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Abstract

The process of study management for learners is concerned with the pursuit of a specific learning goal using different resources over a certain time period. It is considered to be an important and effective method for learners to plan and identify what they must do and by when they must complete it. Many learning systems do not offer sufficient individuality or personalization for the user and the existence of internal and external interruptions deter the learner from achieving their desired goals. This thesis discusses the design and development of the Interactive Study Guide (ISG); an application that allows learners to personalize their own study plan and motivates them to partake in study by providing guidelines from the system and a timing method known as the Pomodoro technique. It offers an interactive environment that aims to assist the learner throughout their study process and motivates them to achieve their personal goals. This thesis provides a state of the art pertaining to all of the relevant areas of the application, the design and implementation procedures taken and the perceived benefits that this system has after the necessary testing. Detailed testing was carried out on the Interactive Study Guide upon completion and the results along with the conclusions are covered in detail in this thesis.

1. Introduction

1.1 Background

Preparation for upcoming study periods is a key characteristic of the study process that every learner must adhere to [4]. Studying is a finite activity, not only in time, but also in the use of resources. Study management therefore, is concerned with the pursuit of specific learning goals, using given resources over a certain time period. This will most often require the planning and establishment of the appropriate and upcoming tasks [19]. Each individual learner has different needs and requirements when studying and therefore, there is a need to move away from the “*one size fits all*” paradigm and to develop methods whereby the system is solely focused on the individual [9].

In order to allow a learner to individualize their preferred study allotments, a personalized system should be implemented that suits the lone user’s needs [46]. That is where the Interactive Study Guide application is introduced. Current study planners that exist only offer a template for the learner to enter their subjects in a static manner [57][40][60]; none of which are web based applications. The problem with these templates is that they are just templates; they are not web based applications that interact and support the learner and the only option users have is to enter their subjects and proceed with the study process without assistance. The Interactive Study Guide application however will allow learner’s to create their own individual study plan and the system will monitor how long the learner has been carrying out the study process. The system offers an interactive user interface and provides support to the learner and inherits the properties of the Pomodoro timing technique [13]. The Pomodoro technique is introduced in chapter two of this report.

Self Regulated Learning (SRL) is also introduced in chapter two of this report and the idea of SRL is that the learner is somewhat responsible for what they themselves learn and achieve academically [67]. This is explicitly apparent throughout the entire Interactive Study Guide application and throughout this report. The goal of the system is to allow the learner to develop their individual personalized study plan and then the system encourages and motivates them in a subtle yet effective method.

Once the individual learner has created their preferred study schedule, and enters the study mode aspect of the system, the main objectives of the system are to record the amount of time the learner has been studying for and provide recommendations for the learner to aid them most effectively. This project is concerned with not just the technical aspect of delivering a personalized adaptive system but also examines the perceived benefits that a system of this stature would provide to the individual learner.

1.2 Research Question

The development of the system will be covered in detail throughout chapter three of this paper but the question the research that will be carried out for this project can be narrowed down to the following:

“What is the appropriate design of an interactive study guide that is personalized and to what extend would the interactive personalized study guide support the learner?”

1.3 Scope

The primary goal of this project is to investigate the potential perceived benefits that a system such as the Interactive Study Guide would have for learners. More specifically, the aim is to provide a functional application that motivates the individual learners' of the system and encourages them to partake in the study process with the aid of the Interactive Study Guide. To achieve said goals; the system was developed with a rich interface and functional MySQL database. The application is personalized and adaptive with an essence of self regulated learning flowing throughout and main goal is to support the learner in as many ways possible whilst they interact with the system.

The broad scope and objectives for this project can be summarized as follows:

- To review the associated areas of research compliant with the research question for this project.
- To develop a system to cater for learners when they are required to partake in study periods.
- To evaluate the system developed by analysing user test results provided and determine the appropriate response to the research question of this paper.

1.4 Proposed Contribution

Many systems exist that contain adaptive or personalized aspects and the world of e-learning is a vast and well studied area [24]. What the Interactive Study Guide opts to do is promote the individualized aspect of e-learning related systems. Many LMS' (Learning Management Systems) exist such as Moodle or Blackboard but these only look out for groups of users. The ISG will be based around the individual. The idea of studying is an unpleasant experience for learners and is a difficult and unavoidable aspect of many learners' lives [4]. The ISG will offer a system that promotes studying efficiency and remove the stigmatism associated with the study process. It will take study planner templates and provide a rich and functional environment where study is encouraged among users.

1.5 Research Approach

To complete this thesis, I plan on writing a literature review relating to the main aspects of the Interactive Study Guide system including personalized systems and recommender systems; A review of current similar systems that exist on the Internet today will also be carried out, identifying their characteristics and then I will aim to build a more usable and functional system. The knowledge gained from my research will allow me to identify what features need to be present in my application along with the appropriate design methods that should be chosen to maximize the learner's satisfaction. The research carried out will allow me to identify the most important features that are required to be implemented into the Interactive Study Guide system. The design of the application will be based on the information ascertained throughout the literature review and then implemented accordingly. To evaluate the perceived benefits that the Interactive Study Guide would have for the learner, the appropriate testing will be carried out and the results analyzed thoroughly.



2. Literature Review

2.1 Introduction

The next section of the thesis will provide an overview of the different literature based on the various adaptive eLearning environments, including adaptive hypermedia systems and personalized systems. The importance of personalized systems is highlighted to support the question of this paper and identifies and highlights why personalization is an important aspect of any eLearning system. A state of the art on recent papers about Self Regulated Learning is covered as this is an important area of the ISG. I will also look at the importance of study management as that plays an important and necessary role upon using the Interactive Study Guide.

2.2 Personalized Systems Overview

To support the learner, literature identifies that the system should meet the needs of the individual user, not the general consensus [14][46][49]. Personalized systems are built to adapt to each user's preference and to assist them with their own goals and tasks [31]. Adaptive systems such as learning management systems (LMS) like Moodle, Blackboard or Claroline can be useful and effective in learning environments [1]. Aammou (2010) discusses that the main problem with LMS' is that they do not offer enough personalized services. It provides the same educational material to large numbers of users and does not take into consideration the different levels of knowledge, interest, objectives and motivation. He continues to state that it is essential to focus more attention on the capabilities of the individual learner to apply the more personalized approach [1] thus strengthening the idea that personalized systems aid the user in an effective manner.

Stiubiener (2001) opts for a personalized approach to LMS' to attempt to counteract the non-personalized elements that exist within them [49]. He introduces the concept of a Personalized Learning Policy (PLP) which aimed to represent the necessary criteria used in the adaption process of the system, and proposes a data structure

known as the Orientation Layer. What this layer does is configures the interactions between the student and the system and the aspects that the instructor/teacher deems relevant to be observed, it facilitates the introduction of additional approaches or directions for each individual student observation at any time. [49].

User modeling is one of the many important components for adaptation and personalization within the system [24]. Adaptive E-Learning services are developed using user profile to conduct personalized learning support (Sumner, 2006). Retrieving the information from the user to adopt the personalized approach is done by gathering the information about the user or learner, then processing the information about the learner to discover the appropriate response and then providing the adaptation [55]. “*A perfect user model would include all features of the user's behavior and knowledge that effect their learning and performance*” (Kavcic 2000). An important aspect of personalized systems is user modeling as it allows the system to identify important and relevant information about each individual user thus allowing for full support and guidance of the learner. Information regarding the user can be broken down into two separate areas; static properties and dynamic properties [24]. Static deals with the basic and personal characteristics of the user, i.e. age, gender, user preferences etc. Dynamic properties however cover the user's interaction with the system and incorporate the user's knowledge, learning style, motivation, current goals and plans to name but a few. [24]

Dagger (2005) speaks of the complexity and time involved in implementing a personalized eLearning system, in his case for development tools to support the teacher in composing adaptive and non-adaptive eLearning experiences. It is clearly evident that he feels that personalized learning systems are essential for learner's to progress. He states that by providing the appropriate and necessary tools and mechanisms to provide a learner with a personalized learning experience successfully, that this can be applied to improve the learning experience for each individual [14].

It is evident from the literature discussed that there is a place for more personalization within adaptive systems. Aammou (2010) identifies this when discussing the lack of individual personalization within the LMS's that exist today (Moodle, Blackboard). A personalized user-centric system that supports learners

while they interact with the system could offer a solution to Aammou and Dagger's predicament.

2.3 Adaptive E-learning Environments/Systems Overview

There are many definitions of adaptive eLearning. For example, Burgos (2006) states that adaptive eLearning is a method to create a learning experience for the student based on the configuration of a set of elements in a specific period aiming to increase the performance of a pre-defined criteria [10]. Bork (2005) suggests that adaptive eLearning is eLearning that focuses on each individual student, and is individually paced to suit the need of each student [6]. Burgos (2006) continues on to identify four main approaches to adaptive learning;

- *Macro-adaptive* – this is the process of selecting a small number of components that define the general guidelines for the elearning process.
- *Aptitude-treatment interaction*- this deals with proposing different types of instructions for the user.
- *Micro-adaptive* – micro-adaptive elearning suggests monitoring the learning behaviour of the user and adapting the system to fit the requirements of the user.
- *Constructivist-collaborative* – this approach focuses on how the user actually learns while interacting and sharing knowledge and activities with others.

These approaches can apply to any adaptive eLearning systems. There are a number of different adaptive learning systems [1] [9][24][33]. An adaptive system is built to accommodate and adapt to the user's needs [33]. Brusilovsky (2003) emphasizes that Adaptive Hypermedia (AH) offers an alternative to the "one-size-fits-all" traditional approach and build models of the goals, knowledge and preference of each individual user in order to effectively adapt to that user. Adaptive Hypermedia systems refer to the merging of two technologies; intelligent tutoring systems and hypermedia systems. (Kavcic, 2000). Intelligent tutoring systems (ITS) involve the interaction of a user whilst being guided towards a particular goal and providing various types of feedback [31]

Aammou (2010) states that adaptation in Adaptive hypermedia systems (AHS) can take 3 forms:

- Adapted Systems: the adaptation is hard-coded by the application's developer meaning that the system's requirements and design will be established and developed before implementation.
- Adaptable Systems: this involves the user identifying his/her own preferences. This can be done by manually creating their own individual profiles thus allowing the system to deal with a fixed profile that is only changeable by the owner of the profile.
- Adaptive Systems: In this case, the system continuously monitors the preferences and needs of the users and chooses the correct method to apply adaptation to the system. This means that the user's profiles is no longer static, updates are added dynamically by the system after extensive and continuous monitoring and analysing the user's actions and behaviourisms [1].

