CM3203 Final Report

One Semester Individual Project

[42]

Author: Cassie Magee
Student Number: C1642647
Project Supervisor: Dr Matthew J W Morgan
Project Moderator: Dr Padraig Corcoran

Abstract

While the technology industry grows rapidly, the number of females working in computing does not. This project aims to explore the reasons why women do not study IT and build a system to tackle what I believe is one of the main causes. The goal of the project is to provide an online platform that can be used as a tool to test the user's abilities against the core skill that is required for the role of a computer scientist. As a result, a technical minimum viable product was completed where the user can submit their answers in a form and receive their results. The project also includes an interactive facts and figures page outlining interesting information about this topic.

Acknowledgements

I would like to thank my supervisor, Dr Matthew J W Morgan for his support throughout my project, without it I couldn't have produced a project that investigates a topic that I truly believe is relevant and requires action. Also, for his guidance and being able to keep me on track when I strayed down different routes.

I would also like to thank my friends and family who have taken the time to proofread my work, I appreciate this more than you know.

Table of Contents

Table of Figures

Introduction

Paper Topic

Broadly, the topic of this paper is women in IT. The background of this topic is so vast and ranges from Ada Lovelace being one of the biggest names for females in IT, to the work that females underwent during the second world war. Females in IT have been intentionally left out of world renowned findings for hundreds of years, yet without females in IT the historical moments like the Moon Landing would never have happened [42].

More specific, the topic of this paper is encouraging females to think about STEM careers by increasing their confidence in the skills that are found in professionals in this industry. I have explored previous research into this topic and picked out the most common reasons why females are dissuaded or choose not to study STEM subjects.

Motivation for the Project

The motivation for writing this report is because the important issues surrounding women's inclusion in science and technology have persisted for centuries and remain an issue today. By raising them I am answering what I believe, as a female in IT are the main deterrents for not entering the industry and I am offering my insight into this topic.

At the White House Science Fair in 2014, Barack Obama used a sports metaphor; 'half our team we're not even putting on the field' to describe the lack of females in the IT industry [13]. I am writing this paper because despite the global awareness of the gender difference and the attempts to change it, the numbers aren't equal.

The potential benefits of an increase in females into the IT industry are profitable for both companies and females. Some benefits include:

Growth in the economy, as women make up half the world's working-age population, they're failing to meet their economic potential by not working in higher paid jobs like the IT industry offers and as a result the global economy suffers. [10]

Improvement in social inclusion, the co-founder of 'Huggle' believes that if there were more women leading tech companies then it would change how women are treated in society [11]. IT professions are the highest paid in the world [12], increasing females in this industry would contribute to increasing female empowerment as women would be exercising their opportunity to benefit from the resources that come with working in a high paid job.

Issues I wanted to solve

The overall issue that I wanted to solve was a lack of females in IT. Obviously, this is a large statement for anyone to make so I began to break it down. As I myself am a female in IT, I have experienced low numbers of females in this industry first-hand and wanted to research ways that have been tackled previously.

By being a female in IT, I have made decisions that go against the societal norm [46] to choose IT based subjects at GCSE and A-Level that have led me onto choosing 'Computer Science' for my degree. Therefore, I had a personal understanding of why females choose this career path and I am interested to see the main reasons why other females are dissuaded from this path.

My personal connection to this topic piques an interest in solving this issue because I have not worked with any female developers while in industry, I have not met any female role models and have longed for inspiration from a female mentor. I want to change this for future females entering the industry.

Previous insights into why number of females in IT are low

Stereotypes Threats on Performance

Shapiro and Williams conducted a study where one group of males and females were introduced to a stereotype threat that males were more talented and successful in math and science and another group of males and females that were not confronted with this stereotype.

In almost all cases, the group that were introduced to the stereotype had females achieve the worst results for maths and they lost interest in the task [22]. This is why it's important that there are resources available for schools to ensure that even if they are exposed to this stereotype that their confidence and self-belief can be built up enough that they're encouraged to choose an IT career path.

The stereotype threat can cause two results: the females hearing it could internalise it and begin to believe that it's true, which causes a loss in their self-confidence. Or the females hearing it could choose not to identify with the stereotype and not be affected by it directly, but it could affect the perception of the task. Meaning that although in the second case the female hasn't lost self-confidence to engage in the task, they will feel pressure to do well in the task and this results in impaired performance, making the female believe that she doesn't have the ability to complete the task.

For this research, the overall reason for females not choosing IT is due to lack of self-confidence.

Engaging Females in STEM

This paper denotes that there is no evidence to support that gender has a role in the ability to have STEM competencies or skills. An important note taken from this paper is females are discouraged from participating in STEM due to their own negative perceptions of their abilities and that this could be the ultimate factor in deciding whether they pursue a career in stem or not[15].

Additionally, 'Engaging Females in STEM' mentions how teachers have a crucial role in changing these perceptions. This is why it's pivotal to encourage females from a young age and why aiming applications at school will be the determining change.

When undertaking these studies, the paper has outlined that when students are aware of what is being measured and what the purpose of the test is then they're inclined to think and feel a certain way that will align with expectations. This insight made me think about the wording on my form and not revealing the purpose of the 'Self-assessment' form until the results.

Women In Tech Survey

This survey asked 1000 women who work in the technology industry 20 questions regarding why women were put off entering the industry.

From the data seen in Figure 1, they found that the top reason was 'Fewer opportunities for senior roles/ promotion', followed by 'Male domination' and 'Perceptions'.[2]
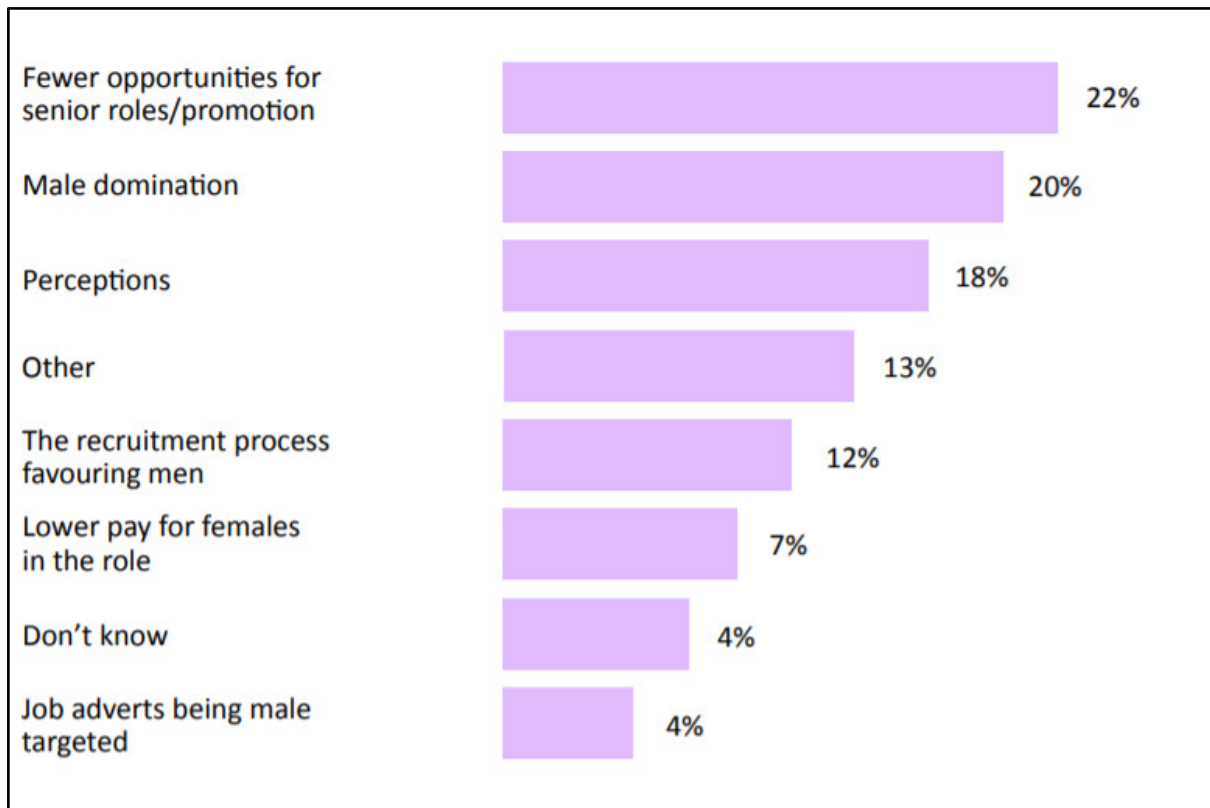
Figure 1: Why Women are put off? From Women In Tech Survey

It's important to note the survey found that 31% of the respondents believed that gender imbalance in the tech industry can be solved through schools, as this is where the ideology that 'IT is for men' can be changed.

In effect, I targeted my examples on the website towards everyday life so that females of all ages could relate to the skills. For example, females ages 14-18, who are choosing or undertaking GCSEs and A-Levels can make the decision for subject choices in time to consider IT as an option.

Office for National Statistics

The office for national statistics explored the gender gaps by occupation. Their data in figure 2, showed that that only 12% of women contributed to 'Programmers and software development professionals' occupation.
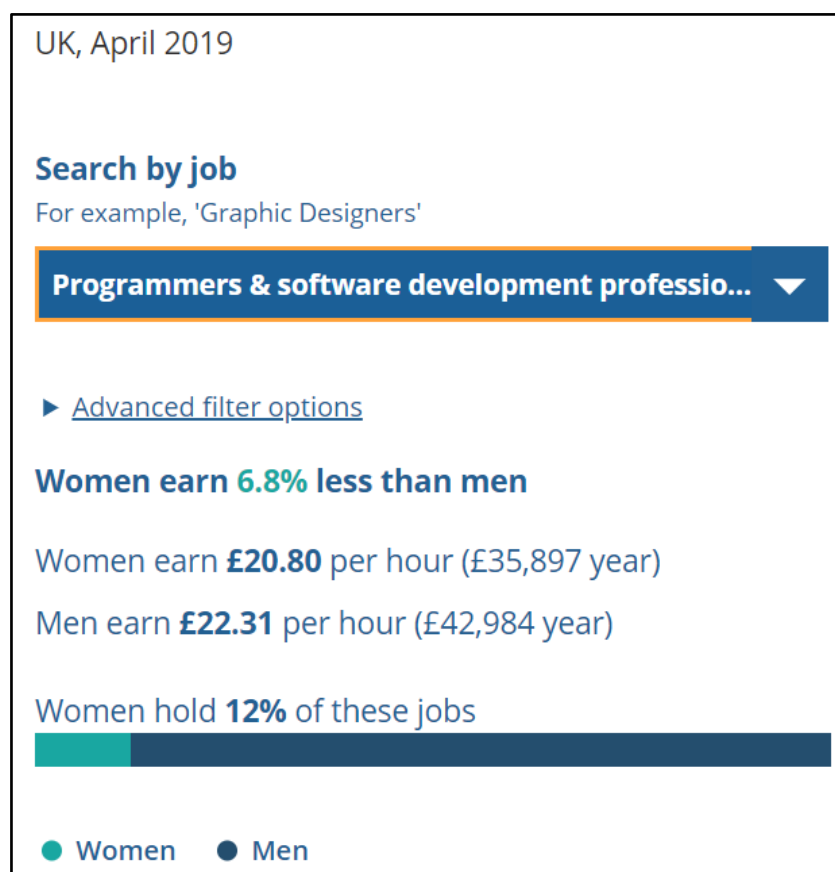
Figure 2: *Gender gap for 'Programmers and software development professionals'. Office for National Statistics*

These recent figures demonstrate how low the numbers of females in IT are. On the other hand, they also show the average salary in the industry and show how this occupation has one of the lower pay gaps at 6.8%. This could be used to persuade females that the IT industry has a low pay gap compared to jobs such as 'Carpenter' and 'Joiner' that have a pay gap of 44%. This statistic can be used as a positive example for females to choose IT and represent the kind of statistics that I wanted to display on the 'Statistics Page'. [1]

UCAS

UCAS is the admission service for universities and colleges in the UK. Their data in figure 3, shows the number of applicants for subjects based on gender.
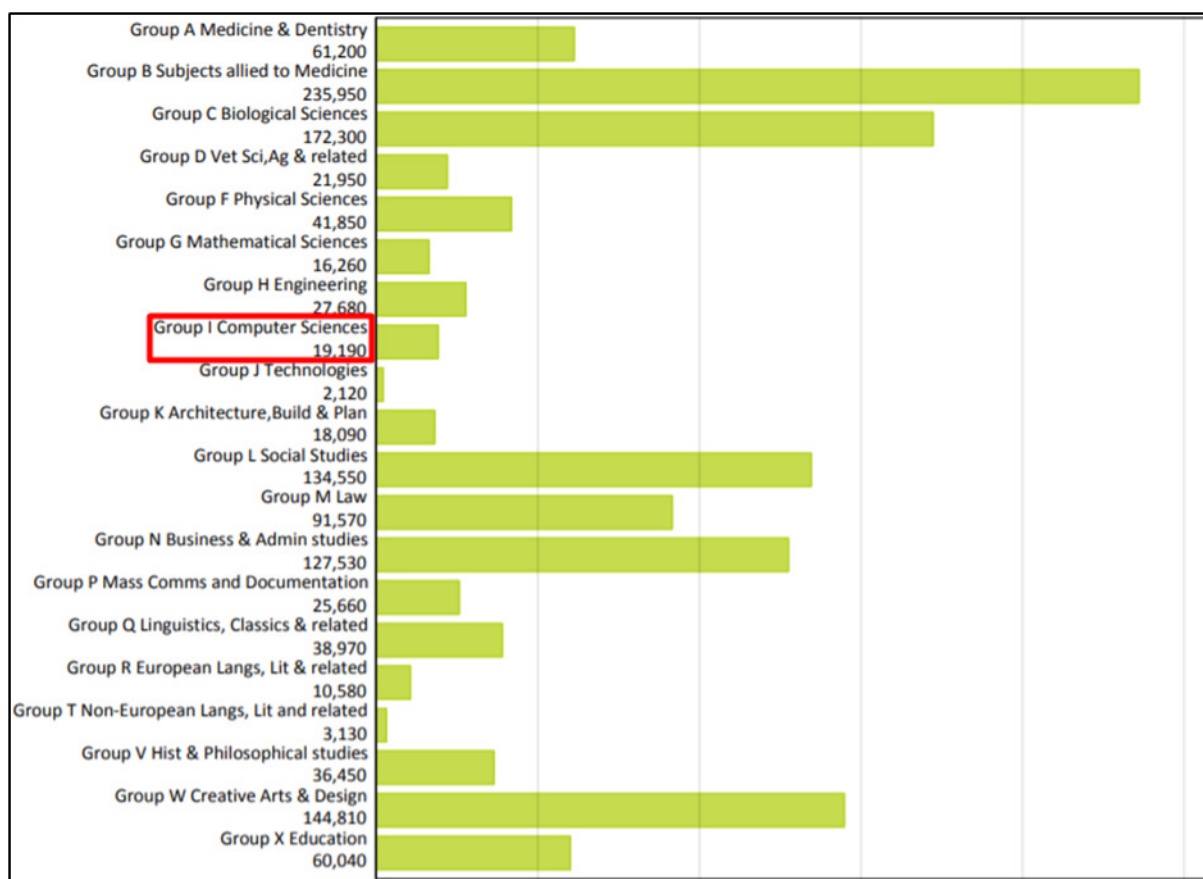
Figure 3: Number of women per subject across UK universities.

