Improving Access to Resource Utilisation Education

Jack Simms

UP891784

A dissertation submitted in partial fulfilment
of the requirements for the degree of
Bachelor of Science
of the
University of Portsmouth.

School of Computing
Engineering Project

2023

Declaration

No portion of the work contained in this document has been submitted in support of an application for a degree or qualification of this or any other university or other institution of learning. All verbatim extracts have been distinguished by quotation marks, and all sources of information have been specifically acknowledged.

Date: 2023

Abstract

This dissertation initiates the development of the web platform - "WhatCanYouDoWith," a tool designed to address the global problem of scarcity and unsustainable resource consumption. Harnessing the immense potential of software engineering to stimulate sustainable behaviors, the project aims to induce sustainable behavioural change, whilst also increasing global productivity, reducing poverty and waste, and improving access to education. The presented work reveals a gap in resource utilisation education and technology that provides it, proposing an innovative solution for public engagement. Despite constraints and challenges encountered, the project lays a solid foundation for the continued development of "WhatCanYouDoWith," which hopes to inspire further novel software solutions that address the concerns of climate change.

Acknowledgements

Thank you Dr Rich Boakes and Dr Gail Ollis, for supporting me and helping me to believe in myself again.

Consent to Share

I consent for this project to be archived by the University Library and potentially used as an example project for future students.

Contents

List of Tables

List of Figures

Chapter 1

Introduction

1.1 The Problem

Resources are scarce, but human wants are unlimited. This is the "Problem of Scarcity" – the inherent tension between human expansion and the finite resources of our planet offers, (Sloman and Garratt, 2018). This fundamental issue underpins all economic study and has taken on a new sense of urgency in the face of accelerating climate change and unsustainable resource consumption patterns.

1.1.1 Context

The pressing issue of scarcity has reached a critical juncture, amplified by the deepening climate crisis. The 2015 Paris Agreement was monumental global pact on which member nations agreed to curbing climate change by reducing greenhouse gas emissions (United Nations, 2015). Despite this accord, the crisis has only intensified in 2023, a fact strongly supported by contemporary research presented in Chapter 2.

Further crises have only made global sustainability efforts more difficult. With recent events such as: The economic shockwaves of the COVID-19 pandemic claiming over 7 million lives (WHO, 2023), Russia's Ukrainian invasion (United Nations, 2023b) and escalating global conflicts (United Nations, 2020), climate change is at risk of being overshadowed; when in-fact it should be addressed as humanities largest threat.

Software engineering offers a unique perspective to stimulate sustainable behavioural changes. Without rapid, collective action to incorporate sustainability practises into our daily lives, future generations may inherit an unrecognisable world. This software engineering project aims to address scarcity by developing the beginnings of a solution that aims to boost productivity and economic growth, whilst also fostering sustainable behaviours globally.

1.2 Goals/Aims/Objectives

This project sets out with the long term, ambitious goals of:

1. Reducing global poverty (G1).
2. Increasing global productivity and innovation (G2).
3. Reducing global waste production (G3).
4. Promoting and foster sustainable behavioural change within individuals worldwide (G4).
5. Improve access to factual and useful education (G5).
6. Inspire ambitious innovative solutions to combat climate change (G6).

These broad goals will be dissected into specific, measurable targets in the requirements chapter, to ensure that the project's deliverable's are both ambitious, but also feasible, given the project constraints.

1.3 Project Limitations and Constraints

As an undergraduate software engineering student working solo in their final year of study, various constraints are faced, and risks posed. Potential issues can arise from mental health, stress, limited knowledge, university degree responsibilities, and above all, time. Specific detail on these limitations will be provided in requirements, Chapter 4, where they will be evaluated before the setting of specific tasks to complete the project, ensuring the scope is achievable.

1.4 Structure of Report

- Literature Review, Chapter 2, journeys through the relevant literature, revealing a gap in knowledge that this project aims to address.
- Proposal, Chapter 3, reviews current solutions to bridge the gap, before outlining this project's unique solution.
- Requirements, Chapter 4, breaks down the project's goals, Section 1.2, into specific, measurable targets, setting the stage for the software development to follow.
- Methodology, Chapter 5, explains the chosen agile development process, justifying its use in the context of the project's specific requirements, formulating a plan detailing the project's expected progression.
- Design, Chapter 6, describes how the proposed platform will meet the requirements previously identified.

- Implementation, Chapter 7, documents the practical steps taken to develop the project in line with the Design chapter.
- Evaluation, Chapter 8, provides an assessment of the final project and all aspects of work done, including a personal reflection on the project journey, detailing lessons learnt.
- Future Work, Chapter 9, provides clear instructions to carry on the development of the proposed solution.
- Conclusion, Chapter 10, summarises the project, assessing the success of achieving the goals of this project outlined in Section 1.2.

Chapter 2

Literature Review

2.1 Introduction

This literature review provides a narrative through the established problem of scarcity, Section 1.1, investigating further until a gap is discovered. This chapter providing context for conceptualisation of the proposed software solution in Chapter 3.

2.1.1 Literature Review Structure

The literature review starts by examining the current state of the planet and the pressing need for progress towards achieving the "United Nations Sustainable Development Goals" (UN SDGs) by 2030 (United Nations, 2022). This progress is essential in order to prevent the continuation of irreversible damage, mitigating the potential for natural disasters, ensuring the continued survival and well-being of all humanity on Earth.

Education is then explored as a mitigation method to combating climate change and its limitations, exposing a gap in the provision of resource utilisation education.

2.2 Current State of Planet Earth

Search Strategy

The April 2022 report "Climate Change 2022: Mitigation of Climate Change" provides a comprehensive evaluation of climate change mitigation strategies across 2258 pages (IPCC, 2022). This literature review heavily utilises this report and its wealth of cited references to provide further investigation.

Investigation Results

In 2023, environmental challenges pose some of the greatest threats humanity faces. Global population reached approximately 7.89 billion in 2021, increasing from 7.82 billion in 2020, (World Bank, 2023); putting severe stress on the Earth's resources and ecosystems. This rapid increase in population leads to quick urbanisation, rising waste production, and unsustainable consumption habits (Hoornweg & Bhada-Tata, 2012;

World Bank, 2022). In 2018, humans created 2.01 billion tons of waste in that year alone, a number expected to reach 3.40 billion tons in 2050; leading to significant health and environmental issues (Kaza et al., 2018).

In 2023, global unrest is at its highest since 1946, with two billion people living in areas affected by ongoing conflict (United Nations, 2022). According to Kreibiehl et al. (2022), the COVID-19 pandemic it continuing to complicate matters; as it economic shock-waves have lead, leading to job losses, a rise in poverty, long-term impacts on public health and education, and increased public debt across the globe. Sectors like tourism and trade, crucial for jobs and income of which manly nations rely on, (UNWTO, 2023; World Bank, n.d.) will take time to recover, (Eichengreen et al., 2021). These challenges continue to slow progress towards a more sustainable world, as resources and public attention are largely devoted to dealing with the pandemics trauma, resulting in most governments unable to foster a low-carbon transition, (Hepburn et al., 2020; Maffettone & Oldani, 2020; Steffen et al., 2020).

The sources cited by Kreibiehl et al. (2022) highlight the need for more co-operation in reducing greenhouse gas emissions and improving the climate situation. Critically analysing, it can be indirectly deduced that there is an over-reliance on government bodies and policies to drive progress in mitigating climate change. It is crucial to consider these sources' limitations, biases, or gaps in their analysis; operating in such a manner enables this review to provide a more balanced and critical view of our planet's current state and the challenges it faces.

2.2.1 Impending Doom?

The Secretary General of the United Nations published a worrying report in May 2023, assessing the progress towards the Sustainable Development Goals (SDGs) (United Nations, 2023a). These goals, agreed upon by all UN member states in 2015, aimed for full achievement by 2030. The report assesses and reports how global crises, such as the COVID-19 pandemic and Russia's invasion of Ukraine, have drastically affected efforts towards achieving the SDGs. The upcoming UN SDG summit in September 2023 is expected to stress an urgent need for immediate change and concerted actions from all nations, seeking to mitigate the upcoming wave of environmental devastation, that humanity will endure, due to our environment's deteriorating condition (United Nations, 2022).

United Nations (2023b) paints a stark picture with only approximately 12% of the SDG targets expected to be achieved by 2030. Further, it states that nearly half of the targets are off track to varying degrees despite showing progress, in addition, the report states around 30% have seen no advancement or have regressed below the baseline set in 2015 (refer to Figure 2.1).

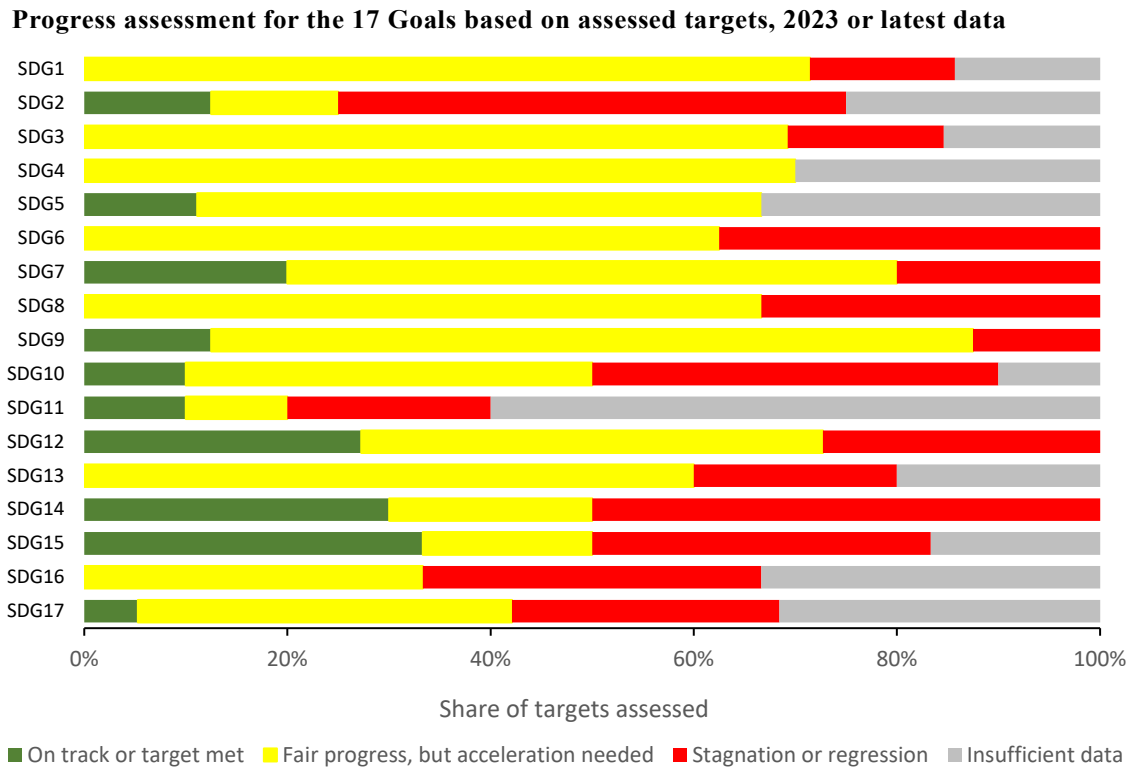

Figure 2.1: Progress Assessment of UN SDGs 2023 (United Nations, 2023b)

Listing some key statistics from the United Nations (2023b) and United Nations (2022) sources include:

- 575 million people (nearly 7% of the world's population) are projected to still be living in extreme poverty in 2030, compared to 800 million in 2015 (10.8%) (United Nations, 2023b, p. 7).
- Hunger levels have returned to where they were in 2005, with 1 in 10 people worldwide suffering from hunger and 1 in 3 people lacking regular access to adequate food (United Nations, 2022).
- An estimated 84 million children and young people are still out of school, and around 300 million students lacking basic numeracy and literacy skills by 2030 (United Nations, 2023b, p. 10).
- Only 82% of municipal solid waste is collected globally, with only 55% of that managed in controlled facilities such as recycling plants (United Nations, 2022).
- The global average temperature is projected to rise to 1.5°C, leading to the loss of 70-90% of coral reefs; if the temperature rises to 2°C, all coral reefs will die (United Nations, 2022).
- Sea levels are projected to rise by 30-60cm by 2100 at current trajectories (United

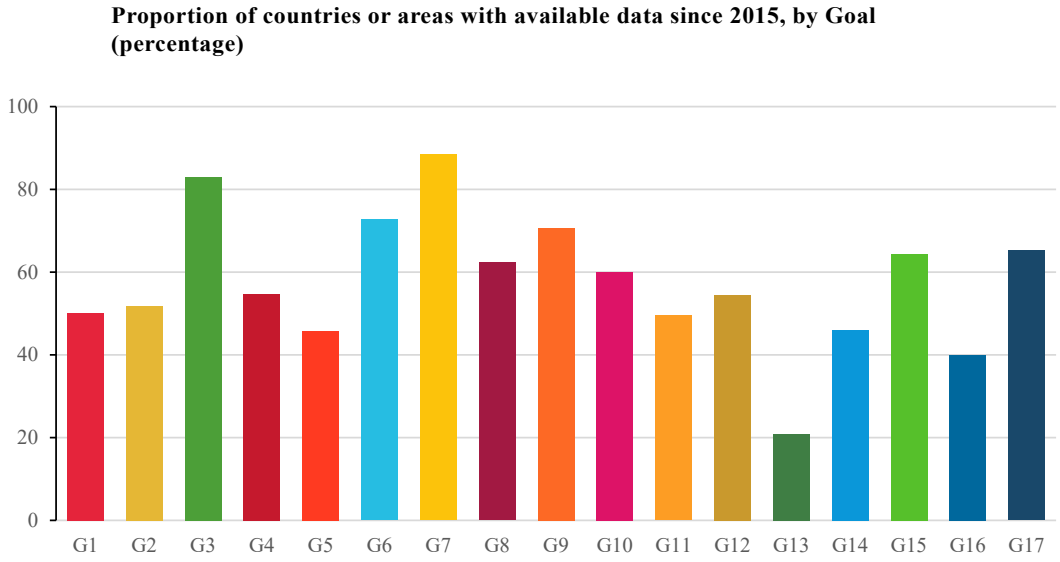

Figure 2.2: SDGs with Available Data Table (United Nations, 2023b)

Nations, 2022).

- Climate finance from developed countries reached only $79.6 billion in 2019, falling short of the $100 billion annual target (United Nations, 2022).

- CO2 emissions increased by 6% in 2021, reaching the highest-ever level (United Nations, 2022).

The report, although providing insightful information, admits difficulties in monitoring SDG data due to geographic coverage, timeliness, and disaggregation problems (United Nations, 2023b, p. 6) which is represented by Figure 2.2. Despite these limitations, this is likely to be, worryingly, highly accurate due to the credibility of data that is available.

the literature accentuates the immediate necessity for action. It highlights the importance of responding to the global emergency to of climate change and spotlights the further need for help from outside governing bodies to drive change, which alludes to the potential of software engineering to help.

The upcoming UN SDG summit in September 2023 will hopefully provide a platform for nations to re-evaluate their approaches and promote increased collaboration to surmount these obstacles, however it is unlikely that any monumental action will incur given the current political and economical climate; therefore, greater action from individuals is evidently required.

2.3 Education's Role in UN SDGs

Education plays a pivotal role in achieving all the UN SDGs. The following analysed literature proves, that by improving education and accessibility to knowledge, greater sustainable behaviours can be fostered.

2.3.1 OER and Poverty Reduction

UNESCO (2021) suggests that Open Education Resources (OER) can help reduce poverty, a key goal of the Sustainable Development Goal (SDG) 1, (United Nations, 2023a).

By making educational resources more accessible, OER provides people with the knowledge and skills needed to get better jobs and improve their lives (UNESCO, 2010). As a result, their financial situation can improve, indirectly contributing to the fight against world hunger, or SDG 2 (United Nations, 2023a), as people will be able to afford more and better food; given the close relationship between poverty and malnutrition (Siddiqui et al., 2020, p. 8). This idea is supported by Lecocq et al. (2022), who points out that accessible education can help low-skilled workers adapt to technological changes, thereby improving their job prospects. Helping individuals stay competitive in existing and emerging job markets.

2.3.2 Income Inequality

Income inequality is rive across the globe as shown by (OECD, n.d.). However, Job creation and education can help reduce inequality, alongside poverty. This is evidenced in South Africa and India by Rao and Min (2018) and Winkler et al. (2015), who argues it gives lower income households the skills to improve, providing opportunities to adapt to the rapidly changing environment. By offering public re-training schemes that improve employability, income inequality, as represented by the GINI ce-efficent, (OECD, n.d.), will likely decrease. By providing education that encourages sustainable mindsets, thus individuals will be more likely to aid progression towards mitigating climate change as they directly benefit from it, as it provides them with greater employability.

2.3.3 Environmental Attitudes

Research indicates that increased environmental knowledge can lead to more environmentally favourable attitudes amongst students. A study by Bradley et al. (1999) found that 22% of student's environmental knowledge scores increased after completing a course in environmental science. Furthermore, their attitudes towards environmental policy and sustainable practices improved also. Therefore, providing up-to-date, environmentally-aware education can foster sustainable behaviours and attitudes, leading to a scalable method of achieving economic growth that considers the environment, however the limitations of this data should not be ignored, as it targets only individuals from Texas, USA;

twenty-four years ago.

2.3.4 Education for Sustainability

UNESCO's "Education for Sustainability" initiative aims to develop a comprehensive understanding of the intricate relationships between environmental, social, and economic systems, thereby enabling informed decision-making and responsible resource use. This holistic approach to education is essential for fostering the skills required for sustainable living, such as critical thinking, collaboration, and problem-solving (UNESCO, 2017). Sustainable living is not only about individual actions but also about systemic changes that require a collaborative and informed approach to problem-solving.

Workshops vs Formal Education

Denton et al. (2022) emphasises the importance of climate change education and action-oriented research in shaping mindsets and promoting climate-friendly development pathways. Through social experiments and real-world labs, research has facilitated shifts in thinking about energy, food, transport, and other systems, leading to more sustainable behaviours and practices, of which may prove more successful than Bradley et al. (1999). This understanding is further supported by various credible literature sources, of which they all provide evidence that through the provision of education, sustainability practises are increased (Berkhout et al., 2010; Bernstein & Hoffmann, 2018; Bulkeley et al., 2014; Fazey et al., 2018; Hoffman, 2010; Ives et al., 2020; Schäpke et al., 2018; Schneidewind et al., 2016).

Indirect Behavioural Change

To bring about tangible change in unsustainable behaviours, it is essential to make the impacts of climate change more relatable and comprehensible to individuals. Simply providing ambiguous facts about the environment's decline, of which United Nations (2022) does, may not be enough to elicit change, as people may struggle to visualise the greater impact of climate change on their lives, until it is too late. from Denton et al. (2022) and the other sources cited in Section 2.3.4, it is clear that in order to bring about a change towards greater sustainable behaviour, the education of sustainability should be subtle, learnt in the background whilst primarily learning new skills that address households immediate problems, such as inequality, poverty and famine. By improving these directly, with sustainable practise woven in, individuals will be likely to adapt sustainable behaviour changes.

2.3.5 Finnish Case Study

Babiker et al. (2022) shines light on an example of using education to promote healthy and sustainable dietary behaviours through the provision of software: Raising awareness about food choices through multimedia campaigns and the "Food Facts" website

project. The Finnish government contributed to sustainable development, successfully reducing national food waste, (Agriculture & Forestry, 2021; Finland, 2017; Luke, 2021), as a result of the deployment of the website. However, much like the static attempts made to communicate sustainability education of Bradley et al. (1999) and United Nations (2023a), a software solution that teaches through practical application could prove more beneficial, as backed up by Section 2.3.4.

2.3.6 Conclusion

In conclusion, is it clear from the credible literature that education is a fundamental tool that needs to be utilised in order to achieve the UN SDGs. Education can create long-term sustainable behavioural changes whilst also improving job mobility through teaching and training that considers the environmental impact. Regardless of subject, individuals can be empowered to contribute to sustainable development by improving their financial situations while operating with sustainability in mind.

2.3.7 Challenges and Future Directions

While the referenced literature highlights the need for a revolution in incorporating greater sustainability into education, providing evidence of its effectiveness, it largely omits the challenges surrounding access to education in general. This omission poses a serious bottleneck to the impact that increased education could bring towards achieving greater global sustainability. Overcoming the challenge of accessibility will be crucial, to fully realise the potential of education in promoting sustainable development and achieving the UN SDGs. UNESCO has started good progress in this challenge, with OER as shown in Section 2.3.1, however it is clear more can be done.

2.4 Barriers to Education Accessibility

Accessibility to knowledge and education has historically restricted societal progress and enlightenment. This section examines the current state of global knowledge accessibility in 2023, discussing the issues and potential solutions that could lead to the achievement of the UN SDGs through greater accessibility of knowledge, and thus education.

Accessibility to education is crucial for equipping learners with the knowledge and skills needed to promote sustainable development (UNESCO, 2017). Lecocq et al. (2022) suggests that education and training can mitigate labour market impacts, such as job losses from crises and automation technologies, by preparing workers for job changes.

2.4.1 Current State of Education Accessibility

in 2023 various barriers limit access to education, such as financial constraints, limited access to educational resources and digital infrastructures, and socio-economic disparities. Denton et al. (2022) highlights the equity issues that emerge in households due to the inability of low-income groups to afford the introduction of new technologies.

2.4.2 Internet Accessibility

Although global internet uptake has increased from 54% to 63% between 2019 and 2021 (United Nations, 2022), however, this progress is not sufficient enough to close the currently significant gaps in education accessibility. UNEP (2019) notes that knowledge gaps regarding the link between material efficiency and climate change mitigation continue to exist, but the report does not explore how to better distribute this knowledge.

2.4.3 Food Waste

Babiker et al. (2022, p. 1294) cites that some consumers are reluctant to adopt sustainable healthy dietary patterns due to a lack of awareness or knowledge on how to prepare or eat unfamiliar foods.

Temme et al. (2020) argues that more policy is required to encourage the consumption of plant-based proteins in order to reduce greenhouse gas emissions. However, Nabuurs et al. (2022, p. 825) argues that educational approaches have limited potential due to free-riders, rebound effects, and other limitations.

2.4.4 Socioeconomic Influences on Education Accessibility

Socioeconomic factors significantly impact knowledge accessibility. The United Nations (United Nations, 2023b, p. 31) reports that only one in 10 people in the world have access to assistive technology products and services. This finding emphasises the need for more equitable distribution of technological resources. Similarly, the UN's estimates that children living in "learning poverty" could possibly reach 70% by 2030 (United Nations, 2023b, p. 32), highlighting the importance of addressing the root causes of learning poverty.

2.4.5 Concluding on Education Accessibility

In conclusion, knowledge accessibility remains a significant challenge in achieving the UN SDGs through the provision of education. While the literature provides insights into these challenges, there is a huge lack discussion of potential innovative solutions to overcome these barriers.

For example, while the authors identify a problem in Section 2.4.3, they do not delve into the role technology could play in disseminating knowledge and awareness about sustainable diets, educating on how to eat and prepare unfamiliar foods.

