

Project

by Lee Anthony Williams

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Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Stuject: Student Assignment Manager

by

Lee Williams

Supervisor: Tim Bashford

Second Marker: Gaynor Thomas

Project submitted as part of the requirements for the
award of BSc (Hons) Computer Information Systems

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Declaration

I, Lee Anthony Williams declare that I am the sole author of this Project; that all references cited have been consulted; that I have conducted all work of which this is a record, and that the finished work lies within the prescribed word limits.

This work has not previously been accepted as part of any other degree submission.

Signed :

Date :

Form of Consent

I Lee Anthony Williams hereby consent that my Project, submitted in candidature for the B.Sc.(Hons) Computing & Information Systems degree, if successful, may be made available for inter-library loan or photocopying (subject to the law of copyright), and that the title and abstract may be made available to outside organisations.

Signed :

Date :

Abstract

Avoiding the task of producing assignments during the course of studying further education is almost impossible. Whether the student is studying in the area of art or science, assignments are given in order to grade the student's knowledge on the subject. Assignments are one of the most important areas in higher education and usually comprise of a large proportion of the course's overall marks. Achieving high grades in assignments given during the course can help ease the dependency on end of year exam results. Capitalisation on this for a student is crucial for achieving high grades in the course.

With this in mind, the primary goal of this study is to successfully implement a variety of motivational theories into an Android mobile application for students to use during their study. Motivating the students to begin assignments as early as possible and to work consistently with fewer breaks can lead to an increase in students' academic results. These motivational theories include the highly influential theory that is Maslow's Hierarchy of Needs and the more recent theory of Gamification.

Over the course of the study, the application was distributed amongst a group of students in a class to try the application during their assignments. Two separate assignment results were recorded of all students and were both analysed and compared. During the first assignment the students had no access or use of the developed application. However in the second assignment the students had access and use of the application. This provided the ability to study the applications impact on students' motivation, and the effect that followed in assignment results.

The study draws to an end conclusion based on the results of the research. For future work to the application, a list of improvements that could be made to the application is created and discussed.

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Introduction

Many students hand in assignments close to the submission deadline according to a research released by the University of Warwick conducted by Professor David Arnott and colleagues. In the research, Professor David Arnott finds that 86.1% of students submit their assignments within the last 24 hours of the deadline. The average mark dropped by each hour in comparison to those who submitted assignments over 24 hours before the deadline. Students who submitted assignments at the last minute on average received up to 5% in lower marks (1). What this indicates is that students who start assignments late, resulting in late submission, receive on average less than students who start and submit assignments early.

The idea behind the project is to create a mobile application in which helps motivate the student to begin assignments early, resulting in more time spent on the assignment increasing the chance of early completion and early submission.

The objective of the project is to create a task management application which regularly notifies the student of progress and upcoming deadlines of current assignments. By providing regular goals to complete, this should help remind and motivate the student to begin assignments early and to continue working on it regularly.

A selected group of students will be monitored, studying results of assignments where the application is not used versus the results of assignments where the application is used.

Research & Review of Literature

In this section, research is to be conducted on motivation and motivational theories in order to gain sufficient knowledge of the subject. A variety of mobile operating systems is also to be researched to assist the implementation stage.

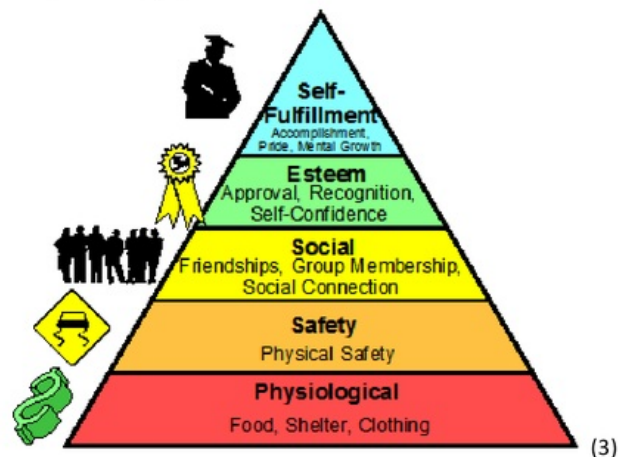
Motivation Theories

There are many theories behind motivation, all having their own concept of how motivation is achieved. Theories behind motivation are important and the understanding of these can help individuals become more motivated. Many theories have been around for years, such as Maslow's Hierarchy of Needs, however there are new concepts that have arisen, such as Gamification.

Maslow's Hierarchy of Needs

Abraham Maslow introduced the theory hierarchy of needs in a paper he wrote called "A Theory of Human Motivation" in 1943 (2). The theory shows the importance of each motivation, organised by importance from the bottom up, starting with the most important first. Displayed in a pyramid, the hierarchy consists of five different needs as seen in Figure 1. These include physiological, safety, love and belonging, esteem and self-actualization. Progression to the next level is dependent on accomplishing the previous level. This is because focus on the next level can only come once the current level is complete.

Figure 1: Maslow's Hierarchy of Needs Pyramid



Physiological

Physiological consists of all the basic needs in which we require to live. These are things that humans cannot live without such as food, water, air and sleep. If a person was to become stuck in a remote area with nothing, the first thing to do for survival would be to find the basic needs of food and water. Another example of this is changing time zones and sleep-deprivation during a flight, even more so on long distance. This can cause motivation to drop during transportation, and upon arrival, getting refreshed with food, drink and rest helps boost motivation.

Safety

The next level on the hierarchy, safety and protecting against danger, can be met once the physiological stage has been achieved. Humans who know that they are safe, have higher motivation. This is because they have less to worry about as there is less to be threatened by. When safety becomes threatened, the next level cannot be proceeded to as focus on safety is a priority. When locking all the windows and doors at night, sleep is easily achieved as a greater sense of safety is accomplished from the protection locked windows and doors provide. If there were no windows or doors with locks, safety would become a huge concern as anyone could gain access and cause harm, especially when asleep and less vigilant.

Love and Belonging

Building relationships between friends and being accepted into a group of friends gives a feeling of belonging. Knowing there are people who care is motivation to build the relationship further. Without love and belonging, it is easy to become isolated and lonely. Building new friendships leads

to high motivation and confidence, however losing a friend or separating from a relationship is a large de-motivator.

Joining a new company can be difficult as relationships with new work colleagues have to be built. But once the relationships are built and a sign of acceptance has been shown such as being invited out for lunch, motivation is boosted. If we were to flip this scenario and no acceptance or belonging was achieved at the new company, de-motivation would be felt and the feeling of being lost in work too.

Esteem

Esteem is accomplished when the respect and approval of family, friends, work colleagues and more have been gained. Receiving recognition of self-worth from them can define self-status and provide and maintain self-respect. With this status comes responsibility. For example, status in the area of medicine comes with the responsibility of looking after the people's health around you.

Examples of how this effects motivation is having someone ask for advice and becoming flattered that this person asked you, when there are many other people that could alternatively have been asked. This indicates that the person asking has respect and approval for the person being asked.

Self-actualization

Once all of the hierarchy needs have been accomplished, the next level self-actualization is achieved. At this level, the individual has become fully-rounded as a person and is more than able to make a positive contribution to society. The individual can decide what is important to them in their life, and with having all the correct motivation skills knows how to use these skills and pass on the knowledge and good fortune to others.

Good examples of these include traveling abroad to help countries less able than ours in medicine, providing care and support for those who truly need it, or leaving a high-end, well-paid job to pursue an aspiration such as becoming an artist or musician.

Hertzberg's Motivation-Hygiene Theory

Hertzberg's Motivation-Hygiene Theory, also known as the Two Factor Theory, was first published in 1959 in a book called "The Motivation to Work" by Frederick Hertzberg. In it, Hertzberg wrote about his studies based on satisfaction and dissatisfaction in the workplace. Being concerned with the wellbeing of people in a workplace, Herzberg interviewed employees and asked what both pleased

and displeased them about their work. What was discovered by conducting these interviews was what caused satisfaction was different from what caused dissatisfaction.

Hertzberg names the satisfiers as motivators and the dissatisfiers as hygiene factors. The theory was named hygiene because people felt unhappy when needs were not met. However, once they had achieved the needs, the satisfaction effects eventually wore off, just like they do with normal hygiene (4). In Figure 2, a list of hygiene factors are listed on the left and a list of motivators are listed on the right.

Figure 2: Hertzberg's Motivation-Hygiene Theory Table

Dissatisfaction (Hygiene Factors)	Satisfaction (Motivators)
Company policies	Achievement
Supervision	Recognition
Relationship with supervisor and peers	Work itself
Work conditions	Responsibility
Salary	Advancement
Status	Personal growth
Security	

What Hertzberg discovered was that people weren't motivated by achieving the hygiene needs alone. No matter what the company could offer, such as higher salary and better working conditions, true motivation can only be achieved from the motivators such as achievements and recognition.

Take an employee working for a company in the sales department on a standard salary. For each sale made, the employee receives commission. If the company were to decide to stop paying commission to the employee, the employee's resentment towards the company would decrease motivation massively.

What is worth noting is that although the factors for causing dissatisfaction are different from those causing satisfaction, they are not complete opposites of each other. The opposite of the factors listed in the satisfaction column do not cause dissatisfaction, but just cause no satisfaction. The same is said for the factors listed in the dissatisfaction column. The opposite of these factors do not cause satisfaction, but cause no dissatisfaction.

Theory X and Theory Y

Developed in 1960 by Douglas McGregor, Theory X and Theory Y both take very different approaches in helping with motivation in the workplace (5). What McGregor found in his research was that companies either followed one theory, or followed the other. The theories were termed

Theory X and Theory Y in order to project neutrality as neither theories were devised to be bad or good (6).