This data shows that in 2019, 19,190 females applied for 'Computer Science'. From this figure you can see that although it is not the lowest subject, it is proportionally low in comparison to other higher paid salary subjects like 'Medicine' or 'Biological Sciences'. [3]

From the figure you can also see that 'Computer Sciences' and 'Technologies' are two of the lowest subject choices for females, noticeably these two subjects are STEM subjects.
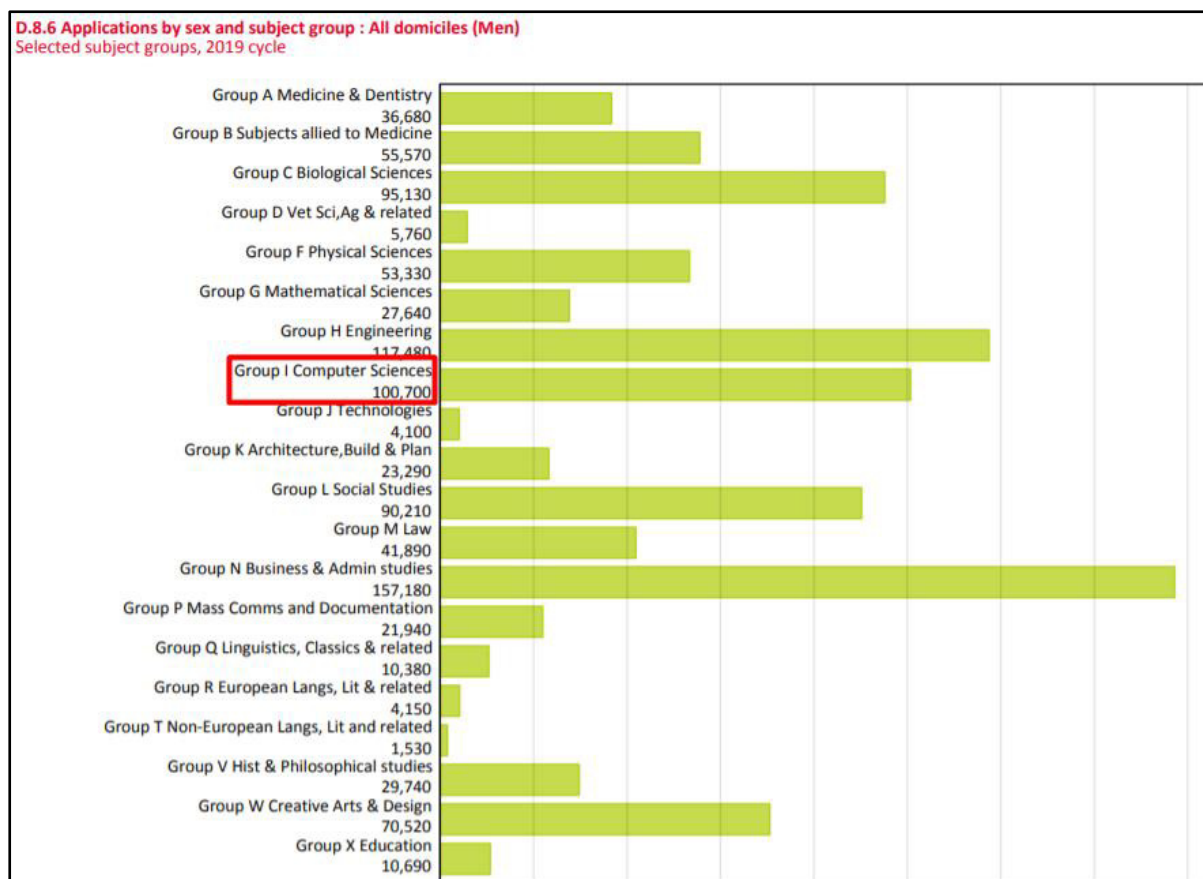
Figure 4: Number of men per subject across UK universities.

A significant comparison can be made between the male and females for 'Computer Science', as 100,700 applicants were recorded for males versus 19,190 for females shown in figure 4. This is a notable difference for evidence that more males study 'Computer Science' than females.

From all students that have chosen to study 'Computer Science' in the UK, females equate to 16% of the number, this number is similar to the figure of 12% of females who hold programmer jobs according to the Office for National Statistics. Which implies that logical remark that if less females are choosing to study 'Computer Science' at university then there will be less females working software facing jobs in industry.
This figure motivates me to find the cause of the problem and proves that 'male domination' could be the reason behind this as the difference is so notable.

Higher Education Statistics Agency

HESA have outlined the total percentages of females studying 'Computer Science' through the UK. The highest percent is Northern Ireland at 23.6%, followed by Scotland with 21%, then England with 17.6% and finally Wales with 16.1%. [4]

The range between the countries is 7.5% which isn't that high, suggesting that it's not an issue affected by region. This might be due to a number of reasons, perhaps Northern Ireland are making more of an effort towards encouraging females in IT.

One outlook may be that Northern Ireland has 13 all girl schools [18], Scotland has 8 [20], Wales has 7 [19] and England has 377 [21]. On first glance you may think that England has the most all female schools, however if you take the population into consideration then Northern Ireland has relatively more single gender schools than anywhere in the UK [17].

Northern Ireland having all female schools might contribute to this country having the highest percentage of females studying 'Computer Science'. Simply because without the presence of males you are removing the opportunity for 'Male Domination', as mentioned above this was the top reason for not studying in the field.

PwC

'Women in Technology' was a study conducted on 2174 students across the UK on university and pre-university students. The top five reasons for females not choosing STEM subjects were found to be
- Getting better grades in more essay-based subjects
- Lack of interest in STEM subjects
- STEM irrelevant to their career path
- STEM subjects made uninteresting by teachers
- The pressure to achieve the highest grade possible

In addition to these reasons, PwC found that females are less likely to choose a career path in the STEM industry because it's too 'Male-dominated'. This can be compared to the Women In Tech Survey who found 'Male-domination' was the second highest reason for females being put off. [5]

The first reason for not choosing stem because females get better grades in essay based subjects may be due to females believing that they should be better at these subjects compared to STEM subjects because of stereotypes, this self-doubt is linked to females doubting their abilities and having low confidence. [22]

The PwC report found that 33% of males had STEM careers suggested to them compared to 16% of females. Only 16% of males felt they have not learned about a career in STEM, whereas 35% of females have said this.

This suggests that males are encouraged towards STEM subjects more than females, and aids in the theory that the perception of females not choosing STEM subjects begins at school. Therefore, by creating an application that would attempt to increase the confidence of females, it would work two-fold if the application was used in schools. The application would act as a tool that teachers could use in a workshop setting where the females could use school computers or laptops to fill out the self-assessment form.

In essence; if the application was taken further for future work it would provide a resource for schools to encourage females towards STEM.

PwC also has a 'Tech She Can Charter' which is a commitment for companies to work together in hope that they can increase the number of females working in STEM roles throughout the UK. 'Tech She Can' aims to inspire young girls and women to enter the STEM industry. PwC believes that technology is a part of everything in our lives and by tackling this at a societal level they will make sure that females will be part of those who are creating technology for the future.[14]

This is an important commitment which shows that tech companies are playing their part and working to keep females in the industry. For females who have already chosen to pursue a career in IT or have already chosen to study IT at further education it's vital that companies are continuing incentives for females to remain in these professions and they can become role models for younger generations to come.

It also shows that females' self-confidence should still be built up even after females have received their qualifications and are employed as it would be a shame for the numbers of

females to drop later in their careers after working so hard to encourage them towards this career path. This is something that I have considered when trying to write examples relevant to everyday life.

British Computer Society Women

BCS Women is a specialist group in the British Computer Society whose main objective is to provide support for female IT professionals and encourage females to enter IT for their career [24].

This group was created by Sue Black who experienced a setting where she was one of few women at a conference, she felt very isolated and discouraged until she found herself talking to the other few women at the conference. This was her motivation to create a platform and support group for other women who might be experiencing something similar to what she did.

The foundation of the BCS Women came from a setting where there was a female who felt incompetent and uncomfortable in a male dominated environment. It's important to see how an online application can be used to set up meetings and events for those involved and how this supports females in IT.

This society made me want to create a space where females can be motivated from their belief in themselves and their abilities, while creating a potential platform to be built up for future work.

WISE Campaign

WISE is a campaign for gender balance in STEM from the classroom to the boardroom. They offer an array of resources from organising events to setting targets like getting 1 million females involved in STEM occupations by 2020 [25].

An interesting aspect of their campaign that stands out amongst the rest is their 'Role Model Registration'; this is where you sign up to be a role model in your area and can become involved in training schemes in schools or you can build up a portfolio to be used as an example in the training days. There is also an option for role models to attend sessions across the UK and build up the training to lead the sessions.

Using this online platform to provide real life examples of role models for students across the UK is an innovative way to tackle one of the issues that puts females off choosing IT as their career path.

This campaign is something that I felt tackled a problem that I didn't consider when building my application but highlights how there are many routes for female encouragement.

Institute For Fiscal Studies

In 2018 the 'Institute for Fiscal Studies' investigated 'How can we increase girls' uptake of maths and physics A-level?' It was found that '92% agree or strongly agree that working in a STEM job would enable me to make a good living'.

The same study found that 67% of females agreed or strongly agreed that STEM jobs are male dominated. Within the focus groups of the study it was found that the participants often discussed that male dominance and boys' behaviour in the classroom were reasons for not pursuing STEM subjects at A-level or university. [6]

This study highlights how females are aware of the benefits of the IT industry, which suggests there is another reason why females don't choose IT for their career path.

Purpose of this research

The purpose of the research was to encourage females that the skills to be a computer scientist are universal. My aspirations for this research was to explore previous research into the root of why females don't choose STEM subjects and how to tackle it. My ambition was to learn from the mistakes of previous research and rectify them in what I believed would tackle the solution. Through my rectification I intended to reassure females that they were capable of entering the STEM industry.

The significance and justification of the research

The significance of this research is that most people actually believe females don't study IT for reasons such as they're not aware of the benefits associated with this industry but many studies show this isn't the case [2] [14] [6].

So I wanted to build something that was going to allow females to change their minds about themselves and their abilities rather than the industry. Realistically the number of males in the industry isn't going to drop suddenly, so coming at this from another angle I decided I would build something to show females that they are capable.

The limitations to the project

The first limitation to this project was my lack of knowledge. After having worked in industry, I felt that I had learned enough to be able to create a website from scratch and use software that I had no experience in. I was naive to believe that I was able to do this without watching tutorials and researching the best methods for setting up the architecture.

I was also naive to believe that I would be able to commit all my time to the project and work on it every day, like I had previously stated in my original plan. Realistically, other assignments combined with everyday life lead me to work on it significantly less than I had intended.

Due to the current climate, Covid-19 meant that I had to move home during the peak of what I had planned to be my implementation, which caused another set back in my project.

As a result of this, other coursework and assignments that were due to be finished were pushed back to overlap with my implementation time which was not originally planned.

Background

Women's introduction to the Computing World

The etymology of the word computer is 'one who calculates' from the 1640s. 'Computer' was an occupation that was given to women during World War II when mathematicians were needed but men were unavailable and women were perfect for mundane calculation work.

Women were the drive for the computing industry from the second world war to the sixties, performing military logistics, ballistic calculations, and cracking codes on room-sized electromechanical computers.

In the seventies, the workforce began to realise how powerful computers were, this is when men were introduced to the field to take over the computing roles, where they were paid more and had better job titles.

Often society tries to persuade females to join the IT industry, but often what isn't known is that females were equally part of the foundation. This is something that I wanted to include in my projects facts and figures as I believe that it isn't common knowledge and grabs the attention of females who might have an interest in history as well as IT.

Self-Concept

Stereotypes about STEM professions and subjects being 'male' dominated are commonly believed by many females in the Western world and these stereotypes are being applied to how confident they are in their abilities.

Females are susceptible to stereotypes having negative effects on their learning and act as blockages for females reaching their full potential [22]. Stereotypes are often unavoidable and although there are positive stereotypes that are associated with the IT industry such as a high salary and intelligence, the negative ones lower females' self-esteem and sense of competence. Negatives for the IT industry with young girls include being a 'nerd' or a 'geek' [23], often friendless and these stereotypes can stick with impressionable girls.

This is why I have tried to highlight the positive stereotypes through the 'Statistic Page' of my application and tackle the issue of self-confidence that negative stereotypes bring through the self-assessment form.

Approach

How has my approach changed from my original plan and why?

I initially stated that I wanted to change the misconceptions about females in IT and I was going to do this through statistics that I believed to be shocking. I soon realised that using facts to convince people that the numbers of females in IT were so low wasn't going to bring more of them to the field.

After discussing this at review meetings with my supervisor mentioned in the initial plan, I started to focus on the females themselves and I asked myself what is the main reason why females either don't choose IT or predominantly choose other subjects.

From the research, I found three common reasons why females don't choose IT:

- Male domination
- Lack of confidence/ ability
- Lack of role model

My thought process was that I realistically can't do anything directly about the first reason, so I moved onto the second.

Implementation

Initial steps taken to build the application.

I wanted to build a web application for my final project because I was familiar with the technologies from my placement year. In my placement year I was using Visual studio 2017 and Umbraco 7, therefore I wanted to upgrade these technologies to the latest releases, so I was in familiar settings yet still challenging myself.

Having recently become an Umbraco Certified Developer, I wanted to use Umbraco 8 to be the foundation of my project.

In my initial plan I said that I was going to use Azure DevOps to manage the project, see figure 5. This was also because of my experience in industry. I considered just committing my code to GitHub but I had used the sprint boards feature before and thought that they would help me adhere to the plan of the project.
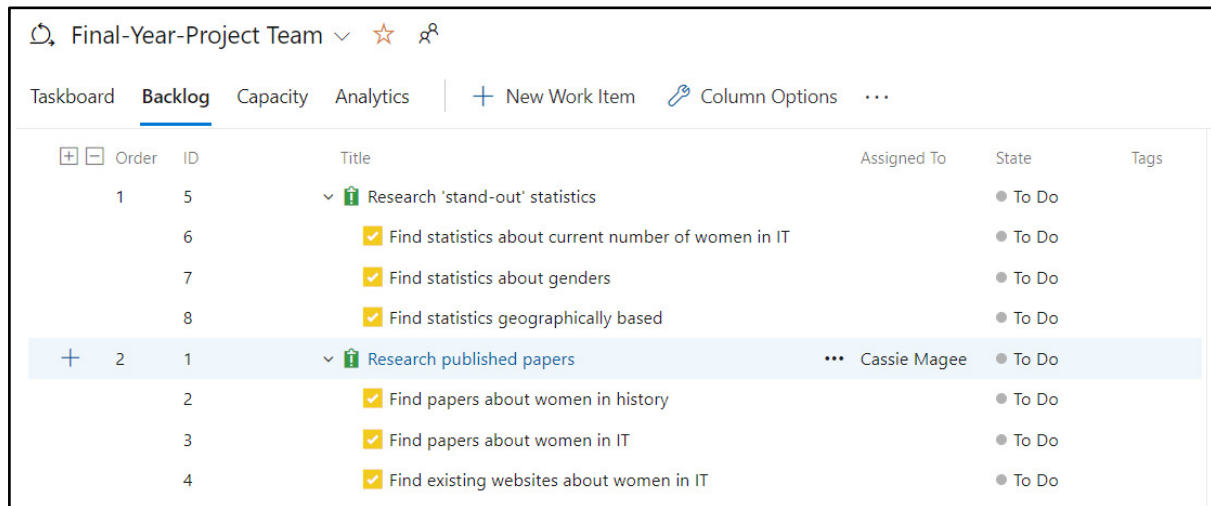
Figure 5: Sprint board layout of Sprint 1.

In theory it would have been a good idea if I stuck to it, but my experience using it was more focused towards team development and I didn't adhere to it for my individual development. In essence, the setup of sprint boards and the overall work plan would have been easier if I was using the waterfall method, but I worked in an agile approach.

I decided to use an agile approach because of the nature of the project. This was a solo project that I have little experience in and having a step by step plan isn't realistically going to work when I was learning 'on-the-go' for most of the development.

