consequently, the scope will be directed towards User experience design to a larger extent.

## **2.1 The Sociological aspects:**

### **2.1.1 How people make career choices:**

For both genders, choosing a future career is a critical decision; it plays a role in shaping the future of students' lives (Sharif et al., 2019). Career choices can be influenced by media, parents and the personalities developed during childhood (Kazi et al., 2017). For example, media can draw an image of lawyers being wealthy and luxurious (Kazi et al., 2017). According to Grissmer (2003), one of the most influential factors is the family educational background. Thompson (2016) mentions that career choices can depend on passiveness, social pressure and can occur accidentally. Therefore, career conferences could raise the awareness of the available career opportunities, and which careers can match the students' interests (Kazi et al., 2017). In primary schools, students start relating future carers with the gender type (Bamberger, 2014). For instance, when they are asked to draw a scientist most of the students of both genders will draw the scientist as a man (Finson, 2003). Lastly, it is worth noting that these studies were done in different countries, and it can be considered a generalised overview.

## **2.1.2 Factors influencing women's choice of careers:**

Layman et al. (2007) state that females desire careers which have an impact on society and considered meaningful. Similarly, Huston (2016) and Rossini (2023) mentions that female tend to care about their society and for the needs of the people. The following studies have reached the similar conclusion of these claims. Firstly, Tang et al. (2008) has analysed career choices amongst 141 American high schools. Likewise, Tao et al. (2022) conducted research among forty-two countries in different continents. In addition to the analysis of Kuhn et al. (2022) regarding a Swiss apprenticeship program. Therefore, these studies concluded that females tended to choose careers where they can help others (Beyer, 2014; Kuhn et al., 2022; Tang et al., 2008; Tao et al., 2022). However, males tended to choose to work with things, for example, machines and data (Beyer, 2014; Kuhn et al., 2022; Tang et al., 2008; Tao et al., 2022). Likewise, Rossini (2023) mentions that in the science and technology field, females prefer to be a veterinarian, nurse or a doctor. Additionally, people tend to think females would be collaborative as political leaders to provide help for others (Huston, 2016).

Another factor suggested by Beyer (2014) is that females have low-self-confident in male-dominant careers, for example, computing. However, Beyer (2014) states that if the relevant sessions to these careers were delivered by female teachers in schools it might increase their confident towards these careers. Finally, Geary (2017) claims that this issue might trace back to evolutionary reasons because in the past it was the men's job to build tools, for example, knives and arrows. However, this article was generalised and not specific on which region this justification can be applicable. Whereas in some period in Ancient Egypt history women used to build and utilise weapons (Dean, 2013). In addition to trading in the market, and leading armies; while some men used to do the weaving (Fletcher, 2011). It can be reiterated that, there are still not enough evidence to support these claims because it did not take into consideration different cultures and timing periods.

### **2.1.3 Women under-representation in IT and reasons behind this issue:**

Montilla (2023) mentions that thirty-eight of females are planning to quit IT by the end of 2023. Mishra et al. (2013) mention that IT is one of the high demanded jobs and the available positions are increasing. However, the numbers of females filling these jobs is decreasing. Beyer (2014) concludes that female underrepresentation in IT raises concerns about equality and fairness. An article published by Alaghband et al. (2022), shows that ninety percent of leadership positions in the metaverse are given to men. Alaghband et al. (2022) concluded that this makes female feel that it is unattainable to think of career progression. According to McKinsey (2022), only eighty-six females are getting promotion for every one-hundred male in the US. Women avoid joining IT because of the stereotype that it is a career for nerdy men who lack communication skills and interest in society (Beyers, 2014; Sax et al., 2017; Vitores et al., 2015). In addition, being only concerned about technology which opposes females desire in helping their societies (Beyers, 2014; Sax et al., 2017; Vitores et al., 2015).

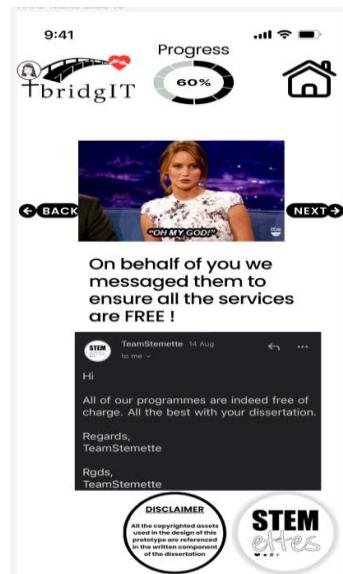
In the age of high school, families and teachers do not encourage girls to choose IT as a possible career; and media usually portray computer scientists as males (DuBow, 2013). Additionally, Harrison (2022), and Mishra et al. (2013) explain that females are not familiarised with inspiring role models and insufficient information about computing careers. Similarly, DuBow (2013) claims that some high school female students in the US do not know that this field of study exists. Payment gender gap can be one of the reasons why females do not choose IT as a possible career (Herr, 2023). In addition, the global gender gap and that payment raises are always given to men (Montilla, 2023). In Illustration, these articles might be regarded as biased to the countries they were published at. Therefore, in the next section the issue will be addressed in different countries separately.

## 2.1.4 The under-representation of women in IT across different countries:

### 2.1.4.1 United Kingdom

The All-Party Parliamentary Group on Diversity and Inclusion in STEM (2020) has mentioned that females represent twenty-one percent of the British IT working force. In Alan Turing institute, only twenty percent of women are enrolled in data science and artificial intelligence fields (Young et al. (2021). Harrison (2022), states that there was a survey done in London Tech Week; it has shown that the British females are not supported enough to consider a career in IT. In addition, the difficulty of being funded to establish a startup compared to men (Harrison, 2022). Accordingly, Anne-Marie Imafidon has co-founded Stemettes enterprise which aims on encouraging females into studying Computing (Black History Month, 2023). On their official website, Stemettes claims that they have increased the interest towards technology careers for 95 percent of the participants. It is worth noting that the researcher has emailed the enterprise, and they confirmed that all their programs are free (Figure 1). The email content was integrated into the developed high-fidelity mobile app. Similarly, dressCode charity was established by Toni Scullion, it is functioning both online and in 55 British schools (Prime Minister's Office 10 Downing Street Point Of Light., 2021).

**Figure 1**  
*Emailing Stemettes*



#### **2.1.4.2 United States of America**

Beyer (2014), and Cheryan et al. (2022) state that only around twenty one percent of IT undergraduates are female. Additionally, Vidores et al. (2015) claim that the underrepresentation issue of women is increasing despite all the efforts done to address this issue in the US. DuBow (2013), mentions that an individual female student on an IT course found that the program is less female friendly, and she felt ostracised by her fellow students. In 2016, President Barack Obama has launched a program to encourage students in all educational stages to learn computing, and develop the skills needed for this field (Smith, 2016). It is worth mentioning that the program was not targeting a specific gender.

#### **2.1.4.3 Israel**

The following research suggest that Israeli females are less underrepresented than the previously mentioned countries. However, as Israel has a significantly lower population which is nearly 10 million (The Times of Israel, 2023) than the UK or the US which have 68 and 400 million respectively (Worldometer, 2023). However, the statistics are still subjective and open to interpretation. Ben-David (2022) states that females' representation in IT accounts for thirty percent of the labour pool, and accounts for nearly thirty-one percent of university female students. Furthermore, The Chair Council for Higher Education in Israel has published a plan to increase the females IT undergraduate's representation into thirty five percent. The plan includes granting the females with scholarship and workshops to familiarise them with the industry (Council for Higher Education, 2019).

Fritzhand (2022) mentions that females are represented in executive teams, alongside taking a leading role in almost all startups In Israel. In addition, the Metaverse and Microsoft offices in Israel are led by females (Fritzhand, 2022). One of the reasons why women were able to gain leading roles in the IT sector in Israel is due to a program called "Fem Forward" based in Jerusalem and offers management courses for females (Farber-Ball, 2021). As mentioned by Fritzhand (2022), the program was able to increase the

wage or grant a promotion for fifty percent of the attendees. “Fem Forward” has expanded to include females from all the Abraham Accord countries and the first round started in Jerusalem January 2023 (Confino, 2022). It can be reiterated that the abovementioned resources are still insufficient because the scope of the dissertation cannot be tailored to focus on Sociology.

### **2.1.5 Why achieving gender representation equality in IT is important.**

The IT sector is losing the chance of having female’s innovation and ideas which can tailor the field differently (Beyer, 2014; Imafidon, 2022). Creativity and problem solving could be improved by achieving diversity in the workforce including diverse gender, race, and personalities (DuBow, 2013; Israel Innovation Authority, 2022). The current technology products lack some attention to females (Imafidon, 2022; Sax et al., 2017). For example, in 2014 Apple was criticised because it has launched a health application which was not equipped with a way of tracking menstrual period (Sax, et al., 2017). Imafidon (2022) mentions that there is an enterprise which developed an app that only tracks ten days of the menstrual cycle. Imafidon (2022) relates this to the fact that the app developers were not fully knowledgeable about the needs of the target users. Additionally, conversational assistants, for example, Siri and Cortana, did not recognise the situations which affect girls, for example, rape and sexual assault (Miner, et al., 2016). Imafidon (2022) mentions in her recently published book that under representation of women in IT would lead to a digital world tailored to only one gender.

### **2.1.6 Approaches of fixing the underrepresentation issue of females in IT:**

Familiarising the high school students with female role models in IT can increase their confidence towards that field (DuBow, 2013; Israel Innovation Authority, 2022; Rossini, 2023). Beyer (2014) describes that delivering computing classes in high schools by female teachers; can motivate the girls to

consider it as a career. Alternatively, reforming the curriculum can play a role in encouraging females to consider careers in IT because they do not know that the career can help the society (Beyer, 2014; DuBow, 2013). For example, the Universities of Indiana and Stanford has linked their Computing program's descriptions and curriculums with direct benefits on the society (DuBow, 2013). Furthermore, Parents can play a role in influencing their children towards IT (Imafidon , 2022). For example, Hedy Lamarr was motivated by her father, and she pioneered the technology that led to today's WIFI and Bluetooth communications (Imafidon , 2022).

## **2.2 The User Experience aspects**

### **2.2.1 User Experience design**

User experience is the perceived impressions the user would have during and after using an application or a website, it can include psychological and behavioural effects (ISO 9241-11:2018, 3.2.3, 2018). Accordingly, Tullis et al. (2013), emphasise on the importance of considering the engagement and the perceptions of the user while using the software, alongside ensuring that the design is user centred. User centred design is a strategy of prioritising user needs, behaviours, and capabilities before designing the product (Norman, 2013). By other means a professional design requires the integration between psychology and technology, which can facilitate the communication between the product and the user (Norman, 2013) . Accordingly, User-centred design begins by discovering the user needs and making sure that the design will meet these needs (Norman, 2013). For a successful usability design, Voil (2020) suggest that the attractiveness of the design should not be the main concern, but the main concern should be to make the app works smoothly.

In terms of the app smoothness this could be achieved by making the important piece of information discoverable, and to make the app interactive with the user (Tullis et al., 2013; Voil, 2020). This is

justified by Norman (2013), as it is simple to design things that work perfectly, but it would be hard to solve any arising errors if good design practices were not considered prior designing (Norman, 2013). For instance, UX designers should investigate the scenarios where errors could occur not only on the predicted outcome that things would work perfectly (Norman, 2013). Another usability approach is to make the design consistent and self-explanatory to the users by using simple language and following usability industry standards (Krug , 2014). In conclusion, these approaches are essential to be utilised while developing mobile applications or webpages.

## 2.2.2 The Design Sprint

One of the strategic approaches to designing mobile apps and an industry usability standard is the Design Sprint process of Knapp et al. (2016) (Lo, 2018). The Design Sprint approach can save the costs of developing the final version of the expected mobile application (Southall et al., 2019) This can be achieved by building a high-fidelity prototype and testing it with participants and fixing any encountered usability issues (Southall et al., 2019). Knapp et al. (2016) introduce two different types of prototypes which are built on different stages. The first one is a low fidelity prototype which is drawn using a pen and paper just to remark the researchers' ideas (Knapp et al., 2016). While on a later stage the high-fidelity prototyping takes place to produce a functional interactive view of the intended product (Esposito, 2018). (Kopf, n.d) suggests on using the Figma platform for developing high-fidelity prototypes because of its simple user interface, and that it integrates all the needed tools for the prototype stage. The Design Sprint requires a team of five to eight members with variety of roles divided amongst them (Knapp et al., 2016). However, for an MSc dissertation, the Design Sprint will have to be tailored to be functional for use by an individual researcher supervised by his lecturer. The process illustrated by Knapp et al. (2016), is divided into 5 days and it is illustrated as shown in Table 1. It is worth noting that each stage is corresponding to a day in the week beginning from Monday until Friday. The days, stages

and their descriptions are adopted from Knapp et al. (2016). However, the ideas of tailoring the process for an individual was referenced when appropriate. Eventually, Knapp et al. (2016) emphasise that the expectations of a Design Sprint implemented by an individual would not be as expected as a Sprint of a team in terms of efficacy.

**Table 1**  
*The Design Sprint process*

<b>The Day</b>	<b>The Stage</b>	<b>The description</b>	<b>Tailoring the process for an individual instead of a team</b>
<b>Monday (1)</b>	<b>Mapping</b>	The outlining of the issue in question. Alongside, focusing on the long term aim after being advised by the market experts.	Individual thinking about various way of solving the issue, while using a stopwatch (Knapp et al., 2016). In addition, getting the advice of the supervisor.
<b>Tuesday (2)</b>	<b>Sketching</b>	Assessing and improving similar old ideas that can be reused in the desired app. In addition to sketching the proposed ideas in a low-fidelity form.	This can be done by individual research (Eiche, 2020).
<b>Wednesday (3)</b>	<b>Deciding</b>	Individually deciding on the best approach of the intended user journey. In addition to draw a plan containing each individual idea and voting on the most agreeable approach.	The storyboard final decision will be based on the individual research ideas (Eiche, 2020). In addition, getting advice from the supervisor of the research.
<b>Thursday (4)</b>	<b>Prototyping</b>	Developing a high-fidelity form of the excepted app.	This can be done individually (Knapp et al., 2016)
<b>Friday (5)</b>	<b>Testing</b>	Testing the high-fidelity app with five participants. In addition to analysing their feedback and any usability issues encountered	This can be done individually. Finalising the product in the desirable deadline could be motivated by scheduling the testing before prototyping the app (Eiche, 2020)

### **2.2.3 The Ten Heuristic Evaluation Criteria:**

The heuristic evaluation was developed by Nielsen (1994) and updated in 2020. It is used to adjust expected usability issues and to enhance the User experience of the app before testing with the participants (Bonderud, 2023; Monika, 2019). The criteria can be utilised to critically analyse personal or already published designs (Rowland, 2014). It can be reiterated that the use of the heuristic evaluation can substitute the Design Sprint stages which require the presence of a team. For example, the ideas of voting will not be applicable for a dissertation project undertaken by an individual researcher. Furthermore, using the heuristic evaluation (Nielsen, 2020) is valuable in analysing the previously published mobile apps aimed on solving the underrepresentation of females in IT issue. Finally, it will be used to evaluate the low-fidelity sketches before implementing the high-fidelity prototype.

### **2.2.4 The use of gamification and humorous elements in designing:**

Bitri'an et al. (2021) state that using gamification in the design of mobile application can enhance the user experience and engagement. This is especially true in mobile applications which are intended to be informative and educational (Khaddage et al., 2014). Anderson (2011) claims that adding games and humorous elements can make the product attractive for users and can create a pleasurable emotional user experience. In addition, it increases the user retention and referrals to the product (Anderson, 2011). Yang (2015) made a study on 555 college students as consumers of mobile apps. Yang (2015) concluded that the enjoyment of the app was the student's priority aspect. In addition, having humorous and pleasurable elements would create positive impacts towards the product (Yang, 2015). Furthermore, Bakhshi et al. (2016) concluded in their study that animated GIFs can communicate emotions and can increase the engagement of users with mobile apps. Likewise, Li et al. (1999) implemented a study which has shown that animations can increase the recognition of information more than static images. In conclusion, these

ideas could be integrated together to form hypotheses that can be integrated and tested in a high-fidelity prototype.

## **2.2.5 The use of mobile apps to solve the underrepresentation problem of females in IT:**

There were previous implementations to solve the underrepresentation of females in IT. These apps will be evaluated based on the ten UX heuristic evaluation criteria (Chapter 4.3; Appendix E; Appendix F).

