MEMORY RETENTION FOR MULTILINGUAL NOTE TAKING PLATFORM

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ABSTRACT

Technology developments such as laptop, smartphone, and video lectures are altering pedagogy dynamics and influencing the way students compose and review notes. Confused on how to learn effectively have led to a lot of trial and error on the note taking methods between students. This study explore the effect of memorization retention using the pen, the laptop, and the smartphone on multilingual note taking which is in Malay (Jawi Script), English (Latin Script), Chinese (Hanzi script) and Tamil (Tamil script). A model of note taking is designed to assist in the development of an effective learning platform. A progressive web application (PWA) named MemRetz for mobile and laptops respectively were developed based on the designed model. During this analysis, about thirty participants for each language are given a group of articles and video in three different mediums that consists of various lengths of characters for each article and duration for each video. The note taken, medium used and memory retention score (percentage of correctness × time taken to complete the test) are recorded and measured to determine the effect of memorization retention using different mediums. Results proved that note taking does influence memory retention. However, different scripted language or medium used do not have an effect on memory retention score. Study's results suggest that students may read article and take notes using any language or medium they prefer and comfortable with as it does not affect the memory retention. The usage of note-taking software in an E-learning platform is useful since it increases participants' ability to take notes and helps them remember.

Keywords: Memory Retention, Human Computer Interaction, Note taking, E-learning

[PENINGKATAN DAYA INGATAN DALAM PLATFORM PENGAMBILAN NOTA BERBILANG BAHASA]

ABSTRAK

Perkembangan teknologi seperti komputer riba, telefon pintar dan video kuliah telah mengubah kedinamikan pengajaran dan mempengaruhi cara pelajar menulis and membaca nota. Kajian ini dijalankan untuk mencari kesan pencatatan nota dalam tiga medium iaitu pen, komputer riba dan telefon pintar dengan menggunakan empat skrip tulisan iaitu Bahasa Melayu (tulisan Jawi), Inggeris (tulisan Latin), Cina (tulisan Hanzi) dan Tamil (tulisan Tamil). Model pencatatan nota direka bentuk untuk membantu mengembangkan platform pembelajaran yang berkesan. Laman web aplikasi progresif (PWA) bernama MemRetz telah dibangunkan bagi menilai keberkesanan aplikasi ini dalam peningkatan daya ingatan apabila mencatat nota. Semasa analisis ini, tiga puluh peserta untuk setiap bahasa diberi sekumpulan artikel dan video dalam tiga medium yang berbeza yang terdiri daripada berbilang aksara untuk setiap artikel dan jangka masa video. Setiap ujian diberikan markah bagi membantu analisis catatan nota dan ujian dengan tepat (peratus ketepatan × masa untuk menyelesaikan ujian) untuk menentukan kesan penggunaan media yang berbeza untuk meningkatkan daya ingatan. Hasil kajian membuktikan bahawa pengambilan nota mempengaruhi kemampuan daya ingatan. Skrip tulisan berbeza atau media yang digunakan tidak mempengaruhi skor kemampuan daya ingatan. Hasil kajian menunjukkan bahawa pelajar boleh membaca artikel dan membuat catatan menggunakan bahasa atau media yang mereka sukai dan selesa kerana tidak mempengaruhi kemampuan daya ingatan. Aplikasi pengambilan nota dengan tepat meningkatkan kemampuan peserta dalam mencatat dan membantu mereka mengingat, jadi bermanfaat untuk digunakan dalam platform E-learning.

Kata kunci: daya ingatan, interaksi manusia-komputer, pencatatan nota, e-pembelajaran

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Author

Chandra Latha Ramachandran

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Human-computer interaction (HCI) is a multidisciplinary area in which psychology and other social sciences are linked to computer sciences and a related technical field in order to improve the usability of computer interfaces (Fazio & Olson, 2003). Usability is an attribute of consistency that measures how easy it is to use user interfaces. According to Nielsen (2012), the term "usability" also applies to methods to improve ease-of-use during the design process. In order to support usability, making applications easy to understand and easy to use, various principles need to be followed. One of the principles of usability is memorability which is defined as how easily the user will remember the system functions, after a period of time of not using it.