As Umbraco 8 was released in the beginning of 2019, I had no experience using it in industry and as I wasn't familiar with setting up an environment I challenged myself to set up this for my own project. To install Umbraco 8 I used the 'Package Manager Console', see figure 6. I installed the package this way because after reading a few forums before I started development, this was the recommended approach [40].
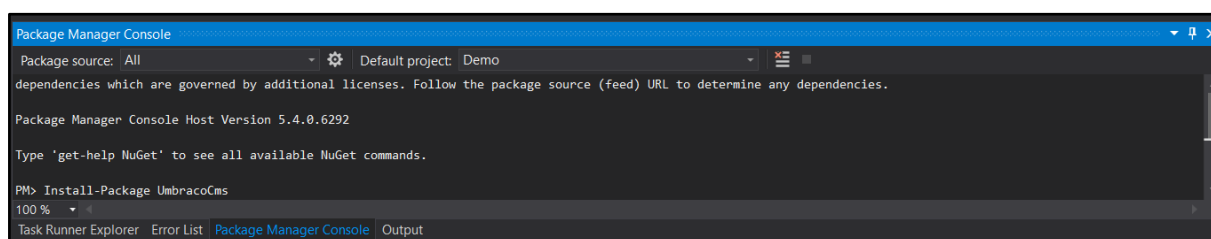
Figure 6: Installing of Umbraco 8 through Package Manager Console

After writing 'Install-Package UmbracoCms' into the Package Manager Console of Visual Studio, I was certain that Umbraco was successfully installed when I saw the ASCII text, seen in figure 7.

Figure 7: Umbraco has been successfully installed when you see the Umbraco ASCII text.

Umbraco BackOffice

When I successfully set up Umbraco, I was then able to log into the Umbraco BackOffice and create credentials to begin building my management system, see figure 8. This is a feature that I was happy to include in my application because I want to be able to manage

the content of the application as it is a project that I could consider extending in the future.
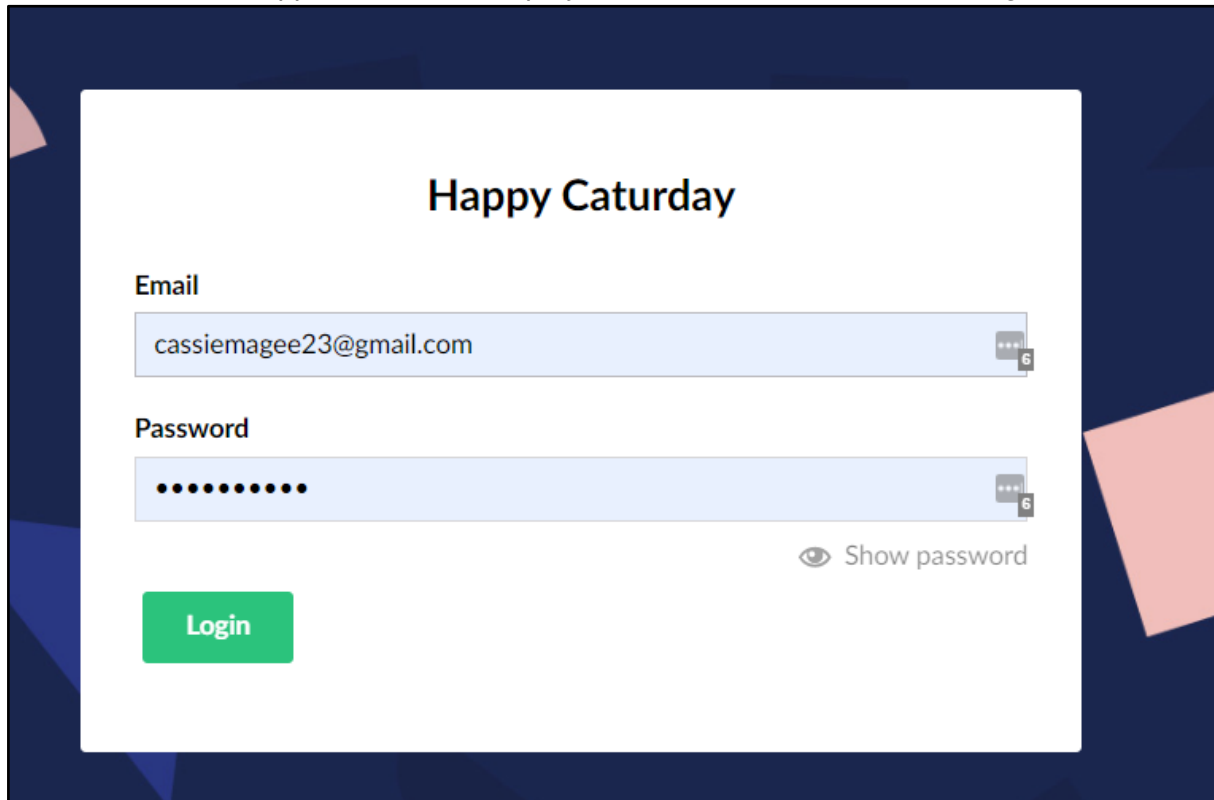
Figure 8: Login screen for the Umbraco Backoffice.

Before I was able to create any content, I had to create the 'Document Types' for the pages, see figure 9. I created a basic composition that contained a 'title' and a 'brief', the purpose of this was that every page could have a title and an introductory text, and partly because while creating the pages I could use the properties to ensure that the correct text was appearing on the pages. It also aids with the consistency of the website.
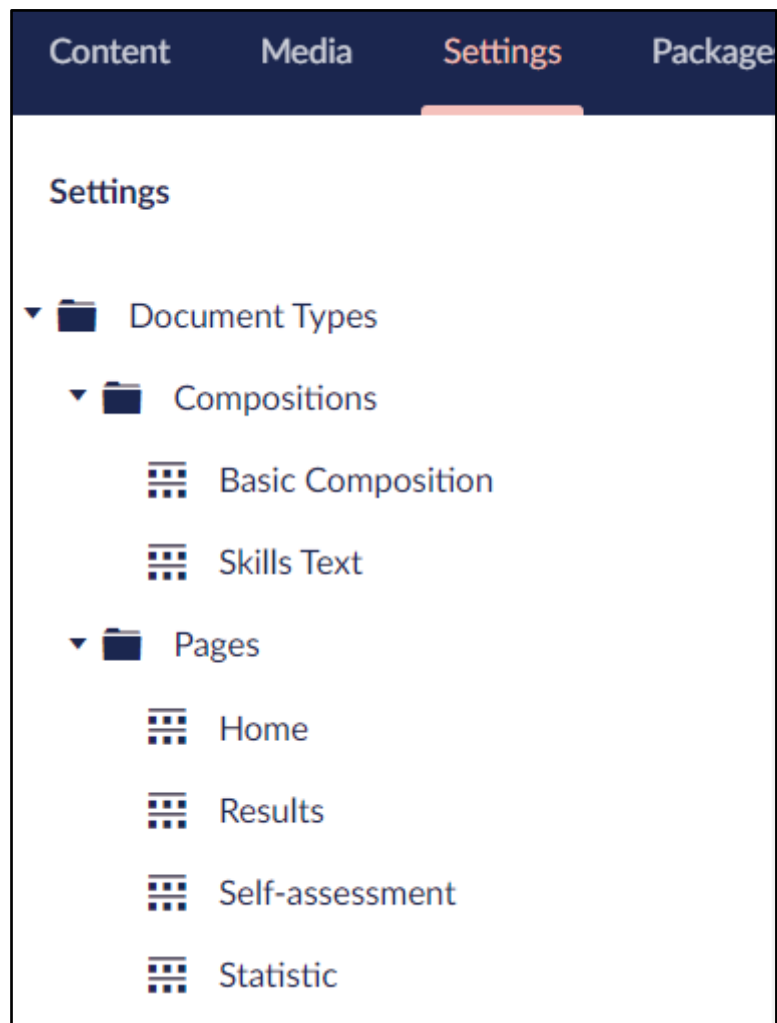
Figure 9: Document types within the web application

I started the web application by building the home page. As you can see from figure 10 the title and brief properties are inherited from the basic composition and the added properties that are unique to the home page are the introduction, image and content. I designed it like this because only the home page has an image that appears in its background.
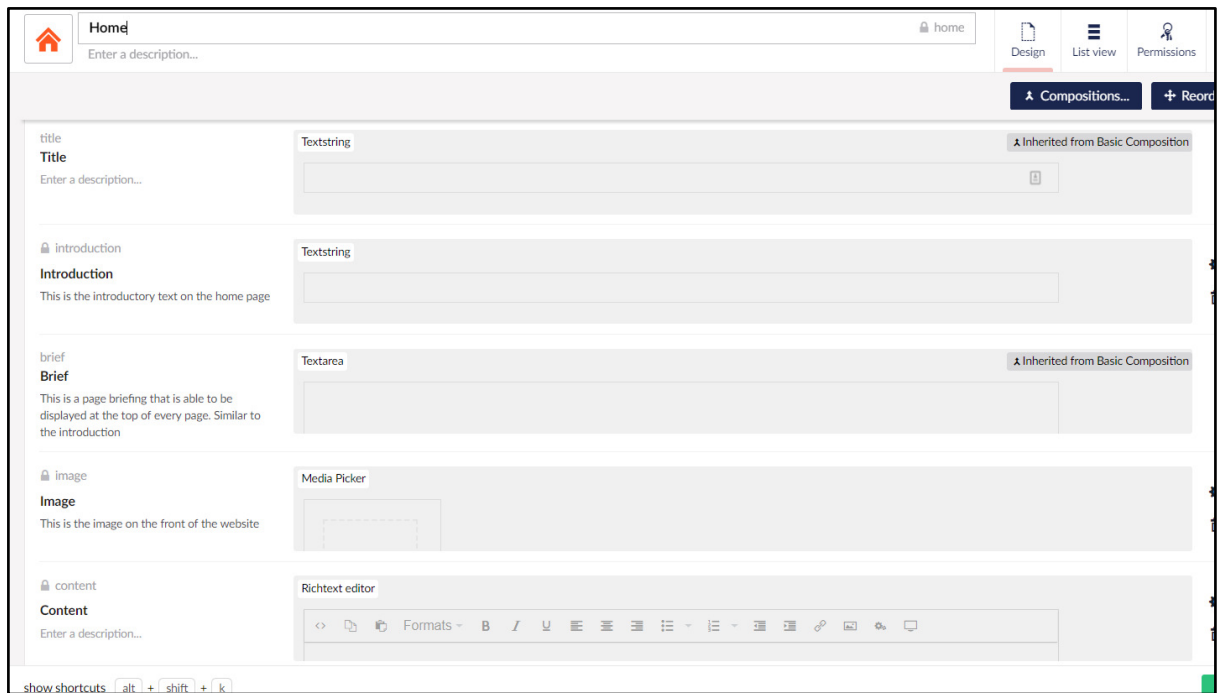
Figure 10: Properties within the Home Page.

After the home page I built the 'Statistic Page'. According to my initial plan I was building this to provoke a response of shock from the user but after looking more closely at it I have used it as a last resort as a form of persuasion. I have now designed it so that if the user is still unconvinced that the computing industry is for them after building self-confidence, then they might be persuaded by the positive prospects that working in the industry brings. See figure 11 for the properties in the 'Statistic' page.
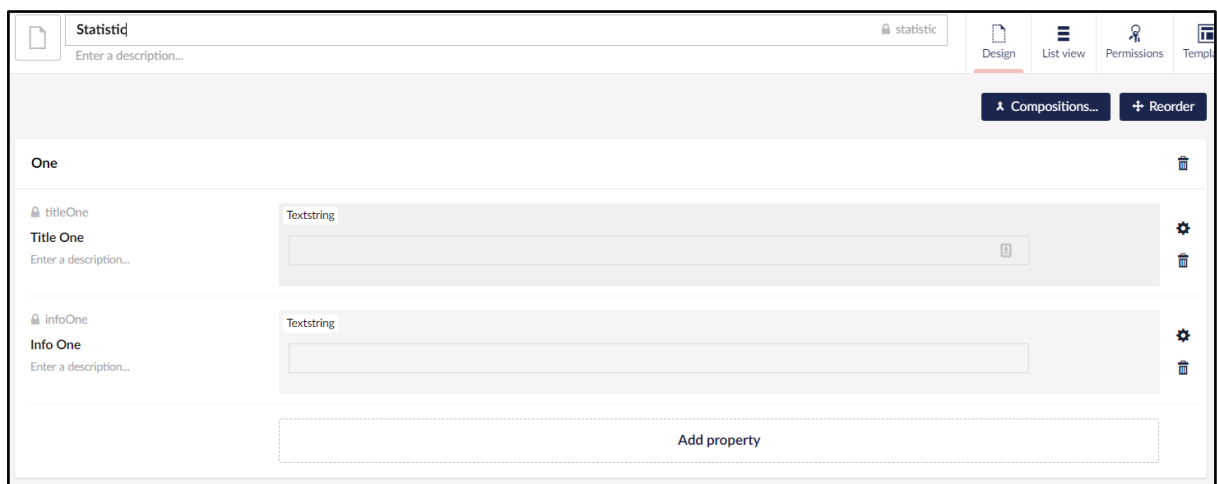
Figure 11: Document type for the 'Statistic' page.

After I had created the Home page and the Statistic page, I decided that I was changing my approach from the perception of females in IT to an online self-assessment. This was when I created the 'Self-assessment' document type and the content for it. Before I was able to put the form onto the content section, I had to create the self-assessment with Umbraco Forms.

Why Umbraco Forms

I chose to use Umbraco forms because I felt that it was the most efficient way to store the entries and although I have no previous experience using 'Umbraco Forms' the documentation was straightforward and easy to follow.

I had considered using other methods of building forms through MVC (Models, View, Controller) by using 'Html Helpers' such as 'Html.LabelFor' and 'Html.EditorFor' using view models and saving the results to the database in the controller. However, as I was using Umbraco to create the views and manage the content, I chose to use Umbraco Forms for the consistency of software.

YouTube Tutorials

When I first created the project, I thought that I was able to do so without using any documentation because I had made a project in Visual Studio a few times before. However, I underestimated how much work was required to build the solution, install Umbraco 8 and connect the project to version control.

When working in industry, the projects that I had joined had existing architecture and I just had to follow the procedure for it, with other team members ensuring that I was using it correctly, for this project I didn't have that. This was when I realised that I was going to need more resources, so I started researching and came across Paul Seal's YouTube channel. [31]

Paul is an experienced web developer who has created his own site called 'Codeshare' that uses tutorials and blogs to share what he has learned about web development and specifically Umbraco.[32]

I considered using written documents like the Umbraco forums or popular websites like 'Stack Overflow' to learn but personally I have a kinaesthetic approach to learning, so YouTube tutorials were suited to me.

I adhered to Paul's recommendation to Install Umbraco 8 through the 'Package Manager Console' but decided to include the template for MVC whereas Paul did not. I did this because I knew that I was familiar with the structure of Models, View and Controller and believe that this is an easier way to build a website. In the tutorials Paul uses the 'CleanBlog' template from his 'Codeshare' site but I decided I wanted to put my own design on the website and used a different bootstrap template called 'Freelancer'. [33]

After watching the first 4 tutorials of a 17-part playlist, I strayed away from the tutorials as I was developing things that were no longer generic but relevant for my application.

Reasons behind choosing a Self-Assessment Form

Self-assessments enforce users to think about their abilities in a way of reflection that they're perhaps not used to, allowing users to become aware of their strengths and weaknesses. I wanted this to be a factor when creating my website because reflecting on abilities is a skill that is important in itself. Being able to learn from your strengths and weaknesses is crucial for building an understanding of yourself and will allow you to adapt to changing situations and tough circumstances. [9]

I considered using a skills test where the user would be faced with an interactive code snippet where they could change and run the code. The idea of this is similar to how 'PluralSight' teaches their online classes[43], but as I began to see how the application could be used in

schools I thought that it would be better to build something more basic to avoid putting users off straight away when faced with code.