Theory X

Theory X managers believe that their workers lack responsibility and that their behaviour had to be controlled in order to undertake their work. Theory X managers are likely to use either punishment or rewards to control their workers in order to get them to perform at work (7).

Theory X Assumptions (8)

- People do not enjoy work and try to avoid doing any.
- Managers must control and threaten staff in order for them to achieve their goals.
- Due to low ambitions, people usually need to be led.
- People will stray from responsibilities and are mainly concerned with security.

Theory Y

In distinct difference to Theory X, Theory Y managers believe that their workers are naturally active and responsible. By controlling the workers less and leaving them to naturally accomplish their goals, Theory Y managers believed the workers become more motivated. Instead of either punishing or rewarding the workers like in Theory X, Theory Y managers are likely to give their workers challenges and extra responsibilities as these are things their workers like to strive towards (7).

Theory Y Assumptions (8)

- People generally enjoy work and it's often an important part of their life.
- People will work towards goals off their own back.
- People know accomplishing goals will lead to personal rewards.
- People often look for responsibility.

What is shown by these theories is that Theory X is used for employees who are naturally lazy, have little ambition and avoid responsibility. Whereas Theory Y is used for employees who enjoy their work, have a large amount of ambition and enjoy being given the opportunity to be creative.

Bandura's Self-Efficacy Theory

Albert Bandura is a psychologist and is best known for his theory on self-efficacy. He also served as the eighty second President of the American Psychological Association (APA) in 1974 (9). Bandura describes self-efficacy as *"the belief in one's capabilities to organize and execute courses of action*

required to produce given attainments” (10). Bandura believed one of the important elements to being able to accomplish something is confidence, and having the confidence that it can be done. He referred to self-efficacy as the mind's self-regulatory function, and that this function tells us when to both try and stop (11).

Having the ability to be in control of your thoughts, and therefore your actions, helps set and execute goals. By managing thoughts well, belief will come naturally and will influence motivation leading to positive action. For example, if someone believed that they could run a marathon, they would be much more likely to start running and set achievable goals. By controlling thoughts and believing that the next goal can be achieved, the overall goal of completing a marathon becomes much more likely to be achieved.

If there is no belief that a goal can be accomplished, then there is very little or even no motive to attempt or even do that goal. Going back to the marathon example, if there is no belief that running a marathon could be accomplished, then there would be little motive to start training. Even a talented runner that has been running for a long duration will struggle to complete a marathon, or start training for one if there is no belief and motivation.

When suffering from low self-efficacy, it can be increased by many things in which boost confidence such as;

- Receiving reassurance or encouragement to build up confidence.
- Relate previous positive scenarios with current scenarios.
- Experiencing success.
- Devising a new way or an alternative way of achieving a goal.

Bandura claimed that there were four sources for self-efficacy. These were mastery experience, vicarious experience, verbal persuasion and physiological arousal (12).

Mastery Experience

The best way to improve self-efficacy towards a particular task is to master the subject in which the task is in. When succeeded, the chances of attempting again are high because the task has been accomplished before. Failure can cause doubt on further attempts.

Vicarious Experience

Studying someone else performing a task can help another perform a task by imitation. Observing people who are similar will increase the belief in being able to master the same or a similar task.

Verbal Persuasion

When receiving encouragement or being convinced to perform a task by another person can increase belief in one's ability to do it. Receiving feedback in which is constructive is important as it helps overcome self-doubt.

Physiological Arousal

Mood, emotions, stress levels and physical reactions impacts whether success is gained. When someone is stressed or in a bad mood, confidence and self-efficacy are also normally low.

The Expectancy Theory

Originally proposed by Victor Vroom in 1964, the Expectancy Theory is the thinking process regarding choice. It explains why individuals choose one choice over another. There are three variables in the theory and they all effect how an individual feels and performs. They are as follows:

Expectancy

Expectancy is when one believes that their effort will result in successfully accomplishing a desired goal. Example would include self-efficacy, when self-efficacy is high, the expectancy is high. Or if a goal seems too difficult, the expectancy is low.

Instrumentality

Instrumentality is the belief that one will receive a reward if the expectation is met. For example, if a job is done well, you expect to be praised.

Valence

Valence is the value one places on the expected outcome. For example, how important is it for one to do well in a performance.

With these variables, Vroom developed an equation in which explains the motivation to why individuals choose to take a particular course of action.

Motivation = perceived probability of success (Expectancy) x connection of success and reward (Instrumentality) x value of obtaining goals (Valence) (4).

Vroom proposes that all three variables must be present and high for motivation to be achieved. If any one of these variables is low or missing then the level of motivation will be affected negatively.

To give a good example of how Vroom's equation works, take an individual that is applying for a new job. The individual is expecting to be offered the position, believing that the increase in salary is worth having and that because a goal is reached, the individual will be satisfied. The individual expecting to be offered the position is Expectancy. Believing that the increase in salary is worth having is Instrumentality, and that being satisfied by achieving a goal is Valence. Due to all three variables being present, the individual's motivation will be high.

The Flow Theory

Proposed by Mihalyi Csikszentmihalyi, the Flow Theory is based on the feeling one has when performing an activity and being fully immersed in it with focus, full involvement and enjoyment (13). In some cases, people's experiences become optimal. This is when a strong concentration is given to the task at hand and everything else is blurred out from a loss of awareness, including awareness of time (14).

One of the most common scenarios in which people experiencing flow is when they are presented with a challenge and believe that they have the skills to complete it, however the skills are balanced with the skills needed to complete the project. For example, take a web developer that develops small websites daily. This web developer is then given a bigger and more challenging project such as creating an ecommerce website with shopping basket and checkout procedures. The web developer's knowledge and skills are balanced with the projects complicity and therefore requires full focus and concentration during development, leading to a state of flow.

Gamification

The word gamification is deemed as a ridiculous word and although the concept has been around for many years, the term was first coined by Nick Pelling around 2002 (15). Gamification is used in order to motivate individuals to perform a task by using game design techniques. These game design techniques are heavily based around the idea of users impulses for achievements and status. They get people engaged and motivated in their activities using game mechanics such as point systems, badges, achievements, levels and leader boards.

In research that Brian Burke conducted, many organisations apply gamification in order to set rules and goals. This is done by encouraging players to work in teams and compete against each other (16).

In the original Xbox video game Halo 2, users could compete against one another in multiplayer games. Each game win would earn the player points and contribute to the players overall rank level. Each level was represented with different symbol, and when reaching the highest levels, the symbol would become more symbolic. The final level symbol was represented by a halo ring and it was what nearly every Halo 2 player strived towards. Having a halo ring next to your username was a huge representation of your success and status. Players would spend hours on the video game, working on improving their performance to try and achieve higher levels as each one not only increased their status, but had a better looking symbol.

This shows the power of what introducing a game design technique such as a point system can do, motivate individuals to increase productivity, improve skills and become more engaged with an activity. The rewards for implementing such techniques correctly could highly improve an individual's motivation.

Motivation

Gillian Burn wrote that *"Motivation is a feeling, an emotional force, stimulating and encouraging you to do something."* (4) Simplistically, this is precisely what motivation is, though motivation is effected by a vast amount of factors. Motivation is what drives people's decisions that lead to actions, whether it is to eat, drink, visit friends, and attend further education or even send humans to the moon.

Student Motivation

It is commonly known that students have poor motivation when it comes to academic work such as assignments. In a private correspondence with lecturer Tim Bashford of the University of Wales Trinity Saint David, Bashford noted that students do indeed tend to be poorly motivated in comparison to people who are not studying in education.

One of the biggest culprits in students' low motivation is procrastination. It is something that is brought to light in many studies of students reasoning for poor motivation. Dr Piers Steel mentions

that nobody procrastinates as much as students (17). In the article "My Instructor Made Me Do It: Task Characteristics of Procrastination" there is an overwhelming amount of evidence of this. In the article, Ackerman and Gross state that "*procrastination may be even more widespread within an academic context*". They mention that various studies have found that procrastination can affect anything from 50% to 95% of undergraduate students. This is an alarmingly large percentage of students and although in the article it states that the cause of procrastination has been linked with lack of motivation, it can be argued that procrastination itself causes low motivation (18).

Demotivation

Demotivation is the opposite of motivation, it is when an individual has no motivation to perform a particular task. Demotivation can affect each individual differently and what causes demotivation can differ depending on the individual. That being said, there are many common factors that create demotivation such as lack of sleep, feeling unwell, being under pressure, feeling overwhelmed and irritability.

When someone is feeling unwell, due to a cold for example, they can become demotivated because the task that they wish to accomplish has now an extra obstacle in its way. The individual needs to focus on recovering from the illness and fulfilling basic needs such as hunger before they can accomplish their desired task.

Procrastination

Procrastination is when a task which is needed to be done is avoided and replaced by things that give an individual pleasure such as playing video games or watching television. Dr Piers Steel, one of the world's leading researchers on the science of motivation and procrastination, described procrastination as "*when we voluntarily put off tasks despite believing ourselves to be worse off for doing so*" (17). It can show a person's struggle with self-control. Dr Piers Steel also mentions that procrastination is not a state of laziness and that more often than not the task that is being avoided does eventually get completed. Wiegartz and Gyoerkoe both state that anxiety is often the driving force behind procrastination. Fear of failure for example can lead to putting off tasks (19).

