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How can technology benefit children with SEN?

by

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In

Computer Science

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Abstract

Individuals with special educational needs (SEN) now have more alternatives because of the development of mobile applications. Learning With U aims to improve children's communication and educational skills. The application has an easy-to-use interface and a wide range of interactive educational activities that are specific to the needs of children with various levels of disability. The app is user-friendly, and stimulating, and it encourages learning through play. The app includes several features, among them visual aids, audio support, and symbol learning, which assist children in communicating efficiently. The app additionally offers an array of educational tasks that target various learning styles, assisting children in developing important mathematical and literacy abilities. The application is intended for use either inside or outside of the classroom. The mobile application has multiple benefits for children with special needs. It improves their communication skills by allowing them to express themselves efficiently. Promoting their education while offering them access to various educational resources customized to their specific learning needs. enabling them to access educational materials independently gives them a sense of independence.

Acknowledgements

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Introduction

Introduction

This project has an important goal to have an understanding of SEN and what types of technologies can benefit them in learning, communication and life skills. The aim for the project is to show how technologies impact children with SEN. Identifying the types of SEN would give an overview of the project, as there are over 50 types of SEN, and they all affect the mind and body in very different ways. There are many technologies at the moment that bring a beneficial aspect to the development of their communication skills, but it is a high cost. Although, in this project, an application is created to enhance the children's learning, communication and life skills by having a built-in e-learning section to having a built-in AAC device to help the children have a form of communication.

To understand the many types of SEN, which can link to the many types of technologies, the understanding of the right technologies which in the case will be an e-learning, AAC device mobile application which will have many functions and features to benefit children with SEN in communication and education. This project aims to understand how technologies can change the life of a child with SEN. Moving onto the objectives by establishing the needs for this project it must be understood as further research into existing sources must be explained. Identifying suitable technologies, to get a clear understanding of what the project will create by the end of it. There are many mobile applications like Speech Blubs, Splingo and Voca Ques which all aim at improving speech learning but the application for this project wishes to have more functionality to improve more than their speech skills but wishes to improve their education and their understanding of symbol learning so it can enhance a better lifestyle for them in the future. In the chapters to come, there will ideas to be looked upon to see the types of blueprint for future designs of this project.

This project is to have a type of technology that can bring the best out of these children to make them more confident during school and when they have finished. To discuss the vital points of the implementation of the features which benefit children with SEN. Getting formal feedback from testers will pave a clear path to understanding what the right element is to improve further for the application. The aim is to understand the types of technologies which have the right set of functions and features to build a strong connection between machine and child to benefit their communication, education and life skills.



CONTEXT

Introduction

The goal of this project is to determine which technologies are best suited for children with special needs. Recognizing SEN is essential for this project because it provides an accurate picture of what types of technologies are best suited to each type of SEN. Special needs include behaviour, emotions, speech, communication, autism, and physical disabilities. The analysis of these types of SEN provided useful insight into which technologies are best suited to them. To comprehend the various types of technologies used in today's classrooms, including interactive whiteboards, tablets, and e-learning resources. There are numerous other technologies available to help children with communication and reading. As the world moves forward into this tech way of life, the advancement of technology will result in improved learning development because it encourages a more engaging way of teaching, which can benefit not only children with SEN but all children. For technologies that provide high-level assistance to children with SEN, training courses for staff and possibly even parents would be required to understand how that piece of equipment works. There are numerous SEN disorders, and some techniques help them while others do not. A text-to-speech programme can be used for children who struggle to communicate using sound; the programme works by inputting text and converting it into speech. This is one of the leading technologies for assisting children with SEN since it performs a simple but effective function.

## Children With SEN

Many programmes assist children in learning to speak and establishing a sense of proper conservation forming. Learning to speak may be challenging for blind and deaf children, however, if they use the programme at a young age, they can develop a deeper understanding of word structures and communication knowledge**(1).** As the population grows, so does the number of disabled children. According to the report, SEN has increased to 16.5% of all students. As there are different types of SEN, their causes, degrees, and effects on the child's educational progress. Additional research to accumulate enough data on SEN to improve our knowledge of which SEN is considered as a range of disabilities suggests the following, "more than half of all students receiving special services are male”**(2).** Every child is unique in terms of how they live, interact, learn, and process. We hope that by focusing on assistive technologies, they will not only benefit their learning but should also have a well-structured life when they finish school. There are various types of SEN, and it is critical to analyse all of them to obtain a wide range of solutions. It assumes that these learning disabilities cause central nervous system dysfunction**(3)** N. J. Cercone and K. Naruedomkul investigated assistive technology that could assist with additional disabilities.

It's essential to comprehend children who have trouble seeing or can't see at all. Investigating screen magnification software will benefit children because the software ensures that text is enlarged from its normal size to twenty times its original size**(3).** When designing a device to assist SEN, the screen magnifier will be considered since it applies not only to visually impaired children, but also to children with Down syndrome, dyspraxia, and multi-sensory impairment. When implementing this concept on future devices, it must take into account the possibility of enhancing the entire screen and allowing inverted colours to meet the criteria of their eyesight. The brain's development is constantly influenced by its current environment. When children engage in activities, their brain development shifts into a retroactive ring, triggering the link that allows the brain to have a purpose. Pruning improves the brain's ability to determine what it can and cannot do. Understanding how they think while incorporating their ways of living and learning into a device will reveal whether their brain uses it or not. Although paper worksheets create a more artistic discussion for the children, the software will provide a full range of resources that can all be achieved. The children will be able to complete the tasks assigned to them if devices are enhanced with an improved user interface. As children all work on different levels, the software will ensure that they all work on the same level due to the way the software is designed. However, it is important to remember that these types of technologies do not produce a more tuned-in student who is more motivated to learn.

The software should provide enough context so that educational goals can be met as a result of the software's interaction. Having different types of structured learning for each section, which can motivate children to learn and deflect attention from the outside world**(4)** When the user interface is discussed, all guidelines that will come into play for a new type of interaction must be followed to create a reliable learning process for the children.

In the last decade, technological advancement has changed many aspects of life, both positively and negatively. Education is expanding and it's critical to educate all children to a high level for the future. For children with SEN, many interaction methods, including a multi-touch desk, can be used. This is a costly device that is currently being transferred to schools, but it will be implemented in all schools in the future because it not only improves learning for all students, but it also has a sustainable side to it. There is an issue with multi-touch desks that causes a problem with posture; now because special needs children have physical limitations, this may affect them more**(5).** It is not a significant factor to have the device displayed on a table because it will perform the same function if displayed on a tablet or a PC.

Recognizing how children with SEN function while learning is an essential part of assistive technologies that can improve their understanding. For many children with SEN, communication is a vital factor, and there is one type of technology that can help them develop their communication further**(6).** Technology Augmentative and Alternative Communication (AAC) utilises symbols. Each symbol describes a word or sentence with the use of an icon. Compared to the text to speech, AAC devices widen their aim to help more children who find it to communicate. Created in the 1920s and further implemented in society in the late 60s. This created a new way of communicating due to its number of features as children with SEN find it hard to express themselves and this device makes them a clear vision to communicate appropriately. Two types of AAC devices can benefit children with SEN. The text-based AAC has a keyboard intended for children who prefer to type their content. Children from the age of 14 to 18 prefer to use this device as a higher educational level. When using text-based AAC, spelling and pre-written combination messages are used, and most text-based devices include word forecasting to help with communication. The AAC device has two variants in which someone with SEN can take their time learning the symbol-based control first. Both devices are useful to whoever needs support in reading, spelling and communicating**(7).**

So, why is the symbol-based AAC device more effective than the text-based one? Children with SEN have a different work function in which graphic images represent whole words. It prompts them to communicate more quickly. This symbol-based AAC device is the concept that will be developed, but it is critical to comprehend its advantages and disadvantages. One disadvantage is that some children may find it easier to simply type the word because it speeds up the process of their learning. The symbol-based device, on the other hand, is primarily used for students under the age of 11 because of SEN, some children up to the age of 18 will use this device**(8).** There is significant work to be done on an AAC device, and when development begins, the device must take into account both sides of the AAC device. The application will expand the children's ability to learn and develop skills in communicating. As everyone has a phone and tablet they shouldn't find it hard in downloading it. Having the AAC device implemented on the application can benefit the user as the AAC device can be rather high in cost.