The online aspect of the self-assessment avoids any pressure from peers or groups and results in a more honest evaluation of themselves.

A conformity experiment conducted by Solomon Asch [16], investigated if social pressure could affect a person to conform. He found that 75% of participants conformed at least once in the experiment. The interview after the experiment to find out why participants conformed, resulted with the majority answer, 'in fear of being ridiculed' and this is something that I intend to avoid. Making females feel nonsensical while using my application is exactly the opposite of what I want to achieve. This is similar to the situation that occurred to form the BCS Women [24].

The user is able to answer the questions in the privacy of their own time and space, this is important because if there is already presence of low confidence or a lack in ability, the setting of a self-assessment form removes any public situations that might influence the users choices.

Reasons behind Self-Assessment Form layout

My justification for the lack of text on the form was to see what the user thought of their own ability without knowing any background as to why they were answering the questions i.e. to match their abilities to a computer scientist as mentioned in the Engaging Females in STEM paper above [15].

Form Structure

Originally, I had designed the questions on the form to introduce the definition of the skill and common ways that the skill is used. I thought that the user would be deterred from reading the form if there was lots of content to read before answering the question. Therefore, I have chosen to layout the form with a series of short questions. See figure 12 for a visual representation of how a paragraph looks compared to a sentence. I originally had my form looking like the 'paragraph' side on the left column and I have changed it to look more like the 'sentence' column. Using Nick Babich's (2018) effective rules for UX writing I chose to do this to avoid long blocks of text [34].

Figure 12: Comparing content in paragraph and a sentence.

Ask only what's required

To avoid affecting the conversation rate by adding unnecessary fields to a form, I designed the form in a way that the user is asked only the required questions to evaluate their self-assessment of their skills [28]. I considered asking questions like if the user had considered the IT industry for their career and questions relating to what subjects they have studied but I decided that if the questions did not directly relate to the purpose of the application then I would remove them.

Input Fields

Figure 14 demonstrates the layout for the skills where the form asks the user if they have the skill then a choice of three radio buttons to select from.

My justification for using radio buttons was to avoid open ended inputs and to enforce only one option to be chosen. By having one option I would be able to have the option of adding a scoring system for each selection and be able to quantify the results for future work.

I also chose the option of three radio buttons because I expected the majority of users to answer 'Sometimes' for the skills. I expected this because after researching the studies, if the self-confidence for low in females then 'Definitely' wouldn't always be chosen. I also hoped that 'Never' was not the most common answer for these skills as I chose what I believed to be fairly universal skills that most people would recognise with.

This was to give the user a range of answers so if they thought that they can have a skill sometimes then they were on the right track and even if they seldom used the skill, then

they still have the skill in their repertoire but they're just not confident enough to say they 'Definitely' have it.

Radio buttons is the logical input field to put here because it allows for only one answer, using checkboxes wouldn't be suitable because answering 'Never' and 'Definitely' wouldn't be suitable. Using a text area would also not be suitable as the input field because it allows for a qualitative response. This is not suitable for this application as it would be more difficult to return results based on the user's entries.

Radio buttons are best suited when there is no clear default or recommended option, this is relevant for my application because there is no right answer. The self-assessment form has set answers that offer a range of responses to make it easier for the user to fill the form in and in effect enhance the user experience [29]. I have also chosen to use radio buttons as the input field because they prevent users from entering erroneous data.

As with check boxes, the order of radio button options could persuade the users in their selection [29]. For example, they may choose the first option just because of its placement in the list, but I hope that the method of only asking what's required balances this out because what's asked of the user is very little as the answers are provided and the submit button is clearly shown.

On the other hand, radio buttons require a lot of space in terms of the layout of the form and go against my desire for the form to be visually appealing to the user. I think that if I expanded the form to have more than 8 skills evaluated then I would consider using a slider. See figure 13 for a visual example, the slider could have a range of 1-5 and 1 equating to the user 'Never' using the skill and 5 equating to the user 'Definitely' having the skill. By using a slider instead of radio buttons I'd be able to scale the results up easier with a score or percentage.

Figure 13: Visual example of a slider.

Figure 14: Structure of the self assessment form

I wanted to avoid the user having a qualitative response for this instance because I wanted to gather quantitative results that would make it easier to tailor to their responses in the results page. Additionally, I believed that if younger females were filling out this form qualitatively then there would be less responses as users would lose interest in typing their results or would write something that would make the data redundant compared to radio buttons where the choice of answer is already determined.

Saving the form

When the form was submitted the entries for the form were saved in the Umbraco back office. The user was informed that their results were submitted and were taken to the submitted form page where they were able to click through to see their results, the workflow can be seen in figure 18. I designed the form this way so that the user could feel a sense of uniqueness and that the results page wasn't generic and it was tailored to them.

Figure 15 shows how I have inserted the form into the view. '@Model.SelfAssessmentForm' is the form that I have created in Umbraco Forms and have inserted it into a rich text editor on the Self-Assessment page. Figure 15 shows I have put the 'Self-Assessment Form' between a div and then using the built in Umbraco Forms package, MVC recognises that when the form is submitted it goes to the default submit functionality as seen in Figure 16.


```
<div class="row">
    <div class="col-lg-8 mx-auto">
        @Model.SelfAssessmentForm
    </div>
</div>
```

Figure 15: Displaying Form in the view

```
else
{
    <input type="submit"
            class="btn primary"
            value="@Model.SubmitCaption"
            name="__next" />
}
```

Figure 16: Submit input for the self-assessment form

When the form is submitted then the entries are saved to the form entries in the back office. See figure 17.

Forms

▼ 📁 Forms

   ▼ 🖉 Self-Assessment Form
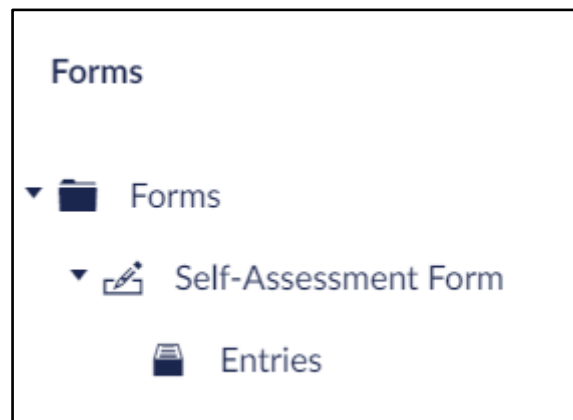
      📇 Entries

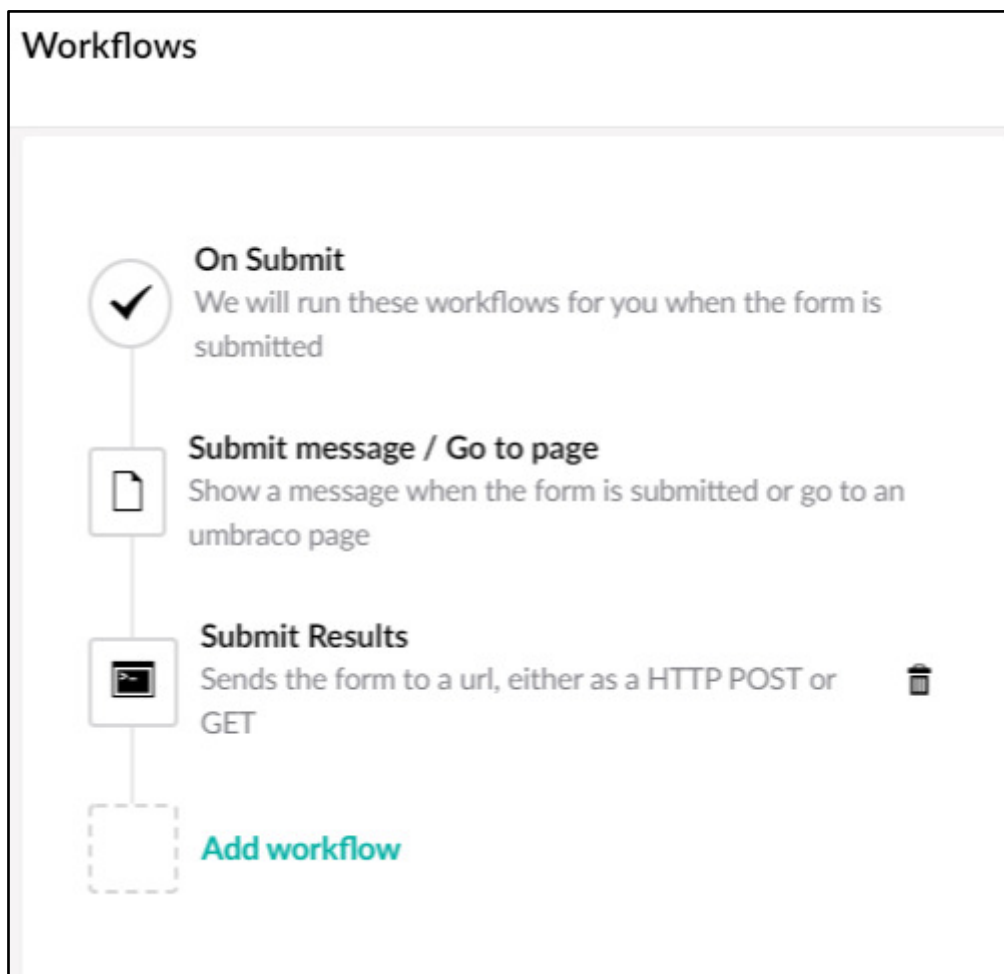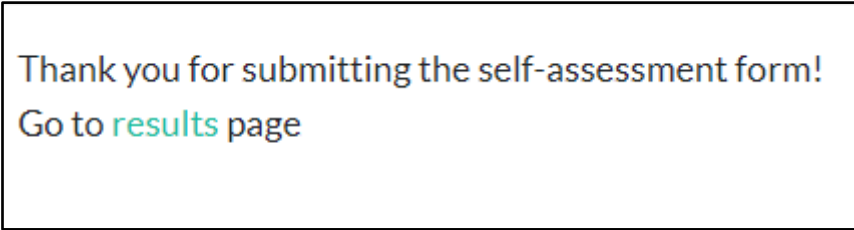Figure 17: Where to access entries for a form

Figure 18: The workflow once the form is submitted.

Accessing the last entry

For the user to view their results, I found the last entry of the form submissions using the code in Figure 21. An overview of the commented code includes finding the form, finding the records in the form, then getting the last submitted record. The user can only go to their results page if they click on the link after they have submitted the form, see figure 19.

Thank you for submitting the self-assessment form!
Go to results page

Figure 19: Link to results page

The biggest limitation for this is if the user directs themselves to another page before they click on the link then they lose the path that takes them to the main part of the web application. I designed it this way because I wanted the user experience to flow through like a questionnaire or a form usually would [44], I thought that the targeted user would be most familiar with this setting.

I considered using the 'TempData' feature seen in Figure 20, this method of accessing the last record submitted to the form is used when the submitted form is redirected to the results page in the workflow. I chose not to use this method because I didn't want to use a session method to access results.

```
if (TempData["umbracoformsform"] != null && TempData["Forms_Current_Record_id"] != null)
    {
        var currentForm = (Umbraco.Forms.Mvc.Models.FormViewModel) TempData["umbracoformsform"];
        var currentRecordId = TempData["Forms_Current_Record_id"].ToString();
```

Figure 20: Temp Data approach to getting records from form.

```
//create an instance of the Record Reader
var recordReaderService = Current.Factory.GetInstance<IRecordReaderService>();
//get the form using the unique id from the backoffice
Guid formGuid = new Guid("37f405f4-cfc2-4355-a3fe-b4efa718b574");
//create an instance of the form storage
IFormStorage _formStorage = Current.Factory.GetInstance<IFormStorage>();
//get the form using the unique id
var allforms = _formStorage.GetForm(formGuid);
//create an instance of the record storage
IRecordStorage _recordStorage = Current.Factory.GetInstance<IRecordStorage>();
//get all the entries from the form
var allEntries = _recordStorage.GetAllRecords(allforms);
//get the total number of entries that have been submitted
var lastEntry = allEntries.Count();
//get the last record in the form
var record = recordReaderService.GetRecordsFromForm(formGuid, lastEntry, 1).Items.OrderByDescending(x => x.Created).ToList();
```

Figure 21: Code to retrieve the users form results.

When the release of Umbraco 8 came out Umbraco Forms Storage changed to a singleton [30]. This caused issues when accessing the 'FormStorage' directly, so I had to change my approach from using the Interface 'IFormStorage' to using only the Record Storage as seen in figure 22.

```
//manually refering the form through its guid.
Guid formGuid = new Guid("da52c886-8fdf-483d-8e1b-8859404082f5");
//getting the last entry from the view bag session
var lastEntry = ViewBag.LastEntry;
//using the record storage service
var recordReaderService = Current.Factory.GetInstance<IRecordReaderService>();
//accessing the last record in the form by getting the last created |
var record = recordReaderService.GetRecordsFromForm(formGuid, 1, 1).Items.OrderByDescending(x=>x.Created).ToList();
```

Figure 22: Accessing last record using record service.

Comparing figure 21 and figure 22, it can be seen that Form Storage is removed and the last Entry is held in the 'ViewBag'.

Results Page Design

Similarly to the self-assessment form, I didn't initially plan for the user to have a results page. When first creating the results page, I had all the results displaying on one page which accumulated lots of text on one page and created the same issues I had with the self-assessment form in which there was lots of content in one space.

To address this, I used a JavaScript slideshow to make it look like each skill was appearing on a new page which solved the issue of spreading the content out for the user's visual experience.

I designed it this way because I did not want the user to lose interest while reading the persuasive text. I also included an image in the slideshow because some people relate and remember things better when images are used [27]. I had considered using modals for the design of the 'Results Page' but decided that I wanted to implement something different from the 'Statistic Page'.

I thought that slideshows were only beneficial for images but after some research I found that slideshows are also good for distributing information [35]. By adding an image to the skills, I wanted to provide a way for users to read the results and remember them. I came across the 'Picture Superiority Effect' that refers to images and pictures being remembered more than words [36]. Although this phenomenon is widely debated, there has been published research by Childers, T.L. and Houston, M.J., (1984) [37] to suggest that there is evidence to support it.

Tailoring the Results Page

To be able to direct the user to the 'Results Page' they must submit the form. In the back office of the 'Results Page', I created a 'Brief', 'Never', 'Sometimes' and 'Definitely' text area for each skill so that depending on what the user answered in the form, the appropriate text area would appear.

By tailoring the text areas to the results, I made the experience more personal for the user and showed them that it wasn't a generic form about skills but specifically relevant to their understanding of their skills. See figure 23 for an example of how the skills are displayed.