The first approach was described by Holgado et al. (2020), as a prototype mobile application funded by the European Union which is planned to be used in the schools across Latin America. The mobile application is named as “W-STEM: Women in STEM” and it is also available on the Android and IOS app stores for individual use (W-STEM Project, W-STEM: Women in STEM, 2020). The content of the app includes recorded videos and articles of female role models which were done exclusively for this app. However, the female role models did not only represent IT but also Science, Engineering and Math this was implemented to encourage females to consider STEM careers. In other words, they aimed on providing references to female role models on those careers, which is matching the previously mentioned reviews (Section 2.1.2). Holgado et al. (2020) conducted user testing sessions and they found that nearly eight one percent of the testers mentioned that they browse the internet to find information about careers.

They also stated that one of the participants said that she can achieve success in any career if she is inspired to do it (Holgado et al., 2020). However, one of the testers said that she would continue with her childhood choice of career; and that the app would work for someone who already has an interest in that field (Holgado et al., 2020). According to Holgado et al. (2020) nearly forty percent of the participants did not know about females in those careers, and the participants who did know about them defined them by exceptional terms. It can be reiterated that the app is informative. However, making use of interactive

techniques would make the app smoother (Tullis et al., 2013; Voil, 2020). Additionally, the use of gamification techniques would increase the user engagement (Chapter 2.9).

Secondly, there is a mobile application which is called “Women Who Changed the World” which was launched in 2019. The app uses animated storylines of successful females in the STEM careers and links their achievements with direct benefits on the society, for example, Marie Curie. The app methodology is matching with the previously mentioned reviews in regards of including female role models and gamification techniques (Section 2.1.2; Section 2.2.4) as they described that females tends to choose careers which draw a direct benefit on human beings. Likewise, the app focus was also scattered on all the scientific careers not only IT, which will be the focus in this dissertation. It is worth noting that the app uses gamification and animation techniques which can increase the user engagement (Section 2.2.4). However, the user interface was not simple because the hints needed to complete the games were not always available, alongside various usability issues (Chapter 4.3; Appendix F).

Furthermore, there was not a research paper available to address how the user testing procedures were done before publishing the app. It worth mentioning that the feedback and rating of the app are nearly 4.5 out of 5 in the Android and IOS app store (Learny Land, Women Who Changed the World, 2023). Nevertheless, the rating cannot be relied on, and the app will be evaluated based on the heuristic evaluation as mentioned previously. Alternatively, there was a prototype app developed by Masood et al. (2021) which focuses on delivering gamified computational thinking modules to teenagers in Pakistan. The name of the intended app was chosen to be “Meri Kahani”. The app utilises the idea of including female role models to motivate females into considering IT as a career, alongside gamification techniques. These can also be considered agreeing with the previously mentioned reviews in terms of using female role models and gamification elements (Section 2.1.2; Section 2.2.4).

However, the app is not published until the time of writing this dissertation, so extensive UX and heuristic evaluation were not attainable. Additionally, there are distance learning robotics and tablets

which aim to encourage different genders to study Computing, for example, “Smart Buddies”, “Scratch JR” and “Coding Galaxy”. Unfortunately, there are not enough academic evidences to support whether they can encourage females to study IT or not. Therefore, these are outside of the scope of this research and could be an area for future research.

# **Chapter 3: The methodology of developing the prototype mobile application:**

This chapter will reveal the methodology of developing the high-fidelity prototype. There will be a discussion of the research question, aims and the hypotheses. At the end of the chapter the methods of testing the hypotheses will be illustrated.

## **3.1 Aims and research questions:**

The HIFI prototype mobile application is intended to answer the research question, whether a mobile app which includes the storylines of female role models in IT can motivate females to consider careers in IT. In addition, linking the female role models achievements in IT with direct benefits on society. The literature review (Chapter 2.1) highlighted the literature exploring female role models making a difference to society as a mean of motivating girls to consider careers in IT. It is worth noting that the project will rely on the UX more than the sociology scope to meet the requirements of the Computing department. Accordingly, the app will follow the industry usability standards (Chapter 2.2.2; Chapter 2.2.3). Alongside, the use of gamification and humorous elements to achieve user retention and engagement (Chapter 2.2.4). The project will aim to test the three hypotheses (Section 3.1.1; Section 3.1.2; Section 3.1.3). Consequently, the hypotheses will be tested by inviting five participants to test the prototype based on Knapp et al. (2016) recommendation.

Knapp et al. (2016) has adjusted their process to be applicable for a team of seven members or less with several roles divided amongst them. As this is an individual research project so there was an attempt of tailoring the Design Sprint process to be functional for an individual researcher. In addition, getting feedback from the supervisor. Knapp et al. (2016), has mentioned that parts of the sprint could be implemented without utilising the whole Design Sprint process, and that the process could be

implemented without a team. However, Knapp et al. (2016) noted that the expected outcomes will be less efficient than doing it with a team. It can be reiterated that this prototype app could be improved by employing a graphic designer, since it was developed without prior experience or talent in designing. In addition to recruiting a complete team to share further innovative ideas. It can be noted that although the Design Sprint is developed to work for a group, but it can be used by an individual.

### **3.1.1 Hypothesis A:**

Including examples of female role models in an industry standard usability prototype app can motivate females to consider IT as a career.

### **3.1.2 Hypothesis B:**

Linking the achievements of female role models in IT with a direct benefit on society can encourage females to consider IT as a career while complying with the usability industry standards.

### **3.1.3 Hypothesis C:**

Adding humorous and gamification elements can improve user engagement and retention with prototype mobile apps.

## **3.2 How the hypotheses will be tested:**

In order to test the previously mentioned hypotheses, there was a necessity to obtain ethical clearance and recruit participants for the user testing of the mobile app. These will be further discussed in the following sub sections.

### **3.2.1 Ethics Committee approval for the user testing of the prototype mobile application:**

Knapp et al. (2016) suggest that it is essential to test the prototype mobile application with participants. The aim of the user testing is to get their feedback and to analyse their verbal and non-verbal cues while using the app. Accordingly, an ethics form was submitted (Appendix K) to the University of Chester Ethics Committee, and it was approved alongside pieces of advice (Appendix B). For example, the criteria of choosing the participant were female students or graduates of the University of Chester who did not study IT. The Ethics Committee advised that the testing could bring more informative results if either students or graduates were chosen. It worth mentioning that the Ethics committee advised on making the title of the dissertation more descriptive that it has a greater portion to do with IT and UX not Sociology or Education. Accordingly, their pieces of advice were utilised to improve this project.

### **3.2.2 Participant information Sheet for the prototype mobile app testing:**

Orb et al. (2004) emphasise on the importance of considering ethical issues for studies which include participants. The participant information sheet (Appendix C) was part of the submitted ethics form which was accepted by the ethics committee. The user testing was done in adherence to the details approved by the committee. The aim of the participant information sheet was to deliver enough information about the prototype mobile app and the participant's right to withdraw at any point. In addition to the types of

questions that the users will expect. For example, if they have faced difficulties while using the app, and their suggestions on how to improve the mobile app.

### **3.2.3 The required number of participants for the user testing process:**

The project aims on testing the high-fidelity prototype mobile app with five participants. The project is based on the industry-standard practices for usability. Hence, Nielsen (2020) and Knapp et al. (2016) suggest that five participants are sufficient for spotting eighty-five percent of the consistent usability issues in prototype applications. Furthermore, as described by Nielsen (2020), repeated outcomes will be more frequent by increasing the number of participants beyond five. Accordingly, Nielsen (2020) advises on fixing the spotted eighty-five percent usability issues first instead of recruiting more participants to spot the remaining fifteen percent. It is worth noting that the heuristic evaluation criteria (Nielsen, 2020) were created to evaluate websites, but Knapp et al. (2016) has adopted it for mobile applications as well in their Design sprint.

### **3.2.4 Participants Selection:**

According to the approved ethics form (Appendix B), the participants were recruited from the University of Chester female students who did not choose to study IT. The recruitment process was done by emailing the non-computing faculty administrators in the University of Chester, and “Student Shoutout magazine”. Furthermore, advertisements were posted on the notice boards of Seabourne library in the University of Chester. Interested participant emailed the researcher, and they were sent the participant information sheet and the timing slots according to their convenience.

# **Chapter 4: The implementation of the mobile prototype application:**

The journey of developing the high-fidelity prototype app will be discussed in this chapter. The journey started by the skills developed during the academic year and how they were acquired. Then there is an evaluation of the previously implemented mobile applications sharing similar aims. Finally, the prototype design and the main aspects were considered alongside self-criticism and declaration of the assets used.

## **4.1 Preliminaries skills acquired before attempting to build the HIFI prototype:**

Prior to attempting to build the HIFI prototype there was an accumulation of skills developed during the period of doing the Computing MSc degree in the University of Chester. Most of the skills were developed thanks to the University curriculum alongside further self-study. The importance of developing these skills was crucial in the process of building the prototype and doing the written component of this research dissertation. These skills will be further discussed in the following sub sections.

### **4.1.1 Research Methods module:**

The module helped in developing critical analysis skills in reading and researching. For instance, when attempting to read academic papers since there was an assignment about critical evaluation of two written academic papers. Furthermore, this was crucial into developing an approach of self-criticism during the whole research process. Wallace et al. (2021) describe the self-criticism as a method of anticipating the possible objections by others. Additionally, there was an emphasis on the importance of narrowing the

research focus scope and being specific when writing academically. For example, the second project submitted in the module was a literature review and high marks were granted for being highly focused on the research question. In conclusion, this has led to a critical evaluation of the resources used in the literature review (Chapter 2). In addition to a continuous self-criticism and objectiveness whenever necessary in the following sections.

#### **4.1.2 Concepts of User Experience module:**

The module has addressed the concepts of User Experience, Usability and User- Centred design. In addition to the Design Sprint concepts of Knapp et al. (2016) and the division of roles amongst the team members. The Design Sprint was explained in detail throughout the module, which provided high familiarity with the process throughout the academic year. This accumulation of learnt outcomes were utilised in a team project which aimed on developing a HIFI prototype mobile application of an already published app which had Usability issues. The module has given the researcher a motivation to apply for a UX voluntary project in the digital week in the University of Chester. The voluntary project was based on the same concepts of the modules, and it aimed on helping an external client under the supervision of the UX lecturer. It can be reiterated that these acquired skills played a role in shaping the design of the prototype regarding the usability and UX aspects. Additionally, it facilitated the utilisation of the Design Sprint process in the prototype app due to the prior familiarity with it.

#### **4.1.3 Web Systems module**

The module emphasised on the cruciality of developing accessible websites. For example, using the alt-text to provide an alternative description of the pictures used for screen readers. Several outcomes learnt from the module were implemented in the high-fidelity prototype design (Section 4.6). For example, the

contrast between background and the text. However, the prototype was dependent on the use of GIFs which were not accessible for screen readers. Although the user participants were not disabled, but this was criticised and there were suggestions for improvement provided (Chapter 6.3).

#### **4.1.4 Figma**

The self-study part was essential before developing the HIFI app. There was a need to develop skills on how to use the Figma platform which is an interface designing tool (Chapter 2.2.2). This was important since the role assigned to the researcher in the team project of the UX module was to collect assets. Accordingly, there was a use of YouTube videos for the sake of acknowledging the options and limitations of using Figma (Mizko, 2023). Alongside, self-trials and error especially because Figma provides an easy-to-use platform.

### **4.2 The preliminary marked presentation of the intended project:**

The presentation has played a role in improving and restating the intended implementation plans. In addition to gathering constructive feedback from the first and second markers. For example, they agreed with the Ethics Committee on making the dissertation title more specific to the faculty area of study. As a result, the Sociology part of this dissertation was mentioned in less details (Chapter 2.1).

### **4.3 Heuristic evaluation of previously published mobile applications in the app stores:**

The previously mentioned attempts of using mobile applications to motivate females into joining IT will be evaluated using the Heuristic evaluation (Nielsen, 2020). The heuristic evaluation was implemented as an alternative of having a team as in the Design Sprint because this research is only conducted by one

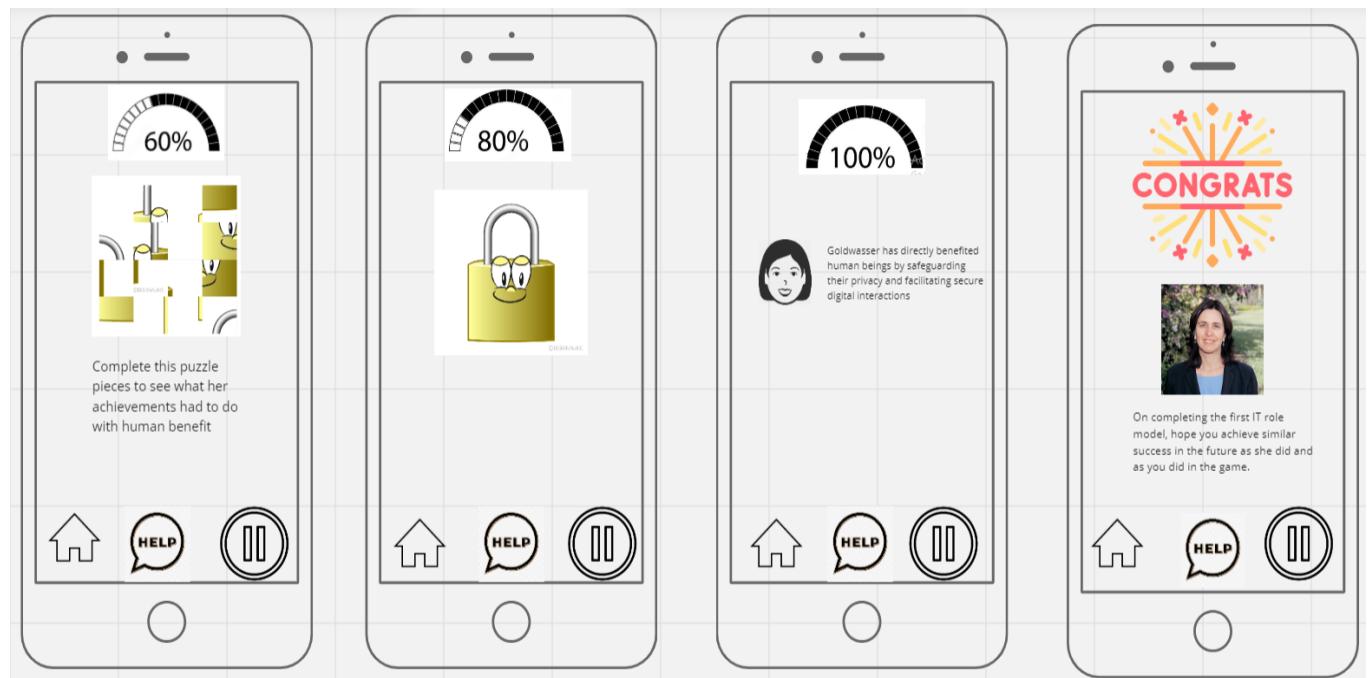
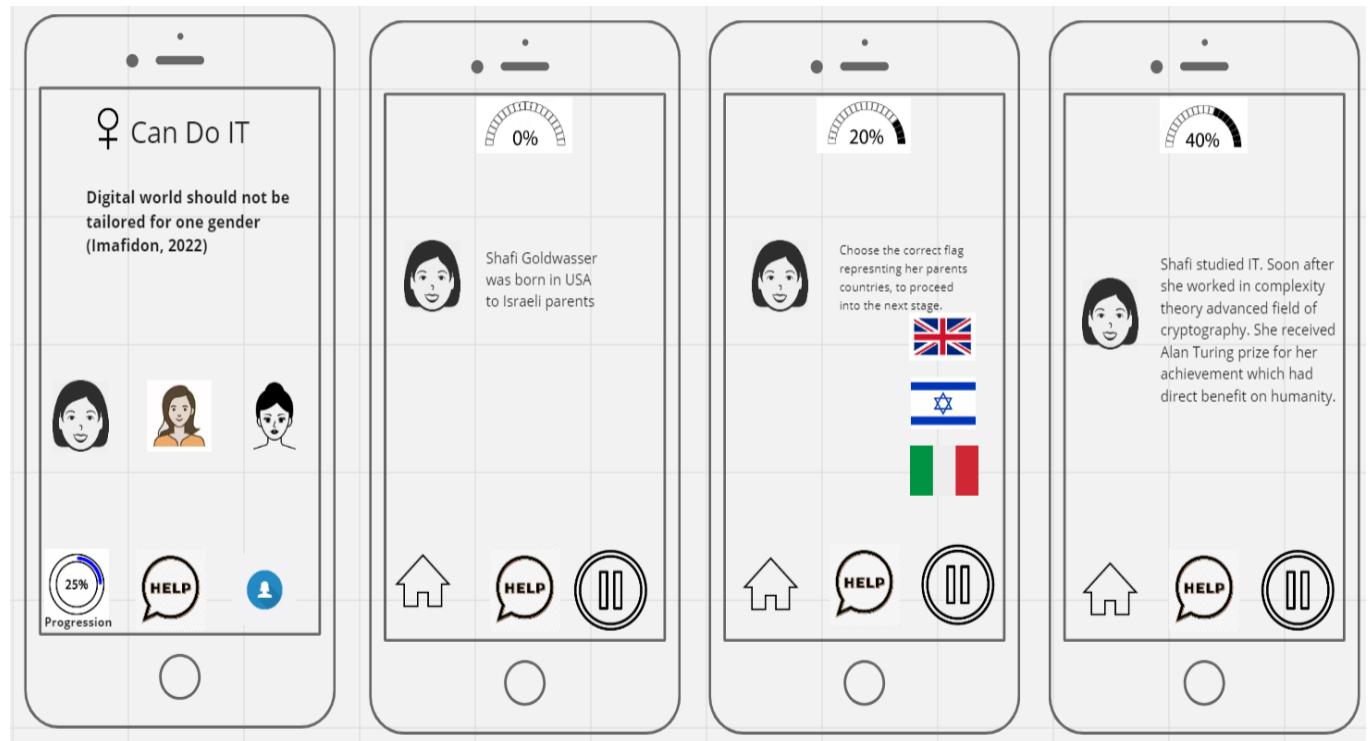
individual. It is worth noting that the criticism or the appreciation of the applications is constructive and is only intended to improve the chances of meeting the mutual intended aims. The full heuristic evaluation implemented can be viewed in (Appendix E; Appendix F). However, there were mutual issues in the two apps evaluated. For example, their landing and home page were not descriptive about the aim of the app, and the progress of users is not provided during the user journey. This evaluation is based on the first heuristic criteria (Nielsen, 2020) which emphasises on showing the system status.

