**Revision Master**

CS39440 Major Project Report

A blue and white logo

Description automatically generated

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**Declaration of originality**

I confirm that:

* This submission is my own work, except where clearly indicated.
* I understand that there are severe penalties for Unacceptable Academic Practice, which can lead to loss of marks or even the withholding of a degree.
* I have read the regulations on Unacceptable Academic Practice from the University’s Academic Registry (AR) and the relevant sections of the current Student Handbook of the Department of Computer Science.
* In submitting this work, I understand and agree to abide by the University’s regulations governing these issues.

Name: Lauren Davis

Date:

**Consent to share this work**

By including my name below, I hereby agree to this project’s report and technical work

being made available to other students and academic staff of the Aberystwyth Computer

Science Department.

Name: Lauren Davis

Date:

**Acknowledgments**

I am incredibly grateful for the advice and motivation given throughout the project from Chris Loftus, and for the weekly meetings which have been incredibly useful for keeping the whole project on track. I am also thankful to Neil Taylor for his support throughout this year.

MAM, NAN, GRANDPA, DAN & others

**Abstract**

The Revision Master application is designed to help students

**Remember - fail to prepare, prepare to fail!**

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**Chapter 1 (2549 words)**

# Background & Objectives

## 1.1 Introduction

This project is an android-based project, where the aim is to ensure that people have free access to a suitable revision tool where key features are not hidden behind a paywall. This application was designed with students in mind, and what they require from revision applications.

## 1.2 Background

This section is going to give an overview of the problem I am trying to tackle in this project, some research into the learning styles of students, revision methods which have proven to be effective, and some existing solutions.

### 1.2.1 Problem Overview

In today’s educational landscape, students encounter the daunting task of keeping pace with the ever-expanding volume of information they must grasp and remember. While traditional methods prove effective for some, they can be resource-intensive and impractical for those seeking more flexible learning options. Enter modern revision applications, offering a multifaceted solution to this challenge. These platforms boast features catering to diverse learning styles, including visual aids like flashcards with images and diagrams, as well as auditory tools such as text-to-speech capabilities.

However, a significant obstacle stands in the way of widespread access: paywalls. These barriers hinder many students from benefiting from these invaluable resources, thus perpetuating inequalities in educational opportunities. Therefore, it is imperative to bridge this accessibility gap, ensuring that all students, regardless of financial constraints, can engage with these effective revision techniques. By doing so, we can level the playing field and empower every student to achieve optimal learning outcomes and academic success.

### 1.2.2 Learning Styles

#### Introduction to Learning Styles

Learning styles refer to an individual’s approach to studying and retaining information. While there’s debate about the effectiveness of rigid learning style models, it is still valuable for students to identify their preferences and customise their study strategies accordingly [1].

#### Popular Learning Style Models

Various models have been developed to categorise these styles - with the simplest being the Visual-Auditory-Kinaesthetic (VAK) model, proposed by Walter Burke Barbe, which identifies three main modalities:

1. **Visual Learners** prefer when information is given to them through the use of diagrams, charts, graphs, and videos. They often benefit from seeing information in a more structured format, such as written notes and handouts.
2. **Auditory Learners** absorb information through listening, they prefer lectures, discussions, audiobooks, and verbal instructions. They often benefit from engaging in conversations and explaining concepts out loud to themselves or other people.
3. **Kinaesthetic Learners** are more hands-on with their learning, using physical activities to engage with material – such as movement, touch, and experimentation. They often benefit from interactive tasks and real-world applications of concepts. [2]

While the VAK model provides a foundational understanding of learning styles, further models have been developed to expand on these classifications. For instance, Neil Fleming’s VARK model, which incorporates two additional modalities: Read/Write and Multimodality. Although not considered a learning style, the Multimodal category allows for individuals to be categorised appropriately when they fit equally across two or more areas. [3]

#### Cognitive Approaches to Learning Styles

Although there are numerous models which could be mentioned, there is another angle which focuses on the cognitive approach rather than learning modalities. The Grasha-Riechmann Learning Style Scale, which was developed to analyse the various attitudes of students towards different aspects of academia. There were 6 styles identified:

1. **Competitive** students learn the material in order to perform better than others in class, they feel as though they must compete for greater rewards and attention for their achievements. Their preferences include being group leaders, domination of discussions, and activities where performances are ranked.
2. **Collaborative** students learn by sharing ideas and material, they cooperate with others and enjoy groupwork. Their preferences include lectures with group discussions, seminars, and group projects.
3. **Avoidant** students tend to perform poorly, unenthusiastic about learning, and do not engage with others. They often get overwhelmed by what is going on. They generally have a lack of interest in most classroom activities, they would prefer no exams or tests, and a more relaxed teaching style my appeal to them.
4. **Participative** students engage well with others, they are good at accepting responsibility for their own work and will make the most of all opportunities. They usually prefer lectures with a discussion and any opportunity to discuss the material.
5. **Dependent** students often show little intellectual curiosity and only learn what is required, they will rely on others for structure and support, and dislike change. They prefer clear deadlines and instructions for assignments, clear outlines, notes, and as little ambiguity as possible.
6. **Independent** students will think for themselves, they prefer to work alone but will listen to others’ ideas, they will learn the content they feel is important and are confident in their ability. They prefer independent study, self-paced instruction, assignments which give them the opportunity to expand on their ideas. [4]

