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Creating a Web Application to Support Parental Involvement in Children's Computer Science Education

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Declaration

I, the undersigned, declare that this work has not previously been submitted as an exercise for a degree at this, or any other University, and that unless otherwise stated, is my own work

Signed: _____ Date: _____

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Abstract

This study aims to develop a web application that would support parental involvement in their children's Computer Science education, with a primary focus on improving parental engagement in Ireland. The paper analyses the current state of Computer Science subjects integration into Irish primary and secondary school curricula through a thorough literature review, highlighting ongoing issues in this field. Additionally, the research explores the significance of parental involvement in a child's life, emphasising its potential to lead to educational achievements in the future for them.

The study involved reviewing existing programmes geared towards nurturing children's interest in Computer Science such as CoderDojo. The findings from this research revealed a scarcity of initiatives that addresses this issue of parental support in their children's Computer Science education. Notably, a research project called OurKidsCode aspires to increase parental involvement and encourage greater diversity in computer education.

The web application designed and developed in this paper was inspired by the OurKidsCode initiative, which seeks to support their mission of providing STEM (Science, Technology, Engineering, and Mathematics) opportunities to families with primary-aged children all around Ireland. The design process was informed using primary qualitative research, including stakeholder interviews and firsthand participation in OurKidsCode workshops. The web application designed from this research features a carefully selected collection of projects that have been approved by the OurKidsCode team, as well as interactive tabs that enables users to contribute new projects or explore existing ones.

By evaluating the web framework developed as part of this study, it was found that its potential to drive parental involvement in children's Computer Science education is significant. By facilitating active usage of the platform, parents are empowered to gain basic knowledge in Computer Science, which in turn fosters a supportive environment for their children's Computer Science education. It was also found that the web application's capacity to facilitate user contributions enhances engagement, enabling parents to play a proactive role in encouraging their children's participation in computing-related activities.

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1 Introduction

1.1 Motivation

The motivation for this project was influenced by the author's personal experience as a Computer Science (CS) student with no prior exposure or experience in the field. Precisely, the focus was on exploring the area of parental involvement (PI) in their children's educational endeavours, particularly within the domain of CS education. There have been many studies that reveal the profound impact PI has on a child's educational trajectory. Recognising this, the aim of this project is to support the increase of a lifelong interest in STEM subjects by empowering parents to actively participate in their children's CS education. Then, the question arose, *what strategies or programs have been developed to promote PI in children's CS education, and what are their core components?*

After conducting some research, the author realised that there are not many initiatives out there that effectively bridges the divide between parental engagement and children's CS learning. This realisation propelled the author's aspiration to develop a collaborative learning environment where families can actively participate in fun projects that involve both coding and creativity, via a purpose-built web application. This process does not only cultivate a warm educational atmosphere but also enables parents to actively participate in fostering their child's interest in and comfort with technology. I, the author, hope to contribute in laying the foundation for children to develop a passion for coding by promoting hands-on learning and exploration within the family, giving them important skills for success in an increasingly digital world.

1.2 Background and Context

Over the last few years, the rate at which technology has developed has brought in a new era marked by unprecedented innovation and digital transformation. All across the world, countries are struggling with the need to modify their educational programmes in order to

give the upcoming generation the skills they need to succeed in this high-tech environment. However, in Ireland, there have been several obstacles and delays in getting computer-related courses into the curricula, especially in the primary and secondary grades. Ireland's technological advancement can be severely hindered by the lack of curriculum integration for CS education. Without sufficient training and exposure to these essential skills, people would find themselves ill-prepared to meet the demands of a society that is becoming increasingly digital.

The crucial role that PI plays in a child's educational path, especially in the field of CS, is essential to tackling this problem. However, a major barrier to effective engagement is the lack of basic understanding in Computer Science that many parents struggle with. Research has shown that this can lead to feelings of insecurity and disinterest among both parents and children alike (Bresnihan et al. (2021)). To combat this barrier, educating parents on the value of being actively involved in their children's CS education is essential. Parents who create an atmosphere that is supportive of exploring and acquiring knowledge can help their children develop a feeling of curiosity and excitement in addition to boosting their own self-esteem. Families can foster a shared interest in Computer Science by engaging in STEM-related activities and cooperative learning opportunities, which can serve as a foundation for future academic and professional endeavours.

1.3 Objectives

The objectives outlined in this study serve as the guiding framework to achieve the overarching aim of promoting PI in their children's CS education. These objectives cover different phases of research, design, development, and evaluation, which address the opportunities and problems inherent in this endeavour. They include:

- Conducting a comprehensive literature review to research existing literature on CS education in Ireland.
- Understanding the impact of PI in their children's CS education.
- Identifying strategies for motivating parental engagement.
- Designing a system that can help bridge the gap of PI in their children's CS education.
- Creating a functioning and engaging web application that can promote PI.
- Designing a child-friendly user interface (UI) that is accessible and useful, which encourages both parents and their children to be motivated to use the platform.

- Evaluating the web application and user experience through user testing and feedback.

1.4 Scope

This study encompasses a comprehensive exploration of parental involvement (PI) in CS education, that focuses on creating a web application which encourages family interaction and collaboration. The scope of the research includes conducting a literature review, where the author aims to learn about the best approaches for involving parents in CS education. To gather insights and feedback on the desired functionalities and usability of the web application, various interviews were conducted with stakeholders including team members of a similar project and potential users. The author worked together with teammates on related projects to benefit from their experience and best practices.

From the data obtained from the research phase, prototypes of the web application were designed allowing for exploration of functionality and user experience. A functional web application was then developed that enables families to document projects they have worked on, and explore suggested projects by other families, thus encouraging PI. Usability testing to evaluate the effectiveness and functionality of both prototypes and the final application was also carried out, ensuring alignment with user needs and preferences. Assessing the web application's rate of adoption and usage trends among families to gauge its impact and effectiveness in promoting parent involvement was outside the scope of this research.

1.5 Overview

The rest of this dissertation is structured to provide a comprehensive exploration of the research journey and findings:

- Literature Review gives an in-depth explanation of the background of this study surrounding CS education in Ireland, parental involvement (PI) in CS education, and related works. It delves into the analysis of previous research, defining the research problem and deriving potential solutions based on existing knowledge and gaps in the field.
- Methodology outlines the research approach undertaken to gather data, encompassing various methodologies and techniques employed throughout the research process. It also includes the results obtained from these methods, providing insight into the research findings and their implications.
- Design discusses the iterative process of UI design, influenced by the feedback obtained

through interviews and stakeholder engagement. It also explains the requirements and success criteria of the envisioned web application, detailing the evolution of the design choices and their alignment with user needs..

- Implementation details the development journey of translating design concepts into a functional web application. The chapter explores the technologies used, challenges encountered, and strategies employed to overcome obstacles during this phase.
- Evaluation examines the result of the final product in relation to the defined requirements and success criteria. It also analyses the impact of the web application, and addresses any limitations encountered during the implementation phase.
- Conclusion provides a reflection on the outcome of this research, highlighting key insights, and contributions. Additionally, it offers the opportunity for further exploration and advancement by outlining possible directions for future work and development in the field of study.

2 Literature Review

2.1 Introduction

Ireland now serves as a key global hub for technology, containing the headquarters of numerous multinational tech corporations. The need for qualified individuals in the technology sector has increased as a result of this. Ireland has made major improvements to the school system in recognition of the need to educate the country's future workers. The goal is to incorporate Computer Science (CS) into the curriculum and encourage a love of technology from a young age. This chapter looks at how CS education has changed in Ireland from secondary to primary school, and it also looks at the particular struggles and efforts that have influenced this field of study.

Next, a thorough research on the topic of parental involvement (PI) in education was explored. This investigation examines how much PI contributes to children's increased interest in CS. Comprehending the critical role that parents play in moulding their children's academic aspirations becomes critical when considering the larger picture of raising a technologically savvy generation.

In addition, the chapter delves deeply into the OurKidsCode project, an innovative programme designed to close the knowledge gap between young students and CS instruction. Examining the project's effects and methods for fostering a collaborative and learning atmosphere helps to clarify its potential implications for the development of education.

Finally, the discussion widens to include an in-depth analysis of various programmes designed for primary school students, from formal educational frameworks to unofficial endeavours. In addition to assessing the state of CS education today, this broad overview looks at areas that could use improvement and provides a solid basis for fostering young passion in the exciting field of CS.

2.2 Methods

For the purpose of the study, the author discovered and gathered relevant information using a systematic methodology. Google Scholar, a comprehensive database of academic articles and papers, was the main resource used to find relevant academic materials. Furthermore, Trinity College Library Dublin's Stella Search, a specialised search engine designed for academic study, was a remarkable resource.

To successfully target appropriate information and refine the findings, the author employed precise search terms. The terms "Parental Involvement" AND "Computer Science Education" AND "'children' OR 'kids'" AND "'benefit' OR 'effect'", Computing education in Ireland, Conducting Educational Design Research, OurKidsCode, CoderDojo Movement, Kids Code Jeunesse, were some of the search terms used. The material that was gathered was guaranteed to be directly related to the study topic and objectives thanks to this methodical technique.

To obtain insights and additional information, official documentation from websites that were directly relevant to the study, like the OurKidsCode website, was also assessed. The goal of this multifaceted method to literature review and search was to gather a wide range of academic sources and perspectives that were pertinent to the research question.

2.3 Computer Science Education in Ireland

In recent years, there has been a rise in the demand for more workers in the technology sector. Ireland, a country with a small population, has remained in first or second place for decades as the world's second-largest software exporter. Many multinational tech companies have their EMEA (Europe, Middle East, and Africa) headquarters in Ireland; Apple, Facebook, Google, Microsoft, and 16 out of the top 20 global tech corporations have strategic operations there. Since about 1990, Dell/EMC, Ericsson, HPE, IBM, Intel, Microsoft, and Oracle have all maintained sizable operations in Ireland positioning Ireland as a tech hub (Becker (2019)). In response, the education sector has undergone various changes to incorporate new subjects into the curriculum to foster children's interest in this field. According to Faherty et al. (2023), trying to integrate CS subjects into the secondary school curriculum took almost fifty years. This was finally done in 2018 when one of the Leaving Certificate Computer Science (LCCS) subjects was introduced into 40 schools. Out of the schools chosen, 31% were already offering the Junior Cycle (JC) Coding Short course. The LCCS curriculum specification recommends 180 contact hours for the subject. The

subject comprises three interconnected strands, Practices and Principles, Core Concepts, and Computer Science in Practice. The third strand consists of 4 Applied Learning Tasks (ALTs) which offers a means of facilitating skills-based, hands-on learning in the classroom. Python and JavaScript are used to teach the coding portion of the course, although it is intended to be periodically reviewed in accordance with changes in the industry.

For the JC that is, from the first to third year of post-primary school, a CS-related course, Coding short course (NCCA (2016)) was established. The course includes Computer Science (CS) Introduction, Let's get Connected, and Coding at the Next Level but, since it is a JC short course which is a 100-hour course instead of the standard 200 to 240 hours, it is optional. The course was designed to familiarise students with coding and the field of CS in general, covering algorithms, problem-solving techniques, and code testing. This was meant to serve as a starting point by supporting and documenting the experiences of a selected group of schools as they integrate the course into the JC programme. The initiative aimed to provide valuable insights and pave the way for further exploration of support options for schools and teachers engaged in offering the Coding short course. Research showed that out of the students that took the Coding short course, 48% of them had some previous exposure to coding (Faherty et al. (2023)). The prior exposure varied widely across students; some had gone to summer camps, while others had experienced it at home. Unfortunately, only 20% of the students who studied the course said they would consider taking CS at third level. Some of the challenges faced included timetabling of the subject, teachers' demands for more time, and access to resources. Overall, in the 2017/2018 academic year, 75% of the schools involved planned to continue delivering the course despite the challenges (Faherty et al. (2023)).

Introducing Computer Science (CS) in Irish primary schools has been very challenging, mainly due to teachers' lack of expertise in the field. Teachers also stated that curriculum overload, teacher confidence, professional development, and school infrastructure were the most urgent concerns. In July 2016, The National Council for Curriculum Assessment (NCCA) began their research into coding in primary schools, and started the "Coding in Primary Schools Initiative" (Becker et al. (2023)). Phase one started in September 2017, which was to record the coding procedures used in the participating schools. The result from phase one was used in the initiative of phase two which ran between May 2018 and February 2019. The feedback from teachers (3,463) that participated in this phase indicated that there will be a need for time to fully integrate the principles of computational thinking and coding into the classroom (NCCA (2016)). Although there isn't a specific CS curriculum for elementary school students in Ireland yet, preparations are underway to create one.

According to NCCA, a group dedicated to developing mathematics curriculum for primary education has been formed to work on early childhood and primary education. However, there have been several programmes workshops and clubs put in place in order to introduce children in primary school to CS related work such as coding. For instance, CoderDojo, an Irish startup founded in 2011, and has its headquarters in Dublin, aims to bridge this gap by offering workshops and clubs.

2.4 Parental Involvement in Computing Education

Parental Involvement (PI) can be defined as when parents engage with schools and their kids to support academic achievement (Hill et al. (2004)). PI can mean anything in terms of being formal (school-based) or informal (home-based). There has been debate over the relative benefits of each type of PI, coming to a conclusion that PI in their children's home-based learning had the biggest impact on student progress (Bresnihan et al. (2021)). There are many factors that affect PI in their children's education. The major ones being ethnicity and socioeconomic status (SES) (Hill et al. (2004)). Children who grow up in families with lower parental education levels who are academically involved, tend to have higher goals for school and careers because they want to be able to move into a higher social or economic position. Hill et al discussed that PI in academics with lower education levels raises aspirations without always enhancing the conditions (i.e., school behaviour and success levels) for achieving the goals of education and employment. Lower SES parents might not feel competent or at ease of helping their kids with their homework. As a result, low-SES parents might not get involved in their kids' education in ways that improve or alter behaviour or performance in the classroom, but their involvement might convey their hopes for their children's future success and upward mobility. Meanwhile, families with higher parental education levels confirmed beliefs about how PI influences accomplishment and later aspirations through better school behaviour. In other words, for these families, PI in academics was linked to behavioural issues at school, which in turn suggested aspirations and achievement, pointing to social control mechanisms (Hill et al. (2004)).

PI in CS education is an important aspect affecting children's engagement and success in the field. This can be seen by the important role parents play in selecting extracurricular activities, with coding clubs. The success of programmes like Code Club and the CoderDojo movement highlights parents' proactive involvement. A significant portion of these are run by parent volunteers, even though many of them are school-based and overseen by instructors. This demonstrates how eager parents are to get involved in their kids' CS education, both inside and outside of the conventional classroom setting (Bresnihan et al.

(2021)). A lot of research indicates that PI in CS education is linked with significantly higher enthusiasm and motivation for children in STEM in later life and is predictive of later academic achievement in mathematics knowledge and skills (Hill et al. (2004); Bresnihan et al. (2023)). However, there are still many parents who have little to no experience in CS or CS-related courses, but are interested in supporting CS education. Parents have a greater impact on their children's educational decisions than extracurricular activities. Studies have identified a notable correlation between the level of parental support and students' overall "career decidedness and career self-efficacy" (Clarke-Midura et al. (2019)). Parental knowledge of STEM (Science, Technology, Engineering, and Mathematics) job options and industry demands is still lacking, despite this significant influence. Even with their great influence, only one in four parents (24%) feel "very informed" about the range of STEM job options, and a 54% said they have no initial understanding of modern STEM careers to share with their kids (John (2017)).

According to Bresnihan et al. (2021), the computing-related factors that can be applied to study the relationship between parental computing attitudes and behaviours in the home and parental attitudes towards and desire for PI in CS education are confidence, usage, experience, and availability. The findings showed that there is a positive correlation between experience and attitude to PI. That is, parents were more likely to be positively motivated to participate in their kids' CS education if they felt that they had more experience. The relationship between the types of technology usage in the family context and both levels of confidence and attitude to PI was also positively correlated. This suggests that parents who use technology for creative purposes are more likely to view PI positively. The analysis done in the paper showed that higher levels of attitude towards PI are significantly predicted by higher levels of confidence. Also, higher levels of motivation for PI were shown to be significantly predicted by the level of parental confidence. The number of devices in the home is also a predictor of motivation for PI. Just like how parents with lower parental education levels lack the confidence to get involved in their kids' education due to lack of knowledge, parents who have no experience in STEM activities would also struggle to get involved. These findings showed that parental confidence is the major factor for PI. Recognising and addressing this factor is crucial in fostering a supportive ecosystem for children's exploration and success in the dynamic world of CS.

2.5 The OurKidsCode Project

The OurKidsCode project is an innovative research project based in the School of Computer Science and Statistics, Trinity College Dublin, that focuses on promoting diversity in CS

education and PI. The main goal is to offer STEM opportunities to families with primary-aged children (5-13), with a focus on reaching rural areas. OurKidsCode is making CS education more accessible and inclusive by creating a network and community of family coding clubs throughout Ireland. But unlike typical programmes, OurKidsCode utilises a novel approach by organising family coding clubs that are operated by families themselves in local venues such as community centres, sports clubs, libraries, or after-school settings. The project has demonstrated its dedication to solving gaps in education in various parts of Ireland. OurKidsCode is unique due to its collaborative platform. Families engage in STEAM (Science, Technology, Engineering, Art, and Mathematics) projects together, creating a collaborative environment for both children and their parents (OurKidsCode (2023a)). The OurKidsCode concept places an emphasis on collaborative involvement, contrary to standard drop-and-go programmes. This creates a safe space for collaborative creativity, playfulness, informed discovery, and empowerment in the use of technology. The method of learning is in line with recent educational theories that place equal emphasis on developing students' critical thinking, creativity, and good interactions with technology as well as knowledge acquisition. The OurKidsCode initiative is a living example of the transformation power of family-centred, collaborative techniques in influencing the direction of CS education, as it grows its network and community. OurKidsCode stands out by its emphasis on diversity, creativity, and shared learning experiences which makes it a significant and progressive project in the field of STEM education.

The OurKidsCode project's design principles are a result of careful examination of organised collaborative learning standards, with the goal of establishing an environment that encourages meaningful involvement among participating families (Bresnihan et al. (2020)). The creation of an activity model for workshops, which uses timed phases of activities to organise group learning, highlights this strategy. A number of workshop stages demonstrate how these ideas are successfully converted into achievable actions. The paper listed the workshop phases and how each addresses relevant principles. At the setup phase, the physical setting is carefully chosen to create an environment that is favourable for group learning. The facilitator is essential as they set up refreshments, distribute documents, and make sure the equipment works. This phase correlates with the design principle emphasising the relevance of interventions that bring many families together, developing inter-family support and communication. This also complies with the idea that interventions should be composed of planned activities, guaranteeing that the workshop gets off to a scheduled and meaningful start. At the share phase, families present their contributions in an organised way throughout the OurKidsCode workshop, usually through tournaments or showcases. This phase supports several design principles. First of all, it underlines the idea that family unity

should be fostered through interventions by encouraging communication and support among families. Additionally, it aligns with the principle that interventions should utilise computers as creative tools, emphasising the active role of technology in the creative process that contributes to the making of meaningful artefacts. Ultimately, this phase's celebration and sharing of achievements aligns even more with the idea that intervention outcomes should be shared and celebrated in order to foster a sense of community and accomplishment. All things considered, the intentional matching of workshop phases to the accepted design principles in the OurKidsCode project emphasises a thorough method of organised group learning. This strategy is in line with the more general objectives of encouraging diversity and PI in CS education, in addition to following modern collaborative learning ideas.

The combination of stand-alone workshops and the phases that go along with them, as well as the overall structure and content of the OurKidsCode initiative, represent a deliberate and inclusive approach to CS education. The project provides six unique workshops: Dance Mat, Rock-Paper-Scissors, Conductor, Pet, Frustration, and Reflexes, which are all in accordance with the accepted design principles at the time of this research. The six key phases of each workshop are carefully crafted to include: setup, warm-up, create, share, reflect, and plan (OurKidsCode (2023b)). Although the workshop is intended to be finished in 60 to 90 minutes, two hours were allocated for scheduling purposes to allow for flexibility and guarantee that everyone finished the challenge and went home on time (Bresnihan et al. (2020)). The setup phase emphasises cooperation and coordination among families. The foundation for a cooperative and well-run workshop is laid by participants discussing and assigning responsibilities, such as organiser, designer, coder, maker, and reviewer. An icebreaker is used in the warm-up phase, which is placed to provide participants a mental grasp of the activity that lies ahead. This stage helps to provide a welcoming and upbeat environment in addition to providing an interesting introduction. The create phase is divided into two sub-phases: make and code. These phases are essential in achieving the main objective of showcasing Computer Science's dual nature as a highly creative and technical field. In the make phase, fun creations are created and then combined with technology, such as Makey Makey or Micro:Bit. In addition, the code phase emphasises the combination of creativity and coding skills by introducing programming activities through the use of software applications such as Scratch or MakeCode. In the share phase, participants are encouraged to present their work, which helps to build a sense of accomplishment and facilitates learning from each other's experiences. During the reflect phase, participants are encouraged to share their thoughts and feelings regarding the workshop through dialogue. A more in-depth understanding of the technical and creative elements of CS is facilitated by this reflective practice, which also improves the overall learning experience. In the plan phase, the

facilitator interacts with parents and offers a forum for them to talk about possible next steps, especially if they decide to start a coding club. This phase is in line with the primary goal of generating an influence that lasts longer than just a single workshop. The project's goals of encouraging PI and diversity in computer education are essentially met by the way that creativity and coding are integrated, teamwork is prioritised, and participants are given a supportive environment and enriched educational experience.

While the OurKidsCode project offers three stand-alone workshops, after the third session, families are encouraged to continue the learning process on their own by managing their own clubs. However, families may encounter challenges in starting independent coding clubs due to a lack of suitable projects tailored to their level and interests. To address this gap and further support the mission of the OurKidsCode project, a web application can serve as a solution. This platform would enable parents to add their own projects, or discover new ones either added by other families or sourced from online resources, and it would provide a central repository of OurKidsCode projects. By facilitating access to a diverse range of projects involving code and craft, the web application would empower families to continue their learning journey beyond organised workshops and foster sustained engagement in CS education. Through collaborative participation, and knowledge sharing on the web application, both parents and children can explore, create, and learn together, enhancing their relationship and fostering a lifelong interest in technology.

2.6 Related Work

The need for coding skills among children has led to a notable expansion in the non-formal computing education scene. Numerous well-known programmes have been established, each having its own methodology. Four different CS programmes in this literature review are being addressed: CoderDojo, Code Club, Kids Code Jeunesse (KCJ), and Computing at School (CAS), emphasising their primary characteristics and contributions to the field. CoderDojo and Code Club are programmes run by Raspberry Pi which is a charity organisation established to help young people reach their full potential by fully utilising the power of computers and technology. CoderDojo was founded in Cork, Ireland in 2011, and has now become an international volunteer-led programme. Its aim is to teach coding and related skills to young people (individuals aged between 7 to 17), in a safe and sociable setting. Self-led and project-based learning are prioritised by CoderDojo, which fosters creativity. The core values of the programme are establishing a supportive environment, encouraging teamwork, and providing mentorship. The ethos of the CoderDojo movement encourages mentors to step in only when participants are unable to resolve a problem on their own.

Participants (ninjas), are encouraged to work on their projects after receiving guidance on the fundamentals. Through the integration of technology and arts and crafts, CoderDojo mentors aim to foster creativity in the classroom environment. Making the material interesting is the goal; a dry teaching style is not to be adopted (Alsheaibi et al. (2020)).

Code Club was founded in the United Kingdom in 2012, and aims to expose primary school children to programming. It falls at the centre of innovative education and the rapidly evolving field of digital literacy. Code Club provides training using languages such as Python and Scratch. The model functions in schools with a "drop-in" method of operation. Code Club's implementation of project-based learning is in line with current educational trends. Scholars have acknowledged the benefits of this technique (Blumenfeld et al. (1991)). It places a strong emphasis on real-world problem-solving, inspiring kids to interact with the content and pick up programming skills on their own. During projects, children create discrete artefacts that not only provide them with a sense of success but also allow them to display their efforts, which enhances the learning process. Surveys taken during the first year of Code Club's launch showed that 2233 kids from 150 clubs were enrolled, with an average of 14.9 kids per club. 77% of participants had no prior programming expertise, demonstrating Code Club's accessibility and promise as an introductory platform for a broad range of students (Smith et al. (2014)). Although the results were encouraging, difficulties were encountered when moving from guided instructions to unstructured work, indicating areas where pedagogical strategies needed to be improved.

Kids Code Jeunesse (KCJ) is a charity organisation which was founded in Canada in 2013, and aims to provide coding skills to children, parents, and educators. The organisation teaches kids to code through a variety of programmes. In Canada, KCJ has a major national footprint, doing projects and programmes to reach kids all throughout the nation. The organisation takes a comprehensive approach to education that includes computational thinking and digital skills in addition to coding. One notable feature of KCJ's strategy is its emphasis on teacher training. Together with volunteers, the organisation employs both full-time and part-time staff. A community-driven strategy is demonstrated by the reliance on volunteers from the community, who are frequently teachers. The fact that volunteers are included even if they do not have any prior coding knowledge illustrates how inclusive KCJ's objective is. This approach is similar to more general developments in educational technology, where bridging the digital gap requires active community engagement. The #kids2030 campaign embodies KCJ's dedication to teaching kids about the 17 Global Goals that the UN has established. This is in line with global initiatives to include sustainable development concepts into the classroom. With a focus on reaching the UN Global Goals by 2030, KCJ's

objective to educate over a million children and 50,000 educators about AI, ethics, and technology shows an innovative dedication to global citizenship and societal influence through education (Klaus Junior (2020)). With its creative teaching methods, emphasis on volunteerism, and clear integration of the Sustainable Development Goals (SDGs), KCJ is positioned as a leader in the rapidly changing field of digital education.