## **4.4 Developing the two low-fidelity prototypes and evaluating them:**

Following the guidelines of the Design Sprint (Chapter 2.2.2), it is essential to develop low fidelity prototypes or sketches of the planned HIFI prototype. As a result, the two low-fidelity prototypes were developed using Miro platform which provide a design interface for sketching. The use of Miro was easier for the researcher than drawing sketches using pen and paper because he does not have the talent of drawing. The first developed low-fidelity prototype (Figure 2) was evaluated using the heuristic evaluation (Nielsen, 2020). The evaluation (Appendix G) has revealed that the profile section was not needed, and it was replaced by the names of suggested platforms to visit. These platforms were founded or co-founded by the female role models mentioned in the app. This was based on the 8<sup>th</sup> heuristic evaluation criterion (Nielsen, 2020) which suggests on the use of a minimalist design. Afterwards, the second low-fidelity prototype (Figure 3) was also evaluated (Appendix H), alongside seeking the feedback of the supervisor. The use of animated photos representing the role models was switched into their actual real photos. The reason behind this is to show the user how these role models look like. Alongside that these photos are how the role models accept themselves to look like. In addition to omitting the use of the pause button following the 8<sup>th</sup> heuristic evaluation criterion (Nielsen, 2020). This

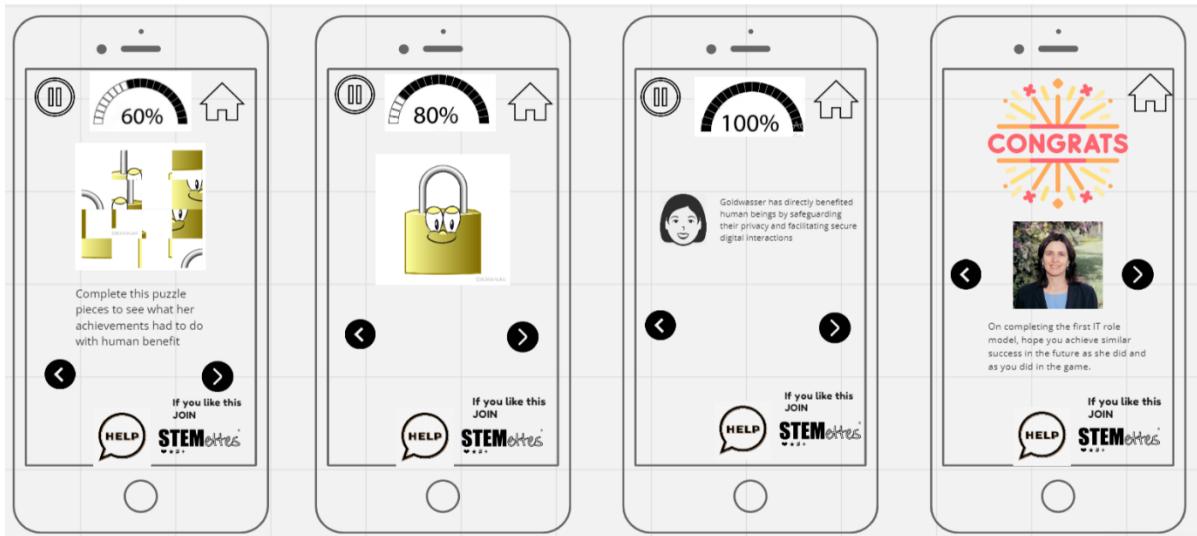
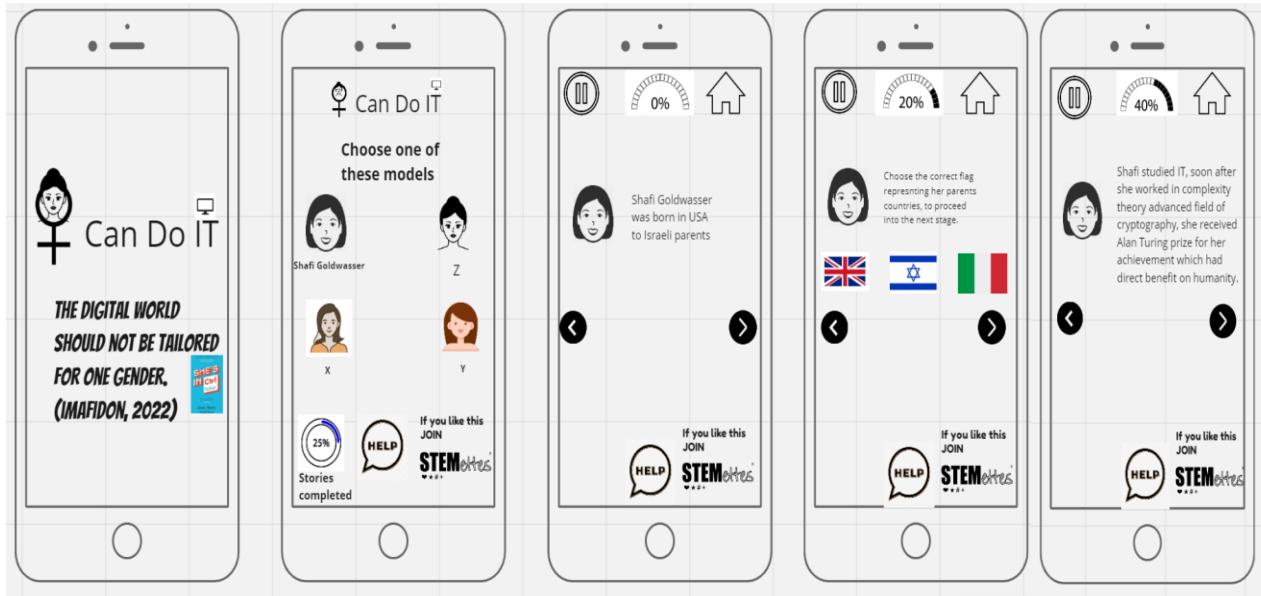
was also done because the app does not include a countdown timer for finishing each part in the story. It worth noting that this was just a brief discussion, but the complete heuristic evaluation can be viewed in Appendices G and H.

**Figure 2**  
The first low-fidelity prototype



**Figure 3**

The second low-fidelity prototype



## 4.5 Critical mistakes which could have affected the intended outcomes of the app:

The following sections will describe the final version of the high-fidelity prototype which was tested by the participants. However, a few days before the testing begins there were critical mistakes done. For

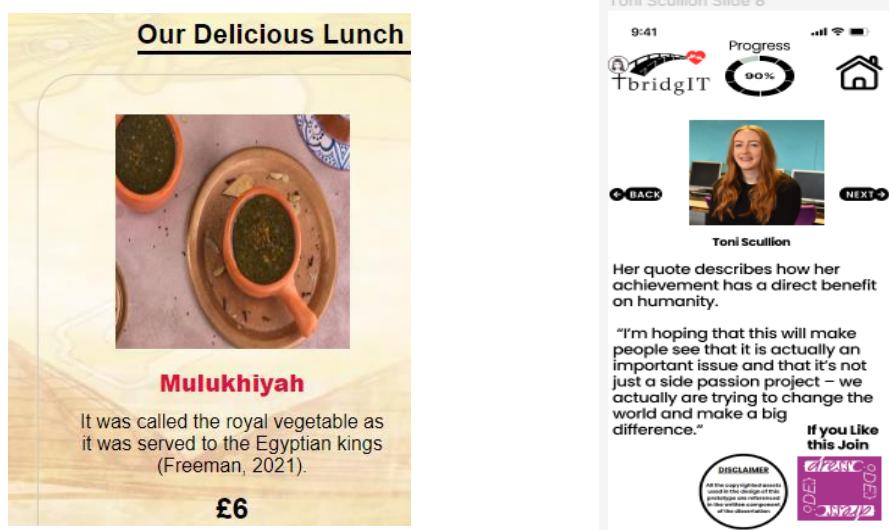
instance, the app was designed by the brain of a male and it was intended to be tested by females. By other means, the language used in the app should match the target users. Nickel et al. (2020) describe that males and females view the attractiveness of the product's design differently. Likewise, Imafidon (2022) suggests that there might be innovative obstacles when developing apps for a different gender. As a result, the app interface used some quotes from male scientists, for example, Dr Richard Dawkins to encourage females for science careers. Alongside quotes from Christopher Hitchens emphasising on the empowerment of women. Fortunately, the female supervisor has advised that these male's quotes and GIFs can be substituted by female's quotes to possibly achieve the aim of encouraging girls into considering IT as a career. Furthermore, there was a detailed explanation of the meaning of the logo in the instructions page in the app, but it was removed. Westgarth (2018), states that proper logos are self-explanatory, without any need of explaining them. It can be viewed that the cooperation between different genders ideas and brains can produce innovative ideas that can suit the needs of the different genders.

## 4.6 Description of the design of the HIFI prototype:

The prototype design followed the heuristic evaluation criteria of Nielsen (2020). Accordingly, there was an attempt of achieving consistency of the design by keeping the colours and the fonts used consistent during the whole user journey. The font selected for the typography of the app was Poppins, which was minimalistic and easily readable font (Morcillo, n.d). The logo was designed by GFS Didot font which was used due to its uniqueness and suitability for writing headlines (Befonts, 2020). Furthermore, (Babich, 2019) suggests on matching the colours used in the product to the colours of the logo. Therefore, the content of the app included three colours which are red, white, and black which were used to design the logo as well. The consistency was also accomplished by keeping the next and back button in the same part of the screens. In the module of Web Systems (Chapter 4.1.4); there was a feedback on the submitted assignment which explained that using a non-textured background could have made the platform more

accessible. As a result, the background colour used in this prototype is white, especially since the app requires the user to read various paragraphs. Figure 4 shows a comparison between the textured background used in the Web Systems assignment versus the non- textured background used in the high-fidelity prototype.

**Figure 4**  
Textured background versus non textured background



Another aspect that was followed is the minimalist design by including only the essential icons and assets that the user is going to need (Nielsen, 2020). For example, to show the Help icon only when the user needs a hint to solve a game. The minimalist design was also useful since the researcher design abilities were not of high standard. It is worth noting that the design has also followed the learning outcomes from the UX module. For instance, in one of the lectures there was an emphasis on giving the freedom to the user to whether enter their credentials or not. This was referred to as “users are not entering into a relationship” when they are demanding a service. Accordingly, in the design of this prototype app there was not a signing up option. However, in an actual version of this app there might be a signup option to collect data on the users age and residency for the sake of improving the application. It can be reiterated that the design was combined of a build-up of skills developed during the MSc year, and reference to the industry usability standards.

## **4.7 Utilising the previously mentioned hypotheses into the HIFI prototype design:**

The prototype mobile application was attempted to be informative with elements of humour and gamification. Firstly, the informative part was attained through the view of each female role model achievements and linking them with a direct impact on society. This was viewed as one of the things that attract females into joining specific careers (Chapter 2.1.2). Additionally, the users were provided with various platforms and enterprises to visit. These platforms were often created by the female role models mentioned in each storyline. For example, the Stemettes Enterprise (Chapter 2.1.4.1). To ensure that these services are still provided for free there was a necessity to email Stemettes, and their confirmation was mentioned in the mobile app (Figure 1). Eventually, when the user reaches the ending of the app the prize earned is a roadmap to IT with alternative pathways depending on the user situation. For instance, there is a pathway for individuals seeking a career shift and a pathway for individuals who are still deciding on which degree to study. In addition to individuals who might not have sufficient budget for a university degree, so they were referred to online resources. There was another pathway for parents to inspire their children for IT by referring them to dressCode and Stemettes Enterprises (Chapter 2.1.4.1).

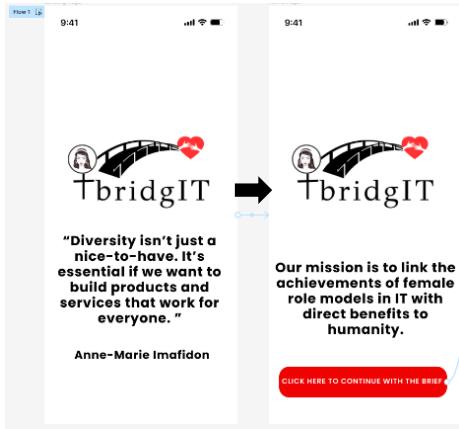
Secondly, the humorous part was implemented using various GIFs which are animated photos of celebrities in movies and tv shows. These GIFs were descriptive of a particular situation or commenting on a specific scenario in each storyline. From a critical view, the use of GIFs was also intended to mask the low designing skills of the researcher and to give an alternative to animation. It is worth noting that all the rights of the copyrighted assets used are reserved (Appendix I). The inclusion of humorous elements was intended to increase the emotional UX of the users and engagement (Chapter 2.24). Li et al. (1999) concluded in their study that the use of animations can enhance the recognition of information than static designs. Lastly, the gamification part was composed of a journey to complete and a reward to

win at the end of the user journey. However, there were some limitations in the games provided since the HIFI prototypes do not include actual programming. Accordingly, the gamification was achieved by hiding some items in the screen and asking the users to allocate them through a descriptive riddle. In addition to reordering a word or a puzzle which represent facts related to the role models achievements. The user was provided with hints during the gamification part resembled in the Help icon. The use of gamification was due to its efficacy in increasing user engagement (Chapter 2.2.4). In conclusion, there was a combination of ideas to achieve a usable, informative, humorous, and engaging mobile app. In addition to resembling the gamified prize of the users at the end of their journey as the Golden Snitch which is inspired from Harry Potter.

## **4.8 Description of the main aspects of the user journey throughout the HIFI prototype:**

The user journey was designed to show the aim of the application at the very beginning (Figure 5), so there was a descriptive quote of Anne-Marie Imafidon (Black History Month, 2023). On the second page the user can see the methodology behind the app which is represented in a written statement (Figure 5). The methodology was also signified in the logo which resembles the female biological icon and the bridge symbol connecting females' achievements in IT with direct benefits on society. The society was resembled in a red heart with two hands providing support (Figure 5). This was based on the suggestion of Westgarth (2018), that logos should be descriptive of the intended aim.

**Figure 5**  
*The aim versus the methodology of the application*



When the users click on the red button it takes them to the instructions slide which provides guidance on the options available in the app. Then comes the promised reward that the user will receive after completing the game. The prize was resembled in the Golden Snitch inspired from Harry Potter (Figure 6).