2.5 The Knowledge Gap

2.5.1 The Need for Technological Innovation

The literature analysed suggests a clear need to improve the accessibility of education in order to improve sustainability. The United Nations (2023b) report emphasises the importance of enhancing digital literacy and data literacy, both in and outside the public

sector, with a focus on self-reliance and lifelong learning (p. 32). This includes investment in inclusive and accessible digital infrastructures to ensure meaningful connectivity for all (p. 32), further investment could therefore solve the bottleneck identified in Section 2.4.2. Furthermore, the report underlines the potential of science, technology, and innovation (STI) in addressing the SDGs and the need for increased funding for SDG-related research and innovation on underlying social issues (p. 40). As this report was published only in May 2023, it shrieks out to the reader that there is a clear need for innovative works to break down the barriers of access to education and knowledge.

2.5.2 Education as a Solution

Education plays a crucial role in addressing the inefficiencies in current resource utilisation practises. Building trust in scientific knowledge is essential and can be achieved through open and inclusive platforms (p. 40). It is blindingly clear from the literature that by increasing SDG-related innovation, it becomes possible to provide the necessary education and accessibility to promote sustainable resource utilisation practises across the globe (p. 40), helping to solve the issues of the accessibility of education as shown in Section 2.4.1; helping to reduce waste from inspiring greater sustainable practice.

2.5.3 Literature Gap Identified

Although research specifically focused on education surrounding proper and sustainable resource utilisation is limited (see Table 2.1, p25), a substantial body of literature exists on education for sustainability, as previously noted.

2.5.4 Search Results

A search was performed on the EBSCO database to search for literature surrounding sustainable resource utilisation education, it should be noted this search is limited by the database, and the search terms.

Search Terms	**Search Engine**	**Number of Results**	**Search Description**	**Search Outcome**
Sustainable consumption and production	EBSCO	1,265	Initial search	The majority of results focus on the business aspect of the subject
"Sustainable consumption and production" and "teaching"	EBSCO	6	Focused on studies investigating the teaching of sustainable practices	There's an evident lack of research regarding the teaching of sustainable consumption and production; none of the found articles were relevant

Search Terms	Search Engine	Number of Results	Search Description	Search Outcome
"Sustainable consumption and production" and "teaching" and "resource utilisation"	EBSCO	0	Attempt to find academic literature combining the three primary topics of the project	No results indicate a dearth of research on education promoting sustainable consumption and production via the teaching of sustainable resource utilisation
"Teaching" and "resource utilisation"	EBSCO	139	Searching for models developed for teaching resource utilisation	All results were specific to medical studies and detailed different resource utilisations within this domain
"Education" and "resource utilisation"	EBSCO	313	Searching with 'education' instead of 'teaching' to observe any change in results	Results continued to remained highly specific to the field of medicine, with no information on general education benefits of sustainable resource utilisation
"Education" and "resource utilisation" and software	EBSCO	20	Adding 'software' to the previous search parameters	None of the 20 results were relevant; all were related to medicine and health
"Education" and "resource utilization"	EBSCO	10,120	Incorporating the American English spelling of "utilisation"	The vast majority of results pertained to medical studies, with no findings on resource utilisation education. However all were not read due to time constraints, omitting possible relevant literature
"Education" and "resource utilization" and software	EBSCO	855	Adding 'software' to the previous search parameters	Despite a large number of results, the focus remained predominantly on medicine
"Education" and "resource utilization" and software NOT medicine or medical or health	EBSCO	59	Adding exclusions for medicine, medical, or health to previous search parameters	None of the 59 results were relevant, focusing instead on child education, cloud computing, or medicine

Search Terms	Search Engine	Number of Results	Search Description	Search Outcome
Sustainability and accessibility to education	EBSCO	1,371	Initial search	Too many results to process effectively, needs narrowing
Sustainability and "accessibility to education"	EBSCO	464	More specific search for relevant articles	Primarily results pertaining to medical studies, thus not relevant
Sustainability and "accessibility to education" NOT medicine or medical or health	EBSCO	351	Excluding medical-related articles by adding NOT medicine, medical, or health to previous search parameters	No obvious relevance in results
Sustainability and "accessibility to education" NOT medicine or medical or health AND resources	EBSCO	95	Adding "and resources" to the previous search parameters	Only one relevant result, which was marginally related, suggesting Open Educational Resources as a means to increase accessibility of education, of which is already known to be useful from Section 2.3.1. However, the focus is on higher education, which is not the target of this tool that aims to provide general knowledge with a focus on "resource utilisation," - (Geith & Vignare, 2007)
Noun and utilization	EBSCO	199	Exploring the use of 'noun' as a potential keyword due to its similar definition to 'resource'	All results focused on language learning, with no definitions of the uses of nouns in the respective studies
Noun and utilization and education	EBSCO	21	Narrowing down the previous search parameters	All articles were irrelevant; none of the 21 results were relevant

Table 2.1: Search Summary Table

The term "Education" carries varied interpretations across different sources. Often, it encompasses primary, secondary, or higher education along with associated reforms. This is unfortunate, and continues to back up the need for a focus on innovation and life-long learning, rather then addressing issues surrounding educational policy and politics, as noted by Section 2.4.5. Within this project's context, "Education" simply means the act of learning, encompassing any resource or activity that promotes direct learning.

Although the "EBSCO" system doesn't present direct results related to sustainable resource utilisation or its education, it is clear that enhancing accessibility to knowledge aids in sustainability education. Thus, greater accessibility to education on sustainable resource utilisation should be acknowledged as a crucial factor in achieving the UN SDGs, even if it's not explicitly documented in the "EBSCO" system or other analysed literature yet.

2.5.5 Conclusion of Gaps

sustainable resource utilisation education is discovered as a knowledge gap as shown by the table Table 2.1. The other evident gap is shown by the lack of technological innovation to solve the the problem of accessibility to education, as shown in Section 2.4.5.

2.6 Conclusion of Literature Review

This review has discussed and critically analysed various aspects, including Planet Earth's current state, the role of education in achieving the UN SDGs, barriers to education accessibility, inefficiencies in resource utilisation, and the literature gaps identified in Section 2.5.5.

2.6.1 Summary

Summarising the revelations, it has been found that much of the literature aimed at enhancing education is through policy implementation, revealing a noticeable lack of innovative technologies in bringing about sustainable behavioural changes, giving way to the recent call for greater Science, Technology and Innovation (STI) made in May 2023 by United Nations (2023b) to resolve this. As a result of a lack of STI, the literature does not present quantifiable data in how the provision of greater STI for sustainability will close the gaps identified in Section 2.5.5. Therefore, more research is needed in order to measure its potential to bring about sustainable behavioural changes, as the literature critically analyses presents none.

Chapter 3

Proposal

This chapter builds on the findings from the previous literature review to present the proposed solution for this dissertation project, which aims to address the identified knowledge gap of sustainable resource utilisation education and technologies that provide it Section 2.5.5.

3.1 Resource Utilisation Education

3.1.1 Definition

"Resource Utilisation Education" (RUE) can be succinctly defined as education focused on the effective use of available resources (Cambridge Dictionary, 2019, 2022).

3.2 Existing Digital Platforms Providing RUE

The development of a platform that seeks to provide Resource Utilisation Education (RUE) necessitates a comprehensive understanding of the existing digital platforms that currently exist. By, examining the strengths and weaknesses of these platforms, potential areas for enhancement by the proposed solution can be pinpointed, providing insights that will be invaluable in shaping the design requirements of the proposed software tool.

To identify such platforms, an exhaustive search will be conducted with the aim of locating digital platforms focused on delivering RUE. This investigation will yield an overview of the most pertinent platforms discovered, each of which will then be critically analysed in depth.

3.2.1 Search Strategy

To search for existing tools that provide resource utilisation education, a combination of search engines, social media platforms, and online communities focused on sustainability and waste reduction were searched. The keyword search terms used for this were: "waste reduction apps," "sustainable living tools," "zero waste platforms," and "online resources for sustainable living." From the searches, the following websites were found:

(see Table 3.1, p28)

Platform	Concept	Relevance	Justification
LoveFood Hate Waste	Food waste reduction tips and recipes	Highly relevant	Directly addresses resource utilisation, offers practical tips, and provides resources for users.
Zero Waste Chef	Recipes and tips for sustainable living	Highly relevant	Offers comprehensive guidance on sustainable living choices, which is an essential aspect of resource utilisation.
OLIO	Food sharing revolution app	Relevant	Focuses on reducing food waste by sharing resources.
Ecolife Recycling	Waste reduction guide	Relevant	Only provides helpful guidance on reducing waste.
Earth911	Recycling search platform	Moderately relevant	Covers recycling information, but lacks broader coverage of resource utilisation.
FoodKeeper App	Food storage and shelf life information	Moderately relevant	Addresses food waste reduction, but does not cover the full scope of resource utilisation.
Too Good To Go App	App to rescue unsold food from local businesses	Relevant	Helps reduce food waste, but doesn't provide education.
ShareWaste App	App connecting composters with neighbors	Moderately relevant	Encourages composting and waste reduction, but not as comprehensive as other platforms.
MakeSmthng	DIY, upcycling, and repair tutorials	Highly relevant	Directly focuses on resource utilisation by promoting upcycling, repair, and DIY projects.
Precious Plastic	Community platform for plastic recycling solutions	Relevant	Addresses plastic waste reduction and recycling, contributing to resource utilisation but with a specific focus on plastic.

Table 3.1: Platform Search Results

3.2.2 Depth Study of Most Relevant Platforms

Exploring the three most relevant websites found, investigating further to produce a list of advantages and disadvantages for each.

Love Food Hate Waste

See table (see Table 3.2, p29)

Pros	Cons
Comprehensive food waste reduction tips and recipes	Limited scope, as it mainly focuses on food waste reduction and not all resources
Designed to provide educational resources for different audiences, including households, communities, and schools	Focused on informing about sustainability issues from the front page, concealing the powerful search engine functionality and surrounding it with other information
Provides tools, such as portion planners and food waste diaries, to help users apply the knowledge in practice	
Uses a searchable database to provide applications of foods, including tips and tricks to make food go further	
Regularly updated content keeps the platform current and engaging	

Table 3.2: Pros and Cons Analysis of "Love Food Hate Waste"

Conclusion on "Love Food Hate Waste": (Love Food Hate Waste, 2019), provides extensive food waste reduction tips, recipes, and resources. However, it lacks coverage in broader resource use. The platform's simple web design houses somewhat untidy information presentation, potentially overwhelming users. Despite this, it offers practical tools such as portion planners and food waste diaries, encouraging real-world application. Its searchable food use tips database and frequent content updates maintain user engagement.

MakeSmthng

See table (see Table 3.3, p29)

Pros	Cons
Directly focuses on resource utilisation through DIY, upcycling, and repair tutorials	Lacks a structured educational approach, as content is primarily user-generated and project-based
Encourages creativity and problem-solving, empowering users to find new uses for existing resources	Information layout and deployment could be made clearer, as the website is colorful and inviting but lacks direction of use
Offers a wide range of projects and ideas, catering to various skill levels and interests	Platform's scope is limited to DIY, upcycling, and repair, excluding all other aspects of resource utilisation
Collaborative platform that allows users to share their own projects and ideas	

Table 3.3: Pros and Cons of "Make Smthng"

Conclusion of 'MakeSmthng': (Make Smthng, n.d.), platform promotes a creative,

community-driven environment, focusing on DIY, upcycling, and repair projects. It lacks a structured educational approach due to its reliance on user-generated content and project-based learning. Its vibrant interface, while visually pleasing, could be confusing due to unclear navigation. The platform's narrow focus leaves other resource utilisation aspects unexplored.

ZeroWasteChef

See table (see Table 3.4, p30)

Pros	Cons
Offers a wide range of content, including recipes, tips, and tutorials, covering various aspects of sustainable living	Primarily focused on zero waste living, which is just one aspect of resource utilisation
Written in a friendly and approachable tone, making the content easy to understand and relatable for users	Lacks structured educational content or tools, making it less suitable for formal learning settings
Regularly updated with new content and ideas, ensuring the platform remains relevant and engaging	Requires large amounts of reading to understand and navigate the information available
Encourages community participation through social media and comments	

Table 3.4: Pros and Cons of "Zero Waste Chef"

Conclusion on 'Zero Waste Chef': (Zero Waste Chef, 2023), provides a wide range of content on sustainable living and zero waste, including recipes, tips, and tutorials. Its friendly tone doesn't compensate for the absence of a structured educational framework, making it less suitable for formal learning environments. Regular content updates keep the platform engaging, but the volume of text may discourage some users. Despite promoting community participation, its narrow focus and informal approach limit its effectiveness for resource use efficiency.

3.3 Conclusion of Existing System Analysis

Given the evolving nature of sustainability and waste reduction, digital platforms addressing RUE must be dynamic, innovative, and adaptable. As the understanding of environmental issues expands and technology progresses, these platforms must remain relevant and effective. Thus, the proposed solution should embody adaptability and flexibility, allowing for prompt updates that reflect changes in sustainability.

From analysing the platforms 'Love Food Hate Waste', 'MakeSmthng', and 'Zero Waste Chef', it is clear that while they provide valuable content and ideas on resource utilisation, they lack a comprehensive and structured educational approach. Drawing from

these observations, the following key requirements for the proposed solution can be identified:

- An encompassing, structured approach to resource utilisation education.
- An indirect education method on sustainable practices, designed to engage users not initially interested in the message but drawn in by the platform's usefulness.
- A facts-based approach, avoiding anecdotes.
- User functionality to improve interactive experiences.
- Engaging, user-friendly content tailored for a range of audiences and learning styles.
- A clutter-free, user-friendly website delivering only relevant information.

3.3.1 WhatCanYouDoWith

"WhatCanYouDoWith" is the proposed web solution aimed at improving global accessibility to education on RUE, addressing issues identified from the literature review gap, Section 2.5.5, and improving upon current solutions.

Responding to the United Nations' call for technology and innovation to promoting global sustainability as discussed in Section 2.5.1, "WhatCanYouDoWith" will look to use behavioural nudges to subtly guide users towards adopting sustainable habits. This approach appeals to a broad audience, including those resistant to overt environmental messaging.

"WhatCanYouDoWith" overcomes identified limitations in current platforms and offers key advantages to promote sustainable resource utilisation:

- **Comprehensive and Updated Content:** Covering all known concrete nouns, WhatCanYouDoWith offers a comprehensive range of resource utilisation information; continuously updating with new resources, utilisations, and tutorials.
- **Indirect User Engagement:** Rather than overtly promoting sustainability, WhatCanYouDoWith subtly integrates sustainability into a universally useful tool, thereby reaching a wider audience.
- **Factual Information:** Contrasting with platforms that rely on anecdotal advice, WhatCanYouDoWith will commit to providing concise, accurate information from reliable sources, providing credible OER.
- **User Functionality:** The platform will allow users to save personal lists, submit new utilisations/tutorials, and rate resource effectiveness.

- **Universal Usability:** WhatCanYouDoWith strives to be universally usable, catering to a global audience irrespective of age, language, or comprehension level. Being inclusive is vital, considering the challenges faced by developing economies, as highlighted in Section 2.4.4.
- **Crowd Sourcing:** Providing crowd-sourcing of utilisation knowledge that is not currently documented such as "trade secrets" will enable all to utilise most efficient practises.

WhatCanYouDoWith's comprehensive, updated content, subtle educational approach, factual information, user-focused design, and universal usability make it a promising tool for increasing sustainable behaviour changes which are urgently required to mitigate the impact of climate change as shown in Section 2.2.1.

Chapter 4

Requirements

The requirements chapter converts the broad project goals of Section 1.2 into precise, quantifiable criteria. Notably, these requirements were not conceived from user surveys. Instead focusing on completing a comprehensive literature review and analysis of existing systems to provide foundational requirement gathering.

4.1 Personas

The 'Personas' section introduces fictional characters derived from the literature review and analysis of current systems. These personas provide context for WhatCanYouDoWith's role in achieving the defined goals, Section 1.2. The project targets individuals and organisations in both developed and developing economies for a comprehensive understanding of use cases. These personas, representing various situations, help envisage the tool's potential impact across different contexts.

4.1.1 Developed Economies

Developed economies operate under different circumstances to developing economies, thus a distinction must be made.

Individuals: Developed Economy

The following personas represent individuals in a developed economy who could potentially leverage WhatCanYouDoWith to enhance their understanding and application of sustainable practices (see Table 4.1, p34).

Individuals: Developed Economy

The following personas represent individuals in a developed economy who could potentially leverage this search engine to enhance their productivity and efficiency (see Table 4.1, p34).

Persona	Description	Goals	Use Cases
User A: Young Professional	A 25-year-old city-dweller, tech-savvy with a busy schedule	1. Find quick and efficient uses for everyday items. 2. Locate efficient recipes. 3. Save useful tutorials for future reference.	1. Searches for "potatoes" and finds a tutorial on quick meals. Saves it to "Meal Ideas". 2. Explores the app for ways to use everyday items productively.
User B: Senior Citizen	A 70-year-old retiree who enjoys gardening and DIY projects, not very tech-savvy but likes learning new things.	1. Discover efficient uses for gardening tools. 2. Learn how to automate household chores.	1. Searches for "gardening shears" and finds a guide on their various uses. 2. Looks up for ways to use household items to engage grandchildren in productivity-focused activities.
User C: Teenager	A 15-year-old student who loves arts and crafts.	1. Learn about quick uses for art supplies. 2. Discover efficient ways to use school supplies.	1. Searches for "pencils" and finds a tutorial on creating easy desk organizers. 2. Browses the app for quick uses of common school items.
User D: Child	A 10-year-old learning about productivity at school. Enjoys fun and creative activities.	1. Discover quick uses for toys and games. 2. Learn about productivity in an engaging way.	1. Searches for "legos" and finds a tutorial on creating various useful items. 2. Browses the app with parents for fun and easy ways to use everyday objects productively.

Table 4.1: Personas: Individuals in a Developed Economy

Organisations: Developed Economy

The personas in this section represent organisations in a developed economy. These organisations are not traditionally associated with sustainability but have the potential to greatly benefit from the implementation of sustainable practices.

Organisation	Description	Goals	Use Cases
Org A: Manufacturing	A company manufacturing everyday goods, seeking to increase productivity.	1. Find efficient alternatives for their manufacturing processes. 2. Learn from other industries' best practices for productivity.	1. Browses the app for best practices in efficient manufacturing. 2. Searches for "example manufacturing machine" to increase productivity.
Org B: Service-based	A service-based company, looking to enhance productivity in their operations.	1. Discover methods to streamline their services. 2. Explore technological advancements for efficiency.	1. Searches for "time management" to implement better practices. 2. Explores the app for technology upgrades.

Organisation	Description	Goals	Use Cases
Org C: Education	A local school striving to enhance student productivity.	1. Discover educational resources on productivity. 2. Develop a more efficient school schedule or system.	1. Browses the app for educational materials on productivity. 2. Searches for "timetables" for guidance.

Table 4.2: Personas: Organisations in a Developed Economy

4.1.2 Developing Economy

The Developing Economy category focuses on individuals and organisations operating within economies characterised by lower income and developmental levels, and where sustainable practices could significantly improve living conditions and operational efficiency.

Individuals: Developing Economy

The following personas are individuals in a developing economy who could utilise WhatCanYouDoWith to support their communities and improve their standard of living.

Persona	Description	Goals	Use Cases
User E: Farmer	A small-scale farmer seeking more sustainable farming practices.	1. Learn about sustainable farming methods. 2. Discover ways to reuse waste products.	1. Searches for "food waste" and finds a tutorial. 2. Explores the app for natural pest control methods.
User F: Teacher	A rural school teacher trying to introduce sustainability into their curriculum.	1. Discover resources for teaching sustainability. 2. Develop school projects that promote sustainability.	1. Searches for "teaching resources" to find age-appropriate materials. 2. Browses the app for project ideas.
User G: Community Leader	A community leader looking to promote sustainable living.	1. Find methods to provide clean water. 2. Explore resources to train community members on sustainability.	1. Searches for "clean water" to find applicable solutions. 2. Explores the app for community-level projects.

Table 4.3: Personas: Individuals in a Developing Economy

Organisations: Developing Economy

The personas in this section represent organisations in a developing economy. These organisations could leverage WhatCanYouDoWith to drive sustainability efforts and improve operational efficiencies and community impact.

Organisation	Description	Goals	Use Cases
Org D: Agriculture	A cooperative of small farmers seeking to adopt more sustainable methods.	1. Discover sustainable farming practices. 2. Find ways to manage water and soil effectively.	1. Searches for "sustainable farming" for guidance. 2. Browses the app for soil and water conservation methods.
Org E: Non-Profit	A non-profit working to promote sustainability in the region.	1. Find resources to educate community members. 2. Develop sustainable projects to improve living conditions.	1. Browses the app for educational materials on sustainability. 2. Searches for "community projects" for ideas.

Table 4.4: Personas: Organisations in a Developing Economy

4.2 Limitations

As a solo developer and university student, significant hurdles are expected:

- **Time Constraints:** Balancing project work with other academic tasks is challenging. This might limit the project's scope and detail. To handle this, a detailed plan will be created, setting priorities for tasks and milestones, detailed in, Chapter 5.
- **Technical Limitations:** This project will be a challenge. Current knowledge and ability is limited. To manage this, the focus will be core requirements first. However, these will still be difficult to implement, requiring learning and problem-solving. The project supervisor's expert knowledge will be used heavily to overcome these challenges, alongside library and online resources.
- **Mental Health:** The complexity and time pressure of the project could lead to stress, lack of motivation, or burnout. To prevent this, the workload will be managed effectively, a healthy work-life balance will be maintained, and use will be made of support resources like university services, personal networks, or professional counselling.

4.3 Requirement Table Context

4.3.1 Core Requirement Context

Core requirements outline the essentials for the project, considering constraints outlined in Section 4.2.

4.3.2 Simplicity and Stability

The requirements are simple and clear, aiming to provide a stable base without the risk of over-promising. This base delivers the platform's main value, setting the stage for future enhancements.

4.3.3 Future Requirement Context

In order for WhatCanYouDoWith to be fully engaging, providing full functionalities to provide engaging resource utilisation education and create a large user base, these features should be implemented in the future.

4.4 Dependency Diagram

The figure (see Fig. 4.1) presents a visual layout of the core requirements (CR) and future requirements (FR). It illustrates which requirements must be successfully fulfilled before the next can proceed. For instance, the root node is CR1, and to offer FR10 - "Personalised Recommendations", the system must initially have a functional FR9 - "Track User Behaviour".

Rating	Importance
Dark Red	Core requirements - Highest priority, to be done first
Light Red	Subsequent requirements - High priority, to be done after core requirements

Yellow	Supplementary tasks - Medium priority, can be done after high priority tasks
Green	Non-essential tasks - Lowest priority, to be considered if time allows

Table 4.5: Colour Scale for Dependency Diagram

4.4.1 Dependency Tree and Relationships

The future requirements are indicated by light blue and the core requirements by navy blue. The 'Depends On' column in the tables below provide clarity of the dependency diagram, creating a visual road map of what functionalities to implement next, guiding future development.

4.5 Core Requirements Table

Req ID	Requirement	Justification	Table 4.5	Reason for Importance	Dependency	Alignment with Goals	Justification for Goal Alignment
CR1	User-friendly web application	For easy user accessibility and interaction, promoting efficient platform usage and user retention. The interface design can significantly impact the user's perception and experience.	Dark Red	Without it, there will be no web application	Root	G1, G2, G3, G4, G5, G6	A user-centric design encourages more users to adopt the platform.
CR2	Access to a library of resource utilisations	Provides the essential information for users to re-purpose or recycle resources, directly delivering on the platform's value proposition.	Dark Red	The core function of the platform. The quality, variety, and usefulness of the content directly influence user engagement and satisfaction.	CR1	G1, G2, G3, G4, G5, G6	Facilitates resource reuse, reducing waste and promoting productivity, aligning with global sustainability goals.