A standard example of adaptive hypermedia would be systems like Amazon.com; they provide users with book recommendations based on user preferences and the users' history. A personalized study planner would need to adapt to the learner's needs based on time spent at certain aspects of the system, e.g. if the learner allocates x number of hours to a certain subject, then the system prompts the learner with a suggestion on how to potentially aid them with their current situation.

Adaptive systems change and adapt to suit the needs of users but personalized systems provide learning requirements for each individual user [55].

2.4 Recommender Systems

"Nowadays, recommender systems are increasingly being used in several domains to assist the user in making his choice and in his decision making processes"
(Souali, 2010).

Recommender systems are used widely throughout the area of elearning nowadays [58] [48] [46]. They are being used to suggest various resources and learning materials to learners therefore improving and supporting a learner's experience [48]. With the ever increasing and rapid expansive nature of the web the idea of recommendation engines is becoming more and more essential within the World Wide Web. In this vein, Shan (2010) introduces the idea of a Browsing Behaviour Personalized Information Recommendation System (BBIRS). The system uses two separate algorithms to mine through web data and interactive data [58]. Not applicable to the ISG application but highlights the ever growing need for recommendation systems.

WAN (2008) opts for an alternative strategy for developing by using the Markov Chain Model to divide the learners into separate categories, in this case; advanced and beginner learners, this is done by using the user's learning processes along with their learning activities. Therefore specific recommendations are provided for the advanced learners and likewise for the beginner learners.

Literature suggests that recommender systems provide the user with assistance within the overwhelming information spaces on the Internet today [38]. P. Pan *et al* (2010) have developed the Ontology-Based Adaptive Personalized Recommender System (OARS). The goal of OARS is to propose to eliminate all the static elements of recommender systems; static being systems that provide the pure knowledge-based approaches that repeatedly provide the same recommendations according to the pre-defined utility function or functional knowledge. They aim to achieve this by using knowledge based techniques and data mining techniques.[38]

It is evident that the use of recommender systems within adaptive systems is beneficial for both the user and the system. However in depth recommender systems are such as the OARS system that Pan *et al* (2010) or whatever methods they

choose to implement within a system it is clear that the user will have many benefits from using a system or application that contains some form of recommendation system developed to support them. It provides added functionality and interactivity to systems and can always be considered an important component of any personalized adaptive eLearning system [55][46].

2.5 Self Regulated Learning

"Self-regulated learning is an active, constructive process whereby learners set goals for their learning and then attempt to monitor, regulate, and control their cognition, motivation, and behaviour, guided and constrained by their goals and the contextual features in the environment."

(Wolters, 2003)

Self Regulated Learning (SRL) is the belief that the learner is somewhat responsible for what they themselves learn and achieve academically. Zimmerman (1990) views self-regulated learners in terms of meta-cognitive processes as learners that plan, set goals, organize, self monitor and at various stages throughout their learning process, self-evaluate to determine all the progress made. It is quite evident that SRL would be an important aspect of a study planner application as it incorporates all of what Zimmerman states above. To support this statement, another way to explain SRL would be to say that it is an active mixture or combination of skill and will [26]. The Skill aspect of SRL refers to the learner's ability to use different meta-cognitive strategies that include the aforementioned planning and executing goals, time management and resource management strategies. Kuo (2010) states that the Will aspect of SRL refers to the learner's motivation when tackling goals and expectations. Kuo (2010) discussed taking the theory behind SRL and applying it in practical situations. The objectives of the paper were to investigate how teachers can incorporate the theory of self-regulated learning in to a practical environment within the classroom. The next objective was to provide learner's with a better understanding of the theory behind self-regulated theory and how they could apply it to enhance their learning.

Van Den Hurk's (2006) journal on "*The relation between self-regulated strategies and individual study time, prepared participation and achievement in a problem-based curriculum*" focuses on problem based learning and within that, time planning and self-monitoring. Time planning involves scheduling, time management, planning and managing one's study time where as self-monitoring involves the process of setting personal goals, focusing attention and monitoring personal study activities [15]. The aim of Van Den Hurk's study was to carry out an assessment that determined whether or not students at a university in Netherlands were currently or indeed capable of partaking in Self Regulated Learning [15]. Van Den Hurk (2006) concludes with:

"Results from this study suggest that students experience difficulties in time planning and monitoring their individual study activities".

Taking from Van Der Hurk's (2006) quote above, it is clear that study planning and time management is a difficult task for the learner and it can be a challenge to partake in the study process. What we can take from Kuo's (2010) paper "*Self-Regulated Learning: From Theory to Practice*" is that to apply an element of self-regulated learning to the learner, then the learner must have goals along with the motivation to attain these desired goals. It is perceivable from the literature that an application designed with an essence of self-regulated learning would encourage the learner to become more self-regulated in their learning and support them while interaction between the learner and the system.

2.6 Study Management

Study management for learners is concerned with the pursuit of a specific learning goal, using different resources over a pre-defined time period [19]. It is of upmost importance for the learner to be able to identify and prioritize their relevant subjects for their upcoming exams [4].

Planning out the subjects learners propose to study according to Bingham (1998) is the most vital element when setting out to study. She continues to divulge that students should identify their strongest and weakest subjects before plotting out their study plan as by doing so will allow the learner to step back and identify where to allocate the appropriate amount of time to each subject. There are many different methods in which the student can adopt to a study management strategy [19][4] but most important is to:

"Identify what you have to do and by when" – (Bingham, 2006).

However, there are several study planner/management templates that exist in MS word or pdf format whereby students simply enter their proposed study periods and save the file locally where it relies upon them to recheck and re-edit by typing their proposed preferences.

An application known as WebTUTOR [22] was created by Harri Hamalainen in 2005 which provides users' with a PSP (personal study plan). Hamalainen describes WebTUTOR as:

"A web based application for creating and maintaining student's personal study plan (PSP). By using the application, student can create himself a personal plan that is based on the rules defined in the curriculum by his university and department. " – (Hamalainen 2005)

The application itself does not allow for free flowing personalized attributes for the user and can only be associated with the blackboard LMS (Learning Management System) thus limiting the usage offered towards each individual learner.

2.7 The Pomodoro Technique

The Pomodoro technique is an optional time-based aspect of the system that the user can avail of if they so choose;

"The Pomodoro Technique was created with the aim of using time as a valuable ally to accomplish what we want to do the way we want to do it, and to empower us to continually improve our work or study processes."

(Cirillo, 2006)

Pomodoro is based upon a timing system that consists of twenty-five minute intervals with five minute breaks and after four twenty-five minute sessions (known as Pomodoro's) a longer break consisting of 30 minutes is taken. [37] [13]

Cirillo (2006) states that this technique was created on three assumptions; the first being that the Pomodoro technique offers a different method of seeing time, secondly, that better use of the mind enables learners to achieve higher consciousness and a greater clarity of thought. Cirillo (2006) continues to state that the third assumption that the Pomodoro technique was based upon was that by employing efficient and unobtrusive tools it reduces the complexity of applying the Pomodoro technique thus allowing the learner to concentrate their efforts on the goals they have set.

Pomodoro technique goal is to try and avoid as many internal and external interruptions as possible. [37] Noteberg (2009) describes internal interruptions as anything that occurs within the learner's mind, the sudden urge and distraction of hunger or the need to constantly check and re-check your emails. External distractions occur when the learner is trying to focus on a specific activity and something out of his/her control occurs, for example, a colleague interrupts and asks them a question or starts a conversation. The Pomodoro technique enforces that you must simply observe, accept and plan or remove, it is vital that you never leave or switch in the middle of a Pomodoro. [37][13].

The Pomodoro technique is intended for use within the ISG as its goals share several similarities with the intended system. Cirillo (2006) states:

"The aim of the Pomodoro Technique is to provide a simple tool/process for improving productivity"

According to Cirillo, the goals of the Pomodoro Technique in summary are:

- Cut down on interruptions thus enhancing focus and concentration.
- To increase the focus of the learner.
- Boost the learner's motivation and maintain motivation.
- Improve the study or work process for the learner.
- Increase the learner's determination to drive them to achieve their goals.

The most recognized and popular example of the Pomodoro Technique is the Pomodairo application [41]. Pomodairo is an Adobe Air application that includes all the features of the Pomodoro technique; the timer set to twenty-five minutes with allocated five minute breaks at the end of each Pomodoro. This is currently a stand-alone piece of software and there is a need for a web based approach to make this application available online or perhaps available to include on different websites. The Pomodoro technique will be implemented within my system and will be offered as an optional method for the learner, therefore allowing the user to find their ideal studying techniques.

2.8 Conclusion

Judging by both past and present literature, adapted personalized systems that adopt the Self Regulated Learning (SRL) technique motivate and encourage interaction between the learner and the system. As mentioned, it is evident that using recommendation systems and suggestions assist the user in more conventional methods but it is the subtle presence of SRL and meta-cognition that support and push the learner to achieve in their studies.

It is easy to see that judging by the research carried out, that the importance of study management for the learner can be a great asset to them in achieving their goals.

There are indeed some applications out there that may adopt some of the features of a suitable system, most notably WebTUTOR but there is room for a more usable, personalized and effective system to ensure that the user is interacting with the system in an enjoyable and effective manner and with the addition of the optional Pomodoro technique it would greatly assist the learner. A system that offers a motivational edge that will enable learner's to optimize their study time would be very beneficial to the user.

After the appropriate research covered in this literature review, it is now possible to gauge what design and implementation needs to be applied to the application that will be built in accordance to this thesis. The next section will describe the design choices made prior to the actual development of the Interactive Study Guide system and will also cover in detail the steps taken throughout implementation.

3. Architecture and Implementation

3.1 Requirements

The following section describes the requirements for the Interactive Study Guide application detailing the functional and non-functional requirements for the application. The functional requirements will be introduced in this section and later covered in detail throughout the implementation section of this thesis.

3.1.2 Approach

The goal of the Interactive Study Guide application is to merge as much of the literature mentioned in the previous section and provide the learner with the optimal application and environment for them to partake in studying. By applying a personalized approach with a blend of self regulated learning and an interactive adapted system, the Interactive Study Guide will allow the user to optimize and utilize their study time.