**Figure 6**  
*The gamification prize*



Afterwards, the home page appears featuring six female role models. The user will have to unlock their storylines in an order and when each role model is unlocked her photo becomes coloured and her name appears beneath her photo (Figure 7). The view of the home page in the beginning versus the ending of the user journey can be viewed in Figure 7.

**Figure 7**

The view of the home page in the beginning versus the ending of the user journey

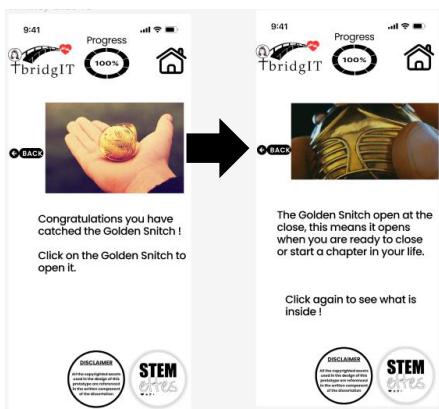


There was a consistent display of the disclaimer statement in the app to reserve the rights of the copyrighted assets used which are referenced in Appendix I. In addition, there was a consistent inclusion of enterprises to visit which were founded or co-founded by the female role models mentioned in the app. Additionally, there was a consistent use of the Help icon which appears in every game to provide a hint for the user. After finishing each storyline there are slides intended to congratulate the user.

Consequently, when the user unlocke all the role models games, the Golden Snitch will be colorfied (Figure 7) and accessible by clicking on it (Figure 8).

**Figure 8**

The gamified prize



Consequently, the users will be represented with a roadmap of alternative pathways to the IT field (Figure 9).

**Figure 9**  
*The roadmap to IT*

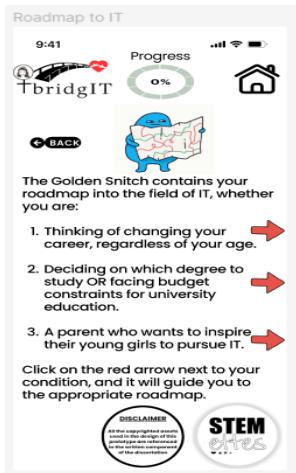


Figure 10 represents the career shifting pathway for individuals with non-computing background. It is worth noting that there is a statement claiming that the UK is one of the few countries offering Computing conversion master's degree (Figure 11).

**Figure 10**  
*The career shifting pathway.*



As a support to do this claim, the Careers Service in the University of Chester was contacted, and they advised on several websites to search domestically. Accordingly, the search was made on these websites in addition to other global websites (CS Conversion Programme List, n.d; Find A Masters, n.d).

It was found that the MSc conversion computing courses are offered in Australia, Canada, Denmark, New Zealand, Republic of Ireland, South Africa, United Kingdom, and United States. There is also the IE University in Spain which offers the conversion course but for students with business background (IE University School of Science & Technology, n.d). However, further extensive, and periodic search will be required for future versions of this prototype to ensure that the data is credible and updated. Eventually, when the user journey ends, they are provided with the last screens showing more role model to be included in possible future editions of the app, and a farewell screen. The main aspects of the user journey were mentioned in this section, however for the whole user journey (Appendix A).

## **4.9 Assets used:**

The design of the app required the use of several copyrighted assets. There were some usability standard assets for example, the home icon. In addition, there were the female role model's photos, alongside excessive use of GIFs. All the assets used in the design process of this app are mentioned in (Appendix I).

# **Chapter 5: the testing and results of the high-fidelity prototype mobile app:**

In this chapter the process of the user testing will be discussed including the preparations of the testing procedure and the tools needed. The second part of the chapter will be focused on the collection and analysis of the data using verbal and non-verbal cues.

## **5.1 User testing procedure**

### **5.1.1 Setting up the user testing room:**

The testing was conducted from the 3rd of September to the 11th of September 2023. There were essential preparations for the testing since they were done in person. Therefore, the consent forms were printed, alongside preparing spare white paper to write informal notes. The participants were given the opportunity to read the participant's information sheet again (Appendix C) after sending it previously via email. Afterwards, both the participant and the researcher have signed the consent forms before beginning the testing. The researcher took permissions from the testers to voice record the meeting. The participants were given the choice to either record the meeting by the researcher's spare mobile or their own mobile phone so they can have a copy. The testing was done on the researcher mobile phone.

### **5.1.2 During the testing sessions:**

The session followed Knapp (2016) instructions (Chapter 2.2.2). According to Knapp (2016) instructions, there was a warm welcome and a talk about how their day was to ensure that they are comfortable with the testing. Then, there was a definition of the meaning of a prototype (Chapter 2.2.2), and an emphasis

on the importance of their feedback to improve this prototype. Accordingly, they were asked kindly to think aloud and to explain whether they like or dislike something, and if there was something confusing or something humorous. Before the testing began, they were assured that it would just be a game and they should just enjoy the game. This was backed up by designing the app to look like a game (Chapter 4.8; Appendix A). However, due to different personalities the nonverbal cues were used as well to analyse their facial expressions and body language while using the app. For example, their smiles, laughs, signs of confusion. Knapp et al. (2016) illustrate that before showing the users the prototype, they should be asked some background information. However, this step was already done in the recruitment stage through emails. At the end of the testing, the users were asked questions to obtain their feedback about the app.

## **5.2 The collection and analysis of the data:**

The data collection and analysis were aimed to test the three hypotheses. The researcher has expected the possibility that participants might only tend to deliver positive comments. Therefore, there was a necessity to make use of non-verbal cues and body language analysis, alongside the verbal cues. The testing was done with five participants who were current students in the University of Chester. They participants were all English speakers. The testing sessions took between 15 -25 minutes and the participants will be referred to anonymously as mentioned in (Table 1).

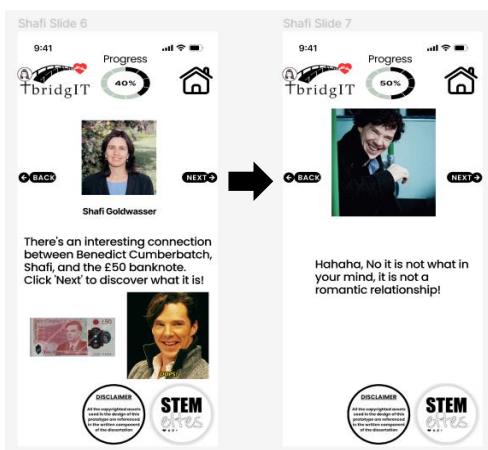
**Table 1**  
Participant's background

Tester number	Age group	Participants background
Tester 1	20 – 24	Psychology - Undergraduate
Tester 2	20 – 24	Theology and Religious Studies - Undergraduate
Tester 3	20 – 24	Biological Sciences - Undergraduate
Tester 4	25 – 30	Medical School - Postgraduate
Tester 5	25 – 30	Educational, Society and Globalisation - Postgraduate

### 5.2.1 Nonverbal cues during the testing sessions

Hypothesis C and the usability of the app were tested by observing the participants' facial expressions and their body language, for example, their smiles and laughs. Overall, there were positive gestures during all the testing sessions. For instance, there was a common pattern of laughing and smiling about some of the jokes and references to movies and tv shows which were included in the app. For example, Figure 11. It is worth mentioning that this agrees with the literature view (Chapter 2.2.4).

**Figure 11**  
Common pattern of laughter or smiling.



In addition, 4 out of 5 participants has read the instructions of the game carefully and 2 out of 5 have solved all the games without pressing the help icon. There was a common pattern of joy when they finish

one of the games and it reveals that Bumble was created by a female role model, Whitney Wolfe Herd (Devaney, 2021; Figure 12).

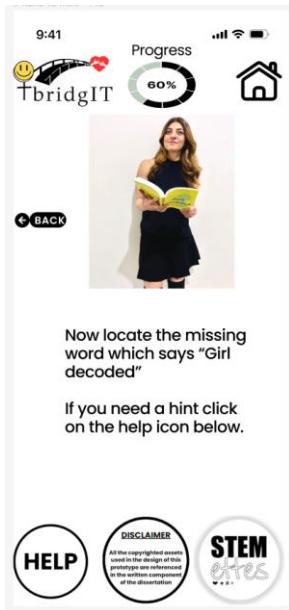
**Figure 12**  
*Bumble mobile app*



However, 3 out 5 participant showed signs of confusion in one of the games (Figure 13). They were supposed to click on the book which is carried by the role-model. Krug (2014) advises on facilitating the written language in the apps for the users (Krug , 2014). Nevertheless, this issue could be fixed by using a higher quality image or changing the wording of the riddle to be easier to understand.

**Figure 13**

*A game which was difficult to complete.*



Moreover, in a few slides of the app the participants tended to click on the GIFs before they load. It is worth noting that this could be fixed by adding a sentence saying “loading”. Additionally, on one hand, when Tester 4 was clicking on the hidden items, she had to click several times instead of once. On the other hand, when Tester 3 was asked if she has faced any difficulties, she said that all the buttons worked with her from the first time and there were not any bugs. It can be noted that this could be fixed by asking the user only to hover on the missing items instead of clicking. Although none of the participant had shown any signs of disabilities, but increasing the buttons margins can make the app accessible for individuals with motor disabilities (Chen et al., 2013; Dickerson, 2018). It can be reiterated that the effect of using GIFs and humorous elements and their enhancement of the emotional pleasurable UX is promising (Chapter 2.2.4).

## **5.2.2 Verbal cues:**

The participants were asked few questions which aimed to test the overall usability of the app and hypotheses A, B and C. Alongside, asking them to think aloud and describe if they like or dislike something in the app or if there were usability obstacles.

### **5.2.2.1 Difficulties faced while using the app:**

The first question was whether they faced difficulties while using the mobile application. Almost all the participants said that the prototype was simple to use. However, 4 out of 5 participants has admitted that one of the games was challenging (Figure 13). Unfortunately, this has triggered one of the participants to blame herself for not completing that game. The researcher has apologised and assured her that it was his own mistake for not using a clearer photo or a simpler language.

### **5.2.2.2 The features that were disliked or liked by the participants:**

The participants were asked about the elements they did dislike or liked during their journey in the app. Tester 5 mentioned that “I liked that I am getting educated while playing a game and solving puzzles”. Tester 2 said that she liked the small icons on the bottom right which are refereeing the user for several enterprises, and that the researcher has emailed Stemettes to ensure their services are free (Figure 1). Moreover, 2 out of the 5 participants mentioned that they liked the roadmap to IT careers (Figure 9). One justified it because it is telling the users where they can go after finishing the app. Additionally, 4 out of the 5 participants stated that the app was informative and taught them about women who they did not hear about and who made a difference. For example, 4 out of the 5 participants admired that Bumble was created by a woman (Figure 12). Tester 5 added “She is making a lot of people find love”. It is worth noting that this comment agrees with the literature review (Chapter 2.1.2). Furthermore, 3 out of the 5

participants mentioned that they liked the GIFs and references to movies and tv shows. One of the participants added that it made the app interactive, and another participant added that she liked the references to Harry Potter. However, one of the participants added that although she does not watch many movies, but she felt the inclusion of them was in line with the story and made sense. It can be noted that the effect of using GIFs was discussed in Chapter 2.2.4.

#### **5.2.2.3 The participants suggestions for improvements of the app:**

The participants then were asked about their suggestions to improve the prototype app. Tester 1 said adding more types of puzzles. Tester 5 said adding more role models since it is educational so it would be better not to be restricted only to six models. Tester 3 suggested “Adding more information on the first few role models similar to the amount of info regarding Anne Marie Imafidon which was quite inspiring and interactive”.

#### **5.2.2.4 How can the app motivate girls to consider careers in IT:**

Finally, the participants were asked whether this app has motivated them, or can it motivate others to join IT. Tester 2 has pointed that “It can because there is a balance of information, fun things to do and a little bit of humour, jokes and GIFs”. Tester 1 said that it would be useful for young people who are still considering their career choices. She clearly said that “it is an opportunity rather than schools pushing them to do girls subjects”. Tester 3 stated that the mobile app can be effective if it is used in a career website or blogs where people can search for careers. She added that it can be useful for girls who are thinking about choosing their GCSE and A levels. Then she stated that “Although I do not think it would sway my decisions now, but if I saw it a few years ago I likely would have considered a career in IT.”. Furthermore, tester 4 remarked that the app can motivate young girls, “It is suitable for the TikTok

generation, the fast-paced generation, because it is interactive rather than reading a whole university career page saying come to us and study IT". She related this to the fact that there were references to movies, games, and the jokes. Moreover, she suggested that the app can be tailored for different courses in the University instead of the career pages. In addition to the creation of a sister version of the app to teach children about the Romans history in Chester.

# **Chapter 6: Discussion:**

In this chapter, the project's aims will be overviewed and there will be further assessment of the results of the testing. There will be also an explanation of the limitations of this research. In the end, the research will be concluded with some recommendations for further studies.

## **6.1 Overview of the project's aim:**

The project aimed on testing three hypotheses. The first one was whether linking the achievements of female role model in IT with benefits on society; can encourage them to study IT using a prototype following usability standards. Secondly, whether a UX prototype app using examples of female IT role models can motivate females to study IT. Finally, the mixing between jokes, humorous and gamification elements can make the UX interactive and engaging.

### **6.1.1 Testing Hypotheses A and B**

The first two hypotheses have shown promising results, but they could be considered partly proved. Almost all the participants mentioned that they did not know about the role models mentioned in the app before. For example, they have shown signs of surprise that Bumble was created by a woman. Alongside, they liked the fact that these role models are helping their society. For instance, one of the participants commented on the storyline of Whitney Wolfe Herd by saying “she is making a lot of people find love”. It can be mentioned that this agrees with the literature review (Chapter 2.1.2; Chapter 2.1.6). However, since most of the participants have suggested the use of the app in career pages and blogs for individuals who are still considering their career choice as mentioned in Chapter 5.2.2.4. For example, by describing the new generation as the “fast-paced generation” who would prefer an interactive app more than a university career page. As a result, to prove or disprove the hypotheses, an enhanced version of the app

will need to be tested by the age group which was recommended by the participants. However, this was not attainable because the ethics clearance for this project have proved the testing to be conducted with the current students in the University of Chester.

### **6.2.2 Testing hypothesis C**

Hypothesis C has also shown promising results following the analysis of the user's nonverbal and verbal cues. The participants have liked that the app is not only informative but also has gamification and humorous elements (Chapter 5.2). For example, one of the participants noted that she liked the fact that while she is playing a game she is also getting educated. However, this hypothesis was only tested with individuals who do not have disabilities and it has shown promising results with them. Therefore, the app was not tested with disabled individuals. Additional section 6.3 will view that the app is not fully accessible. For instance, screen readers and individuals with motor disabilities. Since, the hypothesis depended on the use of GIFs and gamification elements to increase user engagement and enhance the emotional user experience (Chapter 2.2.4). Therefore, the app would require further adjustments to increase its accessibility. Followed by the testing with disabled individuals to prove or disprove the hypothesis.

## **6.3 Stepping back and reassessment of the prototype following the user testing sessions:**

After completing the last user testing session and gathering the feedback of the users, alongside representing the results to the supervisor. The researcher had to take another user journey in the prototype mobile app to check if there were any undetected errors or ways of improving the app. In the Web

Systems module, there was an emphasis on designing websites which are accessible to different users. While in the app there was a mentioning of Dr. Chieko Asakawa who is a blind Japanese female role model. Unfortunately, the humorous and joking side of the app which depended on the GIFs was not accessible for users using screen readers. Li et al. (2021) have criticised that the tools used in prototyping are not providing features to develop accessible high-fidelity prototypes. However, Hurd (2019) has developed a plugin which can add alt texts to the GIFs that can be read by screen readers. It is worth noting that this plugin is adjusted for WordPress designed websites or mobile applications.