Computing at School (CAS) was founded in the United Kingdom in 2008, and works to advance and develop high standards in CS education. CAS provides assistance to teachers and educators in offering top-notch computing education. The focus is on offering educators a community, resources, and training. CAS has a close relationship with formal education and actively contributes to the development of the computing curriculum in schools, in comparison to many non-formal projects. The organisation's main objective is to bring passion back into the topic of computing by debunking the myth that many students hold about it which makes them actively despise it. To advance certifications and promote computing education, CAS works with national examination boards and partners on projects such as Technocamps. CAS's dedication to creating a community of practice among teachers, encouraging shared learning, and fostering professional development is demonstrated by local hub meetings, online events like "TeachShare," and continuous professional development (CPD) courses (Crick and Sentance (2011)). Within Computing at School (CAS), the Barefoot project is a significant initiative with a primary school focus. Barefoot sets itself apart with a sophisticated methodology that blends focused teacher professional development with excellent lesson designs. This relationship incorporates live lessons, interactive workshops, specialist partnerships, and supporting resources Barefoot (2023)). By putting these components together, Barefoot creates a continuous learning environment that is in line with the dynamic nature of computing education while also providing teachers with useful and interesting lesson plans.

Amidst these notable programmes, the OurKidsCode project emerges as a unique and innovative initiative targeting parents of young children. Unlike other programmes out there, OurKidsCode acknowledges the critical role that parents play in encouraging and engaging their kids in CS education. By creating a family-oriented coding club, it recognises the role of parents in supporting and participating in their children's coding education. The goal is to build parents' confidence, fostering parental involvement in the home, to stimulate children's interest in computing, and related courses. OurKidsCode also goes beyond just coding, incorporating a STEAM approach. This in integration enriches the learning experience, making it more holistic and creative. The program also brings CS education to local communities which ensures accessibility and inclusivity. The project's design principles

prioritise structured collaborative learning. By incorporating timed phases of activities, it provides a well-organised and engaging learning environment. This is a useful thing to do and it needs to be done because nobody else has done it.

2.7 Conclusion

Ireland's Computer Science (CS) education setting is characterised by an active relationship between proactive initiatives and obstacles. There have been initiatives to provide pupils with the necessary coding abilities, ranging from the incorporation of Leaving Certificate Computer Science (LCCS) in secondary schools to the optional Coding Short Course in post-primary education. But problems still exist, especially in primary education, where a major obstacle is the inexperience of teachers. Ireland's dedication to tackling these issues is demonstrated by the "Coding in Primary Schools Initiative" and continuous efforts to create a specialised curriculum.

PI is one of the most important factors affecting children's engagement and success in CS education. Although programmes like CoderDojo and Code Club employ the help of parents, it is acknowledged that many of them are not CS experts. The OurKidsCode Project stands out as an inventive strategy since it actively involves parents in addition to focusing on children. Through family-focused coding clubs, it aims to close knowledge gaps in parents and improve the learning process by fostering a collaborative learning environment.

This literature review provides a wider framework for comprehending the complex environment of CS education by discussing global programmes like Computing at School and Kids Code Jeunesse. Among these remarkable initiatives, OurKidsCode stands out as a special and innovative project that highlights the critical role that parents play in influencing their children's views towards CS.

In conclusion, the development of CS education in Ireland has been characterised by ongoing modification to meet the needs of a technologically advanced society. The cooperative and inclusive initiatives described in this literature review offer a road map for a more comprehensive and easily accessible CS education system as the country navigates obstacles. Ireland is positioned for a more inclusive and inventive future in CS education thanks to the convergence of structured learning methodologies, community-led initiatives, and parental involvement.

2.8 Summary

This literature review was carried out to act as the preliminary investigation before a transformative initiative is launched. From this research, the goal is to create a web application that addresses the issue associated with PI in CS education. The application is intended to serve as a complement to the well-known OurKidsCode website, with the goal of bringing families together over collaborative CS projects. The proposed online application combines existing projects from OurKidsCode workshops, creating an environment where different families can experience the joy of cooperative learning as well as exhibit their projects. The website also offers a repository function that is purposefully created for families and the OurKidsCode team. The repository serves as an exciting space for project sharing ideas, enhancing the collaborative attitude that underlies the OurKidsCode initiative.

3 Methodology

3.1 Overview

This chapter describes the general methodology of this study which follows a design-based research (DBR) approach with the aim of guiding the design process and providing a systematic approach to answer the research questions. Observation was conducted to provide valuable insights into the dynamics of parent-child interaction within the workshop settings. Throughout the research process, iterative designs and reviews of web application prototypes were done. Multiple rounds of interviews were also carried out to obtain feedback from stakeholders including potential users. The iterative design process made it easier to incorporate user feedback, resulting in a final product that successfully satisfies user requirements. Throughout the research procedure, ethical standards were strictly adhered to by taking informed permission and data protection into account.

3.2 Research Approach

The research approach adopted for this study is design-based research (DBR), which combines theoretically driven inquiry with iterative design and development cycles to address practical issues in real-world contexts. DBR is particularly well-suited for delving into sophisticated educational problems and creating innovative remedies to enhance learning outcomes. It is in line with research techniques frequently employed in applied physics or engineering, where products are systematically developed and enhanced to fulfil particular functions (Brown, 1992; Joseph, 2004; Middleton et al., 2008; Kelly, 2014 as cited in Scott et al. (2020)).

DBR provides a methodical framework for investigating these interconnected factors, considering the research focuses on understanding how parental involvement (PI) fosters children's CS education, and the development of a web application to facilitate this process. According to a research paper, DBR enables the identification of learning issues that

students confront and the design and development of educational resources (in this case, a web application) intended to solve these challenges (Reiser et al., 2001, as cited in Scott et al. (2020)). With the use of theoretical ideas and real-world data, DBR enables the web application to be refined iteratively.

3.2.1 Iterative Process of Design-Based Research

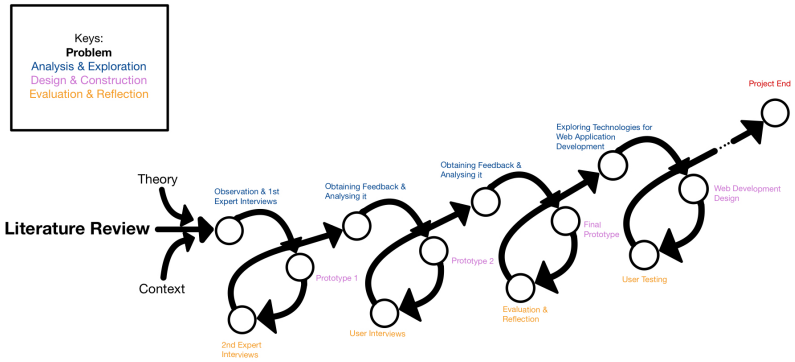

Figure 3.1: Iterative Process of Design-Based Research

The research approach involves multiple cycles of development, implementation, and evaluation of the web application. In Figure 3.1, analysis is a crucial component of DBR since it helps researchers define and comprehend the issues that need to be solved. Researchers collaborate with practitioners to understand every aspect of the issue and pinpoint knowledge gaps through exploring previous studies (Armstrong et al. (2020)). At first, the learning problem (in this case, barriers to PI in their children's Computer Science (CS) education) is identified by the researcher, who then proposes possible solutions. With the research findings as a guide, researchers design interventions that try to address the issues that have been found (Armstrong et al. (2020)). During the design phase, choices are investigated and the most promising concepts are chosen. Based on the feedback provided by experts and potential users, the application's features, functionality and usability are improved with each iteration. The web application is made to be responsive to the demands and preferences of the people for whom it is designed, through this iterative approach. In DBR, evaluation is a continual process that enables researchers to evaluate the impact of their interventions and refine them iteratively. Researchers can improve future iterations and advance the field of knowledge by learning from each iteration and knowing what works and what doesn't.

The research approach combines real-world design issues with theoretical frameworks from human-computer interaction and education. The goal of the web application is to meet

practical objectives related to parental involvement in CS education by firmly establishing the design and development process in relevant theoretical principles.

3.2.2 Qualitative Research Methods

Qualitative research methods were used to obtain rich, detailed insights into the requirements for the web application's design and the parental involvement in their children's CS education. Two primary qualitative research methods were used: semi-structured interviews and overt participation through field observation. Through the use of these techniques, participant perspectives, experiences, and recommendations for enhancing the application's usefulness and efficacy can be explored.

Semi-structured interviews also known as qualitative research interviews are a flexible yet focused method of gathering data, which enables a thorough analysis of participant perspectives and experiences (Drew (2023a)). For this research, semi-structured interviews were done with both experts from OurKidsCode and potential users (parents). The interviews were conducted by a standard set of open-ended questions, allowing participants to speak freely while giving the interviewer the opportunity to delve deeper based on their responses. Initially, three separate interviews were conducted with OurKidsCode experts to gather ideas for the web application's design. The same group of professionals were then interviewed once more following the making of the initial prototype to get their input on its usefulness and efficacy. Successive prototypes were then developed as a result of iterative modifications made based on this feedback. In addition, potential users, parents were interviewed on four separate occasions in order to get their input on the second prototype's design. A final prototype was produced through an iterative process of interviewing and prototyping.

Another primary method used was overt participation through field observation. Field observation entails researchers going into an environment to conduct systematic observations (Drew (2023b)). Overt participation involves the researcher actively participating in the activities of the research environment, in order to observe participant behaviours and interactions up close. Through observation, the researcher was able to see how families interact, the level of parental engagement, and how well facilitator techniques worked to support kids' learning.

3.3 Ethical Considerations

Approval from the School of Computer Science and Statistics Research Ethics Committee for the overarching OurKidsCode project was already in place and covered the sampling, data

collection and data analysis for this particular project. Details of ethical considerations can be found in the submission for the OurKidsCode project in Appendix 7.4. See Appendix 1 for the screenshot of the approval in the Research Ethics Application Management System (REAMS).

Prior to interviewing individuals, ethical approval was acquired, and every participant gave their informed consent and confidentiality was maintained to protect their privacy. In order to promote openness and trust among participants, the researcher also made sure that the nature and goal of the study were transparent. The researcher made it explicitly clear that the sessions would be voice recorded, and verbal consent was obtained from the interviewees before commencing the interviews. Additionally, all recordings and individual data were securely destroyed upon completion of the study. It is significant to highlight that all study participants were over the age of 18, and no children were questioned for data collection.

Furthermore, the terms and conditions and privacy policy of the web application created for this study contained an extensive amount of information about data collection and storage procedures. Users receive comprehensive explanations about why their data is being gathered, how it will be used, and the precautions taken to protect their privacy. By giving users access to this information up front, they are better equipped to decide how to participate in and use the web service. (See Appendix 2 and 6).

3.4 Observation

In order to gain more understanding about the OurKidsCode research project, two sets of observational research were carried out: the observation of a facilitator training workshop and of a taster OurKidsCode workshop. The first observational research involved attending a facilitator training workshop conducted by OurKidsCode. The facilitator training session is designed to train the facilitators on how to guide families through the process of starting an OurKidsCode club (OurKidsCode (2024)). By participating overtly in the workshop, the researcher gained firsthand experience of how facilitators encourage collaboration between families which causes them to gain more confidence in coding in an informal and enjoyable atmosphere. The workshop was on for about six hours and had different sessions. During the workshop, the researcher got to realise what the OurKidsCode research project is about and how they help foster parental involvement in children's Computer Science education. They covered the four steps to form a club and how facilitators play a vital role in bringing this to life. The 6-step meetup structure was also explained thoroughly. This involves the order in

which the activities take place, that is, setup, warm up, create, share, reflect, and plan. They also went through the key message for facilitators and also for families. The participants were then divided into groups of twos in order to take part in some of the projects families get to work on. This is to help facilitators get a better understanding of the projects and get a bit of experience in coding as this would be beneficial when supervising independently. It took about ninety minutes to get through a project that involved the six steps. From this experience, the researcher got to understand the aim of the OurKidsCode research project, and was able to gather information that would help the researcher to develop something that would further foster parent involvement in children's Computer Science education. Since the OurKidsCode programme is finite, the goal is to have a way for parents who want to continue developing their coding skills along with their kids by working on projects, to find a way to access other projects that have been worked on by other families across the country.

The second observational research entailed attending a taster workshop hosted at a primary school. The taster workshop introduces families to OurKidsCode and the idea of a family-run coding club in the hopes of inspiring them to launch their own club. The program involved six parents and their children who would have registered to take part in the session after school hours. The workshop lasted for ninety minutes which involved working on a project called Dance Mat. Since the researcher already participated in the facilitator training, they were able to assist with facilitating the taster workshop. The Dance Mat project includes using MakeyMakey and Scratch to develop a musical dance mat from paper plates and aluminium foil. This experience enabled the researcher to capture nuances such as how interested parents are in learning to do something that is beneficial to their children's education, and their attitudes towards technology. They also noticed the enthusiasm and confidence the children had as they worked alongside their parents in developing something fun and creative using code. The children were very passionate about learning in this environment and willing to do more projects like this. This further validated the idea of creating a platform to help both parents and children find more projects to work on at home or as part of a local club. Enabling parents to work with their children on these projects not only boost their confidence but allows them to develop a strong interest in STEM courses.

3.5 Interview Questions

In order to get more information and answers to aid in coming up with a concrete design idea, the following questions were made before conducting interviews with the OurKidsCode experts:

1. *What are the basic/essential features and functionalities that should be considered when designing a platform for the families?*
2. *Are there any specific requirements or constraints that should be taken into consideration?*
3. *What are the main goals and objectives for this product?*
4. *Are there any specific design preferences or user interface requirements?*
5. *Is there a database containing the information for the projects?*
6. *Are there more projects that can be added with step-by-step instructions to follow to increase options?*
7. *Would adding links to other projects out there, and also adding level of difficulty be necessary?*
8. *Are there existing similar web applications that address a similar problem?*

After conducting the interviews and designing prototypes for the web application, another set of interviews was conducted aimed at a different stakeholder group that is the potential users (parents). These interviews sought to answer and explain the following questions in regards to the prototype:

1. *What do you think of the design? Is it family friendly, that is, easy to understand?*
2. *What important feature do you think is missing? Any suggestions to improve it?*
3. *Is there any part that needs further clarification?*
4. *Would you use this website?*
5. *What part of the website contributes to your engagement?*
6. *How motivated do you feel to stay involved in your child(ren)'s Computer Science education using this website?*
7. *Would you recommend this web application to other families and why?*

3.6 Expert Interviews

In relation to the study being done, the author had to gather data by interviewing some major stakeholders of the programme, OurKidsCode, to get ideas on the product to be

developed. The type of interview conducted was the semi-structured interview which is a non-standardised method of interview, and the main purpose of this was to gather more information about what they expect from the product. Three people were interviewed, two of which were online and the last one was an in-person meeting. The roles held by the participants interviewed from the OurKidsCode project include development lead, programme manager, and research lead. Section 3.5 contains the open questions being asked, and some probing questions were also made up to create a flow during the meeting. The researcher also got consent from the participants to allow voice recording of the meeting. After the interviews, a realisation was made that there were a lot of similarities in what was said, which gave clarification with certain ideas proposed by the researcher.

3.6.1 Participant 1

The main point made is that the website should be kept simple since it is aimed at kids and parents who might not be tech savvy. When asked the question about the essential features, the reply was that the web application should be one that is not too heavy duty to do. They suggested that there should be a text entry, but also be able to record their voices for people who are not very literate to avoid discrimination. They suggested having a two stage approach, where the first time the user comes in, they find out what they can do, to understand what the application is about. Then, the second time, they know what to expect and can then upload. Three things were concluded on, which included; understanding what is wanted of the user as a club member to send in projects worked on. Another is a chance to upload and send in the things prepared by the user having found the web application. The last thing is seeing the outcome, and then being able to communicate with the administrators through the website to know whether they are going to do anything with the content posted, and monitoring it.

There was also a discussion about the software/tools used for the current web application, WordPress. According to the participant, working with WordPress is "*pretty good*" and also helps in keeping things simple. They stated; "*The value of WordPress is that whatever you make, could easily be transferred across and incorporated into the current website, if you are able to create a working and functioning website*". Submissions via forms were also discussed, as WordPress is good for this. GravityForms was also mentioned, and how it stores its data in a way that is not easily accessible.

The participant mentioned that there are three projects that have been tried and tested, and there is also one project that is currently a work in progress. These four projects would be posted under the tried and tested tab for users to see and understand the expectations of

projects for the club. The expectations and hope of the club is a project that has a bit of both craft and coding which becomes a meaningful product. The other projects uploaded by the parents and kids that do not meet this standard are not to be dismissed but also not to be accepted as the type of projects we want. The participant sees an issue with how the projects that do not meet the standard can discourage parents from uploading. The questions asked were; "*Are we going to take a good idea and make it into a proper project?*", "*How do the users feel about submitting this with an expectation that we are not going to publish it?*", and "*What is the promise we make to them through the website?*" The goal is to find the right balance as we are trying to encourage the club members to be enthusiastic and come forward with their ideas even if they are not quite exactly what we are looking for. The website should be flexible to accept all types of projects without overpromising. Adopting and celebrating the users' ideas is the goal as their enthusiasm and confidence is more important than any quality project.

When asked question 7 from the first part of Section 3.5 above, the reply was that on the current websites, there is currently a page that directs them to other projects. The project the club is focused on are projects that are easy as the goal is to build confidence. A great idea is to give more ideas to help parents explore, for example advising them to take a course.

With regards to the user interface, the response was that it should be user friendly as it can be a kid on the other end. In a case where the child is on the other end, the authentication of the parent is required for security and privacy reasons. Adding videos to explain what is required was also suggested to help those who cannot read. The participant also gave advice to explore the colour theme, font and logo of the current OurKidsCode website. Ethics application was also mentioned, and should be a part of my dissertation.

3.6.2 Participant 2

When asked the question about the essential features, the reply was that the web application should be easy for the families to upload some contents, and for them to be able to see what other families have posted, and also for them to be able to add comments and suggestions to other families' projects. One of the main things needed is the capacity for the clubs themselves to be able to share information across the clubs, mainly projects for now and then, maybe events later on.

In regards to security and privacy, only the parents should be allowed to set up and manage the family profile. The children should not be able to add things by themselves without the

parents. There should be a code of conduct somewhere on the website. A security concern would be if access was gained by someone who is not part of the OurKidsCode family. The participant suggested some moderation is needed and a new profile needs to be approved. Only profiles that have been approved can then comment as it would be a known user. The participant also suggested keeping some content private for only users that have been approved. That way, more families can sign up and join the program. There must be sufficient level of both code and craft in a project before it should be promoted to other families, but every project posted should still be celebrated.

When asked question 7 from the first part of Section 3.5 above, the reply was that having a space where users can add links to projects that they have seen and looks cool, or just ones that families have found is a good idea. Users are encouraged to share their saved projects, almost like a repository for them. The participant really liked the idea that was suggested about having three tabs which shows the different stages of the projects. One stage being the ideas seen on the internet, that users think is cool or want to try. The next stage is the work in progress, where users can upload content from projects they have tried or are working on. And the last stage, which is the ones picked out by the administration, that is, the tried and tested ones which would primarily be for the new users that are yet to attend the program or the younger clubs, and also clubs with parents who are not so free. The idea is that projects can be moved from one stage to another with more information being added to them by the administration.

3.6.3 Participant 3

The participant started by speaking about WordPress and how it would be full editing like the users were writing a post. They were curious about how people are going to discover the content. The questions asked were; "*Does there need to be a stream?*", "*Is it going to be like a blog, time organised?*", and "*Or is it going to be like a wiki with categories and collections?*" There needs to be a way for families to discover what has been added. Finding favourite materials is also important. Comments and ratings were mentioned. According to the participant, the downside to star rating is that it does not capture every important thing about the project, but it is especially not capturing the diversity of experience people would have. Other questions asked were; "*Does 5 star mean we really enjoyed it or we learnt a lot from it?*" The ratings would include technical difficulty, fun, and creativity, and users can pick from a 5-star scale. This would help users to know what other families thought about a project. The participant also asked; "*Do I search the site or can I browse it?*", and "*Can I browse it according to the equipment I need, for example, makey-makey?*" These could be

tags.

The participant also asked; "*Are we getting into making a forum? Where families can come together and discuss their ideas about a certain project?*" The participant showed his concerns about the web application getting too ambitious.

The participant also liked the idea about the three stages, where one tab is about something the user found interesting or maybe thought of and would like to explore. And then, the next tab being an experience report where families can input what they have tried and other users can then comment. A button that says "I tried this", and then, they can add how their experience went.

When asked question 4 from the first part of Section 3.5 above, the reply given was to keep it really simple. They also talked about SSO (Single Sign-On). This is to enable users to securely authenticate using their already existing credentials for example, Google account. Having user login can be a barrier that prevents some users from visiting the page. It was agreed upon that it would be better to make the website visible to everyone, but in order to comment or post, users need to register or sign-in.

If people are putting photos up they need to be aware that it is going up on the internet hence, there needs to be a place on the website stating this like under the terms and conditions.

When asked question 7 from the first part of section 3.5 above, the participant talked about other websites that are similar but do not provide the same services and do not have the same goal. The websites mentioned were CAS (Computing at School), and CoderDojo.

The interviews with key stakeholders from OurKidsCode revealed a number of similar themes and viewpoints regarding the features and functionality that the web application should have. Participants emphasised the importance of simplicity and accessibility, particularly for families that might not be tech-savvy. Everyone agreed that a user-friendly interface was necessary, and that different user needs should be catered for with features like voice recording and text entry. All of the interviews agreed on the idea of an ordered approach to project curation, starting with idea development and working up to established projects. However, there were variations in the particular features that were recommended, such as implementing Single Sign-On (SSO), and adding features like forums, comments, and ratings. Notwithstanding these differences, participants' overall objective of encouraging cooperation, creativity, and involvement within the OurKidsCode community did not change.

Some of the ideas obtained from this include focusing on three main tabs which perform different functions. That is, having a tab for the tried and tested projects, another tab for the projects the users are working on or have worked on, and the last tab for adding ideas of projects or external sources to other computing-related learning sources. From interviewing the participants, another important feature taken into consideration is having a sign-in system to regulate user contribution to the web application.

3.7 Expert Feedback

After the interviews done with three of the OurKidsCode team members, the researcher was able to come up with some concrete ideas for the design of the website. The fact that they all had similar ideas made it easier to know what the functional and non-functional requirements were. To make the prototype, Figma was used, which is an application for interface designs. A mobile phone (iPhone) structure was chosen for displaying the user interface design as it is believed that a lot of users would use a mobile phone to view the website. However, the plan is to make a website that would be responsive to both a PC (personal computer) screen and a mobile phone. The prototype was presented to the same team members to get their feedback which would be taken into account when making the second prototype, that would be an improved version of the first one.

3.7.1 Participant 1

The participant was impressed with the design presented, but there were few things they advised to take into consideration. The main suggestion was to make the projects which had been tried and tested by OurKidsCode team members redirect the user to the main OurKidsCode website, which has all the information about every project available. The reason for this is to prevent duplication and misinformation, since the information provided on the main website was written by someone who has enough knowledge on the project. The participant also mentioned that it is possible that the project gets updated on the main website which would be an issue since the information provided on this website would then be out of date.

The participant also talked about the "level" system which was added to give users an idea of how easy or challenging a project is. They stated that a better way to give users an idea would be to use more user friendly words like; "easy", "beginner", "intermediate". They believe that these are the type of terms used in regards to skills, and are easier to understand from a user's perspective. They also made a suggestion for the comments to be visible to the

public, that is, users without an account. They said; "*This could draw the user to want to register in order to comment and help other parents, or ask a question*".

They also suggested having two buttons to replace the "I have tried this". One being the "I have tried this" button, and another being the "like" button. They stated; "*I have tried this button with a heart is an automatic assumption that I have tried it and it went well*" Meanwhile, some users might not have tried it but might find the project interesting and want to try it. This would make the page more interactive in terms of the reviews. They also suggested that users should be able to like the suggested projects without having signed in, in order to build a sense of interaction and validation for people who are putting things up.

The researcher made a comment about the top menu which they were not satisfied with, and asked if the participant had better suited names for them. The reply obtained off the top of their head was "Project Guide" for the tried and tested projects which was currently written as "Projects". They suggested a couple of names for the "Family Projects" like; "Suggested Projects", "Community Suggestions", "Club Suggestions", and "Project Ideas". For the last tab which is currently called "Ideas", they suggested "Ideas Board". They mentioned "*...because you are not looking for people to do a whole lot more*".

Finally, they suggested adding a little message below the feedback button to make it clear to users what the feedback page is about. The participant stated; "*So that they don't get confused thinking they are sending feedback to the project but they are actually sending feedback on the application itself*". They also advised to change the feedback question from "Was this page helpful?" to "Was this helpful?" to make sure users know what is required is feedback for the entire website and there is a clear distinction.