This entails offering learners an innovative and intuitive system. It aims to allow users the opportunity to create and execute their own personalized study plan and increase their own creativity and cognition. The Interactive Study Guide is planning to remove some of the stigmatism and 'chore' aspect of studying and learning by allowing the user to modify, create and edit their very own personalized study plan. The minimalistic social side of the application will come from allowing users to see what the other users of the system are currently studying and for how long a period of time they have indeed been studying. This aspect of the ISG intends to encourage the learner and motivate the learner to partake in their own study.

The system is aiming to identify each element covered in the state of the art of this paper and provide a solution and method that improves upon previous methods implemented. The following objectives will detail what requirements I will fulfill to support my research.

Objectives

The objectives of the Interactive Study Guide are to tackle the following challenges that exist within current personalized systems.

- Personalization - To identify the users need for a personalized approach to the application, I will develop unique profiles per user along with their own study plan. The study plan is where users have the ability to add and delete subjects in three different views; month view, day view, week view, thus allowing them to specify their study time that is ideal for them as an individual. The calendar will adopt some features of the Google Calendar as that also uses a month view, day view and week view [21].
- To support the recommendation aspect of the Interactive Study Guide system, users will be provided with study tips if they wish and the system will monitor they're time studying and allow the user to avail of the Pomodoro technique for studying. As mentioned the Adobe Air Pomodairo software avails of the Pomodoro Technique [41]. I aim to take this technique and apply it to the Interactive Study Guide application.
- Time management – Along with the Pomodoro Technique which will be time based, the Interactive Study Guide's full screen mode will record how long the learner has been partaking in the study process. The time can be checked at any time by the learner and they learners will also be prompted their elapsed study time upon exiting the full screen mode of the application.
- Encourage the idea of Self-Regulated Learning (SRL) – the system will aim to motivate the learner to motivate themselves by displaying a feed of what others are currently studying but also using different prompts to support the learner. Along with this the 'study mode' of the application will be designed to be as non-distractable as possible thus encouraging the learner to continue in achieving their study goals.

The next section will provide an overview of the functional requirements that the system will adhere to. The functional requirements have been developed based on the research performed and relate to each of the objectives that have been stated previously.

3.1.3 Functional Requirements

Functional requirements capture the intended behavior of the system. The application's functional requirements are intended to match each area of research that I have carried out to provide methods that relate closely to my research question. This section will provide a brief overview of the functional requirements that ISG will adhere to. I will discuss later on how each requirement was implemented in detail.

The system must be personalized to suit each individual learner

Each user of the ISG application must be allowed to create their own personal study plan which allows them to add their desired subjects they plan on studying, for how long they wish to study them and a brief description of the intended subject. Deleting objects from their personal study plan must also be implemented into the system so that the user may edit their study plan as they progress. Along with editing their study plans, learners may edit their own individual profiles with the necessary and basic information that is required for all users of the application to see.

The system must allow the learner to engage in 'Study Mode'

Study mode will be available to all users' of the Interactive Study Guide system. What this mode offers is a full screen element of the application developed with the idea of removing distractions from each learner and to be used when the learner begins their study. The study mode element of the application will contain all the prompts and recommendations available for the learner.

The 'Study Mode' element of the application must try and encourage the process of SRL (self regulated learning). SRL as mentioned is concerned with the idea that the learner is somewhat responsible for what they themselves learn and achieve and the ISG will aid the learner on their path for both learning and achieving.

The system must provide suggestions to the learner

To coincide with one of Burgos' (2006) approaches to adaptive learning; Adaptive-treatment interaction which deals with proposing different types of instructions for the user, time based prompts will be displayed to the user along with different hints and tips for the learner to avail of if they so wish. Random study tips are provided to the user if they would like to avail of them and the system opts to discourage learners from exiting 'Study Mode'. Suggestions are also provided to the learner based on the Pomodoro technique which will be covered in detail later in this report.

The system must adopt the Pomodoro Technique.

The Pomodoro Technique created by Francis Cirillo is a proven method of time based efficiency where it states that working for a certain amount of time and having regular intermissions is most effective. A 'Pomodoro' is twenty-five minutes long and as Cirillo discusses, the Pomodoro technique consists of one Pomodoro, followed by a five minute break, then another Pomodoro followed by another five minute break and so on. The ISG application must follow the rules of the Pomodoro technique in the quest to support the learner's availing of the system.

The system must contain rich features to ensure maximum usability

The ISG application should include rich features to ensure that the application is labeled a Rich Internet Application. Rich Internet applications are web applications that contain many features of desktop applications [36] and the Interactive Study Guide will intend to include a number of the six design principles that Neil *et al* (2009) discuss. Why this is so important for the application is due to the fact that the system is fully user-centric; it is all about the user and has been created to allow the user to feel comfortable whilst undergoing the daunting task of studying. The features that will be a part of the system will vary and their implementation will be covered in detail later in this report.

3.1.4 Non-Functional Requirements

Non-functional requirements are the global constraints of a system. This section will provide an overview of the non-functional requirements of ISG.

Accessibility

ISG will be built with the Web Content Accessibility Guidelines (WCAG) 2.0 [59] adhered to as much as feasible in every aspect of the application. To allow the user to feel comfortable and to be able to support the learner the ISG will provide an efficient and accessible environment to aid the user whilst they partake in study. The application will adopt the four principles of accessibility wherever it is applicable and feasible. These four principles are as follows:

- Perceivable – The user interface and information should be presentable in ways that the user can understand.
- Operable – The users should be able to operate the interface.
- Understandable – All users should find that the application is easy and understandable to operate and should contain no content or operations that are beyond their understanding.
- Robust – The users should be able to access the application as technologies improve and develop and as time goes by.

Security

This requirement is important to any application and this is no different when it comes to ISG. The application will ensure that each user only has the ability to edit their profiles and their individual personalized study plans.

Reliability

The system must always be available for users to access and the system's integrity should be maintained at all times to allow a fully operational and flowing application to aid learners to use their personalized study planner.

3.2 Design

This section will look at the design of the ISG and detail what features I will include in the application and for what purpose each feature will serve. I will also provide an overview on how I intend to include these features into the application.

3.2.1 Overview

The application is intended to be a personalized interactive study guide that implies an essence of self regulated learning that encourages and supports the learner to interact with the system whilst they carry out their studies. The design of the system will be focusing on an easy to use and heavily interactive user interface to ensure ease of use when accessing the application. The bulk of the design will be developed using jQuery [23] and CSS. The design will be centered on the various core aspects of my research question. It will aim to take each core feature of the web application and apply a rich user friendly environment that ensures maximum user enjoyment when interacting with the application.

The application as a whole will be designed with a colorful palette to attract the user with the exception of the full screen mode to ensure that the user does not become overtly distracted once applying themselves to their study. Again jQuery will be used to ensure this is achieved successfully. The method I take to develop this design will be discussed in detail along with the appropriate screenshots in the implementation section of this paper.

3.2.2 Features

The core of the ISG will be the user's calendar that they will access upon logging in to the system. The calendar is the hub of the application and learner's plot out their proposed study sessions here. The calendar's design will be divided into three formats; day, week, month therefore allowing users to specify according to their preferences when exactly they intend to study. It will use strong colors to indicate and display user's subjects on the calendar and subject can be removed and added by using dialog boxes that appear via the user's commands to personalize and customize their own study plan. The aim of the design of the calendar/study plan in the application is to counter act Aammou's (2001) dispute that many current personalized systems tend to focus on a group of people rather than the individual. The application's calendar will be designed

with the individual in mind. The individual user will be presented with a neatly structured calendar where they can edit to suit their individual needs.

The design of the home feed feature that users view when they initially log in or opt to click on the 'Feed' link navigation menu on the page will be designed on the center of the page displaying the learner's of the systems' names, what they are studying and for how long they have been studying. The name will be displayed in bold style, the subject in plain automatic text and the period of time in a faded italic grey. Each user update will be divided by a modified

 tag to easily identify where one user begins and the other ends.

Another core design feature of the ISG application will be the full screen or pop out window study mode that the system offers to the learner when the aptly titled 'study mode' button is clicked. This will show a full screen view of the learner's study plan with a black background to try and prevent users from being distracted by their own computer. The study plan will be essentially the same calendar used when the user is editing their subjects but will not be allow users to modify their study plans therefore reducing further distractions for the users. The only navigation on the page will be to jump between different views of the calendar. The calendar will be designed to fit the screen and the full screen page will contain four different customized buttons that allow the users various options. Each button will generate a dialog popup with the exclusion of the 'Exit Study Mode' button which simply closes the window. The functions of the remaining three buttons all run in the background of the application once the study mode is entered and the only design feature that is required for these are dialog popup that will be designed to suit the tone of the application.

The basic profile for each user will contain an edit profile function which allows the user to edit some basic information about them. The editing options will be name, college, course and a standard text area that allows the user to add information to their bio. This information will be what other user's will see. The users of the system listed on the page will be displayed using modified scrollbars to traverse through the user list.

It is essential for the system to be designed with a free flowing logical feel to it. User's must be able to access each page with ease from anywhere in the application. This can be achieved with efficient design principles. The application should operate like a rich internet application and many of the features of a rich internet application will be

included in the design of the Interactive Study Guide system including drag and drop, tooltips and the accordion jQuery feature. These will be included to allow maximum enjoyment for the user when interacting with the system.

3.2.3 Research

Throughout my research for the discussed areas, I have acquired the sufficient knowledge to successfully design an appropriate and efficient application to suit the needs of the individual user. For the personalized aspect of the system, I aim to design the Interactive Study Guide to suit the individual users' needs; a separate study plan and profiles are owned by each individual user of the system. Although it can be a complex task [14], it is clear that:

"To provide more effective services, individuality of each learner is taken into account"

(Sumner, 2006)

This can be directly related to Aammou's (2001) theory that many personalized systems are built for groups of learners, not the individual. Acquiring the appropriate knowledge from the research I carried out is essential for the methods I will decide upon basing the design of the Interactive Study Guide on. The main design approaches I will take from the research carried out on the various areas of this paper will be that a rich, usable, personalized and user-centric application needs to be implemented to support and encourage the user for interaction with the ISG system. The application must be user friendly and inviting to use for the learner whilst they partake in the study process.