Procrastination can lead to guilt, depression and self-doubt. These can be felt because putting things off can lead to missing deadlines, missing payments, poor grades and much more. If an employee is missing deadlines then they can start feeling guilty for not reaching them, start to self-doubt their ability to hit the targets and perhaps become depressed for not frequently hitting them.

Students often procrastinate when confronted with an assignment or project. Students can get stuck on the first few words of an assignment and their mind starts drifting eventually leading to sending a message on Facebook that they've been meaning to do, leading them to fully browse and socialise on Facebook. This can lead to hours of distraction time and before the student knows it, the deadline is hours away and nothing is written. In fact, Dr Piers Steel mentions that nobody procrastinates as much as students (17). In a report published by StudyMode in which asked approximately 1,300 high school and college students, 87% say they procrastinate and that it effects they're performance (20).

There are many reasons that students start procrastinating. Ackerman and Gross (18) mention that procrastination is linked with low motivation, low self-regulation, fear of failure, low self-efficacy and more. Another cause that appears regularly is the interest a student has in the assignment itself. If the student has a higher interest in the subject alongside a variety of skills required and clear instructions from the instructor, students are less likely to procrastinate.

Conclusion

It is fair to say under the research taken that many students struggle with motivation, with procrastination being one of the biggest contributors. With the results showing that students struggle when there is no interest in the subject, perhaps the procrastination is due to the fact that when studying a subject, some modules do not take the students interest but must be taken in order to pass the course.

Whatever the cause may be, there are ways in which the student can overcome procrastination and lack of motivation. Ackerman and Gross (18) found that students are less likely to procrastinate when there are rewards and incentives are given for a student to start early. These rewards could be smiley face stickers or encouraging comments on work in progress. It is also mentioned that when reminders are given to students of the benefits of starting early are given with early feedback on their work. This can help reduce the fear of failure which is one of the contributing factors of procrastination.

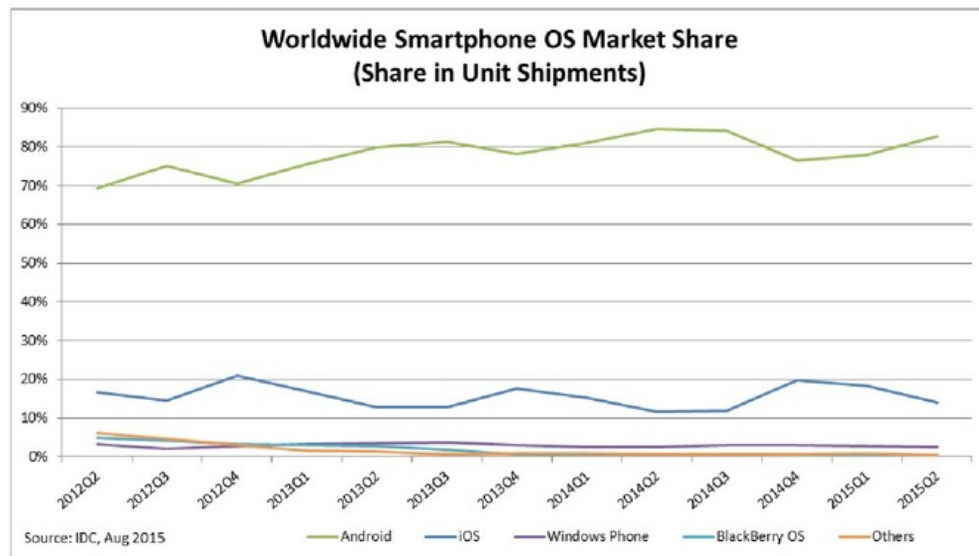
Mobile Operating Systems

Mobile operating systems are operating systems which run on mobile devices such as mobile phones, tablets and PDAs. Mobile operating systems were developed in order to work with mobile devices due to the lack of power in comparison to other computers such as laptops and personal computers. However the gap between these are getting smaller and as such, some mobile devices run a hybrid version of the operating system or in some cases, the full operating system. Mobile operating systems also have many basic features that are essential to handheld devices that are not so for other operating systems such as cellular network, Bluetooth, GPS, camera, touchscreen, mobile navigation and more. They have also introduced new technologies such as NFC (Near Field Communication). One could argue that these technologies are being pushed to non-mobile operating systems as standard due to mobile operating systems.

One of the many great benefits of having a mobile device, mainly a smartphone, is that the devices are usually constantly on, meaning that information can be obtained quickly and conveniently. The user can access information on such things as upcoming events, emails, sporting results, weather forecasts and more. Most mobile operating systems have a notification system that can notify the users of information that the user could perhaps normally miss. Waking up to the weather forecast on a smartphone is handy for planning the full day ahead.

There are many mobile operating systems available however the three largest in market share value are Android, iOS and Windows Phone. The market share of these three operating systems in the second quarter of 2015 can be seen in Figure 3. Android had 82.8% of the worldwide smartphone market share. iOS followed in second place at 13.9% and Windows Phone came in third place with 2.6%.

Figure 3: Worldwide Smartphone OS Market Share 2nd Quarter 2015



(21)

iOS

Developed by Apple, iOS is a mobile operating system that was launched on the first generation iPhone in June 2007 (22). iOS is distributed exclusively for Apple hardware and is used by many Apple mobile devices such as the iPhone, iPad and iPod Touch. When launched on the iPhone, iOS revolutionised the mobile industry, selling over 6.1 million devices worldwide (23).

With iPhone's pen free multi-touch screen and revolutionary mobile operating system iOS, many considering the iPhone as the first true smartphone device. The first version of iOS included features including Safari web browser, HTML email, threaded text messaging, YouTube, touch keyboard and more. The success of the iPhone lead to Apple releasing its second version of iOS, iPhone OS 2, which was released with iPhone 3G and as a free upgrade available from iTunes. iPhone OS 2 introduced the App Store allowing the installation of third party applications. Apple released further versions of iOS and launched the latest version 9.1 on the 21st of October 2015 (24).

iOS user can download additional apps via the Apple App Store. Introduced in the second version of iOS, the App Store provides the user with a catalogue of free and paid for mobile applications. Currently the Apple App Store has the highest revenue being around 70% higher than its closest competitor Google Play (25).

Apple provides developers with an IDE called Xcode in order to build iOS applications. Xcode can be installed on compatible Apple Mac computers and include the SDK tools for iOS. For the Microsoft Windows operating system, there are currently no official IDE from Apple however other third party software are available.

In order for a developer to submit an application to the App Store, an Apple Developer Program membership obtained which incurs an annual fee starting from \$99 USD. The application must then be submitted for a review. No application is able to be published on the App Store without it first being reviewed by Apple. Once published, Apple receives 30% of the revenue, leaving the developer with the remaining 70%.

Android

Android is a mobile operating system developed by Google based on the Linux kernel. Unlike both Apple's iOS and Microsoft Windows, Android is an open source operating system which allows other to distribute and modify the software (26). Because of this, many big manufacturers such as Samsung, Sony and HTC modify the software and launch devices with Android installed. In fact there are very few devices available running a vanilla version of Android, the most popular being Google's very own Nexus range of devices.

The first Android device launched was the HTC G1 mobile phone and ran Android version 1.5 dubbed Cupcake. The Android Cupcake mobile operating system featured many smartphone features such as internet browsing, HTML email and many Google services such as Gmail, YouTube and Google maps. Android received many version upgrades including version 3 Honeycomb in which introduced support for tablet devices. Android current version is Android 6 marshmallow.

Google provide developers with a great range of tools in order for developer to create applications in the Java language. Android Studio is an official IDE and is based on the IntelliJ IDEA Java IDE. Android Studio is available on all three of the biggest operating systems, Microsoft Windows, Apple Mac OS X and Linux. Google also provide an SDK manager in which manages SDK packages and SDK tools such as the Android Emulator, making it easier for developer to keep up to date with the latest developer tools.

Although the Android platform is free, in order to install Google Play Services on their device, the developer must pay a license fee. Google Play Services provide many Google applications including Google Play, formally known as Android Marketplace. Google Play allows users to download applications over the internet and install them on their device. Currently there are over 1.6 million

applications available on Google Play (27). Developer must pay a fee of \$25 USD in order to register for a Google Play publisher account in which will allow the developer to publish applications on Google Play (28).

Google Play is not required in order to install Android applications. Applications can be downloaded onto the device and installed using the operating system alone, however settings must be adjusted to do so. There are also third party application stores available including the Amazon Appstore developed by Amazon.

Windows Phone

Microsoft have released many mobile operating systems in the past including Windows Mobile for pocket PC's, which could be used on mobiles phones. In October 2010 Microsoft launched its first mainstream smartphone operating system, Windows Phone 7. The operating system was released in order to compete with Apple iOS and Android. The Windows Phone operating system is not open source like Android and requires a license from the mobile device manufacturer. However unlike Apple, Windows Phone is distributed on multiple manufacturers' devices such as HTC, Samsung, LG and more.

Microsoft have released three additional versions of Windows Phone, these are Windows Phone 8, 8.1 and the most recent, 10. In version 8, Microsoft changed the Windows CE-based architecture of the operating system to one based on the Windows NT kernel. This meant that applications could be ported from and to the Windows 8 desktop operating system. Microsoft took this further in the release of Windows 10 Mobile by allowing applications to be designed for use across multiple Windows 10 based products, for example PC and mobile.

Microsoft uses its current software package Visual Studio in order to provide its developers with an official IDE for Windows Phone development. Developers who are familiar with coding for Microsoft Windows will feel right at home with Windows Phone development as both C# and C++ languages can be used. Additionally, HTML5 with JavaScript can be used to create Windows Phone applications.