The memorability relates in boosting the memory retention and reminds participants on the test. In the context of educational settings using technology, related memorization study is very minimal although the result can give a major impact in setting up guidelines on supporting memorization using note taking medium. In the context of text memorization, such as historical facts, language rules such as in the Jawi language, formulas and others, many memorization approaches can be used to achieve memorization of these items.

Dunkel & Davy (1989) and Carrell & Mollaun (2004) said that in this academic world, one of the main factors facilitating effective learning is the ability to take notes during lectures. Note taking is the main and powerful way for the students to acquire knowledge and gain control over their own learning (Burns & Sinfield, 2012). Besides, Gur, Dilci, Coskun & Delican (2013) said that note taking is an active and multifaceted skill that requires academic listening and purposeful attendance to the speaker. Students are expected to write fast enough to keep up with the pace of the lecture, pay attention,

decide what is important to record, and make sense of their notes after class during a note taking process (Suritsky, 1992).

According to Russell & Haney (1997) and Mogey, Sarab, Haywood, Van Heyningen, Dewhurst, Hounsell, & Neilson (2008), while many students in this era are currently turning to laptop, tablet, or alternative types of portable computers to try to maximize their efficiency in note taking in the classroom however there are some students who still prefer to take lecture notes by hand using pen and paper. In the context of Muslim culture, the memorization of the Qur'anic Text is also done through writing. According to a study by Mueller and Oppenheimer (2014), taking notes using pen and paper, not laptops, helps to boost memory and the ability to retain and understand taking notes using pen and paper not laptops, helps to boost memory and concepts. However, this study concentrates on notes-taking while in a lecture setting.

Three primary ethnic groups dominate Malaysian multicultural society: Malays, Chinese, and Indians (Ibrahim, 2007). The Malayan government adopted the Razak Report as the education framework for independent Malaysia in 1956. The national school system included Malay, Tamil, English and Chinese medium for primary level schools and Malay and English medium schools for secondary schools which was advocated by the Razak Report (Guan, 1956).

Generally in Malay community and Muslims particularly, the arabic language cannot be separated. Many Arabic words were brought into Malay languages since the arrival of Islam. The influence of Islam had facilitated the teaching and learning process of the language through the fusion of Arabic and Malay in Malaysia. During Islamic culture, the Arabic language represents a key to educational accomplishment. Since the Malay community wanted to understand the sacred Quran, Arabic became the official language of Islam. Furthermore, a major increase in direct investment from the Middle East has

resulted in a significant increase in job possibilities, (Al-Muhsin, 2021). Therefore it is vital to focus on Malay, Jawi, English, Tamil, and Chinese.

The adaptation of multi-languages can also be supported by the proposition of the research by Asaly-Zetawi and Lipka (2019) which states from an experiment that, first language students produced notes of higher quality than second language students. Also, significant differences were found between the measures of students' vocabulary, handwriting speed, and reading fluency, depending on their language nativity. Even with good academic performance, bilingualism played an integral part in determining their listening comprehension, such as native speakers had sufficient cognitive skills and fluency to perform significantly better. In conclusion, note taking is a personalized ability and hence a person's priority of language should be heeded before proceeding to its method.

1.2 Background

It's ridiculous to think that we used pen and paper a couple of years ago to do all the critical classwork and homework. Quick forward a few years technology has turned the educational spectrum upside down. Now it's all laptops and smartphones. 75% of teachers believe that technology can enhance learning outcomes and influence the way teachers and students learn. Helps students learn at a pace of their own. This implies that students are eager to understand, eventually personalizing the educational experience in relation to their own skills and needs. Today, when timely access to information is vital, mediums such as smartphones, netbooks, laptops and tablets have spread very rapidly and become common (El-Hussein & Cronje, 2010 and Franklin, 2011).