3.2.4 Conclusion

The overall design of the ISG is intended to be simple but effective and should not be too distracting for the user to interact with as it could end up not supporting them with their study. It must have a personalized feel to it which is where the calendar comes in to fruition; the simplistic design approach allows the learner's to focus on the important subject of studying rather than turning the application into a mini social network where abrupt distractions exist throughout. The thinking behind the design of the study mode feature of the application was that darker colors would be less distracting for the user, a calendar that takes up almost the entirely the whole page would keep players focused on the current tasks at hand and encourage them to endure with their studies.

3.3 Implementation

3.3.1 Overview

The implementation section of this paper will describe how I developed each of the requirements that the system intended to create. A table displaying an overview of each of the requirements will be given and then a detailed analysis of how I actually implemented each feature of the application along with the appropriate screenshots will be provided.

The actual development of the Interactive Study Guide was done so using HTML, CSS, and jQuery, JavaScript, PHP and MySQL. I will discuss in full detail the different aspects of the system that were implemented. This section will cover how I initially set up the application and discuss the different technologies I used.

- HTML [63] and CSS [28]

Like standard development of web pages, HTML (HyperText Markup Language) was used to code the web page and the application itself along with CSS (Cascading Style Sheets). The HTML is used to structure the content of a web page and CSS is then used to format and design this structured content. For added features and design, jQueryUI was used.

- jQueryUI [23]

For all the graphical and rich features of the application, jQueryUI was used. JQueryUI provides advanced effects at a high-level and is built on top of the JavaScript library; it simplifies event handling, animating, document traversing and AJAX interactions for web development. It allows for the inclusion of theme frameworks and the addition of prebuilt functions and widgets. It plays a big part in bringing to life the rich features of the Interactive Study Guide application.

- AJAX [61]

Asynchronous JavaScript and XML (Ajax) is used for the development of interactive websites. The main use of Ajax is to retrieve small amounts of data from the web server (in my case, the WAMP server which I will discuss shortly)

and then showing it in your applications. In this case, Ajax is used to send a XMLHttpRequest object to request the drag and drop delete subject method within the application therefore removing the subject from the learner's study plan.

- **JavaScript [62]**

JavaScript is a well-known scripting language used for client side scripting. It is used primarily as a method for validating forms and providing interactive content to web sites. JavaScript is used throughout the application, apart from the AJAX and jQuery UI elements, many pure JavaScript functions were used including the timer aspect of the application and many of the prompts including the Pomodoro Technique were implemented using JavaScript.

- **PHP [64]**

Although the application is initially being run on the localhost, PHP was a necessity for handling interaction with the server side of things. PHP (PHP: Hypertext Preprocessor) is embedded within the HTML of your webpage and is used for forms, login pages and communicating with the database. In the case of the Interactive Study Guide application, PHP is used for a secure register, login and logout. It is also used to print out different variables from the database, for example the username of the learner who logs into the system or the listing of all users of the ISG system on several pages of the application.

- **MySQL [34]**

MySQL is a popular database management system that is widely used throughout the web today. It is used to store collections of data that can be accessed at anytime from your website. For the Interactive Study Guide application, MySQL was used to store the learner's information and subjects from their study plan.

- **WAMP**

WAMP (Windows, Apache, MySQL, PHP) is a form of server that can be run on any windows operating system and as suggested comes with pre-installed versions of PHP and MySQL. For the Interactive Study Guide application, WAMP

allowed the setup of databases and a server on the localhost of my machine. It was perfect for initial setup and testing.

3.3.2 Functional Requirements

Figure 1.1 shows a table containing the functional requirements of the Interactive study guide previously mentioned and this next section will analyze each requirement and provide a detailed account of how I successfully achieved to implement each specified requirement.

Functional Requirements	
[f1]	The system must be personalized to suit each individual learner
[f2]	The system must allow the learner to engage in 'Study Mode'
[f3]	The system must provide suggestions to the learner
[f4]	The system must adopt the Pomodoro Technique
[f5]	The system must contain rich features to ensure maximum usability

Figure 1 – Functional Requirements of the ISG

[f1] The system must be personalized to suit each individual learner

This is a vital element of the Interactive Study Guide as it separates the system from so many out there that work for groups of users such as current LMS' like Moodle or Blackboard. What the ISG is offering the user is an individualized and user centric application that's main interest is to support the learner. The personalized side of the application can be seen throughout but the main features of the ISG that act solely for the user are the study plan and the user profiles. I will now detail how each personalized aspect of the system was implemented and provide an overview of why I chose the methods I took.

[f1.1] The Study Plan

I had always decided upon using a calendar with multiple views for the planner side of the application. This was because it offers learner's the most efficient method of planning but with not being too strenuous to initiate. The calendar consists of a month view, a day view and a week view (see figure 1.2, see appendix). This was worked into the application using the jQuery tabs feature which I will discuss later. By using the Tabs feature however, meant that all actions could be carried out by the learner on the one page to ensure the user maximum efficiency when creating their own study plan.

Initially, I set up a month view calendar where user's could add and delete subjects. This was so that I could set up the add and delete methods that the learner's would need for their study plans. The add function was done using PHP and MySQL. The month view of the calendar was done using a HTML `<table>` tags with modified `<tr>` and `<td>` tags to add different design features. The layout of the month view of the calendar can be seen in figure 1.2 and the remaining views of the calendar are shown in the appendix.

The functionality of the calendar however is the most important part as this is how the user interacts with the calendar and creates and updates their study plan. Firstly, the calendar needed to display real time information, i.e. the current date and time. Thankfully PHP has `PHP calendar()` function which allows you to display dates within your PHP application. `$currentTimeStamp = strtotime("$year-$month")` would display the current month and year above the appropriate month of the calendar. The days of the month were implemented using a for loop and `<td></td>` tags to display the content within the table. As you can see in figure 1.2, the current day of the month is highlighted using the `.today` class and days with subjects within them are part of the `.event` class which highlights them in the specified colour to separate them from the rest of the calendar.

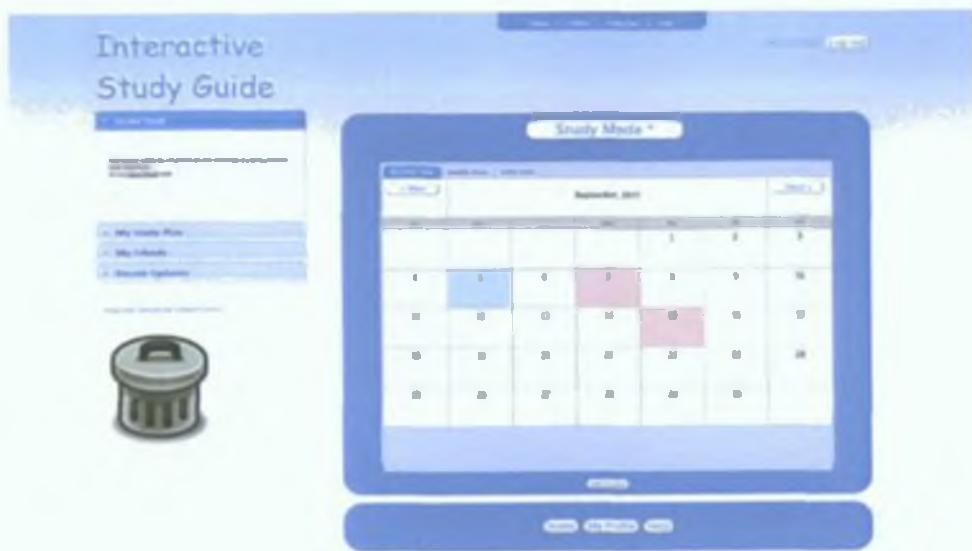


Figure 2 – Month View of ISG's Calendar

For the learners' interaction with their study plans, as mentioned there are two methods for which they interact with the calendar; add and delete.

Add Method

If the user clicks on a day, an 'Add Subject' button appears for the user to avail of. Once clicked, a jQuery dialog box pops up containing a form that users can enter their subject title and description about that subject (usually what they would have to cover on said subject, see figure 1.3). jQuery is used throughout the application to add rich entities to the application and is covered in detail later in this report. The information entered by the learner is stored in the database of the application using MySQL; `INSERT into eventcalendar (Title, Detail, eventDate, dateAdded) values ('".$title."','".$detail."','".$eventdate."','".$now()."')`. Once the user enters the necessary information about the subject, and hits the 'add subject' button underneath the form then the information is added to the database and shown on the calendar for the user to avail of.

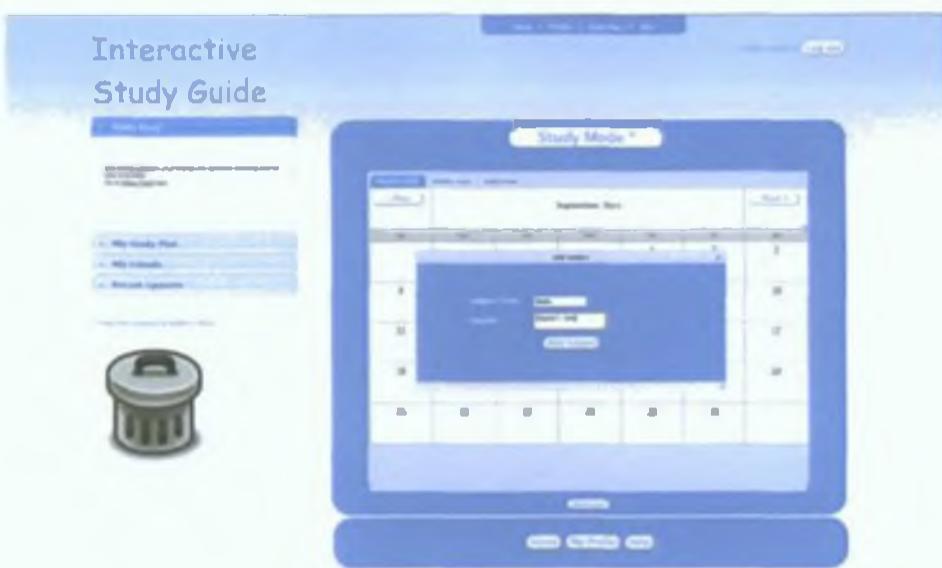


Figure 3 – Adding Subjects to the ISG

Delete Method

For deleting subjects the user has two options, a button click or a drag and drop feature. When the user clicks on the day that contains subjects, a dialog box like the one aforementioned is displayed showing the information about the subject(s) that the user has added for that day. Underneath this a delete button is there that if clicked, the subject will be removed, this time using an AJAX method `doDelete` which removes the necessary objects from the database. Secondly there is a drag and drop feature that has been implemented in the application again adding to the rich features included for the learner's benefit. The drag and drop feature was included again using jQuery and the design will be discussed later in this report. What is important here is the functionality that the feature implies. How it works is that I specified what is able to be dragged within the DOM of the page, i.e. the variables `$title` and `$detail` which essentially are the user's subjects on the calendar. These variables are now draggable and when the learner drags the subject over the trashcan .png on the page and 'drops' the subject, they are greeted with a JavaScript confirm box ensuring that they want to delete the specified subjects. Once confirmed, the AJAX method `doDelete` is called upon once again.