Technology Table

### Text to speech

|  |  |  |  |
| --- | --- | --- | --- |
| Text To Speech**(44)** | | | |
| Image | Strengths | Weaknesses | Key points | |
| Speech To Text - Apps on Google Play  Figure : Text to speech | **Access to all**: All humans can now communicate with their devices by speaking to them, thanks to text-to-speech technology, which generates speech. This provides access to those who have a speaking disability, multilingual speakers, and the audience of the older generation. People with disabilities will receive more assistance, children with SEN understand when words are spoken, and their brains will be able to hear the words spoken out aloud, which they will be able to understand. Given that this feature has so many advantages, implementing it would be ideal. However, there will be kids with visual impairments, and the way the app is made will help these kids as well. They will be able to hear information on every topic that is shown. Due to the inclusion of text-to-speech, they will be able to complete the learning tasks**(9).**  **Affordable**: As text-to-speech is on every device the price can range from £300- £1000, but some websites are free to use text-to-speech.  **Outcome**: The project's goal is to create an app that meets all requirements so that the final product is satisfactory. These kids want to hear and see the spelling at the same time so they can learn how it's said and spelt. Providing the children with two outcomes can improve their learning experience. Text-to-speech will provide an affordable solution by improving learning outcomes in math, English, and symbol learning.  **Pronunciation**: Children with SEN have difficulty reading and understanding how words are pronounced. As this will allow the children to learn as much as possible about communication. The entire purpose of this application is to help these children by providing a suitable and structured implementation that will make the clicked-on button sound clear, understandable, and accurate words.  **Improve reading**: Thus, implementing text-to-speech in this area will teach children about word flow and word structure efficiency.  **Multilingual**: Text-to-speech technology can recognise any language in the world. For the time being, the app will be developed in English. | **Conveying emotions**: Children understand how a word sounds more than what it means. Since text-to-speech is an AI-based tool, it can be difficult to sound like a human. However, this isn't a big deal because it won't be a problem in the long run. The children would prefer to hear a joyful voice because it will make them more engaged with the subject.  **Limited vocabulary**: At the time being it hard to cover all words but in the next coming years all words should be implemented into the text-to-speech software making it beneficial for all users around the world.  **Not 100% accurate**: Text-to-speech technology is improving year after year, but it can still be inaccurate. This can affect many users who want to write reports or send simple messages.  **Retention**: Since the voice isn't human, many users may struggle to understand the information provided to them. This confuses users, and they will occasionally prefer to read themselves. | * Assist everyone * Increase understanding of word structure and pronunciation * Text-to-speech will help improve word recognition, making the children more engaged in their learning so that they can remember the information**(10).** * Text-to-speech is the best solution for processing generated speech by a computer from start to finish**(11).** * Improve grammar | |

Table :Text to Speech

### Interactive Touchscreens

|  |  |  |  |
| --- | --- | --- | --- |
| Interactive Touchscreens**(45)** | | | |
| Image | Strengths | Weaknesses | Key points |
| 483,555 Interactive Touch Screen Stock Photos, Pictures & Royalty-Free  Images - iStock  Figure : Interactive Touchscreen | **Navigation**: Humans have transitioned from buttons to touch screens. This makes device movement much easier and more effective because users will be able to use their fingers as the primary source of navigation.  **Less space**: A touchscreen device such as a phone or tablet can have very easy storage space and it doesn't require any additional devices like keyboards and mice. The device can be stored in a bag with no problem and the weight of the device is nothing compared to a laptop.  **Efficient**: A touchscreen makes any device more efficient to use since users will find it easier to progress around the device as well as the application will run smoothly. It is critical to create an app with a smooth and straightforward layout for children with SEN; doing so will make the application and touchscreen usage efficient.  **Reliable**: If the user's face is user-friendly then this makes the function of the application or device reliable for them to be more engaged with the subjects displayed in each section. | **Size**: T The size depends on the device and whenever an application is created must be created to re-size to any device.  **Range and Vision**: To use any touchscreen device, the user must be relatively close to the device because the screen size is small in comparison to a PC or laptop. Staring at any device for too long can damage vision.  **Obscure**: As the device will be handheld, most of the content must be displayed at a reasonable size to ensure that no information is missed by the children. all information for the application will be displayed in the centre of the screen, to help with vison and understanding.  **Battery**: Using a touchscreen device reduces the battery life by 50%, making the device charge more frequently. The use of bright colours fastens up the battery drainage, but the dark colours lower it.  **Sensitive**: Touch screen devices must be used with caution because pressing the device too hard can break the screen, resulting in the entire device being broken. The device must take into consideration the power of the child as they tend to press hard on the screen, which could result in a damaged device. | * Touchscreen is the future * More interactive * More engaging learning environments * More effect towards teaching |

Table :Interactive Touchscreens

### E-Learning

|  |  |  |  |
| --- | --- | --- | --- |
| E-Learning**(46)** | | | |
| Image | Strengths | Weaknesses | Key points |
| Free Vector | Background e-learning design  Figure 3: E-Learning | Effective: The main benefit of having e-learning is that users can stay at home and listen to a live recording of the lesson, and they will be able to never miss a session. E-learning can be beneficial for people with disabilities, as some find it hard to leave the house. Users will be able to manage their time more effectively by scheduling online classes and other materials displayed in the learning room.  Retention: Making e-learning interactive allows the entire application to have valid content. The more engaging the material is for the user, the faster the user can complete the task and comprehend it.  Learning: Anyone can learn the content from anywhere, which is what makes e-learning unique. The application will include material that is appropriate for children with SEN, enabling them to work at their own pace,  Environmental-Friendly: The environment will benefit because people will not need to travel to school, which causes pollution. However, as beneficial as this is for the environment, in-person teaching is preferable because you can ask pertinent questions in the present moment and interact with other students. | Social interaction: The lack of interaction among students can have an impact on their mental health and learning experience. It's beneficial to interact with others because it allows you to improve your knowledge of the class and the subject.  Inaccessible: E-learning will require Wi-Fi, but if there's an issue they will miss live classes and not be able to access any learning material.  Focus: Students may struggle to learn through e-learning as it doesn't give the same vibe as being in a classroom learning which can impact learning and their focus on the subject. It is critical that when e-learning is being recorded live, teachers make it as interactive as possible or else students will lose focus. during their learning experience.  Material: Students will be able to access their learning room and view any previous lessons at any time whenever the live recording is uploaded. | * It has aided people who find it difficult to leave their homes and learn * A suitable method of learning that provides enough material for the user to interact with * A fair amount of learning materials * Software like Teams and Zoom can be used to use as an e-learn * Improve communication skills, teamwork, problem-solving abilities, planning abilities, and self-management * Beneficial for children with disabilities |

Table :E-Learning

### AAC Device

|  |  |  |  |
| --- | --- | --- | --- |
| AAC Device**(47)** | | | |
| Image | Strengths | Weaknesses | Key points |
| Free AAC Apps for SLPs - Speech Room News  Figure : AAC Device | **Types of AAC**: All have different functions to help with all types of SEN   * Improves sign language skills * Improves communication * Low-tech approaches symbols or image exchange and will assist the user by displaying single images for the user to press to communicate or learn. * The low-tech device is inexpensive and portable, allowing the user to take it wherever they go**(12).** * High-tech is to generate speech * The message's output is a voice that the user can listen to and read to ensure that they comprehend it. * Communication can be difficult for people with SEN, and the high-tech device can assist them in communicating with others without the use of words**(13).**   **Communication**: People with SEN may not be able to communicate using a form of speech, so the AAC device was developed to help them with that issue. Users can communicate by pressing a variety of symbols.  **Symbols**: There is a broad range of symbols in which users can commute, ranging from a single symbol that represents one word to a symbol that represents an entire sentence. | **Low-tech downfalls**: Low-tech has many advantages and disadvantages. There is no auditory feedback for the user, which further interferes with the flow of the sentence and may cause the visual feedback to be disrupted. For children or people with special needs, remembering is an important skill to develop for skills in the context, but the low-tech device shifts the position of the symbols, making it difficult for the user to remember where it was. If this issue persists, it will be difficult for users to locate the symbol and communicate. However, due to the large number of symbols, it may be difficult for the user to find the right symbol to express themselves.  **High-tech downfalls**: The price of the high-tech can exceed a thousand pounds. As a result of the evolution of understanding SEN, the use of symbols and other uses change, and the device's software can become outdated, causing the device to break down. Bringing the device around with them is appropriate for users with SEN, but the high tech is heavy and lacks portability. | * Benefit children with SEN with communication and developing further skills * Improve learning skills such as reading and focusing * Use of symbols as a form of communication |

Table :AAC Device

### Optical Character Recognition (OCR)

|  |  |  |  |
| --- | --- | --- | --- |
| Optical Character Recognition (OCR)**(48)** | | | |
| Image | Strengths | Weaknesses | Key points |
| Optical character recognition - Wikipedia  Figure : OCR | | **Accuracy**: When the users want to read text, they can get the OCR and place it upon a sentence and the device will read it out for them. The accuracy is precise, and this is useful because the users must receive the correct outcome. The device can also create a top-quality image from the sentence or word that the users can scan.  **Processing**: When a user scans a piece of text, the text will be processed quickly and returned to the user.  **Share**: Since scanned text can be stored or sent via email, a piece of text from a paper-based form can often become an electronic form.  **Price**: The device is reasonably priced if the user can afford it, making it advantageous for the user to scan the text in an electronic form, which increases processing speed.  **Scanner**: If the user purchases a new OCR, the scanner is preferable to before, with the ability to re-create tables, columns, and even websites. | **Not efficient**: While scanning a text on a paper-based form is simple, scanning a user's handwritten text or that of another person is difficult because the OCR has difficulty understanding different types of handwriting.  **Price match**: As previously stated, it is a reasonably priced device, but some people will struggle to afford it. Considering how good this device is, purchasing a used one is not advised.  **Mistakes**: Not every device is perfect, and mistakes are inevitable, but the user must sometimes double-check the scan that the document is checked, and that the device has scanned the text. The user will have to correct it manually because there will be errors.  **Is it worth it**: The device has many drawbacks, and it only works if the user scans a significant amount of text rather than just one line**(14).** | * Effective * The price is too high * Accuracy to a degree * Improve reading and speech * Environmentally friendly as the data is stored online |

Table :Optical Character Recognition

## Summary

Technology is essential to comprehending SEN since it significantly benefits them. However, there is a flaw in these technologies in that no device implements all of these features. As a consequence of growing populations, the number of special needs is growing, and this recommendation is only made when there is a desire to help these children have a better learning experience. Obtaining a way to create a device that can do this can thus help to expand the development of learning. Many technologies are being developed, but only after extensive research. The five technologies mentioned above have strong details that will provide a flexible display of the device to be created. The text-to-speech programme will continue to evolve in the coming years, making it a strong candidate for future implementation in SEN learning. There will be limitations associated with all of the technologies displayed, but it is essential to highlight the strengths. To devise a device that has no disadvantages for the children, such as making the programme produce accurate comprehension As a result, the children will be able to help make their daily lives more efficient.