#### Practical Applications of Learning Styles

During various levels of academia, teachers often encourage students to explore and identify their own learning styles. This exploration fosters a degree of self-awareness and encourages students to adapt their study techniques to suit their individual strengths and preferences. By recognising and embracing their unique learning styles, students can optimise their revision strategies and enhance their academic performance. For example, a visual learner will likely benefit from creating flashcards, concept maps and diagrams, while an auditory learner could record themselves explaining concepts and listen back for review. (SRC)

#### Resources for Identifying Learning Styles

To aid in the identification of their preferred learning styles, various online tests and assessments are available. These tools provide valuable insights into the preferences in learning and guide the development of personalised study strategies. By leveraging these resources, students and educators are able to tailor learning experiences to suit individual needs, ultimately fostering more effective outcomes. (SRC)

### 1.2.3 Revision Methods

Traditional revision methods usually involve the use of textbooks and paper notes, which can be inconvenient and ineffective for retaining information. Students face challenges in revising facts and concepts effectively, especially with the increasing volume of information they need to learn and retain. While tried and tested, traditional methods like passive rereading of notes or highlighting passages often do not lead to the deep understanding required for long-term retention. To combat this, more effective, evidence based, revision techniques have gained popularity, focusing on engaging students with the material. (SRC)

#### Active Recall

Active recall is an incredibly effective study method which involves actively retrieving information from memory rather than passively reviewing materials. Instead of simply re-reading notes or textbooks, active recall requires students to actively engage with the material by actively trying to remember it. There are several ways to implement active recall while studying:

1. **Self-Quizzing** – Students can create their own questions based on their study material, encompassing definitions, key points, and application-based scenarios. Regularly testing with these questions promotes greater retention.
2. **Flashcards -** Flashcards are a classic tool for active recall. A question or cue is written on one side and the answer on the other. The student quizzes themselves on the cards, focusing on retrieving the answer from memory before revealing it.
3. **Practice Tests** - Answering practice tests found online or in textbooks forces students to recall information under timed pressure, similar to an exam scenario.
4. **Explain it Out Loud:** A student can explain a concept they are learning to someone else or themselves. Explaining the information in their own words helps solidify understanding, they could record this for later review to identify areas needing further study. (SRC)

Active recall is effective for several reasons:

* **Strengthens Memory** - Actively retrieving information from memory strengthens neural connections associated with that information, making it easier to recall in the future.
* **Promotes Understanding** - By actively engaging with the material, students deepen their understanding of concepts and how they relate to one another.
* **Identifies Weaknesses** - Active recall helps students identify areas of weakness or gaps in their knowledge, allowing them to focus their efforts on areas that need improvement.
* **Improves Long-Term Retention** - Because active recall requires effortful retrieval, it leads to more durable memories, resulting in better long-term retention of the material. (SRC)

#### The Feynman Technique

The Feynman Technique is a method for understanding complex concepts by simplifying them and explaining them as if you were explaining the concept to a beginner. The technique consists of the following steps:

1. **Choosing Concept** – The student will pick a concept which they want to understand better, usually something quite challenging.
2. **Teach it to a Child** – The student will then explain the concept as though they are teaching it to a child, using simple language and avoiding technical terms. This forces them to break it down into its most basic form, which ensures that the student truly understands it.
3. **Identify Gaps** – As the student explains the concept, they should pay attention to the areas where they struggle to explain, or it becomes unclear. Then they should review the material again, focusing on those areas, trying to simplify the explanation further until they can explain the concept clearly and concisely.
4. **Review and Refine** – After their explanation, they should review it again and see if they can further simplify or clarify any aspects. The goal is to create a clear, concise, and understandable explanation which anyone can grasp, regardless of their background. (SRC)

The Feynman Technique is effective for several reasons:

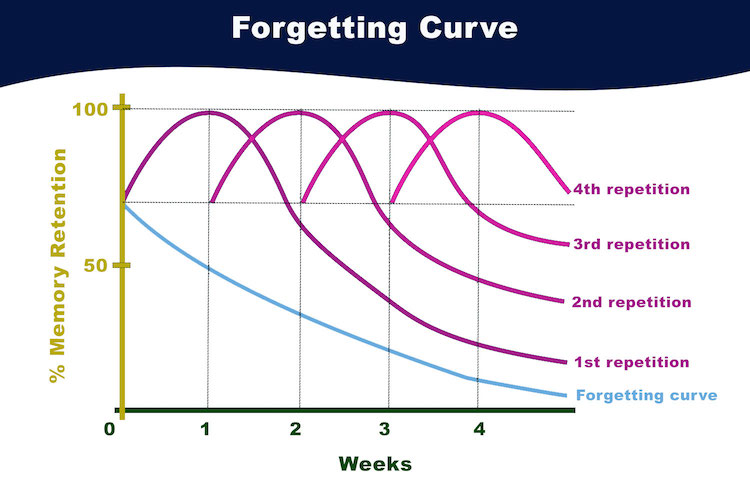
* **Forces Active Learning-** By teaching the concept to someone else, they are actively engaging with the material and reinforcing their understanding.
* **Identifies Gaps in Understanding** – The process of simplifying and teaching the concept can reveal misunderstandings in knowledge, allowing them to address and deepen their understanding of the topic.
* **Promotes Deep Learning** – Breaking down complex concepts into simple explanations require a deep understanding of the material, therefore, this technique encourages this depth of understanding through the explanation of the concept in their own words. (SRC)

#### Spaced Repetition

Spaced repetition is a powerful strategy based on the concept that reviewing information at increasingly spaced intervals optimises long-term memory retention. It is completely opposite to cramming, rather than learning information in a short time period which leads to quick forgetting, spaced repetition helps transition information from short-term to long-term memory. The process is as follows:

1. **Initial encounter** - The information is learnt for the first time, studied as normal, through reading a textbook, watching a lecture, or completing practice problems
2. **First review** – After a short interval, typically within a day or two of initial learning, review the material. This first review helps solidify the information into the student’s memory.
3. **Second review** – The next review will occur after a slightly longer interval, usually a few days to a week later. By spacing out these sessions, the student is actively engaging in the retrieval process, which strengthens memory retention.
4. **Subsequent review** – As the student continues to review the material, the intervals between review sessions gradually increase. The spacing is determined by a spaced repetition algorithm, which calculates the optimal timing for each review based on the student’s performance and the forgetting curve. (SRC)

The algorithm is designed to schedule review sessions at the right moments to maximise retention while minimising the time spent studying. One of the most well-known algorithms used for spaced repetition is the SuperMemo algorithm which uses the following principles:



(FIGURE SRC)

* **Forgetting Curve** – The algorithm considers the ‘forgetting curve’ which describes how information is gradually forgotten over time if it is not actively reviewed. By scheduling review sessions before the information is likely forgotten, reinforces memory retention.
* **Retention Interval** – After each review session, the algorithm calculates a retention interval based on the performance during the session. If the information is recalled accurately, the interval before the next review is extended, if not – it is shortened.
* **Adaptive Scheduling** – The algorithm adapts to individual learning pace and performances; it adjusts the timing of the review sessions based on how well the material is recalled. This ensures that more time is spent on difficult concepts. (SRC)

### 1.2.4 Gamification

The gamification of revision involves integrating elements of game design and mechanics into the process of studying and reviewing material. This can include various different features such as points, levels, achievements, leaderboards, challenges, and rewards. The goal is to make learning more engaging, enjoyable, and motivating by appealing to the human desire of feeling accomplished and competition. The effectiveness of gamification in revision and learning stems from several key factors:

* **Increased Engagement** – Games are inherently engaging and can capture students’ attention for extended periods, therefor by transforming revision into a game-like experience, students are more likely to stay focused and motivated to participate actively in the learning process.
* **Enhanced Repetition** – Games often involve repetition, feedback, and reinforcement, which are known to enhance memory retention. By incorporating these elements into revision activities, students can reinforce their understanding of key concepts and improve long-term retention.
* **Immediate Feedback** – Games provide immediate feedback on performance, allowing players to assess their progress and adjust in real-time. This instant feedback loop is conducive to effective learning, as students can identify areas of weakness and address them promptly.
* **Sense of Achievement** – Games offer a sense of achievement and progress as players overcome challenges, earn rewards, and advance through levels. This feeling of accomplishment can boost students' self-esteem and motivation to continue learning.
* **Competition and Collaboration** - Gamification can foster healthy competition among students, driving them to strive for excellence and outperform their peers. Additionally, collaborative elements, such as team-based challenges or multiplayer modes, promote cooperation and peer learning. (SRC)

Overall, gamification of learning and revision makes revision more enjoyable, interactive, and effective by leverage principles of motivation and engagement that appear in games. By transforming learning into a dynamic and immersive experience, revision techniques can lead to improved academic performance and a deeper understanding of the subject matter. (SRC)