Req ID	Requirement	Justification	Table 4.5	Reason for Importance	Dependency	Alignment with Goals	Justification for Goal Alignment
CR3	A search feature	Enables users to easily find specific resources, utilisations, and tutorials, enhancing the platform's usability and efficiency. With an extensive library, navigation becomes a critical issue.	Dark Red	Without it, users can't find resource utilisations	CR2	G1, G2, G3, G4, G5, G6	By finding the most efficent resource utilisations, users can achieve all the goals of Section 1.2

Req ID	Requirement	Justification	Table 4.5	Reason for Importance	Dependency	Alignment with Goals	Justification for Goal Alignment
CR4	Reliable links to tutorials and guides	Ensures users have access to detailed instructions for applying the provided utilisations. Promotes successful resource utilisation education.	Dark Red	Vital for ensuring the credibility and utility of information, contributing to user confidence and the platform's impact.	CR3	G1, G2, G3, G4, G5, G6	Accurate, easy-to-follow tutorials support practical learning and successful resource reuse, promoting education and waste reduction.

Table 4.6: Core Requirements Table

4.6 Future Requirements Table

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR1	Google Account Integration	Enabling Google Account Integration streamlines user on-boarding, leverages existing Google account preferences for personalisation, and enhances security by deferring authentication to a trusted provider.	Yellow	User experience is critical, but not a fundamental functionality.	CR1	G4	Improved user experience through easy access encourages platform usage, leading to sustainable behaviours.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR2	A sustainable ranking system	Allows users to understand and prioritize the sustainability factor of each resource utilisation. Facilitates conscious decision making, encouraging eco-friendly behaviours.	Light Red	Core to the value proposition of the platform: promoting sustainable resource utilisation.	CR2	G3	Drives user decisions to lower environmental impact and minimise waste generation.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR3	A mobile application	Mobile-first approach is crucial as global internet usage shifts towards mobile devices. Also enables access in remote or disadvantaged areas where mobile may be the primary internet device.	Yellow	While a responsive web app could suffice initially, a dedicated mobile app enhances the user experience.	CR1	G1, G5	Supports digital inclusion, educational reach and contributes to poverty alleviation through access to knowledge.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR4	A feature to search for tasks and find the most efficient and sustainable combinations (or singular) of resources to complete it	This feature makes the platform practical and directly usable, increasing its relevance and daily usage potential.	Light Red	Directly impacts the user's ability to derive value from the platform, leading to higher engagement and satisfaction.	FR2	G1, G2	Boosts productivity by suggesting efficient resource combinations, indirectly contributing to poverty reduction and sustainability.
FR5	A feature to search for multiple resources and provide utilisations that included within the requested list	This feature optimises the user's current resources allowing mutliple items to be searched, as individual searches can provide too many results	Yellow	Less critical in early stages but provides significant value as user base grows.	CR3	G3	Supports a circular economy model by encouraging optimal use of existing resources, reducing waste.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR6	A feature to save a resource or utilisation or tutorial into a list	Facilitates future reference and easy access to relevant information, providing a personalised experience.	Green	Enhances user experience but not a core functionality for initial platform delivery.	CR1	G4	Increases user engagement and retention, indirectly encouraging sustained platform usage and adoption of sustainable behaviours.
FR7	Sharing features for utilisations and tutorials	Increases the platform's virality, user base, and impact by facilitating social sharing of interesting content.	Green	Useful for expanding platform reach but not essential for platform operation or initial user value.	FR6	G5	Facilitates knowledge dissemination, promoting educational outreach.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR8	An automated method for sending users regular updates (e.g., newsletter, automated emails, notifications)	Enhances user engagement and keeps the platform top-of-mind, encouraging regular usage and learning.	Green	Non-critical for initial functionality but aids long-term user engagement and platform growth.	CR1	G4	Regular communication encourages sustained platform usage and habit formation towards sustainable behaviours.
FR9	An adaptive UI that changes based on user feedback	Helps maintain user engagement by continuously improving the user interface and experience based on their feedback.	Green	Improves user experience but not a core functionality in the initial stages.	FR1	G2	Drives innovation and continual improvement of the platform, contributing to an evolving user-centric design.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR10	Personalized recommendations for utilisations and tutorials	By considering the user's history, location, preferences, etc., the platform can provide personalized and therefore more relevant and engaging content.	Yellow	Enhances user experience and increases the perceived value, but not a core functionality initially.	FR1	G4	Personalized engagement boosts user satisfaction and loyalty, leading to sustained platform usage and adoption of sustainable behaviours.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR11	Multi-language and region support	Enables global accessibility, helping to reach disadvantaged communities and promoting inclusivity. Also necessary to cater to diverse languages and cultural practices in resource utilisation.	Light Red	Key for global platform reach and impact. The platform's mission aligns with global sustainability, and language should not be a barrier.	CR1	G1	Breaks down language barriers to accessibility, contributing significantly to poverty reduction and educational outreach.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR12	Implementation of a "Resource Library" feature	Helps users track their resource utilisations efficiently, saving time and preventing waste.	Green	Enhances user experience by improving information management, but not a core functionality initially.	FR6	G3	Encourages efficient resource use, contributing to waste reduction and supporting the circular economy model.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR13	Provide crowd sourcing for users to suggest new utilisations	Leverages community knowledge to enrich the platform's content. Encourages user participation and ownership, enhancing user engagement and the platform's dynamism.	Light Red	Enhances community building and content variety, through updates of new utilisations to the search library. However, a substantial initial content base should be in place first.	CR4	G2	Facilitates global collaboration, promoting diversity of thought, innovation, and productivity.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment
FR14	Storage Method for New utilisations	Ensures that crowd-sourced content is effectively stored, retrieved, and presented, making the user-contributed information beneficial for the whole community.	Light Red	Supports the implementation and effectiveness of the crowd-sourced suggestions, adding value to the platform.	FR13	G2	Supports knowledge management, contributing to global productivity, and innovation.
FR15	A method of validating the crowd sourced resource utilisation submissions	Maintains the credibility of the platform by ensuring the quality and reliability of crowd-sourced content.	Light Red	Critical for ensuring reliability and trust in the platform, and for maintaining user engagement.	FR14	G2, G3	Ensures quality and accuracy of content, safeguarding sustainable behaviours and supporting waste reduction.

Req ID	Requirement	Justification	Importance Table 4.5	Reason for Importance	Depends On	Aligns with Goals	Justification for Goal Alignment

Table 4.7: Future Requirements Table

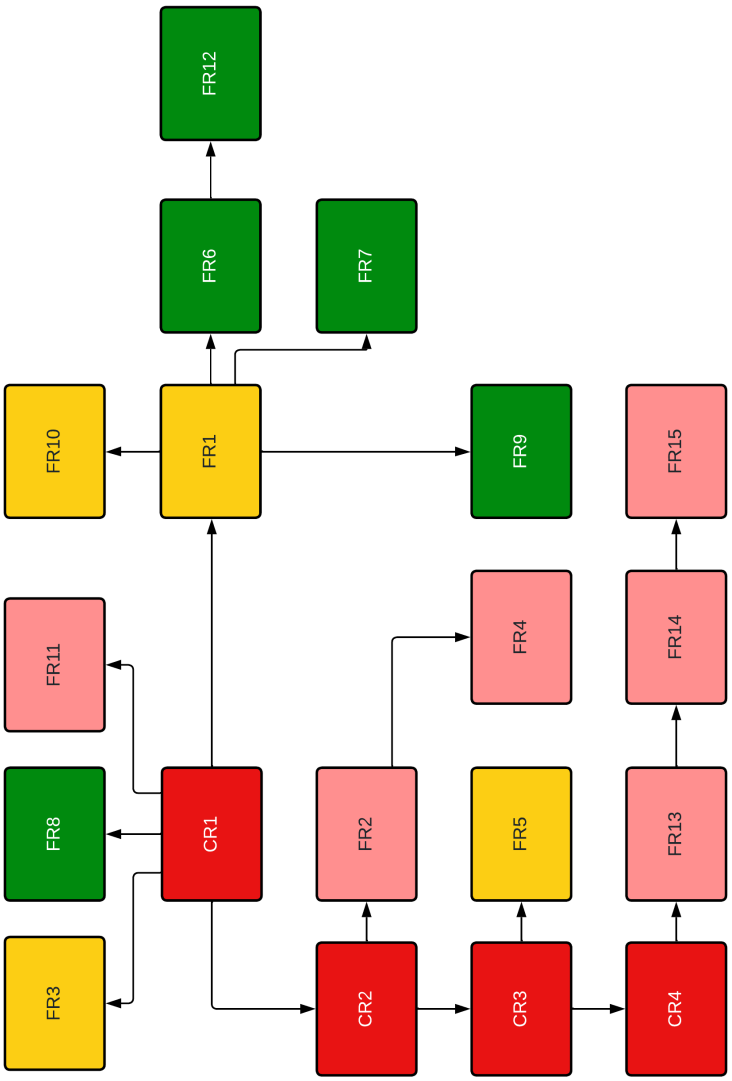

Figure 4.1: Dependency Diagram for Requirements

4.7 Conclusion of Requirements

This chapter has outlined the core and future requirements of the platform. The core requirements provide a stable foundation for the project. The future requirements demonstrate the commitment to enhancing the user experience and expanding the platform's capabilities.

Chapter 5

Methodology

This chapter discusses the methodology chosen for the project, considering its requirements and limitations. The rationale for selecting an iterative and flexible development approach is provided. The chapter explores how the principles of the Agile Manifesto (Manifesto, 2001) will be applied in the project's context. Additionally, it addresses the unique considerations and adaptations required for a solo project, including strategic planning for effective project management and timely completion.

5.1 Introduction

Given the ambitious goals and limitations of the project, an Agile approach has been chosen, as it aligns with the need for ongoing improvements and adaptability.

5.2 Agile Overview

Agile is an ideal methodology for this complex project, given its evolving requirements, as it offers flexibility, adaptability, and responsiveness. It promotes regular inspection and adaptation, focusing on delivering working solutions frequently (Manifesto, 2001). This aligns perfectly with the project's goal of initially providing a set of core features and gradually enhancing them in future development cycles. Although traditionally Agile methodologies involve team collaboration, this solo project will apply the principles of Agile in a manner that suits its unique circumstances. While specific Agile frameworks like Scrum, SAFe, or Extreme Programming (Uludağ et al., 2021) will not be employed in their entirety, the project will adopt Agile principles to ensure a progressive and iterative development process

5.3 Key Principles Application

Agile Principle	**Relevance: 1(Least) - 5(Most)**	**Relevance Justification**	**Related Requirement(s)**	**Application in the Project**
Welcoming Changing Requirements	4	This principle is relevant as flexibility in the face of changing user needs and technological limitations is crucial to the success of the project.	All core and future requirements	As understanding of user requirements and constraints deepen, there may be a need to adjust the functionalities. Embracing this adaptability enables the platform to evolve organically, responding to the users' needs and the project's technological constraints .
Working Software is the Primary Measure of Progress	2	While important, this principle is somewhat less relevant in context of this project where not much software will be implemented.	All core and future requirements	Working, testable software that aligns with user needs will be prioritised.
Continuous Attention to Technical Excellence and Good Design	5	This principle aligns with the project's vision of a user-friendly, scalable, and efficient platform.	All core and future requirements	Attention to technical excellence is absolutely crucial, as this platform will fail to bring about sustainable behavioural changes without providing an engaging service and retaining a user base.
Simplicity is Essential	5	Simplicity is crucial as this project focuses on the only delivering the core requirements	CR1, CR2, CR3, CR4	Without operating with simplicity in mind, it will be difficult to develop this platform in a scalable manner, by following this principle, the future requirements stand a better chance of being successfully developed
Reflecting on How to Become More Effective	3	This principle is relevant in the context of a solo project, as there is a need to constantly improve personal workflows and efficiency.	CR1, CR2, CR3, CR4	Regular reflections on the project's progress will be conducted at the end of each development sprint

Agile Principle	Relevance: 1(Least) - 5(Most)	Relevance Justification	Related Requirement(s)	Application in the Project
Early and Continuous Delivery of Valuable Software	5	By operating with continuous delivery, it ensures the reliable development of the platform, as it will reduce the chance for error, building strong foundations for future work	All core and future requirements	Initial releases of the software will offer minimal viable functionality, enabling users to interact and provide feedback early. This iterative feedback will be used to refine the platform's design and functionality, ensuring user-centric development.

Table 5.1: Application and Relevance of Agile Principles in the Project

5.4 Project Planning

Planning stage of the project is critical, as it sets the pace and direction for the project development. It involves a clear understanding of the project requirements, expected deliverables, and limitations. This, ironically, aids in efficient resource utilisation and effective time management in the design and implementation stages of development.

5.4.1 Communication and Feedback

Communication plays a pivotal role in the success of any project. This is difficult as a solo project. However, regular meetings with the project supervisor will act as an avenue for receiving constructive feedback and guidance. This feedback loop will ensure that the project stays on track, potential issues are identified and addressed promptly, and the project deliverables remain aligned with the original objectives.

5.4.2 Task Breakdown

This project will not attempt to achieve the future requirements. It will simply set out to achieve the core requirements to a complete fashion, avoiding the issues that arise from attempting an over ambitious engineering task, prioritising the agile principles of continuous delivery of working software and simplicity.

The core requirements of the project have been broken down into distinct tasks. This approach ensures better management of each task, promoting understanding of the intricacies involved, and enables tracking of the project's progress with greater accuracy.

Core Requirement	Tasks
CR1: User-friendly web application	1. Design mock ups for the user interface. 2. Develop interactive UI elements. 3. Conduct user testing to ensure intuitiveness and user-friendliness of the UI.
CR2: Access to a library of resource utlisations	1. Define database schema. 2. Implement information retrieval. 3. Implement platform foundations.
CR3: A search feature	1. Investigate search functionality providers. 2. Conduct unit testing of functionality.
CR4: Reliable links to tutorials and guides	1. Identify and gather credible and relevant resource providers. 2. Implement tutorial link delivery system. 3. Test educational value and accessibility and usability.

Table 5.2: Task Breakdown for Core Requirements

5.4.3 Sprint Planning

The project will be executed in four sprints, each sprint lasting one working week. After the completion of each sprint, the work done will be evaluated, and any changes or improvements will be incorporated into the planning for the subsequent sprint. This iterative process, aligning with Agile's principle of adaptive planning, will allow for flexibility and continual improvement throughout the project's life cycle.

Testing

Stringent testing is essential for developing a reliable and reproducible program. To prevent future developmental issues, each sprint will incorporate comprehensive unit tests to maintain dependable progress.

5.4.4 Kanban Board

To visually represent the project's progress, a Kanban board will be utilised (see Table 5.3, p60). It will help organise and manage the workflow at different stages of the project, providing a clear picture of what's been accomplished, what's currently being worked on, and what tasks remain.

To Do	In Progress	Done
Conduct user testing to ensure intuitiveness and user-friendliness of the UI		
Develop interactive UI elements		
Design mock ups for the user interface		

Conduct unit testing of functionality
Test educational value and accessibility and usability
Investigate search functionality providers
Implement tutorial link delivery system
Identify and gather credible and relevant resource providers
Implement information retrieval
Implement platform foundations
Define database schema

Table 5.3: Initial Kanban Board

5.5 Conclusion

This chapter outlined the methodology underpinning this project. Harnessing Agile principles, the methodology caters for a flexible and adaptable approach, which is crucial for such a complex project. The strategy for project planning, including communication, task breakdown, sprint planning, and the use of a Kanban board, aims to ensure a systematic and well-organised project progression.

Chapter 6

Design

6.1 Introduction

This chapter considers potential design strategies conceived for the "WhatCanYouDoWith" platform, honing in on the four critical tasks outlined in the task breakdown table 5.2 in the Methodology chapter:

- **Section 6.2** Define database schema.
- **Section 6.3** Identify subject matter experts and gather relevant resources.
- **Section 6.4** Implement search functionality.
- **Section 6.5** Design mock ups for the user interface.

Each section of this chapter will dissect the corresponding task, addressing the core requirements, Table 4.6, whilst also considering future requirements, Table 4.7, easing their development process. Design choices will be critically analysed and explored, providing alternative approaches, before making justified decisions.

6.1.1 Design Chapter Structure

The table below provides an updated Kanban table for this design chapter: Table 6.1.

Section 6.6 provides a summary of the design decisions tackled in Table 6.1.

To Do	In Progress	Done
Conduct user testing to ensure intuitiveness and user-friendliness of the UI	Design mock ups for the user interface	
Develop interactive UI elements	Investigate search functionality providers	
Conduct unit testing of functionality	Identify and gather credible and relevant resource providers	

Test educational value and accessibility and usability	Define database schema
Implement tutorial link delivery system	
Implement information retrieval	
Implement platform foundations	

Table 6.1: Design Chapter Kanban Board

6.2 Designing and Defining the Database Schema

6.2.1 The Semantic Web

Lifelong learning outside of formal education settings is crucial for advancing towards the Sustainable Development Goals (SDGs). Denton et al. (2022) acknowledges how the internet can have in facilitating this learning; however, the credibility of online education and knowledge is often compromised by misinformation (GOV.UK, 2021).

The Semantic Web, an extension of the World Wide Web, offers a solution to this problem by making web information more meaningful and machine-readable (Berners-Lee et al., 2001). By leveraging the Semantic Web, the "WhatCanYouDoWith" platform can provide validated facts and access a vast amount of structured knowledge without the need for an extensive dedicated database. WhatCanYouDoWith could therefore offer reliable information and enhance its credibility as an educational resource from utilising this. This approach acknowledges the project's constraints and maximises the available resources to deliver a robust and impactful solution, within the time constraints.

DBpedia

DBpedia is a community-driven project aimed at extracting structured information from Wikipedia to make this information accessible on the Web (Auer et al., 2007). With the current DBpedia Snapshot release containing over 850 million facts (Holze, 2023), it serves as a useful resource to kick start this project.

Search Terms	**Search Engine**	**Number of Results**	**Search Description**	**Search Outcome**
DBpedia	EBSCO	899	Initial search	Excessive results
DBpedia AND software agent	EBSCO	1	Added "software agent" to the previous search	Article not relevant – a survey on existing ontologies
Semantic Web	EBSCO	23,333	Initial search	Excessive results

Semantic Web AND DBpedia	EBSCO	347	Added "DBpedia" to the previous search	Still too many results
Semantic Web AND DBpedia AND API	EBSCO	2	Added "API" to the previous search	Limited documentation available. 1/2 relevant – discussing the development of a disease factbase ontology accessible via SPARQL queries. Not entirely relevant as the project aims to utilise existing ontologies and develop a software agent, rather than design a new ontology.
Semantic Web AND DBpedia AND agent	EBSCO	45	Replaced "API" with "Agent" due to the semantic nature of the keywords	5/45 relevant. As the focus is on utilising semantic web ontologies rather than analysing them, only a few articles provide genuinely relevant information, even when considering studies involving DBpedia.
DBpedia	IEEE Xplore	276	Using IEEE Xplore instead of EBSCO	Initial search
DBpedia AND software agent	IEEE Xplore	3	All articles contribute to creating new RDF or utilizing DBpedia and other semantic knowledge bases to build a new ontology	0/3 relevant

DBpedia AND API	IEEE Xplore	9	Added "API" to the previous search	2/9 relevant. These results establish closer links to the project's title and aims compared to the EBSCO results. They identify 4 articles on designing APIs that leverage existing ones to produce visual representations of data stored on semantic web ontologies like DBpedia.

Table 6.2: Table of Searches Performed for Prior DBpedia Implementations

6.2.2 Lack of Literature

DBpedia's complexity and lack of accessible documentation pose challenges for non-technical users. The scarcity of comprehensive documentation using DBpedia reflects the difficulties in interpreting and utilising the Semantic Web.

Existing literature often focuses on visually representing knowledge graphs rather than providing detailed implementation guidance (Papantoniou et al., 2011; Phiwngam & Senivongse, 2016). Descriptions without detailed explanations also hinder the implementation process, such as the sources provided by Cicekli and Suleymanov (2015) and Dambhare and Karale (2017).

Filling the DBpedia Literatur Gap

To address these challenges, this project aims to comprehensively document the development process of utilising DBpedia API, with a specific focus on improving user experience. The review of the DBpedia Faceted Semantic Web browser highlights the platform's limited accessibility for non-expert users, further emphasising the need for improved usability.

Navigating the dbpedia.org website can be challenging, as the landing page does not provide easily accessible information. However, Google searching for a specific topic, such as "DBpedia Tomato," can lead to relevant pages like https://dbpedia.org/page/Tomato (see Figure 6.2, p65). This page provides information on generic tomatoes and includes the "isIngredientIn" category (see Figure 6.3, p65). While this demonstrates DBpedia's potential, it is important to note that the page may not cover all the uses of tomatoes, and there is a lack of links to valid tutorials, which is a CR4 from Table 4.6.