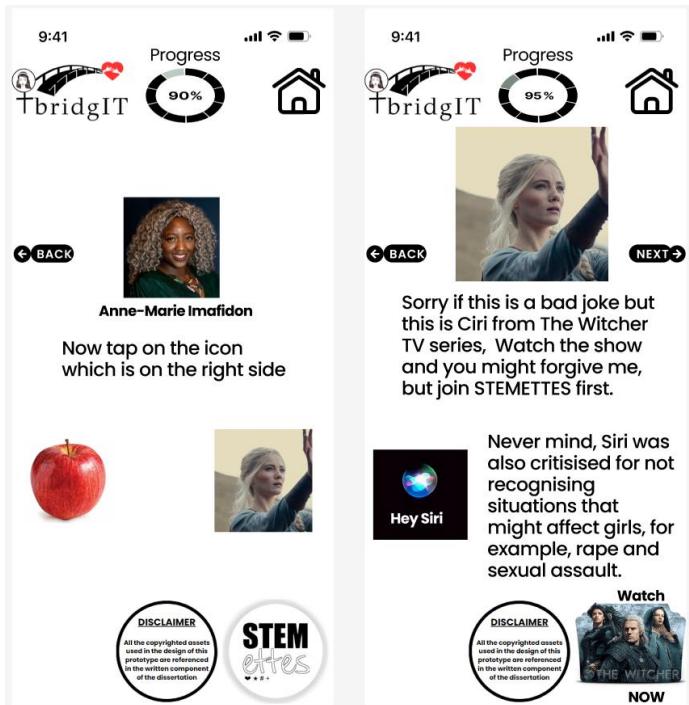
Another aspect of accessibility is the button size, Chen et al. (2013) have made a study to test its effect on the user performance for individuals with motor impairments. They concluded that by increasing the button size the errors decreases, and the highest improvements were observed until the size of 30mm.

Fortunately, the Uniter plugin in Figma can convert the measurement units from pixels into millimetres, and it has shown that the next and back buttons used in the prototype app are 33.5mm. However, in one of the games where the user had to click on hidden items in the screen, some of the item's sizes were nearly 11 and 15 mm (Figure 13). As a result, this particular game can be difficult to play for motor impaired individuals.

Furthermore, Figure 12 shows an attempt of delivering information using a joke and some of the participants smiled or laughed about it. Although, the prototype app was tested by participants who are over 18 years old. Therefore, there should have been a disclaimer stating that the app is +18 or the language used can be changed to suit the younger age groups. This is important because the participants suggested the use of the app in career choice portals, and it would not be appropriate to be published there with the inclusion of terms of rape and assault.

**Figure 14**

An issue in the language in one instance



Similarly, triggering the users to blame themselves for not completing a particular game (Figure 13) can counteract the intended aim of the app. The researcher has dealt with this triggered action by blaming himself for not making the game clearer or not using higher quality pictures. Therefore, it is crucial to use a clear simple English language and high-quality pictures. This can be achieved by reviewing the app under the supervision of an English language specialised team. The specialised English team would be also important to check for grammatic or spelling mistake, since one of the participants mentioned that there was one word which was misspelled. This can be important also since the word “Cheers” was used at the end of some storylines congratulating the user upon finishing a particular part of the game. Chui (2023) states that in UK it is commonly used to thank others or to celebrate, but in other cultures it is only related to drinking occasions. Moreover, the employment of a designing team could be crucial to fix similar arising issues and to design original assets instead of relying upon copyrighted GIFs. It is worth noting, that the use of copyrighted GIFs was relied upon because the researcher did not have an experience or talent in drawing.

## **6.4 Limitations:**

### **6.4.1 Possible bias:**

1 out of the 5 participants was familiar to the researcher. Accordingly, it was made clear that a prototype is meant to collect feedback to improve a possible actual version of the app. Accordingly, there might have been a slight bias towards giving only positive insights on the prototype. However, there were constructive feedback given by them alongside the positive insights (Chapter 5.2).

### **6.4.2 Error prevention:**

In one of the UX module's lectures, usability problems were referred to as "It can eat positive user experience for lunch". In section (5.2.1) it was mentioned that 1 out of the 5 participants did not read the instructions prior to starting the game. It has impacted the user performance, so the researcher had to repeat the instructions verbally. Priscila (2019) justifies this by stating that users tend to ignore reading manuals and prefer to learn from their mistakes. However, the 6th element in the heuristic evaluation (Nielsen, 2020) emphasises that users do not have to remember instructions while using the app. Accordingly, this can be solved by adding an icon which can be clicked to view the instructions again throughout the user journey. Furthermore, there was an issue noticed when one of the participants clicked on the home icon accidentally while playing the game of the fourth role model. This has led her to restart the game of the fourth role model again. The home button was supposed to save the user progress until the last storyline played. However, this issue can be fixed by adding a warning message as stated in the 5<sup>th</sup> heuristic evaluation criteria (Nielsen, 2020).

### **6.4.3 Excessive use of copyrighted assets and GIFs:**

There was an excessive dependency on copyrighted assets and GIFs since the researcher's has not enough experience and talent of drawing. Another reason was to provide a pleasurable emotional user experience (Chapter 2.2.4). The copyrighted assets were referenced properly (Appendix I). However, for an actual version for the app the copyrighted assets owners will need to be contacted, in addition to the role models included. Alternatively, Steiner (2015) emphasise on the importance of hiring a designer to increase the functionality and visualisation of the app.

### **6.4.4 Implementing the Design Sprint by an individual researcher:**

The project was based on the usability industry standard of Knapp et al. (2016). The research was done by one individual, so covering the whole process of the Design Sprint was not attainable. For example, the ideas of voting and group thinking. As a result, the aspects that were followed were searching for previous ideas (Chapter 2.2.5), sketching (Chapter 4.4), the prototyping (Chapter 4.64.8) and the user testing (Chapter 5). The heuristic evaluation criteria (Nielsen, 2020) were used as an alternative to the stages of the Design Sprint which require the presence of a team. This was important since the app was created by an individual researcher. Therefore, the heuristic evaluation was used to evaluate previously published mobile applications (Appendix E; Appendix F), and to self-evaluate the two low fidelity prototypes (Appendix G; Appendix H) developed before the high-fidelity prototype. In the end, the researcher should have adhered to the time of the testing sessions suggested by Knapp et al. (2016). They suggest that the duration of the app testing should be fifteen minutes or less so there could be more time for questions. Unfortunately, this have been exceeded by an average of five minutes.

## 6.5 Conclusion

Underrepresentation of females in Computing is prohibiting the digital world of ideas from the female viewpoint and creative innovations (Beyer, 2014; Imafidon, 2022). The current technology products lack some attention to females needs (Imafidon, 2022; Miner, et al., 2016; Sax, et al., 2017). The literature review has viewed common reasons behind the underrepresentation of females in IT and the negative impacts about their underrepresentation (Chapter 2). There were previously published mobile applications which links female role models with benefits on society (Chapter 2.2.5). For example, W-STEM: Women in STEM, and Women Who Changed the World. Accordingly, this dissertation aimed on developing a high-fidelity prototype mobile application which has undergone user testing. To collect the target users' feedbacks and to test the hypotheses on which the research was based on. The prototype was designed to utilise the hypotheses needed to be tested. As a result, the design focused on making an informative and easy to use app with elements of gamifications and humour. The informative part has focused on introducing successful female role models in IT whose achievement had positively impacted the society (Chapter 2). In addition to introducing the user to enterprises to visit which were mainly founded or co-founded by the role models mentioned in the app.

The extent of the easiness of using the app was based on the evaluation of the low fidelity prototype using the heuristic evaluation criteria of Nielsen (2020). However, further points of improvement in the usability were attained after conducting the user testing. The gamification side was implemented using a series of riddles in each role model story. In addition, informing the user that there will be a reward upon finishing the app which was identified as the Golden Snitch (Inspired from Harry Potter). The reward of the user was not only adding a gamification portion to the app but also an informative part. This is due to the inclusion of a roadmap which provide the user with alternative career pathways according to their current condition (Figure 9). The humorous part was achievable by using GIFs and referring to situations in movies and tv shows. The user testing sessions were conducted in person, there was an analysis of the

non-verbal and verbal cues of the participants. The non-verbal cues were considered because maybe the participants would like only to deliver positive feedbacks. Overall, there were points of laughter, smiling and positivity, however there were also signs of confusion regarding one of the riddles (Figure 13). The verbal cues were obtained by asking them to think aloud and to answer a few questions. Some of the participants agreed that the game (Figure 13) was challenging, but most of them said that the app was simple to use. Most of them admired that the app is informative, gamified and has sorts of humour. In addition, telling them about successful women whom they did not hear about. 3 out of 5 of the participants liked the presence of references to movies. The participants suggested the use of the app in career pages in universities and blogs to guide girls into considering IT as a career. One of them emphasised that the app could work for the age group which she called “TikTok generation, faced paced” instead of reading a whole career page on the internet.

## 6.6 Recommendations for further study

The research has shown that there were various resources discussing the common reasons behind the underrepresentation of females in IT (Chapter 2.1.2; Chapter 2.1.3). There were also various suggestions of ways of reversing this issue (Chapter 2.1.6). However, there are still a need to integrate these suggestions in more mobile apps while following industry usability standards. Based on the work done in this dissertation there are steps that could be utilised by the researcher or other researchers. The recruitment of a whole diverse team of researchers following the Design Sprint of Knapp et al. (2016) would be useful.

This might lead to more creative and innovative ideas rather than a team of one researcher. However, if there is still a requirement for the research to be implemented by an individual then it could be beneficial to be immersed to a higher extent in feminism articles, books, and magazines. This would be crucial if

the research is undertaken by a male to convince the female audience that there were efforts of understanding their problems and needs. Furthermore, the project should not ignore the disabled individuals who are still needed to be represented. It worth noting that Dr Chieko Asakawa has proven that visual impaired individuals can still achieve success in the Computing Career. Since she has developed a navigation robot which is aimed to help visually impaired individuals (Asakawa, 2023). There will also be a necessity to obtain a permission to include the copyrighted assets and the role models in future editions.

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# **Appendices:**

## **Appendix A: Links to the developed the high-fidelity prototype mobile application:**

Link to the interactive prototype mobile application on Figma:

<https://www.figma.com/proto/gP1U8HuQ5B3NtlobOg0dky/Dissertation?node-id=209-1535&starting-point-node-id=219%3A1658&mode=design&t=P8QRQHhZygr3LyVt-1>

Link to the screenshots of the whole user journey of the app:

[Screenshots of the whole user journey of the prototype](#)

## Appendix B: Ethics approval letter



Faculty of Science, Business & Enterprise  
Science & Engineering Research Ethics Committee

Abdelrahman Abdelwahab  
via online system

26<sup>th</sup> June 2023

Dear Abdelrahman,

**Study title:** Exploring female under representation in IT, and some possible solutions.  
**FSE-REC reference:** 267/23/CS/AA  
**Version number:** 1

Thank you for submitting your application for ethical approval. The Committee is conscious of the work involved in the preparation of such research proposals and is grateful for your attention to this.

**Decision:** Approved

I am satisfied that you have considered any potential ethical issues and taken steps to mitigate against these, and am therefore pleased to confirm ethical approval, provided that you comply with the conditions set out in the University's [Research Governance Handbook](#) and adhere to the processes described in your application form and supporting documentation.

While these do not relate to ethical issues, I have the following comments on your study:

- The title of your project is very generic and does not seem entirely appropriate for/focused on the work you are planning to carry out. It may be better to term this a 'pilot study'.
- It is unclear what the style and content of your app will be. If you are basing this on other apps which are already available, these should be clearly referenced in your written work.

Yours sincerely,

A handwritten signature in black ink, appearing to read "S. Oliver".

Dr Simon Oliver  
Chair, Science and Engineering Research Ethics Committee

cc. Supervisor (Helen Southall)

# Appendix C: Participant information sheet



## Appendix 3

### Participant information sheet

Title of the project: Exploring female under representation in IT, and some possible solutions.

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

#### What is the purpose of the study?

There is a gender gap in the field of computer science, and one of the reasons of why females are not adequately represented in this field is that they desire careers which have an impact on society, besides being meaningful (Layman et al., 2007). Additionally, according to Harrison (2022), the lack of role models in IT is one of the barriers for females considering this career opportunity. As a result, a high-fidelity prototype mobile application which has been produced to deliver meaningful computer science assignments in order to encourage females to consider IT as a career.

#### Why have I been chosen?

You have been chosen because you are a female who has not chosen IT as a career

#### Do I have to take part?

It is up to you to decide whether or not to take part. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect you in any way.

#### What will happen to me if I take part?

You will be invited to a 30-minute session and will be asked to use a high-fidelity mobile application prototype, and your impressions and comments will be noted.

You will also be asked if you have faced any difficulties using the prototype, whether the prototype's content has motivated you to consider or encourage others to join the IT track, and what you think would improve this prototype.

#### What are the possible disadvantages and risks of taking part?

There are no disadvantages or risks foreseen in taking part in the study.

#### What are the possible benefits of taking part?

Your contribution will help in achieving equality in the digital world, and to reduce the possibility of having a digital world tailored only for one gender. Additionally, you may also encounter information that you may find beneficial about careers that you have not previously considered.

#### What if something goes wrong?

If you wish to complain or have any concerns please contact Dr Kurt Allman, Dean of the Faculty of Science, Business & Enterprise, University of Chester.  
[k.allman@chester.ac.uk](mailto:k.allman@chester.ac.uk).

#### Will my taking part in the study be kept confidential?

All information which is collected about you will be kept strictly confidential and anonymous so that only the researcher carrying out the research will have access to such information.

#### What will happen to the results of the research study?

The results will be written up into a dissertation for my final project of my MSc. Individuals who participate will not be identified in any subsequent report or publication.

#### Who is organizing the research?

The research is conducted as part of a MSc in Computer Science within the Faculty of Science, Business & Enterprise at the University of Chester. The study is supervised by Dr Helen Soudall.

#### Who may I contact for further information?

If you would like more information about the research before you decide whether or not you would be willing to take part, please contact:  
Abdelrahman Abdelwahab. [2225590@chester.ac.uk](mailto:2225590@chester.ac.uk).

#### Retention and publication of participant's data

Participants should note that data collected from this project will be retained and may be published in an anonymized form. By agreeing to participate in this project, you are consenting to the retention and publication of data.

Thank you for your interest in this research.

# Appendix D: Participant consent form:



## Appendix 4 Consent form

Title of the project: Exploring female under representation in IT, and some possible solutions.

Please initial box

1. I confirm that I have read and understand the information sheet for the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason and without my legal rights being affected.
3. I agree to take part in the above study.

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Name of Participant

---

Date

---

Signature

---

Researcher

---

Date

---

Signature

1 for participant; 1 for researcher

## Appendix E: Heuristic evaluation of “W-STEM: Women in STEM” mobile app

Criteria	Issues	Recommendations
1) Visibility of system status	<ul style="list-style-type: none"> <li>i. The landing page of the app does not explain the aim of the app.</li> <li>ii. The user journey is complicated as they must get inside each article and the only thing to do next is to go back and get inside another article.</li> <li>iii. Users are not informed on their progress and what is have been read and what is left to be read.</li> <li>iv. The section named “Today” does not explain its relative content.</li> </ul>	<ul style="list-style-type: none"> <li>i. Briefly explaining the aim of the app in the beginning of the user journey.</li> <li>ii. Explaining the user journey and how the users can gain the highest benefits of using the app.</li> <li>iii. moving the content in the left bar to be visible and oriented on the centre of the screen</li> <li>iv. -Rewarding users, for example by gamification techniques or congratulating messages after reading each article or visiting a role model profile. And showing the user current progress.</li> <li>v. -Explaining the sections content</li> </ul>

<b>2) Match between system and real world</b>	i. Not every user is familiar with the shape of the navigation bar icon.	i. Following the usability standard design for navigation bar. Alternatively, moving the content of the bar into the home screen without the need for the bar.
<b>3) user control and freedom:</b>	i) When users choose to play videos, it takes them to YouTube instead of integrating the videos inside the app. However, the articles are playable on the website.	I) Integrate the whole content into the app
<b>4) Consistency and standards</b>	i) The profiles listed are not consistent and not filtered into students and lecturers role models.	i) Differentiate the role models included into students and lecturers.
<b>5) Error prevention</b>	i) The photos of role models sometimes take time to load.	i) Show a message saying “loading”
<b>6) Recognition rather than recall</b>	i) The app is recognisable.	i) Changing the icon into a usability standard one can enhance its recognisability.