A compelling argument is that it is a method of learning that can produce this functionality to improve reading speed. Reading can be difficult for children with special needs, but the more they use software to help them with reading and communicating, the easier it will be for them to leave school confidently**(15).** As of now, text-to-speech will not always be accurate, but it allows these children to absorb more information from the words they read and hear. This will also help them remember important lessons throughout their academic careers. Children with SEN have distinct characteristics, and their functioning is remarkable. What matters is how a classroom can be made more interactive to develop their education further. Children with SEN operate differently than other children, however being aware only results in mistakes, and being optimistic about this subject is essential. Every child works differently, but kids who have special needs have a distinct advantage. "Their individuality will set them apart as they grow older, and they may even have special abilities or talents that they would not have otherwise," Marissa Labuz said**(16).**

When used correctly, interactive panels can help to create a more inclusive learning environment. as it enriches a structured environment where children have the confidence to express themselves, allowing them access to devices that are appropriate for their development not only in learning but in life as a whole. As a result of understanding that each child works differently, different types of methods within the classroom can be used to change the entire way of teaching and learning. Interactive panels can engage children in learning by allowing them to work in groups and complete tasks including writing or reading in real-time. It all depends on what is being taught; for children with SEN, visuals are the best way to learn, and interactive panels are ideal for this. The reason for this is that visual learning is more accessible, but it's important to remember that children with SEN are more likely to be distracted, and interactive panels can keep them working if the lesson draws them in**(17).**

The AAC device is appropriate for children of all ages with SEN. The device is aimed at improving the children's interactive learning abilities. The device may benefit the lives of many children to enhance personal communication. According to Millar, Light, and Schlosser, 89% of AAC users in 2006, came back with a result in improved speech**(18).** It promotes a positive attitude toward learning, and the device is designed in such a way that it meets all of the user's needs. Learning can be overwhelming for children with SEN, and this device will reduce psychological stress due to speaking and relieve speech development. The AAC device is designed with many objectives and benefits in mind to provide the user with an impactful learning experience. It also aims to ensure that the AAC device's purpose is to enhance communication and reduce dependence on oral language skills**(19).** Many approaches are available because of the many different types of AAC devices, including such unaided AAC, which does not require any physical assistance and tends to involve body language, facial gestures, and sign language for deaf children. Besides that, due to the multitude of different types of AAC devices, some include an external aid, including aided AAC, which displays symbols, images, keypads, and speech generators. The AAC device has a price range from £4800 to £8900.

This price range is prohibitively expensive for anyone; many schools will already have iPads or tablets, and the AAC converted into an app will be an excellent creation**(20).** The AAC device is a game-changing piece of technology that can help millions of children with special needs communicate and hear. For them to live a more self-sufficient and rewarding life. Given the variety of AAC devices on the market, it would be a massive advantage if they could all be created using the same app. As much as AAC devices have the benefit to improve children's SEN with their communication, reading and life skills. The price is too expensive and should be considered created in a less expensive format.



New Ideas

Introduction

To determine what is most beneficial to kids with SEN by analysing all available technologies and weighing their advantages and disadvantages. Rather than accommodating a specific demographic, the AAC device can be designed to accommodate all types of SEN. Although the original device has limitations, an AAC device that meets all needs can be developed with the right tools and research. So, what helps to distinguish this newly designed AAC device from its predecessors? Its goals are simple: to improve the learning environment for children with SEN by utilising a simple feature. Six sections will be included in the application. Math, English, symbol learning, text-to-speech, a communication canvas, and a quiz. This six-section application will ensure that the children have an application that will benefit them in areas other than education. The application will include numerous functions and features to assist children in their learning abilities. The goal of this application is to create an interactive learning experience for children, and because it will be created in Android Studio, the app will be touchscreen. The best way to develop learning is to make it fun by having the right tools to make the overall function have sets of materials where the children can be engaged. There will be symbols that the children will use to communicate, as well as a text-to-speech section where children who find it difficult to speak can type their sentences and the application will speak to them out. For the application to benefit children with SEN the use of the right tools can develop their learning and life skills.

## **Aims and Objectives**

This project aims to understand how technologies can change the life of a child with SEN. As the objectives stated

* Establish the needs for this project
* Research existing sources
* Carry out some primary research
* Identify suitable technologies
* Develop a true understanding of SEN
* What technologies can benefit their learning
* What technologies help the best with certain disabilities
* Develop and implement the technologies to focus on their communication skills

Logo: A logo is an essential component of any business. A simple logo increases its visibility. A logo includes multiple components, including the brand name, graphic layout, and colour. Since this application is intended for children, there must be aspects that are appropriate for them.

Project aims: The project's objective is to achieve a deep understanding of how technologies can assist a child with special needs. This app will be designed and built to meet the stated goals. Before actually proceeding, it is essential to gather sufficient information on the subject. By taking into account all types of SEN, the app can be developed to be suitable for all. Since the theme is important, using the appropriate colours, images, symbols, and text style can help children focus when using the app. This app will be touchscreen which will improve the learning environment for children with SEN by making the app interactive for them. Children with special needs learn in unique ways, and the app will assist them in improving not only their education but also their communication skills. By ensuring the best possible outcome, this app aims to bring out the best in these children.

## Functional Requirements

Main Functional Requirements: The main goal of this app is to provide users with a device that will assist them to improve their learning experience. Since children with SEN require materials that are easily accessible, making this app free to download will demonstrate a statement.

User Requirements: To meet their needs, the user will require the entire application. Since this application is for children with special needs, it must have a simple but effective interface. The reason for this is that they function differently than others, so increasing the size of text, images, and boxes is essential. Making this app as interactive as possible will help the user focus on their work and develop new skills.

System Requirements: The application will acquire a significant number of inputs to meet the system requirements. Symbol learning will include a set of symbols that children will be required to use for communication. The learning activities, including the maths and English sections, will provide these children with fundamental educational knowledge. When the children are ready for the quiz, there will be a set of questions associated with these two subjects as well as general knowledge questions**(21).**

Laws and Regulations: There are numerous agreements to be processed, and the application must adhere to laws to be approved. he application must reach and aim towards the performance of the scope to achieve the destruction of the concerning content. Since the users are children, it must not display any information that could disturb them.

External interface: This requirement is significant because the app must have an interface that is suitable for effective interaction, including the appropriate colours, images, buttons, functions on each page, and hardware interface for the developer**(22).**

Reporting: This application has many tasks that benefit the learning experience for children with special needs, including researching all possible project outcomes and gathering feedback to improve the application. Implementing a feedback section for the user's parents so that they can discuss what we could add to help the children learn and develop their speech ability even more.

## Non-Functional Requirements

Availability: The application will be accessible to users via mobile and tablet devices. The application will be available for download from the Google Play store to any user**(23).**

Scalability: Since many devices come in different shapes and sizes, the resolution will affect the app's appearance. Further testing will be performed to ensure that it is device compatible. As the user will be working on the application, it has many sections and should be able to withstand the user's usage. As so much will be pressed, calculated, spoken, and labelled, many functions will be in use in a short period.

Network: The application can be used with a WIFI connection. As the children will have to log in. The children's accounts will be linked to an online database. The reason for this is that the app is being developed for children with special needs, and they will be able to use it anywhere, whereas if the app required a WIFI connection, it would be difficult to use, for instance, on a bus or in a car.

Operating System: The application will be created in an android studio which makes the application at the time only available for users who have an Android device.

Performance: Since the app's performance will be designed for children, the response time should be quick for them to start up the app and complete any subject tasks. Let's say the child enters the math section, there will be a fair amount of features to maximize the performance of the application. The child can enter any number into the adding page, and then the simple press of a button will display the answer**(24).**

Responsiveness: The application will have six learning sections and since this application will provide the user with a text-to-speech and symbol-to-speech output, it should be responsive to any user input. The application should not crash and cause the user to be interrupted.

User Ability: The application will be designed to keep the children in a suitable level of context so they're able to navigate the application with convenience. Some numerous features and functions will aid the children in their ability to develop a higher level of education. The interface will be designed simply to make the product's user capability efficient, effective, and rewarding**(25).**

Reliability: For this application to be reliable there need to be regular updates which will ensure that the application doesn't experience any errors occurring. For the education context to change every week or every day to make the children new things to further their education and life skills, as this ensures that the goals of the project meet expectations.

Security: This requirement is significant because the application will be available on the Google Play store, and it is critical to monitor the application's security. Since the user will need to make an account to access the application their data must be kept secure at all times. Weekly checks to ensure the app's structure is up to par.

Accessibility: This application is designed for everyone, but its primary goal is to be suitable and accessible for children with SEN and other disorders. The application will connect to all types so that they can understand the overall function of the app. The application must be designed in such a way that it meets the needs of the user, including its visual, cognitive, and hearing capabilities.

## Application Designs

Logo and Name for the application: The application will be called Learning With U and the logo, see figure 6 is rather straightforward as it sets up the theme for the whole application. As yellow and blue are two colours that go, they don't clash. The design of the logo displays a cow with a lightbulb and the reason behind this is because children like the sight of animals and the lightbulb represents a new idea towards learning. The logo will be displayed on every page as it gives the application life. Using too many colours and images in the logo can result in a complicated design, which results in a poor design**(26).**

Logo

Description automatically generated

Figure : Applications logo

Theme: The choice of colour scheme, figure 7 will be the most straightforward issue to resolve because children with SEN function best when surrounded by colours that support their well-being and educational process**(27).** The reason behind the yellow(#faff00) and blue(#3742fa) colour scheme is that yellow can provoke aggressive behaviour, anger, and distress. However, the use of these two colours assists users who have colour blindness tritanomaly**(28).**

Shape, square

Description automatically generated

Figure :Colour scheme of application

Framework: Learning with U has been designed for children with special needs, and the application will assist them in communicating and learning skills. However, it is critical to consider all aspects of all types of SEN. Creating two designs for the application creates a better understanding of the project. As design one has very limited context compared to Design two. This application is to bring the best out in the children to further develop their education but design one doesn't give that. design two is a more in-depth blueprint and gives appeals to parents and teachers because it will aid in the development of children, and the design and functionality must meet their expectations for future updates to improve the application by adding more subjects and tasks for the children to complete. As these are both blueprints many changes will be made to the application, but the majority of the changes will adhere to the original design as closely as possible**(29).**

Graphical user interface

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Figure : First design for application(Blueprint one)

Table

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Figure :Second design for application(Blueprint two)

Login and Register pages from Blueprint two: There are no login or registration pages in comparison to the blueprint one. This implies that the initial designs would lack a database. A database is essential for any application because it creates a more secure functionality for the app in its entirety. The design of the login and register pages is equivalent, and it adheres to the logo's blue and yellow colour scheme.