### 1.2.5 Existing Solutions

There are solutions which already exist for this problem, however, as previously stated – many restrict effective use unless paid for. The best example which combines the various methods of learning styles, and revision methods – would be Duolingo. While it is not a user made revision program, it stands out as a highly effective revision application for several reasons:

1. **Engaging** **Interface** –The user-friendly interface and gamified approach makes learning languages enjoyable and engaging. Users will progress through levels, earn points, and unlock achievements as they complete lessons, which creates the sense of accomplishment that human nature looks for and encourages them to continue.
2. **Adaptive** **Learning** – The platform utilises adaptive algorithms to personalise the learning experience for each user. Lessons become progressively more challenging based on induvial proficiency levels, which ensures that users are continually challenged and engaged with their learning.
3. **Variety** **of** **Learning** **Activities** – The platform offers a variety of interactive learning activities, including listening exercises, speaking practice, vocabulary drills, and grammar lessons. This diversity helps to reinforce learning, information retention and accommodates different learning styles.
4. **Immediate** **Feedback** – Users receive instant feedback on their responses, helping them identify and correct mistakes in real-time, while making them correct them before the lesson ends. This immediate feedback loop is essential for effective learning and retention.
5. **Accessibility** – It is accessible across multiple devices, including smartphones, tablets, and computers, allowing users to learn anytime, anywhere – as long as they have an internet connection. Additionally, the platform is available free of charge, making it accessible to a wide range of learners but it does have restrictions in how many times a user can make a mistake which can reduce learning motivation if they have to wait for their “lives” to regenerate.
6. **Community and Social Features** - It fosters a sense of community among learners through features such as forums, leaderboards and competition for rankings, and the ability to connect with friends. This social aspect encourages collaboration, competition, and peer support, enhancing the learning experience.
7. **Evidence-Based Learning** – The programs methodology is grounded in research and evidence-based practices in language acquisition. Lessons are designed to maximize learning efficiency and effectiveness, incorporating principles of spaced repetition and contextual learning.

While there are various other applications like Quizlet, which is also effective for the same reasons as above but is based on user-led revision – I feel that Duolingo is the best example as it is the most popular application for learning.

## 1.3 Analysis

GENERAL ANALYSIS HERE

### 1.3.1 Data Storage

As this application is developed for Android devices, there are a few options for data storage – the user could have all their data stored internally in a private database, a Cloud solution using Cloud Firestore, or a Realtime database using Firebase.

WHY NOT INTERNAL

Using an internal database would remove the option for collaboration among peers and teachers.

Implementation issues in past

CLOUD VS REALTIME

### 1.3.2 Security

Built in auth, rules in database, user auth

### 1.3.3 Objectives

Define FR & NFR

## 1.4 Process

### 1.4.1 Development Methodology

Multiple methodologies were researched before I decided which one I wanted to try, this included looking at the project requirements – the timeline, the scope and complexity. I assessed how much I believed I could get done each week and started to look at the different agile methodologies. I also had to consider the fact that I am a solo developer, I do not have the advantage of a team – which then led to me looking at a combination of methodologies. Especially as each methodology had aspects which could be incorporated into my development process, along with their own advantages and disadvantages.

While a plan-driven approach such as waterfall is something I am used to – I found that it would be much harder to complete all required aspects of the project on time if I followed the waterfall process.

Therefore, the main methodologies I focused on were Scrumban and Feature-Driven Development (FDD), it was to be a combination of both.

FDD

Scrumban

What actually happened: XP

However, due to circumstances beyond my control – I had to take a more eXtreme Programming (XP) approach.

### 1.4.2 Testing Methodology

Plan for user tests, personal tests, test table, automated testing (NO)

**Chapter 2**

# Design

## 2.1 Overall Design

## 2.2 Programming Languages

## 2.3 Libraries

**Chapter 3**

# Implementation

## 3.1 General Approach

## 3.2 Iteration 1

## 3.3 Iteration 2

## 3.4 Iteration 3

**Chapter 4**

# Testing

## 4.1 Manual Testing

## 4.2 User Testing

**Chapter 5**

# Evaluation

## 5.1 Methodology

## 5.2 Technologies

## 5.3 Requirements

## 5.4 Design

## 5.5 Implementation

## 5.6 Testing

## 5.7 Future Work

## 5.8 Starting Again

Starting again, I would just not be friends with a terrorist.

## 5.9 Conclusion

**Appendices**

**Appendix A**

**Use of Third-Party Code, Libraries and Generative AI**

* 1. **Third Party Code and Software Libraries**
  2. **Generative AI**

For the development of the application logo, Bing Copilot Designer was used with the prompt “a circular logo for a revision application, with blue/cyan theme, book, no writing”. The result has not been edited in any way; it is being used in the original form given by the AI. Citations and references have been provided in the report when discussing the design of the application.

Bibliography