3.7.2 Participant 2

This participant also liked the design presented to them and had similar suggestions to the first participants. A major suggestion given was regarding the feedback function, which they stated was not clear, as it could mean something different. The participant stated; "*You want me to send something? Feedback about what?*" Also, they suggested adding words to each of the buttons on the feedback page, that is, 1 (Not satisfied) and 5 (Very satisfied). This is also to make it clear for users to give back the right feedback.

They also stated that "Materials needed" on the tried and tested projects page is not needed and should be replaced with images, so the users have an idea of what the projects would

look like before getting redirected to the main OurKidsCode website for a detailed explanation about it. Regarding the question asked to the first participant about the top menu names, this participant suggested having "Suggested Projects" instead of "Family Projects", and also suggested "Other Ideas" instead of "Ideas" for the last tab. They also suggested testing the website with someone who does not understand anything about the projects, as they will have more questions and if there are confusions, changes would be made to the design based on the perspective from a user who has no idea.

They also suggested having a landing page that explains what the major functionalities of the website are, especially the top menu tabs. Another suggestion was to put the "Suggest New Project" and "Suggest Ideas to Explore" buttons at the bottom of the page and not at the top of the page, as that makes it look like a title and could confuse new users. The participant stated; "*You want the users to see the suggested projects first in order to have an idea of what to suggest*". Another suggestion made was to move "upload image" user input to the bottom of the "Suggest New Project" page because the other requirements from the user are text based, and uploading images is probably the hardest one to do.

When discussing the "level" functionality, the participant asked questions like; "*How will they know?*", "*What kind of criteria would they apply when they are thinking that well, this is hard?*". They suggested having an easy to understand way for users. They also talked about adding "including warmups" to the "Description" for the user input. This is to remind the user of the importance of warmups in the project.

For the "Sign-up" and "Sign-in" page, the participant suggested changing the word from "Sign-up" to "Register" to avoid confusion between those two words. They also suggested adding more words to explain what would happen when a user puts their email in after forgetting their password. The participant asked questions like; "*If it doesn't come, is there a button for sorting it out?*" and "*Why didn't I get an email?*"

They also suggested changing the name "Main Website" to "OurKidsCode Website" to make it clear to users where they are getting redirected to. For the about page, they suggested adding a contact link, that is, the researcher's email and the OurKidsCode email, so that users can reach out regarding the website. They also suggested adding the fact that the website is coming from Trinity College.

3.7.3 Participant 3

This participant liked the idea suggested by the first participant to make the tried and tested projects redirect users to the main page, as this prevents issues with following layouts for the projects. They commented on the alignment of the buttons for each project suggested by different families. The suggestion was to align the buttons in a more presentable way. They also suggested combining the "Comment" button with the "View Comment" component, as this gives users an idea of what to comment based on existing comments. The participant agreed with the majority of the suggestions made by the other two participants.

On the "Suggest New Project" page, with regards to the "Description" text box, the participant stated; "*I feel like it might be useful for everybody if there was a little bit of a suggested structure*". This is to give them an idea of things to mention when describing their projects. They also suggested ensuring that users can add images to the description page. They mentioned having a landing page like the second participant, that explains what each main tab is for. The participant stated; "*The first tab which is projects that have been tested by the OurKidsCode main team. If you are new to OurKidsCode, these are the ones you should probably do first*", "*Then Contributed Projects maybe are the projects that OurKidsCode family club have tried and used and have kind of added themselves*", "*Ideas is where you can just record any project you find interesting online that families and the OurKidsCode team can explore online*".

They also suggested making it clear to users what the mobile number would be used for, which in this sense would be for authentication if they decide to input their number. They also mentioned rich text editors when talking about the "Description" text input in order to make text bold for the subtopics.

Lastly they suggested having the "Comment" button visible for users that are not signed in. They stated; "*Leave it there, and then when I press it says you are not signed in. Sign-in or Create an account*". They also suggested doing the same for the "Suggest New Project" button too.

In conclusion, the three participants seemed to have similar feedback about the prototype, which made it straightforward to know what to change and what to add. Some of the major things implemented in the second prototype included;

- Added a landing page to explain what the major functionalities are.
- Made the tried and tested projects redirect users to the OurKidsCode website that has

an up-to-date detailed explanation about each project.

- Changed the names of the top menu.
- Added a clear explanation about the "level" guide for the projects
- Changed the names of Sign-in/Sign-up to more family friendly words.
- Added an explanation to the "Forgot Password" page.
- Made the "Send Feedback" button and page clearer.
- Changed the "Resources" icon.
- Added an admin account so that the OurKidsCode team can edit and delete projects and comments.

3.8 User Feedback

Following the interviews with three members of the OurKidsCode team, the second prototype was designed, incorporating their feedback. Afterwards, the researcher interviewed parents (users) to gather their opinions on the second web application prototype. Section 3.5 contains the open questions being asked, and some probing questions were also made up to create a flow during the meeting. Most of the participants were parents that have attended the OurKidsCode program and were also part of local clubs to continue to engage their children in coding and crafts activities.

3.8.1 Participant 1

This participant expressed enthusiasm for the three separate tabs for users to explore. They stated; "*That's brilliant! Because that really links into what we were talking about. So, we were talking about clubs of a lifecycle...*" They go on to highlight the importance of having these distinct functionalities that would help both parents and their children to continuously progress in their Computer Science knowledge. They were curious about who gets to moderate some of the suggestions coming up. This is a feature that can only be done by the admin users in order for ease of regulation on the web application.

3.8.2 Participant 2

This participant praised the idea of a level guide, as this helps users to know where to start. The participant expressed concerns about having users sign up, based on their previous experiences with applications that require creating an account. They mentioned; "*An issue*

that I have come across with our own club is that it is hard to get people to sign up to things or give their email to you to forward on information. There are people that are just reluctant to sign up to things, and it is just something to be aware of..." They further explained how parents that are keen on it would not have any issue but for some people who have little to no experience, are a little bit more reluctant to sign up for things. This issue can be fixed by ensuring that the web application is still very helpful without having to register or sign in. They loved the idea of parents still being able to view images and click links without having to register or sign up as they strongly believe some people may not want to put down their email addresses, and some users would prefer a simple website without having to do anything. They also asked; "*Would we be able to put up a link to let's say we have a project from MakeCode so that other users can just click the link and see if it's something they are interested in?*" It was explained to them that the description section would be a rich text editor to enable users to add links and images. They also suggested that users should be able to add videos, as videos seem to work well. However, this would be considered an additional feature, and would only be implemented if time permits. Overall, the participant really liked the idea behind the web application and thinks it would be helpful for other clubs to see what they have done within their own club. They stated; "*...I figured it out and got it done anyway but they really had great fun on Halloween because we put it on the door and was scaring kids and all that. But when other kids see that thing, I can see they want to do it you know, or how did they do it? The question would be how did they do it, and the code is there and they could just figure it out you know...*"

3.8.3 Participant 3

Similarly, this participant liked the web application prototype, and believes it is very handy for every parent to have. They had concerns about certain security issues in regards to allowing any user to add to the web application. They asked? "*So you're saying it is going to be a website and anyone can access it from the general public? And there's going to be no deciding who can't access it to put stuff up?*" They were worried about people registering and adding to the suggestions page before anyone from the team checked what they had added. It was explained to them that we cannot control who can or cannot sign up to add to the page. However, the admin users would be able to edit and delete posts on the website. They then asked; "*Or is there a way of stopping it before it is posted, and then allowing it to be posted by the moderators? Because if it is up, it could be days before it is taken down*" It was then explained to them that this is a security issue that affects most web applications, and delaying suggestions made by users would discourage them from adding to the page since they can't see their post immediately. It would also be a disadvantage to users if

mistakes were made but cannot be edited until the post has been approved by the admin user. Nevertheless, it was suggested to them that this could be considered for future work to prevent just anyone on the internet posting anything on the website. They also liked the idea of being able to add links to check out other educational pages.

In relation to coding clubs and location, they asked; "*I was thinking, what about some areas where like I won't say calendar but like idea of things/suggestions that are happening in your area? Stuff that OurKidsCode community would love to hear about and be a part of...*" It was explained to them that it is a very good idea that should be taken into consideration for future work; however, the existing OurKidsCode website has a section that contains news and upcoming events nationwide. They also stated that the web application is really straightforward and would be of great benefit for many parents and kids because "*you know what you want*" in comparison to applications like Slack for sharing, which can be a little bit difficult sometimes because it has a lot of "*hashtags and everything and it is a lot...*" They also mentioned that the website is great because kids can also work away on projects without having to sign in when their parents are not as involved. They said; "*...it is not reliant on parents, and that's what I was hoping for, is that the parents are going in to give the support to the kids but when the night is over, sometimes the kid just want to go and do something else the same and I think that's lovely...*"

They mentioned having a "clubs in your area or find your local club" section. This is a feature that has been added to the existing OurKidsCode website titled "Find a Club" and so, they suggested adding a link to this in the web application. They also mentioned that; "*It is great that we could go to your site and find a new project that would be suitable for them you know...*"

3.8.4 Participant 4

This participant liked the web application but also asked; "*Is there a plan for this format to maybe be in an app version or would they have to go to a website to do it?*" They also said; "*... for me, on my phone at nighttime is when I have time. I find it handy on my phone to just upload pictures... Going into an app rather than into a website might be more user friendly...*" It was explained to them that it is a web application that could be utilised both on a larger screen (laptops, monitor) or a smaller screen (mobile phones, tablets). But, this could be implemented in the future if it is widely used. They also showed concerns about the wording of the three main tabs. They stated; "*...I'd be a little bit worried about the wording of them, the Project Guide, the Community Suggestions, and the Project Ideas. So I don't know, do they fully say what they are, like from our experience of OurKidsCode...?*" They

mentioned that "Project Guide" is not really a guide but the OurKidsCode program that runs for four weeks. They suggested calling it "OurKidsCode Program", as these are the projects that were actually included in the program. For the "Community Suggestions"' tab, they suggested calling it "Club Suggestions" or "Coding Club Suggestions" or "Coding Club Projects". For the "Project Ideas" tab, they suggested "Advanced Project Ideas". They mentioned that the levels on the "Project Guide" page are not needed, as they believe that the projects are on the same level and are just different from each other. They stated; *I wouldn't consider one harder than the other...*"

Overall, participants found the web application prototype straightforward and beneficial for both parents and children. They valued its user-friendly interface and the ability for children to engage independently. Some of the feedback obtained was taken into consideration when designing the final prototype however, there were certain suggestions that would be taken into consideration when stating the future work for later versions. A participant suggested adding a video upload feature which would only be implemented if time permits as the development of the web application is being implemented within a short period of time. Another participant suggested changing the three main tabs' names however, this would not be implemented as not enough interviews were conducted to get a variety of ideas on these names. The suggestions that were implemented in the final prototype include:

- Getting rid of the levels on the Project Guide page.

3.9 Summary

This study's research strategy was to use a design-based research technique to examine how parents are involved in their children's CS education and to create a web application that facilitates this process. The study intends to solve practical issues in technology-enhanced learning while advancing knowledge in the field through an iterative process of creating, implementing, and assessing the application. The iterative nature of the research, driven by qualitative methodologies, ensured that the final prototype effectively meets the needs and expectations of both experts and potential users, as a result, knowledge in this field will be advanced.

4 Design

4.1 Overview

In this chapter, the author delves into various aspects that are essential to the development of the application, and offers insights into its goals, objectives, and success criteria. The researcher clarifies the main characteristics and attributes necessary for the web application to operate effectively by carefully defining the functional and non-functional requirements. In addition, this section provides a thorough explanation of the fundamental website flowchart, which provides a visual depiction of how users, that is, parents and their kids, interact with the website in order to explore Computer Science (CS) projects and develop a stronger interest in this field. At the heart of this section is the final prototype design, which is the result of intensive planning, iteration, and refinement. The prototype gives stakeholders a concrete understanding of the potential influence and usability of the OurKidsCode Collaborative web application by showcasing the intended features and user interface aspects.

4.2 Design Scope

After doing a literature review and carrying out in-depth primary research, the researcher decided to focus on developing a web application with the goal of increasing parents' involvement in their child's CS education. The website was primarily designed for parents to use at home or in local coding clubs with their children; however, it was also created with children in mind, and consists of a kid-friendly interface.

The website includes three main tabs, each tailored to meet certain user needs and preferences, ensuring a seamless and enriching experience for all users. The first tab is carefully designed with the intention of accommodating new users who may not be familiar with OurKidsCode. As an introduction, this section gives users access to a selection of carefully chosen OurKidsCode projects. Through the display of projects designed by the

OurKidsCode Team and previously completed by members of the OurKidsCode community, this page provides new users with in-depth important information about the goals and process of each project, encouraging interaction and familiarity right away.

The second tab is specifically geared towards existing users who are already familiar with the OurKidsCode collaborative website or are actively involved in OurKidsCode clubs. This section acts as a collaborative area where registered users can add their own projects to the network. This section empowers users to actively contribute to the platform's growth and development by fostering community building and information sharing through the promotion of user-generated content.

The third tab serves as an exploratory hub which provides users with a wide range of resources to pique children's interest in CS education. Users can find a carefully chosen collection of external projects and educational websites here, all aimed at motivating and teaching young students. With access to a variety of additional resources to enhance kids' educational journeys, this repository is a great tool for both parents and educators.

The web application was created in a way that users can still benefit from it without having to go through any user authentication although, it is important to note that registered users who are signed into their accounts can perform extra functionalities, such as adding, editing and deleting projects, ensuring they contribute to the website which would help other families out there.

4.3 Objectives and Success Criteria

The objectives of this project were stated earlier in this paper however, they progressed with the iterative design and development process, as well as more understanding gained from the research carried out. The major goal remains focused on using technology to create and evaluate a web application that parents can use for engagement that would foster parental involvement in their children's CS education. Building on this basis, the specific objectives aimed to be achieved through the implementation of the design prototype which is shown later in this chapter includes;

- Develop a functional web application that allows users to collaborate effectively by uploading and sharing projects they have worked on.
- Design a child-friendly user interface that is engaging and accessible, which encourages both parents and their children to be motivated to use the platform.

- The active use of the platform would assist in enhancing parental involvement in their children's Computer Science education while helping the children become more passionate about STEM.

4.4 Requirements

The researcher was able to gather the requirements for this project's design and structure from the interviews conducted with both the OurKidsCode experts and users. The initial set of functional and non-functional requirements have evolved over time with comprehensive analysis and exploration to ensure alignment with the project's objectives and user preferences.

4.4.1 Functional Requirements

The functional requirements of this project are the fundamental features of the web application which would enable the platform to meet its objectives.

Option of Three Different Primary Tabs: These tabs are the major features of the web application, and failure to implement these would result in an unachieved goal. Although the tabs have similar functionalities, the users are different as only administrators can modify the first tab, Project Guide. The other two tabs can be modified by any registered and signed in user. These tabs promote collaboration amongst users and shared learning experiences.

User Registration and Sign-In: User authentication is an essential part of the website as it helps in regulating access to certain functionalities and ensuring platform security. Any user on the internet is able to explore the platform, but only users who are registered and signed in are able to contribute and make changes, enhancing accountability and data integrity.

User-Generated Content Management: Users are authorised to add, edit, or delete information related to projects they have contributed. Users can actively contribute in establishing the website's content by fostering a collaborative environment and enabling the creation of dynamic material.

Database Management: The implementation of a robust database system enables data to be stored efficiently to avoid loss of information. This enables systematic retrieval of user and project data, minimising the risk of data loss and ensuring scalability and reliability.

Implementing a Child-Friendly User Interface: The sole purpose of the web application is to serve as a means of enabling parents to get more involved in their child's CS education.

Since the target users are the parents with their kids working on the projects they have selected, the user interface is designed to be child-friendly, including attractive colours and bold fonts and engaging imagery to appeal to young learners. This in return encourages usability and promotes active participation from the families.

Creating an Engaging User Experience (UX): Emphasis is placed on creating a seamless and intuitive user experience when designing the website hence, focusing on how users would engage with the platform is paramount. Ensuring that each screen of the website is straightforward and easy to navigate is also very important. The landing page which is the home page is designed to give clear and detailed explanations to guide users through the platform's main features of the website.

Security and Privacy Measures: The website includes sturdy security and privacy measures, including Terms and Condition page and also a Privacy Policy page, in order to inform users of the information they are inputting into the system. The Privacy Policy also states how the data collected would be used and protected to prevent cyber issues. The Terms and Conditions allows the users to know what they are signing up for when they add images, especially images showing the faces of their children.

4.4.2 Non-Functional Requirements

Reliability: The website is made to be reliable and stable, with minimal errors or interruptions that can affect how users interact with it. To guarantee peak performance and uptime, maintenance and monitoring are carried out continuously.

Accessibility: The website is designed to be accessible to all users on the internet regardless of their abilities or technical proficiency. Users should be able to register a valid email address and add a password in order to have authorisation to make certain changes to the web application. Enhancing usability and inclusivity, accessibility features like keyboard navigation and screen reader compatibility enable a broader audience to take advantage of the platform's resources and features.

4.5 Prototype Design

This section gives an overview of the design prototypes made for the web application, displaying how they were developed from low-fidelity sketches to high-fidelity prototypes. The prototypes provide insight into the operation and user interface of the website by acting as visual representations of the proposed layout and design.

4.5.1 Low Fidelity Design

At the beginning of the creation of the design, sketches of low fidelity prototypes were made using an iPad notebook to conceptualise the initial layout and features of the website. These served as a guide in helping to visualise the user interface of the website and also its structure. Figure 4.1 shows the image of two screens in the initial design, depicting the landing page and the page that shows more details when a selected project is clicked. The two screens provide a rough outline of the final prototype, with enough information to create a high fidelity prototype.

Low fidelity sketches are incredibly useful tools for rapid testing and iteration, enabling design modifications to be made quickly until the intended layout is reached. They encourage realistic visualisation and the exploration of many design possibilities while brainstorming and sketching. The iterative nature of prototyping makes it possible to continuously optimise and improve the user experience while making sure the final design satisfies the requirements and expectations of the target audience.

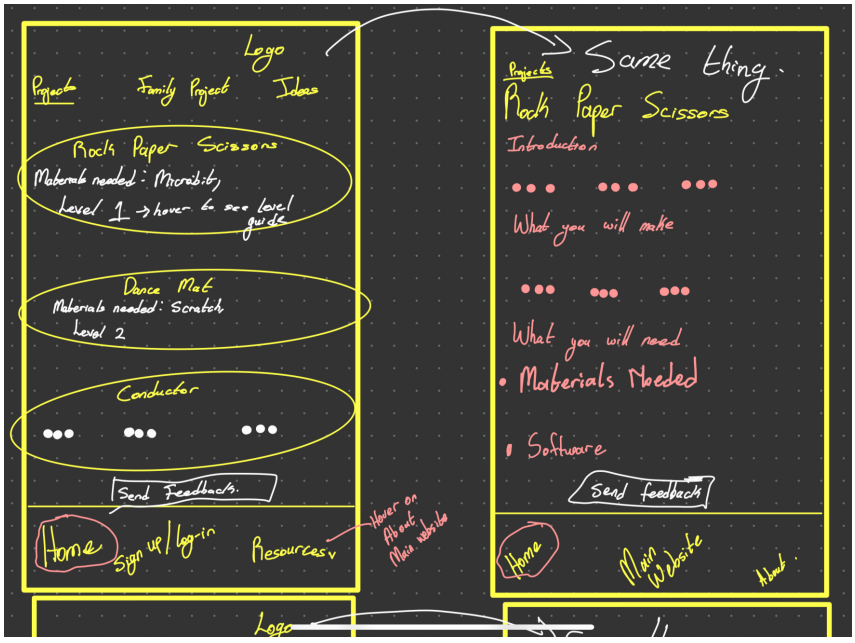

Figure 4.1: Low Fidelity Rendering of the First Tab

4.5.2 High Fidelity Prototype 1

The low fidelity sketches were further improved into high fidelity representations using a software tool called Figma. The use of these types of prototypes provides a more accurate presentation and a greater understanding of the website to be developed. They also help the

researcher to plan ahead in order to anticipate the technical requirements and programming tools necessary to implement the design effectively.

Figure 4.2 below shows the first prototype created and includes the landing page which happens to be one of the main tabs, and a detailed view of a selected project. The prototype provides in-depth information about projects, including images, descriptions, and other relevant details. The high fidelity prototype has more sophisticated visual components, including colours and icons, which improves both the overall user experience and visual attractiveness.

Based on the first prototype, feedback from the OurKidsCode experts were gathered, guiding additional iterations and modifications to optimise the design prior to implementation.

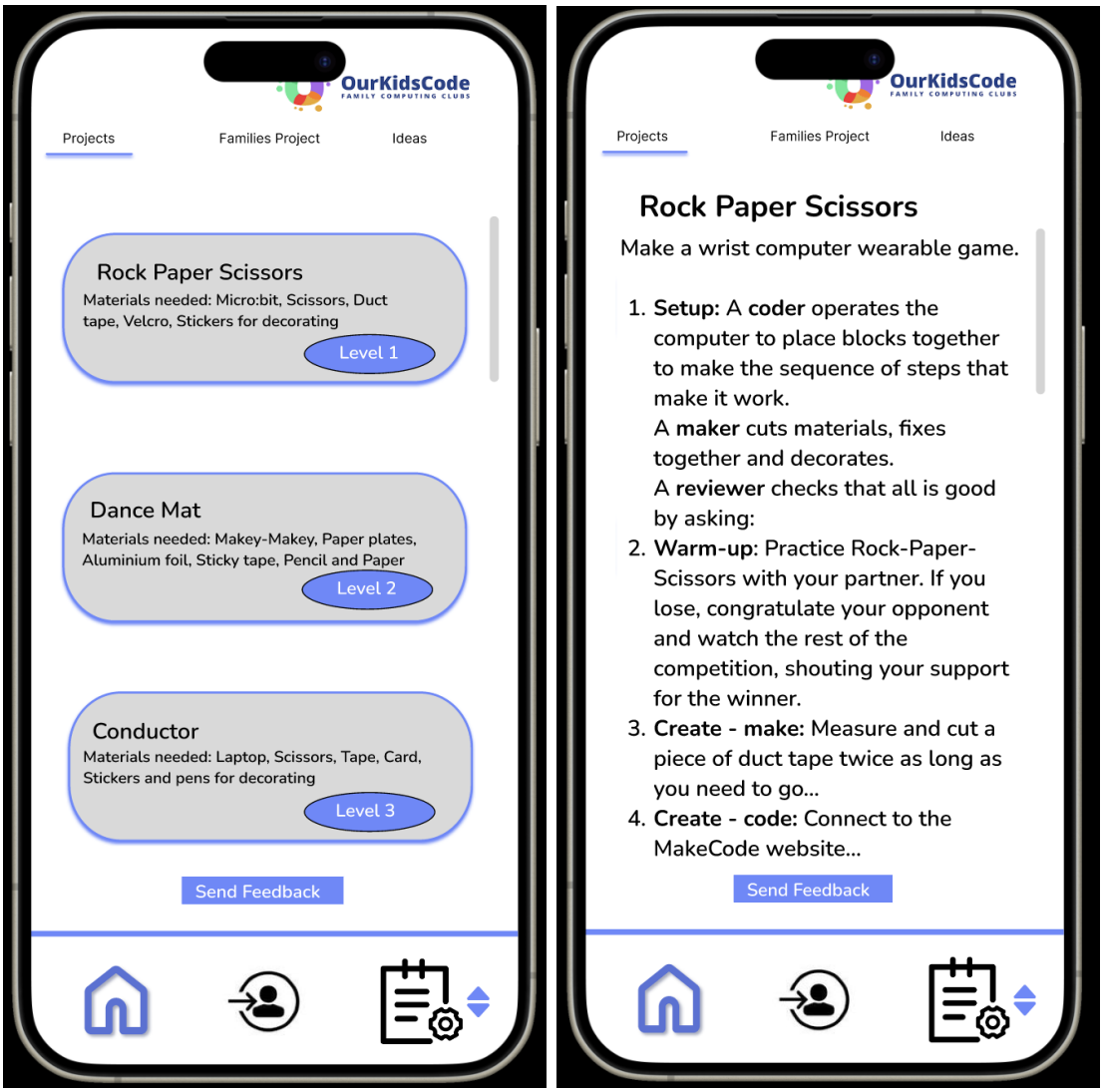

Figure 4.2: First Prototype of the First Tab

4.5.3 High Fidelity Prototype 2

After obtaining feedback on the initial high fidelity prototype from the stakeholders, a second iteration was created in order to incorporate the suggested improvements. Figure 4.3 below, illustrates the second high fidelity prototype, displaying obvious updates and additions aimed at refining the user experience and functionality of the web application.

On the first screen, a landing page was added serving as the homepage of the application. This landing page provides a detailed overview of the main features offered by the web application. The edit and delete features were also added to enhance the platform. Users now have more flexibility and control over the content they upload to the platform thanks to these features.