A picture containing chart

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Figure : Applications login and register page

Startup Page: The start-up page is the first page of the application, figure 12. The designs are very different as design one is very simple and doesn't provide much life to the application. But compared to design two there is more going on. There is an option for the user to log out of the application as design two has a database.

Logo

Description automatically generated with low confidence

Figure : Frist design of the startup page(Blueprint one)

A picture containing graphical user interface

Description automatically generated

Figure : Second design of the start page(Blueprint two)

Home page from blueprint One: These two pages from blueprint one show two sections for the user to adventure in, The first section is symbols learning and the second section is keyboard learning. The user will have a choice as to what section they would like to go in depending on their level of education. The first section will have a built-in AAC device which is a vital tool to benefit children with SEN and this section is mainly for users who find it easy to learn and communicate with the use of symbols. The section as stated above is keyboard learning. Where users will be able to write in text and the output will be speech.

A picture containing text, yellow

Description automatically generated

Figure :Home page from blueprint one

Learning page: Seeing as Blueprint One was created first, it has much less content than Blueprint Two's learning page. Blueprint one has only three sections as well as a simple design. Blueprint two has doubled in learning material due to the essential to create an application with a varied set of learning resources to assist children with special needs. The resources displayed are maths, which most children with SEN find difficult, however, this application aims to have the appropriate amount of maths resources so that the children can focus on the interactive tasks**(30).** English, symbol learning which is the built-in AAC for the children to use as a form of communication. Symbols are an excellent way for children with special needs to express themselves because they allow them to communicate with one another. There will be a more detailed explanation of how symbols can help children develop**(31).** Text to speech, communication canvas where the children can draw content to use as a form of communication and the last a quiz.

Application

Description automatically generated with medium confidence

Figure :First design of the learning page(Blueprint one)

Graphical user interface, application

Description automatically generated

Figure :Second design of the learning page(Blueprint two)

Math pages: The mathematics section in both blueprints is quite different, as the content in blueprint two includes a wider range of maths resources for children with special needs. The math pages will be the first thing users perceive, and Blueprint Two includes an improved layout, more math resources, and an interactive function on the adding and subtraction pages.

A picture containing text

Description automatically generated

Figure :First design of the maths section(Blueprint one)

Chart, table

Description automatically generated

Figure :Second design of the maths sections(Blueprint two)

English pages: The English section is where the children can develop their reading and way of speech further. Blueprint One has limited content to blueprint two as it has material for developing their reading skills with the implementation of a book and a word jigsaw. The alphabet page has stayed the same for the two designs.

A picture containing qr code

Description automatically generated

Figure :First design of the English section(Blueprint one)Table

Description automatically generated

Figure :Second design of the English section(Blueprint two)

Symbol learning page: Since the application includes an AAC device, symbol learning pages are essential. This section is intended to correspond with the aims and objectives by showcasing symbols that can serve as a form of communication. The first two pages of blueprint two show symbols that represent the significance of a single word, whereas the final two pages portray the meaning of a sentence or phrase. Every year, 138,000 children with SEN benefit from AAC implementation, and 40% of children are now willing to learn with the assistance of an AAC device**(32).**

Table

Description automatically generated with medium confidence

Figure :First design of the symbol learning page(Blueprint one)

A screenshot of a game

Description automatically generated with low confidence

Figure :The second designs of symbol learning from blueprint two

Text to speech page from Blueprint two: In blueprint one, the text-to-speech section would be implemented in the keyboard section, although in blueprint two, it is now implemented in its section. The ability to merge the two sections is an essential characteristic to have in the app. This section seeks to provide children who have trouble developing speech with a function which will source text with an output of speech. This section aspires to be an interactive and effective resource that allows learners to enhance their abilities to communicate and further their communication skills.

Diagram

Description automatically generated with medium confidence

Figure :Text to speech from blueprint two

Communication canvas page from Blueprint two: This section is designed for the children to use as a form of communication. Having lots of forms of communication creates a range for all types of SEN. They can also use this section to use as an art page, to broaden their art skill. This makes this page more interactive for the children as it's different from all the other pages in the application.

Background pattern

Description automatically generated with medium confidence

Figure :Communication canvas page from blueprint two

Quiz page from Blueprint two: The quiz section is designed to get the children to think about general knowledge which will help them in the outside world. When this section gets programmed, it will have 20 questions for the children to answer and they have a topic from spelling, and maths to generic questions. The design follows the theme of the app and when the user clicks on one of the answers the button will change to the colour green which is just an indicator of which button is pressed.

Graphical user interface

Description automatically generated with medium confidence

Figure :Quiz section from blueprint two

To complete the understanding of app development due to the consistent change to create an application that can benefit children with SEN. For any app, there must be suitable changes to meet demand on the set requirements. Adding new subjects to the application creates more of a learning environment and it makes the user more hooked to the app due to the implementation of a more impactful app. Education at a low age is all about understanding the fundamentals of any subject. By making suitable decisions pick which is the best blueprint to pick. Blueprint Two has a wider range of learning resources to meet the aims and objectives of the application compared to blueprint one, as blueprint two benefits children with SEN more because of its variety of learning resources and use of symbols which can improve a variety of skills**(33).** This application will have learning resources for the children to absorb so that their development in life skills expands. Blueprint Two defines the scope better than Blueprint One the implementation of a future database makes the application more effective and secure. These implementations can develop and significantly enhance the children's learning and life qualities**(34).** As for any app development, it's important to have more than one blueprint as shown above, blueprint two has been designed to follow the scope requirements and met the aims and objectives so that the children move further into their education and overall well-being as person.

Given that this app is designed for both younger children and children with SEN, the layout must be fairly straightforward. By making an app that will be simple for a child to use, we can show that we respect their intelligence**(35).** By concentrating on the app's development, it will be made sure that kids find it useful for learning and development overall. The goal of the app is interaction; therefore, the design must follow the scope as it will improve the user experience for these kids**(36).** When creating the app, each page must be examined to determine whether it is sufficiently interactive for the kids to remain interested in the topics.

## Software Requirements

|  |  |  |
| --- | --- | --- |
| List | Requirement | Solution |
| 1 | Java or Kotlin | It is critical to choose the most comfortable programming language for any app development so that the application is as high quality as possible. Using a native programming language like java on android studio ensures that the software provides as many hints as possible to ensure that the application is not corrupted with errors. |
| 2 | Cross-platform | When it comes to any development of any application it's important to develop an application with is suitable to all platforms because not everyone in the world has that one device. This application will ensure that it meets all requirements. To test that the application is suitable for all platforms, the emulator has a feature that can test the application on any Android device. However, with a different device, the layout of the application will be different to another because of the screen size, but what's important is that it works fine with no errors. Although, the application will not be able to run on any IOS device because Learning With U has not been created on Flutter. |
| 3 | A clear understanding | Any application in development needs to have a clear grasp of the scope and software since the more ideas that are known, the more the application can be created in a way that meets all requirements**(43)** |
| 4 | Consistent | The amount of time spent, and the terminology engaged will vary. Nonetheless, if the scope is not accompanied, it may have an impact on the entire development of the project, even though unnecessary requirements can lead to the project producing errors. |
| 5 | Traceable | Since the scope must be implemented to ensure the overall success of the project, the principle of the link between the scope and the application must be understood. Testing will be the final step before publication once the project has established a clear statement of all requirements**(43)** |

Table :Software requirement for the application

Learning With U is being created on android studio the software is free to download source and it provides a series of updates to extend its capability. It includes numerous tools and features to ensure that an application produces a high-quality app that is compatible with all hardware platforms. The programming language used to create this application will be Java. It has many advantages that make any application development a comfortable experience, including constant updates and an open-source community. Java has drawbacks for application development, but keeping in mind that most devices are limited, the application must keep the code as close to the requirements as possible so that the application is as efficient as possible. Though the application is designed for children with special needs, by utilising Java to its full potential, the application can be created by using the right set of tools to meet the product requirements. Although there are some limitations when it comes to Java development, it consumes a lot of memory because the application is running on a Java virtual machine, which makes it hard to hold an impactful test run.

For this application, figma made it easy to get a clear understanding of what the app will be like when transferring the idea onto the Android studio. It ensures fast coding because it pushes the code for quick changes which don't require the application to be shut down for a refresh. This makes the development of any application more flexible as a built-in emulator is displayed to define unit testing to be optimal. It can be crafted and tested on any Android phone platform, allowing the application to be displayed in seconds if the project is built successfully. The design and coding features are simple to use for any developer, as there are a variety of tools available such as buttons and text views that can all be used to create a functional application**(42).**



IMPLEMENTATION or INVESTIGATION

Introduction

The project must consider three major aspects of the overall project. The project scope will determine what the project team must and must not do. The app's design must take into account the fact that it is intended for children with SEN. As a result, the app's design must meet its specifications. The project can be prepared for the next steps by discussing the vision and developing a plan. What the stakeholder wants, however, will be very different from what the user wants. The children's primary focus in developing this app was how the app should be laid out and its primary function. Scheduling must always be taken into account when developing any project. It is essential to set up a timetable and assign tasks with tight deadlines. This will result in a well-organized and structured project system. If the project follows the tasks set for each day, then the project will be done on time.