For developers to submit their applications to the Windows Phone Store, developers must register a Windows Dev Center account. This incurs a one-time fee of £12 for individuals or £65 for companies. Having a Windows Dev Center account also allow the developers to publish their applications on the Windows Store. After submission, the application is reviewed by Microsoft before being published to the stores. During the publishing process, if the application is supported by the PC operating system

as well as the mobile operating system, the apps can be published on both the Windows Phone Store and Windows Store simultaneously.

Other Mobile Operating Systems

Although the big three mobile operating systems have the highest market share, it is worth reviewing other mobile operating systems.

BlackBerry OS

BlackBerry OS, which was once had a large percentage of the market share, has in the past years declined massively. Developed by BlackBerry, the latest version of the OS is BlackBerry 10. However due to poor sales, BlackBerry is now developing phones running the Android operating system (29).

Firefox OS

Developed by Mozilla, Firefox OS is an open source mobile operating system based on the Linux kernel. There are currently only a handful of devices available in the market running the Firefox OS, manufactures include LG and ZTE.

Development Language

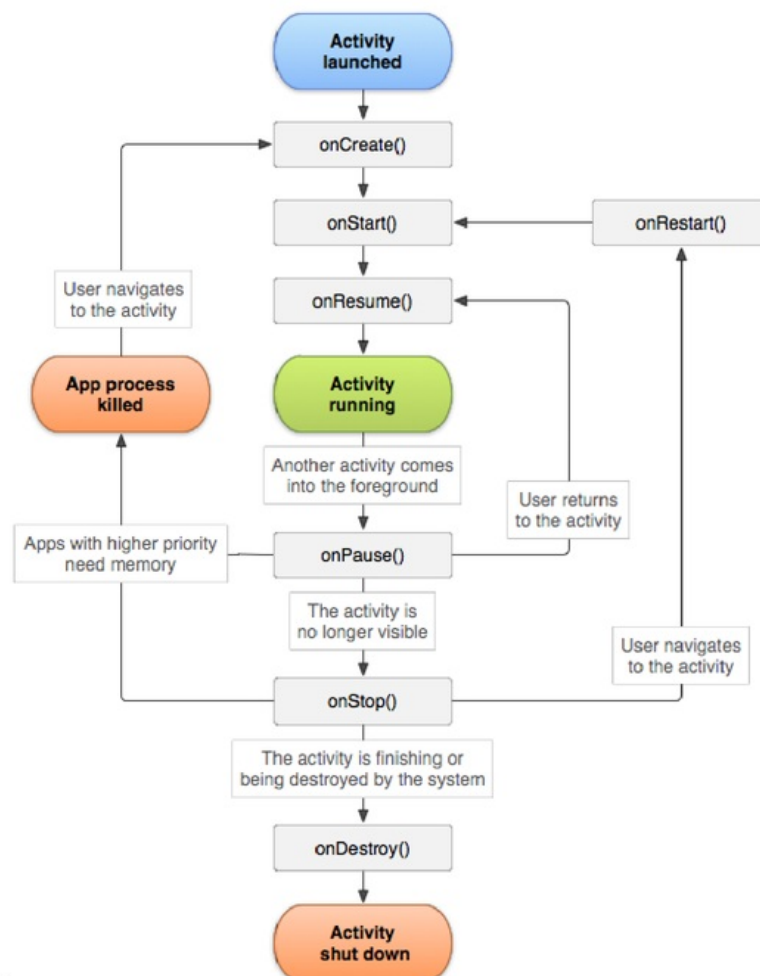
The Android mobile operating is to be selected as the development language and is chosen for many reasons. These include and are not limited to the following;

- Android has the largest market share in the smartphone market. This will provide the application with a greater target audience than any other smartphone mobile operating system.
- Android smartphone devices are on average the cheapest smartphones on the market, starting from around £50. Windows Phone is the closest starting at £70 and Apple third starting from £349. This increases the likelihood of an Android device being purchased by a user now and in the future.
- Developer tools are easily accessible and free to all.
- The popular language of Java is used to create applications on Android, meaning there is plenty of online support from communities and tutorial websites.
- Publishing an application is overall cheaper than its competitors. Applications can also be installed without the need of an app store, this method is free on the android operating system.

Androids main development language for writing applications is Java. Although there is support for writing applications in other languages such as C and C++, Java has complete access to the Androids full API. XML is also another language that Android uses, and it is used for the applications design layout. For storing data, Android uses SQLite database.

Android is heavily based on Activities. Each Activity commonly creates a window for which contains the user interface. Figure 4 shows the lifecycle of an Activity with the list of functions for an Activities general movement. These include create, start, restart, resume, pause, stop and destroy.

Figure 4: Android Activity Lifecycle



(30)

Conclusion

Because smartphones are such an important and almost essential communication device, it is normally in the user's possession throughout the day. This makes the smartphone an ideal device to create and publish the proposed application on. The user will always have the application to hand and notifications can be set up in order to remind the user of tasks to be done.

Research & Development Methodology

Methodologies are important during project development and help guide developers during the project. In this section, the research, development and experiment methodologies are to be discussed and chosen.

Research Methodology

Research methodologies once chosen help guide the developer during the data collection process. They are concepts and theories in how research can be conducted.

Positivism vs. Phenomenology

To be accurate when describing positivism is a difficult task as many researchers have many settings in which it can be used. That being said, in a broad scope, positivism is the idea that science is the only way to gain knowledge. The Oxford Dictionary describes positivism as a philosophical system that is only to recognise which can be scientifically verified or is capable of logical proof (31). Established by Auguste Comte, positivism holds that experimental and observational methods are the only true sources of knowledge (32). It is dependent on calculable observations that lead to statistical analysis. This makes it an ideal approach for scientific research.

Phenomenology studies however are more concerned about what things mean rather than analysing and measuring. Begun by Edmund Husserl in the 1890's it focuses on experiences, events and occurrences (33). Normally these would be gathered from interviews, case studies and ethnographic studies. Although phenomenology cannot provide logical proof, it can give a more knowledgeable and deeper understanding of an experience.

Inductive vs. Deductive

Inductive reasoning is based on a conclusion being made on a hypothesis. It can often be referred to as bottom-up reasoning because it tries to prove a conclusion first. Specific observations are made and get broader throughout the process into theories. Due to this, inductive reasoning can often be weak or in some cases, invalid.

Being opposite to inductive reasoning, deductive reasoning comes to a true and valid conclusion from narrowing down into specific hypotheses that can be tested. Often referred to as top-down reasoning, deductive reasoning is begun with a theory that is then narrowed down into a more specific hypothesis that can be observed and tested. The theory can then be confirmed, or if incorrect, not confirmed, after the testing and observation is complete.

Project Research Methodology

Both positivism and phenomenology research methods are to be used during the study as there is analysis performed on multiple questionnaires, however there is also testing to be conducted which will lead to scientific proof. The Inductive research method approach is also to be used. This is due a pattern already discovered regarding student being poorly motivated and the purpose of the study is to improve this.

In order to assess student requirements for the application, a standardised survey is to be conducted. By using the survey research method, data can be gathered in order to assess what functionality and design to implement. The survey is not to be limited to any particular study level as the application is targeted for all.

The survey is to be a questionnaire type survey to be distributed in print format. By selecting print format over digital format, the questionnaire can be handed to lecturers who are willing to distribute among their students during classes. It is suspected that by doing it this way students will be more inclined to fill the questionnaire as it is placed right in front of them. Each printed questionnaire will have a unique reference number which can then be used for future reference.

For the questionnaire to be measurable, the questions must be closed format questions. Closed format questions are multiple choice questions with restricted choice. Because of this calculating statistical data and percentages are simple as the answers set are known. This helps analyse the results much easier and quicker.

Development Methodology

Due to the small timeframe for both research and development as well as the short time for beta testing and receiving feedback, the development methodology will need to be one in which allows

for change during the programming stage. To accomplish this, a variety of development methodologies are to be used.

Rapid Application Development

Rapid Application Development (RAD) is an ideal development methodology to use as the base. RAD specifies that less time should be spent on the planning of the application, and more time spent on the development of the application. Adjustments to the design of the application can be changed as knowledge of the project grows whilst developing the application. This is ideal for the project as the development time is small.

Extreme Programming

Extreme Programming (XP) specifies that requirements can change based upon the knowledge gained during the development process. This allows adjustments to be made based upon the feedback received for the student in the survey questionnaire. Feedback from the student may indicate that additional features need to be added, or existing features changed. By using the XP development methodology, the application can change after reviewing students' feedback if needed. XP also allows frequent releases in short development cycles allowing for changes and fixes to be tested often. These releases can be provided to the students during the experiment process for feedback.

The Waterfall Model

The Waterfall model is one of the biggest development methodologies in software development. It consists of progression stages in which flows steadily downwards just like a waterfall. There are five progression stages; Requirements, Design, Implementation, Verification and Maintenance. This indicates that all of the requirements and design work is completed before any coding is to begin. Although some of the design and requirements will be completed before any coding begins, these will likely change during the coding process.

To conclude, a variety of methods are to be used from all three development methodologies. A certain amount of requirements and design work is to be completed before the implementation, which is taken from the Waterfall Model. However, requirements can change during the implementation stage as knowledge of the software is grown during creation which is taken from

the Extreme Programming methodology. Overall, more time is to be spent on implementing rather than planning and designing, which is taken from the Rapid Application Development methodology.

Experiment Methodology

Beta testing in software development is the second phase of the testing and it is when the software is provided to its intended audience for testing. Beta is often referred to as the pre-release testing.