7)Flexibility and efficiency of use:	<p>i) The design does not provide shortcuts for filtering, searching, and going to the home screen.</p>	<p>i) Adding shortcuts of filtering and search icons would enhance the usability</p>
8)Aesthetic and Minimalist design:	<p>I) the profile section is not essential and not explained and can confuse user with their own profile.</p>	<p>i) Add a more interactive and user-friendly interface to the prototype.</p>
9) Help users recognise diagnose and recover from errors:	<p>I) It is difficult to recognise if something was added to the favourite list or not.</p> <p>II) If you accidentally added an article to favourites, it is not easy to undo that.</p>	<p>i. Add “Back” or “Undo” buttons to the app.</p>
10)Help and documentation:	<p>I) The about section takes you to an outsource page,</p> <p>II) “Today” is not descriptive.</p> <p>III) The app does not explain its content well</p>	<p>i. Add better documentation to the app to help users understand its goals and objectives</p>

## Appendix F: Heuristic evaluation of “Women Who Changed the World” mobile app

Criteria	Issues	Recommendations
<b>1) Visibility of system status</b>	<ul style="list-style-type: none"> <li>i. The landing page does not explain the intended aim of the app as it only shows pictures and names of female scientists.</li> <li>ii. The user does not receive information about the progress achieved in each story or overall stories.</li> <li>iii. The design communicates well with the user; however, the app is slow in browsing.</li> </ul>	<ul style="list-style-type: none"> <li>i. Describing the aim of the app.</li> <li>ii. Informing the users on their overall progress.</li> <li>iii. Accelerating the fluency of the app.</li> </ul>
<b>2) Match between system and real world:</b>	<ul style="list-style-type: none"> <li>i. The app does not tell the user what to do during the game, by other means there is no help icon.</li> </ul>	<ul style="list-style-type: none"> <li>ii. Adding help icon following the usability standard design.</li> </ul>

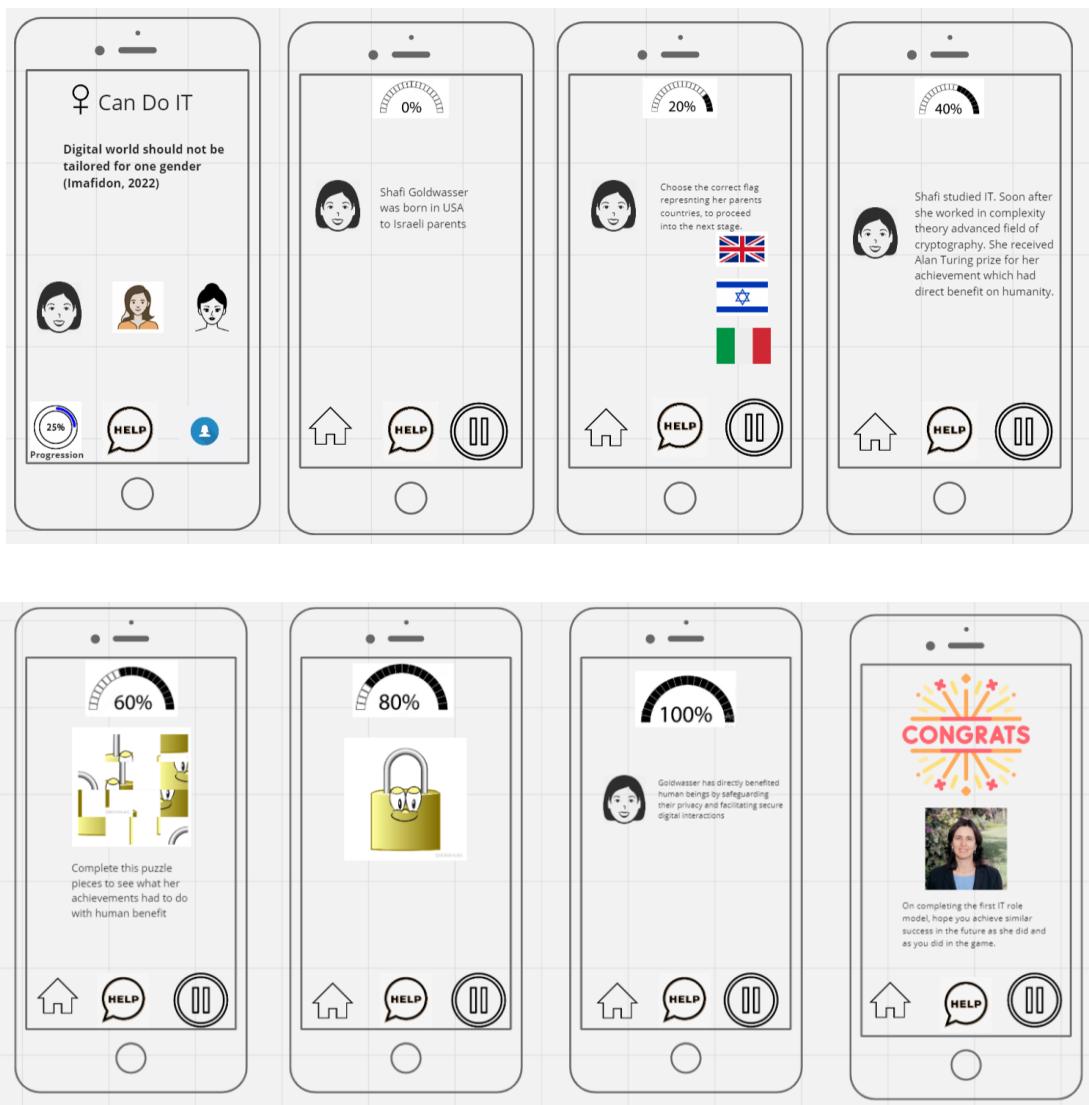
<b>3) user control and freedom:</b>	i) The home icon or the emergency exit is not easy to be discoverable.  ii) The user can not go back to the previous part of the story if they want to re-read what was written previously.	i) Adding emergency exits and making it visible and accessible.  ii) Adding back buttons.
<b>4) Consistency and standards</b>	i) The app is consistent. , however, the hints to complete the tasks were not always provided.	i) Provide consistent help or hints to the users on how they can complete the game.
<b>5) Error prevention</b>	i) When pressing the home icon, the app does not warn the user that this will take them back to the home page without saving the current progress.	i) Implementing a confirmation or warning message when pressing on the home icon

<b>6) Recognition rather than recall</b>	<p>i) Minimise the need of users to recall information when interacting with the app.</p> <p>For instance, the location of the home icon which is not visible enough. In addition to, lack of cues provided to help the user to complete the game.</p>	<p>i) Increase the home icon size to be recognisable whenever the user needs it.</p>
<b>7)Flexibility and efficiency of use:</b>	<p>i) The app does not provide customisation for users in regards for the font size of the written text which might look small to some users.</p> <p>ii) The next icon is not easy discoverable enough.</p> <p>However, the app does depend on touch gestures to navigate through the user journey.</p>	<p>i) Increasing the size of the written text would enhance the accessibility.</p> <p>ii) Increase the size of the next icon to improve the accessibility.</p>

8)Aesthetic and Minimalist design:	<p>i) The design is only focusing on the essential's things, and it was not overwhelming or cluttered</p>	<p>i. Providing user feedback while trying to complete the gamification task either if the user clicked on where he is supposed to or not</p>
9) Help users recognise diagnose and recover from errors:	<p>i) When an answer to a quiz the wrong the user is notified, it gives a red colour to wrong answer and a green to the right answer,</p> <p>ii) However, in some instances user is left in confusion state when there is no guidance provided to complete the task.</p>	<p>i. Add better ways for users to recover from unwanted actions.</p> <p>ii. Add better guidance in tasks (in-context help)</p>
10)Help and documentation:	<p>i) The app does not provide documentation which can include guidance on how to use the app.</p> <p>ii) Additionally, there was no on boarding tutorials or instructions for first time users.</p>	<p>i. Add a proper documentation on the app.</p> <p>ii. First time users need better guidance and documentation.</p> <p>iii. Provide users with better feedback.</p>

	<p>iii) There is no feedback mechanism to allow for improvement of the app.</p>	
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## Appendix G: Heuristic evaluation of the first Low-fidelity prototype

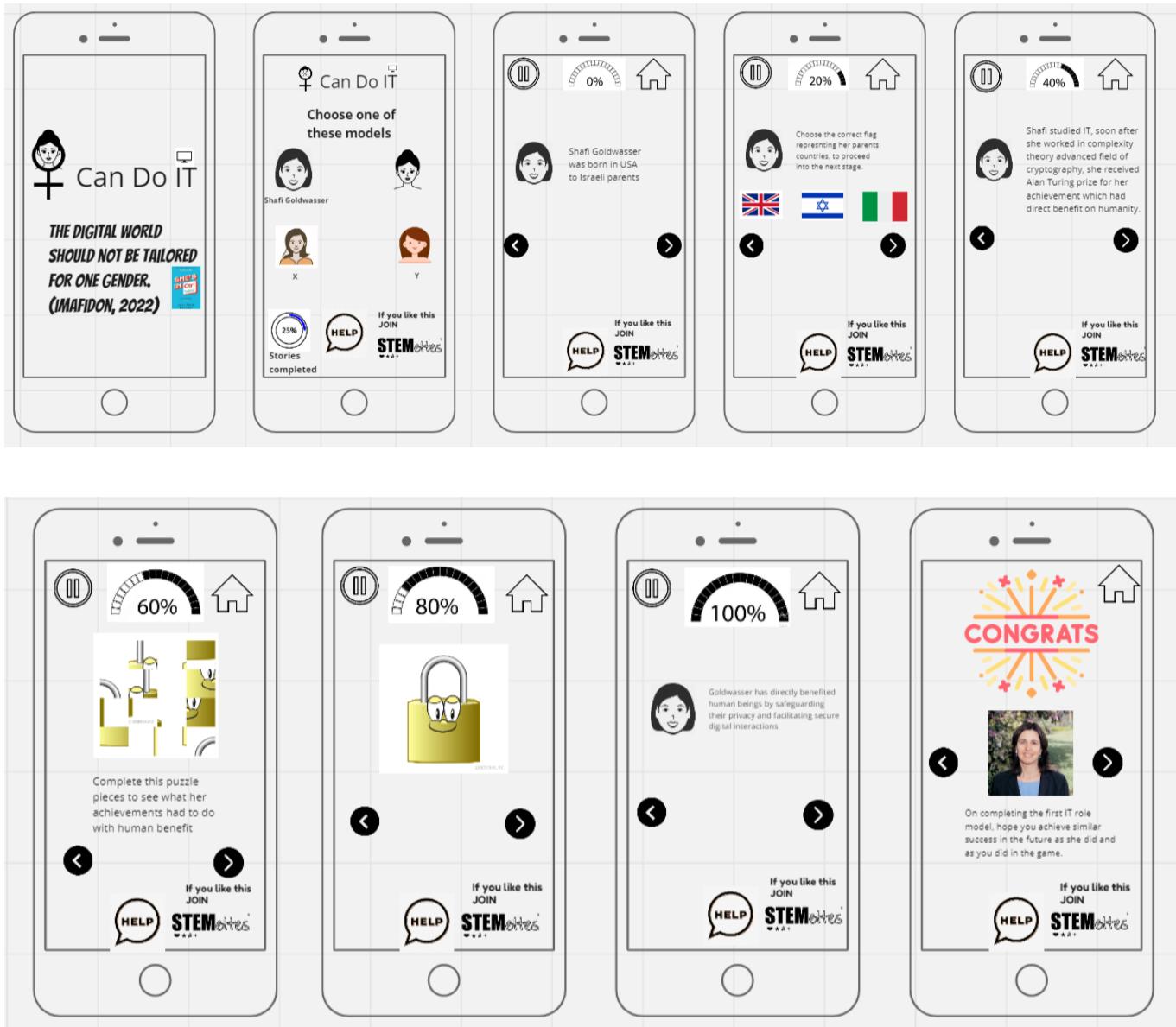


Criteria	Issues	Recommendations
<b>1) Visibility of system status</b>	i. There was no landing page.	i. Adding a landing page
<b>2) Match between system and real world:</b>	i. Punctuation mistake “Shafi studied IT,” it should have been a full stop. ii. The word “IT” in the logo might be misunderstood to be “it” instead of “Information Technology”	i. Double check for the punctuation mistakes. ii. Attempt on making IT descriptive to information technology.
<b>3) user control and freedom:</b>	i) Forgot to add the next and back buttons	ii) The next and back buttons need to be added.
<b>4) Consistency and standards</b>	i) There is inconsistency in the profile, progression and pause icons.	i) Relocate the profile, progression and pause icons.
<b>5) Error prevention</b>	i) There is no error message when selecting the wrong answer in the quiz. ii) It is convenient that there is a home button	i) Add a red alert saying, “Wrong answer”, or add a statement saying “Try again”

<b>6) Recognition rather than recall</b>	i) The app is recognisable.	i) The use of only one progression bar would increase the recognisability rather than having one inside the game and one in the home screen.
<b>7)Flexibility and efficiency of use:</b>	i) The user interface is simple.	ii) Add a more personalised experience to the app
<b>8)Aesthetic and Minimalist design:</b>	I) The profile section is not needed. II) IT might be misunderstood with the word “it”. III) review the profile icon. IV) Putting female face inside bio icon will be better	i) Remove some of the unnecessary information of the app. ii) Keep the design more concise.
<b>9) Help users recognise diagnose and recover from errors:</b>	i) No error messages were added. ii) Users might get confused with the language used on the app	i. Add error messages. ii. Try to keep language as simple as possible.
<b>10)Help and documentation:</b>	i) Help button was added but it was not functional	i) Add a functional help button.

		ii) Provide more in-context assistance.
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## Appendix H: Heuristic evaluation of the second Lo-fi prototype

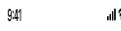


Criteria	Issues	Recommendations
<b>1) Visibility of system status</b>	<p>i. The use of the book image in the landing page was not necessarily, because the quote of Imafidon was already used.</p> <p>ii. The home page needs more description about the aim of the app.</p>	<p>i. Removing the book image.</p> <p>ii. Adding more description regarding the aim of the app.</p>
<b>2) Match between system and real world:</b>	<p>i. The use of animated photos representing role-models was not the right approach. The role models might not accept that these animated photos represent them.</p> <p>ii. “The Digital World” instead of “Digital world”.</p>	<p>i. Using the real images of the role models to draw their image in the conscious of the users.</p> <p>ii. The users will be more confident when they see real person images so you can achieve similar success</p>
<b>3) User control and freedom:</b>	<p>i) The user is provided with emergency exits, and an icon to pause the game.</p>	<p>ii) Add a “Undo” button action so users can cancel unwanted actions.</p>
<b>4) Consistency and standards</b>	<p>i) The app needs improvement in industry conventions.</p>	<p>ii) Keep the app consistent.</p> <p>iii) Icons should always be in the same location.</p>

<b>5) Error prevention</b>	<p>i) There is no error message when selecting the wrong answer in the quiz.</p> <p>ii) It is convenient that there is a home button</p>	<p>i) Add a red alert saying, “Wrong answer”, or add a statement saying, “Try again”.</p> <p>ii) Congratulate the user when choosing the right answer for the quiz.</p>
<b>6) Recognition rather than recall</b>	<p>i) The app is recognisable. However, some information is not easily reachable.</p>	<p>i. Add more in-context help.</p>
<b>7) Flexibility and efficiency of use:</b>	<p>i) The user interface is simple.</p>	<p>i) Add better customisation.</p> <p>ii) Improve logo.</p>
<b>8) Aesthetic and Minimalist design:</b>	<p>i) Ctrl might be misunderstood for ctrl and not control in book photo in landing page</p> <p>ii) Instead of using overall stories completed using the bar loading between images</p>	<p>i. Grey images turning colourful</p>
<b>9) Help users recognise diagnose and</b>	<p>i. Change jargons. Some of the language used on the app</p>	<p>i) Add jargons that are more familiar to the main target audience of the app.</p>

<b>recover from errors:</b>	was not familiar to some of the users.	
<b>10)Help and documentation:</b>	i) Help button was added, but not yet functional	i. Add a function help button.