DBpedia Limitations

Potential credibility issues are posed from its reliance on Wikipedia as a data source. The collaborative nature of Wikipedia can lead to contradictions, inconsistencies, errors, and

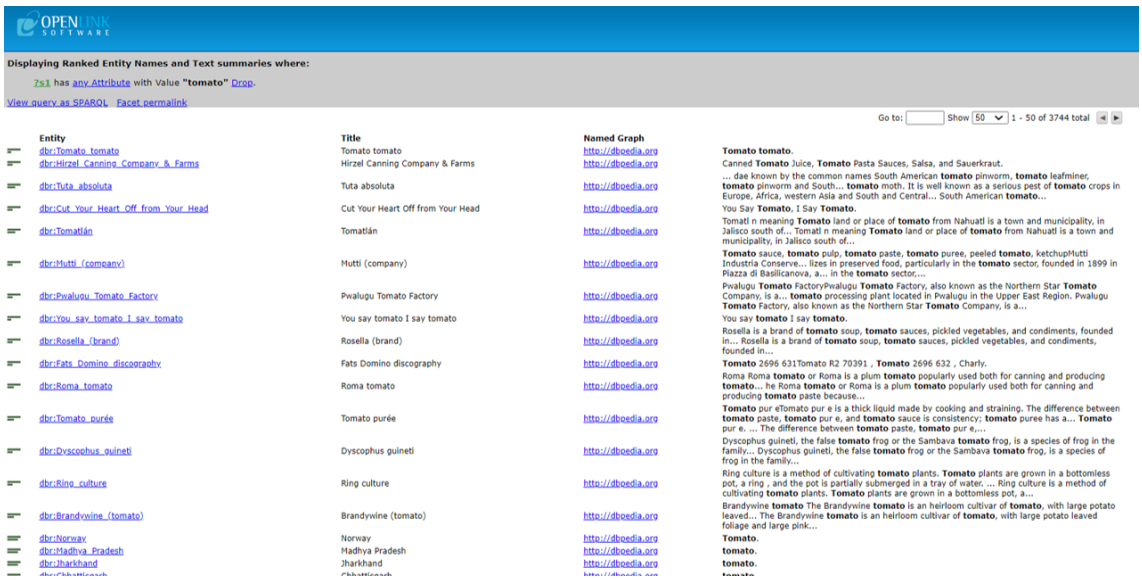

Figure 6.1: DBpedia Faceted Results Page for the Search of "Tomato"

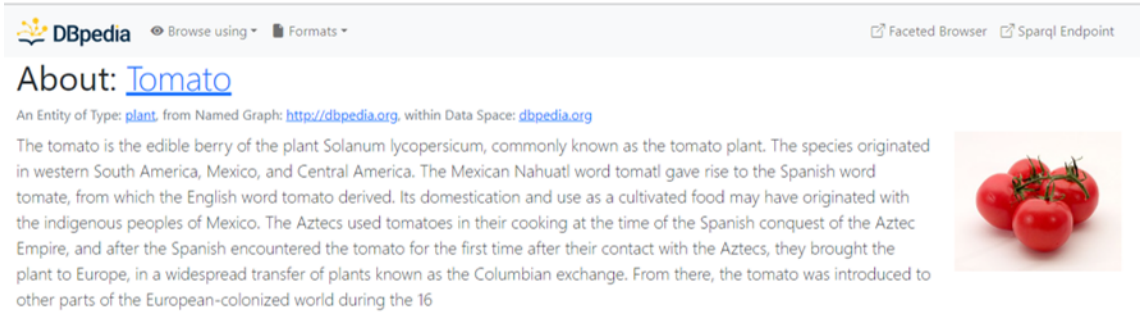

Figure 6.2: https://dbpedia.org/page/Tomato

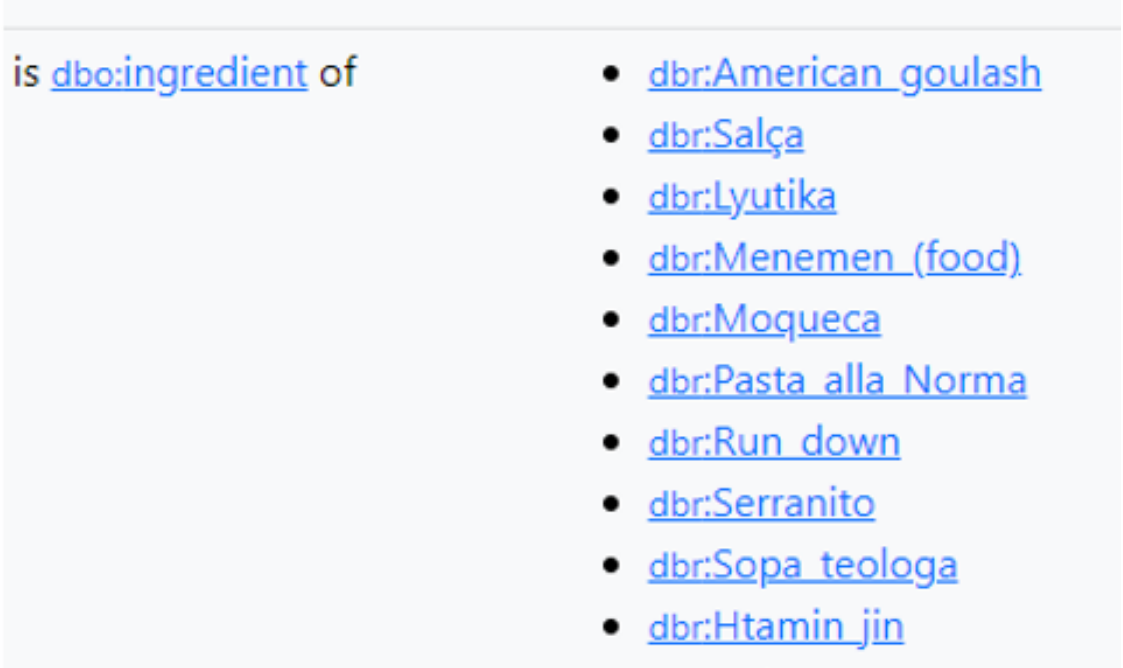

Figure 6.3: List for "is ingredient of" on the https://dbpedia.org/page/Tomato webpage

spam, which must be addressed before implementing DBpedia in this project (Auer et al., 2007).

Understanding and working with RDF, OWL, and querying languages like SPARQL can be difficult, both for developers and end-users. This poses a hurdle in navigating and comprehending complex knowledge graphs, which are crucial for CR2. The limited literature available on DBpedia implementation further highlights this challenge as shown from Table 6.2.

Furthermore, DBpedia may not cover all possible uses for every concrete noun, as new uses and applications will emerge over time. To address this, the project should incorporate a mechanism for crowd sourcing and validating new information (FR6, FR7). Relying solely on DBpedia is insufficient, and the platform must evolve and adapt with the contribution of users and additional sources of information.

6.2.3 DBpedia Alternatives

DBpedia is one of many knowledge graphs, and using multiple graphs through Linked Data (Berners-Lee, 2009)could address some limitations.

Language models like GPT-4, which OpenAI (2023) offers, poses a potentially more efficient alternative to DBpedia. However, they come with limitations, such as generating inaccurate information and API costs. As OpenAI (2023) noted, "while GPT-4 has enhanced capabilities compared to its predecessors, it still isn't fully reliable, as it can generate inaccurate ("hallucinated") facts and exhibit reasoning errors." Further exploration is warranted here, considering the potential benefits and limitations of language models in delivering utilisations and tutorials, omitting the necessity of a initial database in a different approach. DBpedia are aware of the potential use of chatbots to increase usability. Although unfortunately, there current example (see Figure 6.4, p67) shows how it is not yet functional. Evidencing the potential of a large language model chat bot.

In House Knowledge Graph

The challenge to categorise and understand how WhatCanYouDoWith may present a library of all concrete nouns in existence was explored as a result of producing the mock ups. As shown in Figure 6.5, an attempt to visualise how both the core requirement (CR2) and future requirement (FR10) might be completed. This figure illustrates how knowledge graphs like DBpedia can be used to organise the platform's content, ensuring a clear and accessible presentation of resources, utilisations and tutorials, it provides a visualisation of how an in-house database might be formulated as a DBpedia alternative.

This option however will not be considered, as it will take much too long to implement this within this projects time constraints.

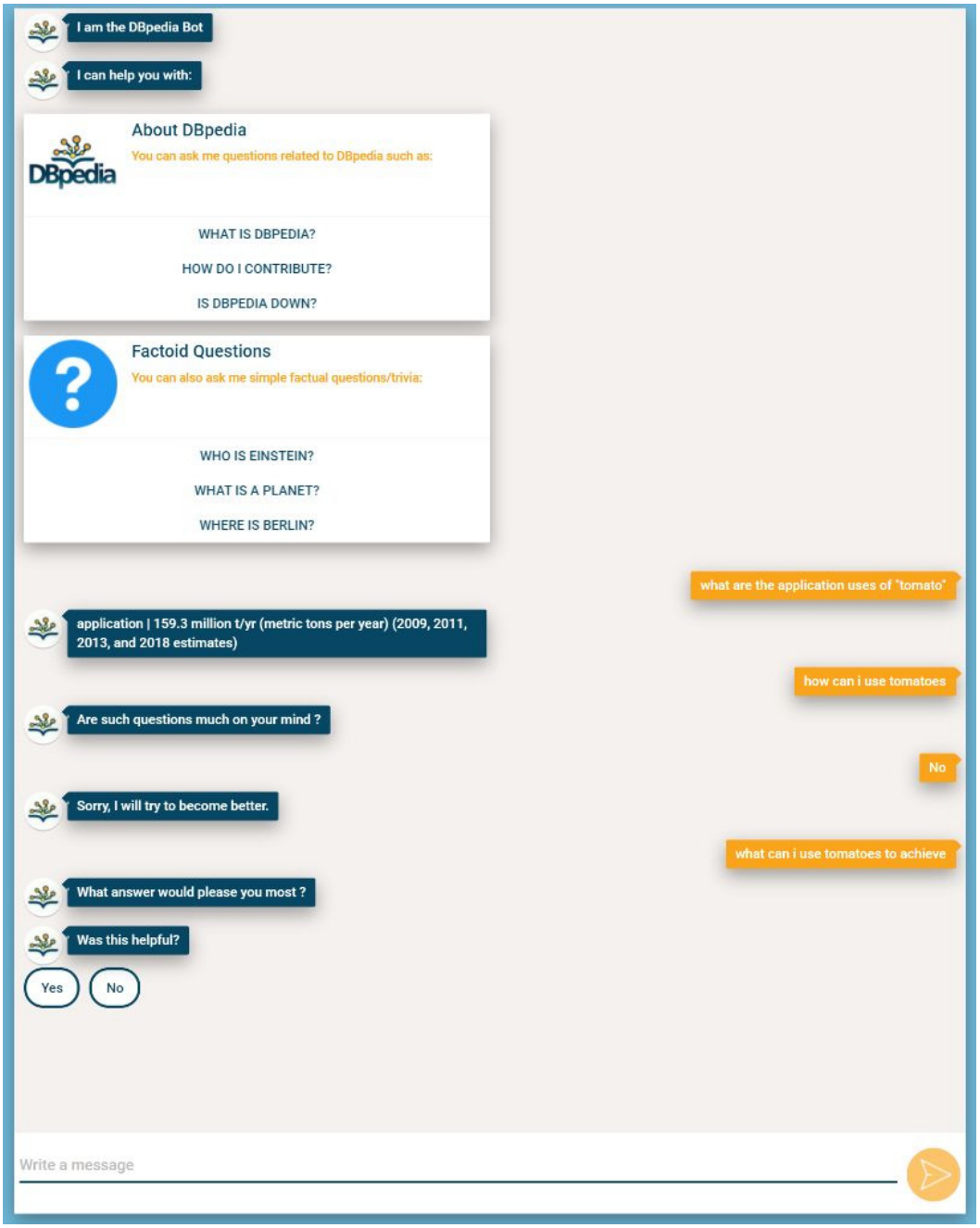

Figure 6.4: DBpedia ChatBot (Screenshotted 12/05/2023)

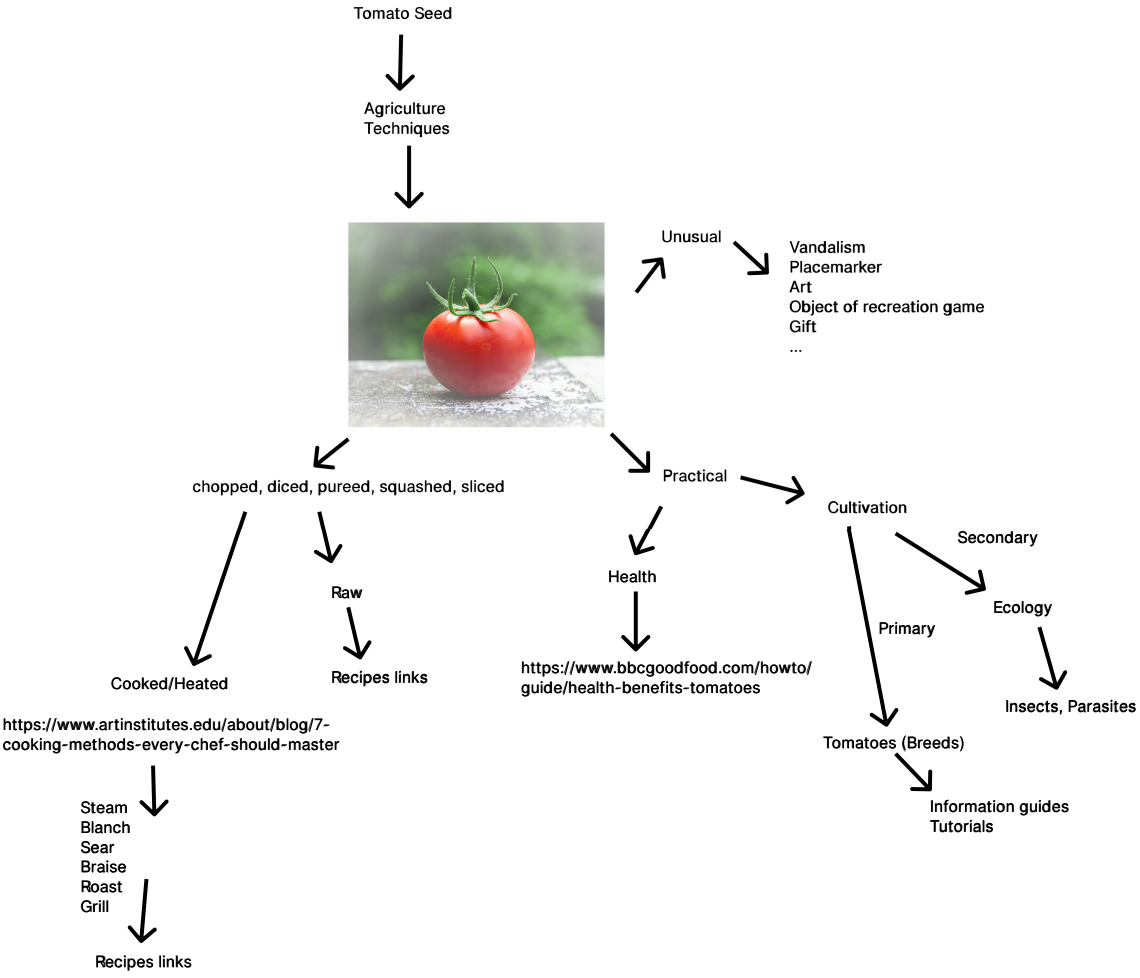

Figure 6.5: Categorisation Visualisation Diagram for Tomato

6.2.4 Conclusion on Database Design

In conclusion, DBpedia provides a possible foundation for the start of this project by offering access to structured data without the need for a dedicated database. Existing literature on DBpedia lacks detail and accessibility, this project aims to provide a more comprehensive and user-friendly implementation, helping to provide greater comprehension of its use for future developers seeking to utilise its knowledge graphs.

Due to time constraints, DBpedia is chosen initially, but future work should consider language models and an in-house database as possible alternatives.

6.3 Identify and Gather Credible and Relevant Resources

As identified from Section 6.2.2, no tutorial links are provided, thus research of credible platforms was completed.

In order to provide credible and relevant resources for utilisations and tutorials, two potential sources have been identified: WikiHow and BBC Good Food.

WikiHow is an open-source platform that offers a wide range of educational articles and guides. It has been credited by the United Nations, making it a reliable source for educational content (WikiHow, 2023).

BBC Good Food is another reputable platform that specialises in culinary recipes and provides credible tutorials and guides (BBC Good Food, 2023). Utilising its resources would contribute significantly to the goal of offering high-quality tutorials for various utilisations.

Further research should be conducted to explore the availability more credible sources of information, of which has been found to be a challenging task, highlighting the issue of knowledge accessibility (see Section 2.4.1, p21) and the importance of reliable and accessible resources in promoting sustainable behaviours and reducing waste.

6.4 Implement Search Functionality

In order to provide a search functionality, HTML must be served to the user. This section analyses possible methods.

6.4.1 Chrome Extension or Node.js Server?

The advantages and disadvantages of Chrome extensions and Node.js are analysed as they are both methods of serving the search functionality to users.

Chrome Extension

A Chrome extension offers several benefits:

- It allows JavaScript to access the browser's context data for manipulation and editing.
- It requires only a Google Account and a Google Chrome browser for a user to access its functionality.
- It provides convenience by eliminating the need for users to navigate away from their current web page.

Nonetheless, Chrome extensions have limitations that may affect the project's long-term objectives:

- They are limited to users of the Chrome browser, excluding other browsers.
- They rely on Chrome storage, which is less versatile and functional than third-party databases available for Node.js applications.

(Google, 2022)

Node.js

In the long run, Node.js emerges as a better choice due to its performance, scalability, and versatility. Its event loop, coupled with asynchronous processing, enables efficient management of multiple tasks, which can be executed concurrently without waiting for one task to finish before starting another. This prevents any single task from blocking the overall process, leading to better performance.

Benefits of Node.js for the long term goals:

- Enhanced efficiency and scalability through the event loop and asynchronous processing.
- Compatibility with various platforms, not limited to a specific browser.
- A more extensive ecosystem and community support for development.
- The ability to integrate with various third-party databases, offering more flexibility and functionality compared to Chrome Storage.

(Node.js, 2023)

Conclusion: Chrome Extension vs Node.js Server

Node.js, with its asynchronous event loop, is more suitable for long-term scalability. Despite the added cost of server hosting required for Node.js, its benefits justify its use in later development stages.

However, to achieve the core requirements given this projects constraints, a chrome extension has been chosen as the design choice for this decision section.

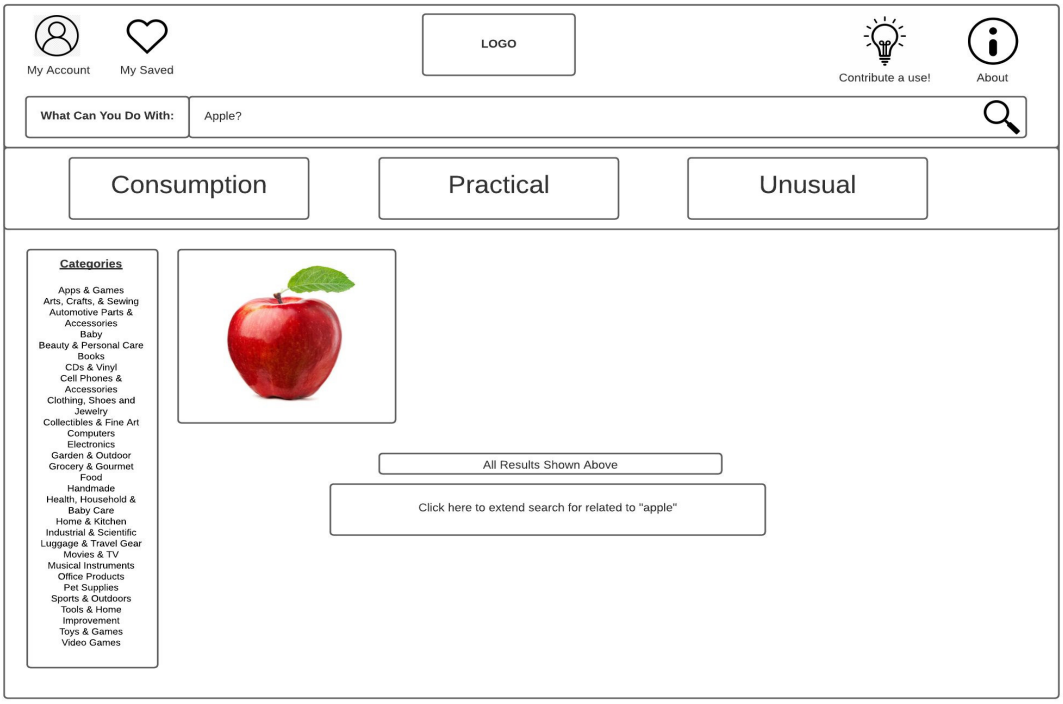

Figure 6.6: Search Results for Apple

Future Requirements

For the development of future requirements, Integrating a Chrome extension with a Node.js server will most likely be needed. Thorough testing will be necessary for smooth integration upon introducing the Node.js server.

6.5 Designing User Interface Mockups

The user interface (UI) for the "WhatCanYouDoWith" platform has been designed with an emphasis on simplicity and user-friendliness. These initial designs serve to address core requirements and guide the early implementation stage.

In adhering to the Agile principles utilised, Table 5.1, a clean, clutter-free design was drawn, ensuring easy navigation for users and to simplify the implementation process.

It's important to view these designs as only a starting point for potential enhancements and modifications.

6.5.1 Large Screen Size Mock Ups

The following mock ups visualise how WhatCanYouDoWith would look when viewed on a standard monitor screen, aiming to meet the list of core requirements, whilst considering the future requirements.

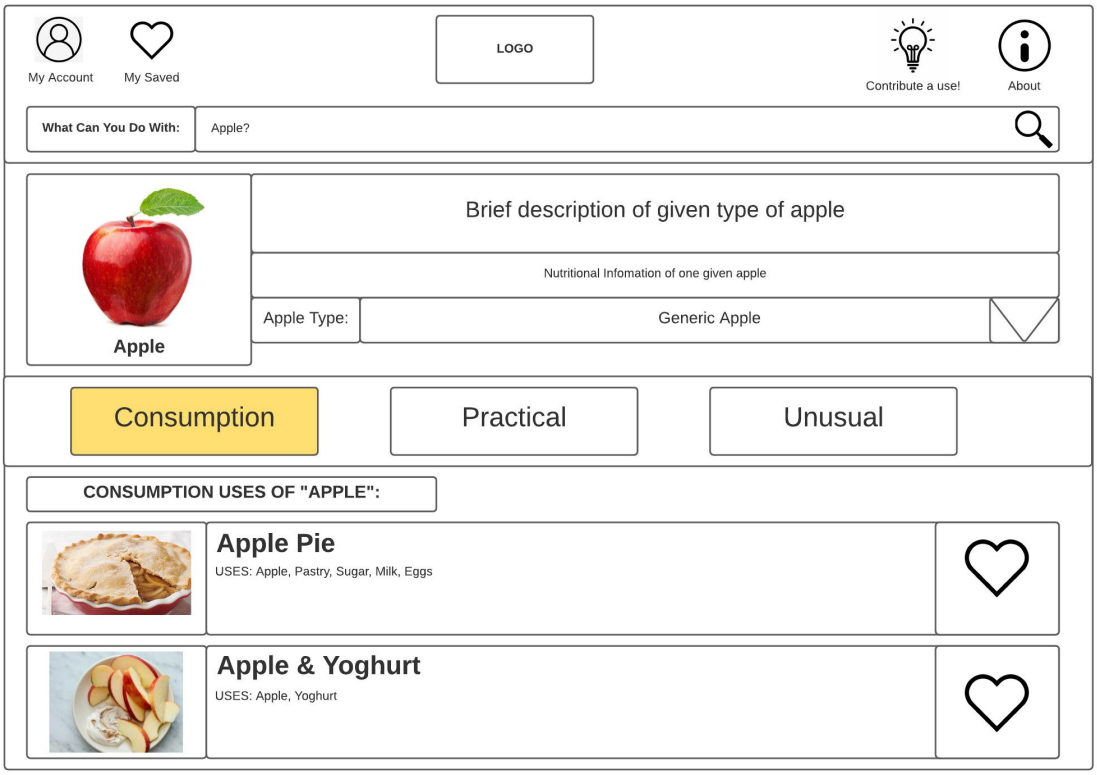

Figure 6.7: Consumption Use Category for Apple

Search Results for Apple

Figure 6.6 presents an initial concept of how a search result for "Apple" might appear. The top row of the website layout includes a search box that fulfills the core requirement (CR3) of a search feature. It attempts to provide a user-friendly web application design (CR1), using minimal language and a simple layout promoting efficient platform usage and user retention.

Furthermore, icons in the top row "Contribute a use!" meets the future requirement of FR13; a "My Saved" icon meets the future requirement FR6. Categories on the left provide a visual guide of the extensive library (CR3). The overlay of categorised utilisations provides three categories, "Consumption, Practical, and Unusual", which is an initial attempt at categorisation of use cases, as mentioned in Section 6.3.

Consumption Use Category for Apple

Figure 6.7 showcases the consumption resource utilisations for "apple", offering a brief description and nutritional facts for a generic apple. It fulfills the core requirement (CR2) of providing relevant information and access to a library of resource utilisations. This section also meets future requirement (FR6) by featuring a heart icon that users can use to bookmark this particular utilisation for future reference.