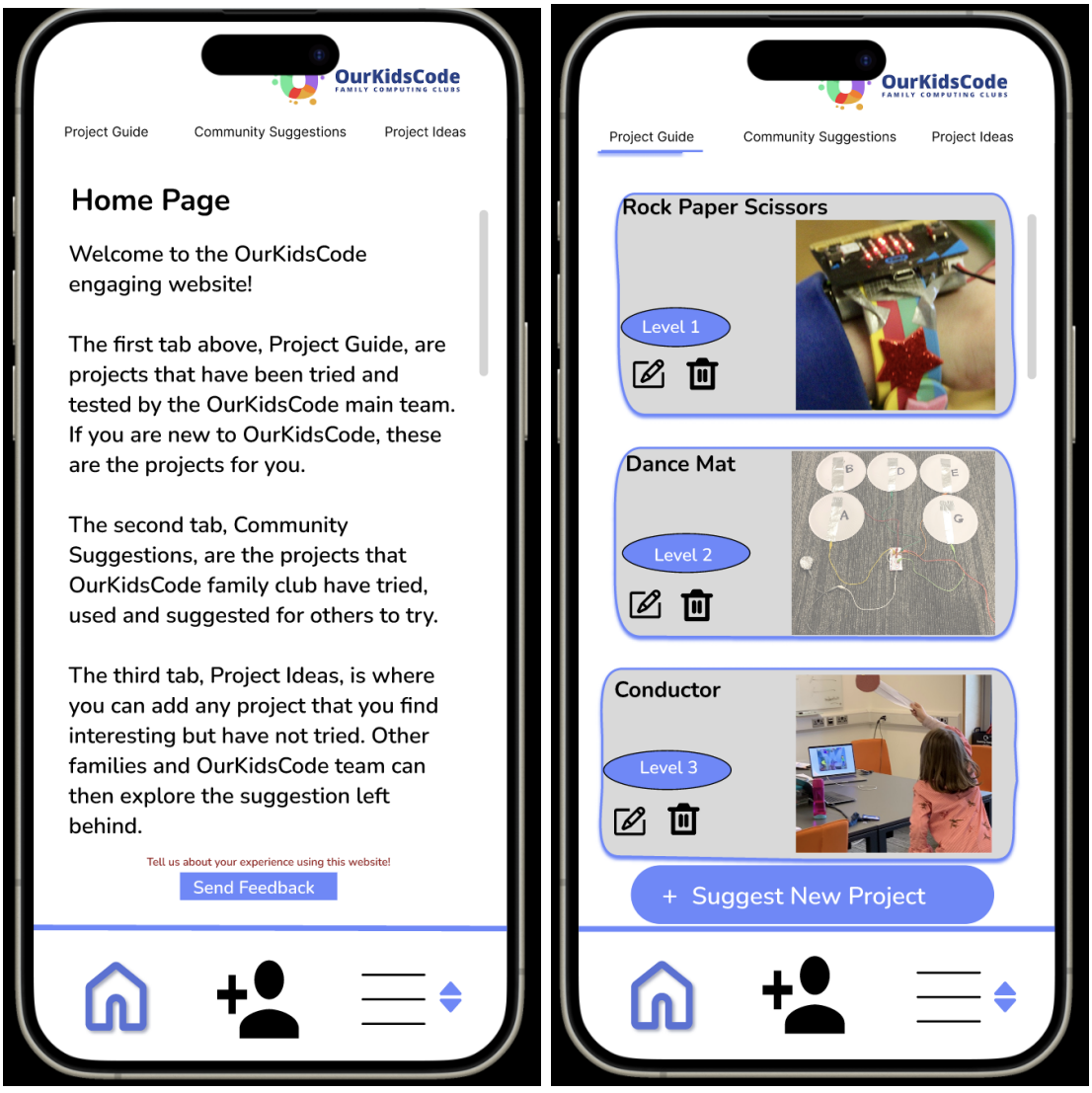

Figure 4.3: Second Prototype of Home Screen and the First Tab

4.5.4 Final Prototype

Based on information obtained from potential users via interviews, the final design includes improvements intended to improve the user interface and user experience in general. At this stage, only little changes were made to further enhance the user interface. See Appendix 8 for the remaining images of the final prototype.

Figure 4.4 shows the updates which included the addition of the copyright information, as well as the inclusion of "Send Feedback", "About", and "OurKidsCode Website" buttons in the footer of the screen. These additions provide users with access to vital information resources, including contact information, additional information about the website, and link to the related website. By integrating these features into the footer, the final prototype improves user accessibility and navigation.

The "Home" and the "User" buttons were also moved to the header of the screen. This strategic arrangement guarantees easy access to essential features and improves the web application's overall usability. Overall, the final prototype reflects the combination of feedback from users and design considerations, resulting in a refined and user-centred interface.

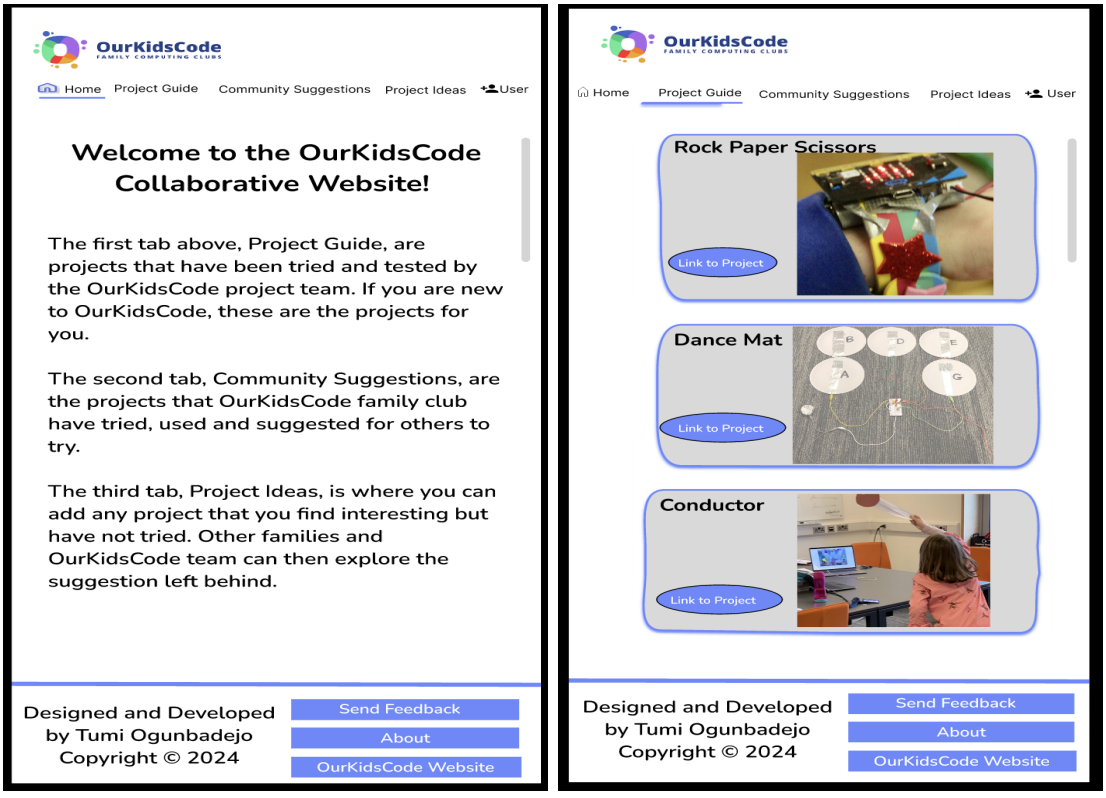

Figure 4.4: Final Prototype of Home Screen and the First Tab

4.6 System Design

The researcher explains the functionality of the web application by using a Use Case diagram, providing a visual representation of the system's main features and interactions. The Use Case description tables in Table 4.1 and Table 4.2 were also utilised for a detailed explanation of the primary use cases. These tables include any preconditions, postconditions, and alternate scenarios in addition to the specific steps needed to carry out each use case.

4.6.1 Use Case Scenario

In Figure 4.5 below, the system consists of two main use cases; "Login" and "BrowseWebsite" which are then broken down into other use cases. The "BrowseWebsite" consists of all the other features on the web application, that is, the three main tabs; Project Guide, Community Suggestions, and Project Ideas, which all have the same add, edit and delete features.

Colour coding has been used for better readability and understanding of the image in Figure 4.5. same add, edit and delete features.
Green: This represents the main use cases of the web application.
Black: This represents use cases that extend from the main use cases.
Pink: This represents branching choices or alternative paths within a use case scenario.
Light Pink: This represents sub-use cases that extend from a branching use case.

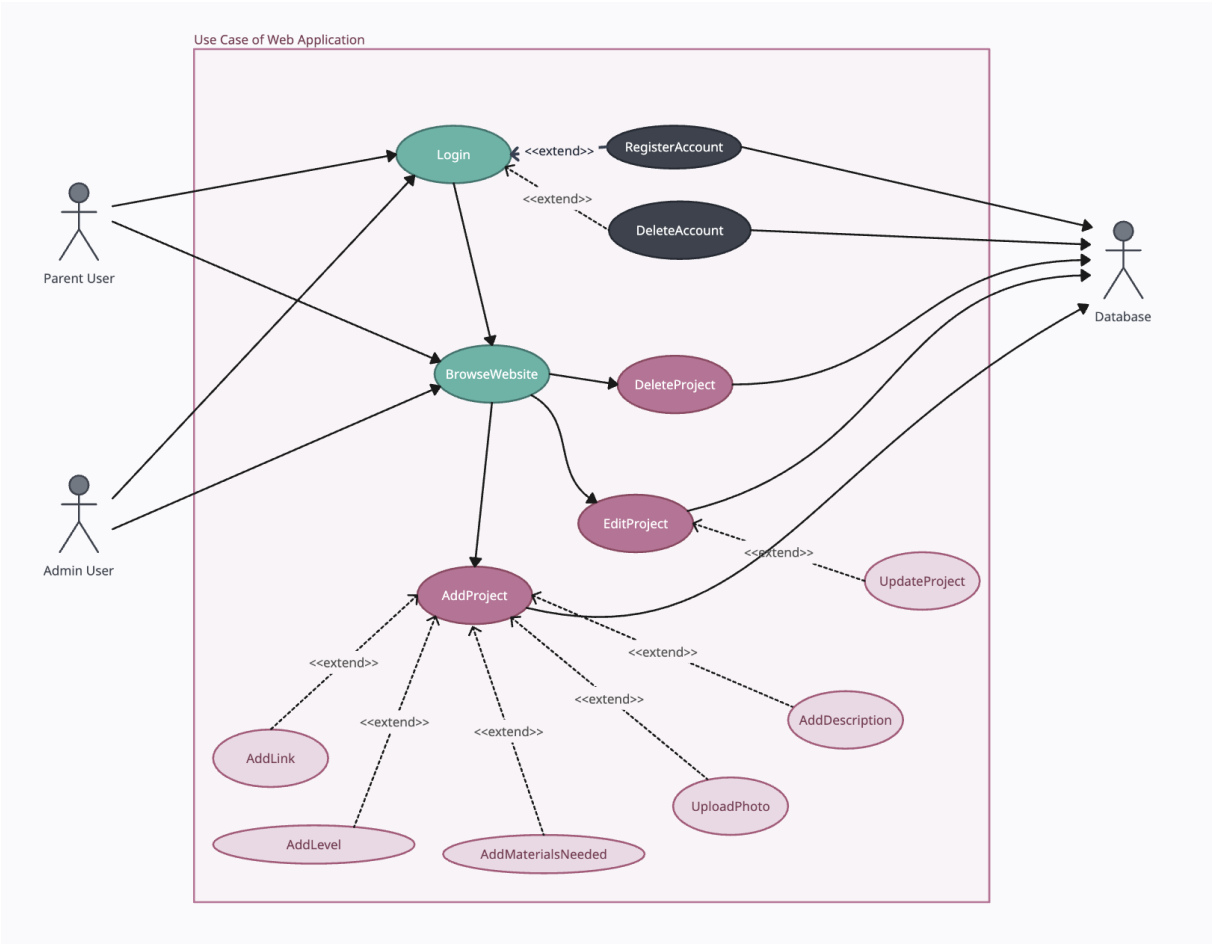

Figure 4.5: Use Case Diagram of the Web Application

Use Case name	**Login**
Primary Actor	1. **Parent** User 2. **Admin** User
Other Actors	**Database**
Description	A user wants to register or login in order to be able to make changes on the web application.
Precondition	If a user already has an account, they just have to sign in.
Trigger	1. The use case is initiated when the user clicks the "User" button. 2. User is redirected after trying to add a new project.
Typical Course of Events	1. User clicks the "User" button on the main screen 2. User enters their credentials on the login screen. 3. User clicks "Login" and the data entered is compared to the data stored in the database.

	4. If the data are a match then the user is successfully logged in. 5. If not, then the user needs to try again with the correct credentials.
Alternate courses	At step 2, the user can decide to create an account if they have not done that already. 1. The user clicks the "Create an account" link which redirects them to the Register page. 2. User enters the requested personal information. 3. User agrees to the terms and conditions of the web application. 4. User clicks "Register" and the data entered is added to the database. 5. User is successfully logged in.
Conclusion	The use case concludes when the user is successfully authorised to add new project(s).
Postcondition	1. User's data has been stored in the database 2. User has left the website.
Implementation constraints and specifications	1. Users must have a valid means of making an account, that is, an email. 2. The database must be running and accessible by the system. 3. The username and email address must be unique.
Error Case	1. User registers with an existing username or email address in the database. 2. User enters the wrong username, email address or password when logging in.

Table 4.1: **Use Case Description for the Login Component**

Use Case name	**BrowseWebsite**
Primary Actor	1. **Parent** User 2. **Admin** User
Other Actors	**Database**
Description	A user wants to explore the website in order to gain more understanding on Computer Science projects which can be done at home in a family setting or at a local coding club.
Precondition	Users must be connected to the internet.

Trigger	1. The use case is initiated when the user enters the Uniform Resource Locator (URL) for the web application. 2. User is redirected to the Home page.
Typical Course of Events	1. User lands on the Home page after entering the website's URL. 2. User explores the main functionalities of the website, that is the three main tabs. 3. User clicks on the "Project Guide" tab, and goes through the existing projects that have been tried and tested. 4. User clicks the link attached to one of the projects to learn more on how to do the tasks within the project. 5. Users are redirected to the main OurKidsCode website, where they have a YouTube video guide for the project, and also a Portable Document Format (PDF), which has the detailed explanation of the project. 6. User chooses to keep exploring the website or exit. 7. User exits the website.
Alternate courses	At step 2, the user can decide to log in or create an account in order to be able to make changes on the website. 1. User goes through the authentication process (see Table 1 for description). 2. User is authenticated. 3. User clicks on the "Community Suggestions" tab. 4. User chooses to suggest a new project. 5. User enters the necessary information about the project they have chosen to upload. 6. User clicks the "Submit" button. 7. The information entered is sent to the database. 8. User has successfully added a new project to the website.
Conclusion	The use case concludes when the system is updated or when the user is satisfied with exploring the website.
Postcondition	1. User's added project has been stored in the database and updated on the user interface. 2. User has left the website.
Implementation constraints and specifications	1. Users must be authorised in order to add, edit or delete a project.

	2. Users must click the "Submit" button before the information added is sent to the database.
Error Case	The information entered cannot be stored if the database is not running.

Table 4.2: **Use Case Description for the BrowseWebsite Component**

4.7 Summary

This chapter provides a comprehensive overview of the web application's development, spanning from the initial design scope to the use cases of the application. The design scope outlines the intended users, features, and structure of the website, highlighting its child-friendly interface and collaborative nature. The objectives and success criteria are provided to clarify the project's overall goals and particular targets. The prototype design illustrates how designs evolve from first ideas to final versions, explaining the iterative process of producing low-fidelity and high-fidelity prototypes. It emphasises how to optimise user interface and experience through iterative refinement and the incorporation of user feedback. Finally, the system design provides a use case diagram, together with detailed descriptions of the main use cases, which provides a visual depiction of the application's operation.

5 Implementation

5.1 Overview

This chapter describes how the conceptual design from Chapter 4 was implemented in order to create a functioning web application. The technologies used for the development are clarified here, along with an explanation behind each technology selection. Additionally, key aspects of the web application's implementation are broken down to offer understanding of the planning and carrying out of particular features, including the challenges encountered.

5.2 Technologies

This was the first time the researcher would develop a full stack application from scratch. Naturally, the researcher had to spend a bit of time ensuring careful consideration was given to selecting technologies that would guarantee simplicity of use, scalability, and stability while streamlining the development process. The technologies chosen were the ones the researcher was either interested in or had a bit of experience using. The project's primary technologies are listed below, along with the justification for each choice.

5.2.1 Visual Studio Code (VSC)

VSC served as the primary Integrated Development Environment (IDE) for the entire development phase. Its robust feature set and user-friendly interface made it an effective environment for version control, debugging, and coding. Code repositories were easy to maintain due to VSC's easy integration with Git, and its large library of extensions increased productivity by providing a variety of tools and plugins.

5.2.2 MySQL Workbench

MySQL Workbench is the visual database design tool used to integrate SQL development and relational database design into the MySQL database system. Performance optimisation, query development, and database schema design were made easier by its user-friendly visual interface. Throughout the lifecycle of the programme, MySQL Workbench guaranteed data integrity, security, and scalability by offering a centralised platform for database administration.

5.2.3 Github

Github served as a central repository for storing and managing the project's source code. This prevents loss of code in a situation where the laptop is not functioning properly. Its vigorous version control features ensured code could be safely backed up in case of data loss or system malfunctions. The deployment process was simplified and code synchronisation was made possible by GitHub's seamless integration with VSC.

5.2.4 TinyMCE

For the description feature of the web application, TinyMCE was selected as the rich text editor, due to its feature set, simplicity of integration, and versatility. TinyMCE provided users with a variety of formatting options, such as bold, italic, and underlining, along with more sophisticated features like image insertion, hyperlinking, and table creation. Its adaptable toolbar and plugin design made it possible for a smooth interaction with the front end of the application, improving user experience and making rich content creation possible.

5.2.5 Dreamhost

Dreamhost was used as the hosting provider and for the domain name registration of the web application. DreamHost provided a hassle-free way to deploy and manage the application in a production environment with its reliable infrastructure, scalable hosting plans, and user-friendly control panel. Its domain registration services also improved the application's brand identity and visibility by offering an easy procedure for obtaining a distinctive domain name.

5.3 System Architecture

5.3.1 Frontend

JavaScript (JS): React JS is a popular and robust JavaScript framework that provided the framework for the client side development. A custom React application was initialised using;

```
npx create-react-app my-app
```

Listing 5.1: Command for initialising a React application

This provided an organised and scalable environment for creating dynamic user interfaces. Different JavaScript and React libraries were integrated to improve functionality and streamline development. Axios, which is a widely adopted HTTP (Hypertext Transfer Protocol) client library, made it easier to communicate with server-side APIs, allowing for smooth data transfer between the frontend and backend.

Cascading Style Sheets (CSS): This was used for styling the user interface of the web application, guaranteeing a cohesive and aesthetically pleasing appearance. By incorporating the Bootstrap CSS stylesheet into the project, pre-designed user interface components and responsive layout tools were accessible.

```
import "bootstrap/dist/css/bootstrap.css";
```

Listing 5.2: Bootstrap CSS import code

A custom css component was also created to customise the appearance of specific features, improving the overall user experience.

5.3.2 Backend

JavaScript (Node.js): Node.js, a lightweight and efficient JavaScript runtime was used for the server side design of the web application. The combination of Express.js, which is an efficient and rapid web framework, and Node.js allowed for the swift development of server applications that are both scalable and effective. The development of strong middleware and APIs was made easier by Express.js, which handled incoming requests and smoothly coordinated the server-side functionality.

To improve functionality and security, a number of middleware libraries were incorporated into the backend infrastructure, including CookieParser, Multer, and CORS (Cross-Origin

Resource Sharing). Cross-origin queries were made easier by CORS middleware, enabling safe communication between the frontend and the backend API. CookieParser made it possible to parse HTTP request cookies, which made authentication and session management easier. Multer enabled file uploads within the programme by providing support for handling multipart/form-data.

5.3.3 Database

MySQL: MySQL is a popular and reliable relational database management system (RDBMS) which served as the web application's underlying data store. To efficiently store and manage application data, database tables were created by utilising the SQL-based query language and transaction support. In order to meet the data requirements of the application, the database schema was carefully created, guaranteeing data integrity, scalability, and performance.

The relationships between various entities within the application domain were reflected in the structure of the database schema. Every table denoted a unique entity, with columns designed to record relevant attributes and relationships. Figure 5.1 shows the database structure, which provides insights into the tables, columns, and relationships defined by the database model.

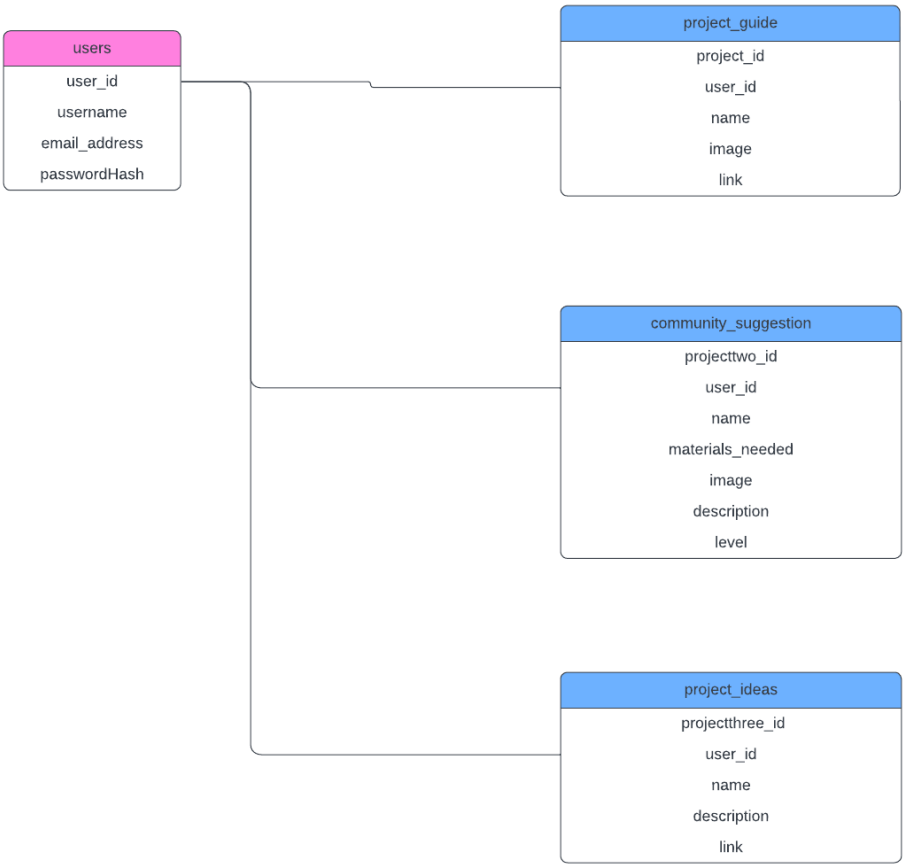

Figure 5.1: Database Structure

5.4 Application Implementation

Navigation Bar (NavBar): The NavBar contains the important features of the application which includes the three main tabs for adding projects, that is, "Project Guide", "Community Suggestions", and "Project Ideas". It also has the "Home" and "User" option within it. Figure 5.2 shows the image of the navigation bar of the web application.

Figure 5.2: Navigation Bar of the Web Application

For the implementation of the NavBar, certain dependencies were imported from React Bootstrap in order to render the navigation bar. The component that does this is "Navbar" which includes a brand logo, a toggle button for collapsing the navigation links on smaller screens, and a collapse component for rendering the navigation links. The "Nav" component renders the navigation links using the "Nav.Link" component, and each link includes an icon and a label, which is wrapped in a "Link" component from "react-router-dom" to enable client-side routing.

```
return (
    <Navbar
      expanded={expand}
      fixed="top"
      expand="md"
      className={navColour ? "sticky" : "navbar"}
    >
      <Container>
        <Navbar.Brand href="/" className="d-flex">
          <img src={Icon} className="img-fluid␣logo" alt="brand"
          />
        </Navbar.Brand>
        <Navbar.Toggle
          aria-controls="responsive-navbar-nav"
          onClick={() => {
            updateExpanded(expand ? false : "expanded");
          }}
```

```
        >
          <span></span>
          <span></span>
          <span></span>
        </Navbar.Toggle>
        <Navbar.Collapse id="responsive-navbar-nav">
          <Nav className="ms-auto" defaultActiveKey="#home">
            <Nav.Item>
              <Nav.Link as={Link} to="/" onClick={()
              => updateExpanded(false)}>
                <AiOutlineHome style={{ marginBottom:
                "2px" }} /> <b>Home</b>
              </Nav.Link>
            </Nav.Item>
```

Listing 5.3: NavBar Code Snippet

Footer: The Footer contains the copyright information and also other secondary features which includes "Send Feedback", "About" and "OurKidsCode Website". The "OurKidsCode Website" link redirects users to the main OurKidsCode website for more information about coding clubs for children with their parents. Figure 5.3 shows the image of the footer of the web application.