## Appendix I: The assets used in order of their appearance in the app:

Figure	Reference
	Designed by the researcher
	Cold Sea Design. (n.d.). Canva. <a href="https://www.canva.com/p/templates/EAFlhWQv7TI-beige-brown-flat-illustrative-beauty-fashion-logo/">https://www.canva.com/p/templates/EAFlhWQv7TI-beige-brown-flat-illustrative-beauty-fashion-logo/</a>
	FlyBets. (n.d.). Canva. <a href="https://www.canva.com/p/templates/EAE0hZVMq80-creative-abSTRACT-bridge-logo-design-template/">https://www.canva.com/p/templates/EAE0hZVMq80-creative-abSTRACT-bridge-logo-design-template/</a>
	Maningga Rungga Design. (n.d.). Canva. <a href="https://www.canva.com/p/templates/EAFKSMYnnic-beige-and-green-simple-charity-community-logo/">https://www.canva.com/p/templates/EAFKSMYnnic-beige-and-green-simple-charity-community-logo/</a>
	Boris Borisov. (n.d.). Figma. <a href="https://www.figma.com/community/file/1060560897585661328/status-bar-iphone-13-series">https://www.figma.com/community/file/1060560897585661328/status-bar-iphone-13-series</a>

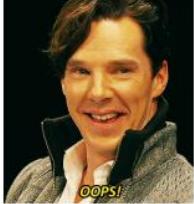
	Designed by the researcher
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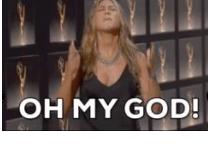
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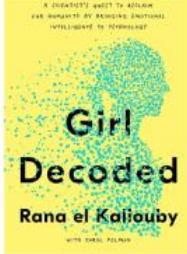
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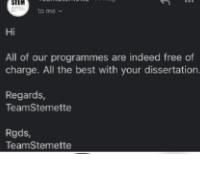
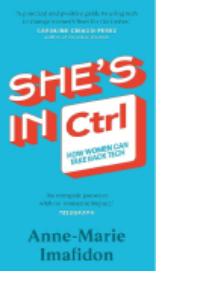
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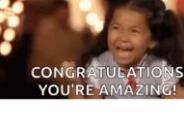
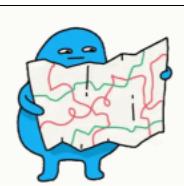
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	<p>Mohindra, L. (2018). Navigating app development and launching tech products at Surrey Business School. University of Surrey.</p> <p><a href="https://blogs.surrey.ac.uk/business-school/2018/12/07/our-students-navigating-app-development-and-learning-how-to-launch-tech-products/">https://blogs.surrey.ac.uk/business-school/2018/12/07/our-students-navigating-app-development-and-learning-how-to-launch-tech-products/</a></p>
	<p>Tiff In Tech. (n.d.). YouTube. <a href="https://www.youtube.com/@TiffInTech">https://www.youtube.com/@TiffInTech</a></p>
	<p>NetworkChuck. (2023). The hacker's roadmap (how to get started in IT in 2023). YouTube. <a href="https://youtu.be/uTAaFExLgwQ?si=AXE4yjV4785j_a2r">https://youtu.be/uTAaFExLgwQ?si=AXE4yjV4785j_a2r</a></p>

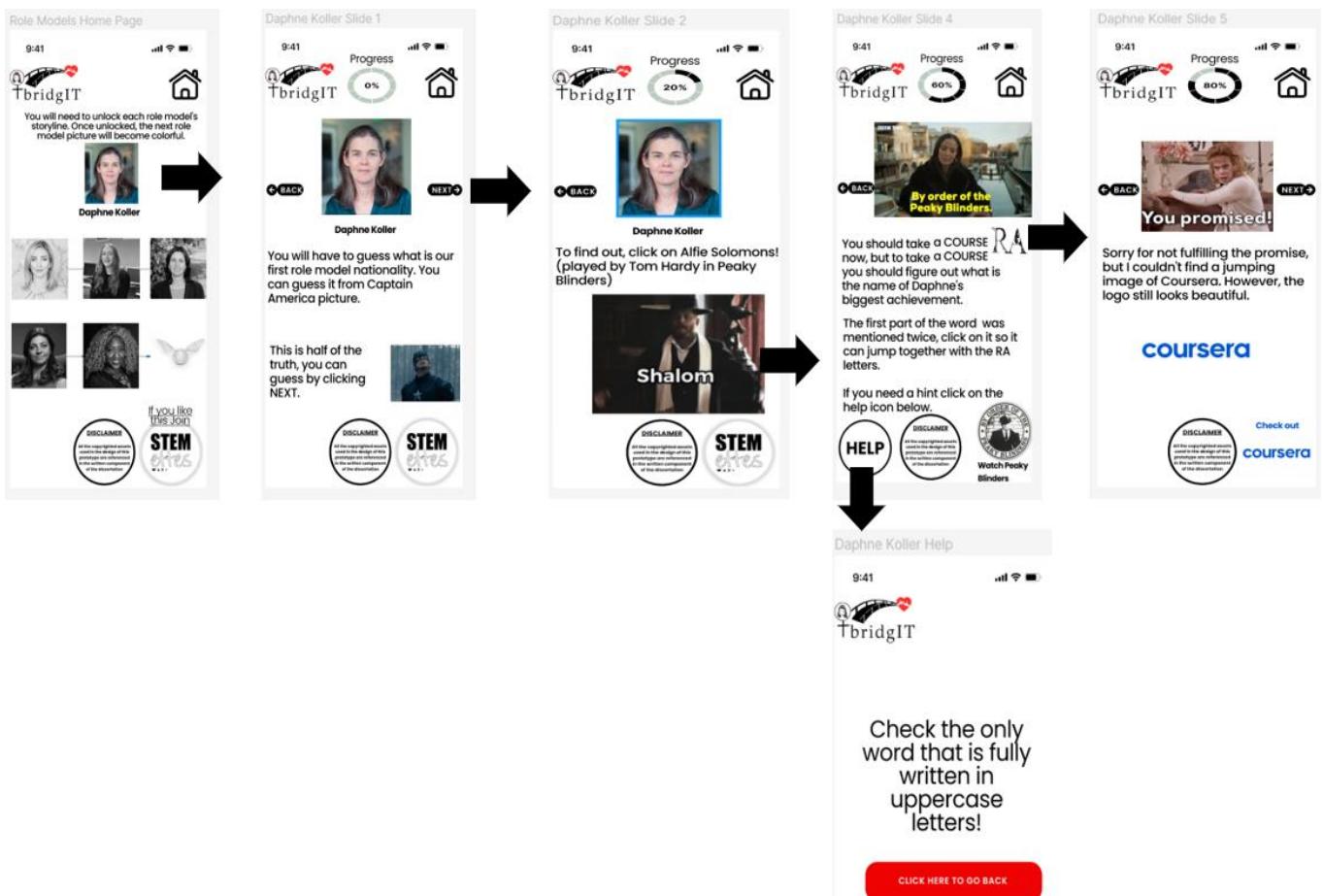
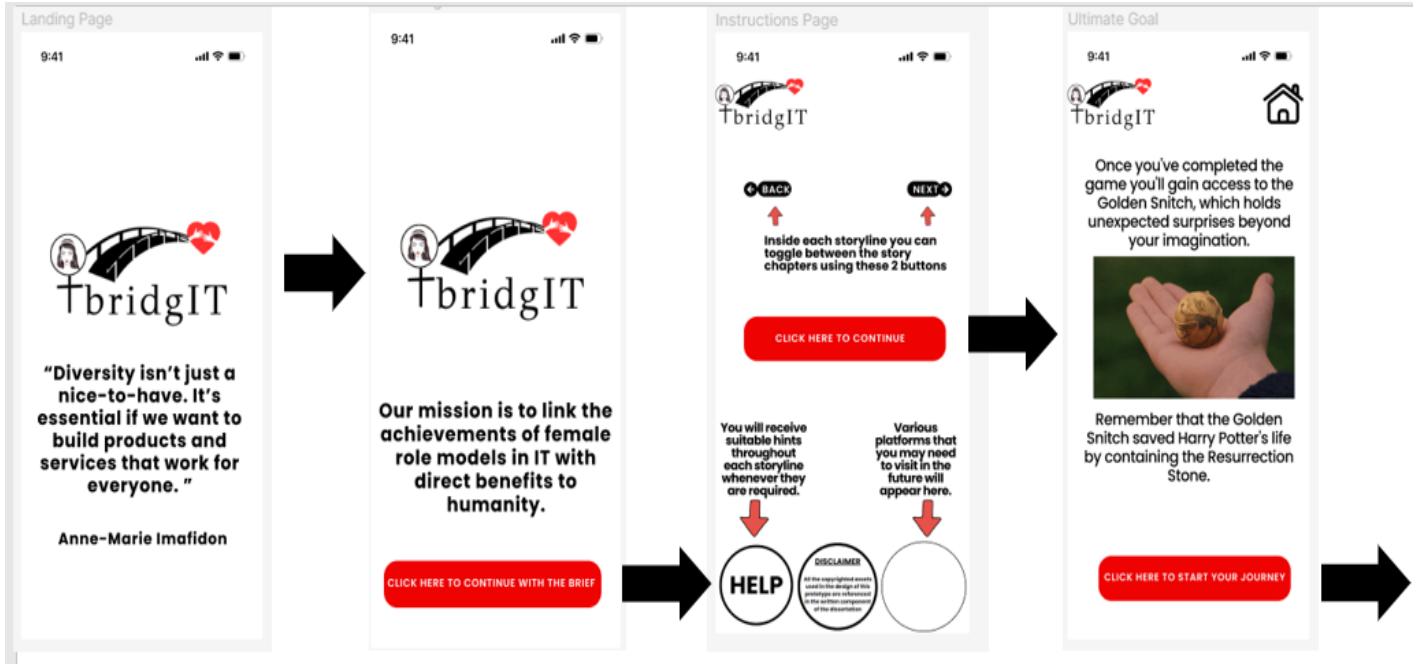
	<p>Stereotype Breakers. (2022). 5 Reasons to Learn How to Code for Non-Technical People. YouTube.</p> <p><a href="https://youtu.be/7nm7TNMg68Q?si=9Kt8l0pkh3gI_iwf">https://youtu.be/7nm7TNMg68Q?si=9Kt8l0pkh3gI_iwf</a></p>
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	<p>(n.d.). Poppy Gustafsson OBE. Darktrace. <a href="https://darktrace.com/people/poppy-gustafsson">https://darktrace.com/people/poppy-gustafsson</a></p>

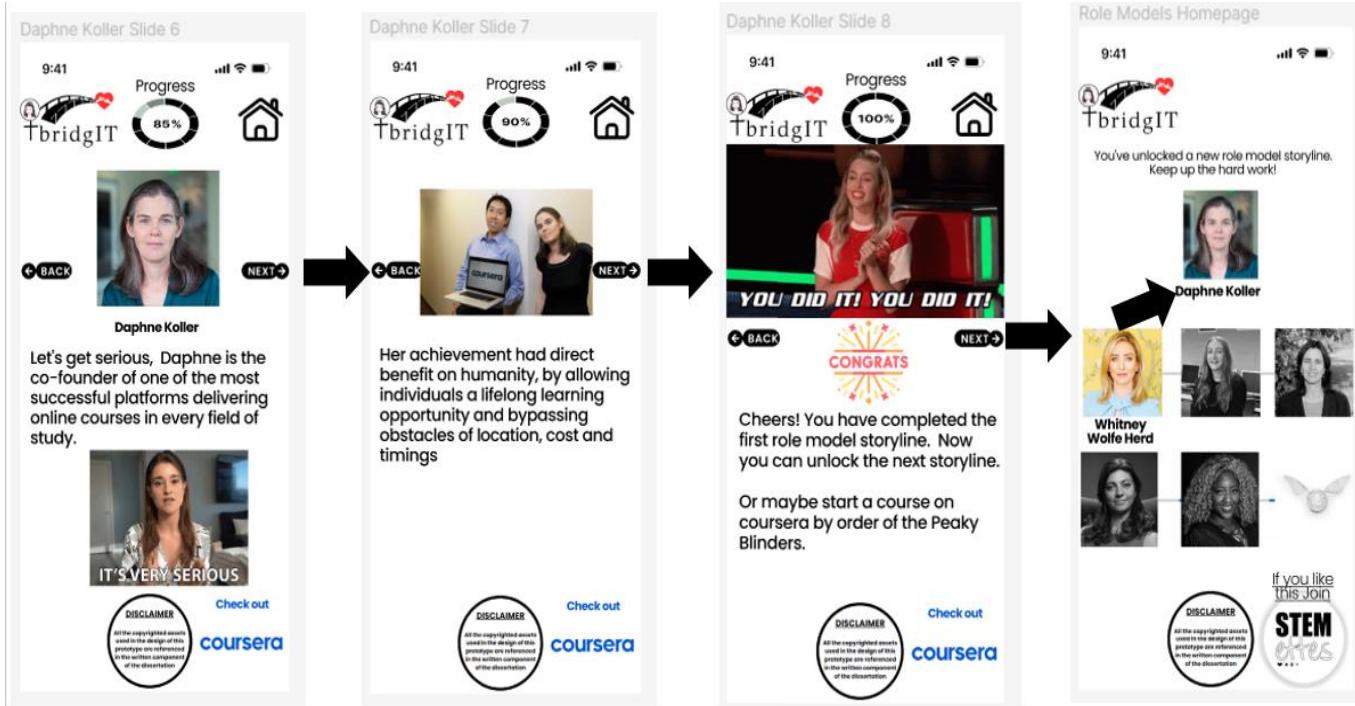
	<p>Baldwin, C. (2013). Computer Weekly UKtech50: Rising stars 2013. Computer weekly. <a href="https://www.computerweekly.com/photostory/2240210251/Computer-Weekly-UKTech50-Rising-stars-2013/8/Rising-Star-Kathryn-Parsons-co-founder-Decoded-code-in-a-day">https://www.computerweekly.com/photostory/2240210251/Computer-Weekly-UKTech50-Rising-stars-2013/8/Rising-Star-Kathryn-Parsons-co-founder-Decoded-code-in-a-day</a></p>
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	(n.d). Diane Greene Quotes. AZ Quotes. <a href="https://www.azquotes.com/author/50676-Diane_Greene">https://www.azquotes.com/author/50676-Diane_Greene</a>
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## Appendix J: Mini user journey

This is the user journey the user encounters starting from the launch of the app until the beginning of the storyline of the second female role model. Appendix A includes the complete user journey of the mobile app.





**Whitney Slide 1**

9:41 Progress 0%

**Whitney Wolfe Herd**

Our next role model is an American who did not study Computer Science.

However, she invaded the IT field through her understanding of user behaviors and needs, especially women.

**The references to the facts written about the role models mentioned in the app which were not including in the main context of the previous chapters or the main referencing list:**

Andonova, D. 2022. *Not a side issue': Teacher who helps young women get into code awarded honorary degree.* <https://www.pressandjournal.co.uk/fp/news/aberdeen-aberdeenshire/4545142/toni-scullion-honorary-rgu-graduation-honorary-stem/>

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Micali, S. (2012). *Shafi Goldwasser*. Alan Turing Award.

[https://amturing.acm.org/award\\_winners/goldwasser\\_8627889.cfm#:~:text=Her%20parents%20were%20Israeli%2C%20and,in%20physics%2C%20mathematics%20and%20literature.](https://amturing.acm.org/award_winners/goldwasser_8627889.cfm#:~:text=Her%20parents%20were%20Israeli%2C%20and,in%20physics%2C%20mathematics%20and%20literature.)

# Appendix K: Ethics application form

1

## Faculty of Science, Business & Enterprise Science & Engineering Research Ethics Committee

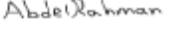
### Application for the Ethical Approval of a Proposed Research Project

Applicant name:	Abdelrahman Abdelwahab		
Department:	Computer Science		
Programme of study:	MSc Computer Science		
New application:	<input checked="" type="checkbox"/>	or	Resubmission: <input type="checkbox"/>
(Please place an X in the appropriate box)			
Title of project:	Exploring female under representation in IT, and some possible solutions.		
Application version number:	1.0		
Country/countries of research:	United Kingdom		
Date of application:	03/May/2023		
Expected end date of project:	05/October/2023		
Date of FSE-REC meeting to which application is being submitted:	14/June/2023		

I confirm that:

- The information in this application is, to the best of my knowledge, accurate and I take full responsibility for it;
- I will follow all of the University of Chester's Research Ethics guidelines as set down in the [Research Governance Handbook](#);
- If the research is approved, I undertake to adhere, without deviation, to the project as outlined in the application;
- I am aware of my responsibility to be up-to-date and compliant with the requirements of the law and relevant guidelines relating to data security. I understand that the Faculty of Science and Engineering requires that research data, both raw and final, are stored on a University of Chester networked drive, and agree to this stipulation;
- I understand that the University of Chester's [Research Governance Handbook](#) states that 'Researchers should be aware that data generated are the property of the University', and agree to this stipulation;
- I understand that personal data about me as a researcher and this application will be held by the Faculty of Science and Engineering Research Ethics Committee and that this will be managed according to the principles established in the [Data Protection Act 2018](#).