Figure 4 – Drag and Drop deleting in ISG

[f1.2] User Profile

As mentioned the Interactive Study Guide application is all about individuality and personalization for the user and to separate the user from the group, profiles were needed, the basic profile in the application allows users to update their information and can be seen by other users of the system.

Upon registering with the system the user is provided with an \$id that is auto_incremented in the MySQL database. The id that the user is given separates them from the rest of the system. It is this id that allows the system to uniquely identify the user and allow them to edit and update their own study plan and profile. Figure 1.4 shows the basic layout of the profile and you can see a list of all the users of the system. The simplicity of the system is due to the nature that the system was built. I was very aware not to implement a social network as the function of the Interactive Study Guide application is to support the learner, not provide them with distractions to deter them from study. All users are listed using `fetch users()` method which grabs all the users of the system from the database. The output of the list of user's is then displayed within a `<table>` and each username acts as a logical URL to the profile of the user clicked.



Figure 5 – User Profiles of the ISG

Adopting to push away from the 'one size fits all' aspect that many applications adhere to, personalization for the individual user is a huge influence for the Interactive Study Guide and the study plan and profiles of the application offer individuality for the user and allows learners to use the system to suit their needs.

[f2] The system must allow the learner to engage in 'Study Mode'

SRL (self regulated learning) as I have mentioned deals with learner's that are self motivated and willing to learn and achieve within themselves. The study mode of the ISG application opts to encourage the user to obtain and support these characteristics; it offers prompts and little distractions to avoid the learner from drifting away from study. It is also where the Pomodoro Technique comes into the application and this will be covered in the next functional requirement section of this paper. The study mode (full screen) aspect of the application was built with the goal of motivating the user to continue study and not let the numerous distractions that exist to take over. The following section will break down the individual elements of the 'study mode' feature and detail how I chose to implement them.

[f2.1] Overall Design

The overall layout of the full screen element of the Interactive Study Guide application as seen in figure 1.5 is essentially a magnified or enlarged view of the editable calendar that the learner's initially prepared their study plan with. A dark background has been put in place to relax the learner and to avoid distractions with bright colours or distracting images. The Next and Previous buttons that would allow the learner's to browse through the months of the year have been removed in an attempt to remove distractions. Tabs are still used to display the other views of the calendar (see appendix for day and week view) and if clicked upon, the subjects can be viewed on a dialog box exactly like with the calendar page. The page is essentially a pop up in itself so a JavaScript function is used to open the page using the fullwin function;

```
window.open("fullscreen.php", "bfs", "fullscreen,scrollbars,  
width=1900, height=1100").
```

This function opens the study mode window with the specified width and height and removes all the browser buttons that might tempt the learner to defer from the application and essentially their studies. Each of the four buttons on the study mode page offer different options for the learner. The 'Study Time' button displays how long the learner has been studying once clicked, 'Random Study Tips' does exactly what it says; provides the user with study tips they may find useful. The 'Pomodoro' button provides information about the Pomodoro technique and how it works. Lastly, the 'Exit Fullscreen' button closes study mode but not before attempting to deter the user from leaving its current state.

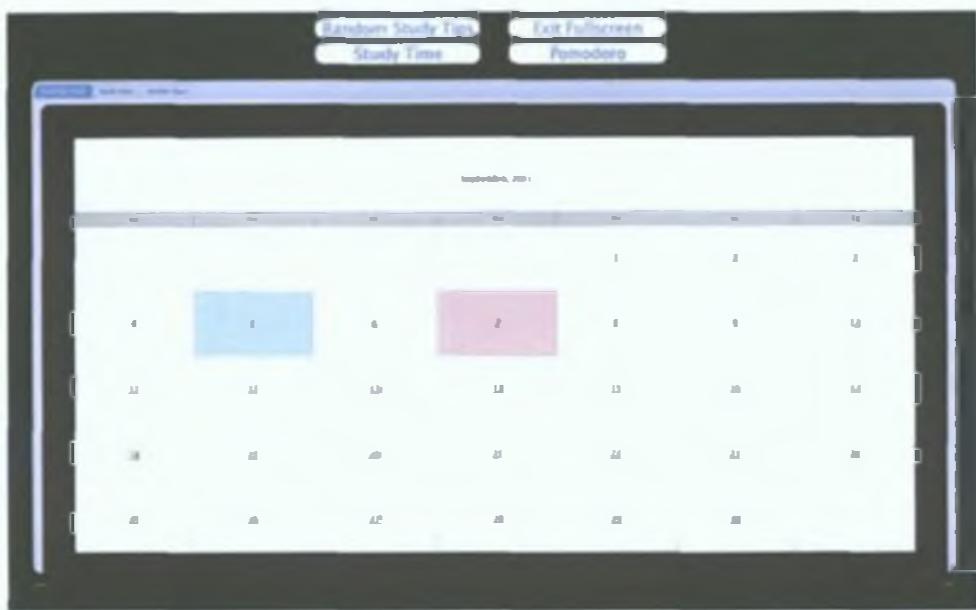


Figure 6 – Study Mode of the Interactive Study Guide.

The reason I chose to use the 'Study Mode' (full screen) idea in the Interactive Study Guide application was to encourage the user to keep at their studies. It is simple to set up a study plan, you can even do it on paper, but this study mode then pushes the learner that bit further, it is there for when the learner is ready to study and once the learner decides to enter 'Study Mode' then the ISG begins running in the background. The next section will discuss how I implemented these features of the system to support the learner throughout their study process.

[f3] The system must provide suggestions to the learner

As you have seen in figure 1.5, the ISG has several buttons in Study Mode; I will cover how I gave these buttons functionality and why I decided to implement them in my system.

[f3.1] Study Time

This feature acts as part of the Pomodoro Technique but was initially implemented into the system for the learner's interest. Once clicked, a dialog pop up will be displayed informing the learner for how long they have been studying for. It allows users to keep track of their progress and how long it has taken them to complete a certain task. It is done using JavaScript and begins as soon as the page is loaded using body onload="timeIt(this.value)". This basically loads the timelt function every time the page is loaded. The function is a timer that works by incrementing one every second using predefined variables.

[f3.2] Exit Fullscreen

This button, when clicked will display a confirm box with how long the learner has been studying for and if the learner is sure they want to stop studying and exit the study mode aspect of the application as seen in figure 1.6. This was done using the timer method from the timelt function mentioned above. The confirm box is a standard function that JavaScript provides and looks simply like var question=confirm(''), the direction the application takes once the user answers the prompt is decided by an If Else statement. The idea of the prompt when the learner attempts to leave the study mode of the ISG is to perhaps allow them to think again and allow them to continue their studies. Displaying the time might fill them with achievement but may also encourage them to go back to the study and give it some more thought.

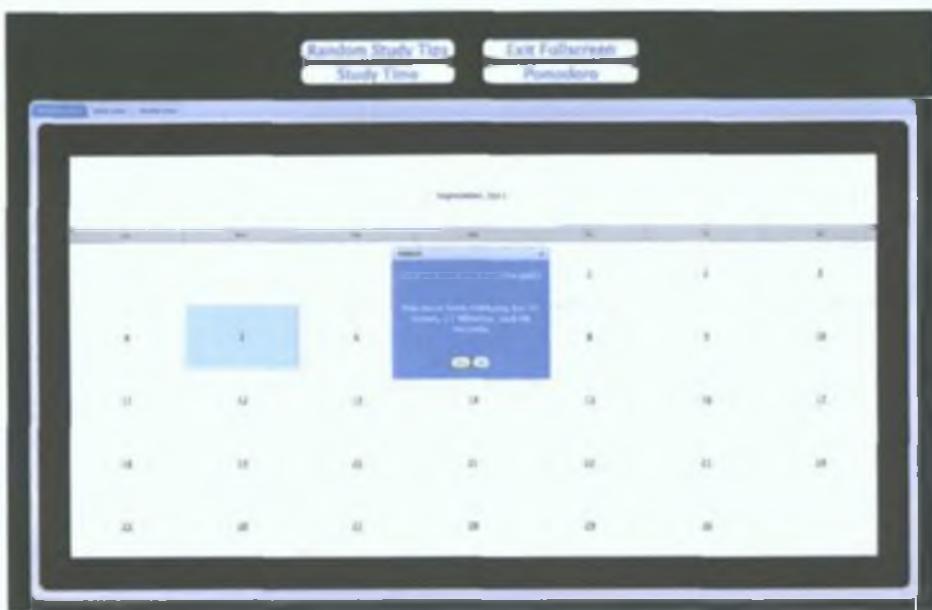


Figure 7 – Upon exiting the study mode of the ISG

The timed suggestions of the application are built around the premise of the Pomodoro Technique which I will discuss in the next section of the paper. It is relevant and important to have suggestions in the system for the learner as it will guide and assist them

[f4] The system must adopt the Pomodoro Technique

The Pomodoro Technique is an important and essential aspect of the Interactive Study Guide system. As mentioned the Pomodoro Technique involves timed intervals of work met with short breaks and then back to work again. A standard 'Pomodoro' lasts twenty-five minutes followed by a five minute break, and then the process is repeated and repeated until the learner opts to take a longer break. The effectiveness of the Pomodoro Technique has been covered in the literature review section of this paper and it justifies why I chose to add this feature into my application. The Pomodoro Technique was implemented using the `setTimeout` method in JavaScript. When the timer method gets to twenty-five seconds, in this case 1500000 milliseconds as this is the time format JavaScript operates in, another confirm box appears (figure 1.7), stating that the learner has been working for twenty five minutes, would they like to take a break, once

confirmed, another five minute timer begins counting down the break for the learner and the timer continues on, skipping those five minutes and notifying the learner when another twenty five minutes or 'pomodoro' has been completed. It was important not to make this too intrusive however because it wouldn't be fair to expect the user to follow the exact amount of time that the Pomodoro Technique adopts. It is put in place to provide guidelines to the user and to support them whilst they study.