Figure 5.3: Footer of the Web Application

For the implementation of the Footer, components including "Container", "Row" and "Col" were imported from React Bootstrap in order to render this section. The footer consists of three columns where; the first column displays the information about the developer, the second column displays the copyright information, which is dynamically generated based on

the current year, and the third column contains a list of icons and links. The styling of the footer was implemented in the "Styles.css" file.

```
function Footer({ updateExpanded }) {
  let date = new Date();
  let year = date.getFullYear();
  return (
    <Container fluid className="footer">
      <Row>
        <Col md="4" className="footer-copywright">
          <h3><b>Designed and Developed by Tumi Ogunbadejo</b>
          </h3>
        </Col>
        <Col md="4" className="footer-copywright">
          <h4><b>Copyright C {year}</b> </h4>
        </Col>
        <Col md="4" className="footer-body">
          <ul className="footer-icons" style={{ listStyle: "none",
          padding: 0, margin: 0 }}>
            <li className="social-icons">
              <a
                href="https://forms.gle/M951PqgMJkWpKHSr9"
                style={{ color: "white", textDecoration: "none" }}
                target="_blank"
                rel="noopener noreferrer"
              >
                <VscFeedback /> Send Feedback
              </a>
            </li>
```

Listing 5.4: Footer Code Snippet

Project Tabs: The three project tabs of the website have similar structures but serve different purposes. They can be viewed by any user on the internet but only authorised users can add projects to the pages. For the first tab, "Project Guide", only the admin user can add new projects to this page. The admin user is also able to edit or delete existing projects from this page. For the other two tabs, projects can be modified by the authorised user who added the project in the first place. The image below shows the "Suggest New Project" pop

up screen of the “Community Suggestions” tab. Figure 5.4 shows the image of the "Suggest New Project" modal that pops up when the button to add new project is clicked on the "Community Suggestions" page.

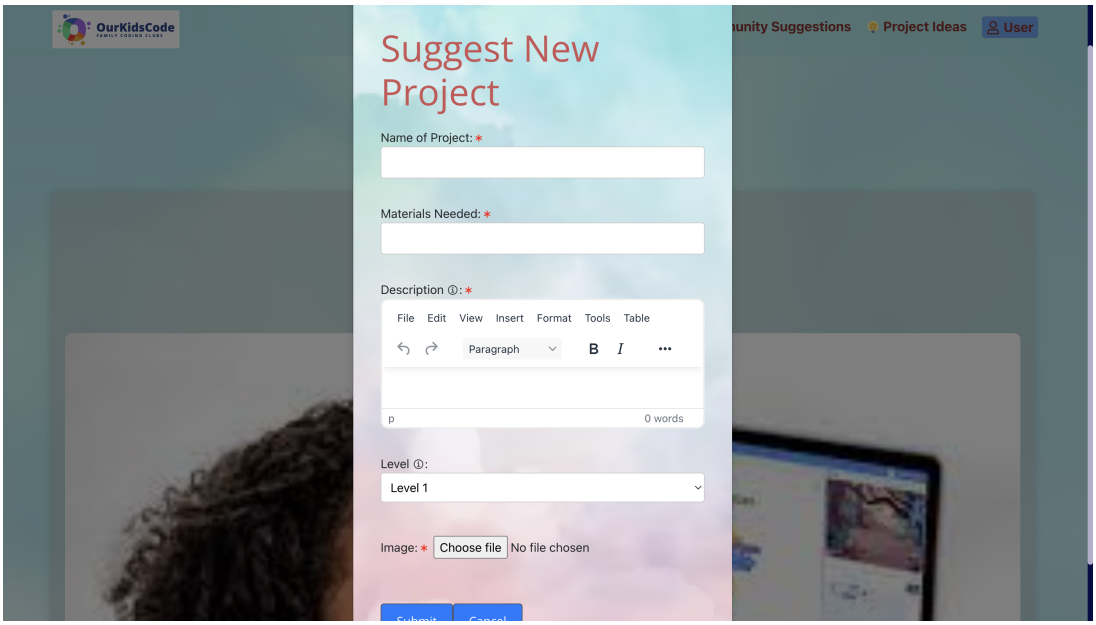

Figure 5.4: Suggest New Project Modal of the Web Application

For the implementation of these features, multiple state variables were used to manage the projects, modal visibility, user login status, user ID, and errors, during form submission. In Figure ?, inside the “useEffect” hook, the component makes two HTTP GET requests using Axios. The first gets the user data to determine if the user is logged in and to obtain the user ID which is needed when adding a new project to the database. The second request fetches the existing “Community Suggestions” projects from the database. The component contains event handler functions for accessing the project edit page, handling changes to the project level, adding a new project, deleting a project, confirming project deletion, and closing the delete confirmation modal. In all project tabs, if the user is logged in and the project belongs to the logged-in user, edit and delete buttons are displayed for that project. Each component for the project tabs include a modal for adding or editing projects. The component carries out simple form validation upon user submission of the project to ensure that all essential fields are filled in. A HTTP POST request is sent to add the new project to the database if the form is valid. Errors are handled cautiously by logging them to the console and giving the user feedback, such as showing error messages for fields that are missing.

```
useEffect(() => {
  axios
    .get("http://localhost:8080/user")
    .then((res) => {
      if (res.data.username) {
        setLoggedIn(true);
        setUserId(res.data.userId); // Set user ID state
      } else {
        setLoggedIn(false);
      }
    })
    .catch((err) => console.log(err));

  axios
    .get("http://localhost:8080/community-suggestions")
    .then((res) => setSuggestedProjects(res.data))
    .catch((err) => console.log(err));
}, []);

const handleAddNewProjectClick = () => {
  if (loggedIn) {
    setShowModal(true);
  } else {
    navigate("/login");
  }
};

const handleSuggest = (newProject) => {
  if (!userId) {
    console.error("User ID not found");
    return;
  }
  newProject.user_id = userId; // Add user ID to the new project
  setSuggestedProjects([...suggestedProjects, newProject]);
  setShowModal(false);
};

const handleDelete = (id) => {
  axios
    .delete("http://localhost:8080/delete/" + id)
    .then((res) => {
      window.location.reload(true);
    })
    .catch((err) => console.log(err));
};
```

```
const handleSubmit = (e) => {
  e.preventDefault();
  // Basic form validation
  if (
    !projectName ||
    !projectMaterials ||
    !projectDescription ||
    !projectImage
  ) {
    setErrors({
      projectName: !projectName,
      projectMaterials: !projectMaterials,
      projectDescription: !projectDescription,
      projectImage: !projectImage,
    });
    return;
  }
  const formData = new FormData();
  formData.append("image", projectImage);
  formData.append("user_id", userId);
  formData.append("projectName", projectName);
  formData.append("projectMaterials", projectMaterials);
  formData.append("projectDescription", projectDescription);
  formData.append("projectLevel", projectLevel);

  axios
    .post("http://localhost:8080/community-suggestions", formData, {
      headers: {
        "Content-Type": "multipart/form-data",
      },
    })
    .then((res) => {
      console.log(res);
```

Figure 5.5: Project Tab Code Snippet

User Authentication: Users are required to register or login before they can add to the website. When a user tries to add a new project without being authenticated, they are redirected to the login page of the website, where they either login or proceed to create a new account. Username and email address has to be unique to prevent users from having multiple accounts and regulate the personal data collection. The registration page also includes the terms and conditions of the web application, and the privacy policy. Figure 5.6 shows the image of the registration page of the web application.

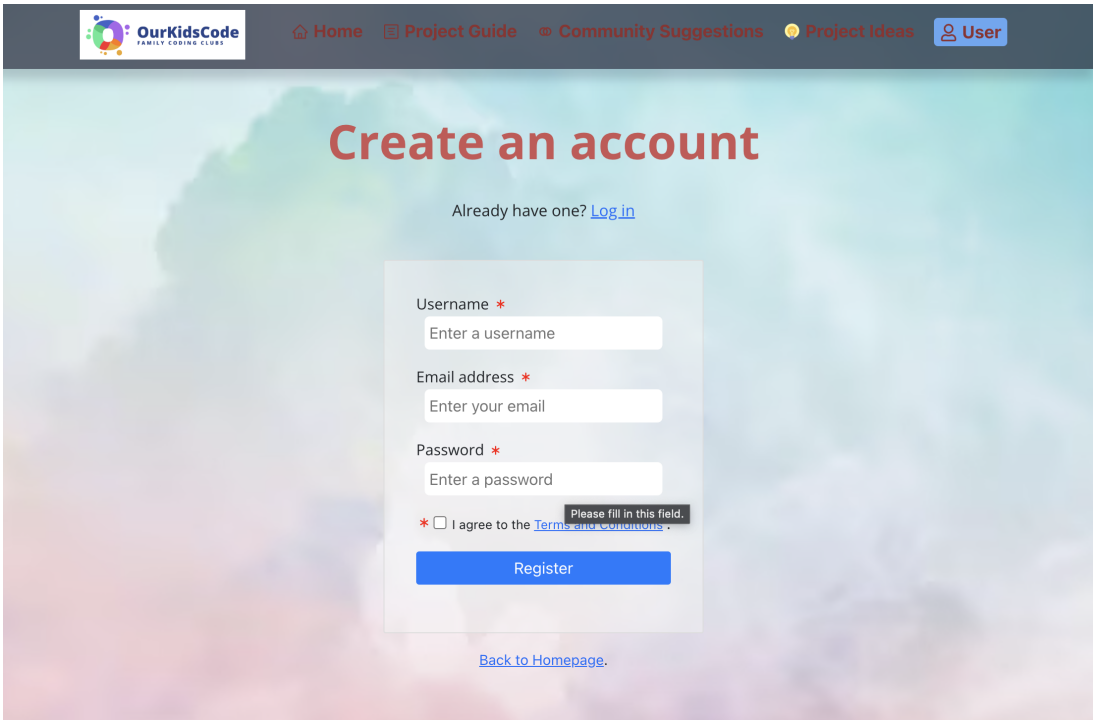

Figure 5.6: Registration Page of the Web Application

The registration component uses React's "useState" hook to manage the state of "username", "password", "email", and "error". Submitting the registration form triggers the "handleRegister" function, which sends a POST request to the server API endpoint with the user's registration information. It checks whether the registration was successful based on the response from the server. If it is successful then the user gets redirected to the homepage, if it is not, an error message is displayed on the screen. To authorise a user, the "useEffect" hook is used to fetch user authentication status from the backend API endpoint when the component mounts. If the user is authenticated, it displays a welcome message with the user's name, and a "Logout" button. If the user is not authenticated, it prompts the user to log-in and a link to the login page is provided. When the user clicks the logout button, the "handleDelete" function is triggered, which sends a GET request to the backend. Upon successful logout, the page is refreshed, and the user is prompted to log-in again.

```
import React, { useState } from "react";
import { Link } from "react-router-dom";
import axios from "axios";
import { useNavigate } from "react-router-dom";
import { LuAsterisk } from "react-icons/lu";

const Register = () => {
  const [username, setUsername] = useState("");
  const [password, setPassword] = useState("");
  const [email, setEmail] = useState("");
  const [error, setError] = useState("");
  const navigate = useNavigate();

  const handleRegister = (e) => {
    e.preventDefault();
    axios
      .post("http://localhost:8080/register", {
        username,
        email,
        password,
      })
      .then((res) => {
        if (res.data.Status === "Registration successful") {
          navigate("/");
        } else {
          setError(res.data.Error);
        }
      })
      .then((err) => console.log(err));
  };
```

```
axios.defaults.withCredentials = true;
useEffect(() => {
  axios
    .get("http://localhost:8080/user")
    .then((res) => {
      if (res.data.Status === "Authorized") {
        setAuth(true);
        setName(res.data.username);
      } else {
        setAuth(false);
        setMessage(res.data.Error);
      }
    })
    .then((err) => console.log(err));
}, []);

const handleDelete = () => {
  axios
    .get("http://localhost:8080/logout")
    .then((res) => {
      window.location.reload(true);
    })
    .catch((err) => console.log(err));
};

return (
  <div className="text-center m-6-auto">
    {auth ? (
      <div>
        <h2>You are now logged in --- {name}</h2>
        <button id="sub_button" type="submit" onClick={handleDelete}>
          Logout
        </button>
      </div>
    ) : (
      <div>
        <h2>{message}</h2>
        <h3>Login Now</h3>
        <Link to="/login">
          <button id="sub_button" type="submit">
            Login
```

Figure 5.7: Registration Page Code Snippet

5.5 Challenges faced

Many obstacles were encountered during the development of the full-stack application, ranging from technological difficulties to the need to pick up new abilities and information. Since this was the researcher's first experience with full-stack programming, there was a steep learning curve when it came to database administration. Understanding database concepts like CRUD (create, read, update and delete) operations, querying, and schema design required extensive research and hands-on practice.

The process of learning how to host the web application presented another major obstacle. This required managing server resources, deployment procedures, and configuration of the server. Getting guidance from professionals and leveraging their expertise in resolving deployment-related issues helped reduce some of the hosting-related complications which resulted in successfully launching the application. There were technical issues in implementing services like file uploads, dynamic content rendering, and user authentication. Debugging and problem-solving techniques were necessary to solve problems with data validation, third-party library integration, and authentication workflows.

It was important to navigate through documentation and online resources because the researcher had limited prior experience with web development. Using resources such as W3Schools, YouTube tutorials, and official documentation from technology providers helped solve problems while understanding complex concepts. There were particular challenges in ensuring interoperability and smooth integration between various components of the application, such as databases, backend servers, and frontend frameworks. It took extensive testing and iteration to resolve problems with version inconsistencies, dependency conflicts, and API compatibility.

The researcher faced the ongoing challenge of continuous learning and adaptation during the development process. It was essential to keep up with new technologies and best practices in order to overcome challenges and provide a reliable, functional application.

5.6 Summary

The implementation of the web application involved careful technology selection, thorough planning, and feature execution to develop a functional and user-friendly platform. React JS and Bootstrap CSS were used in the frontend of the system architecture to provide dynamic user interfaces and responsive layouts. The backend was powered by Node.js and Express.js, which made it easier to swiftly build scalable server applications. Middleware libraries like CookieParser, Multer, and CORS enhanced functionality and security.

Through proactive resolution of these obstacles and utilisation of a blend of self-learning, web-based materials, and expert advice, the researcher effectively managed the complexities of full-stack development, accomplishing their objectives in developing and deploying an online application.

6 Evaluation

6.1 Overview

This chapter gives in-depth information about the evaluation of the web application, emphasising on its functionality, usability and the overall challenges encountered. The researcher assesses the benefits of the website, particularly in the long run, and discusses its potential to meet user needs effectively. The chapter also describes the methods used, which includes user interviews designed to obtain quality feedback to evaluate the application's performance and usability. The researcher identifies any shortcomings or potential areas for improvement in the web application as well as offers insights into its effectiveness through this evaluation process.

6.2 Objectives/Goals

It is important to note that while some of the requirements are considered successful, it has not been proven on a large scale. In other words, the success of the web application cannot be fully evaluated in the timespan of the project. The analysis done here is within the context of the project's scope, aligning with the defined objectives and success criteria.

6.2.1 Functional Requirements

Option of Three Different Primary Tabs: This was a success, as the feature was effectively implemented in the web application. The three tabs offer users distinct avenues for collaboration and exploration. Its functionality was achieved as expected, with administrators granted exclusive modification privileges over the first tab. Users could access essential resources and contribute to the platform's dynamic content by easily interacting with the tabs.

User Registration and Sign-In: This was a success, as the functionalities were executed

without complications, aligning with project expectations. Users were able to create a new account or sign in effortlessly, permitting involvement in content contribution activities, while maintaining access to tab content without authentication.

User-Generated Content Management: This was a success, as the features were seamlessly implemented empowering authorised users to add, edit or delete content as needed. The feature is intuitively distinguished between authenticated users, displaying edit or delete options only for content creators, thus preserving data integrity and user autonomy.

Database Management: This was successfully implemented which ensured robust data storage and retrieval functionalities. User data and project details were safely saved using MySQL, enabling quick and easy data retrieval and display via HTTP GET requests. The effective management of user authentication procedures made possible by this design improved system performance as a whole.

Implementing a Child-Friendly User Interface: This requirement was implemented but in order to judge it to be fully successful, it would have to undergo user testing with children. This was not possible as the ethics approval did not cover user testing with under 18s. The web application effectively catered to its target audience, with very aesthetically pleasing colours, fonts and engaging imagery. The interface's child-friendly design elements fostered user engagement and aligned with the playful concept of the OurKidsCode project, enhancing overall user experience.

Creating an Engaging User Experience (UX): The developer successfully created a web application with an intuitive and engaging user experience. Smooth user interactions were made possible by brief descriptions and clear navigation pathways, which improved usability and comprehension on all tabs. The home page's informative content guided users through the application's functionalities, ensuring a seamless browsing experience.

Security and Privacy Measures: This was a success as user confidence in the application's integrity and data protection was strengthened by the implementation of robust security and privacy measures. The application included a detailed terms and conditions page and also a privacy policy page (see Appendix 2 & 6), which provided users with transparent insights into data usage practices, fostering trust and compliance with regulatory requirements.

6.2.2 Non-Functional Requirements

Reliability: This was somewhat achieved. Although the web application proved to be generally reliable, there were some problems, especially with port configuration and data refreshing. Due to port dependencies, users occasionally reported having trouble accessing the application, and manual URL manipulation was necessary for proper functionality. Furthermore, the automatic redirection to JSON pages following API calls impeded smooth data updates, requiring manual page refreshing in order for changes to be appropriately reflected. While manual interventions were used to resolve these problems, they still revealed areas that needed to be improved in order to increase user satisfaction and long-term reliability.

Accessibility: This was also somewhat achieved. The web application's accessibility demonstrated an average degree of success, with significant restrictions noted throughout the testing and deployment stages. While functionality was verified locally, external accessibility was constrained by dependency on the developer's server hosting. External users faced accessibility hurdles unless the developer initiated server operations, limiting independent usage. To overcome this limitation, deployment processes must be further improved in order to guarantee autonomous and consistent application availability for every user, irrespective of server status.

In conclusion, the functional requirements evaluation showed that important features had been implemented successfully, in line with the project's goals of delivering a safe and user-friendly online application experience. Despite certain constraints, the web application met non-functional requirements with a satisfactory overall performance. The difficulties that have been highlighted show the significance of continuous optimisation efforts to improve accessibility and dependability, guaranteeing seamless user experiences and broad accessibility across a variety of user contexts. The reflection underlines the iterative nature of application development and underscore the necessity of constant enhancement to attain peak performance and contentment from users.

6.3 Testing

6.3.1 Testing to Break

During the development of the web application, rigorous testing procedures were employed to assess the system's robustness and identify potential vulnerabilities. To ensure the application's resilience in real-world usage scenarios, the goal was to replicate user

interactions and behaviours that could potentially interrupt or compromise its functionality. Examples included registering with an existing username or email address, submitting incomplete or invalid form data, closing and reopening the web application tab to assess session persistence. The purpose of these tests was to identify possible edge events and confirm that the application can smoothly manage unexpected user behaviours.

Error handling and recovery procedures received special attention during the testing process. The developer swiftly detected and resolved any problems, such as registration with duplicate credentials or unexpected session termination, to avoid system failures or user frustration. By implementing robust error handling logic and recovery mechanisms, the application demonstrated improved fault tolerance and user resilience, enhancing overall reliability and usability.

6.3.2 User Scenarios

User scenarios are used to obtain more information about how the application would function from different users' perspectives. The scenarios are then used to fill in the gaps within the system to ensure smooth use of the application.

Examples:

Browsing User Scenario: User enters the website's domain name and gets redirected to the homepage of the website. User navigates through the main tabs at the top of the page, and explores the various projects that have been added. The user finds an interesting project on the "Community Suggestions" page, and clicks the "Show More" button for more details. The user then proceeds to the "Project Guide" page where they find the projects that have been tried and tested hence, reliable. The user clicks on the link on one of the projects there, and gets redirected to the main OurKidsCode website, which contains in-depth information about the project including a YouTube tutorial. User clicks on the about page to get more information about the website, and learns that it is a dissertation project from the School of Computer Science and Statistics. The user is impressed with the effectiveness of the website, so they find the "Send Feedback" link and leave their feedback.

New User Registration Scenario: User enters the website's domain name and gets redirected to the homepage of the website. User has previously been on the website in the past and knows how it works. User wants to add a new project to the "Project Ideas" page, and clicks on the "Suggest Ideas to Explore" button. User gets redirected

to the log-in page. Since the user does not have an existing account, they click the "Create an account" link, and get redirected to the "Create an account" page. The user enters their unique username, email address and password, and also reads the terms and conditions before agreeing to it. User is then logged-in, and is now authorised to add a new project. User enters the name of the project idea, its description and the link to the website, and clicks the submit button. The "Project Ideas" page is then updated, and the user exits the page.

Admin User Scenario: Admin user enters the website's domain name and gets redirected to the homepage of the website. The user clicks on the "User" button and is prompted to log-in. The user enters the admin username or email address and the password, and clicks the "Login" button. The user is successfully logged-in and has access to add to the "Project Guide" page, and the edit and delete buttons are visible for the existing projects. The user clicks the "Add New Project" button and enters the project's name, image, and the link to the project's information page, and clicks the "Submit" button. The admin user successfully adds a new OurKidsCode project to the page, and exits the website.

This approach was useful in the development, as it played an essential role in identifying missing functionalities, potential usability issues, and areas for improvement throughout the development process. The scenarios enabled a thorough assessment of the application's functionality, navigation flow, and feature completeness by mimicking a variety of user interactions. The feedback gathered from user scenarios informed iterative refinements and enhancements, ensuring a user-centric design approach and ultimately enhancing the overall user experience.

6.3.3 User Testing

User testing played a pivotal role in order to evaluate the web application's functionality, usability, and overall user experience. Through structured interviews with some of the participants from Section 3.8, and feedback collection, users' insightful opinions were gathered which helped to improve and refine the application. During the interviews, six open questions were asked, and here's a detailed evaluation based on the user testing feedback;

What are your overall impressions of the user interface design? Does it feel intuitive and easy to navigate?

The users found the user interface design to be visually appealing, intuitive, and easy to

navigate. A user suggested adding an interactive NavBar, that is, highlighting the name of the current tab in the navigation bar to enhance navigation clarity. The user stated; "*...so I just found out that when I was on one page there, I wasn't sure whether I was in Project Guide or Community Suggestions...*" Overall, the users found the website clear, well labelled and precise.

Can you confidently navigate through each tab of the website? Were you able to find the information or features you were looking for?

The users had no problem with navigating through each tab of the website, and were able to find features that had either been recommended by them or were very interesting to them. A user appreciated the sense of security provided by the login or registration process.

Please attempt to add a project to the Community Suggestions tab. Were you able to do so successfully? Were there any challenges or difficulties you encountered during the process?

Users were able to successfully add projects to the Community Suggestions tab, although some minor issues were identified. A user mentioned that it would be great if they are redirected back to the page they were on before getting redirected to the login page. When they tried suggesting a new project on the Community Suggestions tab, they got redirected to the User page to login or register. However, after doing that, they had to navigate back to the Community Suggestions page to continue what they were doing, instead of that automatically happening. They suggested just having a user pop-up message at the top of the page where the user was before the login action, that says; "*Welcome <insert username>, you are now logged in*". The user also suggested having a user message at the top of the screen saying, "*Your project has now been successfully added*" after adding a project. Overall, they had no issues adding a new project to the Community Suggestions tab, and found the process fairly straightforward.

How would you describe your experience while using the web application? Did you find it engaging and enjoyable, or did you encounter any frustrations?

In general, users described their experience as smooth, engaging and enjoyable, with clear and concise information provided throughout the website. Minor frustrations were encountered, such as the loss of entered details when navigating back from the terms and conditions page during registration. This is something that has to be fixed so the history is restored for a better user experience. They loved the fact that there are not too many pages which can be daunting. They commented; "*...you want it tight, small with just a few pages...*" Another user stated; "*I found that the site was quite bright and kind of inviting for the eyes*".

Do you have any suggestions for improving the layout, design elements, or visual aesthetics of the website?

Some suggestions for improvements gotten from the users who participated in this user testing phase includes; revising wording on the "User" tab. It currently shows "*You have been logged out - Login Now*" for users that are not authorised. However that could be improved since not all users were logged-in beforehand. They also suggested adjusting the colour of the footer section to a darker colour so the white font can be more visible. The user also suggested implementing image quality enhancement features that only allows users to upload a *.png* file for the image, or have any image being uploaded converted into a *.png* file to improve the quality of all the images on the website.

For the feedback form, a user suggested implementing a form-based feature to avoid the need for users to sign in with their google account.

Overall, how likely would you be to recommend this web application to other parents and children interested in Computer Science education? Are there any specific reasons for your recommendations?

Users expressed a high likelihood of recommending the web application to other parents and children interested in CS education. The reasons for recommendations included the usefulness, ease of use, and potential benefits for children's education, as well as the relevance to existing school clubs and educational initiatives. A user said; "*I think there is a big need for it definitely in OurKidsCode clubs*". Another user mentioned that they would recommend the website not only to parents but teachers in their kid's primary school because they know a couple of kids that would be interested in trying out these fun projects. They stated; "*...especially because their primary school has a physics club, so this would be something I would recommend to the teachers as well to get them more exposed...*"

The feedback from user testing guided the web application's iterative improvements and adjustments by providing insightful information about areas that needed work. The feedback-driven development approach ensured that user needs and preferences were prioritised, resulting in a more user-centric and effective web application.