Name: Abdelrahman Abdelwahab

Signature: 

Date: 15/June/2023

1dda6c7eea93126b378d36d8c3299fd668e69aba4b61f7d953aa5015ef59ff86

- Please ensure that your academic supervisor/line manager has reviewed and agreed to support this proposal; they must sign this form to indicate they are happy for the proposal to be submitted. If you are resubmitting your application, your supervisor must review and sign the latest version.
- All relevant signatures must be obtained before submitting this application. Failure to have all the required signatures will result in your application being returned to you.
- Applicants should note that it is their responsibility to finish their proposal in sufficient time, particularly when working to tight deadlines. This includes allowing adequate time prior to submission for your supervisor/line manager to read the proposal, provide feedback, and review any amendments before agreeing to support the proposal and signing the application form.

**Approval from Academic Supervisor**

I confirm that the applicant has discussed their research proposal with me, and that I have read and agree to support this application.

Name: \_\_\_\_\_ Dr. Helen Southall \_\_\_\_\_



Signature: \_\_\_\_\_

Date: \_\_\_\_\_ 3/5/23 \_\_\_\_\_

**Approval from Line Manager (for staff applications or research being carried out in and/or on behalf of your place of work)**

I confirm that the applicant has discussed their research proposal with me. I understand the purpose of the research and am aware of all the implications (including time) that conducting this research may have. I agree that the research can take place and support this application.

Name: NA

Title: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**Faculty of Science and Engineering  
Research Ethics Committee**

**Applicant Documentation Checklist**

- This document MUST be completed and submitted as part of the application form. Please ensure ONE copy of each document, as detailed below, is uploaded as an appendix to this application form. ALL appendices MUST have dates and version numbers clearly marked.
- Templates for the Participant Information Sheet etc. can be found at <https://rec.fse.network/Home/Resources>
- Indicate 'yes/no' as applicable and continue your document list on a separate continuation sheet if necessary.

Document	Enclosed?	Appendix №	Version №	Date
FSE-REC application form	Mandatory	-		
List of references	Mandatory	1		
Brief C.V. for main researcher	Mandatory	2		
Letter(s) of invitation to participants	No			
Participant Information Sheet(s)	Yes	3		
Participant consent form(s)	Yes	4		
Information sheets/letters to other relevant people	No			
Written permission from relevant personnel or organisations	No			
Interview schedule(s)	No			
Questionnaire(s)	No			
Copies of advertising materials	No			
Risk Assessment form(s)	No			
Other documents (Please give details below)	No			

## Part 1: Introduction

<b>1. Title of research project</b>	
Exploring female under representation in IT, and some possible solutions.	
<b>2. Lead researcher (the applicant)</b>	
Name:	Abdelrahman Abdelwahab
Status: (e.g. MSc student; PhD student; staff; other)	MSc student
Contact email: (must be a University of Chester email address)	2225598@chester.ac.uk
Experience of/training in research methods:	-BSc undergraduate dissertation. -Completion of MSc Research Methods module.
<b>3. Other individuals who may work on the research project</b> <i>If there are more than two additional researchers, please note their details on a separate sheet and append to this application. A summary CV (max. 2 sides of A4) for each additional person must accompany this application.</i>	
Name:	NA
Status: (e.g. student; supervisor; researcher; statistician)	
Institution:	
Contact email address:	
Name:	
Status:	
Institution:	
Contact email address:	
<b>4. Academic supervision</b> <i>Postgraduate students (taught or research) of the University of Chester must state who will act as academic supervisor(s) for their project. Some projects may also be supervised by experts external to the University of Chester. External supervisors should also be listed, and a brief summary CV of their relevant qualifications, training and experience should be uploaded as an appendix to this application. You do not need to submit a CV for your University of Chester supervisor(s).</i>	
Primary supervisor (University of Chester):	Dr.Helen Southall
Additional supervisor(s) (University of Chester and/or External):	NA
<b>QUESTION 5. IS FOR BIOLOGICAL SCIENCES STAFF ONLY. ALL OTHER APPLICANTS SHOULD GO DIRECTLY TO QUESTION 6.</b>	

**5. Umbrella Applications**

If this research will involve University of Chester research students, please note these details below. The names of each additional researcher/student must be submitted to FSE-REC prior to their conducting any research activity.

Student name:	NA
Department:	
Contact email: (must be a University of Chester email address)	
Programme of study:	
Prog. leader (MSc/MRes) or Supervisor (MPhil/PhD):	

**6. Will you require additional ethical approval from another source? (for example: the NHS, a Local Authority, a collaborative partner, an authority in another country)**

NO (delete as appropriate)

If yes, you must provide written evidence of this approval as an appendix to your application.

The University expects all researchers to ensure that they are familiar with the ethical requirements of those countries in which they are knowingly recruiting participants (this includes online surveys, questionnaires, etc.) Applicants must contact a collaborator or academic in a local institution to clarify what the expectation is and find out whether that country would recognise and accept ethical approvals from the University of Chester. (If you require further information on this, please email [THORNTON-REC@chester.ac.uk](mailto:THORNTON-REC@chester.ac.uk))

**7. Confirmation of exclusivity**

Please tick this box	I confirm that this application has NOT been submitted for ethical review by any OTHER Research Ethics Committee
<input checked="" type="checkbox"/>	

**8. Working with public/private sector bodies (Doctoral Theses)**

All Doctoral theses are eventually published on the University of Chester electronic Repository and are thereby in the public domain (although theses can be embargoed for up to five years). If your research engages with any public or private sector bodies, such bodies must be made aware that this work will be published on the Repository.

Provide details below of any public/private sector bodies involved in your research, and tick the box to indicate that they have been made aware of the above :

N/A

## Part 2: The research

<p><b>1. Type of research proposed</b>            Please indicate whether the proposed research is:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">Quantitative</td> <td style="text-align: center;">Qualitative</td> <td style="text-align: center;"><input checked="" type="checkbox"/> Both</td> </tr> </table>			Quantitative	Qualitative	<input checked="" type="checkbox"/> Both
Quantitative	Qualitative	<input checked="" type="checkbox"/> Both			
<p><b>2. Outline of the research</b>            Please provide a brief outline of the proposed research under the sub-headings below.</p>					
<p>i. Aims and objectives (<i>What is the research question your project aims to answer and what objectives have you established to be able to achieve that answer?</i>)</p> <p>The research aim here is to create a prototype mobile application to encourage under-represented groups to consider IT as a career. Topics will include stories of inspiring female role models (e.g., Annie-Marie Imafidon, Daphne Koller and Shafi Goldwasser). Objectives will include designing a prototype using accepted user experience (UX) and user centred design methods and testing with the appropriate number of testers. Conclusions from the testing will allow recommendations to be made for improving the proposed mobile application.</p>					
<p>ii. Rationale, to include a <i>brief synopsis of the background to the research (maximum 300 words)</i></p> <p>There is a gender gap in the field of IT, and one of the reasons is that females desire careers which have an impact on society and considered to be meaningful (Layman et al., 2007). For instance, according to Imafidon (2022) under representation of women in IT would lead to a digital world tailored to only one gender, this was mentioned in her recent book in which she addressed this issue in the UK. The chair council for higher education in Israel has published a plan to decrease the gender gap in technological careers, and according to the Planning and Budgeting Council in Israel (2019), the plan was successful, and the gap will continue to decrease in the future. Additionally, as mentioned by Cheryan et al. (2022), in the US, women are represented in IT undergraduate degrees by only twenty percent.</p> <p>Therefore, for this research a prototype application will be designed to encourage females to consider IT as a career and the prototype will be tested using user-centered design methods. However, according to Knapp (2016), it is unwise to assume what are the possible impressions of users after using a new service and that is why users should be involved, and UX and user-centred approaches should be implemented. UX could be described as the user psychological impressions during the use of an application (Voil, 2020). While user-centred design gives the priority for user needs to ensure that the product will be usable, this could be ensured by user testing and observing how the user interacts with the application (Voil, 2020). For instance, abandonment of the mobile application should be taken into considerations because as mentioned by Al-Shamileh et al. (2023), difficulties in using and understanding the user interface of a mobile application is a cause of abandonment.</p>					

iii. Project design

- a) What does the project involve and how will data be collected and analysed? (*Explain clearly exactly what the project will do. If the project involves human participants or animal subjects it should be clear exactly what will happen to the research participant/animal subjects during the project. Please ensure this section is completed in language clear to someone from outside your subject area.*)
- b) For this project, a high-fidelity prototype mobile application will be produced, and it will be designed and tested using user centred design principles. For instance, a high-fidelity prototype allows for realistic user interaction without including all the programming and back-end infrastructure that would be required for the final version of the application. The prototype application will be produced taking in to account the results of the literature review information. This prototype will then be tested using standard user centred design testing methods by observing how participants react while using the prototype.

For the testing, the participants will be invited to complete some tasks on the prototype mobile application. For example, accessing some features on the application, signing in and signing out. The participant will be made aware before being accepted that the testing will take around 30 minutes, and that it will be recorded to analyse their behaviours and interactions with the application. Additionally, once the number of participants is confirmed, the time slots will be sent to the participants. The participants consent will be signed, and their privacy and confidentiality will be secured.

The respondents will be asked after the test if they have experienced any difficulties in using the prototype, if this prototype content have motivated them to consider or encourage others to join the IT sector, and what they think would improve this prototype.

**ONLY ANSWER QUESTIONS b), c) and d) IF YOU ARE USING HUMAN PARTICIPANTS.**

- c) If you are using human participants, who will they be and how will they be recruited? (*If permission is required to recruit the participants, for example if they are employees of a particular organisation, you must upload a copy of the written permission as an appendix to your application. You must also state whether you have any personal or professional relationship with the participants.*)

The selected participants will be females who are currently studying a bachelor's or master's non-computer science degrees. The sample may also include females who have graduated and do not hold a computer science degree. The participants will be recruited from among students or graduates of the University of Chester. For instance, recruitment invitations and participant information sheet will be sent out via faculty administrators and the University of Chester Students Union representatives, then five suitable testers will be selected from the respondent list.

- d) How many participants will be used? How is this number justified?  
 The project will aim to invite five participants to use the mobile application prototype that is being designed. The project is based on the industry-standard practices, and according to Nielsen (2000) and Knapp (2016), five participants are the minimum number required for reliable data in UX research. Additionally, as mentioned by Nielsen (2000), five participants is sufficient to identify any usability issues and to collect valuable feedbacks. Furthermore, as described by Nielsen (2000), repeated outcomes will be more frequent by increasing the number of participants beyond five. Accordingly,

usability testing is suggested to be conducted using small number of participants which enable the application developer to utilise the feedbacks in a quick and efficient manner.

- e) Is there anyone who should not be recruited? (Are there exclusion criteria? Why? How will this be managed? Are there any abstention criteria, for example, participants should not have drunk alcohol before taking part?)

This study is only open to females and people who identify themselves as females

**QUESTIONS e) to h) ARE FOR BIOLOGICAL SCIENCES APPLICANTS ONLY. ALL OTHER APPLICANTS SHOULD GO DIRECTLY TO QUESTION iv.**

- f) If you are using animal subjects, what will they be and how will they be sourced and examined?

NA

- g) How many animal subjects will be used? How is this number justified?

- h) Does the research involve the use of donated human tissue or other materials that are subject to regulation under the Human Tissue Act 2004, if so, what licenses/provisions are in place?

- i) Does the research involve animal species or land/environments that are protected under other regulatory/legal requirement, e.g. CITES or the Animal Welfare Act 2006? If so, what licences/provisions are in place?

- iv. Where will the proposed research take place? (If this is via social media, you must read the University's guidelines at: <https://portal1.chester.ac.uk/rkto/pages/rge-imrpad.aspx>. If this is on a University of Chester campus or at an external location, you must make sure that the relevant permissions are in place for you to use any rooms or equipment, and that you have completed a Risk Assessment, if required.)

The user testing will be done in-person at the university, if possible, but if that is not possible it will be done online using Teams or Zoom.

**3. Ethical issues**

- i. What are the ethical issues associated with your research – including the possibility of causing harm or distress to the research participants and/or animal subjects, the researchers involved, and the environment?

<p>Some participants may feel distress because they might feel that they have missed out in the past.</p> <p>Captured data will be stored in adherence with the Data Protection Act.</p>		
<p>ii. How are the ethical issues outlined above going to be managed / mitigated against?</p> <p>Participants will not have to continue if they do not want to, and information will be given about sources of wellbeing and career help.</p>		
<p>iii. Are there any potential benefits to participants, or to society as a whole?</p> <p>The participants contribution could help in achieving equality in the digital world and reduce the possibility of having a digital world tailored only for one gender. The participants may also encounter information that they may find beneficial about careers that they have not previously considered.</p>		
<p>iv. Does the research involve any deception (for example, not explaining the exact nature of the research to participants)? If so, how is this justified?</p> <p>The research does not contain any deception.</p>		
<p><b>4. Informed consent</b></p> <p>i. Will informed consent be obtained from the research participants (human participants / animal owners or carers)?</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 15%;">YES</td> <td style="text-align: center;">(delete as appropriate)</td> </tr> </table> <p>If 'YES', please give details of who will obtain consent and how this will be done, including how long participants will have to decide whether or not to take part. If 'NO', please explain why not.</p> <p>Participants will be given the participant information sheet to read through before the start of testing. The participants can then decide if they want to continue. If they do, they will sign the consent form.</p>	YES	(delete as appropriate)
YES	(delete as appropriate)	
<p>ii. Do you confirm that research participants/animal owners or carers will be made aware that they are asked to explicitly give their consent for the data to be retained and published in an anonymised form? By agreeing to participate in the study, they are also consenting to the retention and publication of the data.</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center; width: 15%;">YES</td> <td style="text-align: center;">(delete as appropriate)</td> </tr> </table>	YES	(delete as appropriate)
YES	(delete as appropriate)	
<p>iii. Please state what measures will be taken to ensure that human participants/animal owners or carers are able to withdraw from the research without explanation and without fear of reprisal should they so wish. (You must also state if there is a time limit for withdrawal, and explain what will happen to any partially collected data.)</p> <p>Participants will be informed of their ability to withdraw from the research at any point without a reason required. This notice will be included in the participant information form that they must read before giving consent, participants can leave before or after consent has been given. Any partial data will be deleted.</p>		

- iv. How will participants who may not adequately understand verbal explanations or written information given in English be enabled to consent?

This will be avoided by choosing only English speaker participants.

**5. Vulnerable groups**

- i. Are you intentionally recruiting participants from any of the following groups? (Please tick any that apply)

Adolescents/Children under 18	NA
Pregnant women	NA
People over the age of 70	NA
People suffering from a diagnosed mental health disorder	NA
Adults with learning disabilities	NA
Prisoners/Young offenders	NA
Other vulnerable groups	NA

- ii. If you have ticked any of these, please explain why it is necessary to conduct research involving such participants, and whether the required data could be obtained by any other means. (If you have not ticked any of these, please go to Part 3.)

NA

- iii. Please state what special or additional arrangements, if any, will be applied, particularly in relation to Participant Information Sheets and gaining informed consent, to safeguard the interests of such participants.

NA

- iv. Please state whether, and if so, how participation in the proposed research may/will be of personal benefit to individual participants.

NA

- v. Disclosure statement: If you are working with vulnerable adults or minors (under the age of 18 years old), please state whether or not you have received a disclosure statement from the Disclosure and Barring Service [or equivalent, in the case of research not conducted in England, Wales or Northern Ireland]. (If you have a disclosure statement, please upload it as an appendix to your application.)

NA

**Part 3: Financial and other arrangements**

1.	Please state whether there are any financial or other interests (including any conflicts of interest) that you, your Department, supervisor(s) or employer has in relation to the conduct of this research. (If none, please state 'NONE').
NONE	
2.	Please state the amount of payment, if any, that will be paid to you or any co-researcher or supervisor [over and above their normal salary]. (If none, please state 'NONE').
NONE	
3.	Please state the amount of payment, if any, that will be paid to any human participant/animal owner or care involved in the research? (If none, please state 'NONE').
NONE	
4.	Will additional costs will be incurred by the University of Chester through the conduct of the research, and how are these to be met? Please state the details of any funding which has been secured for the research. (If none, please state 'NONE').
NONE	
5.	What arrangements are in place for monitoring the conduct of the research, and dealing with any issues, complaints or adverse effects which may arise from the research? <i>The research will be supervised by Dr Helen Southall. If there are any complaints or concerns which need to be raised about any aspect of the way the research has been carried out, they should contact Dr Kurt Allman, Dean of the Faculty of Science, Business &amp; Enterprise, University of Chester. <a href="mailto:k.allman@chester.ac.uk">k.allman@chester.ac.uk</a></i>