The beta version of the application will be provided to a number of students in a single class for testing in order to receive feedback. The idea is to allow the students a set time for using the application in the second semester and gather feedback at the end. By providing the application to a number of students for testing, there is a much higher chance of finding all the bugs in the application as it is tested by more people. It is also tested in a real-world environment as the students are the target audience for this application.

During the second semester, the questionnaire will be dispatched and the unique reference number will then be used in order to track students' performance in the next two assignments. Number references are used in order to hide the students' identity, preventing any feedback or results being dispatched prematurely. During the first assignment, the student will not be provided the Stuject mobile application. Once the first assignment deadline has passed, the student will be provided the Stuject mobile application for use during the second assignment. The results from the first assignment can then be analysed and compared to the results from the second assignment. This will give an insight to whether or not the application's design, usability, performance and overall concept are desired. With this feedback, the application can be adjusted to improve the final product.

Emily Hossellman states that *"If you're not collecting meaningful feedback from your testers, then your beta test isn't really doing its job."* (34). In order to improve the application with the received feedback, the data must be collected in a meaningful way. Feedback functions in the application itself are a quick and easy way to allow the testers to provide feedback to the developer. The feedback data can then be programmed to be sent to a personal email address for analysis.

Conclusion

Measuring students' performance, both with the Stuject mobile application and without, will give a good indication of how the Stuject mobile application impacts students' results. Due to its task management and motivational features, it is predicted that students' results will increase during the time with the application as opposed to without.

Design & Implementation

The designing process of the application is one of the most important stages of creating an application. Having a poor design can lead to poor implementation, often resulting in a poor end product. By having a strong design before starting implementation can help pave the path for a strong end product. Firstly the requirements of the software are to be analysed. Once complete, the design and implementation is to follow.

Software Requirements

Before beginning the design of the application, it is important to first review the software's requirements. This is to help assist with the application design and implementation stages. The following are a list of software requirements for the Stuject application.

Android Compatibility

The application will need to run on Android devices including mobile and tablet devices. The application will be required to be compatible with the Android operating system version 4.1 Lollipop and above.

Store Data

The application will need to store data in order for the user to access at a later date. This is a core requirement of the application as many of its features will require data to be stored and accessed.

Create and Manage Tasks

The user will need to be able to create, view and manage tasks. These tasks will be stored as data on the user's device.

Create and Manage Goals

The user will need to be able to create, view and manage goals within a task. There goals will be stored as data on the user's device.

Unlockable Achievements

In order to motivate the students, achievements are required and once achieved, need to have their status updated to unlocked. The achievement details are needed to be stored on the user's device.

Configurable Settings

The application will need to provide the user with settings that can be updated by the user in order to customize the application's features.

Feedback Submission

To improve the application's features and keep up to date with newly discovered software bugs, a feedback form is required. This will allow the user to submit any discovered bugs and any ideas to improve the application.

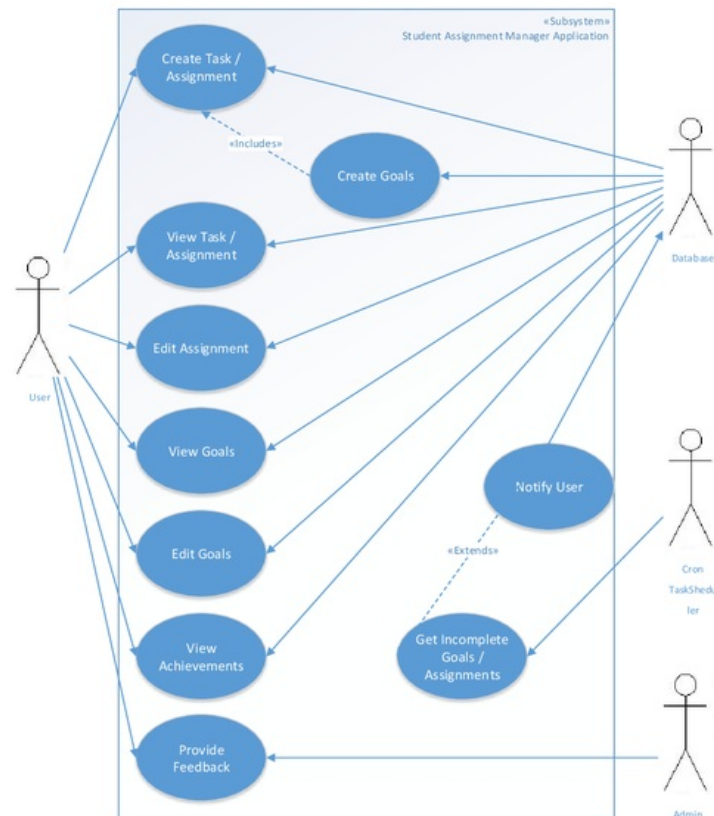
Moodle Sync

To help simplify the application for the user, the application is required to synchronise and fetch assignments from the university's Moodle system over the internet.

Design

With the requirements set for the project, it's important to understand how the user will interact with the application. To accomplish this, a use case diagram is to be constructed. Having a use case diagram will allow an observation to be performed to help design the application's user interface, functionality, code structure, and more. The use case diagram In Figure 5 shows how the user interacts with the application.

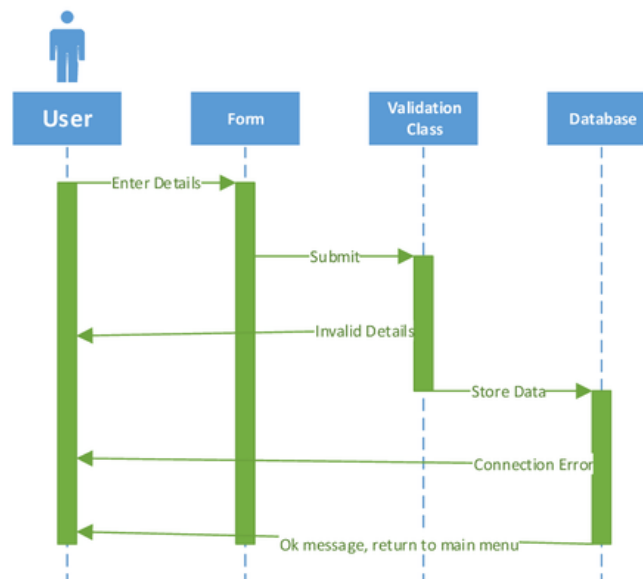
Figure 5: Stuject Use Case Diagram



What is noticeable in the use case diagram is the large role the database has to play in the application. Because the application is based on information that is needed to be stored, being the tasks, their goals and achievements, the database was naturally always going to play a large role. There is to be only a few parts of the application the user will see that will not require retrieving stored data.

Because the application is too often require input from the user, a sequence diagram is to be constructed. Figure 6 demonstrations the flow of form being submitted.

Figure 6: Subject Swquence Diagram



The user fills inputs from the form and submits by clicking the submit button. The input data gets submitted to a validation class in order to check data is valid. If the data is invalid, an error will be displayed. If the data is valid, the data gets sent to the database. A connection is then made to the database to store the data, and the user is notified of its success. If the connection fails, the user is alerted of the error. Keeping to this structure when creating a form will help with design and consistency.

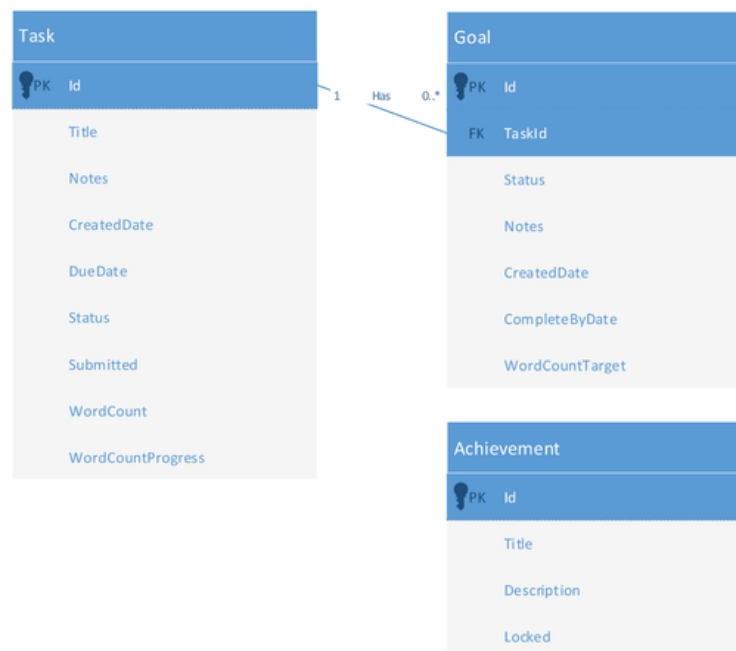
The application is to consist of a list of tasks as per the requirements, with each task having the ability to have a number of set goals. These goals are not to have an overall combined word count target that exceeds the task word count. Both the tasks and their individual goals represent the core of the application and require their information to be stored on the user's device. The application is to also feature achievements which the user will be able to unlock throughout the applications use. These too will need to be stored on the user's device. Both the task and task goals will be created by the user, however the achievements will be pre-created in the development process. The list of user unlockable achievements can be seen in Figure 7.

Figure 7: Table of Unlockable Achievements

Title	Description
Task Task Go	Successfully create your first task.
Goal Setter	Create your first goal.
Task Complete	Complete your first task.
Goal Getter	Complete your first goal.
Two for Two	Complete your second task.
Task Master	Complete your fifth task.
5 Time	Complete your fifth goal.
Goal Master	Complete your tenth goal.
Diolch Yn Fawr	Send your first feedback, thank you!
Boom, done	Complete a goal on the same day as created.
Goal Pro	Create your fifth goal for a single task.