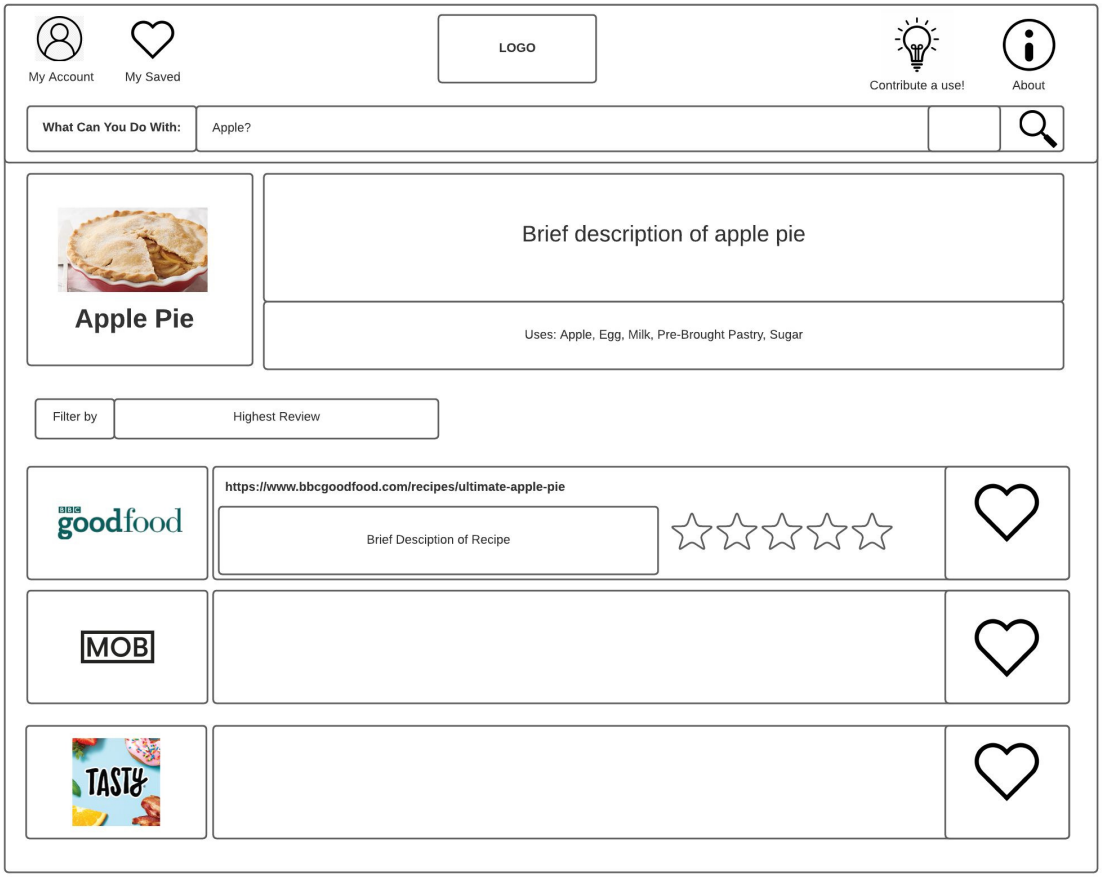

Figure 6.8: List of Tutorials for Apple Pie

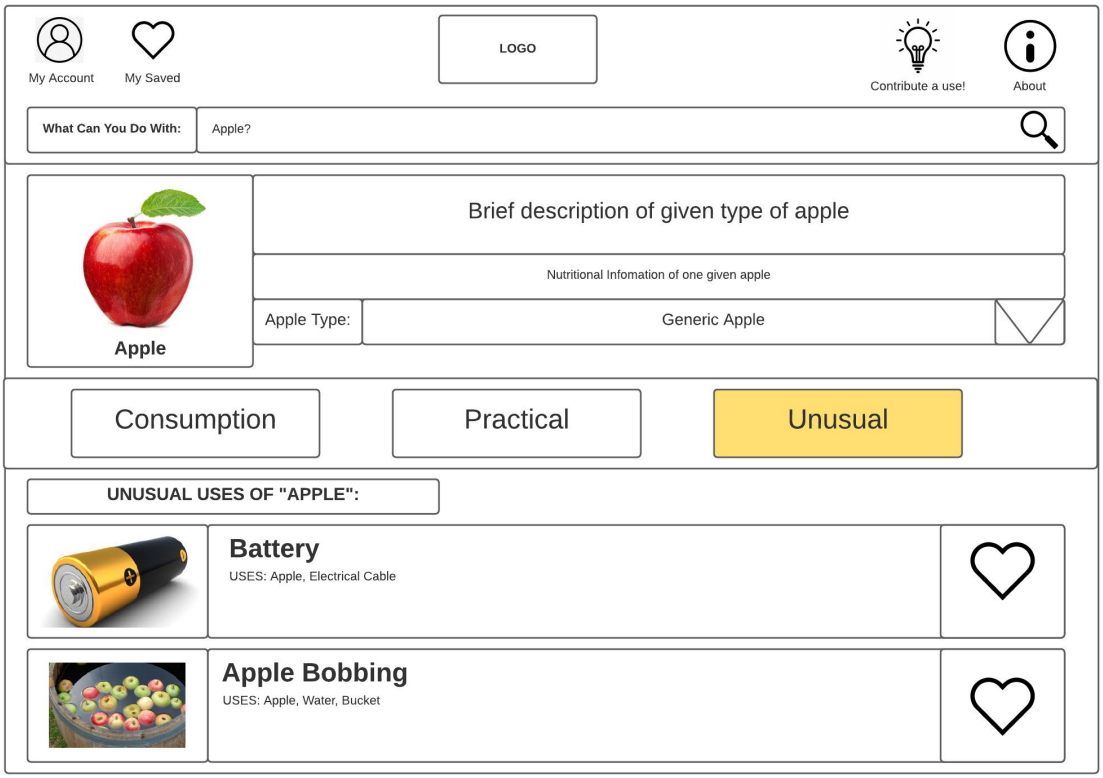

Figure 6.9: Unusual Use Category for Apple

List of Tutorials for Apple Pie

Figure 6.8 addresses core requirement (CR4) by providing reliable links to tutorials and guides. This helps to ensure that users have access to detailed instructions for applying the provided utilisations, promoting successful resource re-purposing and user satisfaction. Additionally, it hints at a potential future feature (FR2) by introducing a star ranking system, which would provide users with a way to prioritize the sustainability factor of each resource utilisation.

Unusual Use Category for Apple

Figure 6.9 is a direct representation of core requirement (CR2). It demonstrates access to a library of resource utilisations and how the platform would provide essential information for users to re-purpose resources. It showcases how the application allows users to explore and discover unusual uses of resources, hoping to inspire creative thinking and resourcefulness, aligning with the platform's sustainability objectives.

Tutorials for Apple Battery

Figure 6.10 again addresses (CR4) by providing reliable links to tutorials and guides. It further teases (FR13), which is the crowd-sourcing feature. The proposal of video submissions to validate contributions signifies the potential application of future requirements (FR13) and (FR14), demonstrating how crowd-sourced content could be effectively stored, retrieved, and presented, and how it could validate resource utilisations.

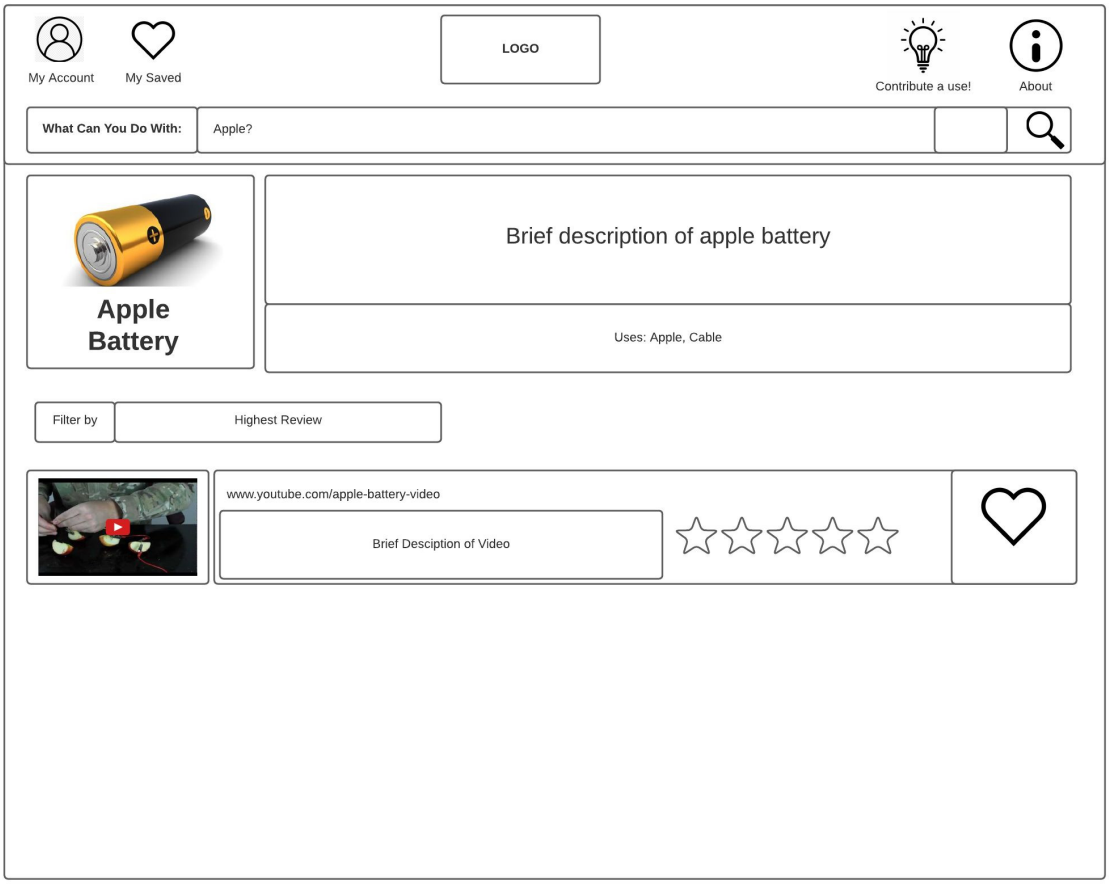

Figure 6.10: Tutorials for Apple Battery

6.5.2 Mobile Screen Size Mock Ups

Attempting to address future requirement (FR3), mobile mock ups were initially designed on paper and then a higher fidelity prototype was attempted using Figma ,(Figma, 2011), to provide a cleaner mock up for design purposes. However, this was a waste of precious time. The likelihood of a mobile application being implemented within this project's limitations is low, with the initial implementation decided on a Google Chrome extension. Thus, the designs provided are not relevant in the initial stage of development and design. However, by providing an idea of how the mobile application may look, it may offer greater clarity for readers and future work to achieve (FR3). Both the paper and Figma works on the mobile screen mock-up can be found in the appendix: (see Figure A.1, p109), (see Figure A.2, p110) (see Figure A.3, p111) (see Figure A.4, p112).

6.5.3 Usability

The lack of user testing is justified by the consideration that the design is still at a preliminary stage. Once implementation is completed, it would be beneficial to perform usability testing on the functional "WhatCanYouDoWith" platform, as user feedback will be grounded in actual experience, thus more accurate and valuable; as opposed to wasting time performing and synthesising user feedback on initial mock up designs.

Performing user testing for the UI at the early stages could also lead to an impact on the vision. This could be detrimental to focus, resulting in time lost, thus again justifying the decision to omit usability testing of this UI at this stage.

6.5.4 Evaluation of the Mobile Mock up

The Figma prototype designing process was halted due to the time it was consuming. It was decided that continuing with other project aspects, such as the supporting literature review, would be a better use of time. The lack of research done on usability practises also seemed to make the task a waste of time, as it would likely need large revisions. Greater emphasis on mobile mock ups should therefore be only considered after initial implementation is completed.

6.5.5 Evaluation of Large Mock up Design

While the current design may not incorporate and visualise all future requirements, it addresses all core requirements adequately. However, the mock-ups still hint at future features.

6.6 Design Conclusion

After completion of the design chapter, the Kanban board can be updated (see Table 6.3, p77)

To Do	In Progress	Done
Conduct user testing to ensure intuitiveness and user-friendliness of the UI	Implement platform foundations	Design mock ups for the user interface
Develop interactive UI elements		Investigate search functionality providers
Conduct unit testing of functionality		Identify and gather credible and relevant resource providers
Test educational value and accessibility and usability		Define database schema
Implement tutorial link delivery system		
Implement information retrieval		

Table 6.3: End of Sprint Two Kanban Board for the Project

Summary of Decisions

- **Design mock ups for the user interface:** Large format mock-ups designed address all core requirements and hints at future requirements, Section 6.5.5.
- **Define database schema:** DBpedia was been chosen as the database of choice.
- **Implement search functionality:** A Google Chrome extension was chose to be the platform to serve the search functionality.
- **Identify subject matter experts and gather relevant resources:** BBC Good Food and WikiHow chosen as the credible tutorial providers.

Chapter 7

Implementation

Each sprint is documented in detail:

- **Sprint 1:** Section 7.1 Foundations.
- **Sprint 2:** Section 7.2 Search Functionality (CR2, CR3).
- **Sprint 3:** Section 7.3 Usability (CR1).
- **Sprint 4:** Section 7.4 DBpedia & Tutorial Pointer (CR2, CR4).

A summary of these sprints is also provided at the end of the chapter: Section 7.5.

The implementation methodology followed is visualised in Figure 7.1.

7.1 Initial Sprint

The initial sprint lays the foundation of the implementation process to achieve the core requirements. Without this initial iteration, it would be difficult to integrate more complex and specialised features in subsequent iterations. Once this sprint is completed, sprint two will be able to directly address the "In Progress" tasks in the Kanban board presented at the end of design (see Table 6.3, p77).

7.1.1 Deliverables

These deliverables address the current task of implementing platform foundations:

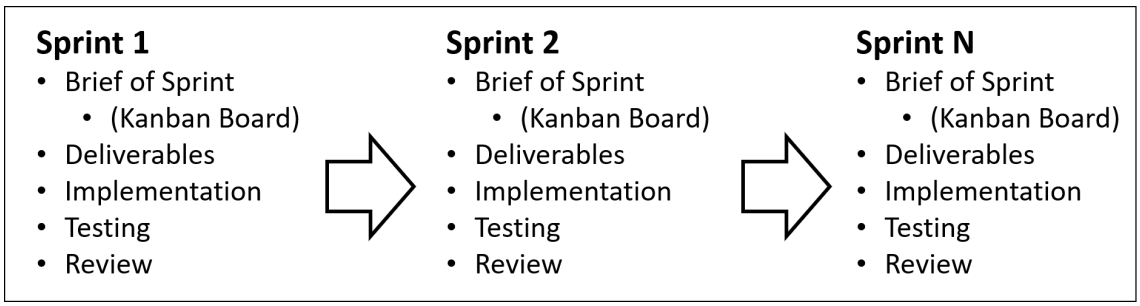

Figure 7.1: Iterative Development Flow Chart

- **Version Control:** Implementing a robust version control system is essential to manage changes to the project, for tracking modifications, and facilitating effective collaboration for potential future teamwork members by establishing an iterative development platform.
- **Development Platform Choice:** The selection of an appropriate development platform forms a basis for the actual coding and testing. While this is trivial, it is still important.
- **Manifest.JSON:** This file is fundamental in Chrome extensions as it provides necessary information about the extension to the Chrome browser. Creating is the first step in developing a Chrome extension.

Version Control

The most important aspect of scalable software engineering is initialising version control. This project will use it for tracking of changes and mitigating risks associated with errors and bugs. Git was chosen to provide this due to its widespread adoption and support for distributed development. A GitHub repository was created to house the project and provide an accessible platform for its version control.

Code Editor Choice

The choice of a reliable code editor is a foundational decision for any programming project. It has a significant impact on the efficiency and ease of the programming process, as well as the ability to integrate with other tools and platforms. The selection process for this project considered several leading code editors, each with their unique strengths and features.

Sublime Text: Lightweight and quick, with a "Goto Anything" feature that significantly speeds up navigation. However, it lacks the built-in terminal and direct Git integration that the other editors offer (Text, 2000).

Atom A product of GitHub, Atom has excellent Git integration and a package manager that allows for extensive customization. However, it can be slower and more resource-intensive than other editors. It also is not longer maintained by GitHub as a result of a security implications and a moved focus onto developing CodeSpaces (GitHub, n.d.).

VS Code Provides built-in support for JavaScript and Node.js, which are integral to the project. It has integrated Git control, which simplifies version control tasks directly within the editor. Its extensive library of extensions allows for a high degree of customisation and additional functionalities. Furthermore, its lightweight nature compared to some other editors ensures that it runs smoothly without consuming excessive system resources (Microsoft, 2016).

By considering the specific needs of the project and weighing the strengths and weaknesses of specified code editors, VS Code was selected as the tool that best meets the requirements for efficient and effective programming.

Manifest.JSON

A Manifest.JSON file is essential for creating a Google Chrome extension, as it specifies basic metadata about the extension such as name, version, and permissions. In 2023, the manifest file was upgraded to v3, providing improved security, privacy, and performance compared to v2 (Google, 2022). Thus study of manifest v3 was required to provide understanding in how to implement it, the initial manifest.JSON file has no functionality, however it can be loaded as a working chrome extension, allowing it to be built onto, in the next sprint.

7.1.2 Testing

There is only one test case for this sprint. Does the Chrome Extension folder successfully upload into the browser. It successfully does so showing no errors, passing testing for this sprint.

7.1.3 Sprint Review

This sprint took longer than anticipated due to the research required on manifest files for Chrome extensions and choosing the development platform. However, it successfully created the initial step of development, laying a solid foundation for subsequent sprints.

7.2 Sprint Two

The second sprint builds on the initial sprint, progressing towards the core requirements of the project. This phase focuses on the development of the key functionality of the extension, such as data retrieval, user interface enhancement, and information delivery. These objectives align directly with the project tasks outlined in the Kanban board (see Table 7.1, p81).

To Do	In Progress	Done
Conduct user testing to ensure intuitiveness and user-friendliness of the UI	Develop interactive UI elements	Design mock ups for the user interface
Test educational value and accessibility and usability	Conduct unit testing of functionality	Investigate search functionality providers
Implement tutorial link delivery system	Implement information retrieval	Identify and gather credible and relevant resource providers
		Define database schema
		Implement platform foundations

Table 7.1: Sprint Two Kanban Board

7.2.1 Deliverables

These deliverables were chosen as they directly align with the tasks in progress and completed tasks, as represented on the Kanban board:

- **Database.JSON:** Developed to serve as a mock database to provide data for popup.js to utilise.
- **Popup.html:** serves as the visible part of the extension where users will interact.
- **Popup.js:** The completion of the popup.js file is key to the search functionality. This JavaScript file will handle the communication between the database and the user interface.

7.2.2 Implementation Process

Database.JSON

This database's purpose is to store and fetch data for the user. In this sprint, the database will hold a singular noun, "tomato", listing several of its applications.

This process serves as a fundamental step in establishing a functioning data retrieval system, proving the system's capability to fetch and display related information. It illustrates a simplified scenario, providing a robust foundation for DBpedia integration.

Popup.html

"popup.html" file forms the extension's user interface. It includes an input field for users to type search queries and a button to initiate the search. The file also defines an unordered list (<ul>) element where search results will be displayed if any matches are found in the "database.JSON" file.

Popup.js

"popup.js" file handles the extension's search feature. It waits for the "DOMContentLoaded" event to ensure that the code is executed only after the entire page has loaded, this is done to avoid any loading errors. The JavaScript in popup.js utilises the "Document Object Model" (DOM), which is used to interact with and manipulate popup.html elements such as the search bar.

The search function is triggered when a user enters text into the search box and clicks the search button. "popup.js" listens for the search button's click event and executes the search function accordingly. The function retrieves the input text, converts it to lowercase to prevent case sensitivity issues, and fetches data from the "database.JSON" file. The function scans this dataset for nouns whose titles match the search text. If a match is

found, the function dynamically inserts the uses of the matching noun into the "results" unordered list (<ul>) element on the "popup.html" page, making them visible to the user in the popup window. If no results are found, the function returns the message "Nothing found in the database." If an error occurs while fetching data, a different error message is displayed to inform the user that a system error has occurred.

Manifest.JSON

An update was made to the manifest.JSON file, which involved adding the "action" of "default_popup". This update allows the extension's HTML to be displayed on the current tab when the extension icon is clicked in the browser. This change required the inclusion of the "activeTab" permission in the manifest.JSON file to enable the current browser tab to overlay with the HTML popup.

7.2.3 Testing

Unit tests will be conducted to ensure each deliverable functions as expected. These tests will include checking whether the GitHub repository contains the newly added files, whether the Chrome extension installs without errors, and whether the search function retrieves the correct data from the "database.JSON" file.

Test	**Expected Outcome**	**Actual Outcome**	**Pass/Fail**
Check that CSS style is implemented	The extension's UI displays the new styling in the browser	The extension's UI displays the new styling in the browser	Pass
Install Chrome extension	The extension installs without errors	The extension installs without errors	Pass
Test search function (exact match)	The search function retrieves the correct data from "database.JSON" when searching for "tomato"	The search function successfully retrieves the utilisations of "tomato" from "database.JSON" when searching for "tomato"	Pass
Test search function (case-insensitive match)	The search function retrieves the correct data from "database.JSON" regardless of the case sensitivity when searching for "Tomato" or "TOMATO"	The search function successfully retrieves the utilisations of "tomato" from "database.JSON" when searching for "Tomato" or "TOMATO"	Pass

Test search function (partial match)	The search function provides "not found in the database" when searching for partial terms like "to" or "mat"	The search function successfully provides "not found in the database" when searching for partial terms like "to" or "mat"	Pass
Test search function (multiple matches)	The search function retrieves all the correct response "not found in the database" from when searching for terms with multiple matches of "tomato" and "example"	The search function successfully provides "not found in the database" when searching for both terms terms	Pass
Test search function (no match)	The search function displays the message "Nothing found in database" when searching for a term that does not exist in "database.JSON"	The search function correctly displays the message "Nothing found in database" when searching for a term that does not exist in "database.JSON"	Pass
Test error handling	The search function handles errors gracefully and displays an appropriate error message when there is an issue fetching data from "database.JSON"	The search function handles errors gracefully and displays the appropriate error message when there is an issue fetching data from "database.JSON"	Pass

Table 7.2: Unit Tests for Sprint Two

7.2.4 Review

The second sprint advanced the project by developing the extension's foundational structure, incorporating the search functionality necessary for "WhatCanYouDoWith". Emphasising code readability, thorough commenting was incorporated to promote ease of understanding for future development, full code is available in the appendices and is accessible by Section 7.5.1. Considerable time was dedicated to understanding JavaScript's ability to incorporate JSON data into an HTML placeholder. Despite being time-consuming, this learning process proved beneficial, with successful test outcomes and tangible progress towards the core project requirements.

7.3 Sprint Three

Building on the foundation established in the first two sprints, the third sprint's primary objective is to enhance user interaction and improve overall usability.