Stakeholders are essential to this endeavour since they are included in the overall project to see who is interested. This app is not just for children with special needs; it is suitable for a wide range of children due to its numerous features that allow children to learn maths, English, symbol learning to even a quiz. All of the tasks on this page will assist these children in developing essential skills that will only improve with time. The more people who use this app, the better the overall project goal will be in the future.

## Gannt Chart

Creating charts and diagrams can help guide the project as when each task is completed, the task should be documented. There are tasks assigned to each day which display the aims and objectives so that each requirement is implemented. As the application is designed for children, the app must have simple navigation to have a learning material to suit their needs. This application has loads of implementation that help children with SEN build on their math, communication and reading skills. Special needs range to having over 50 types of it, so this application must suit all their needs. There are many features to help children who are blind children who can't speak. This application must benefit all types of SEN.

Learning With U is an e-learning resource, and some materials hope to challenge children, as this is a sign of learning development. Besides implementing various types of features, this app will allow the children to have a more adventurous learning style. Since there are other projects, it's critical to create a Gannt chart to help with time management.

A picture containing graphical user interface

Description automatically generated

Figure :Gannt chart for the project

## SEN in the UK

AAC devices are becoming more popular in this day and age as the prevalence of SEN rises. More assistance has been provided to these children in the last two years, and the implementation of applications will further the cause**(37).** Although support for children with special needs has increased, SEN in general has increased by 15.5%, accounting for 1.37 million students**(38).**

Chart, line chart

Description automatically generated

Figure :Graph showing the percentage of pupils in the UK with SEN(38)

As further research is recommended when creating any project because you will gain a better understanding of the project's goal and scope. Sayit easy-AAC is a free application that has the simple function of having the entire application have a communication feature. This is great for an audience of 16 and up, but it serves its purpose and fulfils a function that Learning With U will have, but for children under the age of 16**(39).** To provide children with SEN with an appropriate communication approach to learning so that they can develop a full range of educational functions. Lil Requester is one of the best AAC device applications on the market, and it has three payment options. It is free, but you only receive one request per month. This prevents children from using the application to communicate, and in any conversation, more than 20 words and phrases will be used, limiting the app's usefulness. Applications that assist with SEN should be free because it broadens the market for finding a suitable application. The layout and interface are straightforward but effective**(40).**

Although AAC devices are the most efficient way for children to communicate, more AAC devices are being displayed as paid applications as more research is conducted. Children with SEN must be able to communicate freely to develop as individuals. Despite this, apps like Tocuhchatapp have a great interface and make good use of symbols, allowing children with SEN to communicate effectively**(41).**

When compared to the other examples above, Learning With U has many features that create a more conducive learning environment. Children must be engaged in their learning, and special needs children must learn a variety of techniques to improve their reading and communication skills. Milestones are essential for the project to move forward and ensure the development of children with SEN education abilities.

## The projects objective and Milestones

* Establish the needs for this project
* Research existing sources
* Carry out some primary research
* Identify suitable technologies
* Develop a true understanding of SEN
* What technologies can benefit their learning
* What technologies help the best with certain disabilities
* Develop and implement the technologies to focus on their communication skills

## Risk Assessment

|  |
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Table :Risk Assessment of the application

## Database Entity Relationship Diagram

The project needs to have a complete sense of the project's data requirements as well as how the data will be organised and defined. The Entity Relationship Diagram (ERD) is utilized. The ERD is a graphical representation of the relationships among database entities or objects. It explains clearly how data is related to one another and how data is organised in the database. Entities, attributes, and relationships are the primary elements of the ERD. Entities are the objects and concepts that to which the data is linked. Attributes represent the entities' qualities, which include their email address. Relationships represent the connections between entities, including a logged-in user. The ERD is an essential instrument for any project since it guarantees that information is organized and structured in an efficient, effective, and accurate manner. Moreover, guarantees that the information is reliable throughout the project, seeking to make it simpler to handle and maintain. All in all, the ERD is a vital tool for any project involving the use of a database. It offers an in-depth knowledge of the project's data structure and connections, assisting in ensuring that the data is reliable, stable, and organized.

Diagram

Description automatically generated

Figure :ERD showing the database for the application

## Class Diagram

A Class Diagram serves as an illustration of an object-oriented system's classes, interfaces, and relationships. The class diagram is essential as the object-oriented system is in use. The Class Diagram is utilized throughout the project to provide a clear understanding of the items within the system, the properties of the project, and their interactions. It contributes to ensuring that the system is set up and organised in an effective function. It helps to recognize any possible failures or issues with the project's object-oriented design before implementation. This saves the project a considerable amount of time by recognizing and fixing any issues before they become significant problems. It provides an understanding of the project's object-oriented design by helping to communicate the function of the project, making it easier to collaborate and work towards the project's goal.

Diagram

Description automatically generated

Figure :Class diagram showing the whole application

## Technical Flow Chart

A Technical Flow Chart is a visual representation of a system's records, details, and workflow. It helps explain how the function of the project and how its aspects interact among themselves. The Technical Flow Chart helps determine how the mobile app works for the user. It offers an in-depth comprehension of the user's interactions with the mobile app and how the app can help them with their education and life skills. This is significant because it guarantees that the needs of the user are fulfilled since the mobile app is very user-friendly. Furthermore, the Technical Flow Chart assist communication between both the project and the user. It creates an agreed-upon language and understanding of the project's design, making it easier for the user to collaborate with the mobile app to further develop their education.

Diagram

Description automatically generated

Figure :Technical flow chart showing the login process

## Unit Testing

Testing serves as a vital process for increasing application productivity. Since this application was created to help children with special needs learn and develop their human skills, it was necessary to include subjects that aid in their learning and development. The app's functionality was properly tested to ensure that it met the project's goals and produced the expected result. The app has several features that needed to be tested to ensure that kids would find it simple to use to aid in their learning, including the interactive screen that brought this connection between the children and learning. One of the project's goals is to provide them with enough content to benefit their lives as a whole. Although the project lacked content in its early stages, limiting the application's complexity, it was necessary to add content to the application such as a quiz. This increased the overall functionality of the application to an educational level.

Due to plenty of errors when the Android studio was in use, the project was undergoing coding errors such as lambda expressions. it slowed down the development of the application. As the software updated the function of the application failed now and then which slowed the progress. Although the software provided easy building tools there was a fair amount of error with the development of the project.

## Unit testing Table

|  |  |  |
| --- | --- | --- |
| List | Error and explanation | Image |
| 1 | When a button was pressed, the application crashed due to an error in the on-click listener function. The changes were made after some coding fixes to ensure that the application worked and ran smoothly. Even though it was a warning, it was causing a block in the code even though there was no need to assign values to variables to return the function call. | Figure :lambda warning within the applications code |
| 2 | The third symbol page was experiencing some errors while testing was in progress. This slowed down development as the error wasn't showing up. After some time, the error was that the third page wasn't implemented into the android manifest. So, if a user clicked next to the third page it was crashing. After, it was implemented the third page was showing up. | A picture containing text, electronics  Description automatically generated  Figure :The third page of the symbol page |
| 3 | Media native player error: This error was fixed by first pausing the audio and then playing it again. This was done to prevent the cache from expanding while other audio files were playing. However, this error only appeared when testing the mobile app on the built-in emulator; when testing was done on a mobile phone, the error vanished. | Text  Description automatically generated  Figure :The native player error within the application |

Table :The error tables that occurred during production of the application

Since the software as said above updated, new errors and bugs were introduced. As various components of the application were tested to see if the navigation flow was successful, although as identified testing was completed, any errors or bugs missed during unit testing were successfully implemented. With the project's setbacks, the paramount judgement was to transfer the development from an Android studio to a web-based application, but the lack of HTML knowledge ensured that the Android studio was the only alternative for the futility of the idea.