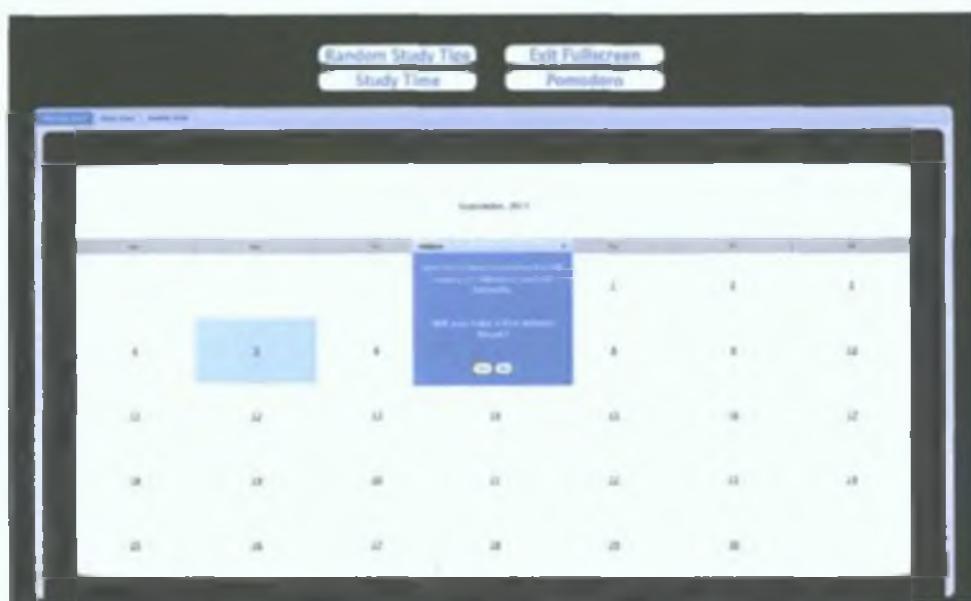


Figure 8 – The Pomodoro Technique of the application

The Pomodoro Technique was implemented into the system to provide the user with an effective study method that supports the learner whilst they take part in the study process. It is essential not to be too intrusive with this technique though as although not preferable for the system the learner's should be allowed choose whether or not they want to avail of the Pomodoro Technique within the Interactive Study Guide application.

[f5] The system must contain rich features to ensure maximum usability

The rich features within the Interactive Study Guide are implemented to encourage user interaction and allow for a free flowing and easy to use application. To achieve a rich application during development the six design principles of an application were adhered to and included as much as possible throughout the development of the Interactive Study Guide [36]. Neil *et al* (2009) define the six principles as:

1. Make It Direct
2. Keep It Lightweight
3. Stay on the Page
4. Provide an Invitation
5. Use Transitions
6. React Immediately

The following will outline which of these six design principles that the ISG had implemented and where the Interactive Study Guide has included these six design principles to allow for a rich user experience.

[f5.1] Make It Direct

This principle deals with allowing input wherever output is present on a page. It suggests that the user should not be kept waiting whilst using your application and that you ensure that no unnecessary interaction that slows down user interaction. This is apparent within the drag and drop function discussed previously (see Figure 4) and ensures that the user won't have to endure any unnecessary waiting, i.e. load times or needless clicking buttons to delete objects.

[f5.2] Stay on the Page

This involves keeping the user's on a single page of your application while carrying out several tasks. It avoids forcing the user to traverse and navigate through numerous amounts of web pages to obtain information or perform tasks. All of this principle's features that are present within the Interactive Study Guide can be seen in Figure 3. The accordion feature along the left hand side of the page allows you to display more information to the user rather than having them navigate to other pages just for textual information. The jQuery [23] tabs feature is also used to display each individual view of the calendar. This allows the application to display three views of the calendar on one

page and making it accessible for the learner to avail of. The adding and deleting of subjects also adhere to this principle as it allows the learner to carry out all the necessary functions required whilst still remaining on the current page. The jQuery dialog as discussed previously was used to implement this feature into the Interactive Study Guide application.

[f5.3] Provide an Invitation

Providing tips or guides for the users on your application allows a more free flowing application and a less frustrated user. The tooltips function that was developed using pure CSS that exist on each header of the core section of each page (calendar, home feed, profile) provides guidance for the learner when using the Interactive Study Guide and allows for the user to be fully aware of what each section of the application beholds.

[f5.4] React Immediately

It is important for an application to be responsive in order to satisfy the users' needs and to flow perfectly. The Interactive Study Guide provides prompts to the user based on times specified and the drag and drop delete method responds immediately to user interaction.

3.4 Conclusion

This section detailed the requirements, design and implementation of the Interactive Study Guide. The design of the system was ascertained throughout the literature review where by researching the appropriate areas, the key design features were able to be identified and decided upon. From the design section and in correlation with the literature review the requirements were identified. The functional requirements were chosen based on the research carried out and identified to relate to each important aspect that the Interactive Study Guide would need in order to answer the research question of this thesis.

The implementation of the application was then carried out to relate to each functional requirement of the system prior to testing from the evaluation group. The next section of this thesis will discuss the evaluation methods taken after implementation of the Interactive Study Guide.

4 Evaluation

4.1 Introduction

The following section is a detailed account on the testing that was carried out with the Interactive Study Guide application. Here, I will describe the methods that were taken when evaluation began and describe how tests were carried out. From my research and understandings, this knowledge was subsequently applied during the design and implementation stages of this project. The results of the testing for the system are provided in detail in the next section of this paper. A group of volunteers from the MSc in Web Technologies class at National College of Ireland agreed to participate in the evaluation process.

4.2 Evaluation Group

The group that evaluated the web application consisted of four volunteers from the MSc in Web Technologies class at National College of Ireland, all of whom had some previous experience using various types of web applications. Each volunteer was asked individually to run through the application and test all the features that exist within the ISG. All four volunteers have had quite a lot of experience with studying and the study process so I felt they were the perfect candidates to test the Interactive Study Guide application.

4.3 Method

Two separate Questionnaires were used to carry out testing on the Interactive Study Guide application. These Questionnaires can be seen in the Appendices (9.2, 9.3).

Firstly a questionnaire of ten statements (see appendix) will be given to the user after their interaction with the application. The user is given a statement and a scale from 1-5; 5 being strongly agree and 1 being strongly disagree. The user reads the statement and shares their opinions; there is also a small comment box underneath each statement in case the user would like to divulge more information about their opinions.

At the end of the questionnaire there is another comment box and the user is encouraged to enter any opinions they may share on the Interactive Study Guide. The statements were designed to cover the most important aspects of the systems and due to the fact that the system is time based and revolves around the user partaking in study whilst using the application, the questionnaire aims to find out the perceived benefits of using the system, therefore the questionnaire needed to identify the following the goals:

1. The user feels that a system like the ISG would aid them with study management.
2. To evaluate if user's would embrace the idea of the 'Study Mode' of the application.
3. To determine the usefulness that the application would pose during study periods.
4. To analyze if the user thinks the Pomodoro Technique would support them throughout their studies.

The second questionnaire was a SUS (System Usability Scale) questionnaire [7], which is a simple, ten-item scale giving a global view of subjective assessments of usability. It assesses the usability and provides an overall SUS score of the system. The SUS score is worked out using the SUS calculation. This is done by summing the score contributions from each statement. Each score contribution will range from 0-4 as opposed to 1-5. I then multiply the sum of scores by 2.5 to obtain the SUS value of the application. I will carry out the SUS score from each individual volunteer's questionnaire first and then work out the mean of the SUS for the entire application.

The process in which the testing will take part will be on the premises of the National College of Ireland in a specified computer lab; the volunteers will use every aspect of the application and then the qualitative analysis will begin, firstly the Perceived Benefits questionnaire followed by the SUS questionnaire. I will then analyse the feedback given from each of the volunteers after they test the Interactive Study Guide application and the results of the evaluation will be covered in detail in the next section.

5 Results

5.1 Introduction

This section will now break down the results and feedback I received after evaluating the Interactive Study Guide system. After carrying out the testing methods discussed previously, I will analyse each snippet of feedback I received from the questionnaires along with tables identifying the most important aspects of the evaluation results. Along with these results, I will also work out the SUS (System Usability Scale) score of the Interactive Study Guide application to identify how the volunteer's rate the usability of the system.

5.2 Learner Results

The following will be a breakdown of the results received on the perceived benefits testing that was done for the Interactive Study Guide application. A bar chart is shown (figure 6.2) with the results from the tester and each statement will be described and the tester's feedback analyzed. The main objective of the questionnaire was to analyze if learners could see the benefits of using the Interactive Study Guide system and if they felt that the system would be of assistance to them whilst in the study process. The evaluation group was limited to students who were in the college during the summer. As mentioned there were four volunteers that took part in the testing of the testing of this application. For this section I will refer to the testers as:

1. [t1] for Tester one
2. [t2] for Tester two
3. [t3] for Tester three
4. [t4] for Tester four

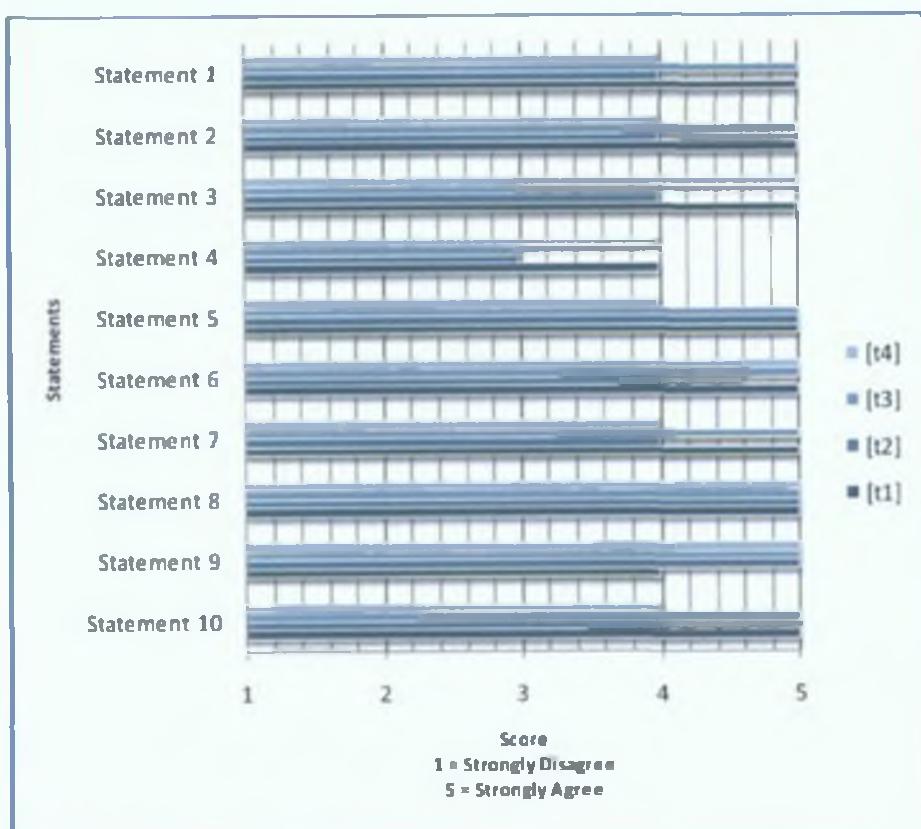


Figure 9 – Perceived Benefits Results

Statement 1: "I feel that this system would aid me in time management"

The first statement of the survey gauges whether the users would see the system as an aid in time management when partaking in the study process. It is evident that all four testers strongly agree with the first statement of the survey.