To Do	In Progress	Done
Conduct user testing to ensure intuitiveness and user-friendliness of the UI	Develop interactive UI elements	Design mock ups for the user interface
Implement tutorial link delivery system	Conduct unit testing of functionality	Develop interactive UI elements
Test educational value and accessibility and usability		Investigate search functionality providers
		Identify and gather credible and relevant resource providers
		Define database schema
		Implement information retrieval

Table 7.3: Sprint Three Kanban Board

7.3.1 Deliverables

- Style.css
- Background.js

These deliverables were chosen to enrich the user interface and introduce browser-specific functionalities, creating a more robust and user-friendly application.

7.3.2 Implementation Process

Style.css

A visually appealing and intuitive user interface is crucial in enhancing user experience. The "style.css" file provides the aesthetic formatting to the user interface components defined in "popup.html." It helps create an easy-to-navigate interface by defining the visual aspects like fonts, colors, and layout. However, as the current HTML content remains minimal, the styling, at this point, is relatively limited. The "style.css" will undergo iterative enhancements as the project progresses and more features are added.

Background.js

It was attempted to improve the usability further through an approach where a script would scan HTML pages and convert identified concrete nouns into hyperlinks. However, the feature's complexity, given time constraints, coupled with the impending integration of the DBpedia functionality, led to a decision to pivot.

The research into the Chrome extension's API surfaced an alternative usability improvement – the context menu functionality. This feature allows users to highlight and right-click a word on any web page and have the option to search the word.

Incorporating the context menu into the extension required the creation of the "background.js" file. This file, working as a service worker, sets up event listeners upon installation, that listens for a context menu click event.

7.3.3 Testing

The test cases include verifying the styles defined in "style.css," as well as testing the functionality of the context menu to ensure it activates the extension as expected.

Test	Expected Outcome	Actual Outcome	Pass/Fail
Test colour scheme	Colours match the defined style.css	Colours match the defined style.css	Pass
Check font application	Fonts correspond to style.css specifications	Fonts correspond to style.css specifications	Pass
Evaluate layout structure	Layout aligns with style.css directives	Layout aligns with style.css directives	Pass
Test context menu activation	Context menu activates with right-click	Context menu activates with right-click	Pass
Validate extension activation for selected text	Extension activates and searches for right-clicked highlighted text	Extension activates and searches for right-clicked highlighted text	Pass

Table 7.4: Unit Tests for Sprint 3

Emphasis on comprehensive unit testing ensures a reliable platform for further development. The aim is to leave no aspect untested, establishing this stage as a solid launchpad for future sprints.

7.3.4 Review

Sprint Three is a expansion on its predecessor, introducing advanced features and enhancing usability. The integration of the context menu item offers users a convenient, efficient extension interaction method.

7.4 Sprint Four

This sprint focuses on providing the tutorial link delivery, whilst also looking to improve the database provision by attempting to utilise DBpedia API in in place of the database.JSON file.

To Do	In Progress	Done
Conduct user testing to ensure intuitiveness and user-friendliness of the UI	Implement tutorial link delivery system	Design mock ups for the user interface

Test educational value and accessibility and usability	Conduct unit testing of functionality	Develop interactive UI elements
	Implement tutorial link delivery system	Investigate search functionality providers
		Identify and gather credible and relevant resource providers
		Define database schema
		Implement information retrieval
		Develop interactive UI elements

Table 7.5: Sprint Four Kanban Board

7.4.1 Deliverables

- **DBpedia:** This is to improve the available library of resource utilisations.
- **Tutorial Pointer:** links identified uses with their corresponding tutorial, providing users with practical guidance on using the identified object from the sources identified and chosen in design.

7.4.2 Implementation Process

DBpedia

The integration of DBpedia for displaying "Tomato" uses posed significant hurdles. A SPARQL query was developed to extract data from the "Tomato" category, which successfully ran. However, interfacing with DBpedia's API proved daunting, largely due to its convoluted documentation, as detailed in the design chapter. This led to a period with little visible progress, resulting in considerable stress. As a result, it was decided to forego this feature despite the invested effort, shifting the focus towards meeting the core requirement of providing reliable tutorials for use cases.

Tutorial Pointer

A "recipes" field was incorporated into the 'database.JSON', facilitating the association of recipes with specific use cases. Consequently, each use case, instead of merely displaying "soup, salad, and sauce", now appends links to corresponding recipes from BBC Good Food, enriching the user experience and adding educational value to the platform.

7.4.3 Testing

A comprehensive set of unit tests will be performed on the deliverables of this sprint:

Unit Test	Purpose	Expected Result

Test DBpedia SPARQL query execution	To verify the successful execution of the SPARQL query to extract "Tomato" data	Successful extraction of "Tomato" data from DBpedia
Test the addition of the "recipes" field to 'database.JSON'	To ensure that the "recipes" field has been correctly added and populated	"recipes" field exists and contains the correct data
Test the display of recipe links on the user interface	To validate that the user interface correctly displays the recipe links returned by the search function	Recipe links are correctly displayed on the user interface and direct users to the correct recipes

Table 7.6: Unit Tests for Sprint Four

7.4.4 Review

Despite the stress ensuing from failing to implement DBpedia API, the tutorial pointers were successful, although minimal, they offer a glimpse into its envisioned full potential of providing full lists of resource utilisation tutorials.

7.5 Implementation Summary

Comprehensive lists of unit tests were also carried out for each sprint.

- **Sprint 1: Section 7.1** Laid solid foundations for future development, setting up a boilerplate chrome extension and GitHub repository.
- **Sprint 2: Section 7.2** Successfully implemented the key basic functionalities of searching for a concrete noun and being presented with it's utilisations.
- **Sprint 3: Section 7.3** Implemented styling and novel context menu functionalities to increase usability.
- **Sprint 4: Section 7.4** Successfully implemented tutorial pointers for utilisations, failed to implement DBpedia functionality.

7.5.1 Full Code

Complete code listings for each file developed for WhatCanYouDoWith:

- Popup.js: See Listing C.1.
- Background.js: See Listing C.2.
- Database.JSON: See Listing C.3.
- Manifest.JSON: See Listing C.4.
- Popup.html: See Listing C.5.
- Style.css: See Listing C.6.
- SPARQL Query: See Listing C.7.

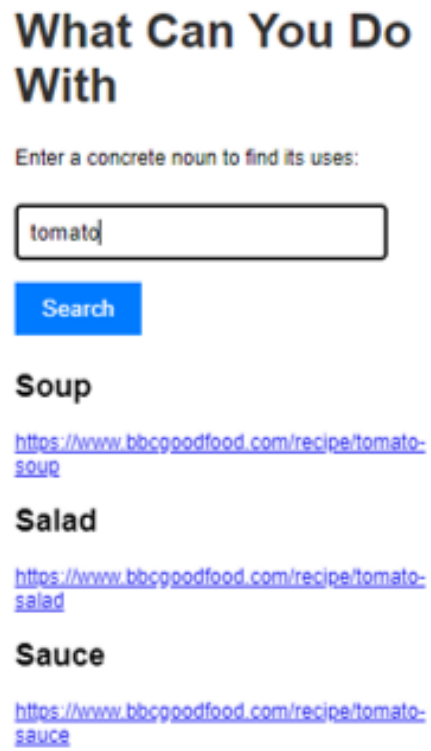

Figure 7.2: Search for tomato in the Working Chrome Extension

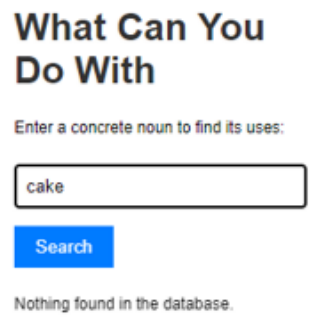

Figure 7.3: Search for Cake in the Working Chrome Extension

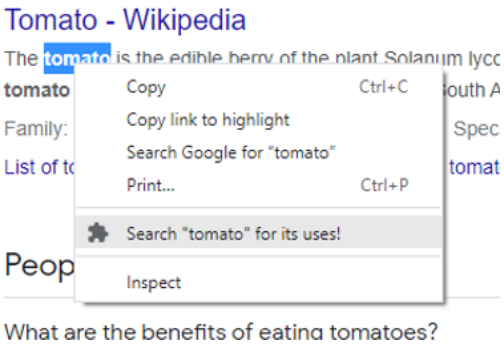

Figure 7.4: Context Menu

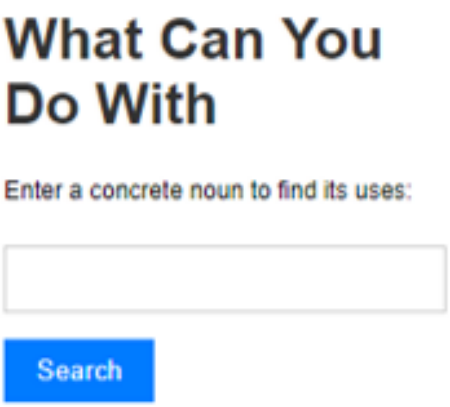

Figure 7.5: Popup.html Display

Chapter 8

Evaluation

8.1 Evaluation of Limitations

The challenges faced in this project were more significant than initially expected. The sole responsibility of driving the project as a single developer, coupled with the unpredictable nature of life, made progress difficult. Although the concept was enthusiastically designed at the outset, enthusiasm dipped when extensive research was needed to explore its feasibility.

Another significant factor was the author's diagnosis of ADHD, just one week before the project deadline. This explained why the initial conceptualisation was easy, while getting started was more daunting. Given the impact ADHD had on the project's execution, any future work will incorporate recommendations from a psychologist to better manage this learning difficulty.

In retrospect, an earlier diagnosis might have allowed for adjustments leading to a more successful outcome, this should be considered throughout the evaluation points made in this chapter.

However, there's no benefit in dwelling on this. The next chapter will focus on future work, outlining clear instructions to continue the development of this project.

8.2 Final Product

The chrome extension provides a service that is significantly underdeveloped, with a highly limited scope. The user interface, while relatively simple, lacks sufficient instructional support, leaving users confused to its purpose and functionality. The tool does not come installed from the Google Store, which significantly reduces its accessibility as it can currently only be installed locally by cloning the GitHub repository and uploading to a local chrome browser.

The search feature, designed to retrieve resource utilisation information, offers a minute

amount of data. Currently, a user is presented with a mere three links to different utilisations of a specific resource (tomato). This is a woefully inadequate amount of information, especially considering the vast potential uses of most resources.

8.2.1 Final Kanban

This final Kanban, Table 8.1, shows the progress made from implementation towards achieving the core requirements Table 4.6

To Do	In Progress	Done
Conduct user testing to ensure intuitiveness and user-friendliness of the UI	Implement tutorial link delivery system	Design mock ups for the user interface
Test educational value and accessibility and usability	Conduct unit testing of functionality	Develop interactive UI elements
	Implement tutorial link delivery system	Investigate search functionality providers
		Identify and gather credible and relevant resource providers
		Define database schema
		Implement information retrieval
		Develop interactive UI elements

Table 8.1: Final Kanban Board

8.3 Requirements

However weak the final product may seem, it is reminded this projects sole goals outlined in Chapter 5 was to only provide the list of core requirements (see Table 4.6, p41). In that respect, the project has been a success.

The Kanban board (Table 8.1) clearly shows that all core requirements were successfully addressed .

The table Table 8.3 provides in depth analysis of the final product against the core requirements, providing a rating from the scale provided in Table 8.2.

8.3.1 Core Requirements Evaluation

(see Table 8.2, p92):

Rating (1-5)	Description
1	Unacceptable
2	Below Standard
3	Meets Standard
4	Exceeds Standard

5	Outstanding

Table 8.2: Rating Scale

Requirement	Level of Success (1-5)	Evaluation
User-friendly web application	3	Provides a functional error-free program, however it provides minimum engagement due the simplicity of the application, it is unlikely to bring about sustainable behavioural change in its current state.
Access to a library of resource utilisations	3	It successfully fetch and serves utilisations from a JSON database, however the database is minimal, providing an extremely narrow scope for its usefulness. This is mostly due to the difficulties experienced in implementing DBpedia, as shown from the lack of discovered literature, Section 2.5.5.
A search feature	4	the search feature works well, it has been rigorously tested in Section 7.2.3, however it doesn't defend against possible JSON injection attacks and doesn't provide suggestions to automatically complete searches as they are typed.
Reliable links to tutorials and guides	3	Due to the lack of concrete nouns available, the minimum of this requirement is solidly met, due to the design research undertook in Section 6.3.

Table 8.3: Evaluation of Final Product Against Core Requirements

Evaluation of Requirements

To be fully evaluative, the requirements themselves must be evaluated. The clear distinct requirements between core and future, the provision of various detailed use cases (see Section 4.1, p33), the colour coded dependency diagram and the detail of relation of the requirements to the goals and aims proved invaluable in guiding the following chapters of the project. By providing clear, categorised requirements future work done benefited from the clear direction provided.

However, the requirements drawn from Chapter 2 and Chapter 3. They don't consider real life end users. In this fact, there exists a level of uncertainty of the requirements arrived at in achieving all the goals and aims of the project, Section 1.2.

8.4 Evaluation of Research

8.4.1 Literature Review

The project owes its entirety to the literature review. Without it, the project would have likely failed. The literature review took the majority of this projects time to complete: Due to the ambitions set out in the goals and aims, Section 1.2, the project stagnated for many weeks as it was difficult understanding how to move forward. Therefore, other university responsibilities took the forefront of efforts. However, in time, through consistent exploratory research of areas of relevance, confidence was slowly built. This was aided by the guidance of the project supervisor, who, in hindsight, should have been informed sooner of the overwhelming fear experienced from the far-sighted vision held for the WhatCanYouDoWith platform. This could be due to factors outlined in Section 8.1. Or, the fact the idea was conceptualised and idealised three years prior to the submission of the PID, Appendix B.

An incredible wealth of documentation was uncovered and studied during the search to provide justification and need for such WhatCanYouDoWith. Through this, courage was inspired through the challenge of understanding how to begin the development of this grand idea. By identifying and understanding the gap Section 2.5.1, immense knowledge and understanding has been acquired, which is absolutely necessary if future work is to be beneficial to the aims and goals of this project.

8.4.2 Design Choice Research

Justified decisions made from extensive research lead to clear and easy decisions, providing a clear route for implementation. However, time restricted further DBpedia research. Given the lack of literature, it would require further efforts to discover helpful documentation. If found, the possibility of successful implementation would increase, which then helps to achieve the discovered aim: filling the gap of comprehensive and accessible documentation of how to utilise DBpedia, as mentioned in Section 6.2.2.

8.5 Methodology

The Agile methodology was largely useful, as it guided the project and gave structure to implementation. If the agile methodology and its principles weren't considered as they have been done, then implementation would of likely been difficult to execute and document.

If Agile wasn't followed this project would likely be considered a complete failure, but by utilising Agile principles, the project becomes a success. This is because it successfully completes the core requirements, providing a solid foundation for future works. which keeps in line with the principles considered Table 5.1.

However, large amounts of time were lost by providing the chapter in detail. Formulating the methodology, while crucial, was less relevant in the initial creation of a platform as time was lost elsewhere, such as researching DBpedia. In hindsight, less time should of been spent on methodology, however given the increasing complexity of the project in future work, it cannot be ignored and will be instrumental to further success.

8.5.1 Implementation

The implementation process overall was moderately successful. The first sprint was merely trivial - Section 7.1. The second sprint was highly successful - Section 7.2. Due to the happiness inspired from its success, usability was then considered, with the thought it would take less than a day. However, as mentioned in Section 7.3.2, difficulty was discovered and this led to Sprint 3, Section 7.3, becoming a waste of time. It does well to provide an idea of how usable the service may become. Although, as a result of its completion, the implementation of DBpedia failed due to time constraints. If this was to be done again, Sprint 3 would be omitted, until all core requirements are fully achieved.

8.6 Personal Reflection of Project Journey

A first person account and evaluation of the project journey follows:

8.6.1 Introduction

Firstly, thank you for taking the time to read and digest this dissertation report - if you did, that is! I have genuinely put my life and soul into this project. So much so, that if you could cut it, it might bleed. It has become a part of me.

Origins of the Project

The concept of WhatCanYouDoWith has been a talking point of mine for the last four years. I cannot remember the exact date; however, I can visualise in my mind the scene where it was conceived: Staring into my half empty cupboard of random food items, with only 50p in my bank account. I remember venting to my housemates at the time, who thought it merely another unachievable crazy idea of mine. They weren't far from being right to be honest! Four years later, this now makes perfect sense; given the fact I recently have been diagnosed with ADHD! As mentioned in Section 8.1, it was only discovered with a mere nine days to the deadline! I have consistently struggled throughout my entire undergraduate degree with issues that are clearly a result of my ADHD not being addressed! However annoying this has been to discover so late in my education; I have managed to push through this time, without any professional treatment. This piece of work I've managed to complete - I'm eternally proud of, even if functionality is minimal.

Future Work

The report speaks heavily on the Agile methodology to ensure scalability and the ease of future work. It can sound like this is directed at potential others who may want to carry this on. However, its real intention is for myself to continue this work once clearance to do so has been given by the University of Portsmouth (after marking finishes). This project is not merely to "provide a degree to get a job", but it is a lifelong project that I will continue to work on until it is fully realised.

Impact of the Pandemic

This project was approved and signed off to my project to undertake in a "Self Employed Placement" (SEP) in 2021/2022. However as a result of COVID-19, I (like many others) suffered with depression. That, alongside the change in study to remote learning, resulted in the failure of two modules in my second year of study.

However, through the time working on this project, realising its potential as a chrome extension and how it may be realised, I started to realise how this project could work for a greater cause, instead of providing me with an income. This enlightening moment is what gave way to the broad goals and aims found in Section 1.2, channeling my economic mindset developed in my A-Level studies.

Research Experience

The research stage was frankly, depressing. It was tough spending day after day reading through highly credible documentation on how our environment is at incredible risk of deterioration. The research impacted me so much that I started questioning my life goal of raising a family.

Call to Action

By continuing work on this project, and providing this chapter, hopefully I will inspire further collaboration. I alone will be unlikely to produce the full requirements detailed Table 4.7. By inspiring collaboration towards achieving the goals and aims, Section 1.2, Goal six is realised. As this project showcases that even if you doubt your abilities, even if you have struggled all through your studies, even if you have been plagued with depression or ADHD or grief or anything else, do not doubt yourself!

8.6.2 Lessons Learnt

- Focus on the immediate next step to avoid anxiety and stagnation that can stem from solely concentrating on the bigger picture.
- Appreciate that what might seem like minor progress can actually represent significant work. Don’t let your ambition overshadow your achievements!

- Don't let perfectionism obstruct your progress. If it's not perfect, that's okay! Moving on will often bring you closer to 'incredible', as much time can be lost in the pursuit of perfecting minor details.
- Do dive deep into the citations, follow the rabbit hole, but be mindful of time constraints.
- Enhance your reading skills with regular practice.
- Start implementation as early as possible, as it creates a pathway to the literature review.
- Aim to work 9in small, consistent bursts throughout the year rather than intensely over a short period, which can be detrimental to sleep, mental health, and relationships.
- Seek university assistance promptly if experiencing symptoms of a learning difficulty, as in my case with ADHD. (Though ironically, ADHD can make seeking ADHD help more challenging!)
- Take frequent walks, allow time for ideas to settle, and resist impulsive actions.
- Persist in asking for help until complete clarity is achieved. Overcome any fear of appearing uninformed to experts and lecturers.
- Avoid falling into a cycle of non-attendance; remember that paranoia about perceived animosity exists only in your mind.
- Be persistent and don't give up on learning; eventually, it will click. Seek help as soon as possible!

8.6.3 Conclusion of Personal Journey

If you have an idea that could potentially benefit society but seems too ambitious to achieve, let me assure you, from my work on this project, it's not! Look at the recent advances in AI technology! Anything is possible in the Age of Information. So, continue to combat the discomfort of 'not knowing', remain consistent in your efforts, and, in time, I firmly believe that nothing is impossible. All visions can be realized in one way or another.

Chapter 9

Future Work

9.1 Future Research

Literature Review

Due to time constraints, there is scope for a more in-depth and broader literature review. Future research should examine how education treats sustainability differently worldwide, given the political or religious influences prevalent in various nations' educational systems. The review failed to consider how existing cultures impact the learning process of sustainable practices, as sources claiming success in improving sustainable attitudes through environmental education, Section 2.3.3, targeted students in the USA. A predominantly Christian and atheist developed economy (Pew Research Center, 2021; World Bank, 2021). Further investigation should be undertaken to understand how this might contrast with enhancing sustainability in nations with different characteristics, exploring potential challenges may arise from imposing a platform like WhatCanYouDoWith.

Frameworks

To enable further development with ease, frameworks should be researched such as vue.js and react.js. The design chapter fails to mention the relevance of frameworks in 2023, which is huge. These will, once understood, provide a easier process towards delivering the future requirements, Table 4.7.

AI

The rise of large language models cannot be understated. The recent exposure of their potential use has essentially made the DBpedia route obsolete. Future work should not attempt to provide DBpedia integration, but should instead seek implementation of a large language model that can be trained and fine tuned to provide resource utilisations of all concrete nouns in existence. Therefore, future research on how to implement such will be required.

However, it should also be researched at the feasibility of utilising a large language model

like GPT-4 to be provided with access to the DBpedia knowledge graphs 850 million facts (Holze, 2023).

9.2 Future Design & Implementation

The dependency diagram from requirements, Section 4.4, provides a clear road map for the realisation of the future requirements Table 4.7. Given the completed implementation progression, this section will outline specific tasks to continue work towards achieving a fully realised core requirements Table 9.1.

9.2.1 Core Requirement Progression Table

Core Requirement	Next Steps
User-friendly web application	• Conduct usability testing to identify areas for improvement. • Apply findings to revise the requirements. • Explore the use of development frameworks like Vue.js and React.js for ease of implementing enhancements.
Access to a library of resource utilisations	• Integrate a large language model API. • Train and fine-tune the language model to generate resource utilisations for a wider variety of concrete nouns. • Integrate the language model with DBpedia.
A search feature	• Implement a defense mechanism against potential JSON injection attacks. • Develop an auto-suggest feature to help users complete searches as they type.
Reliable links to tutorials and guides	• Research further credible providers of tutorials and guides on resource utilisations.

Table 9.1: Next Steps for Core Requirement Progression

9.2.2 Future Requirement Progression

Only once these core requirements are completed, should work towards the future requirements be considered.

Chapter 10

Conclusion

The conclusion chapter provides a detailed summary of the entire project, then it analyses the success of the overall project in achieving the goals and aims Section 1.2.

10.1 Summary

From the literature review summary, Chapter 2, Section 2.6.1, a gaps were discovered and exposed in the accessibility of resource utilisation education Section 2.5.5. Providing evidence that through greater provision RUE could encourage sustainable behavioural changes, which would help all society progress towards achieving the goals set out by the Paris Agreement, (United Nations, 2015). It was found that too often literature only references government policy, to which The United Nations Secretary General backs up in his May 2023 report, (United Nations, 2023b). Exclaiming that more input and collaboration is required from Science, Technology and Innovation, if the SDG goals (United Nations, 2022) are to achieved by 2030, as currently statistics show that on average; progress is regressing, as shown from Figure 2.1.

This lead to an analysis of existing systems that attempt to provide this gap of public education through software: Chapter 3. From executing these two extensive studies, a proposal was then drawn up, WhatCanYouDoWith - Section 3.3.1.