6.4 Discussion

6.4.1 Application Discussion

Most of the features and designs from Section 4.5.4 were implemented successfully in the final web application. However some features were not implemented as explained in Section 6.5. Although certain features were not fully realised, all the functional requirements were successfully implemented as described in Section 6.2, which demonstrated the achievement of key project objectives. By providing users with the ability to browse, contribute, and manage projects, the web application achieved its primary goal of promoting collaborative learning and creativity among families interested in Computer Science education.

The continuous and effective use of the web application would give more families exposure to projects being created by other families, and would encourage them to also contribute by adding projects. Meaningful learning experiences are promoted by this collaborative approach, which encourages family engagement and involvement in their children's educational journey.

Notwithstanding the difficulties encountered, proactive approaches to problem-solving, the use of online resources, and expert support were all crucial in enabling the issues to be managed and eventually contributed to the successful deployment and operation of the web service. There are prospects for the online application to be improved and refined going forward. Reliability problems and accessibility restrictions are two examples of constraints that can be addressed during development to enhance user experience overall and guarantee the long-term sustainability of the programme.

6.5 Limitations

The major limitation of this project stems from time constraints. Based on the final prototype, there are some features that were not implemented because time did not permit. This includes implementing the comment feature that allows users to comment on one another's projects to promote engagement. Users can participate in conversations, exchange ideas, and offer feedback through comments, which helps to build a sense of community on the platform. Furthermore, the Community Suggestions page did not contain features like the "I have tried this" and "Interested" buttons. The purpose of these buttons was to encourage user involvement and cooperation by allowing users to show their interest in particular projects or to indicate that they had tried to replicate the project.

The lack of these engagement-oriented elements on the Community Suggestions page is a missed opportunity to improve user involvement and interaction. Through interactive buttons, users could have expressed their interest or opinion and commented on projects, creating a more dynamic and collaborative environment that would have promoted information sharing and community development. However, there are options for future development to overcome these limitations. In later versions of the web application, giving priority to the integration of engagement elements can improve user experience and encourage community involvement.

6.6 Summary

The evaluation of the web application provided thorough understanding of its functionality, usability, and overall efficacy in satisfying user needs. Many facets of the application's performance were reviewed through careful evaluation and feedback from users, revealing both its advantages and shortcomings. The application's ability to achieve important project objectives was demonstrated by the generally successful implementation of the functional requirements. The majority of the functional needs were satisfied, but there were difficulties meeting some non-functional requirements, mainly those related to accessibility and reliability. User scenarios and testing were essential in assessing the usability and user experience of the programme. By addressing the limitations mentioned above and leveraging user feedback, the website can develop into a more powerful and impactful tool for encouraging creative problem-solving and collaborative learning among families interested in their children's CS education.

7 Conclusion

7.1 Overview

This concluding chapter summarises the research journey that was undertaken for this paper by addressing the objectives stated at the beginning, and discussing how they were achieved It also outlines the study's main conclusions, contributions, and provides insights into the possible future work that may stem from this paper.

7.2 Addressing the Objectives

Conducting a comprehensive literature review to research existing literature on CS education in Ireland

The study assessed the state of CS education in Ireland through a thorough literature analysis, identifying the prevalent barriers and shortcomings in integrating CS subjects into the curriculum. It was seen from the literature review that CS-related subjects are still yet to be added to the primary school curriculum due to teachers' lack of expertise in the field. This goes on to affect the children in secondary schools as they are aware of the fundamental understanding of CS, and because of that are uninterested in taking up the optional Coding short course subject available for students in their first to third year of post-primary school. The findings highlighted the urgent need for programmes to support CS education and close the knowledge gap between educational institutions and advancements in technology.

Understanding the impact of parental involvement in their children's CS education

From the research undertaken, valuable insights on the effectiveness of parental involvement (PI) in children's CS education was obtained. Hill et al. (2004) stated that PI in CS education is linked with significantly higher enthusiasm and motivation for children in STEM in later life and can boost their mathematical knowledge and skills. The study highlighted the possibility for creating a nurturing learning environment that promotes children's interest

in technology and gets them ready for future STEM endeavours by recognising the importance of parental engagement.

Identifying strategies for motivating parental engagement

One of the most important findings of the research was the identification of methods that promote parental participation, highlighting the significance of providing opportunities for families to actively engage in their children's CS education. By utilising existing projects and initiatives, the study aimed to create a platform that encourages family collaboration particularly within the home. This would enable families to share ideas and work together on projects that will improve their children's learning experiences.

Designing a system that can help bridge the gap of parental involvement in their children's CS education

From the knowledge acquired from the literature review, and carrying out interviews with stakeholders, the author was able to design both low and high fidelity prototypes that provided great insight into the operation and user interface of the web application developed afterwards. Based on the feedback gotten from both experts of the OurKidsCode project and potential users, the prototype's design kept improving to satisfy user needs.

Creating a functioning and engaging web application that can promote parental involvement

A web application was successfully developed with most of the requirements being implemented, and working effectively, which marked a significant milestone in the research journey. Using information acquired during the design process, the web application was created with a user-friendly interface that promotes contribution and active participation in order to cater to a wide range of user needs.

Designing a child-friendly user interface (UI) that is accessible and useful, which encourages both parents and their children to be motivated to use the platform

Although the website was not tested with children, the feedback from users, that is, the parents, show that the platform does not only have a child-friendly UI but can also be understood easily by anyone. The web application was tested with different users, who were all able to access the webpage without any complications.

Evaluating the web application and user experience through user testing and feedback

The web application was successfully evaluated with great feedback obtained from the user

testing sessions. The feedback obtained will contribute in greatly enhancing the web application's usability and efficacy.

7.3 Limitations

Small Sample Sizes

While conducting the qualitative research to get information on the web application's design and development, the researcher was constrained by a small sample size due to the project's time frame. Altogether, eight participants were interviewed, consisting of three members of the OurKidsCode team and five parents from various areas in Ireland. The small sample size might have affected the data collection's accuracy and may not have captured a sufficiently diverse range of perspectives.

Not being able to Conduct Research with Children

This project was limited to conducting research only with participants aged 18 and above due to ethical constraints that prevented interaction with children. This was an issue because the web application being designed is aimed at providing projects and an environment for both parents and their children to garner knowledge on CS. This would in turn help the children to have the basic understanding needed to develop interest in CS, and pursue a career in that field. The absence of input from children may have resulted in overlooking features or aspects that could enhance children's engagement with the platform.

Time Constraints

The dissertation was subject to a time constraint of seven months, which influenced the extent to which the objectives could be achieved. As outlined in Section 6.5, some features were not implemented such as the comment feature, and "I have tried this" and "Interested" buttons, due to time limitations. A key part of this dissertation is the iterative process adopted in order to develop a functional web application. However, it was not feasible to continue the iterative cycle to further enhance the web application to meet the goal of the dissertation. Additionally, the final user testing was not as comprehensive as desired, limiting the amount of reliable data obtained. A longer time period would have made it possible to conduct extensive user testing and an iterative development process that would have produced a more polished and refined web application. There are a number of opportunities for future work and improvements that can be made from this dissertation as outlined in Section 7.4.

7.4 Future Work

The project's completion signifies the start of a journey towards the further refinement and expansion of the developed web application. Even though the current web application shows a lot of promise, it was only a first stage working prototype of a system that could be used at home, by researchers and in educational settings in the future. Some of the areas that can be taken into consideration for future works include:

Implementing Remaining Features
As highlighted in Section 6.5, certain features did not get implemented due to time constraints. These features are all part of the Community Suggestion page which includes a comment section for user engagement, as well as "I have tried this" and "Interested" buttons. These features are all important for promoting engagement and usability on the platform.

Video Upload Feature
This is a feature that was suggested by one of the participants of the user interview that was conducted before designing the final prototype. The video feature presents an opportunity to enrich the application's content and accommodate diverse learning. Integrating this feature enables users to upload instructional videos as part of the project descriptions, enhancing the depth and richness of content available on the website.

Incorporating a Club Application
Another future work as suggested by a user would be integrating a club application like ClubZap into the web application. They mentioned that some clubs still use WhatsApp which can be a bit invasive since everyone has each other's number. There have also been issues of hacking within the groups on WhatsApp, hence why some of the groups have switched to using the ClubZap app which hides the user number and is still efficient for being a communicative application. This feature would offer a seamless communication platform for users within the educational community. It is more secure, and people dropping out does not affect the dynamic of the group. The application can be used to send links, images, and messages to other users. The idea is that projects added through this app can also be added to the website with just one move.

Single Sign-On (SSO) Feature
By introducing the SSO functionality, users may register more quickly and conveniently. Making it possible for users to register or log in with their existing accounts from platforms like Facebook, Google, or Apple ID streamlines the registration process and increases user

involvement.

Conducting More Interviews

It is crucial to maintain user engagement through interviews in order to obtain a wide range of views and feedback. A specific feedback obtained from a participant in Section 3.8.4 required changing the names of the primary tabs to suit their preference. However, there were not enough interviews conducted for the author to change the names based on one suggestion. Increasing the number of interviewees will yield insightful information about user needs and preferences, facilitating better decision-making throughout the development process.

Usability and Platform Accessibility

Section 6.2.2 reveals that the web application is not fully accessible to the public without the developer initiating the server operations. Improving deployment processes and security measures will enhance platform accessibility, enabling seamless access for all users. Ensuring that the platform is accessible to a diverse range of users, by adhering to accessibility standards and guidelines should also be considered.

User Testing

Continued user testing and evaluation are essential for refining and optimising the web application functionality and usability. Incorporating user feedback gathered through testing and evaluation processes, as discussed in Sections 6.3 & 6.4, can guide iterative improvements and feature enhancements to meet evolving user needs and preferences. Measuring the level of user engagement through metrics such as active user participation, project uploads, and interaction with platform features will provide valuable insights into the web application's effectiveness and user satisfaction. Evaluating the impact of the platform on PI in children's CS education through qualitative and quantitative analysis of user interactions and feedback would also be a great form of assessment. In the long run, measuring the educational impact of the platform by assessing improvements in children's knowledge skills, and attitudes towards CS and STEM subjects would also help in gauging the effectiveness of the web application.

In conclusion, it is recommended that future development endeavours concentrate on iterative improvements that are informed by user input and preferences. By giving the remaining functionalities top priority, addressing usability and accessibility issues, and incorporating ongoing user testing and feedback, subsequent versions of the web application can provide an even more effective and engaging user experience. This iterative approach ensures that the web application is able to evolve according to the demands and preferences

of its users, leading to increased parental involvement in their children's CS education and the encouragement of lifelong learning in STEM subjects.

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Appendices

Appendix 1: Ethics Approval

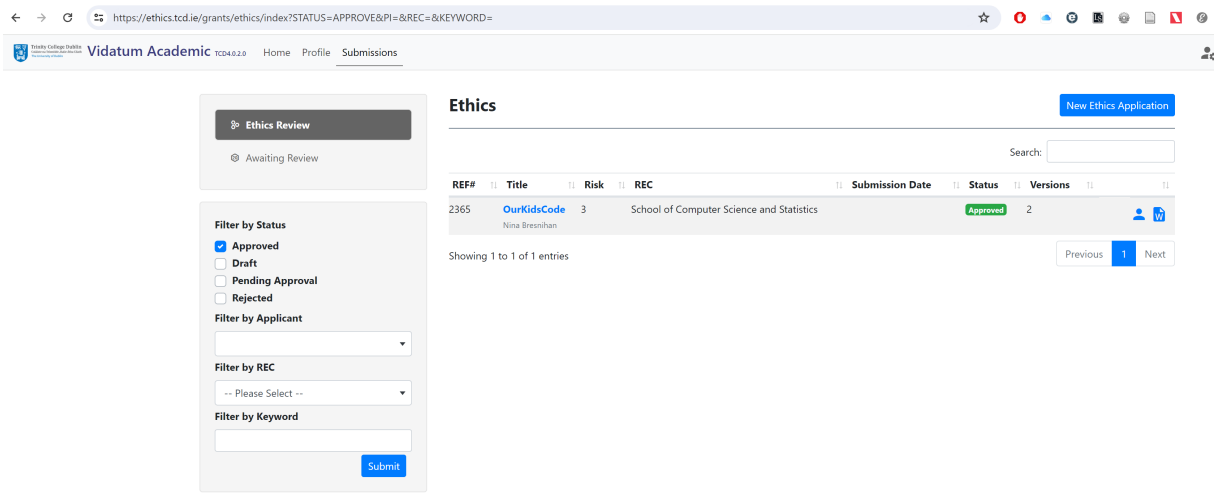

Figure 1: Proof of OurKidsCode Ethics Approval

Appendix 2: Ethics Application

Applicant & Collaborators

Applicant Details

- Applicant Name : Nina Bresnihan

- Is applicant applying as a member of staff or a student? : Staff

- School / Department : School of Computer Science & Statistics - Computer Science

- Role on the Project : Principal Investigator

- Primary Employer (if not TCD) :

- Other affiliations (if applicable) :

- Course (for student applicant only) :

- Part time / full time :

- I have read and understood Trinity policy on Good Research Practice : Yes

- I have read and completed the Integrity module : No

- I have read and completed the Data Protection Training module within the last 24 months : Yes

Trinity Collaborators

User	Role
Glenn Strong	Stakeholder :Academic / Clinical / Professional / Industrial Collaborator
RICHARD Millwood	Stakeholder :Academic / Clinical / Professional / Industrial Collaborator

Other Collaborators

No data available in this section.

Project Details

Main Project Details

- Title of research :OurKidsCode

- Data Collection Start Date : 01/09/2023

- Data Collection End Date : 31/03/2025

- Project End Date : 31/03/2025 12:00:00 AM

- Does the research involve :Humans (or their data)

- Does this Animal research involve :

- Is this AREC research a first application or an amendment :

- Is the research WHOLLY (i) an analysis of statutes/legal provisions AND/OR (ii) legal judgments/cases which have been made public by a judicial process? : No

- Trinity Researchers will have access ONLY to aggregate data or data that otherwise fall outside of the remit of the GDPR. : No

- Could the research have detrimental legal, economic or social consequences for either the participant or their establishments : No

- Intentions of the research: Does the research : None of the above

- State research aim(s) and objective(s), research question or hypothesis : Parental involvement in education is strongly associated with better learning outcomes and we create opportunities for families to learn about computing together. OurKidsCode designs and delivers family creative-coding workshops and, in partnership with the Department of Rural and Community Development (DRCD), supports communities throughout Ireland to establish family-run coding clubs, thereby building parents' confidence and skills so that they can discover technology alongside their children. Our broad research aims for this stage of the project are to continue to evaluate the impact of the workshops and clubs on families and communities and to investigate issues of scalability and sustainability.

- Lay Summary: including background/ rationale/ justification, research approach, study design (exclude detail of measurement instruments and intervention and analysis (if applicable) (Word limit: 250 words) : The importance of parental involvement in education is well established. However, the growth in Computing Education has exposed questions over parents' confidence and competence in engaging in computing with their children, as they often have little experience with technology and struggle to facilitate the learning of interested children. OurKidsCode provides support for those who wish to undertake this role but feel they lack the knowledge and skills. The project has adopted a Mixed-Methods methodology utilising a Design-Based Research (DBR) approach. This involves multiple iterations of design, testing and refinement across different contexts in collaboration with

stakeholders. Previous cycles provided evidence of successfully developed Design Principles and workshop models that engage parents and increase participant confidence and readiness to partake in family computing activities. OurKidsCode is moving to expand capacity and move to a self-sustaining community-led model supported by ongoing research and evidence-based design. The DBR process will continue as the programme is implemented and evaluated across different contexts involving multiple stakeholders. The project considers that workshop models are well-developed, while leaving the door open to addition, improvement and innovation. The focus is now on evaluation of the systemic programme in action, as organised by the project management, delivered by facilitators and supported by other stakeholders. It will continue to report on the impact on participants, but also identify barriers and catalysts to that impact. The aim will be to support understanding of the whole system at programme level, as well as continuing to monitor impact and quality of workshops.

- Identify all countries where data is collected or processed : IE,GB

- Does the project involve :Human participants and /or their data and no biological samples

- Is the project funded : Yes

Details on Human Participants and their Data

- Does your research involve Mixed Methods : Yes

- Does the project use data from :Primary sources only

- Will you obtain Consent from participants (or in the case of children or adults at risk of vulnerability from a parent / legal guardian) for their participation and/ or the use of their data? : Yes

- Provide further information :

- Will payment be made to research participants? :No

- Provide further information :

- Is the research Health Research as defined in the Health Research Regulations? : No

- Does the research require a Consent Declaration form as defined by the Health Research Regulations 2018 and amendments 2021? :

- Which of the following best describes the research Secondary Data Source(s)? :

- Could any of the research data directly identify any participant? : Yes

- Could any of the research data indirectly identify any participant? :Yes

- Do you process Personal Data for study administration purposes? e.g. contacting individuals : Yes

- If yes please outline how you will store the information, keep it confidential, and destroy it in line with the data retention policy. : Data will be retained to facilitate the organisation of workshops and clubs, and for evaluation purposes including contacting participants for follow-up research. Digital data will be stored in TCD Sharepoint and a secure SCSS server and be password accessible by the project team only. Hard-copy data will be stored in a locked filing cabinet in the PI's office on the TCD campus. Data will be retained for 10 years after completion of project and then deleted/shredded, as mandated by TCD good research practice policy.

- Which of the following best describes the general characteristics of the target population? :Adults currently not at risk of vulnerability, Children (<18 years)

- Do any of the following further describe the characteristics of the target population? :

- Please describe :

- List the inclusion/ exclusion criteria for selection of research participants : There are 4 categories of participant: 1. Workshop participants - parents - Must be over 18 - Must be parents of primary school children 2. Workshop participants - children - Must be accompanied by a parent 3. Workshop facilitators - Must be over 18 - Must be Garda-Vetted 4. Delivery stakeholders - Individuals who are involved in the delivery and planning of the workshops (to date they have included policymakers, broadband officers, BCP coordinators, county council employees, librarians, teachers, National Parents Council employees among others). - Must be over 18

Research Sources and Sites

Name	Req
Broadband Connection Points (BCP) across Ireland	NOT-APPLICABLE
Trinity College Dublin	REQUIRED_NOTOBTAINED

Outline of research methods

Method / Measurement
Facilitators: Questionnaire to register interest

Facilitators: Focus Group for training workshop and programme evaluation (audio recorded)
Stakeholders: Questionnaires administered to delivery stakeholders to gather their views on the potential barriers/catalysts to the success of the programme from their domain and geographical perspectives.
Stakeholders: Semi-structured Interviews with key stakeholders to provide more in-depth data
Facilitators: Follow-up Questionnaire for training and programme evaluation.
Families: Registration Questionnaire to provide participant data for organising workshops.
Families: Check-in online Questionnaire to track attendance and meeting activity nationally
Families: Follow-up online Questionnaire at 6-week and 6-month post-intervention for workshop evaluation
Families: Observations and Fieldnotes for workshop evaluation
Families: Questionnaire for post-workshop evaluation
Families: Focus Group workshop and programme evaluation (audio recorded).
Facilitators: Observations and Fieldnotes (written report) for training workshop evaluation

- Does your research use any of the following methods exclusively? : No

- Does the research include an intervention? : Yes

- Please select which of the following best describes the intervention : Educational

- Other :

- Outline the intervention : OurKidsCode designs, develops and delivers family creative-coding workshops. In addition, in partnership with the Department of Rural and Community Development (DRCD), we support communities throughout rural Ireland to establish and run family-led coding clubs. Parental involvement in education is strongly associated with better learning outcomes and we create opportunities for families to learn about computing together. OurKidsCode aims to build parents' confidence and skills so that they can discover technology alongside their children. The workshops consist of a single-session workshop to harness interest and bolster confidence and a 4-part model to foster self-reliance and build self-sustaining communities of practice by increasing competence, and skills in accessing knowledge and using materials. A key feature of both is families learn together and activities are inclusive. Our design process, which places participants at its centre, not only follows international best practice, but also establishes it through ongoing research and publication. Workshops are subject to ongoing evaluation using a Design Based Research(DBR) approach with each cycle leading to refinements in the implementation. Facilitator training follows the same model of evaluation, giving the benefit

of input of professional educators and their growth through dialogue with us. To date, we have trained 53 facilitators nationally. Our partnership with the DRCD, providing access to over 300 BCPs, local expertise and funding for training and delivery, embeds the programme into rural communities providing opportunities and support for self-sustaining family STEAM activities. The infrastructure established will also be available to other providers, greatly increasing the capacity to deliver STEAM Education across Ireland.

- Outline the method of analysis (Word limit :100 words) : Qualitative data will be analysed using direct content analysis. Quantitative data will be analysed using descriptive and inferential statistics.

- What is the approximate size of the target population? : 3610

- What is the proposed sample size -how many participants are involved in the study? : 3610

- What is the justification for the sample size? : Estimated number of workshop participants we can reach with our current funding: 3300 Estimated number of facilitators we can train with our current funding: 260 (10 per county) Estimated number of stakeholders: c.50, we will survey them all in order to obtain a diverse and balanced sample (these currently include the DRCD, County Councils, the BCPs, the NPC and Microsoft Dreamspace, and the library service but may expand to include other STEAM initiatives) a sample of c. 20 will be interviewed.

Risk

Risk , benefit, harm to researcher

- What setting/s will be used for data collection : Online, Place of convenience for participants , Participants' place of work, Classroom

- Other elaborate : As well as classrooms, the location for the workshops will be community Broadband Connection Points (BCPs), these are c.300 public locations in local communities throughout rural Ireland which have been selected by the DRCD as part of the National Broadband Plan to receive highspeed connectivity. The locations of the BCPs have been selected by local authorities and include public areas such as community halls, libraries, sports facilities, enterprise hubs, tourist locations and other public spaces.

Type	Other Type	Impact	Probabilty	Mitigation
None				

Risk , benefit, harm to site environment or Society

Type	Impact	Probabilty	Mitigation
None			

Risk , benefit, harm to participants

- Do you or any of the research team have any dependant relationship to the participants? : : No

- Detail the role of the researcher/s, the relationship of the researcher/s to the participants normally, and how you will mitigate against coercion of participants to participate in the research or in influencing their responses :

Type	Other Type	Impact	Probabilty	Mitigation
Loss of privacy		Low	Low	The research includes the collection and storage of personal data. However, the topic explored is not intrusive and every effort will be made to store the data securely. In addition all personal data will be anonymised during the analysis.
Inconvenience		Low	High	The research instruments will be designed to be as short and clear as possible. Where possible they will be incorporated into the workshop design and also used as a means for the participants to reflect on their learning.

Participant Benefits

- Is it foreseeable that participants could potentially reveal information that you have a legal obligation to disclose (e.g. child protection policy, malpractice, etc.) :Yes

- What information may be disclosed, why, and to whom. : There is no particular information that may be disclosed and it is highly unlikely, however as the research does involve participants who are <18 it cannot be ruled out.

- Outline any direct benefits to research participants of participation : For workshop participants, the research helps us to figure out the best way to help parents/guardians

support and encourage their young children's creative use of technology. They will directly benefit from resultant improvements in our practice. For facilitators the research gives them the opportunity to directly impact the design of the programme that they are delivering. They also get the opportunity and support to reflect on and improve their own practice. For Stakeholders, they will get the opportunity to contribute to the development and dissemination of evidence based best-practice around systemic issues of usability, scalability and sustainability that have relevance to them outside this immediate study.

Conflict of Interest

- Are you aware of any Conflict of Interest from the PI or any collaborator, processor or other person involved in the conduct of the project, that could arise in the course of the project? : No

- Give details of the Conflict of Interest and what mitigation measures are in place :

Consent

Consent

- Do your participants require support to give Consent : Yes

- How will Assent be obtained and by whom : Assent will be obtained from the children through their parents.

- Provide Further Information : The children will need support from their parents.

- Do you require Assent or Proxy Consent from participants e.g. because of their vulnerability : Yes

- Provide Further Information : The participant information sheet is written in child-friendly language and we ask that the parent discuss it with their family. After this, the consent form also contains a section where each child provides their assent before the form is submitted.

- Are you required to have Garda Clearance : Yes

- What is the time interval between giving information and securing Consent : Less Than 7 Days

- Provide Further Information : The parents and facilitators will be given access to the information sheet and consent form as part of the registration process. They will provide consent first and only then be linked directly to the online registration form. In the case of

the stakeholders, the information sheet and consent form will be provided at the beginning of the online questionnaire. If they consent they will be given access to the questionnaire.

- Describe how you will inform participants about the use of their Personal Data : This will be done via information sheets. Contact information for the project team will be provided for any follow-on questions.

- Describe how participants can withdraw their Consent and/or their data : The participants will be informed via the information sheet that if they wish to participate in the workshops they need to register and check in but participating in the rest of the data collection is voluntary and they may change your mind and stop at any time. They may also choose not to answer an individual question at any time and skip it without penalty. In addition they will be informed that until the research is published, participants may still opt out of the study after its conclusion and have all data pertaining to their participation destroyed. However, in the case of some of the surveys, the data gathered is fully anonymous and there is no way for the researcher (or anyone else) to identify an individual participant once they submit the survey and therefore, it will no longer be possible to withdraw once they have submitted the survey. This will also be made clear to the participants in the information sheets. The contact details for the project lead will be provided for all requests to withdraw consent and/or data.