Mobile gadgets are highly popular among young people (Kalinić, Arsovski, Stefanovic, Arsovski, & Ranković, 2011), especially university students (Cheon, Lee,

Crooks & Song, 2012 and Park, Nam & Cha, 2012). In the field of digital learning, the concept of learning using mobile devices has gradually gained popularity (Jeng, Wu, Huang, Tan & Yang, 2010). This is because learning with mobile devices has a lot of potential "new opportunities and could improve the learning process" (Kalinić, Arsovski, Stefanovic, Arsovski, & Ranković, 2011, p. 1345) and if appropriate learning strategies is used during learning with mobile devices, it will definitely help achieving educational goals (Jeng, Wu, Huang, Tan & Yang, 2010). Indeed, from a technological standpoint, mobile devices are increasingly capable of performing all of the functions required for learning design (El-Hussein & Cronje, 2010).

E-learning has proved to be one of education's fastest-moving technologies in education and is a promising alternative to ordinary learning. Studies have shown that people learn significantly better from a combination of both words and photographs than simply from words alone. It has been recommended that the application of technology should indeed be encouraged and even be incorporated, pursuing a section of students' everyday activities inside medical things to do and simple sciences (Al-Hariri and Al-Hattami, 2017).

Incorporating technology usage among Malaysia university education is an initiative of comparatively new beginnings and people who have been struggling to secure rights and recognition, and therefore the purpose to use e-learning remains largely unexplored in Malaysia. It has been urged that the content of e-learning and self-efficacy has a positive impact and substantially related to perceived utility and student satisfaction that impact university students' intention to utilize e-learning. Therefore, with this sort of learning, students attend home-based courses and manage their time counting on their needs and preferences (Al-Rahmi, Alias, Othman, Alzahrani, Alfarraj, Saged & Rahman, 2018).

Drigas and Pappas (2015) examined the foremost representative studies of recent years, involving on-line and mobile applications and tools for mathematics in addition as their result within the academic method. The results of the studies discovered that on-line and mobile learning applications motivated the students, creating mathematics courses additional pleasant and interactive than the standard teaching practices. The work of the developers provides guarantees for additional learning tools within the close to future, making a brand-new academic model.

The study in 2017 examined the extent to which students in one of the Malaysian universities use smartphones to support their school-related learning and also the method these activities relate to CGPA. It had been found that the heap of students used their smartphone for university learning activities, the lower their CGPA. The result of this study suggests a necessity to judge and better understand the educational uses of smartphones for tertiary students (Hassan, Nor, and Malek, 2017).

1.3 Motivation

This study is focusing on the most successful medium for note taking in E-learning. Similarly, this study focuses on the effect of memorization retention on note taking using pen-paper, smartphones, and laptop. The motivation of this study relates to the fact that little study has been done to support various methods of note taking in interacting with memory retention. Besides, the pandemic of Covid-19 has introduced social distancing where education has been migrated to online learning. As online learning is all about the internet and some technologies, this study is done to find the most effective note taking methods in the E-learning platform. Memory retention effect on note taking varies for different methods of note taking. The memory enhancement changes over time, and it is necessary to include both the method of note taking and multilingual context as independent factors to address this issue. On the other hand,

study aim is to develop a model of note taking to assist in the development of an effective learning platform as there is no note taking feature in any existing e-learning platform.

1.4 Problem Statement

Success genuinely understands the ideas and concepts learned; however, many people think success is about how much learned. That is why most of them want to learn faster, retain more information, and improve memories. Unfortunately, many are struggling to remember or memorize certain things whether it is about education or daily usual tasks. Memorization is a complicated process that is made up of a few different brain activities. Many ways are still being researched and have been introduced such as exercising to improve memory recall (Baek, 2016), chew gum to make stronger memories (Thakur, Saxena,& Aruba, 2019), drinking coffee to improve memory consolidation and retention (Sherman, Buckley, Baena, & Ryan, 2016).