The reason why I have different texts appearing depending on the answer is because the different text areas contain different persuasion techniques [26].
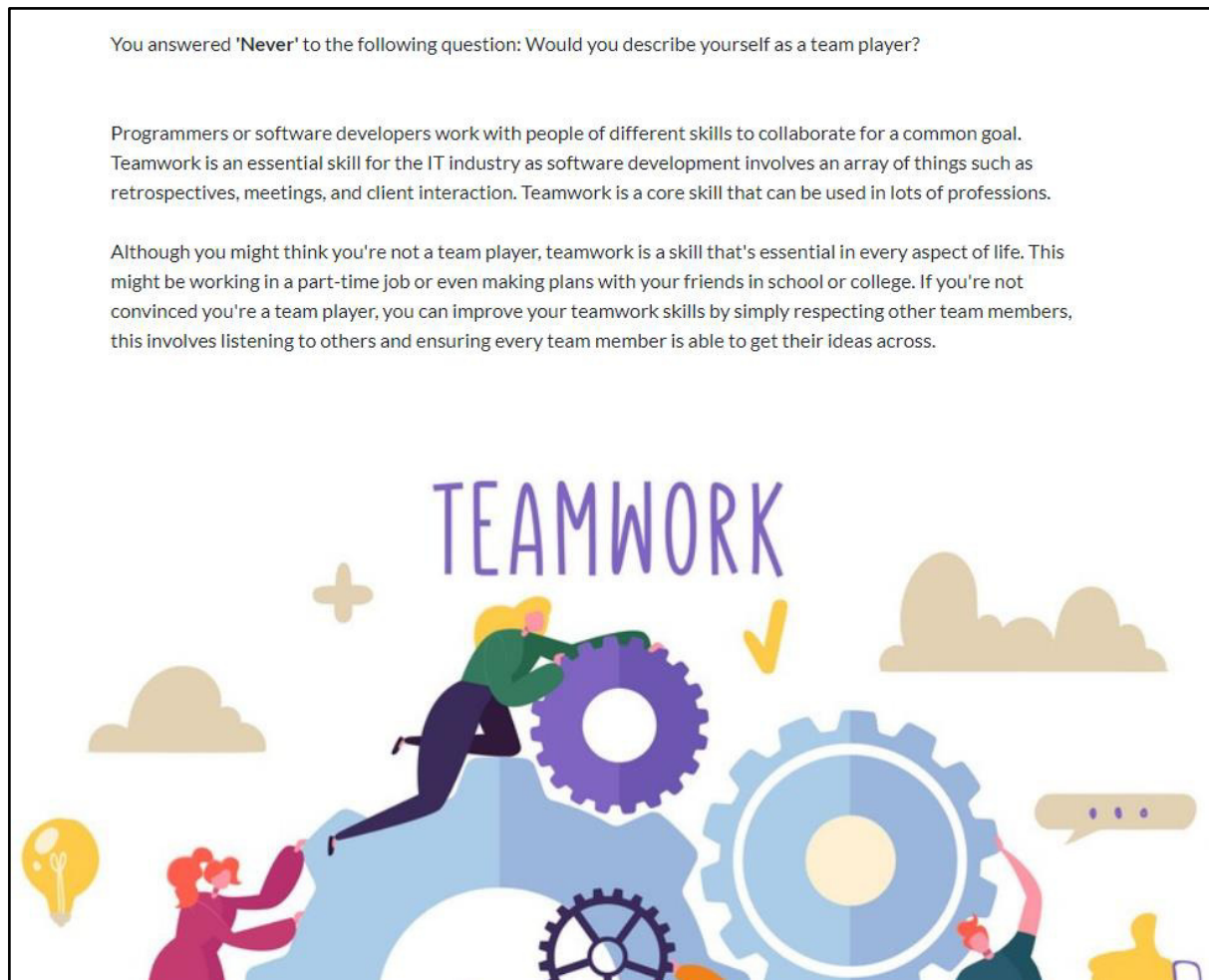
Figure 23: An example of the *results page if the user answered 'Never' for Teamwork.*

See the text areas below to compare what the user is shown on submission. 'Brief' is always shown to the user then 'Never', 'Sometimes' or 'Definitely' is shown depending on the answer.

Teamwork

Brief	Programmers or software developers work with people of different skills to collaborate for a common goal. Teamwork is an essential skill for the IT industry as software development involves an array of things such as retrospectives, meetings, and client interaction. Teamwork is a core skill that can be used in lots of professions.
Never	Although you might think you're not a team player, teamwork is a skill that's essential in every aspect of life. This might be working in a part-time job or even making plans with your friends in school or college. If you're not convinced you are a team player, you can improve your teamwork skills by simply respecting other team members. This involves listening to others and ensuring every team member is able to get their ideas across.
Sometimes	You're already halfway there! Thinking that you only have teamwork sometimes is a step in the right direction. You need to have confidence in yourself and work on your skills, being considerate or thoughtful of other people can help improve any existing teamwork skills you already have.

Definitely	This is great! You have recognised your skills and know what you're capable of. Keep up your teamwork abilities and they will take you far with a profession in the IT industry!

Problem-Solving

Brief	Problem-solving is a core skill for a computer scientist and this is the foundation of the job. It involves translating human solutions into machine through coding. The best problem solvers know when the best approach has been established and when to go with it.
Never	So, you think you're not a problem solver. That's okay, but you might be applying this skill in more ways than you think! You might be a problem-solver if people come to you for advice or if you provide answers to people's problems or before you make a big decision do you way up the pros and cons?
Sometimes	You've got the right attitude! Recognising that you can problem-solve sometimes is a step in the right direction to increase your confidence. To improve your skill, you might be interested in completing games like sudoku or solving riddles.
Definitely	Great! Problem-solving is a skill that will get you far in the IT industry and you already have it, so you're already on your way! It can extend to recognising problems, identifying their causes and finding possible solutions, while assessing the best way forward.

Creativity

Brief	Being creative is vital for a computer scientist to generate new ideas and challenge existing ways of solving problems. Having creativity as a skill allows developers to explore new and more efficient ways of getting the job done. There's more than one way of doing something in programming.
Never	So, you think you're not a creative person? Being able to think 'out of the box' and come up with new, unconventional ways for a solution is a skill relevant for any aspect of life. To improve this skill, you should try and step out of your comfort zone and use brainstorming techniques to come up with new ideas.
Sometimes	Creativity can occur in more ways than you think, it's a skill that's not only relevant to artists or designers. Do your friends say things like 'I never would have thought of that' when you solve a problem? Then it shows that others think that you're creative too.
Definitely	Great, creativity is a skill that can be applied to business challenges and new or interesting ideas or approaches to problems.

Attention For Detail

Brief	Having attention for detail allows developers to pick up on mistakes while coding to be able to get the job done faster. It can also apply to styling websites, for example having this skill results in visually appealing outputs.
Never	So you think you don't have an attention for detail, maybe you feel like never see the fine print to things but don't be disheartened! Attention for detail involves being focused on the details of a task and can be relevant to everyday tasks like counting money; maybe this is in a part-time job where you cash up the tills. You can improve your attention to detail by simply having patience and taking time to do things correctly.
Sometimes	Great, it sounds like you're on your way to ticking off attention for detail on your skills repertoire. This is a worthy skill to develop and shows you're accurate with the work you do. You should have more confidence in your abilities because this skill can be applied to everyday tasks, perhaps reading over an assignment twice before you submit your work.
Definitely	It's great to see that you have confidence in your ability! Attention to detail is a skill that is highly sought after by employers.

Reliability

Brief	Computer scientists need to be able to rely on each other especially when working in a team. Often product owners will rely on their developers to be able to do the job correctly and therefore support the client.
Never	You should have more faith in yourself! Being reliable can stem from simply being honest and doing what you said you were going to do. It shows that you care about others and can be counted on. You can improve your reliability skills by showing up to commitments and being on time.
Sometimes	You shouldn't doubt yourself, having other people count on you sometimes is better than never. It also doesn't mean that you have to say yes to every commitment, sometimes being honest about what you can realistically do can make you a more reliable person.
Definitely	Great! Being reliable is fantastic as it means you have a good track record of keeping promises and you can be depended on to get the job done. Also, a highly sought-after skill in any occupation.

Organisation

Brief	Being organised when developing is vital so other developers can come along and finish off code where you left it. Organising work is important because it shows clients than you are a professional.
Never	You might have said you're unorganised because your bedroom is untidy

	or you have dishes that need to be washed but there's more to this skill than you think. You might be organised by planning your week and scheduling events into a diary or calendar. This skill can be developed from writing to-do lists and scheduling your time around hobbies, for example football two nights a week.
Sometimes	You don't have to be organised in all aspects of your life to have this skill! Good practice for developing this skill can be giving yourself a deadline before the actual deadline or breaking large tasks into smaller ones. This is a broad skill that be applied to make everyday life simpler, for example organising folders and files for work into categories.
Definitely	Great! You know that you're an organised person and probably find that being organised brings more structure to your life. Being organised saves time in the long run as you don't have to spend time looking for things and can spend more time on important tasks, companies like to see an organised employee.

Communication

Brief	Computer scientists will communicate with their team, their client and other people within the company. They must be able to understand what other people are communicating to them and be able to relay information back to others depending on their level of expertise. For example, explaining a webpage will be different depending on whether they're communicating it to the client or another member of the team.
Never	Maybe you've said no because you consider yourself a shy person or maybe you're not the loudest person in the room, but there's more to communication than talking. Having good communication skills can simply involve having a good awareness or understanding of the dynamic in the room. It also involves writing things down in a way that is easily explained, which is a skill many people find difficult.
Sometimes	You should try having more confidence in your ability, as good communication skills stem from being able to appear confident when speaking to someone. If you're friendly, then that's a step towards improving your communication skills.
Definitely	Great communication skills can extend to having the ability to negotiate or be persuasive. It can also mean presenting or speaking in public. Being able to communicate with respect and showing empathy when required is a skill that is not always found in computer science so having this skill puts you a step above the rest.

Resilience

Brief	Programming requires the skill of resilience, when one idea doesn't work out, you must be able to positively adapt to the situation to result in a successful outcome.

Never	You might think that you're not resilient because you give up easily but resilience simply involves acting humble in the face of defeat. You must accept that you're most likely to fail before you succeed. Once you realise this you're on your way to becoming resilient and therefore one step closer to reaching your goals.
Sometimes	Being resilient sometimes can be good, it means that you understand when to pick your battles and when to accept defeat. It's okay when things don't go to plan, but you need to remember to stand up again once you get kicked down. Improving your resilience skills can simply come from remembering the reason why you are doing the task, perspective is a powerful tool.
Definitely	It's great that you think you're resilient, being someone who doesn't give up when times get hard isn't something that's easy to do. It is, however, a skill that will get you far in any career path.

Retrieving Entry for the Results Page

As you can see in figure 24 I have looped around all the records in the form, I also have a nested loop where I loop around all the fields in the record. In the first section of code I check if the question is about teamwork then show what the user answered for that question. Further down I say if the answer was equal to 'Never' then show the persuasive text for that answer. I have made it so there are three different texts that would show for the three different answers. From figure 25, you can see the 'TeamworkNever', 'TeamworkSometimes' and 'TeamworkDefinitely'.

```
foreach (var row in record)
{

    foreach (var field in row.RecordFields)
    {
        var question = field.Value.Field.Caption;
        var answer = field.Value.ValuesAsString();

        <div class="col-lg-8 mx-auto">
            @{
                if (question.Contains("teamwork"))
                {

                    <div class="mySlides">
                        <div class="col-lg-8 mx-auto">You answered <b>'@answer'</b> to the following question: @question</div>
                        <div class="numbertext">1 / 8</div>
                        <br />
                        <div class="col-lg-8 mx-auto">@Model.Teamwork</div>
                        <br />
                        @{
                            var outputTeam = "";
                            if (answer == "Never")
                            {
                                outputTeam = Model.TeamworkNever;
```

Figure 24:Looping around the user results.

```
if (question.Contains("teamwork"))
{

    <div class="mySlides">
        <div class="col-lg-8 mx-auto">You answered <b>'@answ
        <div class="numbertext">1 / 8</div>
        <br />
        <div class="col-lg-8 mx-auto">@Model.Teamwork</div>
        <br />
        @{
            var outputTeam = "";
            if (answer == "Never")
            {
                outputTeam = Model.TeamworkNever;
            }
            else if (answer == "Sometimes")
            {
                outputTeam = Model.TeamworkSometimes;
            }
            else if (answer == "Definitely")
            {
                outputTeam = Model.TeamworkDefinitely;
            }

        }
        <div class="col-lg-8 mx-auto">@outputTeam</div>
```

Figure 25: If clause for the teamwork answer.

I followed this structure for all of the skills and potentially could have made this code more efficient by putting it into a switch statement instead of an if else but because each skill had four text areas that were being toggled and eight skills to include I developed it in a way that was most logical for me.

Content for building confidence

Through my research I found author Courtney E.Ackerman [7] who said 'You can't get inside their head to know how they feel about themselves, so you base your judgement of their self-confidence off of their words and actions'. This quote stood out to me and is partly the justification for using a self-assessment form, because it allows me to see how the users weigh themselves up against the skills through an online platform.

I tried to use a positive approach in response to the users submitted results. I wanted to reinforce that there were no wrong answers for this form and it wasn't a test. My justification for this was to avoid 'scaring' the user and making them believe that they were capable.

I had planned to implement a scoring system to the form, however I felt that it was best if there wasn't a score attached to their ability. So if the user had answered 'Sometimes' for four of the skills and 'Never' for the remaining four, then I could have said that the user had 50% of the skills that would help them on their way to having the core skills of a computer scientist. On the other hand, If I wanted the self-assessment form to be designed so users felt that it wasn't a test, then giving a score to their results would be hypocritical.

For those users who would answer 'never' to every skill, their result would be 0/8 or 0% and this would have the opposite effect of encouraging them to enter the IT industry. Whereas, if the user said 'never' to every skill, then I could counter this by giving common examples of where the skill could be applied and convincing them that perhaps the skill is present, just that they haven't fully realised it without giving them a numerical value to their abilities.

When I was writing the content for the results page, I found a theory called 'Amplification Hypothesis' [8] outlining one way of persuading people is when you express your certainty with a particular attitude and the attitude hardens. I kept this in mind, when a user said that they believed that they didn't have a skill I wouldn't question them any further, I would state that the skill was a core skill and that everyone has a strain of it in some shape or form. For example, if the user answered 'Never' for organisation I said how they satisfy organisation by even simply putting events into a calendar and gave an example of how they could improve their organisation skill; by making to-do lists.

Intended flow of the application

When the application is loaded, the 'Home Page' is the first page that the user will see. From here they will be able to navigate to the 'Self-Assessment Form' or the 'Statistic Page'. Figure 26 shows the ideal route that the user will take depicted by the red arrows, which outlines that from the 'Home Page', the user will navigate to the 'Self-Assessment Form', then when their form is submitted they can navigate to the 'Results Page' and then to the 'Statistics Page'. This is the desired route because the 'Statistic Page' is designed as a final form of persuasion for users to consider the IT industry if the 'Self-assessment Form' didn't work.