## Unit Test Case Table: ADD images

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| List | Test case | Test case description | Test steps | Post test | Expected result | Final result |
| 1 | Startup button | When starting up the application, the startup page will appear, and the only button should navigate the user to the home page. | 1. Checking if the page layout is up to standard 2. Click on the button to see if the button works | There was small errors with the whole project as a whole, but the button is working fine and taking the user to the home page. | Clicking on the button to take the user to the home page. | When testing was done for the startup page, the button was taking the user to the home page. |
| 2 | Home buttons | On the home page there are six subject buttons which will take the user to their own separate home pages | 1. Clicking on each button to see if it doesn’t crash the app 2. When clicking on the button, seeing how fast the next page opens | When buttons where clicked, it was crashing the app. | When the button was click for example the math page, it opened the math home page. | When all the pages where done, each button was clicked on to see if they navigated the user to the subjects home page. |
| 3 | Math home page buttons | For the math home page, it displayed four sections. | 1. Clicking on each button to see if it took the user to the math topic. | The app was crashing a fair amount of time when clicking on the times button. | When all button where pressed, it would open all topics and the user will be able to learn that topic. | When each button was clicked on it navigated the user to all the topics. |
| 4 | Math: Adding  Diagram  Description automatically generated  Figure : Adding page from math section of the application | The fist math topic and when numbers are added into the textbox and the button is pressed the answer will appear under the button. | 1. Entering a number in textbox 1 2. Entering a number in textbox 2 3. Pressing the button to calculate the answer 4. The answer will appear under the button | The page when entering the numbers was getting the right number when the button was pressed. | When the two number are entered and the button is pressed the answer should appear correct. | By having any numbers added by the user ensured the correct answer when the button was pressed. The answer was viewable below the button. |
| 5 | Math: Times audio | The maths timetable section displayed 1 to 5 with button saying the number. | 1. Clicking on each button to see if the button said the right number | There was error with the images and audio which made the time added to the project extend. | When each button was pressed, for example if the user pressed 4X2 = 8. The application should say each of those numbers. | When clicking on each button, the correct audio file was linked the right number to ensure that the user will know what that number sounds like. |
| 6 | Math: Times navigation | On each timetable page there are buttons to take the user from 1-5 timetable to even the timetable home page. | 1. Clicking on each button to see if the button took the user to the right page | The app was crashing due to button ids not declared. | When each button was pressed it would take the user to 1 out 6 pages. | Whenever the user pressed on a button, it took the user to 1 of the 6 pages. |
| 7 | Math: Minus  Diagram  Description automatically generated  Figure :Subtraction page from the math section of the application | The minus page is similar to the adding page, two textboxes with a button that appears the answer below the button. | 1. Entering a number into textbox 1 2. Entering a number into textbox 2 3. Pressing the button to calculate the answer 4. The answer will appear under the button | As this page is similar to the addition page, there was no error with this page in the early testing stage. | When two numbers are in each textbox and the button is pressed, the answer should appear under the button. | When the user has entered in two numbers, and the button is pressed. The answer is viewing below the button. |
| 8 | Math: Counting audio | There are 50 numbers on this page and each number, when pressed should have an outcome of the correct audio. | 1. Clicking on each button to see if the audio matches the number | The buttons where in error and created an error as when entering the page, it would crash the app. | When each button is pressed, the outcome should be that number | After testing was done, each button had the correct audio outcome. |
| 9 | English home page buttons | When entering the English page there are two buttons that take the user to two English subjects. | 1. Press on the alphabet button 2. Press on the reading button | There was error as there was no code that gave direction to the two English pages | When each of these two button are pressed, it should take the user to the allocated pages. | When each button was pressed, it took the user to the alphabet and reading pages. |
| 10 | English: Alphabet buttons | When clicking each letter, the audio should link correctly. | 1. Click on each button to see if the audio matches with the button | The buttons had an issue with the constraints which was crashing the app. | When each button is pressed, the audio should match the button. | Each button had the outcome of the correct letter. |
| 11 | English Reading  Map  Description automatically generated with low confidence  Figure :Reading section of the application | When the user enters the reading page, they will have three option for the user to go into. There will be many activities for the user to take part in to develop their English skill. | 1. Entering the page 2. Going through the three sections 3. Buttons are displayed to advance the user | there was limited content of this page to develop skills. | To have a fair amount of content to develop a clear understanding in English skill. | After testing and evaluating a third section was added to give the user a wider range of material to develop their English to enhance their communication skill. |
| 12 | English reading: book  A picture containing calendar  Description automatically generated  Figure : Main page of the book from the application | The implementation of book would give the user a more interactive learning session. | 1. Entering the reading page 2. Selecting the book 3. Going through the book which has a button that represents an audio book. 4. The user will be able to go back and forth through-out the pages. | When the next page button was pressed, the application was crashing. The audio file was failing to play due to coding error. | When the user enters the book section, the buttons and the audio files should work so that the user will be able to read alone with the audio file to improve their reading and understanding of the word structure. | After full testing was performed, the buttons and audio files worked which resulted in meeting the sections goals. |
| 13 | English reading: word jigsaw  Graphical user interface  Description automatically generated  Figure : The J page from the jigsaw section in the application | Having the letter displayed and showing four words that start with that letter, to give the user understanding of the word and how to say the word. | 1. Able to go back and forth by clicking on buttons at the bottom of the page 2. Reading and pressing buttons to hear how the word sounds | The layout was displaying two words with none vector images which resulted in an unfriendly user interface. | Implementing four words with vectors with the audio files being more direct on the letter and the word. Explain, A is for apple | After full unit testing was done on the word jigsaw, the buttons of the navigation worked, the audio files improved the functionality of this section by the description of the audio files. |
| 14 | Symbol: buttons | There are four symbol buttons that move back and forth for the user to interactive with. | 1. Pressing each button to see if the take the user to the next page or the previous page | There was button id error which was crashing the app when running. | When the button is pressed it take the user back or forth. | After testing was completed, each button navigated the user back and forth around the four symbol pages. |
| 15 | Symbol: button audio | As there are four pages, each page has 44 button making a total of 176 buttons | 1. Pressing each button to see if the audio matches the symbol | The audio was playing after the issue was made to the button ids and constraints. | When each button is pressed the outcome should be the correct audio. | Each button had the correct audio linked to it. |
| 16 | Text to speech  Diagram  Description automatically generated with medium confidence  Figure : Text to speech page from the application | When the user enters a text into the textbox the outcome should be speak to the user. | 1. Entering a word or a number into the textbox 2. Changing the pitch of the audio 3. Pressing the button 4. Hearing the audio match, the number or word in the textbox | The layout was not up to standard, and it has to be changed to create a more learning environment. | Whenever there is a number or word in the textbox, the outcome should match the textbox and speak it to the user. | While testing was done, the |
| 17 | Art/communication page  Background pattern  Description automatically generated with medium confidence  Figure : Communication canvas from the application | The user will be interactive with the application by using the art function. The children will be able to draw whatever they like, or it can be a form of communication. | 1. Choosing the colour which is suitable for their needs 2. Any drawing can be removed by clicking on the “E” button | Colour where not working while testing and it only the pencil colour was only the default black colour. | All the colours when clicked on should change and the children should be able to use any colour. | When testing was done, all colours and buttons worked, and it worked smooth making this page have many functions. |
| 18 | Quiz: Questions    Figure : Questions for the quiz | When entering the quiz page, they will be able to go through the question and by the end of it a total score. | 1. Entering the page 2. Read each question 3. Answer the question 4. Click submit 5. At the end of the 20 questions a total score will appear. | All questions where not connected to the correct answer which would be an unprofessional function displayed for this page. | If the user gets 60% or more then they will pass the quiz but if not they would have to take the quiz again. Each question has four answers in which the user will have to answer. | When testing was performed, all the questions has the correct answers linked which made the program understand the outcome of the total score. |
| 19 | Login page  Graphical user interface  Description automatically generated with low confidence  Figure : Login page for the application | When the user starts the application they will be able to use their email and password to log into the mobile app. | 1. Enter email 2. Enter password 3. Press button to login | The layout was simple as it was important for the hard code to be working perfectly. | When the user has an account, the details should go through, and the user should be able to use the application. | When testing was done, users details where showing up on the firebase database which resulted in the user having a successful login. |
| 20 | Register page  Graphical user interface  Description automatically generated  Figure : Register page for the application | If the user doesn’t have an account, the user will click on the register text view, and they will be able to create an account. | 1. Click on register text view from the login page 2. Enter email 3. Enter password 4. Press button to create an account 5. Full access to the application | When entering the email and password it wasn’t creating an account as the code was experiencing the error. | For the user to enter their email and password which shows a message saying, account created. | The user can access the register page to create and account by entering their email and password. |

Table :Test case for the whole application

### Text to speech code

Text

Description automatically generated



Figure :Text to speech code from application

This piece of code represents the text-to-speech implementation in the application. As this piece of technology is one out of the 4 that goes towards helping children with SEN in their communication skills. In this section of the code, the set language is English seen at point A, but for future implementation, the language will cover all to benefit children with SEN around the world. When a user inputs text the output will speak the text to be a form of communication for the children. At point B, there was an experience of errors since it was enabled to fail but as that was changed to true, the process for this section resulted positive. Lastly, at point C, the implementation of a pitch bar was needed as children will be able to change the pitch of the spoken text so that they have a better understanding of the person they are speaking to.

### Communication canvas code

**Text

Description automatically generated**



Figure :communication canvas code from application

The communication canvas is a section that the user will be able to use for two reasons, the first to use as a form of communication and the second to use as an interactive art centre. There are four sections to this piece of code. Point A is where the user will be able to select the paintbrush to use to write or draw whatever is on their mind; the base colour is black. When the user is done with what's on the screen, at point B the eraser function is implemented as this is a useful function to have in this section. Point C, covers five colours for the user to choose from to give they a range of creatively if they want to use this section for art. At point D, this just tells the user what colour the paintbrush is and every time they change through the six colours, it will interact with them.

### AAC symbols code

**Text

Description automatically generated**



Figure :forth page of the symbol code from application

The AAC device is displayed as the symbol of learning and the piece of code has three functions which are implemented across the four symbol pages. Point A, displays the image button with a description of what that symbol is, in this case, it's the "I'm thirsty" symbol. It is linked to an audio file seen at point B as when the user clicks on the image button the output will say the symbol. It is then paired with a media player ID to give structure within the code, seen at point C.

### E-learning code

**Text

Description automatically generated**



Figure :From the maths adding section code from application

One of the four technologies to benefit SEN is E-learning. This piece of code is from the math adding page. There are three important points for this section. Point A shows when the user inputs a number in textboxes 1 and 2 and when they proceed they click the button to see the answer. That calculation is done by viewing at point B, where num1 is added to num2 to see the result at point C, where the answer is justified.

### Quiz code

**Graphical user interface, text, application

Description automatically generated**

Figure :Questions and answers from the quiz section from the application

This last piece of code is from the quiz section. As seen at points A and B, there are four answers for the user to choose from, and when they think they got the answer the submit function is implemented. When they advance to the new question it will load a new question and the total of the final result is displayed at the end of the quiz. Point D is displayed on another Java file which shows the questions, the choices and the answers which are all within a string function.