From the research performed requirements were drawn up in Chapter 4. Providing in detail use cases for the WhatCanYouDoWith, by analysing how developing, and developed economies might use the software, (see Section 4.1, p33). Understanding project limitations, Section 4.2, two clear distinctions were justified and established. Outlining the aim of this projects design and implementation to complete only the core requirements (Table 4.6.

In order to ensure that design and implementation was well documented and scalable for

future work, a detailed methodology was planned, Chapter 5. Ensuring that development followed relevant Agile principles, Table 5.1, within the project context and limitations.

The design chapter, Chapter 6, researched possible methods of implementing the core requirements, whilst considering the future requirements. It provided justifications for decisions choices made. These were then implemented through four weeks of Agile sprints to develop the core requirements and produce the foundations of WhatCanYouDoWith, Chapter 6. The groundwork was effectively established, as evaluated in Table 8.3.

The evaluation chapter, Chapter 8, then analysed all works done and all processes and chapters covered in this dissertation project, addressing key limitations from the development of the project, and the final product of WhatCanYouDoWith.

10.2 Overall Success of Goals and Aims

It can be asserted that this project moderately accomplishes its set goals and aims, which is further substantiated by Table 10.1. Key findings, as discussed in Section 2.5 and Section 6.2.2, highlight gaps in the area of 'resource utilisation education'. Despite the limitations of the libraries searched, and the search terms used (Table 2.1); it is clear this project represents a pioneering step in documenting this field and it's ability to foster sustainable behavioural changes.

Similarly, this work stands as an innovative example an attempt to harness DBpedia, as shown by the search strategy, Table 6.2.

It is hoped that this project will spark inspire and encourage further ambitious engineering projects that aim to increase the rate of sustainable behavioural change through scientific, technological, and innovative approaches.

10.2.1 Table of Achievement Progress

This table uses the same ranking system outlined by Table 8.2.

Objective	**Level of Success (1-5)**	**Evaluation**
Reduce Global Poverty (G1)	0	The project initiated the foundation of a platform for accessible education, but currently its tangible impact on poverty reduction is still to be assessed.
Increase global productivity and innovation (G2)	0	The project's potential to foster innovation and productivity through educational resources is evident, although measurable impacts need further study.

Reduce global waste production (G3)	0	Although the project aims to foster sustainable behaviour changes, its direct effect on waste production is not yet quantifiable.
Promote and foster sustainable behavioural change worldwide (G4)	0	The project effectively identified a gap in resource utilisation education, establishing a basis for promoting sustainable changes, however it is not yet deployed thus creating no effect.
Improve access to factual and useful education (G5)	1	The project initiated an innovative platform for comprehensive education, but further development is required for it to be fully engaging and functional as it only provides tutorials for three utilisations of a tomato currently.
Inspire ambitious innovative solutions to combat climate change (G6)	3	This project, hopefully, will be recognised as an ambitious attempt to solve climate change while being humble and aware of its limitations. The personal journey section of the evaluation chapter may inspire readers who have been hesitant to share their creative ideas due to the fear of failure. Given these considerations, the project, to a minor extent achieves this goal, providing the basis for its ranking of three in terms of success

Table 10.1: Evaluation of Final Product Against Core Requirements

References

Agriculture & Forestry. (2021). Kampanjen om matens ursprung ökade uppskattningen av inhemsk mat. *Finland*. https://mmm.fi/sv/-/ruuanalkuperaa-korostanut-kampanja-lisasi-kotimaisen-ruuan-arvostusta.

Auer, S., Bizer, C., Kobilarov, G., Lehmann, J., Cyganiak, R., & Ives, Z. (2007). Dbpedia: A nucleus for a web of open data. *The Semantic Web*, *4825*, 722–735. https://doi.org/10.1007/978-3-540-76298-0_52

Babiker, M., Arabia, S., Berndes, G., Al Khourdajie, A., Jannuzzi, G., Brazil, A., & Reisinger. (2022). Veronika ginzburg (the russian federation). *Climate Change 2022: Mitigation of Climate Change*. https://doi.org/10.1017/9781009157926.005

BBC Good Food. (2023). Bbc good food. *BBC Good Food*. https://www.bbcgoodfood.com/

Berkhout, F., Verbong, G., Wieczorek, A. J., Raven, R., Lebel, L., & Bai, X. (2010). Sustainability experiments in asia: Innovations shaping alternative development pathways? *Environmental Science Policy*, *13*, 261–271. https://doi.org/10.1016/j.envsci.2010.03.010

Berners-Lee, T. (2009). Linked data. *W3.org*. https://www.w3.org/DesignIssues/LinkedData.html

Berners-Lee, T., Hendler, J., & Lassila, O. (2001). The semantic web | a new form of web content that is meaningful to computers will unleash a revolution of new possibilities. *Scientific American*. https://www.scientificamerican.com/article/the-semantic-web/

Bernstein, S., & Hoffmann, M. (2018). The politics of decarbonization and the catalytic impact of subnational climate experiments. *Policy Sciences*, *51*, 189–211. https://doi.org/10.1007/s11077-018-9314-8

Bradley, J., Waliczek, T., & Zajicek, J. (1999). Relationship between environmental knowledge and environmental attitude of high school students. *The Journal of Environmental Education*, *30*, 17–21. https://doi.org/10.1080/00958969909601873

Bulkeley, H., Castan Broto, V., & Edwards, G. (2014). *An urban politics of climate change: Experimentation and the governing of socio-technical transitions*. https://doi.org/10.4324/9781315763040

Cambridge Dictionary. (2019). Resource | meaning in the cambridge english dictionary. *Cambridge.org*. Retrieved April 11, 2023, from https://dictionary.cambridge.org/dictionary/english/resource

Cambridge Dictionary. (2022). Utilization | meaning in the cambridge english dictionary. *cambridge.org*. Retrieved April 11, 2023, from https://dictionary.cambridge.org/dictionary/english/utilization

Cicekli, I., & Suleymanov, N. (2015). Developing a platform that supplies processed information from internet resources and services. *IEEE Xplore*. https://doi.org/10.1109/ISCMI.2015.31

Dambhare, S. S., & Karale, S. J. (2017). Smart map for smart city. *IEEE Xplore*. https://doi.org/10.1109/ICIMIA.2017.7975536

Denton, F., Halsnæs, K., Akimoto, K., Burch, S., Diaz Morejon, C., Farias, F., Jupesta, J., Shareef, A., Schweizer-Ries, P., Teng, F., & Zusman, E. (2022). Accelerating the transition in the context of sustainable development. In P. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, & J. Malley (Eds.), *Climate change 2022: Mitigation of climate change. contribution of working group iii to the sixth assessment report of the intergovernmental panel on climate change*. Cambridge University Press. https://doi.org/10.1017/9781009157926.019

Eichengreen, B., Park, D., & Shin, K. (2021). The shape of recovery: Implications of past experience for the duration of the covid-19 recession. *Journal of Macroeconomics*, *69*, 103330. https://doi.org/10.1016/j.jmacro.2021.103330

Fazey, I., Carmen, E., Chapin, F., Ross, H., Rao-Williams, J., Lyon, C., Connon, I., Searle, B., & Knox, K. (2018). Community resilience for a 1.5 °c world. *Current Opinion in Environmental Sustainability*, *31*, 30–40. https://doi.org/10.1016/j.cosust.2017.12.006

Figma. (2011). About figma, the collaborative interface design tool. *Figma*. https://www.figma.com/about/

Finland. (2017). Government report on food policy: Food 2030 – finland feeds us and the world.

Geith, C., & Vignare, K. (2007). Access to education with online learning and open educational resources: Can they close the gap? *J Asynchronous Learn Netw.*, *12*. https://doi.org/10.24059/olj.v12i1.39

GitHub. (n.d.). Atom. *GitHub*. Retrieved May 22, 2023, from https://github.com/atom

Google. (2022). Welcome to manifest v3. *Chrome Developers*. https://developer.chrome.com/docs/extensions/mv3/intro/

GOV.UK. (2021). Government targets false vaccine information on social media. *gov.uk*. https://www.gov.uk/government/news/government-targets-false-vaccine-information-on-social-media

Hepburn, C., O'Callaghan, B., Stern, N., Stiglitz, J., & Zenghelis, D. (2020). Will covid-19 fiscal recovery packages accelerate or retard progress on climate change? *Oxford Review of Economic Policy*, *Smith School Working Paper 20-02*. https://doi.org/10.1093/oxrep/graa015

Hoffman, I. (2010). Climate change in context: Implications for livestock production and diversity.

Holze, J. (2023). Dbpedia snapshot 2022-12 release. *DBpedia Association*. Retrieved April 24, 2023, from https://www.dbpedia.org/blog/dbpedia-snapshot-2022-12-release/

Hoornweg, D., & Bhada-Tata, P. (2012). What a waste : A global review of solid waste management. *openknowledge.worldbank.org*. Retrieved April 11, 2023, from https://openknowledge.worldbank.org/handle/10986/17388;

IPCC. (2022). Climate change 2022: Mitigation of climate change. *www.ipcc.ch*. https://www.ipcc.ch/report/ar6/wg3/

Ives, C. D., Freeth, R., & Fischer, J. (2020). Inside-out sustainability: The neglect of inner worlds. *Ambio*, *49*, 208–217. https://doi.org/10.1007/s13280-019-01187-w

Kaza, S., Yao, L., Bhada-Tata, P., & Van Woerden, F. (2018). What a waste 2.0 | a global snapshot of solid waste management to 2050. *openknowledge.worldbank.org*. Retrieved April 11, 2023, from https://openknowledge.worldbank.org/entities/publication/d3f9d45e-115f-559b-b14f-28552410e90a

Kreibiehl, S., Jung, Y., Battiston, S., Carvajal, P., Clapp, C., Bechtoldt, M., Bertram, C., Couto, L., Brazil, (Hourcade, J.-C., Mercure, J.-F., Abdulla, A., José, M., Blanco, L., Spain, (Kreibiehl, S., Jung, T., Battiston, S., Carvajal, P., ... Malley, J. (2022). Chapter 15 investment and finance. *Justice Issah Surugu Musah*. https://doi.org/10.1017/9781009157926.017

Lecocq, F., Winkler, H., Partson, J., Fu, S., Gerber, J., Domenico, M., Pedace, R., Anwar, K., Lecocq, F., Winkler, H., Daka, J., Fu, S., Gerber, J., Kartha, S., Krey, V., Lofgren, H., Masui, T., Mathur, R., Portugal-Pereira, J., ... Malley, J. (2022). Chapter 4: Mitigation and development pathways in the near to mid-term. *Climate Change 2022: Mitigation of Climate Change*. https://doi.org/10.1017/9781009157926.006

Love Food Hate Waste. (2019). Love food hate waste. *Love Food Hate Waste*. https://www.lovefoodhatewaste.com/

Luke. (2021). Finnish food production methods in international comparison. https://projects.luke.fi/ruokafakta/en/frontpage/

Maffettone, P., & Oldani, C. (2020). Covid-19: A make or break moment for global policy making. *Global Policy*. https://doi.org/10.1111/1758-5899.12860

Make Smthng. (n.d.). Make smthng. *Make Smthng*. https://www.makesmthng.org/

Manifesto, A. (2001). Principles behind the agile manifesto. *Agilemanifesto.org*. https://agilemanifesto.org/principles.html

Microsoft. (2016). Visual studio code. *Visualstudio.com*. https://code.visualstudio.com/

Nabuurs, G.-J., Aoki, L., Ayala-Niño, F., Emmet-Booth, J., Nabuurs, G.-J., Mrabet, R., Hatab, A., Bustamante, M., Clark, H., Havlík, P., House, J., Mbow, C., Ninan, K., Popp, A., Shukla, J., Skea, R., Slade, A., Al Khourdajie, R., Van Diemen, D., … Malley. (2022). Chapter 7 agriculture, forestry and other land uses (afolu). *Climate Change 2022: Mitigation of Climate Change*. https://doi.org/10.1017/9781009157926.009

Node.js. (2023). Introduction to node.js. *Introduction to Node.js*. Retrieved April 13, 2023, from https://nodejs.dev/en/learn/

OECD. (n.d.). Income inequality. *OECD*. Retrieved May 22, 2023, from https://data.oecd.org/inequality/income-inequality.htm

OpenAI. (2023). Gpt-4. *openai.com*. https://openai.com/research/gpt-4

Papantoniou, A., Loumos, V., Poulizos, M., & Rigas, G. (2011). A framework for visualizing the web of data: Combining dbpedia and open apis. *IEEE Xplore*. https://doi.org/10.1109/PCI.2011.32

Pew Research Center. (2021). Religious landscape study. *Pew Research Center*. Retrieved May 20, 2023, from https://www.pewresearch.org/religion/religious-landscape-study/

Phiwngam, N., & Senivongse, T. (2016). Knowledge enhancement of text and visualization based on dbpedia dataset. *IEEE Xplore*. https://doi.org/10.1109/ICISCE.2016.101

Rao, N. D., & Min, J. (2018). Less global inequality can improve climate outcomes. *environment.yale.edu*. Retrieved May 8, 2023, from https://environment.yale.edu/bibcite/reference/2248

Schäpke, N., Bergmann, M., Stelzer, F., & Lang, D. (2018). Labs in the real world: Advancing transdisciplinary research and sustainability transformation: Mapping the field and emerging lines of inquiry. *Sustainability Science*, *13*(4), 1109–1117. https://doi.org/10.1007/s11625-018-0574-8

Schneidewind, U., Singer-Brodowski, M., Augenstein, K., & Stelzer, F. (2016). *Pledge for a transformative science: A conceptual framework* (tech. rep. No. 191). Wuppertal Institut für Klima, Umwelt, Energie. http://nbn-resolving.de/urn:nbn:de:bsz:wup4-opus-64142

Siddiqui, F., A. Salam, R., S. Lassi, Z., & K. Das, J. (2020). The intertwined relationship between malnutrition and poverty. *frontiersin.org*. Retrieved April 12, 2023, from https://www.frontiersin.org/articles/10.3389/fpubh.2020.00453/full

Sloman, J., & Garratt, D. (2018). *Economics* (10th ed.). Pearson.

Steffen, B., Egli, F., Pahle, M., & Schmidt, T. S. (2020). Navigating the clean energy transition in the covid-19 crisis. *Joule*, *Volume 4, Issue 6*, 1137–1141. https://doi.org/10.1016/j.joule.2020.04.011

Temme, E. H. M., Vellinga, R. E., de Ruiter, H., Kugelberg, S., van de Kamp, M., Milford, A., Alessandrini, R., Bartolini, F., Sanz-Cobena, A., & Leip, A. (2020). Demand-side food policies for public and planetary health. *Sustainability*, *12*, 5924. https://doi.org/10.3390/su12155924

Text, S. (2000). Sublime text - a sophisticated text editor for code, markup and prose. *Sublimetext.com*. https://www.sublimetext.com/

Uludağ, Ö., Putta, A., Paasivaara, M., & Matthes, F. (2021). Evolution of the agile scaling frameworks. *Lecture Notes in Business Information Processing*, 123–139. https://doi.org/10.1007/978-3-030-78098-2_8

UNEP. (2019). Emissions gap report 2019. *https://wedocs.unep.org*. Retrieved May 3, 2023, from https://wedocs.unep.org/bitstream/handle/20.500.11822/30797/EGR2019.pdf

UNESCO. (2010). Education counts: Towards the millennium development goals. *unesdoc.unesco.org*. Retrieved April 12, 2023, from https://unesdoc.unesco.org/ark:/48223/pf0000190214

UNESCO. (2017). Education for sustainable development goals: Learning objectives. *unesdoc.unesco.org*. Retrieved April 11, 2023, from https://unesdoc.unesco.org/ark:/48223/pf0000247444

UNESCO. (2021). Open educational resources. *Unesco.org*. Retrieved May 5, 2023, from https://www.unesco.org/en/open-educational-resources

United Nations. (2015). The paris agreement. *United Nations*. https://www.un.org/en/climatechange/paris-agreement

United Nations. (2020). A new era of conflict and violence. *United Nations*. https://www.un.org/en/un75/new-era-conflict-and-violence

United Nations. (2022). The sustainable development goals report 2022. https://unstats.un.org/sdgs/report/2022/The-Sustainable-Development-Goals-Report-2022.pdf

United Nations. (2023a). The 17 sustainable development goals. *United Nations*. Retrieved April 11, 2023, from https://sdgs.un.org/goals

United Nations. (2023b). Progress towards the sustainable development goals: Towards a rescue plan for people and planet. https://sdgs.un.org/sites/default/files/2023-04/SDG_Progress_Report_Special_Edition_2023_ADVANCE_UNEDITED_VERSION.pdf

UNWTO. (2023). Number of international tourist arrivals worldwide from 2005 to 2022, by region (in millions) [graph]. Retrieved May 22, 2023, from https://www.statista.com/statistics/186743/international-tourist-arrivals-worldwide-by-region-since-2010/

WHO. (2023). Who covid-19 dashboard. *World Health Organization*. https://covid19.who.int/

WikiHow. (2023). Main page. *wikiHow*. https://www.wikihow.com/Main-Page

Winkler, H., Boyd, A., Torres Gunfaus, M., & Raubenheimer, S. (2015). Reconsidering development by reflecting on climate change. *International Environmental Agreements: Politics, Law and Economics*, *15*(4), 369–385. https://doi.org/10.1007/s10784-015-9304-7

World Bank. (2021). Gdp per capita (current us$) | data. *World Bank*. Retrieved May 20, 2023, from https://data.worldbank.org/indicator/ny.gdp.pcap.cd?most_recent_value_desc=true

World Bank. (2022). Solid waste management. *World Bank*. Retrieved April 11, 2023, from https://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management

World Bank. (2023). World: Total population from 2011 to 2021 (in billion inhabitants) [graph]. *World Bank*. Retrieved May 22, 2023, from https://www.statista.com/statistics/805044/total-population-worldwide/

World Bank. (n.d.). Exports of goods and services (% of gdp). *World Bank*. Retrieved May 22, 2023, from https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS?end=2021%7B%5C&%7Dstart=2011

Zero Waste Chef. (2023). About/contact. *Zero Waste Chef*. https://zerowastechef.com/about/