Figure 8 shows the Database Entity Relationship Diagram designed to store the data for each task, task goal and achievement. The task table stores all the data for each task such as assignment title, due date and word target. The goal table stores all the data for each task goal such as word count target, due date and notes. The goal table is to have a one-to-many relationship with the task table linked by a foreign key. The achievement has no relationship and store the achievement data such as title and locked status.

Figure 8: Stuject Database Entity Relationship Diagram



With the database design complete, class diagrams can be constructed as many of them will be required to work with the database. Figure 9 shows the class diagram of the task class and goal class. The attributes in these classes mostly match up with the data of the tables in the database, however the task class is to have a goal list. This list is to contain goal objects associated with the task.

Figure 9: Subject Class Diagram



With the goal and task class, there are also to be corresponding mapper classes which follow the Data Mapper pattern. Data Mapper pattern is an architectural pattern coined by Martin Fowler (35) and separates concerns of the object and the objects data source. The database mapper classes use the standard CRUD (create, read, update and delete) model in order to extract data from the

database and return the results in the form of a class. This makes the code much cleaner, quicker, simpler and easy to manage. To obtain data from the Android database, the data mapper uses the Android SQLiteOpenHelper class which helps with database creation and database version management (36). The SQLiteOpenHelper can then be used to return a SQLiteDatabase class in order to perform database queries.

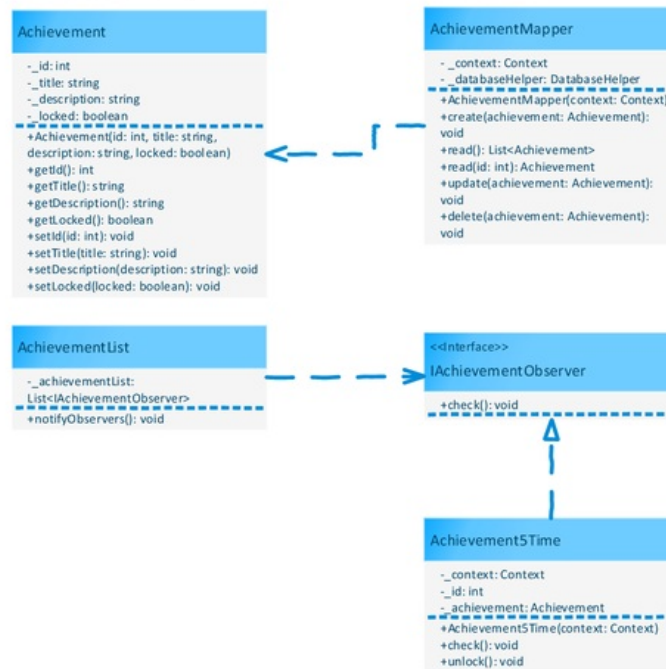
Both classes have their set and get properties methods that allow the attributes to be accessed and set. There are also addition methods such as calculateDaysLeft() which will calculate the days remaining until the due date and createReminder() which is to be used to create the Android notifications.

The Task class is to have two methods which are to be used to calculate figures from the list of goals. refreshWordCountProgress() is to accumulate the word count of all the complete goals and update the wordCountProgress attribute. calculateProgress() can then be used to calculate the progress in percentage to provide the tasks overall progress. This also improves efficiency as updating the wordCountProgress attribute, which in due course will be updated in the database, will reduce the need of scanning each goal to calculate the wordCountProgress each time the task is viewed. It can instead access it from the task alone.

How achievements are to be handled in the application can be seen in the class diagram in Figure 10. The achievement class is to be basic with only get and set property methods. The Data Mapper design pattern is also to be used to separate the database concerns from the achievement class as the task and goal classes do.

For the use of unlocking achievements, a simplified version of the observer design pattern is used. The observer pattern observes changes in the application and performs a task when changes are found (37). This makes the design pattern ideal for checking tasks and goals for any changes and check a list of potential achievements to see if they meet a criteria to be rewarded and unlocked to the user.

Figure 10: Stuject Achievement Class Diagram



Implementation

For implementation, the official Android IDE is to be used, Android Studio. Although Android does support other software languages, Java will be used to code the logic of the application and XML will be used for the views.

Activities in Android represent a view to the user, similar to a window in C# or web page in HTML (38). Below are a list of activities the application is to use.

Achievement Activity

Displays details of an achievement.

Achievement List Activity

Displays a list of achievements which, when clicked, will launch the Achievement Activity to view the achievement selected.

Feedback Activity

Displays a form for the user to submit to provide the developer with feedback regarding the application.

Goal Activity

Displays details of a task goal.

Goal Create Activity

Displays a form for the user to submit and create a new task goal.

Goal Update Activity

Displays a form for the user to submit and update an existing task goal.

Main Activity

Default page displayed on application launch. Displays a list of tasks which, when clicked, will launch the Task Activity to view the task selected.

Task Activity

Displays two views using the Android TabLayout format. Task tab displays details of a task, Goal tab displays a list of task goals which, when clicked, will launch the Goal Activity to view the selected task goal.

Task Create Activity

Displays a form for the user to submit and create a new task.

Task Update Activity

Displays a form for the user to submit and update an existing task.

Once these Activities are created, the DatabaseHelper class, which extends the Android SQLiteOpenHelper class, is to be created. If the database does not already exist, this class when called in the MainActivity, enables the SQLite database tables required by the application to be created. During this process the class also inserts records into the achievements table ready for the application to use.

The class models for task, goal and achievements are to be created once the database is complete with their corresponding data mapping classes. Unlike most SQL databases, SQLite does not support date format. In order to save dates, the date is to be converted to milliseconds and stored in the database as an integer type. This will also allow any queries to be easily ordered by date, unlike if the data was alternatively stored in string format such as 'YYYY-MM-DD'. For the calculateDaysLeft() method in both the Task and Goal class, a popular java library named Joda-Time is to be used which *"provides a quality replacement for the Java date and time classes."* (39). Joda-Time contains a class called Days with the method daysBetween(). This methods calculates the number of days between two dates allowing the application to calculate days left before a goal or task is due. Joda-Time is selected due to no similar function or method existing in the default java library for Android.

To monitor and check whether an achievement has been unlocked, a simplified version of the observer design pattern is used. IAchievementObserver interface is to be created in which contains a public method check(). This method is used to check if the achievement is unlocked. Classes for each existing achievement is to be created, each inheriting from this interface. The attribute _id is used to access the corresponding achievement from the database which is to be used to check whether the achievement is locked or unlocked.

These will be added to the class AchievementList and when certain actions are completed in the application, the notifyObservers() method is called in the AchievementList, which loops through the list and executes the check() method to check whether the criteria has been met to unlock the achievement. If so, the unlock() method is executed which updates the achievements locked status in database.

Android has built in notification features that notifies users of an event (40). When the notification is issued, the user will notice an icon appear in their notification bar which they can interact with. Notifications are to be used to notify the user of both tasks and task goals that are due. Once the task or task goal is created, the method createReminder() in the appropriate class will create an Android PendingIntent which in turn will use the Android BroadcastReceiver to create the notification. However once the notification is created, it is important that the Android device remembers to notify the user. When an Android device is rebooted, the Android device clears all notifications (41). This is where the OnBootReceiver class is to come into effect. The OnBootReceiver class is created to handle the Android broadcast when the Android device is powered on. When called, the OnBootReceiver class loops through each task in the database and re-creates the notifications.

The layout of the application is to be left till last once most if not all of the application logic is complete. Android uses XML to create its layouts as previously noted, and a XML layout file is to be created for each Android Activity and Fragment. Each element in the XML layout files will be supplied a unique ID which can then be used by the Activity and Fragment code to manipulate the layout and add content. Additional views can be added to the applications XML layout dynamically. The application will need to provide a list view to the user of items such as tasks and achievements which are to be acquired from the database. Because the lists are dynamic, the application is to loop through the data, for example a list of achievements, and build a list of Android CardViews. Once the CardViews have been compiled, they can be added to the view directly from the code in the Activity or Fragment. This method is to be used in order to display a list of tasks, task goals and achievements.

Many of the layout files will need to provide text input for the user. There are to be five forms created in the application. These are as follows; two individual forms for creating and updating tasks, two individual forms for creating and updating task goals, and a one form for submitting feedback of the application. To allow the user to input data, Android EditText are to be used which allows the user to type data to the application. For any inputs that require numbers only, such as word count, an android:inputType="number" attribute is added to the EditText XML tag. This will result in the

keyboard changing its mode to numeral format allowing only numbers to be inputted. Additionally an EditText input for inserting dates is needed to be added in order for the user to set a date for task due dates and task goal target dates. Rather than typing the full date with the Android keyboard in 'DD/MM/YYYY' format, an Android DatePickerDialog is to be used to allow the user to simply select a date from the calendar. Once selected, the EditText input is filled with the selected date.

Software Testing

Testing the applications for bugs and ensuring the application runs smoothly with little to no errors is of upmost importance for all applications and Stuject is to be no exception. Android Studio makes debugging Android applications simple. The application can be run from Android Studio either on an Android emulator or directly to an Android device plugged into the computer.

Once the application is installed onto an Android device from Android Studio, the applications are to go through a variety of testing techniques including Alpha, Beta and Black Box testing.

Black Box Testing

The first set of testing to be performed on the software is Black Box testing. Black Box testing is a software testing method which enables the inspection of the application's function only (42).