RESULTS / DISCUSSION

Introduction

We have conducted extensive testing on the mobile application in recent weeks. One of the most difficult aspects of developing a mobile app is guaranteeing that it meets the needs and interests of its users. During testing, we had up to 31 participants who provided honest feedback on the application. Even so, it is essential to not only collect feedback but to additionally act on it to make significant changes to the app. The application was created to meet the aims and objectives, and it is essential to have a clear overview of the whole project. Feedback was required for the project to get a clear picture of what's good about the app and what needs to be improved. The project's goal was to create an application that would aid in the learning of children with special needs.

This research discusses the requirement of an eﬃcient method of collecting and implementing user feedback in the mobile application. Since user testing is an effective instrument for discovering ways to improve, purely offering perspectives without making decisions is often inadequate. To make significant improvements to the app, an overall structure for gathering and analysing user feedback was required

The purpose of the testing was utilized to create a form while in-person and online meetings took place. Each tester filled out a 27-question form so that the project could get a clear understanding of how well the app was designed or what could be improved for further development.

The questions were designed to target each learning section in the application, so the project was able to observe the results of the testing. Since this application is divided into six sections, finding the mean values for each portion is all that is required.

## Questions from the form

Graphical user interface, application

Description automatically generated

Figure :Displaying the math section questions from the testing form

Graphical user interface, application

Description automatically generated

Figure :Question 26 & 27 showing a full discussion and the rating of the whole application

The 31 participants took part in testing the application and once the testing was done they processed to fill out a Microsoft form which had 27 questions so that data on the application can have an overall result. There were sets of questions which targeted each section of the application from maths, English, symbol learning, text to speech, communication canvas and the quiz. The questions given to the participants displayed if that section would benefit children with SEN, how well the functions were implemented, an improvement section and lastly a rating for that section. Each section with their rating is displayed below to give a clear overview of the project. The purpose of having a form created for the participants gave a set rating for each section and if the participants wanted to give feedback on what to change for any future works. In any project, feedback is rather important as it helps build a clear understanding of what to improve about the project. Receiving feedback gave an understanding of what to improve in the future as said in a section of the report 6.2.

## Math rating section

The data collected from the form received an average rating of 7.45 for the maths section. According to the responses, the maths section was designed in the appropriate way to benefit children with SEN, as 28 people out of 31 participants thought it demonstrated a detailed understanding of improving their maths skills. Additionally, 29 participants agreed that the function of the math section ensured that it accomplished its goal of providing children with SEN with a clear understanding of how maths can be set out to improve and benefit their learning. As the qualitative test collected responses from the form end-to-end questions, it indicated that testers acknowledged the math section for being engaging and interactive for the children. However, with this feedback, there is room for improvement in the maths section. As responses came in, it was stated that more activities, including workout sheets and increased timetables, could have been implemented to improve user experience.

Figure :Participants ratings for the math section

The maths section has changed significantly since the application's original blueprints to ensure that the children can find the apparent methods for helping them understand the maths criteria. Despite the modifications before the testing was done, the maths section needs to be redesigned based on the feedback received to ensure that the application meets more requirements in future testing.

## English rating section

Progressing on to the English section, which is an important part of the application, aims to improve the reading and communication skills of children with SEN. According to 18 participants, the English section offered appropriate context for students to develop their reading and communication skills. From the responses received, 28 participants appreciated that the book was implemented into the application, as it would make children stay active during the reading progress to ensure that children would enjoy the use of reading alone to help them develop further reading flow. Nevertheless, 21 respondents agreed that the jigsaw section offered an appropriate variety of learning materials to assist children with SEN in enhancing their reading and communication skills. When participants were asked to rate the English section, it received an average rating of 7.68, indicating that the testers agree that the material displayed is designed in a useful range of knowledge to assist the children.

Figure :Participants rating for the English section

The qualitative result demonstrates that 14 participants filled out the section for a room for improvement, illustrating a positive feedback process. There was a correlation that ensured more books should be added to the application because they felt it would give the children more options for expanding their reading skills. Nonetheless, more words should be added to the jigsaw section, followed by additional worksheets to assist children with spelling and handwriting. Following the data and feedback gathered, the English section was effective and yielded positive results.

## Symbol rating section

AAC devices are an essential tool for children with special needs since they offer an accessible function for improving communication skills. The goal of this section was to create a section that would allow the children to communicate using symbols. As AAC devices are becoming more popular among people with special needs, we needed feedback on incorporating one into the application. According to the form data, 22 participants agreed that the built-in AAC fulfilled its intended function. Based on the data, the symbol section received the highest average rating of 7.87. But even so, while most testers thought the audio was loud enough, 11 participants had mixed reviews. The improvement would be a function to increase the volume for each symbol based on the data obtained. Despite this, this statement was only mentioned twice in the improvement section. In terms of the improvement responses, ten of the thirteen testers would have liked more symbols added to this section because they felt the four pages with 43 symbols each was insufficient. Even though, with this statement, this section can be further developed to improve its features and Functions.

Figure :Participants ratings for the built in AAC device

Overall, the qualitative test results for this section are positive, and the user experience is effective. Since this section is simple to navigate, one improvement that could be made is to include a word under each symbol to help children understand which symbol means what. The findings of this study indicate that additional development can be implemented to improve the user experience and give children a more direct indication of the symbols displayed.

## Text to speech rating section

Text-to-speech is a new feature in the application that allows children to enter any word they want to communicate with. The feedback gathered on what to improve in this section focused on the layout rather than the function. Eight of the eleven responses preferred that the textbox be displayed in the centre of the page. The goal of this section was to have a text-to-speech section to ensure a benefit in their communication skills, and we can see from the data that 27 participants agreed that the functionality came back effective enough to demand a suitable function. We asked for a rating on the form, and the data showed an average rating of 7.65. The test feedback is such an essential part of further development but from the responses to improve this section, the data is limited.

Figure :Participants ratings for the text to speech section

According to the graph above, the qualitative test ensured a positive outcome based on feedback from the testers. Since this section provided the testers with a suitable section, which overall has similar layout improvements, the frequency of the results demonstrated an effective solution to help children with SEN.

## Communication Canvas rating section

This section was designed to allow children to communicate by having them draw words, but it can also be used to allow children to draw whatever they want. In comparison to the form results, 30 out of 31 participants believed that the function of the art/communication canvas would benefit children with SEN in terms of communication and how interactive this feature was programmed. Based on the data gathered, this section proved to be an effective user experience. Six participants commented on how this section could have been improved by adding more colours, while another six wished that the art could be saved. Three respondents suggested that shapes could have been used in this section. Based on this feedback, future development will be made by adding these three improvements to this section, as it would provide a strong connection between the database and the creative side, allowing the children to be freer while this section is being developed.

Figure : Participants ratings for the communication canvas section

According to the overall results, the qualitative data collected by the form was another positive result, receiving an average rating of 7.48. As previously stated, this section will seek to improve based on feedback to improve the user experience.

## Quiz rating section

The quiz was designed to give the children an overall test to see how much they had learned from using the application. As there are questions on maths, English, and how to greet one another, moving onto general knowledge. The quiz feedback was intended to ensure that the quiz met its aims and objectives. From the evidence obtained the outcome feedback came back positive as 9 of the participants scored the quiz as extremely well, 12 as good, 7 as fair, and 3 as balanced. This information indicates that the quiz was well-designed to ensure that children with special needs could pass it. The 27 participants who stated that the questions were appropriate for children with SEN are responsible for this result, as the questions reflect tasks and activities from other parts of the application. The overall average rating from these two groups of data collected was 8.16, making it the highest-rated section in the application.

Figure :Participants ratings for the quiz section

Nevertheless, this section received the highest rating. Seven testers ensured that more questions were displayed. The quiz already has 20 questions, but they would like more, and some stated up to 50. However, another six testers mentioned that there could have been more than one quiz, possibly one for each section of the application. By acknowledging that the findings indicate a positive and useful feature that provides the user with a suitable user experience, the qualitative test indicates that the quiz is an engaging and effective way to help children with SEN continue improving their intellectual capabilities and academic success.

## Applications overall rating

The purpose of this testing that carried out ensured that the application would get feedback to improve how the application will be in the future. As the 30 participants provided positive feedback on each section, the information collected for the overall discussion came back positive, as most of the feedback gained mentioned that the application would benefit children with SEN in developing their learning and communication skills.

Figure :The overall ratings for the application from the 31 participants

As the result showed that the application received an overall rating of 7.77. From this rating and the feedback collected, it suggests that this application met its aims and objectives of having effective tools to improve the learning experience for children with SEN. From the responses from the form, 27 participants stated that the application met its aims and objectives by having the right set of features and functions to assist children with SEN in the development of learning, communication and life skills.



CONCLUSIONS / FUTURE WORK

## Conclusions

The project required a type of technology which will have a beneficial impact on children with SEN. As stated in Chapter 2, the tables of technologies gave an overview of the types of technologies which can help children with SEN with their communication and learning skills. Out of the five technologies suggest, four techniques were chosen to be implemented into the application. Text-to-speech, interactive screen, AAC device and E-learning. The reason for this is because these four are the most effective to ensure that the children with SEN get the best support and learning experience while using the application. These four provide suitable means which help the children with SEN develop skill in communication and growing in their education value. The application Learning With U has generated positive feedback to say that the project is a success. The project had numerous participants supply feedback to get a strong result on understanding if the application met its purpose. As this application was created to benefit children with SEN, the design of the application was suitable for children as a whole. There was an element which attracted children such as bright colours, animals and the simplicity of the interface. Making an application that is simple for the children to use on their own is what is important, to get the children to learn on their behalf and having the right set of learning resources can develop them further. From the feedback gathered from the 31 participants, the user interface, the layout structure, the navigation system and the look of the whole app, all came back positive. These results showed that the application was a success as it bought the right set of learning resources and interactive activities. The project aimed to have the children involved in learning and to get the children more development in education, communication skills and life skills.