Appendix A

Mobile Mockups

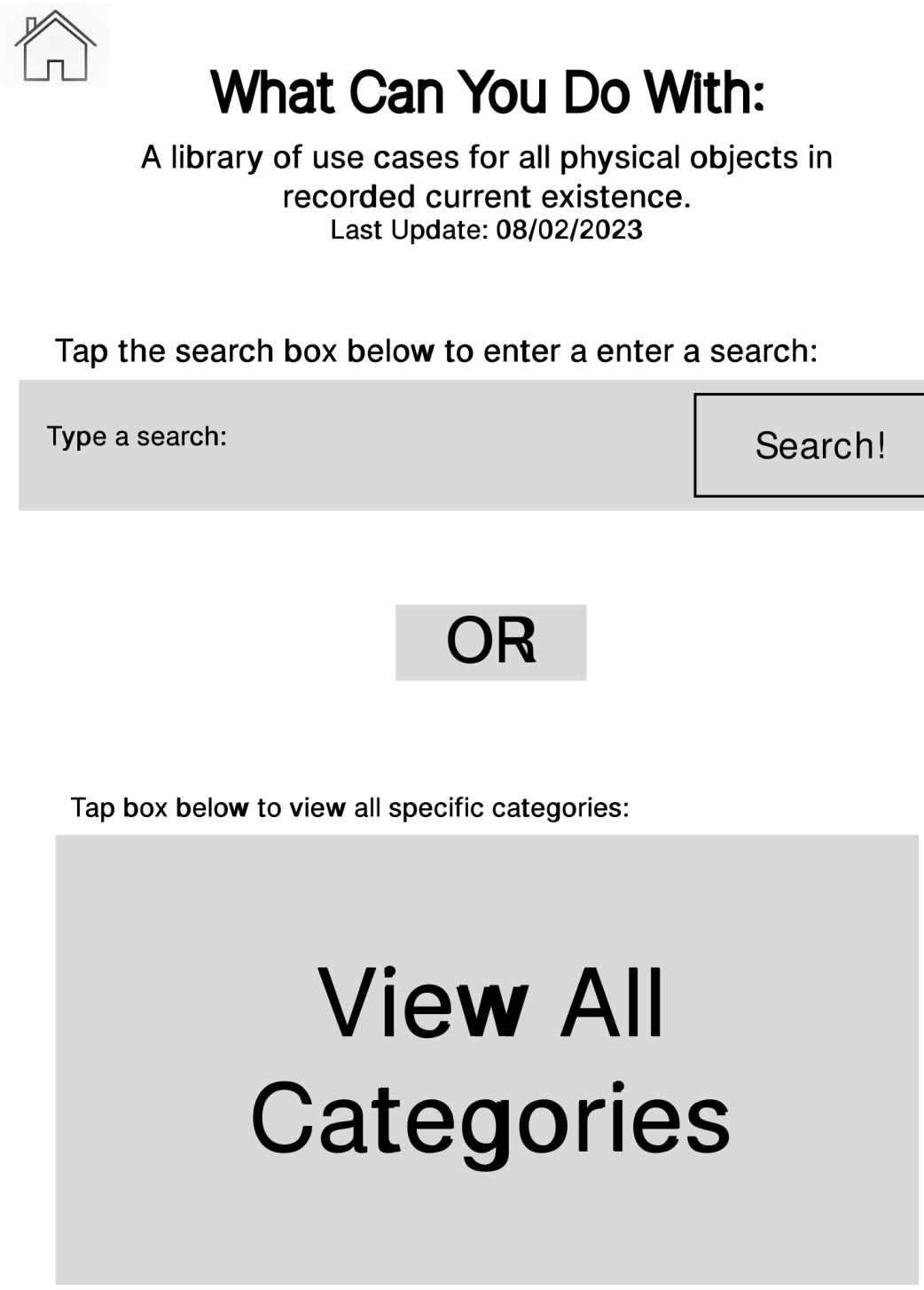

Figure A.1: Figma Mock Up Landing Page

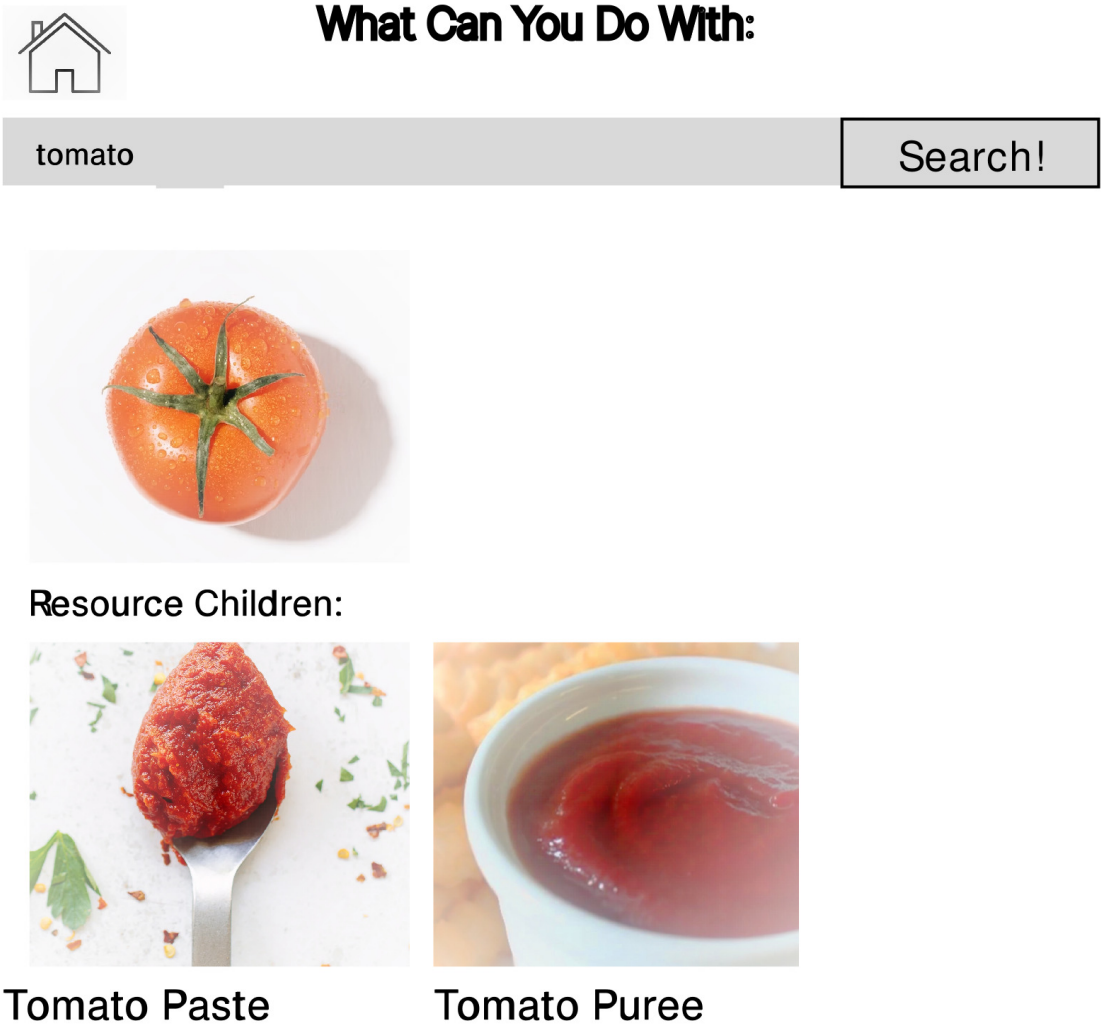

Figure A.2: Figma Mock Up Tomato Search View

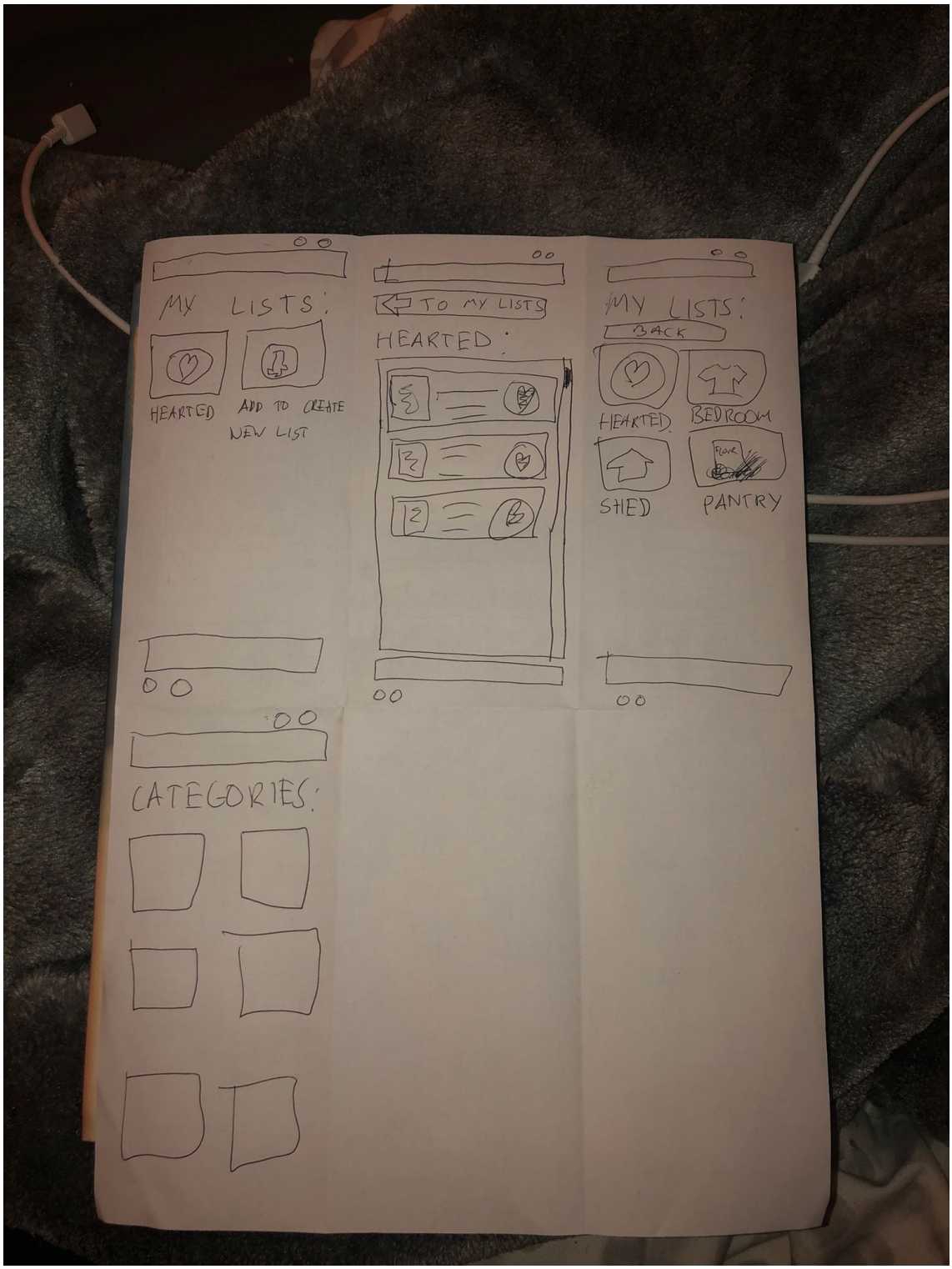

Figure A.3: Drawn Mobile Mockup 1

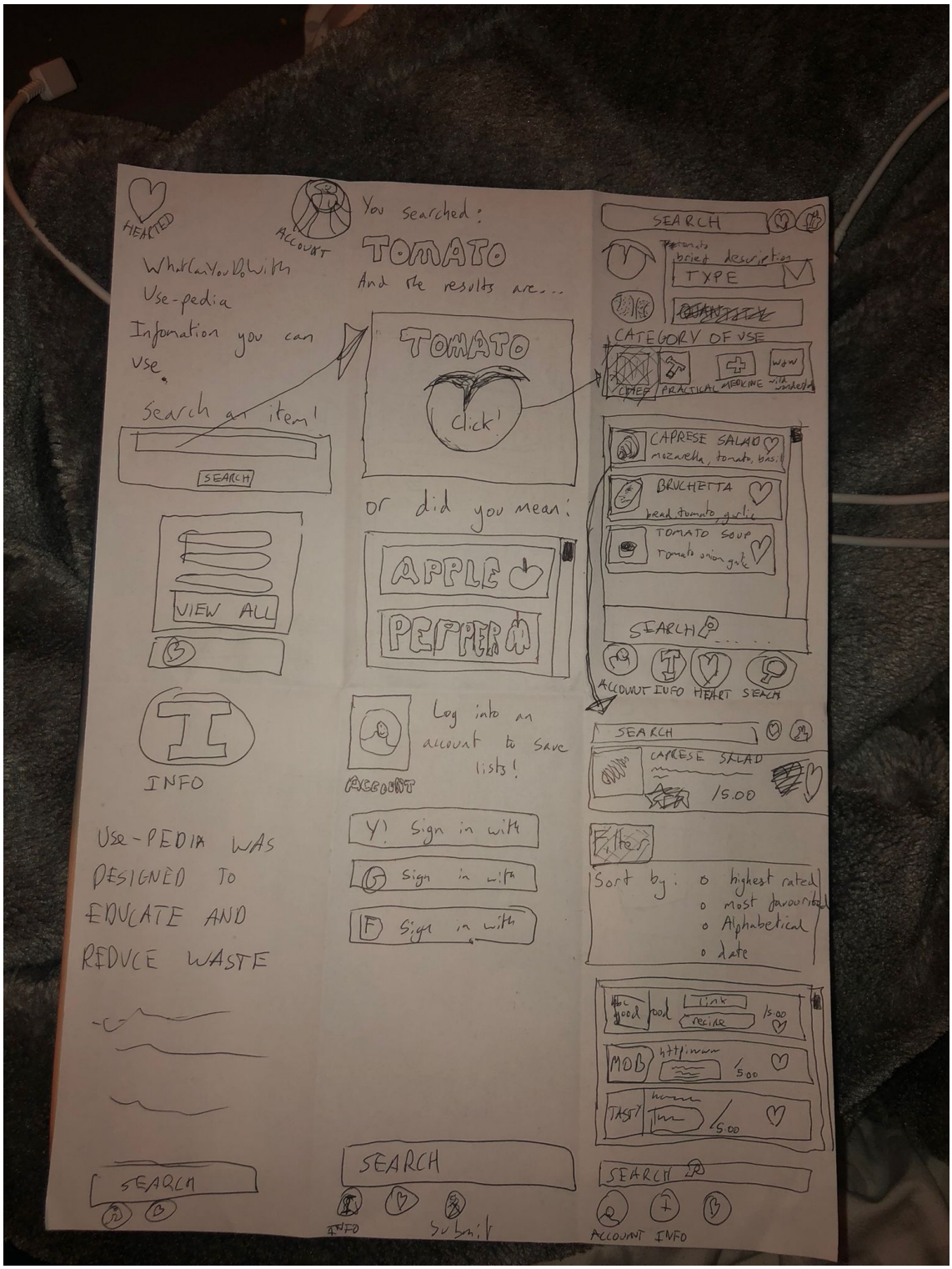

Figure A.4: Drawn Mobile Mockup 2

Appendix B

Project Initiation Document

School of Computing
Final Year Engineering Project

Project Initiation Document

Jack Simms

(WhatCanYouDoWith): A website with embedded A.I. design to interpret existing semantic databases and create information pages for education on the worldwide web with greater usability than existing models

Engineering Project

1. Basic details

Student name:	Jack Samuel Cyril Simms
Draft project title:	Engineer a website with embedded A.I. design to interpret existing semantic databases on the worldwide web for greater usability
Course and year:	BSc (Hons) Software Engineering
Project supervisor:	Rich Boakes
Client organisation:	N/A
Client contact name:	N/A

2. Degree suitability

One definition of software engineering states:

“Software engineering is the process of analyzing user needs and designing, constructing, and testing end-user applications that will satisfy these needs through the use of software programming languages. It is the application of engineering principles to software development.”

(techopedia.com, https://www.techopedia.com/definition/13296/software-engineering)

This project with require machine learning and programming to gather, adapt and interpret data already existing on the Worldwide Web. It will also require the ability to construct a platform that will be scalable in growth whilst simultaneously being easy to understand and learn from by all users of the the internet. Therefore, it is entirely a Software Engineering project and aligns with the degree.

3.

Outline of the project environment and problem to be solved

What is the problem that you will investigate?
Why is it worth working on?

Living as a university student it can become difficult to survive - with no money left it takes creativity to use all the resources already available to create something delicious. I found this task challenging and wished for a platform that would help. I wanted to know the use cases of everything in my cupboard and the best thing i could make from that. This spawned the idea of a platform that provides use cases for all proper nouns. To create a database of such size that would work efficiently would require it to be built with evolving scalability in mind and a method of authenticating true use cases. Engineering a possible A.I that would find all sources of use cases on the semantic web and confirm them, once confirmed it would create a new partition on the database and be instantaneously viable to users on the ‘What Can You Do With’ website platform.

Without programming a A.I. it would take an inconceivable amount of time to create this database and will thus require an initial study deeper into the semantic web.

4. Project aim and objectives

What is the overall aim of the project?
What are the objectives that will lead to you meeting that aim?

the aim of the project is develop an initial platform that can grow into an ever evolving database of useful, reliable and accurate information to help educate the world on how to use everything in the world

the project objectives that I’m meeting to aim are to have a program that assists with populating the database, comparing and narrowing down semantics of items to ensure information is accurate and true to given semantics as to ensure the users understand the information provided in a clear and concise method, whilst capturing all details

5. Project constraints

What constraints (things out of your control) are there on your project?

- University deadlines
- Sudden health issues

6. Facilities and resources

What computing/IT facilities will you use/require?
Acess to the student provided VM for server hosting

What other facilities/resources will you use/require?
University facilities such as the Open Access area's and the Library

7. Log of risks

What are the most likely risks will you encounter when doing your project? What backup plans do you have if identified things go wrong? What is your plan for reviewing risks? Remember that risk probabilities, and hence priorities, will change over the course of the project, so this section should be maintained. Use a table like below.

Description	Impact	Mitigation/Avoidance
PC breaks and all the work is lost	*Lost work and time*	*Back up all work on a cloud drive*
Health Issues	*Inablity to perform the study for a duration of time*	*To reach milestones early as to create a buffer that would result in illness creating minimal impact upon the project.*

8. Project deliverables

For an engineering project:
What artefacts will be developed?

A program that will validate, separate and produce all useful practical, culinary and unusual information of a given specific proper noun (i.e. apple) and all it's semantics that are available on the worldwide web.

A full-stack web application that will display the information and provide useful functionality:
- Multi-item search
- customisable save lists
- user rating system for specific uses

What documents will be produced?

A detailed report of the investigation that will include a literature report of the surrounding subjects including the semantic web, use cases and documentation of use cases. A detailed engineering methodology and evaluation.

9. Project approach

How do you plan to manage your project?

What project management tools and/or methodologies are you going to use? Do you need to use an SDLC?

What primary and/or secondary research do you need to do? What are the starting points for your research? (e.g. specific books or papers in journals, existing reports or documents, online resources, existing systems)

10. Project plan

*What are the **main** stages/tasks of your project? For example:*

- *Carry out a literature review*
- *Establish your requirements*
- *Create artefact*
- *Do the primary research*
- *Write the report*

When are you planning to perform these tasks? When do you need access to other people or resources? What skills do you require and how are you going to acquire those that you do not already have?

1. Create literature review

Research large databases of information and how they were created and understanding the semantics and limitations of speicifying proper nouns using the english language. Scalability research of a database of information to be translated for accurate use by other languages (04/10/22)

Develop upon the knowledge attained from initial research and look at possible paths to solutions. Research upon these new potential paths unveiled from the initial research. (18/10/22)

Finalise literature review and feel confident with the information gathered to move onto the implementation stage (02/10/22)

2. Implementation

Create a plan for the methodology for the creation of the platform, explaining changes to the idea that have come to fruition after the period of research (09/10/22)

Follow the plan and have a functioning artefact for user testing ready (05/02/22)

3. Testing

- create a test chart against initial requirements

- carry out tests (19/03/22)

- create a detailed evaluation from the results of testing and analysis of the entire methodology and project that has taken place

4. Finalise Report for Demonstration and Submission

11. Supervisor Meetings

Weekly meetings will be arranged to organise meetings. It is my responsibility to arrange these meetings and attend. My supervisor has created a discord platform for rapid communication and a timetable to subscribe to timetabled meeting slots in order to ease the process of meetings

12. Legal, ethical, professional, social issues (mandatory)

I will be using data collected online and hosting links to other websites in order to capture and make usable useful practical information for proper nouns

Appendix A: Ethics certificate

TETHIC-2022-104093

Appendix C

Full Code

Listing C.1: Full Popup.js Code

```
// Wait until the DOM content is loaded before executing the code
document.addEventListener('DOMContentLoaded', function() {
  // Get references to the popup.html UI elements
  const searchInput = document.getElementById('search');
  const searchButton = document.getElementById('searchButton');
  const resultsDiv = document.getElementById('results');

  // Get the text from the search box
  const urlParams = new URLSearchParams(window.location.search);
  const searchQuery = urlParams.get('search');

  // If there's text in the search box input, set it as the value of the search input and perform the search
  if (searchQuery) {
    searchInput.value = searchQuery;
    search();
  }

  // Add an event listener to the search button
  searchButton.addEventListener('click', search);

  // Add an event listener to the search input for the Enter key press
  searchInput.addEventListener('keydown', function(event) {
    if (event.key === 'Enter') {
      search();
    }
  });

  // Perform the search when the user clicks the search button
  async function search() {
    console.log('Search␣button␣clicked');
    try {
      // Get the search text and convert it to lowercase
      const searchText = searchInput.value.toLowerCase();
      // Get the link to the database JSON file
      const databaseLink = 'database.json'; // Update with the correct path to the database.json file

      // Fetch the data from the database JSON file
      const response = await fetch(databaseLink);
      const nounData = await response.json();

      // Filter the data to find the noun matching the search text
      const results = nounData.filter(function(db) {
        return db.noun.toLowerCase() === searchText;
      });

      // If results are found, display them in the results div
      if (results.length > 0) {
        // Clear previous results
        while (resultsDiv.firstChild) {
          resultsDiv.removeChild(resultsDiv.firstChild);
        }

        // Iterate over each use of the noun
        results[0].uses.forEach(function(use) {
```

```
        // Create a heading for the use
        const useHeading = document.createElement('h2');
        useHeading.textContent = use.use;
        resultsDiv.appendChild(useHeading);

        // Create a list for the associated recipes
        const recipeList = document.createElement('ul');
        use.recipes.forEach(function(recipe) {
          // Create a list item for each recipe
          const recipeItem = document.createElement('li');
          const recipeLink = document.createElement('a');
          recipeLink.textContent = recipe;
          recipeLink.href = recipe;
          recipeLink.target = '_blank';
          recipeItem.appendChild(recipeLink);
          recipeList.appendChild(recipeItem);
        });

        // Append the recipe list to the results div
        resultsDiv.appendChild(recipeList);
      });
    } else {
      // Display a message if no results are found
      resultsDiv.textContent = 'Nothing␣found␣in␣the␣database.';
    }
  } catch (error) {
    // Handle errors
    console.error('Error␣fetching␣data:', error);
    resultsDiv.textContent = 'An␣error␣occurred␣while␣searching␣the␣database.␣Please␣try␣again␣later.';
  }
 }
});
```

Listing C.2: Full Background.js Code

```
console.log('Background␣script␣loaded');

chrome.runtime.onInstalled.addListener(() => {
  chrome.contextMenus.create({
    id: 'what-can-you-do-with',
    title: 'Search␣"%s"␣for␣its␣uses!',
    contexts: ['selection']
  });
});

// Search for the selected text in the context menu
chrome.contextMenus.onClicked.addListener((info, tab) => {
  if (info.menuItemId === 'what-can-you-do-with') {
    const searchText = info.selectionText.toLowerCase();
    chrome.tabs.create({ url: `popup.html?search=${searchText}` });
  }
});

// Define a function to handle the context menu click event
function handleContextMenuClick(selectedText, tab) {
    // Check if the clicked menu item has the ID 'what-can-you-do-with'
    if (info.menuItemId === 'what-can-you-do-with') {
      // Get the selected text and convert it to lowercase
      const searchText = selectedText.selectionText.toLowerCase();
      // Create a new browser tab with the popup.html file and pass the selected text as a search query parameter
      chrome.tabs.create({ url: `popup.html?search=${searchText}` });
    }
  }

  // Add a listener to the context menu that triggers the handleContextMenuClick function
  chrome.contextMenus.onClicked.addListener(handleContextMenuClick);
```

Listing C.3: Full Database.JSON Code

```
[
  {
    "noun": "tomato",
    "uses": [
      {
        "use": "Soup",
        "recipes": [
          "https://www.bbcgoodfood.com/recipe/tomato-soup"
```

```
      ]
     },
     {
      "use": "Salad",
      "recipes": [
       "https://www.bbcgoodfood.com/recipe/tomato-salad"
      ]
     },
     {
      "use": "Sauce",
      "recipes": [
       "https://www.bbcgoodfood.com/recipe/tomato-sauce"
      ]
     }
    ]
  },
  {
    "noun": "example",
    "uses": [
     {
      "use": "Use␣1",
      "recipes": [
       "https://www.example.com/recipe1",
       "https://www.example.com/recipe2"
      ]
     },
     {
      "use": "Use␣2",
      "recipes": [
       "https://www.example.com/recipe3",
       "https://www.example.com/recipe4"
      ]
     }
    ]
  }
]
```

Listing C.4: Full Manifest.JSON Code

```
{
  "manifest_version": 3,
  "name": "What␣Can␣You␣Do␣With",
  "version": "1.0",
  "description": "A␣tool␣to␣find␣the␣use␣cases␣of␣concrete␣nouns.",
  "permissions": [
    "activeTab",
    "contextMenus"
  ],
  "action": {
    "default_popup": "popup.html"
  },
  "background": {
    "service_worker": "background.js"
  }
}
```

Listing C.5: Full Popup.html Code

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="UTF-8">
    <title>What Can You Do With</title>
    <link rel="stylesheet" href="style.css">
    <script src="popup.js"></script>
  </head>
  <body>
    <h1>What Can You Do With</h1>
    <p>Enter a concrete noun to find its uses:</p>
    <input type="text" id="search">
    <button id="searchButton">Search</button>
    <ul id="results"></ul>
  </body>
</html>
```

Listing C.6: Full Style.css Code

```
/* CSS for the web page */

/* Set the font family to Arial or a generic sans-serif font, which is a font that doesn't have decorative features */
body {
    font-family: Arial, sans-serif;
    margin: 0; /* Remove any default margin around the body */
    padding: 20px; /* Add 20 pixels of padding around the body */
  }

  /* Style the main heading */
  h1 {
    font-size: 28px; /* Set the font size of the heading to 28 pixels */
    color: #333; /* Set the text color to a dark gray (#333) */
  }

  /* Add a bottom margin of 20 pixels to paragraphs */
  p {
    margin-bottom: 20px;
  }

  /* Style the text input fields */
  input[type="text"] {
    width: 200px; /* Set the width of the text input field to 200 pixels */
    padding: 8px; /* Add 8 pixels of padding around the text input field */
    border: 1px solid #ccc; /* Add a 1-pixel solid border with a light gray color (#ccc) */
  }

  /* Style the search button */
  button {
    margin-top: 1em; /* Add a top margin of 1em (relative to the previous element) to create some spacing */
    padding: 8px 16px; /* Add 8 pixels of padding on the top and bottom, and 16 pixels of padding on the left and right */
    background-color: #007bff; /* Set the background color to a shade of blue (#007bff) */
    color: #fff; /* Set the text color to white */
    border: none; /* Remove the border */
    cursor: pointer; /* Set the cursor to a pointer when hovering over the button */
  }

  /* Remove the default bullet points and spacing for unordered lists */
  ul {
    list-style-type: none; /* Remove the default bullet points */
    margin: 0; /* Remove any default margin around the unordered list */
    padding: 0; /* Remove any default padding around the unordered list */
  }

  /* Add a bottom margin of 8 pixels to list items */
  li {
    margin-bottom: 8px;
  }

  /* Add a top margin of 20 pixels to the results div */
  #results {
    margin-top: 20px;
  }
```

Listing C.7: SPARQL Query

```
SELECT ?dish WHERE {
    ?dish dbo:ingredient dbr:Tomato.
}
```