The features to be tested in the application are the ones with the most importance. These are creating and updating a task and goal, marking both a task and goal as complete and unlocking achievements. During the Black Box testing, all test but one passed. The Update Task Test, which can be seen in Figure 11, brought a bug to light in which when the task word count was reduced whilst updating the task. When reducing the task word count the software would not check if the new word count is less than the combined word count targets of the users set task goals, which in turn lead to an obscure overall task progress figure. To give an example, if the task had a word count target of a thousand words and had two goals, both with a five hundred word target, once the task word count target is reduced to seven hundred, there would then be a larger combined goal target than the task itself.

Figure 11: Create Task Black Box Test Results

Test ID	Test Case Name	Status	Priority	SW Version	Setup	Teardown	Test Substeps	
1	Create Task Test	Pass	High	1.0	• N/A	• N/A		
Tester		Lee Williams						
Date		07/04/16						
Test Description		Test form validation by inputting invalid data. Test form validation passes valid data. Test DatePicker dialog box. Test task is created successfully.						

Figure 12: Create Goal Black Box Test Results

Test ID	Test Case Name	Status	Priority	SW Version	Setup	Teardown	Test Substeps	
1	Create Goal Test	Pass	High	1.0	• Create a Task	• N/A		
Tester		Lee Williams						
Date		07/04/16						
Test Description		Test form validation by inputting invalid data. Test form validation passes valid data. Test DatePicker dialog box. Test goal is created successfully.						

Figure 13: Mark Task Complete Black Box Test Results

Test ID	Test Case Name	Status	Priority	SW Version	Setup	Teardown	Test Substeps	
1	Mark Task Complete Test	Pass	Medium	1.0	• Create a Task, Create multiple Goals	• N/A		
Tester		Lee Williams						
Date		07/04/16						
Test Description		Check Task marked complete. Check all Task Goals marked complete. Check Task Word Count Progress is equal to Task Word Count.						

Figure 14: Mark Goal Complete Black Box Test Results

Test ID	Test Case Name	Status	Priority	SW Version	Setup	Teardown	Test Substeps	
1	Mark Goal Complete Test	Pass	Medium	1.0	• Create a Task, Create Goal	• N/A		
Tester	Lee Williams							
Date	07/04/16							
Test Description								
Check Goal marked complete.								
Check Task Word Count Progress is updated.								

Figure 15: Update Task Black Box Test Results

Test ID	Test Case Name	Status	Priority	SW Version	Setup	Teardown	Test Substeps	
1	Update Task Test	Warn	Medium	1.0	• Create Task, Create multiple Goals	• N/A		
Tester	Lee Williams							
Date	08/04/16							
Test Description								
Test form validation by inputting invalid data. Test form validation passes valid data. Test DatePicker dialog box. Test task is updated sucesfully. Check effects on Task Goals when Task Word Count reduced and increased.								

Figure 16: Update Goal Black Box Test Results

Test ID	Test Case Name	Status	Priority	SW Version	Setup	Teardown	Test Substeps	
1	Update Goal Test	Pass	Medium	1.0	• Create a Task, Create a Goal	• N/A		
Tester	Lee Williams							
Date	08/04/16							
Test Description								
Test form validation by inputting invalid data. Test form validation passes valid data. Test DatePicker dialog box. Test goal is updated sucesfully.								

Figure 17: Achievement Black Box Test Results

Test ID	Test Case Name	Status	Priority	SW Version	Setup	Teardown	Test Substeps
1	Achievement Test	Pass	High	1.0	• Create five Tasks, Create ten Goals	• N/A	
Tester	Lee Williams						
Date	07/04/16						
Test Description							
Test Achievements unlock. Test Android Toast displays when unlocking Achievements.							

Alpha Testing

The second stage of software testing is to roll the application out for alpha testing. Alpha testing is a software testing method in which a software is tested by the developers and in some cases family and friends of the developers (43).

For the alpha testing of this application, personal friends are to be given a copy to install and test on their devices. They will be able to provide direct feedback of the application. The developer is also to perform the same task. With a variety of users installing the software, potential Android operating system versions compatibility issues can be identified if there are to be any.

In order to provide the application for the user to install, an Android installation file is to be provided. To accomplish this, the build APK option in Android Studio is to be used in which will compile the Android .apk format installation file. The file is to be hosted using Google Drive, providing simple sharing capabilities in order to share via social media.

During the alpha testing stage, a software bug was found in the achievements section of the application. Achievements were incorrectly linked from the database to the corresponding achievement classes which caused a failure of unlocking achievements all together. These are to be updated before the beta testing takes place.

Beta Testing

The third stage of software testing and the last is to roll the application out for beta testing. Beta testing is a software testing method in which the software is provided to its intended target audience for testing. It is the last stage of software testing (43).

For the beta testing stage, the application is to be distributed to a number of students at the University of Wales Trinity Saint David Swansea Campus for use during one of their assignments. To introduce and explain the application to the students, a presentation is to be done at the end of one of the students' lectures. In this presentation, a brief explanation of the applications background will be given along with a short tutorial of how to use it. The application is to be hosted on Google Drive and the link provided to students for easy access. A copy of the application will also be provided on USB stick.

In order to gain feedback of the application from the students, a second questionnaire is to be handed out. The questionnaire is to provide feedback on the usability and design of the application as well as its overall purpose. It is also to provide information on whether or not the students believed the application improved their motivation towards their assignment. There is also an opportunity for the student to provide feedback via the feedback section within the application. This is explained during the presentation to the students.

Analysis

In order to gather data in the most meaningful way, a specific class of students are to be used throughout the beta testing. The best class is to be selected along with assistance from a lecturer. For full disclosure, the students are assigned a specific reference number by their lecturer which will then give the ability to track the individual students' progress without knowing who the student is.

During the process there are to be two questionnaires handed out to students. The first questionnaire will be distributed before the students are given the application for beta testing with the intention of discovering how motivated the students are and if a motivational student assignment manager application would be of any help and interest to them. The second questionnaire is to be distributed after the beta testing is complete. For the second questionnaire, the intention is to discover if the effects of the motivational techniques implemented in the application had affected the participating students.

First Questionnaire

The table in Figure 18 shows the results of the first questionnaire distributed to all participating students. The results show that all students who undertook the questionnaire currently have smartphones. 28.57% of these students were using an Android device, 57.14% were using an iPhone device, 14.29% were using a Windows Phone device and no users were using Blackberry OS or any other mobile operating system. This information gathered from the students contradicts the earlier conducted research regarding market share of mobile operating systems. Windows Phone being less than both Android and Apple iOS and Blackberry being less than both and Windows Phone is correct, however the research showed that Android had a larger share than Apple iOS. The data captured not matching the research data could be perhaps due to the student demographic having a preference to Apple iOS over Android and all other mobile operating systems.

The results also show that 57.14% of students believe that achievements in video games help encourage them to play the video game more often and that it extends the life of the game. The same students also purposely work hard towards unlocking these achievements. This has huge potential to improve students' motivation during study if implemented correctly. If implemented into a task management application there is good indication that it could result in positive

improvements to the students' motivation. What helps further prove this point is that 85.71% of students feel that having achievements in a task management application help motivate them to perform and complete a particular task. This also helps prove the gamification motivation theory previously researched.

When studying the data to see whether students would benefit from having set targets for their assignments, 85.71% of students felt that targets with rewards help motivate them to complete a task. 57.14% feel that an application with set targets and reminders would help motivate them to start assignments earlier. By motivating the students to begin assignments earlier, student assignment results could be increased by 5% based upon the previously discussed research conducted by Professor David Arnott and colleagues. This would provide a large increase to overall results if successfully achieved in all assignments throughout the students' course. When asked, 57.14% of students admitted to not starting an assignment with adequate time remaining for completion, with 75% of these students admitting this was the case with over 40% of their assignments. This shows that a large percentage of students do not start assignments early enough despite the evidence that shows the importance and effects of starting early.

The questionnaire shows that there is a demand for a smartphone task management application to help students' motivation during assignments. There are also clear signs that this type of application has potential to improve students' motivation, thus improving students' assignment marks.

Figure 18: First Questionnaire Results

1) Do you currently own a smartphone?

Yes	<u>7</u>	No
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2) What mobile operating system does your smartphone have?

Google Android	<u>2</u>	Apple iOS	<u>4</u>
Blackberry OS		Windows Phone (Windows Mobile)	<u>1</u>
Other (please specify):			

3) From a rating of 1-5, 5 being the highest, how motivated do you consider yourself to be?

1	2	3	<u>5</u>	4	<u>2</u>	5
---	---	---	----------	---	----------	---

4) Do you start assignments with adequate time remaining for completion?

Yes	<u>3</u>	No	<u>4</u>
-----	----------	----	----------

Please skip to question 5 if 'Yes' was selected for questions 3.

- 5) What percentage of assignments do you start without adequate time remaining for completion?