Statement 2: "There would be benefits from using this system during study periods"

Statement two attempts to ascertain if the learner would feel that using the Interactive Study Guide system throughout their studies would be beneficial to them. All testers provided positive feedback and again reacted positively to the statement. [t1] stated:

"I can definitely see benefits being gained from this application for studying. All the organizational features would really focus and motivate me to study"

[t2] mentions that the time monitoring system would work really well for them as they would have a system that ensures they wouldn't become bogged down by the workload they plan to progress through. All testers had a positive outlook to using the system and felt that a system such as the Interactive Study Guide would become beneficial for them during study periods.

Statement 3: "I think that the system could help me focus my attention on my study"

This statement attempts to identify if the testers would feel that using the system would assist them to focus their time and interest on the important task at hand; their study. The entire group agreed that the system brings you into the study mindset and allows you to focus yourself. Most notably [t4] suggests that:

"The full screen study mode, time and study tips would be a huge help in focusing on study. These are really helpful features that I think have many benefits"

[t3] had one main concern that they would not be able to gauge the exact level that the system would be able to maintain your focus as they felt that they could not replicate the mindset that they would be in when under stress from studying or in a procrastinator's dream world. However the overall feedback was positive that the system could support the statement in question.

Statement 4: "The system would keep me from other distractions on the web"

The above statement, although similar to the previous statement was asked so to identify the specific distractions that the internet may provide. There are numerous amounts of distractions away from the computer or web but considering the Interactive Study Guide application is a web application, it was important to focus towards that area. No negative feedback was given, [t4] was adamant that the full screen or 'study mode' of the application would provide a basis not to distract one's self from studying as it isn't distracting on the eye and it doesn't require a lot of user interaction that may deter the user from their studies.

Statement 5: "Seeing what others are studying would motivate me to get work done"

The home page of the application (access is gained once user logs in to system) displays a list of what the current users are studying and for how long they have been studying. This can be seen in the screenshots in the appendix. The rationale behind this was that by seeing that others are currently working, learners might feel motivated into carrying out their own studies. The tester's all agreed strongly with this statement and felt that it has always been a drive to achieve goals hearing or seeing that other's are working away whilst you may not be. [t1] states:

"This would definitely motivate me because I would not want to fall behind others and what they are doing."

[t3] says that they like to keep on top of everything throughout their studying or working and by seeing others and what they are currently spending their time on would be a great way to monitor whether or not they are falling behind with their studies or not. [t2] suggests that this could be a vital area of the application as they stress that pressure seeing what your peers are currently achieving is one of the main drive forces for you to get in gear and get working. The entire group reinforce the logic behind what [t3] stated that they always like to know whether or not they have fallen behind.

Statement 6: "Creating a personalized calendar would help me begin the study process"

This statement refers to the core of the application where learners create and edit their own personalized study plans using the systems calendar. The statement aims to find out if this personalized calendar is indeed an effective method of initiating the study process. All the testers agreed that it is a vital element of any study periods to plan out what you have to do and when you are going to do it. [t2] even suggests:

"I already try to create some type of study plan but I can never find myself sticking to it, but this system provides a very simple and interactive way of creating that plan with the calendar. I like how I can add/remove my subjects as needed, and plotting out when to study them is a great way to motivate me to study."

This quote is clearly aligned with the goals of the calendar aspect of the Interactive Study Guide application. The system aims to remove the stress or negative stigmatism that exists presently when dealing with planning your approach to studying. [t3] claims that by using the calendar of the system is an excellent way to clearly visualize what

needs to be done. [t1] said that they had only made study plans for a few occasions but the easy to use and interactive method that the Interactive Study Guide has encouraged them more to opt to use this method for study planning. They continue to state that by providing a user friendly environment with simplistic methods to create your personal study plan allows you to carry it out with ease and see the potential benefits that using this aspect of the system can bring whilst studying.

Statement 7: "The full screen mode would deter me from drifting from my studies"

The main purpose of the full screen or 'study mode' of the application is to support the learner which includes keeping them from drifting from their studies; this is why the page is maximized removing URLs and prompting the user when attempting to exit. The statement above attempts to ascertain if the testers agree with the purpose of the study mode of the system. As evident in the graph, we can see that they agree considerably with what the study mode is trying to achieve within the system. [t4] feels that this feature of the ISG would definitely keep their focus on the tasks at hand. To further enforce the agreement behind the statement, [t3] states:

"The idea of the full screen mode is an excellent one. The main worry about using a computer during study time is the immediate distractions that are in front of you. The dark, relaxing colours and prompts, I feel would most certainly keep me from drifting away from my studies."

Flashing images, opened tabs and large back and forward buttons that exist on browsers are always a concern for [t2] they state and they feel that by removing these aspects of the page, you almost forget that you are on the web; therefore you would be less likely to move away from your current page.

Statement 8: "I feel that receiving prompts on study breaks would help regulate my time and increase efficient study of time"

The aim of this statement was to receive feedback on the Pomodoro Technique implemented within the system. The entire testing group felt that this was an interesting and effective feature of the Interactive Study Guide. They agreed that it wasn't forced on the user but was in fact an intriguing idea and they couldn't see how there would not be

benefits of this technique. [t4] comments on their personal ability for time management stating that:

"As my natural time management ability is so poor this feature would be really beneficial to me in my studies."

They all feel that this feature would aid them in their studies. [t1] mentions that if the Pomodoro Technique was successful in making their study time more effective and efficient, then potentially they could reduce the amount of time they actually spend studying. [t2] mentioned something of a similar note; stating that if the method was effective as they predict it should be then time spent stressing and pondering whilst attempting to study may be radically reduced.

Statement 9: "I feel that this system would aid me in study management"

"There is no doubt that this application would be an excellent addition to my study management."

This statement ponders if the testers could perceive that their study management techniques could be improved using the Interactive Study Guide application. [t3] stated above that they do as did [t4]. [t4] mentions that the whole process of creating a study plan to suit your personal schedule, then allowing to enter the aptly named 'study mode' allows you to feel like you're achieving goals just by getting yourself ready to study. The entire group of testers were all in accordance that planning before executing study goals is an effective and necessary area in study management.

Statement 10: "Using the 'Rich' features of the application would encourage me to prepare my study plan"

Assessing the rich and usable side of the application needed to be included as it is a big part of what the application stands for. The ISG is modelled as a user friendly, easy to use and interactive application and it was these so called rich features that brought these attributes to the forefront of the Interactive Study Guide application. The statement aims to assess whether or not the learner's would find it more enjoyable or less of a

chore working with a rich system rather than a bland text based application. Most notably [t1] states:

"The rich and interactive elements of the user interface really encourage you to get into the study frame of mind and really plan out what needs to get done."

[t3] states that it almost distracts you that you are planning what will be a painful period of time studying when using a colourful and interactive application that is the Interactive Study Guide. The rich aspects of the element encourage user interaction according to [t2] which in turn supports the learner when they begin their study process.

5.3 Perceived Benefits Results Summary

This section provides a summary of user feedback following their completion of their testing the Interactive Study Guide developed in conjunction with this report. In general learners responded well to what the system intended to achieve and welcomed the interactive and rich elements of the application. They found that by creating a easy to use, user centric, interactive and usable system, it made the preparation for the study process easier and by implementing such features as the 'study mode' that the Interactive Study Guide supports each individual learner in achieving their study goals.

The users seemed to adapt to the system rapidly and navigate throughout the application with ease; in most cases the tooltips on each header of each page provided enough information for the next step therefore the help page in the application was not needed.

The main elements of feedback were that the users would most certainly be open to using a system like the ISG and that they feel that using the system would hold numerous benefits to their studying schedule. The overall theme of the feedback can be summarised through what [t1] comments at the end of the questionnaires provided:

"I would definitely use this system for studying in the future. It is very well presented and easy to use, no frills. I think the time management system is a brilliant feature and will certainly benefit my study, hopefully by increasing the length of time I study for."

As evident with the quotes throughout the results section and the bar chart of this paper, the study mode of the Interactive Study Guide system intrigued and impressed the users. The overall response regarding the study mode of the application was that it

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would be beneficial to them in the sense that it would allow the users to focus on their current study goals and deter them from other distractions that exist.

5.4 SUS Results

As mentioned, the SUS or System Usability Scale is an evaluation tool to assess the usability of different systems. It is attained by the survey seen in the appendix of this paper. This section will provide a brief guide of how to work out the SUS of a system along with each individual tester SUS score of the application and an overall mean of the Interactive Study Guide application. Brooke [7] states that the SUS should be used after the tester or user has had an opportunity to use the system being evaluated and before any further discussion or debriefing occurs. This is used so to record the users' immediate response rather than thinking about the application for a long period of time. This technique was used for calculating the SUS score of the Interactive Study Guide.