However, if the user chose to navigate to the 'Statistic Page' first then they're free to do so. To design this in a way that would constrain the user from following something other than the desired path, I could hide the navigation link for the 'Statistic Page' until the user submits the form or until they have navigated to the 'Results Page'.
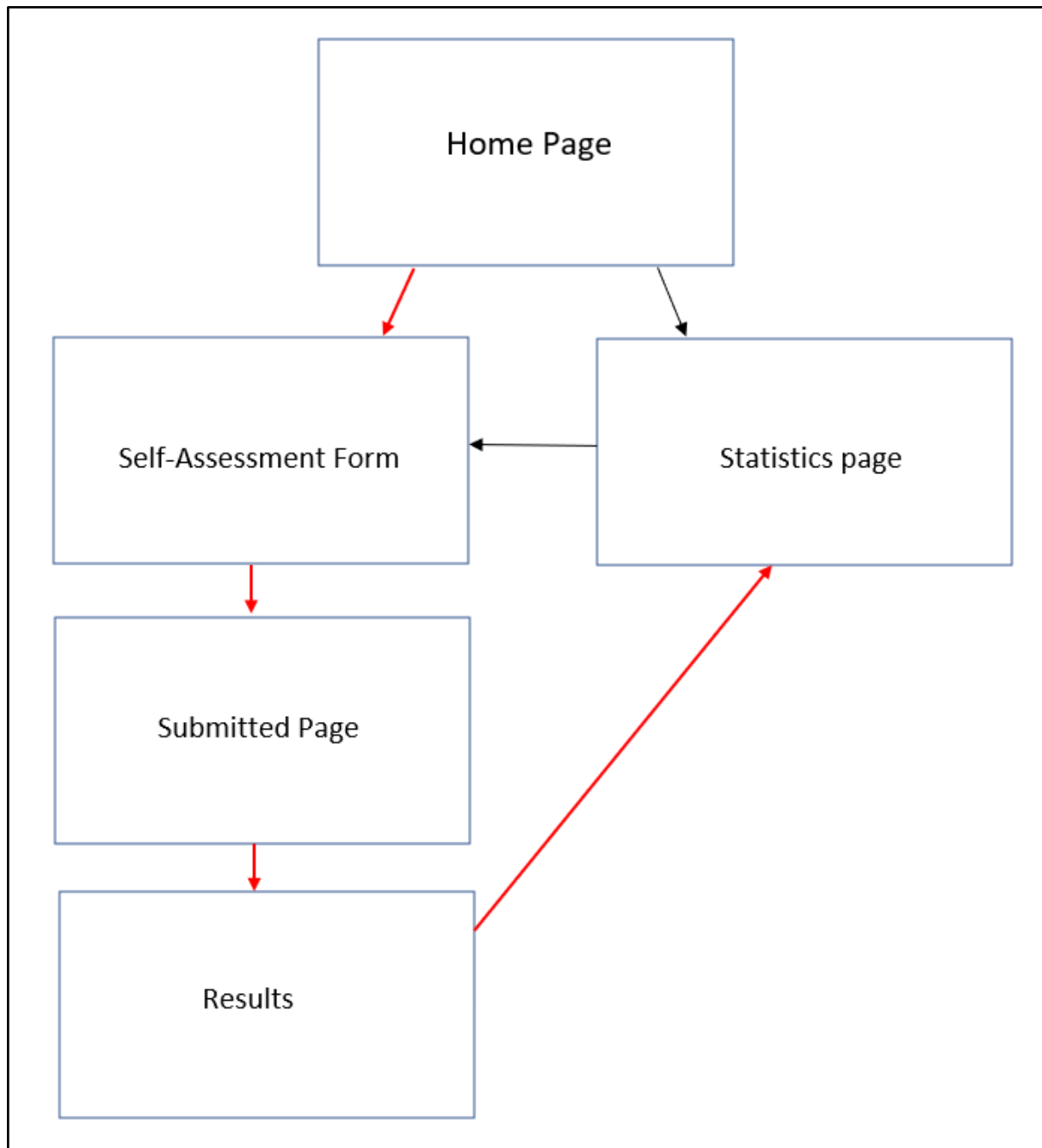
Figure 26: Red arrows showing intended flow of user in application.

Software used

The main architecture for building the application included Azure DevOps, Umbraco 8, ReSharper, Visual Studio 2019, MVC, C# and JavaScript.

Packages used

I installed the 'Umbraco Forms' package to manage the saving of my entries in the Back Office but after realising that Umbraco 8 had an updated method for accessing the entries I installed Scott Meikle (2019) re-working version of Form Storage by extending the back office [39]. This

package was a compatible resource that allowed developers to use Form Storage directly in the view.

Figure 27 shows two usings for umbraco form storage and I made the mistake of only using 'Umbraco.Forms.Data.Storage' because this is the one that 'Visual Studio' determines as required. However, after installing the extension of Form Storage V8, both usings are required in order to access the Form Storage, although Visual studio recognises the using as unnecessary, shown in the code on the top line in figure 27.

This small difference caused my entire Results page to stop working and I wasn't able to retrieve the last entry. This was also not something that I have not seen online or 'Our Umbraco' the support forum.

```
@using Umbraco.Forms.Core.Data.Storage;
@using Umbraco.Forms.Data.Storage;
```

Figure 27: Results View Usings

C# Code

HomeController

My 'HomeController' class as seen in figure 28 shows the instantiation of the 'IFormStorage' and 'IRecordStorage' class. These classes were necessary to access the records on the form because Umbraco doesn't offer a direct route to the entries.

```
namespace TestApplication.Controllers
{
    public class HomeController : SurfaceController
    {
        public readonly IFormStorage _formStorage;
        private readonly IRecordStorage _recordStorage;
        // GET: Home
```

Figure 28:Instantiation of Form Storage and Record Storage Interfaces

.

The 'HomeController' class contains the 'RenderHeader()' method, see figure 29, which is called in the 'master.cshtml' view that renders the header at the top of every page to ensure that the look of the application is consistent throughout.

```
public ActionResult RenderHeader()
{
    return PartialView("~/Views/Partials/Header.cshtml");
}
[Htt-D--t]
```

Figure 29: Rendering partial view on every page

The 'GetRecord()' method uses the instantiation of the 'IFormStorage' interface that is declared as a read only variable at the beginning of the 'HomeController' to get the entries in the form, see figure 30.

```
public ActionResult GetRecord(ResultsViewModel viewModel)
{
    //access the form id through the guid
    Guid formGuid = new Guid("dbeea4a6-0674-4fc1-bd3a-c1e33b7d70ff");
    //use the form id to access to form using an instance of the IFormStorage interface
    var allforms = _formStorage.GetForm(formGuid);
    //use the instance of the IRecordStroage to access the entries in the form
    var allEntries = _recordStorage.GetAllRecords(allforms);
    //count the number of entries submitted on the form
    var lastEntry = allEntries.Count();
    //return the view with the total number of entries to the view
    return View(lastEntry);

}
```

Figure 30: Accessing the record from the form

Results.cshtml

Within the view I have added a Javascript slideshow script that displays the results of the user's submitted self-assessment form See figure 31 [38]. I simply numbered my skills accordingly and populated the slides with my own content.

```
<script>
        var slideIndex = 1;
        showSlides(slideIndex);

        function plusSlides(n) {
            showSlides(slideIndex += n);
        }

        function currentSlide(n) {
            showSlides(slideIndex = n);
        }

        function showSlides(n) {
            var i;
            var slides = document.getElementsByClassName("mySlides");
            var dots = document.getElementsByClassName("dot");
            if (n > slides.length) { slideIndex = 1 }
            if (n < 1) { slideIndex = slides.length }
            for (i = 0; i < slides.length; i++) {
                slides[i].style.display = "none";
            }
            for (i = 0; i < dots.length; i++) {
                dots[i].className = dots[i].className.replace(" active", "");
            }
            slides[slideIndex - 1].style.display = "block";
            dots[slideIndex - 1].className += " active";
        }
    </script>
```

Figure 31: Javascript slideshow

Statistic.cshtml

The statistic page is a 3x3 grid that contains different facts and statistics that are relevant to women in IT. Figure 32 shows the code that displays the first property '@Model.TitleOne' and that target for the modal 'portfolioModal1'.

```html
<!-- Portfolio Item 1 -->

<div class="col-md-6 col-lg-4 portfolio-box">
    <div class="portfolio-item mx-auto" data-toggle="modal" data-target="#portfolioModal1">
        <div class="portfolio-item-caption d-flex align-items-center justify-content-center h-100 w-100">
            <div class="portfolio-item-caption-content text-center text-white">
                <i class="fas fa-plus fa-3x"></i>
            </div>
        </div>
        <h4>@Model.TitleOne</h4>
        @*<img class="img-fluid" src="img/portfolio/cabin.png" alt="">*@
    </div>
</div>
```

Figure 32: Code for the first statistic box

Figure 33 shows the modal that appears as an overlay when you click on the first box and the full information of the statistic is held in '@Model.InfoOne'.

```html
<!-- Portfolio Modal 1 -->
<div class="portfolio-modal modal fade" id="portfolioModal1" tabindex="-1" role="dialog" aria-labelledby="portfolioModal1Label" aria-hidden="true">
    <div class="modal-dialog modal-xl" role="document">
        <div class="modal-content">
            <button type="button" class="close" data-dismiss="modal" aria-label="Close">
                <span aria-hidden="true">
                    <i class="fas fa-times"></i>
                </span>
            </button>
            <div class="modal-body text-center">
                <div class="container">
                    <div class="row justify-content-center">
                        <div class="col-lg-8">
                            <!-- Portfolio Modal - Title -->
                            @*<h3 class="portfolio-modal-title text-secondary text-uppercase mb-0">@Model.TitleOne</h3>*@
                            <h3 class="">@Model.TitleOne</h3>
                            <!-- Icon Divider -->
                            <div class="divider-custom">
                                <div class="divider-custom-line"></div>
                                <div class="divider-custom-icon">
                                    <i class="fas fa-star"></i>
                                </div>
                                <div class="divider-custom-line"></div>
                            </div>
                            <!-- Portfolio Modal - Image -->
                            @*<img class="img-fluid rounded mb-5" src="img/portfolio/cabin.png" alt="">*@
                            <!-- Portfolio Modal - Text -->
                            <h4 class="mb-5">@Model.InfoOne</h4>
                            <button class="btn btn-primary" href="#" data-dismiss="modal">
                                <i class="fas fa-times fa-fw"></i>
                                Close Window
                            </button>
                        </div>
                    </div>
```

Figure 33: Code showing the modal for the first statistic.

Issues that I came across

The very first issue that I came across as mentioned above is the lack of knowledge when setting up a project. From figure 34, it can be seen that there was an error when trying to install NuGet packages because I had created a project in 'Visual Basic' instead of 'C#'. This highlights how unsure I was but how I learned from my mistakes to get the project running successfully.
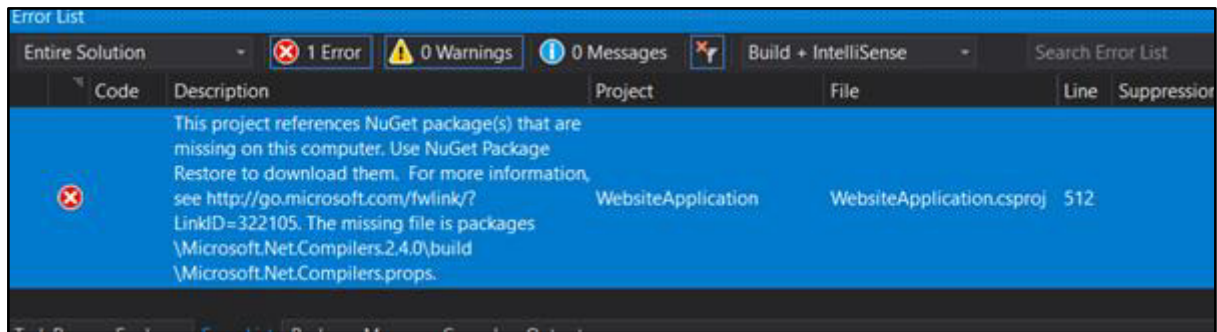
Figure 34: Project created in Visual Basic instead of C#

One issue was that the assembly info file was duplicated in the start-up, so I had to remove it from the project, see figure 35. This was a recurring issue that happened when I tried to download the latest version of Umbraco 8 and to solve it I had to continually remove the file until I remembered that adding it to my .gitignore file would stop the file from being added to development when I committed code.
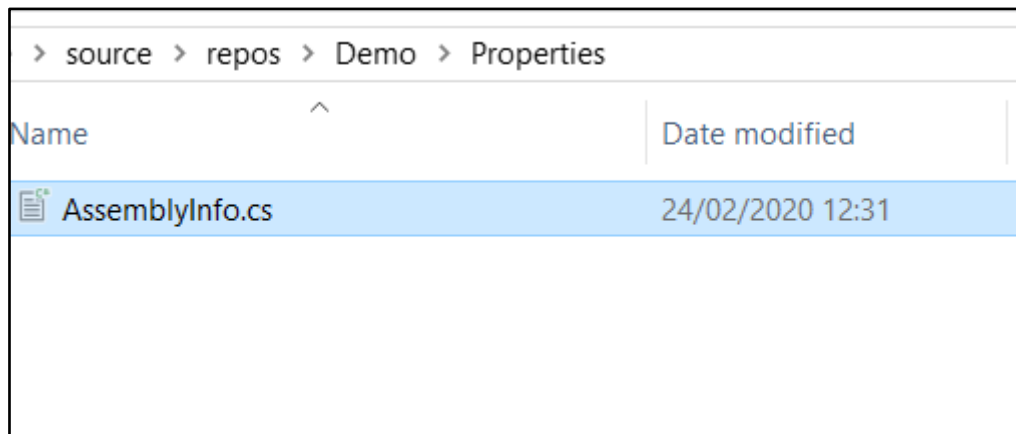

Figure 35: Duplicated 'AssemblyInfo.cs' file

I'm unsure why the generated files kept becoming duplicated and when I researched this problem I found that other people had the same issue, they said that removing the 'AssemblyInfo.cs' file solved this issue, but this wasn't the case for me, see figure 36. This leads me to believe that these two issues are related and both are a result of a versioning issue.

Figure 36: Duplicated generated files

If the user hardcodes the suffix of the url to '/results' then they're able to access the results of the last person who submitted the form. This should not be the case as it is a breach of privacy and would cause bigger issues if the form held more sensitive data or personal details. To solve this, I would implement a login system for the application where users would have profiles and they would be restricted from seeing results except their own.

Figure 37 shows changes in 'Web.config' file, this issue only happened once and I believe it was because I uninstalled and reinstalled a package, to solve it I had to go through the solution References shown in figure 38 and ensure that the version numbering in the properties matched the version number in the 'Web.config' file.
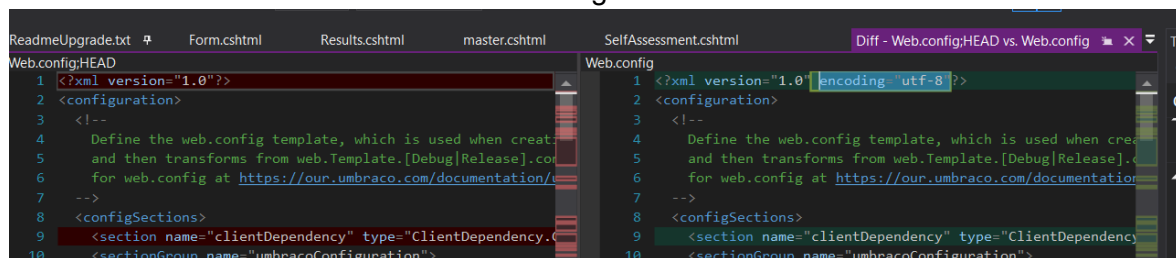
Figure 37: Versioning issue in web config
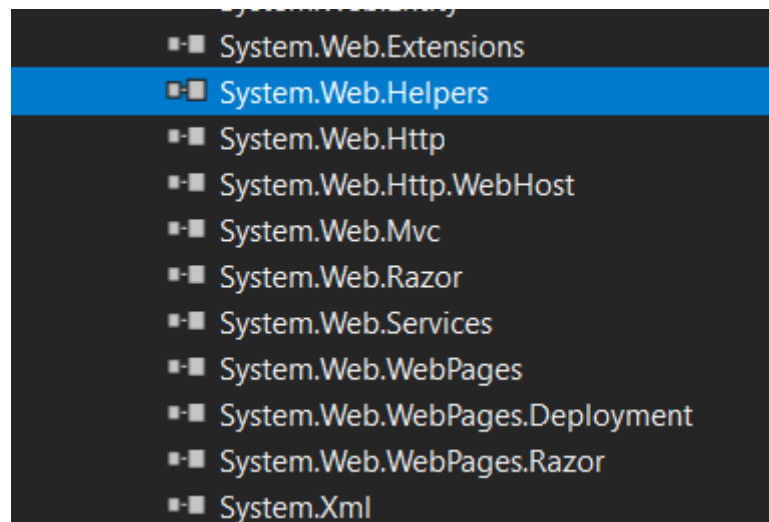
Figure 38: Solution References

How I overcame these issues

A lot of my issues were caused by 'Umbraco Forms' versioning and by uninstalling them and reinstalling them solved a lot of these problems, see figure 39 for my solution to the versioning.
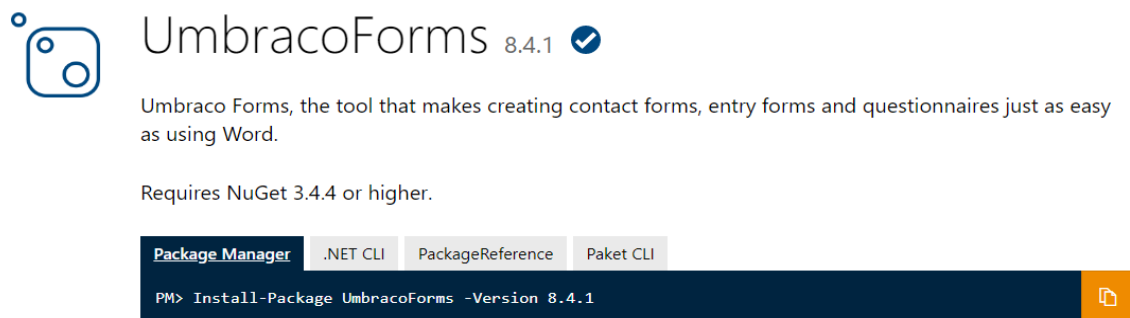

Figure 39: Install of Umbraco Forms through Package Manager Console.