0-20%	21-40%	<u>1</u>	41-50%	<u>2</u>
51-60%	61-80%	<u>1</u>	81-100%	

- 6) How strongly do you agree with the following statements? (Please tick correct field)

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
6.a) I often use task management to assist task completion.	<u>2</u>	<u>2</u>	<u>3</u>		
6.b) I often use task management applications on my smartphone.	<u>1</u>	<u>4</u>	<u>2</u>		
6.c) I believe that task management software is better suited on a mobile device.			<u>6</u>	<u>1</u>	
6.d) I have struggled / failed to meet assignment deadlines due to time management.	<u>1</u>	<u>4</u>	<u>1</u>		<u>1</u>
6.e) I feel that breaking down tasks to manageable sizes help complete the overall task.				<u>5</u>	<u>2</u>
6.f) I am likely to use a smartphone task management application to help manage assignments.		<u>2</u>	<u>4</u>	<u>1</u>	
6.g) I feel that targets with rewards help motivate me to complete a task.			<u>1</u>	<u>6</u>	
6.h) I feel that having achievements in a task management application, such as an achievement for completing the first assignment, help motivate me to perform and complete a particular task.			<u>1</u>	<u>5</u>	<u>1</u>
6.i) I feel that an application with set targets and reminders would help motivate me to start assignments earlier.			<u>3</u>	<u>3</u>	<u>1</u>
6.j) I believe that positive feedback from completing tasks help motivate to complete further tasks.		<u>1</u>	<u>2</u>	<u>4</u>	

- 7) How strongly do you agree with the following statements? (Please tick correct field)

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
7.a) I often play games on an electronic device such as a games console, smartphone, tablet or other devices.		<u>1</u>	<u>1</u>	<u>3</u>	<u>2</u>
7.b) I am familiar with in game achievements and rewards during game progression.			<u>1</u>	<u>4</u>	<u>2</u>
7.c) I feel that in game achievements motivate me to play more often.			<u>3</u>	<u>2</u>	<u>2</u>
7.d) I feel that in game achievements extend the games playability and life.			<u>3</u>	<u>2</u>	<u>2</u>
7.e) I purposely work hard towards unlocking achievements and rewards.		<u>2</u>	<u>1</u>	<u>2</u>	<u>2</u>

Second Questionnaire

The table in Figure 19 shows the results of the second questionnaire distributed to all participating students. Unfortunately only one student participated in the beta testing leading to only one questionnaire being returned. Although the results showed many positive effects of using the application, they are not statistically significant and a fair conclusion cannot be made.

Figure 19: Second Questionnaire Results

1) Did you use the Stuject application?

Yes	<u>1</u>	No
-----	----------	----

Please skip to question 3 if 'Yes' was selected for questions 1, otherwise only answer questions 2.

2) Which of the following reasons did you not use the application?

Compatibility Issues	Not Interested
Other (please specify):	

3) Would you recommend Stuject to other students?

Yes	<u>1</u>	No
-----	----------	----

4) How strongly do you agree with the following statements? (Please tick correct field)

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
4.a) I feel that the application was simple to use.				<u>1</u>	
4.b) I feel that the application helped my time management for my assignments.				<u>1</u>	
4.c) I feel that the application helped motivate me to start my assignments early.			<u>1</u>		
4.d) I feel that the application helped motivate me to complete my assignments.			<u>1</u>		
4.e) I feel that the application helped reduce procrastination.				<u>1</u>	
4.f) I feel that breaking down tasks to manageable task goals helped motivate me to complete the overall task.			<u>1</u>		
4.g) I feel that finishing and marking task goals complete motivated me to complete others.			<u>1</u>		
4.h) I feel that finishing and marking task goals complete provided me with confidence to complete the assignment.			<u>1</u>		

4.i) I feel that the application helped me work on my assignments consistently with fewer and smaller gaps between sessions.		<u>1</u>			
4.j) I always finished my task goals I set in the application on time.		<u>1</u>			
4.k) I used the application at times to deliberately unlock achievements.	<u>1</u>				
4.l) I feel that having achievements in a task management application helped motivate me to perform and complete my assignments.				<u>1</u>	
4.m) I would use Stuject again for any other future assignments.				<u>1</u>	

Evaluation

The goal for this project was a simple one, to successfully motivate students by developing and supplying a smartphone task management application in which implements motivational techniques. The extensive research taken prior to the applications development provided an understanding of many motivational techniques that could be implemented in the application. This variety of techniques had the potential to motivate the student in different ways, however due to the nature of the application the focus in the later stages fell on both Maslow's Hierarchy of Needs and Gamification theories.

For the first questionnaire that was distributed to students, the idea was to capture what students thought of motivation, how motivated they believed themselves to be and if a task management application with motivational techniques would be of use to them. It was also to capture their familiarity with gamification methods and information on their current smartphone. This information was to then be used in order to assist with selecting features and methods of the application. Due to the time frame of the project, the application was in development before the questionnaire was distributed. The intention was to modify any features of the application that was already developed in conjunction with the questionnaire results. Upon receiving the questionnaire results, the data collected was meaningful, however there was an issue with the amount of students that participated. Only seven students participated in the survey, and although all students had a smartphone, only two of these had an Android smartphone. This posed a huge issue as the application developed was only compatible with Android devices which were selected from research conducted on the market share of mobile operating systems. Due to time constraints, the first questionnaire was received much later than expected and at the point of receiving the application had already been distributed amongst students for beta testing.

For the second questionnaire only a single student participated. Because of this, a proper analysis of the questionnaire cannot be performed. The idea behind the second questionnaire was to gain feedback from the students' use of the application including whether or not it helped with motivation, procrastination and time management. Although only one student took part, there were positive results shown from the one student participating. These included reduced procrastination, motivation gained from the use of achievements and time management improvements.

Development of the application from a web developer prospective proved to be difficult and time consuming. With no prior experience of coding in Java, the language seemed to firstly pose a

challenge however due to it being similar to C#, Java caused little to no challenges due to familiarity. The biggest issue lay with a very difficult framework that is Android. The Android framework proved to be more difficult than estimated and posed many challenges which resulted in a time consuming development period. Because of the extent of the development period, some features that were intended to be in the application had to be excluded. Having the application sync with Moodle to automatically add assignments to the application on behalf of the user was in itself a big task. The understanding and use of Moodle's API would prove to be too time consuming and therefore the feature was dropped. Providing users with settings in the application was mainly to allow configuration for connecting to their Moodle account and changing notification settings. When the decision was made to drop the Moodle sync feature, there made no sense developing a settings feature in the application just to handle notification settings. This meant the settings feature was also dropped from the application.

The final version of the application that was distributed amongst the students, being the beta version, had an easy to use design which implemented almost all the features specified in the software requirements section. The design based on Android's Material Design allowed ease of navigation and ease of managing and creating both task and task goals. The compatibility was excellent, working with all versions of the Android operating system 4.1 Lollipop and above, covering a 95.1% of all existing Android devices according to the Android's common platform version (44). Achievements in the application work well, allowing the users to unlock throughout the application use. When unlocked, the achievement unlock message would pop up and the user can view a full list of achievements with its locked or unlocked status.

Motivational techniques in the application were implemented well. The Gamification theory was heavily based in the application through the use of achievements. Allowing users to unlock achievements throughout the use of the application by performing certain tasks such as completing tasks and task goals. Maslow's Hierarchy of Needs is also present, with social representing users being able to compare unlocked achievements and progress, esteem representing the progress of the task and marking task goals and tasks complete, and self-fulfilment representing finishing all task, task goals and achievements.

The expected outcome from students using the application is an overall increase in assignment results. This expectancy has derived from the applications motivational techniques that encourage the user to start assignments earlier, working on them more consistently. This according to Professor David Arnott can increase individual assignment marks by up to 5% (1). Sadly, due to a lack of

participants, it is impossible to draw a fair conclusion. Results based on a single participating student is not sufficient and would represent a false conclusion.

Conclusion

During the study there were two questions that needed to be answered. Do motivational techniques derived from influential motivational theories help motivate students during their studies? If so, how effective are these motivational techniques and how best are they to be implemented?

When looking at the theories implemented in the application, research conducted suggest that the users' motivation should be increased from the use of the application. When the application is distributed to the students for use during their second assignment, results from the use of the application should have increased in comparison to their first assignment.

From the results of the first questionnaire a high percentage of students believed that having targets and rewards helped motivate them to complete an assignment, and having an application which set targets and provide reminders would help motivate to start assignments earlier. The results also indicated that a high percentage of students believed that video game achievements helped encourage them to play the video game and that having the same feature in a task management application would help motivate them. This provided good evidence that going forward, the application and its features could indeed help motivate students to start assignments early.

Unfortunately the first questionnaire results were preliminary, indicating that only a maximum of two students could participate due to mobile operating system compatibility issues. During the beta a single student participated leading to one participant in the second questionnaire. This means that the results are not statistically significant and no solid or fair conclusion can be made. For this reason, there it is not possible to determine whether the application was successful or not.

Reflection

The application provides many useful features to help manage and track progress on assignments. Many of these features provide motivation to the users alone, helping them manage assignments in smaller chunks and reminding the user via notifications of set targets that are due. Combining these with the achievement feature helps create a useful application for students that provides helpful motivation techniques. Unfortunately, it is undetermined whether the application is a success due to the amount of participants within the study.

In order to measure whether or not the application created is a success, an additional study would be performed on a larger scale, including a much larger amount of participating students. By having a much larger group of participating students, a more valid and fair conclusion could be drawn on the applications success.

The biggest issue that the study had was the fact that the conducted research of mobile operating system market share did not properly reflect the true amount of Android users in the selected group of students involved in the study. Creating the same application that supports Apple iOS mobile operating system would be of great benefit as the research shows the operating system having the second biggest market share. The operating system was also the most used in the selected group of students participating in the study. There are software tools available that can convert Android applications to Apple iOS compatible applications. One of these is J2ObjC, which converts the Android Java code to Objective-C code for Apple iOS (45). This would need to be undertaken in order to maximise student participation.

With a much larger amount of participating students by introducing an iOS version of the application and increasing the amount of overall students participating, the success of the Stuject mobile application could be measured using the same methods in this study. This would help determine a statistically significant conclusion on whether or not the Stuject application is a success.

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