Funding

Funding

- Insert RPAMS number if applicable and available :

- Outline sources of funding, list names of all confirmed sources of funding or support (including in-kind benefit). For all, state if they are industry/commercial, state/public, philanthropic/charitable, other : SFI Discover Programme - public Department of Rural and Community Development - state National Parents Council - charitable Microsoft Ireland - industry

- Please specify any funder specific requirements or obligations which should be brought to the attention of the ethics committee and or Trinity Innovation & Enterprise : None

- Will the results of the project be used or disclosed for commercial purposes : No

- Please clarify which party shall have the commercialisation and/or intellectual property rights : TCD has both

Conflict of Interest

- Are you aware of any possible Conflict of Interest arising from the funding or commercialisation of this project : : No

- Give details of the Conflict of Interest and what mitigation measures are in place :

- It there likely to be possible Conflict of Interest between the funders of the project and the aims and results of the project : No

- Give details of the Conflict of Interest and what mitigation measures are in place :

Sampling & Recruitment

Sampling and Recruitment

- Outline the sampling method : Convenience sampling is used to recruit the participants who are self-selecting.

- Describe the time commitment of the participant : Workshop Participants: Questionnaire Registration - <10 minutes Questionnaire Workshop check in <2 minutes Focus Group Workshop evaluation c.10 minutes Observations and Fieldnotes c. 90 minutes per workshop [The previous two data collection items take place during the workshops and do not include any additional effort as the focus group and reflection are built into the workshop design and form part of the learning (i.e. participants would take part in these whether or not they are participating research subjects, however their data, in that case, would not be collected).] Post-Questionnaire <5 minutes Follow-up questionnaire (6 week and 6 month) c.5 minutes Facilitators: Questionnaire (Registration of interest) <10 minutes Observations & Fieldnotes c. 60 minutes per workshop Focus Group c.10 minutes [As above, the previous two data collection items take place during the workshops and do not include any additional effort as the focus group and reflection are built into the workshop design and form part of the learning] Follow-up questionnaire c.5 minutes Stakeholders: Questionnaire c.20 minutes Semi-structured interviews 30-60 minutes

- Will the research require/use a gatekeeper :No

- Outline the position/role of the gatekeeper within the organisation :

- Detail the role of the gatekeeper in the research :

- Is there a dependant relationship between the gatekeeper and the participants :

- Outline how this is going to be managed to mitigate against the dependencies :

- Please give a detailed step by step description of how participants will be recruited and append the recruitment material (Word limit: 100 words). : Facilitators are recruited in a number of ways They are employed by project partners, the NPC. Self-selecting, recruited through the CESI mailing list and other professional contacts Parents who have participated and wish to act as facilitators Workshop participants are recruited primarily through local community organisers, facilitators and the NPC. The stakeholders have been recruited through project partners the DRCD and NPC as well as networking and professional contacts and the project will already be working with them to bring the programme to their communities. They will be emailed with an invitation to take part in the research.

Data Protection

Opening Questions

- Have all Trinity researchers (staff and students) in this project completed the College Data Protection GDPR training module? * :Yes

- Are all Trinity Staff and Trinity Students familiar with the Trinity College Personal Data Breach Procedural Guidelines? : Yes

Data Protection Assessement

- What is Trinity's role in the research? : Controller

- How many participants' Personal Data is being processed in this project? : >30

- List all types of Personal Data (including any special category or sensitive Personal Data) that you will process during the lifecycle of the project? : Workshop Participants - Name - Age - Gender - Contact Details - School - Previous experience with CS Facilitators - Name - Age - Gender - Contact Details - Previous facilitation experience - Previous experience with CS - Garda vetting status Stakeholders - Name - Age - Gender - Contact Details - Job Title

- Does the research involve processing of special category data or data relating to criminal convictions and/or offences (sensitive personal data)? : No

- Is the Personal Data shared outside the research team with any other units within Trinity College? :No

- Name these units :

- Is this data shared with any third party outside of Trinity ? : No

- Provide names of these organisations and detail what Personal Data will be shared with them and why. :

- Describe what IT due diligence you have carried out on these organisations. : N/A

- Provide a general description of the security measures in place to keep Personal Data secure for each system, platform and application you will use for access, storage, and transfer, including but not limited to multi factor authentication, use of passwords, use of VPN, devise encryption, vendor ISO certification, anti-virus used, use of secure file transfers such as HEA net, and detail on how data is backed up etc. : All digital data will be stored securely on TCD SharePoint and the SCSS server, and be password accessible (with multi-factor authentication) to the project team only. Any hand-written materials (e.g. fieldnotes/observations or written interview notes) will be stored in a locked filing cabinet located in on the TCD campus. Once this data has been digitised by the project team it will be destroyed and only the digital copies securely maintained.

- Is the data transferred outside of the UK & EEA? If yes, you must contact the Data Protection Office : No

- Detail how long Personal Data will be retained in an identifiable or coded format. : Data will be retained for 10 years after completion of project, as mandated by TCD good research practice policy.

Data Protection Risk Assessment (DPRA)

- Does the research involve matching or combining data sets? :

- Are the topics explored in the research intrusive or sensitive in nature? :

- Does the research use Personal Data on a large scale (NB large scale does not equate to large number) :

- Does the research involve the processing of Personal Data relating to participants who belong to a vulnerable segment of the population? :

- Are the participants individuals with a rare condition or disease? :

- Does the research involve the use of new technologies or organisational solutions? :

- Does the project involve processing of special category data or data relating to criminal convictions and/or offences (sensitive personal data)? :

- Does the research involve systematic monitoring, tracking or observing individuals' location or behaviour? :

- Could the research result in automated decisions being made, including profiling, or actions being taking against individual(s) in ways that could have a significant impact on them? :

- Does the research involve the evaluation or scoring, including profiling and predicting, of participants to make generalisations about an individual that could lead to significant decisions being made that could directly affect the individual? :

- Could the research prevent individuals from exercising a right, using a service, or fulfilling a contract? :

Processing Risk

Type	Impact	Probabilty	Mitigation
Hacking of computers where project data is stored	Low	Low	No personal data will be kept on local machines. All such data will be stored on TCD SharePoint or a secure SCSS server. The personal data involved is not of a sensitive nature.
Failure to explain effectively how data would be used.	Low	Low	The project team will ensure that all participants are provided with a clear and comprehensive information sheet outlining how their data will be used. In the case of the interviews, this will be supplemented verbally before the start of each interview.
Lack of effective governance.	Medium	Low	All members of the project team have completed the Data Protection Training Module. Any new members will be required to complete it before they are given access to any of the personal data.

Closing Section

- Include any additional information in respect of the research which may be relevant * :N/A