The biggest technical issue that I had to overcome was using the 'IFormStorage' and 'IRecordStorage' interfaces in the controller when I was originally using them directly in the view. As mentioned above I was able to overcome this issue when I added the using to the top of the view, despite Visual Studio recommending to remove it. I had to reroute all of my code so that the controller was retrieving the records and passing the last record back to the view. In one way, I was glad that I had to overcome this issue because it follows the design pattern of MVC.

Results and Evaluation

After finishing the implementation of the application and seeing how the research leans significantly towards schools having a huge impact on the numbers of females choosing IT, I wanted to demonstrate my project to the school I attended. Due to the situation with Covid-19, I was unable to present my project to females who were choosing GCSE subjects in the school that I completed my GCSEs and A-Levels.

If time allowed, my intentions were to take a small number of females from each registration class, approximately 10 randomly selected. I believed that 10 was an appropriate amount to get a sample from and if the study was conducted in the computer suites then I would be able to spread the participants out around the room to avoid the participants influencing each other. Fortunately, I had the advantage of knowing the layout of the school and had contact with the 'Head of IT' since I left school in 2016.

I believe that this would have been an interesting experiment to undergo and one that might have left an impact on at least one pupil. This is something that I will consider taking further for future work.

Evaluate my approach to development

My approach to develop was not as involved as I had hoped for myself, when faced with other deadlines and commitments I realised how I wasn't able to develop everyday like my intentions of the initial plan. My downfall for development in the beginning was that I believed that I could set up the architecture without following tutorials or guides because of my experience working with the software. I soon found out that setting up the architecture requires different knowledge than what I had gained from working on my placement.

On the other hand, my approach to development remained resilient. As I was able to recreate the project with the correct underlying software when I failed on the first attempt. I was also resilient when the project stopped working because of a mistake I made when trying to update packages.

Despite having other assignments and exams to undergo I remained determined to finish the application to at least meet requirements that allowed the application to be functional. I feel that I was also successful in including different aspects of software development that I have learned throughout my degree, including front end design, design patterns and project management.

I am happy with how I was able to enhance skills from my placement year of my degree by adapting to existing software like the 'Umbraco Forms' package and extending the design of 'Bootstrap' templates.

I also believe that the topic of my project is relevant and I have built an application that has the potential to be extended further. In addition to the motivations for the topic, I wanted to build something that I would be able to eventually publish and be proud of for the purpose of future employers and I feel that I have done this.

Expected Results

Given that I would have tested my project on participants I would have expected the majority of the results to be either 'Never' or 'Sometimes' for the 'Self-assessment' form. This is because given the research the majority of females answering would have low-confidence.

After being directed to the results page and then moving on to see the statistics, I was going to ask the participants two questions: 1. Did they consider a career in IT before using the application? 2. Has the application changed their mind and why?

This would have determined whether the user found the application to be persuasive in any way and if they have built confidence to consider a career in the IT industry. This open ended question would have been suitable after they have filled in the form as they would be supplying valuable insight into their choices.

I expected maybe for every 10 participants, 2 or 3 would say they considered a career in the IT industry, this is based on the figures from UCAS and HESA mentioned above. After using the application and completing the form I was hoping for up to 5 out of 10 of the participants to say they would not consider a career in the IT industry, based on the self-assessment form successfully increasing the confidence of the users.

I would not expect that more than 5 out of 10 participants said they would consider a career after using the application. Solely because I would have touched directly on one factor, 'Lack of confidence', and to expect a higher result I believe I would have had to look more in depth at this factor and include many others, for example a lack of role models.

Worst-Case Scenario
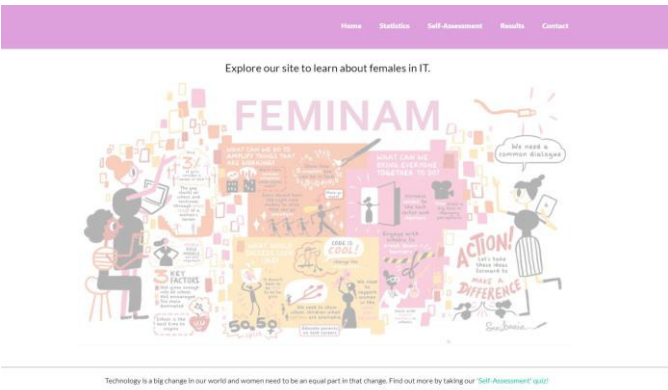
If time allowed and I was able to test my application out on participants and it was found that there was no increase in the number of females who would consider a career in IT after using the application. Then I would deem that I have given some insight into the IT industry through the 'Statistics' page, even if it has made no impact on the females using it.
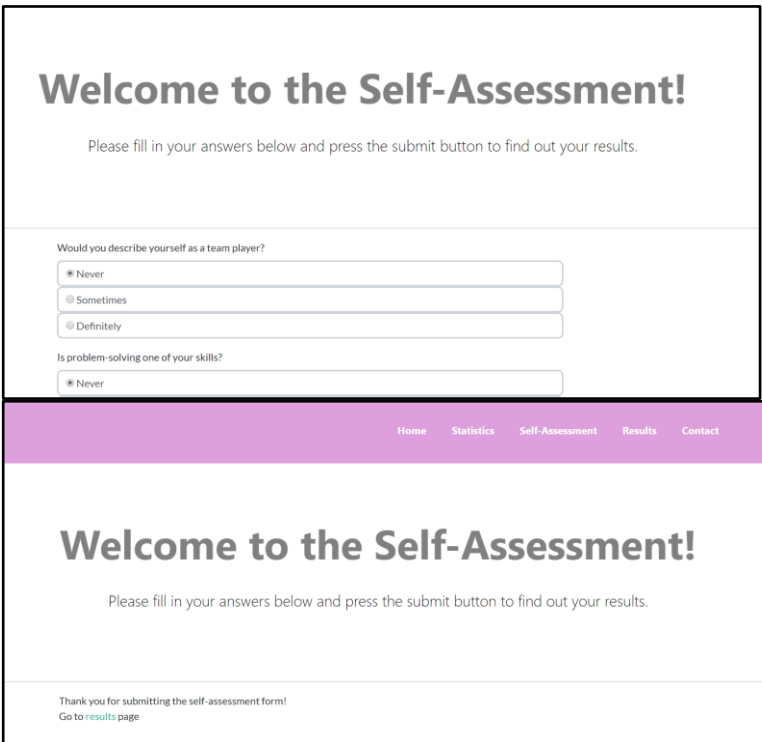
I would also say that if the 'Self-Assessment' form didn't increase the confidence of females' ability to consider the IT industry for their career path then at least it allowed the participants to build confidence in their skills, irrelevant to it being for a career in the IT industry. Or on the other hand if the 'Self-assessment' form didn't increase self-confidence then it allowed the users to reflect on their own performance which is a skill in itself.

Formalised Testing System

Below I have outlined a few test cases to analyse whether the system meets the requirements to meet the Minimum Viable Product.
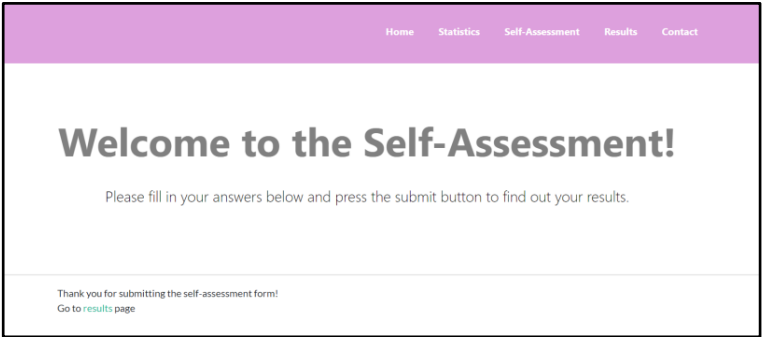
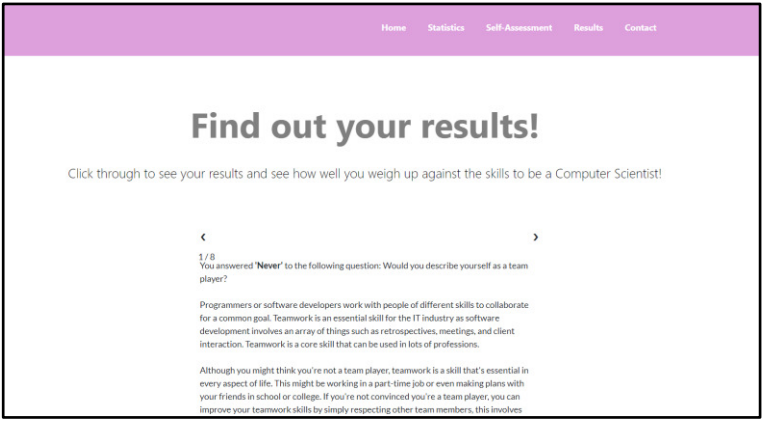| Test ID	Expected Result	Actual Results

1	When the website loads the 'Home Page' should load.	
Pass/Fail	**Comments**	
Pass	The application loads on the home page as expected. From here the user can navigate to the other pages.	

Test ID	Expected Result	Actual Results
2	The self-assessment form loads and the user is able to submit their results.	
Pass/Fail	**Comments**	
Pass	When the user navigates to the self-assessment form they're able to change the answers of the questions with radio buttons and submit the form with the submit button at the bottom of the form. They are then taken	
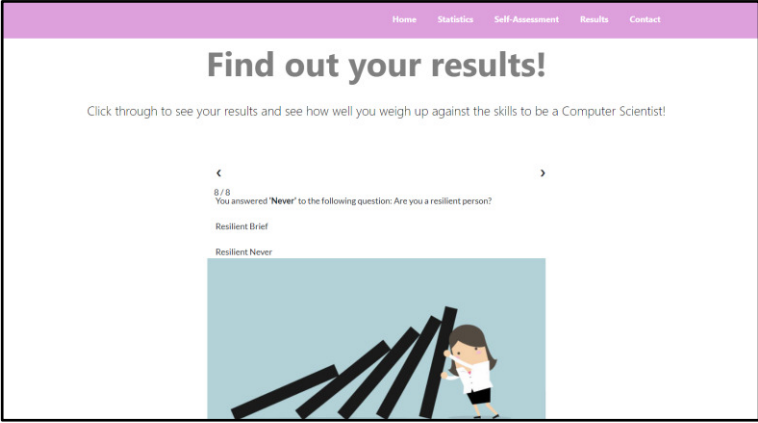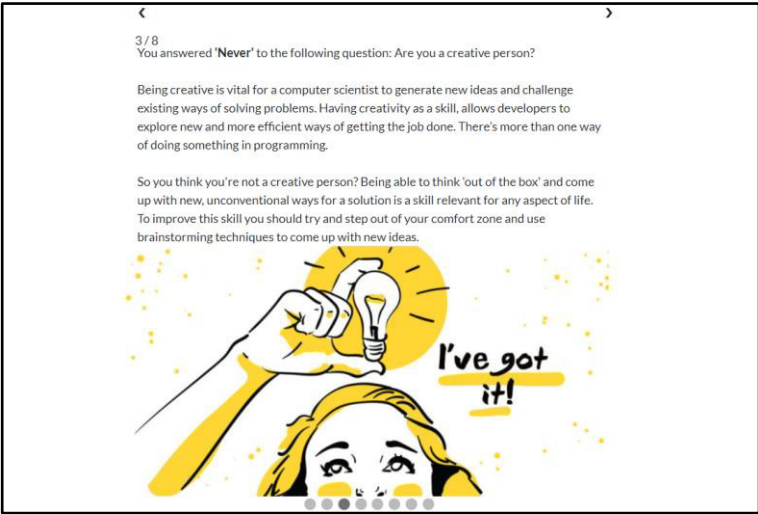
		to the submitted form where the user is thanked for submitting the form and there's a link for the results page.

Test ID	Expected Result	Actual Results
3	When the user clicks on the link to see the results, The 'Results' Page loads.	

Pass/Fail	Comments
Pass	The 'Results' page loads whether the user navigates to the page from the navigation bar or from the link on the submitted form page.

Test ID	Expected Result	Actual Results
4	The results page has a slideshow of the answers for the submitted form.	

Pass/Fail	Comments
Pass	The results are retrieved from the form and the user can find out what their results mean.

Test ID	Expected Result	Actual Results

5	The slide show clicks through up to 8 slides for the 8th skill.	
Pass/Fail	**Comments**	
Pass	The numbers for the slides 8/8 also show the user how far through the slides they are.	

Test ID	Expected Result	Actual Results
6	Each slide has a picture on the skill review.	
Pass/Fail	**Comments**	
Pass	Each picture is different and relevant to the skill.	

Test ID	Expected Result	Actual Results

7	When the user clicks on the 'statistic' page it should load.	
Pass/Fail	**Comments**	
Pass	The 'Statistic' Page loads as expected.	

Test ID	Expected Result	Actual Results
8	When the user hovers over the statistics, they are reactive and show an overlay.	
Pass/Fail	**Comments**	
Pass	The user is able to see that there is an action linked with these statistics and should be prompted to click through the hover.	

Test ID	Expected Result	Actual Results

9	The modal appears for the statistic when the user clicks on the question.	
Pass/Fail	**Comments**	
Pass	The user can see the question that they clicked on and view the answer that is relevant to the question.	

Test ID	Expected Result	Actual Results
10	The 'close window' button closes the modal and returns the user to the statistic page.	
Pass/Fail	**Comments**	
Pass	The user can toggle between modal view and page view by opening and closing the modals.	

Future Work

The potential for future work on this application are plentiful. Through developing a website application, I am able to add multiple web pages to the project and build it up to be a platform that will encourage females to choose IT and not just increase females lack of confidence in IT.

Online Presentation

This application could be used as a tool to be used in schools as a form of female encouragement through presentation. I would intend for this application to be used in a group setting where a teacher or supervisor would lead the presentation to a group of females and it would be interactive in the way that the presenter would click next to follow through to the next section.

This would mean that any school would be able to use this tool and be able to present it to any group of females of any size between the ages of 14-18, without myself, the creator having to be present. The tool would contain all the information and resources necessary to present the information.

If this idea was sought after, it could be set up so that schools or education establishments could sign up for a subscription so that they would get weekly updates about female role models or pay for services that the application may go on to provide.