Research ensured that the application was created in a manner to suit all types of SEN. However, the application was tested with children with SEN only participants who thought that it help their needs to help them advance in communication, learning and life skills. As there are functions in the application to help all at the same time while in the learning process. As there are four broad special needs groups, the application due to its results ensured that the children would have a positive experience while using this application. Children with learning difficulties can benefit from this app, children that are on the autism spectrum find it hard to communicate and there are resources such as the symbol learning section, if children have problems with their emotions there were materials on the application that consists of drawing or reading. For children who have physical difficulties, the text-to-speech and the whole application can help them to get the best possible learning experience.

As the feedback ensured that the application was up to par for these children and revising feedback messages of great for communication, simple navigation and very interactive, good attention to detail for understanding how children with SEN learn, etc. These results show a positive but although the application is always looking for improvement, the form supplied a fair amount of improvements for the app in future works.

## Future work

Learning With U got positive feedback but there was feedback to advance the future work of the application. There is always room for improvement in app development. The layout and the theme of the application won't see an improvement as it got positive feedback and for any application, to have something unique like the logo and the colour scheme can make the functionality of the app come together.

Although the math section is such an educational perspective for the children who undertake the activity, the room for improvement is there. From the feedback gained they wished that the time section went up to the 12 times tables instead of finishing at 5. The reason behind this is because children work on different levels and children who are working on a higher level would want to learn further than the 5 times table. This would also help the application as a whole because it grows in learning resources the growth to also. To finish off the math section, one review came back saying that division should have been added. In the easy stages of development, the division was kept out as it might have been too difficult for the children to take part in, but learning is about growing, and to learn something you must try it. For the future of the math section, a new division activity will be added to ensure that all basic math knowledge is displayed for the children to undergo.

The feedback gave the application insight of seeing how every section can have improvement, English is where the children can learn to read and learn to develop their communication skills further. Although, the English section got an average rating of 7.68 the improved feedback came back positive. As they thought the implementation of a book was an effective idea to have in the application as it would bring the children into a reading state for them to develop further. They wished upon having more books implemented in the English section. For the future of this section, when the user enters the English reading section there will be a button to direct the user to a library where there will be a series of books for them to read. This gives the application more functionality of the required scope further, as the children will be able to read all types of the book due to their level of education. Another implementation to be added to the English section is a vocabulary wall where this section consisting of a more advanced jigsaw word section. These words will tell the user about grammar, and word structure and when to use the right word in a sentence. This newly added section will help the children learn more about speaking to form a beneficial communication standpoint in the real world. Having these elements implemented for the future can help the children further develop their reading and communication skills.

The built-in AAC device is an important function of the application as its one of the most used technologies to assist children with SEN, and although the feedback came back positive all improvement feedbacks wished that there were more symbols for the children to use. The symbols used in the application are basic communication phrases but having more can ensure that the children can use find them to advance their knowledge of all aspects of communicating and knowledge of what symbol is which. However, each symbol page has 43 symbols it can be rather difficult to remember what symbol represents what, by displaying the word or phrase under the icon will be a slight improvement to the functionality of the pages as it helps the children out a lot.

The text-to-speech section had very positive reviews which resulted in an average rating of 7.65. Although, this rating is stated there was a fair amount of similar feedback improvements. The layout was an issue that occurred as the textbox at the top of the screen was experiencing some faults. When the user would type a long sentence they would find it hard to read what they wrote. So, moving the textbox into the centre of the page would solve this issue it would create a more professional layout standard for the application, and it would leave room for valuable design patterns. Another feature that could be added for the future of this page is by implementing a second bar which represented volume. Children who find it hard in hearing would benefit from this sound bar as they would be able to increase the volume to help the person they are talking to hear what they have said. This would improve the functionality of this page by changing and adding two implementations.

The communication canvas was created for another form of communication. Many children might find it hard to type a word out and this page revised positive feedback as 30 testers agreed that it would benefit the children with their communication and that the function of this section would make the children more engaged. From the feedback, three points were stated to improve this section. The implementation of having a wider range of colours would be beneficial to the children as they would be able to draw anything they like in any colour. There are only four colours on the page and that can be changed with a colour wheel making the children unlimited colours to choose from. This would make the art side of this page have more life as children with SEN enjoy creating things of their mind and this can be a healthy exercise to perform. Regardless, three feedback statements out of 19 would constitute a brilliant contribution to the page, as it brings a creative feature to the page to build on the development of the children. Finally, since the application is linked to a database, the artwork should be saved and stored on the user's profile. This would represent a relatively insignificant but meaningful enhancement to the application as a whole because the children would be able to print and view their artwork at any time.

The quiz section is the highest-rated section of the application, but 12 comments were so similar on how to improve this section. Some wanted questions to range from 20 to 50 and some wanted there to be at least 5 quizzes to match the level of education. However, the quiz size of 20 is a suitable amount for the children to undergo but if the questions change the difficulty as the moving up questions, which would be effective implementation. On the other hand, having the quiz to be updated daily or weekly would be beneficial as having a quiz too long might make the child bored and children with SEN like to stay interactive with simple and enjoy content and 50 questions can make the child not interested which would result in the application in a fail. Despite the types of SEN, the level of education can range making it a long process to create more than one quiz. The best method for the overall process is by having a quiz that ranges in difficulty when you advance up the questions, this would make the children more involved as they would have to think more.

There were a significant number of similar comments in the maths and English feedback sections that expressed a desire for worksheets. As a result of this positive feedback, a new section called Prints will be created. Learning With U will create the worksheets, and the children will be able to print maths and English worksheets to complete at home or school. The math section will include usual math sheets beginning with adding sheets, subtraction sheets, multiplication sheets, division sheets and one mixed math sheet. This would put the children to the test and further develop their maths skills. Children must test their knowledge with these worksheets and if they require assistance, the application can always lend a helping hand; the same goes for their parents and teachers. The English section will be slightly different, but the concept will be the same, with worksheets on spelling, handwriting, grammar and punctuation. It is essential that the children interact with the application and the resources that it provides but would benefit them in performing the task in person. It creates a more effective learning environment in which the children can actively engage.

## Legal, Social, Ethical and Professional Issues

### Legal

In terms of legal issues for this project, the Data Protection Act 2018 ensures that any personal information collected from testers will be collected, stored safely, and kept confidential. Even so, once this app is up and running if the data is not safely protected, it may have an impact on personal data. When unauthorised access exceeds security access, the Computer Misuse Act of 1990 will review the situation and ensure that the data is not altered. This could be a factor because the user's login information will be stored on an online database. Although this application is designed for children, access to the Freedom of Information Act 2000 is understandable. This may have an impact on the project, but with a formal request, all information will be generated and made available to the public. This application was designed primarily for children with special needs, and the Equality Act of 2010 aims to protect all people from discrimination in society. So, this project will aid in the understanding and development of SEN from an educational standpoint, they must first understand what SEN is. This has a significant impact because having an opinion of anyone is wrong.

### Social

The objective of the project is to develop technology that will benefit children with special needs. Even though this application has an educational goal, it was designed for all children, not just those with SEN. Some resources are available to everyone and will aid in maths, reading, art and having a quiz. It is about creating an application that all children can use to learn in a fun way and to interact with all activities since it's an excellent learning exercise. As social awareness of SEN grows, so should its pervasiveness. All children with SEN are bright and creative, and the more technologies like Learning With U that are available, the greater the awareness. When developing any technology, it is vital to think about how long the project will be sustainable. Since everyone owns a smartphone or tablet, they will be able to download the application from the online store. Even though there is a major global issue occurring in the Congo's cobalt mines, the future of technology must find a way to avoid making devices that use slavery and unsustainable materials.

### Ethical

As this application is designed for children with SEN, the content displayed will ensure the safety and well-being of the users to wish for no violence or abuse. Safeguarding Vulnerable Groups Act 2006 aims to be comprehending the knowledge of SEN to protect all users wellbeing. As a risk assessment was created in the above chapters to outline any possible risks that could occur during the development of this project. Many issues and risks did occur, but they were taken care of before the impact grew. When testing was in process of the application the Health and Safety Act 1974 had to be taken into account, as the goal is to keep all links to the project left in a safe manner.

### Professional

As stated above, the project is for everyone as this code of conduct is linked to the equality act 2010. No discrimination is accepted as this project isn't just linked to one group to use the application but to all groups. As the application is an educational product, the resources displayed can help any develop further within education. During the development of this application, all legislation was followed to keep professional standards to ensure that all legal issues were considered and performed during the completion of the project. Although this application is designed for a child audience, it has been designed in a professional manner to be repented in a positive atmosphere. The impact if the application were designed differently could have altered the whole project leaving the project not achieving its aims and objectives.

## Synoptic Reflections

At first, I was always thinking about the end which was the 21st of April but it's the journey that means so much more. Coming to NTU, I have learnt a fair amount, but most skills developed are from me putting in the time to make who I am today. For this project, I’ve put so much effort as I became very passionate towards the subject of SEN and only wished to learn more about it. From having this knowledge, I might advance in this field and work with technology to help special needs children or disabilities as a whole. I’ve always been someone to have an eye to help someone, more than myself and I wish to only help people further after my time at NTU. I’ve been studying computer science since year 9 and I can say that my skill in researching, coding, and designing an application has all grown but there's always room to go further to become better. I would never have of thought coming to university and I’ve gave it a go and tried my hardest to perform the best possible work. My time at NTU might be coming to an end and I will never forget the memories that have solidified in my subconscious but to think about what's right is very hard to tell. In my third year, I’ve developed two mobile applications and after university, I would love to go into mobile development as I'm most passionate about that subject. This project as a whole has developed me to learn new skills which I can take further when I start working. I want to thank all the staff for my three years here at NTU.

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