The SUS is worked out when the tester responds to a statement by indicating the degree of agreement or disagreement on a 5 point scale. This can be seen on the SUS survey provided in the Appendix. The SUS is figured out by taking the testers' responses and applying the appropriate SUS calculations to it. To calculate the SUS score of a system, each score contribution will range from 0-4 as opposed to 1-5. To do this, we minus 1 from the scale position for statements 1,3,5,7 and 9. For statements 2,4,6,8 and 10, we minus 5 from the scale position. The overall sum of the scores is multiplied by 2.5 to obtain the SUS value of the application. The SUS score is rated out of 100. The table below represents what each individual tester SUS scale and then I will provide the mean SUS of the Interactive Study Guide.

Tester	Tester Score	SUS
[t1]	35 (*2.5)	87.5
[t2]	39 (*2.5)	97.5
[t3]	40 (*2.5)	100
[t4]	36 (*2.5)	90

Figure 10 – SUS Results of the Interactive Study Guide

Therefore by taking these results provided by the several testers of the Interactive Study Guide system, we can work out the mean or average of the SUS score relating to the system.

$$\frac{87.5 + 97.5 + 100 + 90}{4} = 93.75$$

4

As you can see the mean of the SUS score of the Interactive Study Guide is **93.75** out of a possible 100. With the SUS survey there was a comments section as shown in the appendix. [t1] suggests:

"This is a really well made application. I found it easy to use as the UI elements are presented in a logical and usable way. Using the application for a long time does not cause any eye strain because the colours chosen are neutral yet strongly defined. This definition in colour clearly separates the different sections of the interface in a nice way."

The above quote reinforces the high SUS score the system was given and the testers were impressed with the navigation within the application and the interactivity that was present. [t3] states:

"This system is very well structured and the flow is easy to follow. Along with tooltips and a help section there were no problems in figuring out how to use the system efficiently. The user friendly features provide a very accessible application."

The usability of any system is important to encourage user interaction and from the results given for the SUS of the Interactive Study Guide it is evident that the ISG application is a usable and user friendly system.

5.5 Conclusion

Overall the results received from testing the Interactive Study Guide can be perceived as positive. The perceived benefits testing were vital to identifying if learners could foresee themselves using the ISG system in the future. It allowed me to gauge the want and desire for an application like the Interactive Study Guide. The interactivity and rich features have impressed the testers and as stated, they are encouraged and enjoy interacting with the system. The Pomodoro Technique was perceived as an interesting and encouraging feature of the system. The entire evaluation group felt that using a method such as the Pomodoro Technique is an excellent way to keep learner's focused whilst partaking in the study process. The testers see numerous amounts of benefits using such a feature and insist that their time management skills would be greatly improved and more efficient using the Pomodoro Technique of the Interactive Study Guide system.

The testers found that the calendar's simplistic yet colourful design effective yet not too distractive. [t3] states:

"I found the personalized calendar simply laid out, multiple views allow a user to choose what suits them best and inputting your own subjects with your own time limits will work to motivate users to study."

The usability of the Interactive Study Guide according to the testers is reflected in the SUS score (Individual SUS score table is available in appendix) and can be perceived as a conclusive result. The comments given in the SUS section reflect the importance of having a usable and functional application for users to interact with. A usable system allows the user to interact with ease, is interactive and user friendly; all of which the Interactive Study Guide adhere to.

6 Conclusion

6.1 Introduction

Distinct objectives were outlined in the scope in chapter one of this thesis. This chapter identifies and concludes on these objectives along with a review on the entire thesis and each section involved.

6.1.2 Objective 1

To review the associated areas of research compliant with the research question for this project.

A literature review was carried out and presented in chapter two of this dissertation to ascertain as much information regarding the specified areas that the Interactive Study Guide would be associated with. An important part of the literature review research personalized systems and the Pomodoro Technique. Within the personalized system section of the literature review, it became apparent that many adaptive systems focused on groups of learners rather than the individual such as LMS' (Learning Management Systems) such as Moodle or Blackboard. The Pomodoro Technique was introduced in the literature review and became an important aspect of the Interactive Study Guide's system. The design and implementation presented in this dissertation attempted to build on the knowledge acquired from the research that was carried out.

6.1.3 Objective 2

To develop a system to cater for learners when they are required to partake in study periods.

Following the extensive research of the many different areas related to the dissertation, the design and implementation of the Interactive Study Guide began. It was built with the individual user as its priority and to adopt all the features discussed in the design section of the dissertation. The majority of the features implemented had been decided upon as a result of background reading on personalized systems and recommender systems. It was important to ensure that this application worked for the learner and supported them; therefore the customizable calendar/study planner was focused on throughout development. Initially the core of the application was built including profiles, calendars

and the home and index page and then the 'study mode' was implemented. The study mode or full screen of the application was another necessary and important aspect of the system as it set out to achieve a number of goals whilst learners were in the study process. It was built to adopt the Pomodoro Technique, and provide an environment that did not distract or deter the learner from their studies. The different aspects of the study mode of the application including study break prompts, study tips and prompting the user upon trying to leave study mode were all attempts to keep the study focused and as efficient as possible. To conclude, the Interactive Study Guide system was built with one overall main goal; to support for the learner when they are required to take part in the study process.

6.1.4 Objective 3

To evaluate the system developed by analysing user test results provided and determine the appropriate response to the research question of this paper.

The research question related to this dissertation is:

"What is the appropriate design of an Interactive Study Guide that is personalized and to what extend would the interactive personalized study guide support the learner?"

Following the implementation of the Interactive Study Guide application, the system was then evaluated by a group of volunteers. These volunteers (testers) offered to use the system and all its features and then provide feedback through a questionnaire and a SUS test. The results of this evaluation are presented in chapter five of this paper. The main aim of testing was to identify the perceived benefits of the Interactive Study Guide application which entailed the testers to identify whether or not they could see this application having benefits to the learner and whether or not the application would support the learner whilst they are studying.

Overall users expressed their satisfaction with the study mode aspect of the system along with the personalized and interactive calendar that they could map out their study plan with. The results received from the evaluation of the system are very promising and every tester liked each aspect of the system whether it was the study mode that the Interactive Study Guide offered, the rich and interactive environment or the personalized calendar, all the results were positive. From the research carried out, I decided upon the

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Interactive Study Guide to answer my research question but to also provide a novel addition to the areas covered in the literature review that according to testing carried out would indeed support the learner throughout the study process.

Ideas for future work arose from the user's feedback received throughout the evaluation of the Interactive Study Guide and the next section of this thesis details the future work that could be investigated as a further development to this project.

7 Future Perspectives

7.1 Introduction

The following section identifies and suggests future work which could be implemented into the Interactive Study Guide system. The work discussed was thought upon throughout development or by the evaluators of the application.

7.2 Future Work

As mentioned the following could be possible extended work on this thesis if work was to continue on the Interactive Study Guide.

Implement the option for learners to enter their own timing schedule as opposed to solely the Pomodoro Technique; they could be allowed to enter how long each session should last and how long their breaks should be scheduled for. This feature would allow for further personalization for the learner.

One of the testers suggested an alarm clock feature where the learner can set themselves a specific alarm clock or countdown timer so to set a time limit on goals they aim to achieve. This feature could also be used on the calendar aspect of the Interactive Study Guide; for instance, when a learner sets their subject to end a specified time, then the Interactive Study Guide could alert them that it is now time to move on the next subject. This allows for even more personalization to be injected into the application for the individual learner to avail of.

If the system was to expand and acquire more users to the system then it may not be optimal to display all the users of the system to each individual user. Perhaps an Add as a Friend feature could be implemented to allow users to add other learners they know and only receive updates on what they are currently studying. If this was to be an added feature, due to the nature and goals of the Interactive Study Guide, i.e. an application to support learners throughout their studies, it would be advised to avoid turning the system to a type of social network as this would inevitably cause unnecessary distractions for the learner.

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9 Appendices

9.1 Table of Figures

Figure 1: Functional Requirements of the ISG

Figure 2: Month View of ISG's Calendar

Figure 3: Adding Subjects to the ISG

Figure 4: Drag and Drop deleting in ISG

Figure 5: User Profiles of the ISG

Figure 6: Study Mode of the Interactive Study Guide.

Figure 7: Upon exiting the study mode of the ISG.

Figure 8: The Pomodoro Technique of the application

Figure 9: Perceived Benefits Results

Figure 10: SUS Results of the Interactive Study Guide

9.2 SUS Questionnaire

	Strongly disagree					Strongly agree
1. I think that I would like to use this system frequently	<input type="checkbox"/>	1 2 3 4 5				
2. I found the system unnecessarily complex	<input type="checkbox"/>	1 2 3 4 5				
3. I thought the system was easy to use	<input type="checkbox"/>	1 2 3 4 5				
4. I think that I would need the support of a technical person to be able to use this system	<input type="checkbox"/>	1 2 3 4 5				
5. I found the various functions in this system were well integrated	<input type="checkbox"/>	1 2 3 4 5				
6. I thought there was too much inconsistency in this system	<input type="checkbox"/>	1 2 3 4 5				
7. I would imagine that most people would learn to use this system very quickly	<input type="checkbox"/>	1 2 3 4 5				
8. I found the system very cumbersome to use	<input type="checkbox"/>	1 2 3 4 5				
9. I felt very confident using the system	<input type="checkbox"/>	1 2 3 4 5				
10. I needed to learn a lot of things before I could get going with this system	<input type="checkbox"/>	1 2 3 4 5				

Comments

9.3 Perceived Benefits Testing Questionnaire

	Strongly disagree					Strongly agree
1. I feel that this system would aid me in time management	<input type="checkbox"/>	1 2 3 4 5				
2. There be benefits from using this system during study periods	<input type="checkbox"/>	1 2 3 4 5				
3. I think that the system could help Me focus my attention on my study	<input type="checkbox"/>	1 2 3 4 5				
4. The system would keep me from other other distractions on the web	<input type="checkbox"/>	1 2 3 4 5				
5. Seeing what others are study would motivate me to get work done.	<input type="checkbox"/>	1 2 3 4 5				
6. Creating a personalized calendar would help me begin the study process.	<input type="checkbox"/>	1 2 3 4 5				
7. The full screen mode would deter me from drifting from my site.	<input type="checkbox"/>	1 2 3 4 5				
8. I feel that receiving prompts on study breaks would help regulate my time and increase efficient study time.	<input type="checkbox"/>	1 2 3 4 5				
9. I feel that this system would aid me in study management	<input type="checkbox"/>	1 2 3 4 5				
10. Using the 'Rich' features of the application would encourage me to prepare my study plan	<input type="checkbox"/>	1 2 3 4 5				

Comments