Results Gathering and Publication of Results

Eventually, my intentions would be to get results from my application and put them onto the website application. With the hope that this application would be used by other schools and colleges, these results would provide evidence that increasing females confidence in the core skills helps to increase the number of females interested in the IT industry.

Someday, the result section of the website application would be a collection of results from a range of ages from different schools. There would be no limitations as to where the form could be used and the form could be set up to use location settings, so I would be able to see where the tool is being used.

Currently, the entries for the form are set up as a single collection, if other schools and colleges used the tool, it could be set up so that the teachers or presenters would fill in some basic information like their location, when they expect users to fill in the forms and how many entries they're expecting in that sitting. From here, I would be able to group the results by location and this would add a type of distinction to my results.

Online Forum

With the hope that my application will branch out to something more than a tool to encourage females that they have the essential skills for the industry, I aspire for it to become a website application where females can communicate on a forum and there might be a frequently asked question section where users can support one another.

Through this forum, I would hope that users would meet like-minded people or perhaps people in the same situation, for example it could be a user who has chosen to take on technology and design for their A-level and they're the only female in a class of twenty. Somebody on the forum might leave a comment of support or encouragement for the concerned user and this could make all the difference in this situation.

Additionally, females who are unsure about entering the IT industry could communicate with professionals who are in the industry to get a real-life insight and perspective about what kind of work they do on a daily basis. This would introduce females to the industry in addition to the targeted users who are interested in entering it.

Conclusions

The root of my project was to find a way to get more females to enter the IT industry. Originally, I thought that I would be able to change females' outlook on STEM. I was planning to encourage females by outlining the benefits that come with a career in the IT industry through facts and figures, in the hope that I could persuade them.

When I began development to implement this, I soon realised that the best route for my application would not be to show females that the IT industry was ready for more females, but that females are ready to enter the IT industry.

From here I investigated why females didn't choose IT and focused on increasing the confidence of their abilities.

After having investigated two different paths for the implementation and researching previous work into the topic. I believe the importance of finding a solution is necessary for the industry to grow however, to solve this problem there needs to be larger societal changes. I have come to the conclusion that women will not change careers or industries through the use of a website. I do believe this project can help the issue in a small way through education and challenging the user's assumptions about their skillset.

I conclude that the application would be successful in educating females about facts and figures about the industry that they didn't previously know.

I also believe that the self-assessment form would have success for increasing self-confidence in females based on the advantages that self-assessment forms bring as mentioned above[45] and the research that I have undergone to make it specific to this topic.

I believe that even if the application works to either get one female thinking about the IT industry for their career path or confirm this for a female who is unsure, then I would deem my project as a success because the solution to this problem will be a slow process.

I can also conclude that making this change at a societal level stems from schools. This was something that became highly relevant when I began researching and was not something I had considered before implementation. Due to this revelation, I believe that my application would have been better focused if I intended for it to be used in schools from the beginning, as it's the early years that career choices are made.

Was the project successful?

In some areas my project was very successful. I feel I worked well at using new technologies such as Umbraco and overcame barriers of knowledge. I also feel I was successful with combining this technology within Visual Studio as the integrated development environment to build up a successful working application.

I feel that I was successful in using different technologies on top of this, for example the javascript code to create the front end modals of the statistics page and I was successful in using the file storage feature of umbraco to access the last record of the form for the results page.

I was happy that I was able to use a MVC design pattern in my application because this is a type of software design that is commonly used with professionals in industry [41].

I also feel that even if the application can not improve the self-confidence of every user, I believe that it will at least help users to become more self-aware of their skills. The ability to do this alone is something that I believe will help females in the IT industry.
I believe that the application has the potential to be extended to be used as a tool in schools to introduce females to the idea of IT as a career path and also as a tool where females can be persuaded further if they are already considering this.

My passion for the topic

I conclude that after undergoing this project I'm only more interested in the topic of females in IT. I believe that researching previous attempts at increasing females in IT and investigating studies, many people feel that this is a problem that needs to be solved.

I have concluded that because I will be a female in IT for the remainder of my career, I will be tackling this problem for the remainder of my time in this industry. Increasing the numbers of females is not going to be a problem that can be solved through one website or one person and will certainly not be solved overnight. However, like all problems it only takes one person to take a step in the right direction.

Reflection on Learning

In hindsight, I believe that at times I found it difficult to focus on one aspect of 'females in IT'. As this topic has such a large range of directions it can go in, I found that I wanted to cover all of them at once rather than targeting one aspect of this problem. If I were to tackle this issue again with the knowledge I have gained, I would focus this project on a particular age group. For example, I would make females who are in their second year of study in GCSEs the focal point, ask them how likely they are to pursue a career in the IT industry. I would allow them to navigate through the web application, involving completing the self-assessment form and exploring the facts and figures on the statistics page. I would then re-ask how likely they are to pursue a career in the IT industry and then record the results.

From this I would be able to analyse the trends in the data and map the rate of change in opinions. I could even take this further and ask them, if their percentage decreased, to outline why they might have been put off the industry. The opposite applies for a percentage increase and then ask the participants to outline which parts of the application persuaded them to consider this career path more than before.

Another avenue this project might have explored could have been using the application in schools. I would have used my application to develop a geographical map of influential women in IT throughout the UK.

From research into existing studies relevant to females in IT, I found that commonly many females couldn't name a female in IT, or those who could, named someone from the 1800s which could be argued that this doesn't reflect on their knowledge about IT role models, but more of their historical knowledge.

This application would allow the user to put their postcode into the search criteria and the application would determine how far they are from famous females in IT, whether that means females who are awarded for their publications and research, or females who are

CEO's or founders of tech companies. I would hope that this application would be a step towards normalising females in IT and making females feel like a career in IT is possible if someone from their area has been successful.

Another route I may have explored would be changing the application to be a supporting tool, this may be that the web application would be live and any user could go onto the site and complete the self-assessment form and view the statistics page.

This design would still satisfy the requirement that females who lacked confidence would be able to check their ability against the core skills relevant for a computer scientist. On reflection, this application could be extended further for users to weigh up their ability in various occupations within the IT industry. This could involve a range that is more specific to exact roles such as a business manager, product owner, a tester or a technical lead.

With regards to changing how the application could have been built up for this project, one thing that doesn't change is how computing is a change that is becoming apparent in everyone's daily life and females need to be an equal part of that change.

References

[1] Office for National Statistics 2019 - "Gender pay gap in the UK", Available at: https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/genderpaygapintheuk/2019 Accessed on 17/3/20

[2] Women in Technology Survey 2019 - "Women in Technology"
Available at: https://www.womenintech.co.uk/women-technology-survey-2019 Accessed on 19/3/20.

[3] UCAS 2019 -"January Deadline Analysis: Subject by sex
Available at: https://www.ucas.com/file/213921/download?token=D2nDRYv0 Accessed on 19/3/20.

[4] HESA 2019 - "HE student enrolments by subject area and sex 2014/15 to 2018/19"
Available at: https://www.hesa.ac.uk/data-and-analysis/sb255/figure-13 Accessed on 20/3/20.

[5] PwC Report 2017- "Women in Tech Report Infographic"
Available at: https://www.pwc.co.uk/women-in-technology/women-in-tech-report-infographic.pdf Accessed on 23/3/20.

[6] IFS 2018 "How can we increase girls' update of maths and physics A-level?"

Available at: https://www.ifs.org.uk/publications/13277 Accessed on 23/3/20.

[7] Positive Psychology 2019 "12 Tips for Building Self-Confidence and Self-Belief"
Available at: https://positivepsychology.com/self-confidence-self-belief/ Accessed on 27/4/20.

[8] Fast Company 2014- "How to Use 10 Psychological Theories to Persuade People"
Available at: https://www.fastcompany.com/3030173/how-to-use-10-psychological-theories-to-persuade-people Accessed on 27/4/20.

[9] The Centre for HAS 2015 - "The Importance of Self Reflection"
Available at: https://www.thecenterforhas.com/the-importance-of-self-reflection/ Accessed on 27/4/20.

[10] McKinsey 2015 - "How advancing women's equality can add $12 trillion to global growth"
Available at: https://www.mckinsey.com/featured-insights/employment-and-growth/how-advancing-womens-equality-can-add-12-trillion-to-global-growth Accessed 29/4/20.

[11] Guardian Interview 2017 - "Would tech be different if women made up half the workforce?"
Available at: https://www.theguardian.com/careers/blog/2017/oct/12/gender-parity-women-tech-equality-workforce Accessed on 29/4/20.

[12] Career Addict 2019 - "The 20 Highest-Paying Jobs in the World"
Available at: https://www.careeraddict.com/the-highest-paid-jobs-in-the-world Accessed on 29/4/20.

[13] Obama Archives 2014 - "Remarks by the Present at the White House Science Fair"
Available at: https://obamawhitehouse.archives.gov/the-press-office/2014/05/27/remarks-president-white-house-science-fair Accessed on 30/4/20

[14] PwC Tech She Can 2020 -"The Tech She Can Charter"
Available at: https://www.pwc.co.uk/who-we-are/women-in-technology/tech-she-can-charter.html Accessed on 29/4/20.

[15] Engaging Females in STEM 2017 - "Engaging Females in STEM"
Available at:
https://search.proquest.com/openview/b534ecb4a0753708d9a5c95b2369b403/1?pq-origsite=gscholar&cbl=34845 Accessed 1/5/20

[16] Simply Psychology 2018 - "Asch Conformity Experiment"
Available at: https://www.simplypsychology.org/asch-conformity.html
Accessed 2/5/20.

[17] UK Population 2020 - "UK: Population by country"
Available at: https://www.statista.com/statistics/294729/population-united-kingdom-uk-by-country/ Accessed 3/5/20.

[18] NI Single-Gender Schools 2017 - "Category: Single-gender schools in Northern Ireland"
Available at: https://en.wikipedia.org/wiki/Category:Single-gender_schools_in_Northern_Ireland Accessed 3/5/20.

[19] Wales Single-Gender Schools 2017 - "Category: Single-gender schools in Wales"
Available at: https://en.wikipedia.org/wiki/Category:Single-gender_schools_in_Wales Accessed 3/5/20.

[20] Scotland Single-Gender Schools 2017 - "Category: Single-gender schools in Scotland"
Available at: https://en.wikipedia.org/wiki/Category:Single-gender_schools_in_Scotland Accessed 3/5/20.

[21] England Single-Gender Schools 2017 - "Category: Girls' schools in England"

Available at: https://en.wikipedia.org/wiki/Category:Girls%27_schools_in_England Accessed 3/5/20.

[22] Impact of Stereotypes on Self-concept 2017 - "The Impact of Gender Stereotypes on the Self-Concept of Female Students in STEM Subjects with an Under-Representation of Females".
Available at: https://www.frontiersin.org/articles/10.3389/fpsyg.2017.00703/full Accessed on 3/5/20.

[23] Tech Stereotypes 2016 - "Too geeky for girls? Tech industry stereotypes are hindering equality" Available at: https://www.theguardian.com/sustainable-business/2016/may/13/geeky-image-girls-tech-industry-stereotypes-hinder-equality Accessed 3/5/20.

[24] BCSWomen 2016 - "The BCS Specialist Group that provides networking opportunities for all BCS professional women working in IT around the world"
Available at: https://bcswomen.bcs.org/ Accessed 3/5/20

[25] WISE 2020-" Role Model Registration"
Available at: https://www.wisecampaign.org.uk/role-model-registration Accessed 3/5/20.

[26] Very Well Mind 2020 -"Psychological Methods of Persuasion"
Available at: https://www.verywellmind.com/how-to-become-a-master-of-persuasion-2795901 Accessed 3/5/20

[27] PNAS 2008 -"Visual long-term memory has a massive storage capacity for object details"
Available at: https://www.pnas.org/content/105/38/14325 Accessed 3/5/20.

[28] Designing Web Forms 2017 -"Designing Efficient Web Forms: On Structure, Inputs, Labels and Actions"
Available at: https://www.smashingmagazine.com/2017/06/designing-efficient-web-forms/ Accessed 8/5/20.

[29] UX World 2018 -"7 Rules of Using Radio Buttons vs Drop-Down Menus"
Available at: https://uxdworld.com/2018/05/06/7-rules-of-using-radio-buttons-vs-drop-down-menus/ Accessed 9/5/20.

[30] Form Storage Singleton 2019 -"Using Umbraco and Getting Started"
Available at: https://our.umbraco.com/forum/using-umbraco-and-getting-started/99493-formstorage-inaccessible-now-in-forms-for-v8 Accessed 9/5/20.

[31] Paul Seal 2020 - "Youtube Tutorials"
Available at: https://www.youtube.com/user/pcHelpFromPaul/about Accessed 10/5/20.

[32] Umbraco 8 website Tutorial 2020 - "How to build a website with Umbraco v8"
Available at: https://www.youtube.com/playlist?list=PL90L_HquhD-
_N2mO8kYzhZL15sh1lyxVKAccessed 10/5/20.

[33] Freelancer Template 2014 -"Freelancer - One Page Theme"
Available at: https://startbootstrap.com/themes/freelancer/ Accessed 10/5/20.

[34] Rules for UX Writing 2018 - "16 Rules of Effective UX Writing" Available at:
https://uxplanet.org/16-rules-of-effective-ux-writing-2a20cf85fdbf Accessed on 10/5/20.

[35] Moove Agency 2019- "The Advantages of Slideshows"
Available at: https://www.mooveagency.com/web-design/web-design-tip-the-advantage-of-
slideshows/ Accessed on 10/5/20.

[36] Picture Superiority Effect 2020- "Picture Superiority Effect"
Available at:https://en.wikipedia.org/wiki/Picture_superiority_effect Accessed on 10/5/20.

[37] Childers, T.L. and Houston, M.J., 1984. Conditions for a picture-superiority effect on
consumer memory. Journal of consumer research, 11(2), pp.643-654. Available at:
https://www.researchgate.net/profile/Terry_Childers/publication/239278291_Conditions_for_
a_Picture-Superiority_Effect_on_Consumer_Memory/links/00b7d529ce9df9422a000000.pdf
Accessed on 10/5/20.

[38] W3 Schools 2020- "How To Slideshow" Available at:
https://www.w3schools.com/howto/tryit.asp?filename=tryhow_js_slideshow Accessed on
10/5/20.

[39] Our Umbraco 2019 - "Form Storage V8"
Available at: https://our.umbraco.com/packages/backoffice-extensions/form-storage-v8/
Accessed on 10/5/20.

[40] Our Umbraco 2019 -"Install Umbraco with NuGet" Available at:
https://our.umbraco.com/documentation/getting-started/setup/install/install-umbraco-with-
nuget Accessed on 20/5/20.

[41] Stack Exchange 2011 - "Is the MVC pattern used in industry a lot?" Available
at:https://softwareengineering.stackexchange.com/questions/89721/is-the-mvc-pattern-used-
in-industry-a-lot-whats-all-the-hype Accessed on 21/5/20.

[42] History Extra 2020 - "The changing role of women in British computing"
Available at: https://www.historyextra.com/period/20th-century/the-changing-role-of-women-
in-british-computing/ Accessed on 25/5/20.

[43] Pluralsight 2020 – "C# Development"
Available at: https://www.pluralsight.com/paths/csharp Accessed on 25/5/20.

[44] Question Pro 2020- "Characteristics of a Questionnaire"
Available at: https://www.questionpro.com/blog/what-is-a-questionnaire/#Characteristics_of_a_Questionnaire Accessed on 25/5/20,

[45] Self Peer 2010- "Self and Peer Assessment"
Available at: https://ar.cetl.hku.hk/self_peer.htm Accessed on 25/5/20.

[46] Economic Times 2017 - "How societal norms work against women choosing STEM careers. Available at: https://economictimes.indiatimes.com/small-biz/entrepreneurship/how-societal-norms-work-against-women-choosing-stem-careers/articleshow/60804962.cms?from=mdr Accessed on 26/5/20.