Appendix 3: Github Source Code

Source Code

Appendix 4: Terms and Conditions

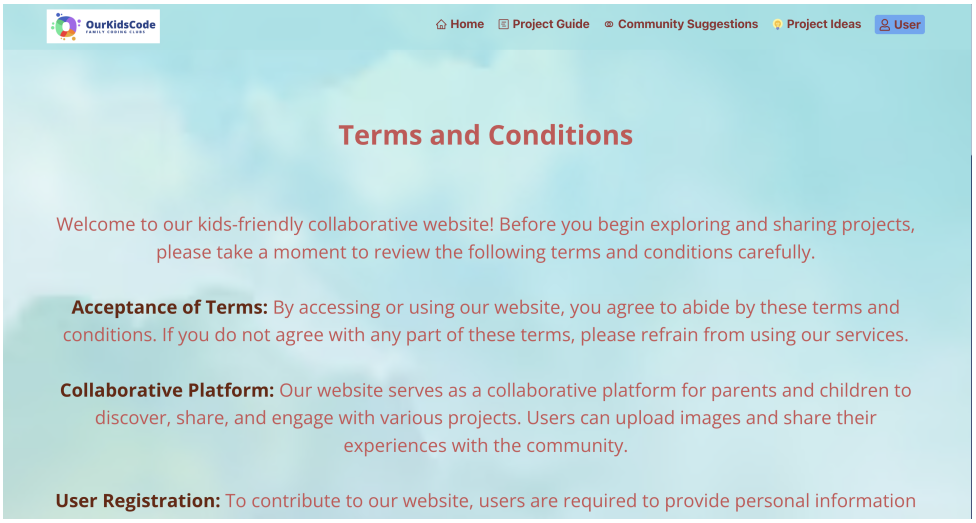

Figure 2: Terms and Conditions page A

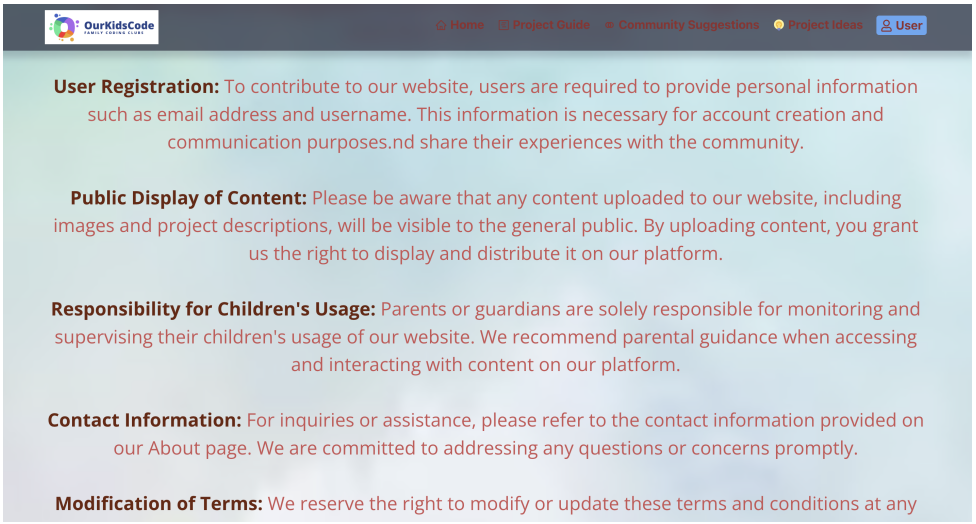

Figure 3: Terms and Conditions page B

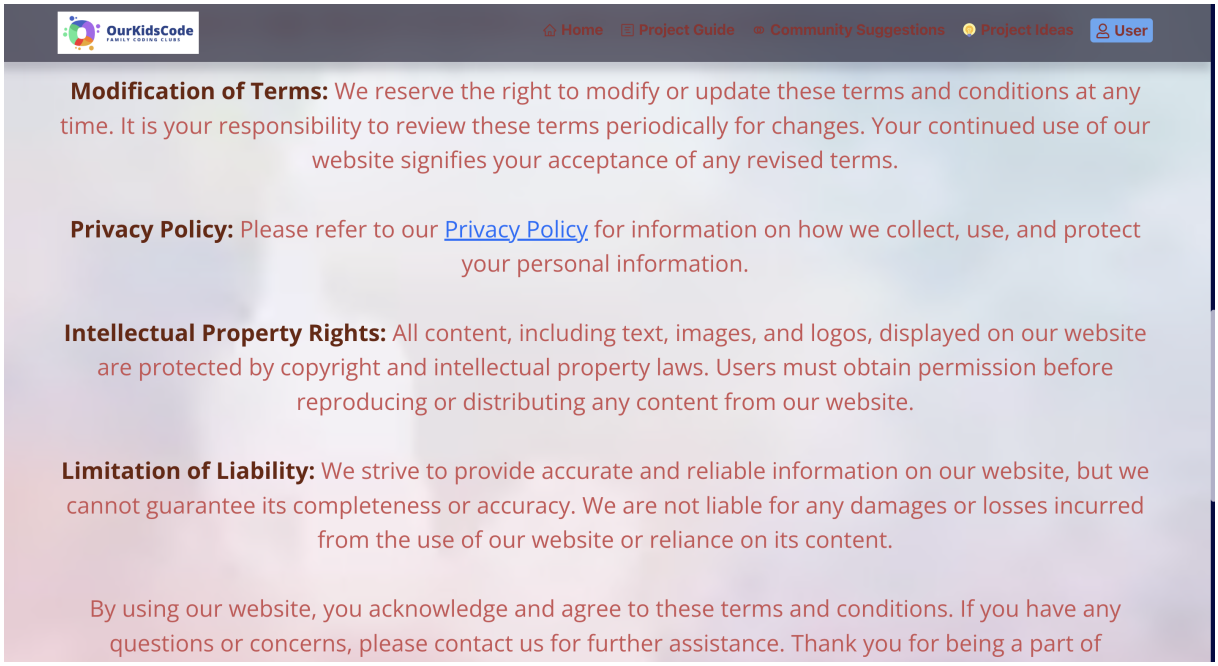

Figure 4: Terms and Conditions page C

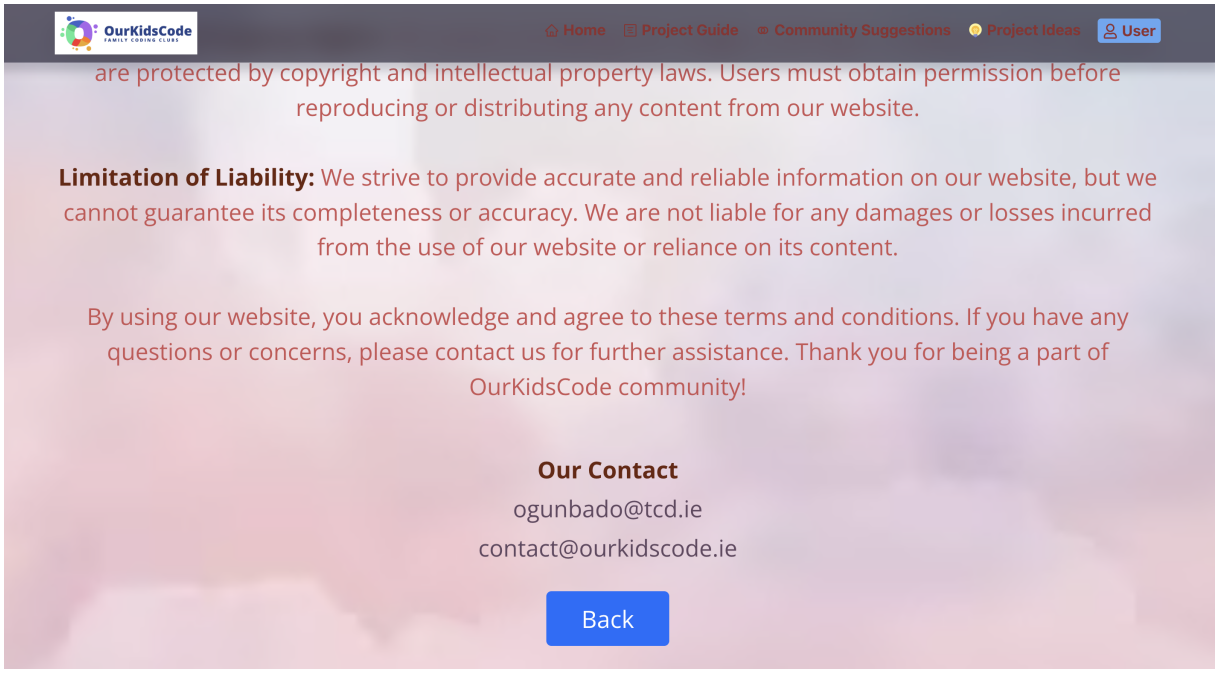

Figure 5: Terms and Conditions page D

Appendix 5: Privacy Policy

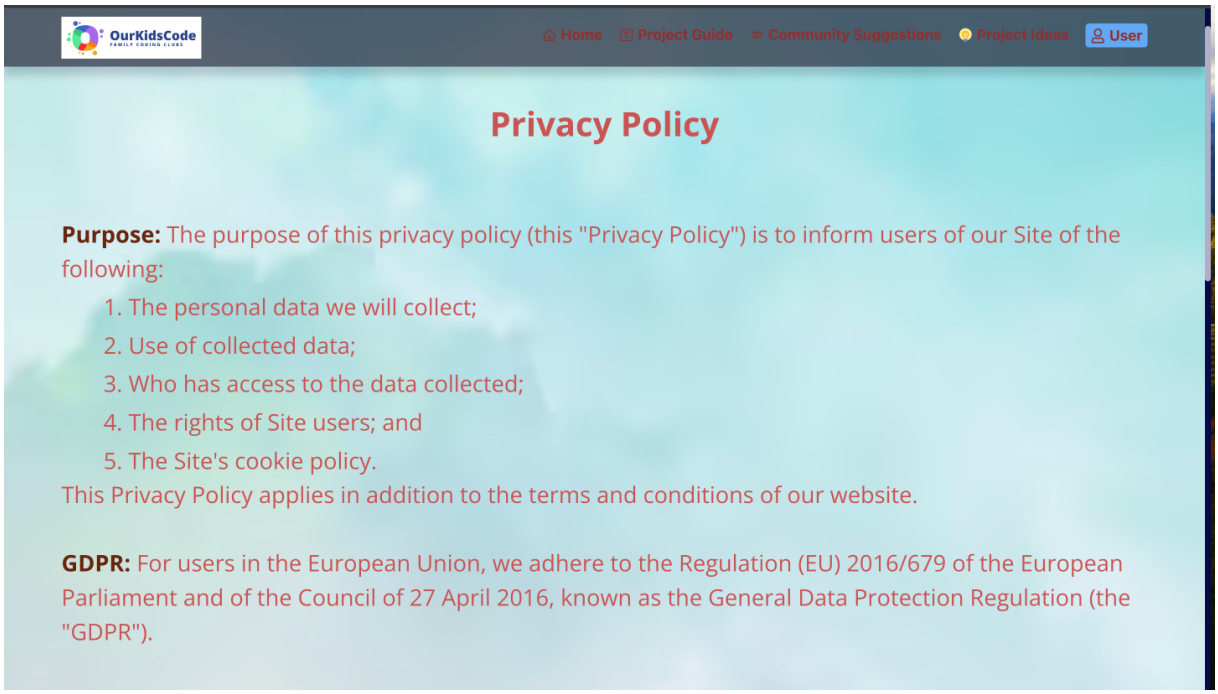

Figure 6: Privacy Policy page A

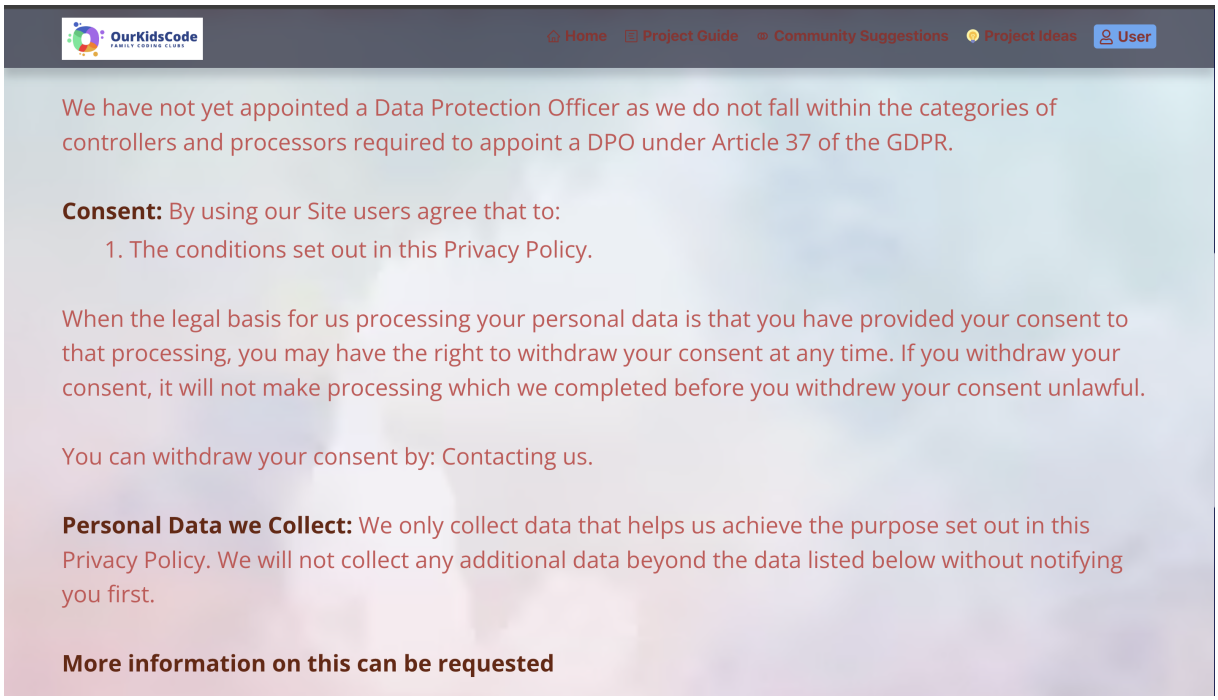

Figure 7: Privacy Policy page B

Appendix 6: Sequential Final Prototype Web Application Design Screenshots

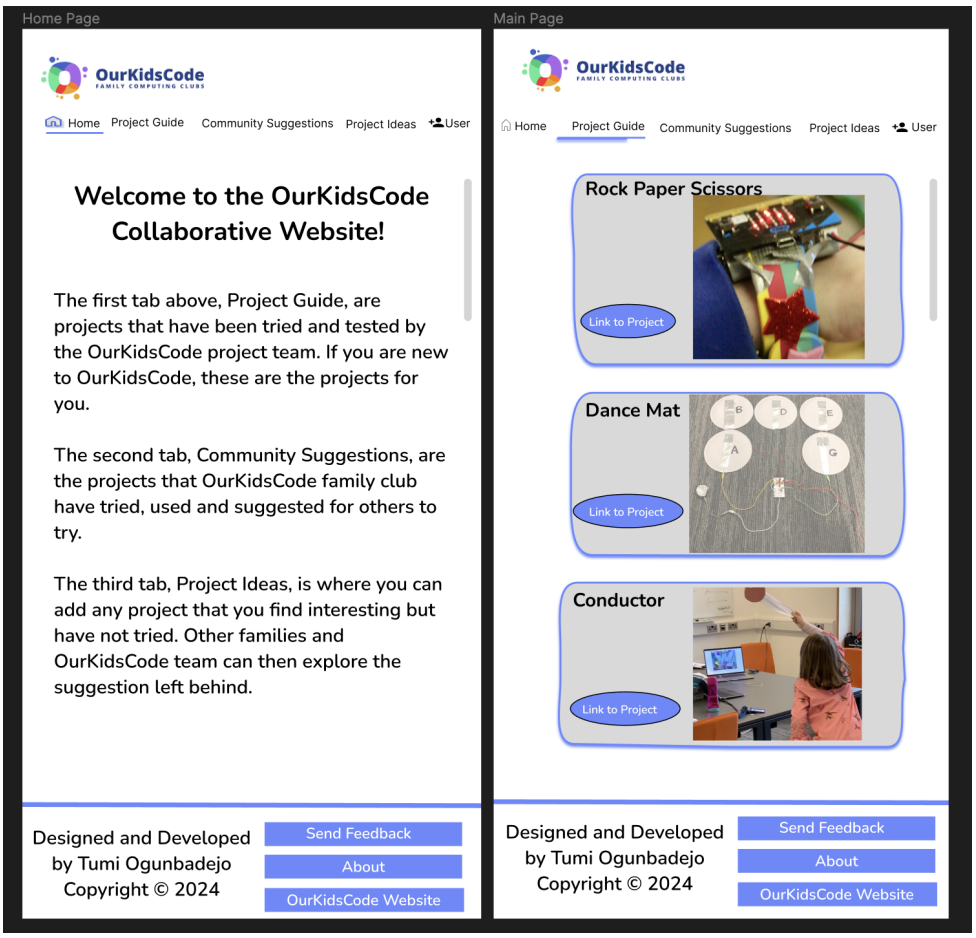

Figure 8: Final Prototype Images

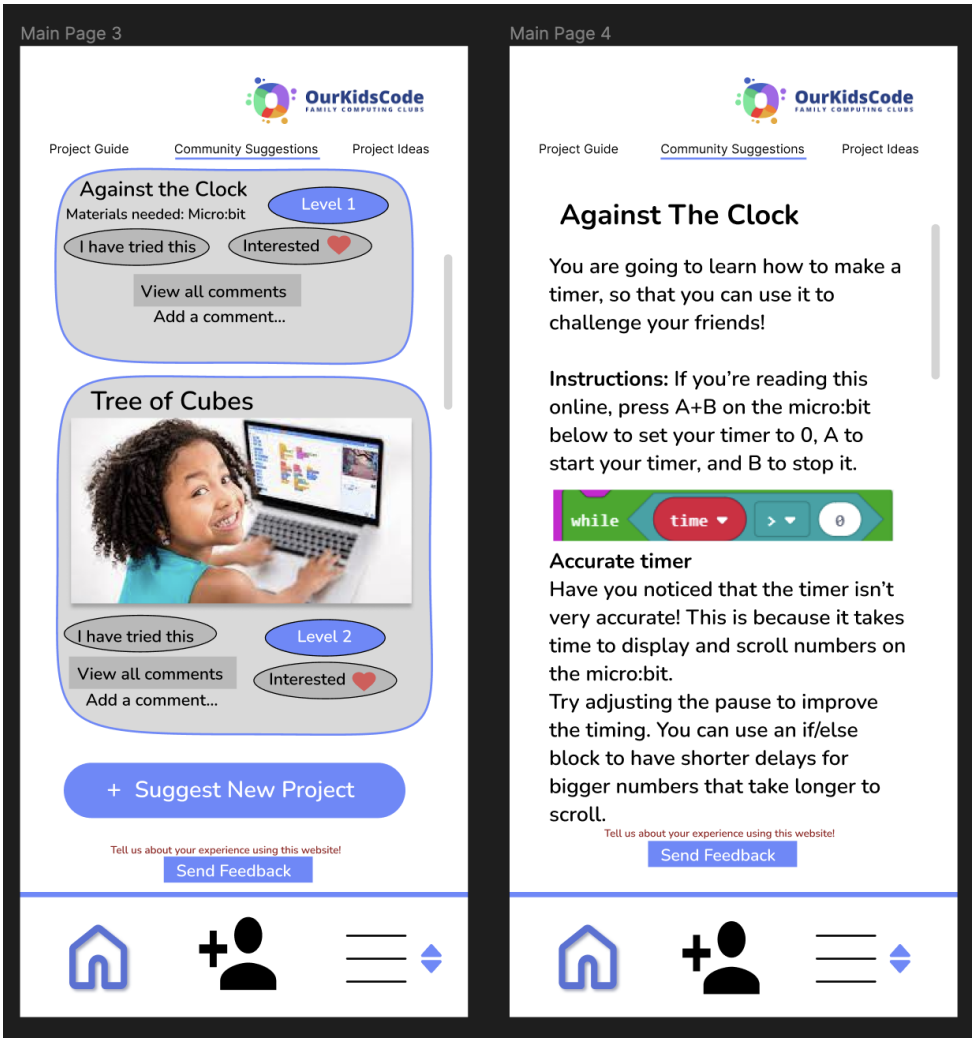

Figure 9: Final Prototype Images

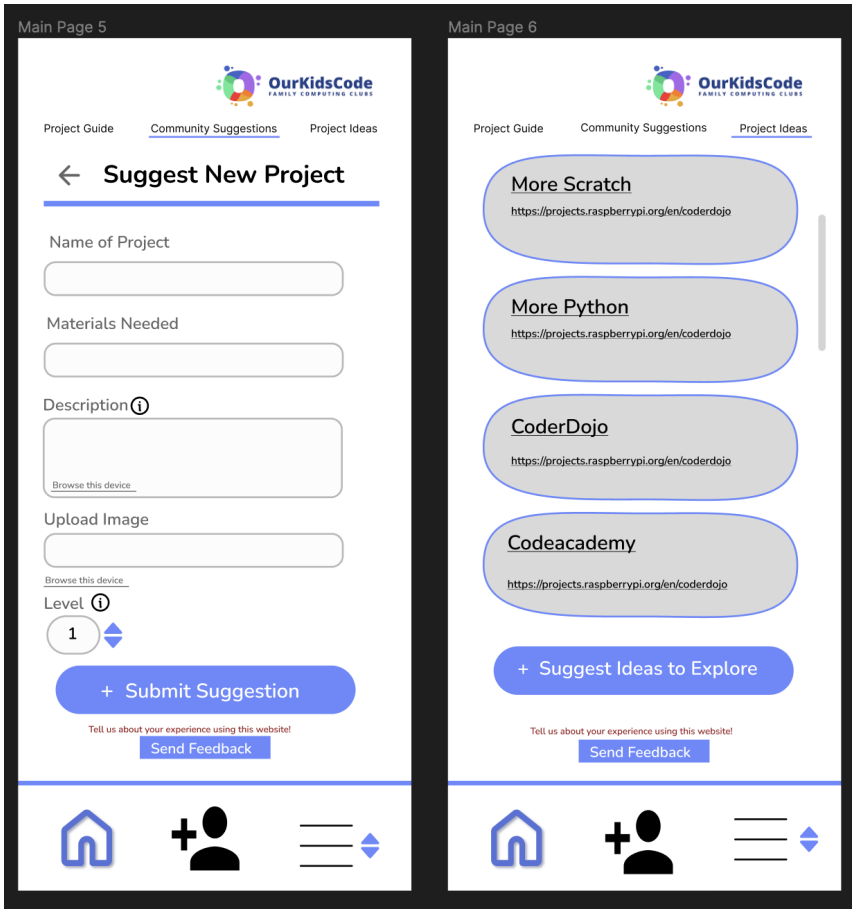

Figure 10: Final Prototype Images

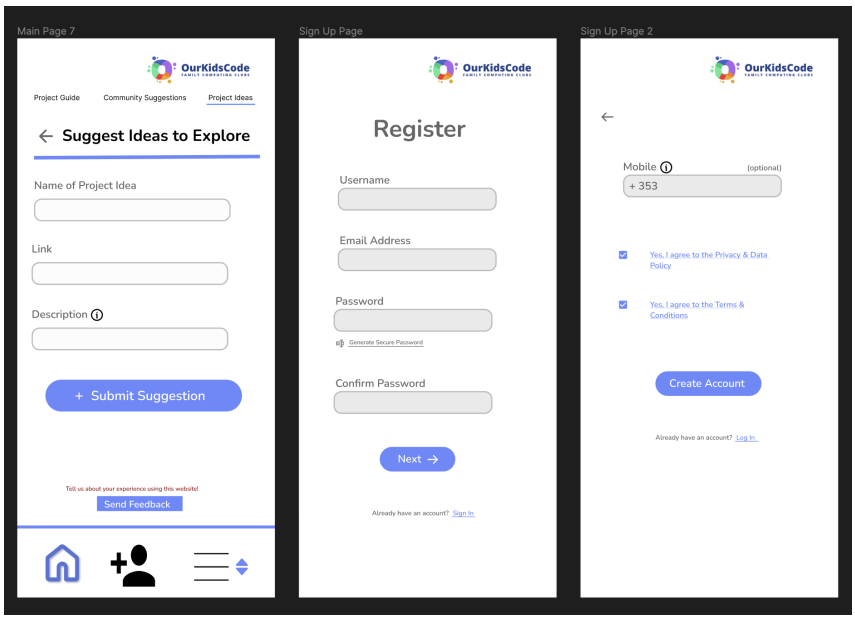

Figure 11: Final Prototype Images

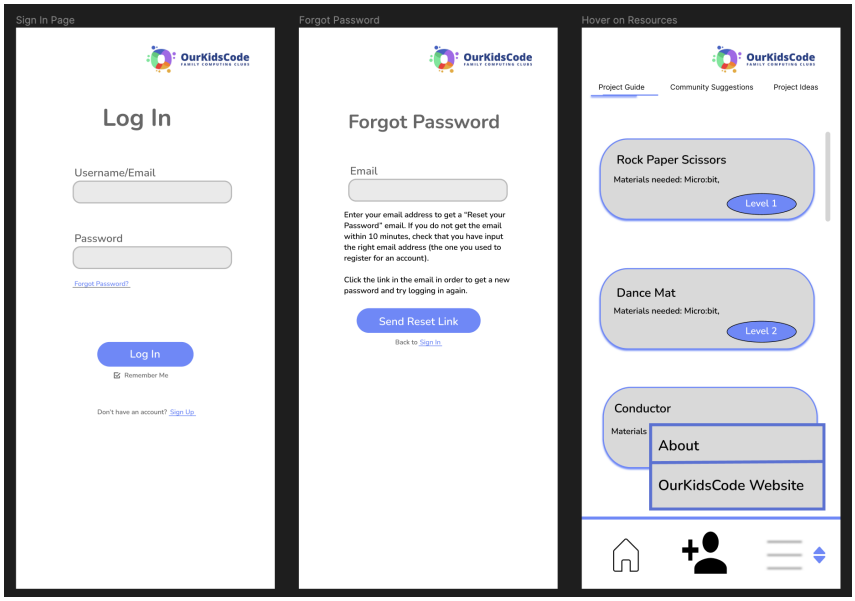

Figure 12: Final Prototype Images

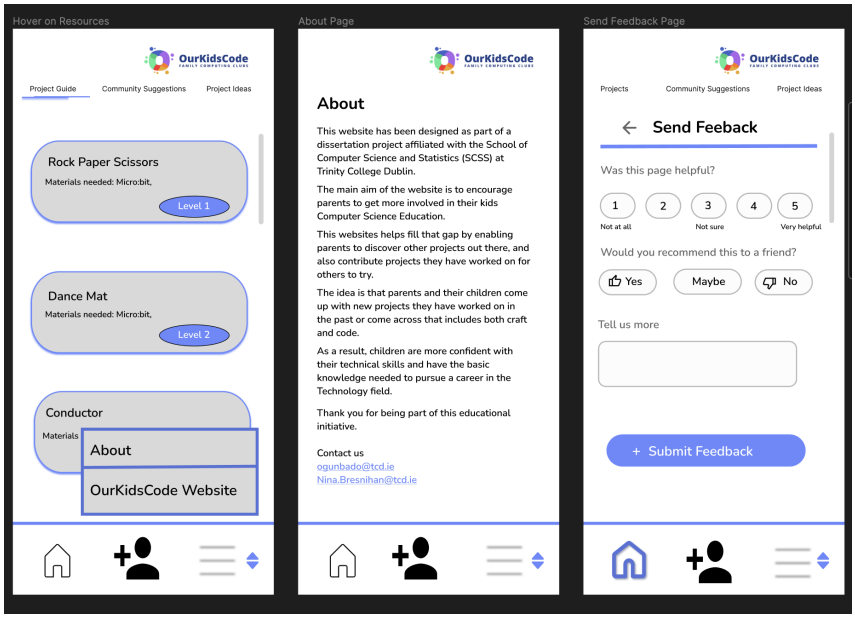

Figure 13: Final Prototype Images

Appendix 7: Web Application Images

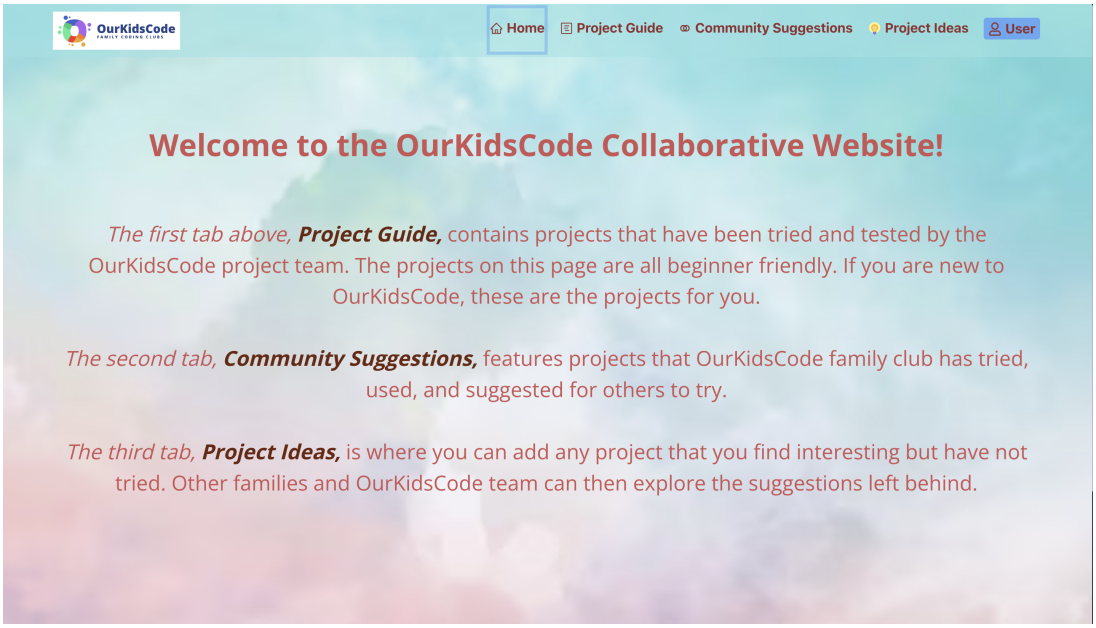

Figure 14: Web Application Home Page

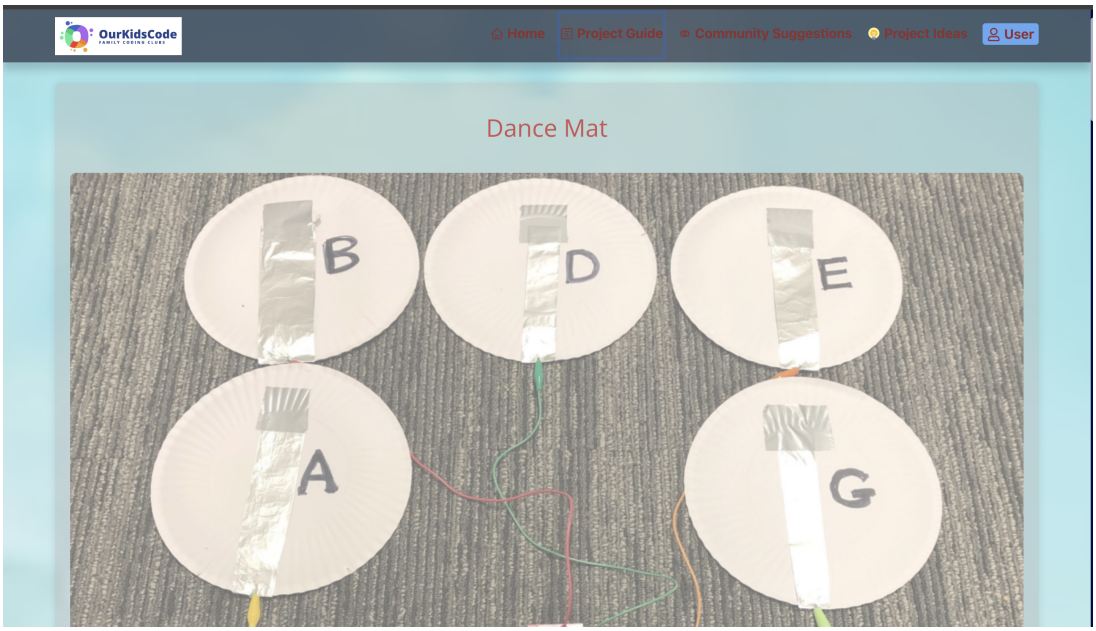

Figure 15: Web Application Project Guide Page

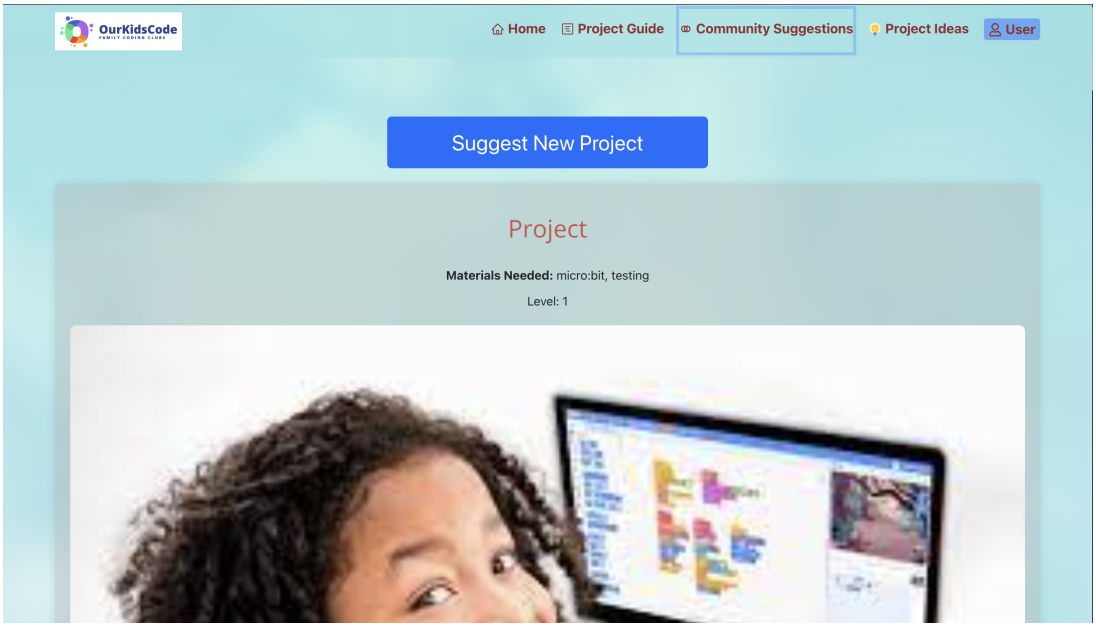

Figure 16: Web Application Community Suggestions Page

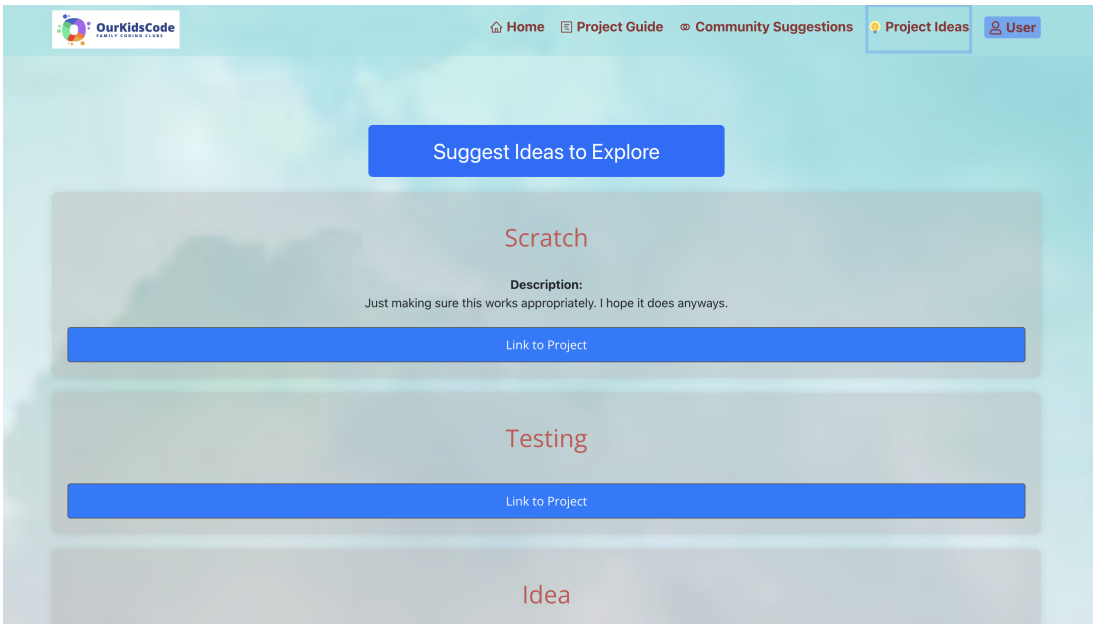

Figure 17: Web Application Project Ideas Page

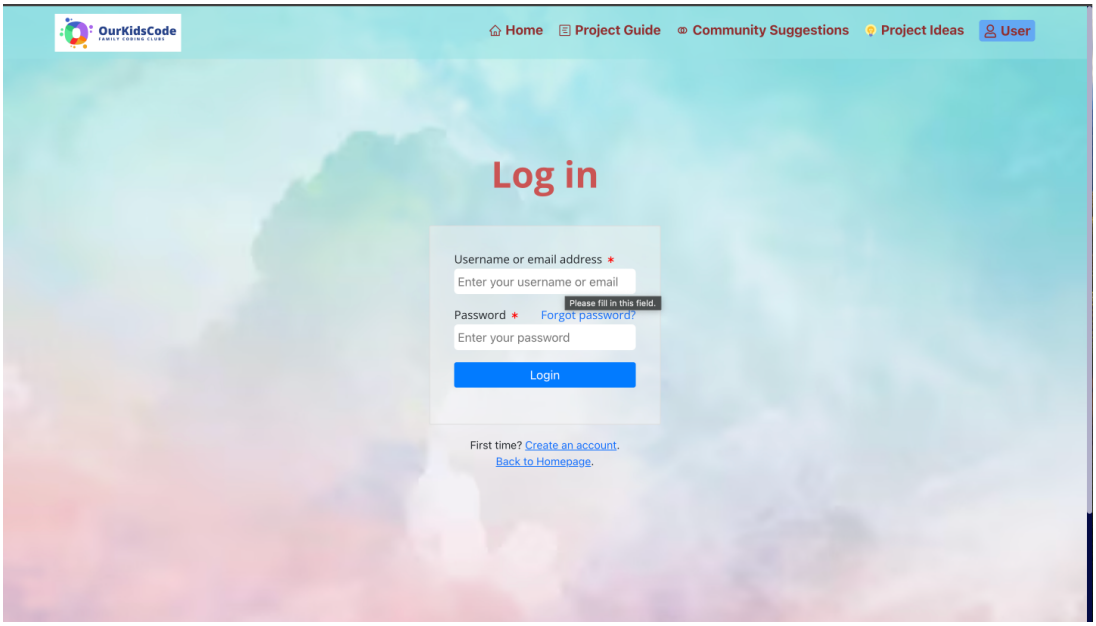

Figure 18: Web Application Login Page

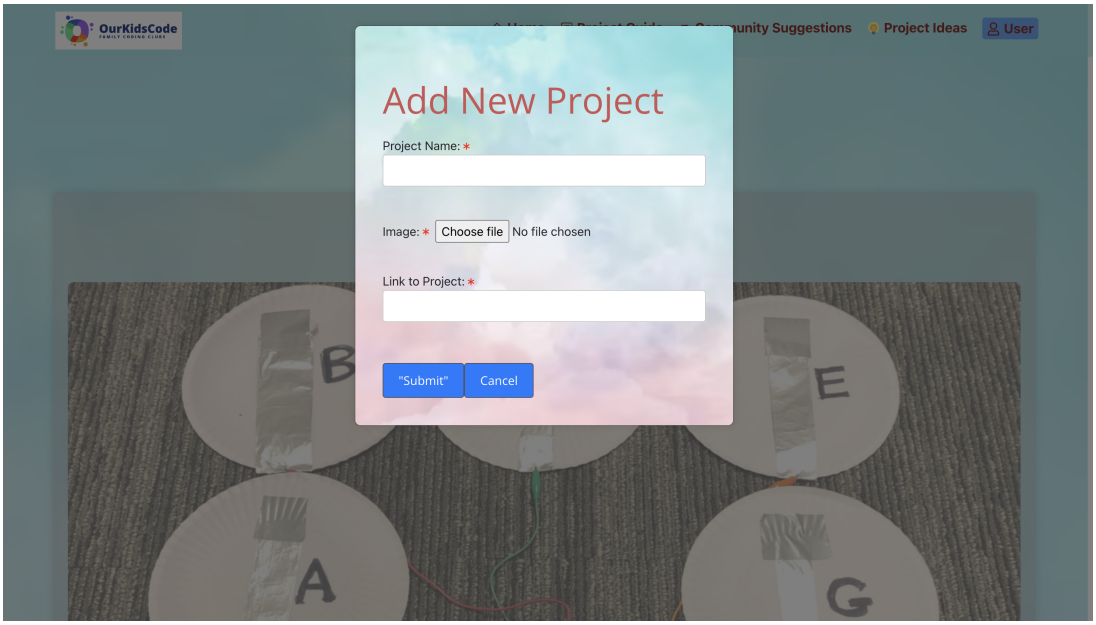

Figure 19: Web Application Add New Project Page

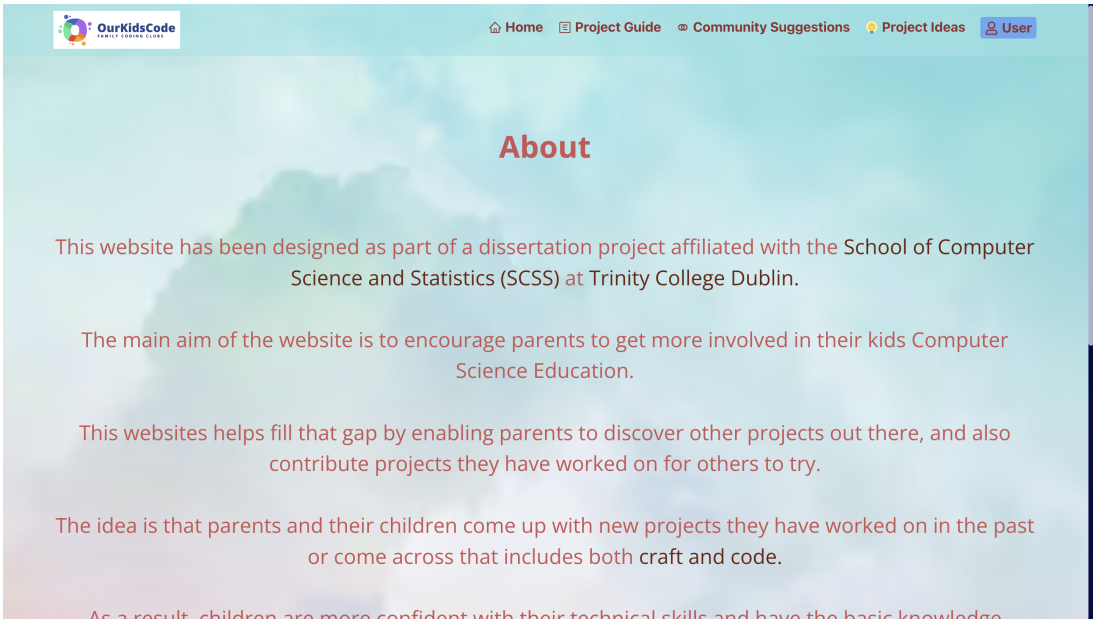

Figure 20: Web Application About Page