Over the years, the spiral notebooks and pens once throughout daily classes are replaced with smartphones, laptops, and slim, touch-screen tablets. It is a trend currently in many colleges and universities on taking notes using a laptop computer or snapping from the smartphones. Note taking may be a vital element of formal classroom learning. Devices like laptop computers and mobile applications are altering classroom dynamics and affecting the method of note taking by students (Stacy and Cain, 2015).

Growing culture of internet and technology use in the current world has introduced a new landscape of educational practices. These practices are growing within the form of e-pedagogy: technology integrated teaching and learning activities. Common educational application in higher education within the traditional classroom is lecturer writing on chalkboard/whiteboard. Students nowadays are lacking note taking skills because teachers are supplying PowerPoint and lecture notes, as students are demanding

those and in part trying to be responsive to students. Helping students by supplying notes is not going to help the students to succeed as students will have the good notes but skip the process of actual taking and reconstructing of notes. Based on the study by Maryellen Weimer (2015), proof that providing teacher prepared notes to students does not improve their performance.

Schoen (2012), Ward and Tatsukawa (2003) said that note taking using laptop is effective in a lecture context due to greater transcription fluency and found such that retaining memory and processing information was better for those taking notes using laptop than using pen and paper as well as allows students to take notes faster, keep them organized, more legible, easier to search in and easier to edit. However, a study by Mueller and Oppenheimer (2014) found that note taking using pen increased memory retention compared to note taking using laptop. It may be that the recent traditional approach of taking notes using pen and pencil is a more practical way to learn, and remember?

As the first step in learning at class is not efficient enough, this leads to low scores in tests and drag their interest in studying. Students are struggling to remember new learnings. What do students miss when taking notes using a laptop? There are several researches on the utilization of laptops and smartphones to require notes throughout lecture elements of courses. However, there's little analysis to specify the result of memory retention using the pen, the laptop computer and the smartphone. Nowadays, this application has been modified because of the growing culture of internet and technology use. Technology integrated pedagogy within the name of e-learning, m-learning, etc. are rising (Dhakal & Sharma, 2016). Studies on memory retention are therefore implied to be significant.

Due to the rapid breakout of a deadly disease called Covid-19 in India, educational institutions that were previously dependent on traditional methods of learning were forced to switch to an online way of teaching (Dhawan, 2020). Every institution from primary school to universities is practicing E-platform pedagogy that brings books to life through a variety of medium and provides schools with tools that will encourage and inspire. Most of the e-platform does not have a note taking feature for the students to take notes after reading the slides or viewing a video shared by the lecturer. Students are required to print out then scribble notes or write notes on separate platforms. It is much easier for the students if they are able to take notes on the e-platform itself.

1.5 Objectives

i) To investigate the effect of note taking and memory retention using pen-paper, smartphone, and laptop in context of an E-learning platform.

ii) To design an effective model of note taking in an E-learning platform for memory retention.

iii) To develop and evaluate the E-learning platform for memory retention based on the model above.

1.6 Research Questions

i) What is the existing literature related to this study?

ii) What is the effect of note taking and memory retention using pen-paper, smartphone, and laptop in context of an E-learning platform?

iii) How to design an effective model of note taking in an E-learning platform for memory retention?

iv) How to develop and evaluate the E-learning platform for memory retention based on the model above?

1.7 Scope

This study is conducted to investigate the effect of memorization retention using pen-paper, smartphone, and laptop. Moreover the study is to design multilingual note taking in E-learning platform to support memory retention based on the above input. Besides, the aim of this study is to develop a model of note taking to assist in the development of an effective learning platform for the students to take notes during reading slides and viewing videos shared in the platform. Furthermore, the scope of this study is to develop and evaluate a prototype to measure memorization effectiveness based on the model.

1.8 Methodology

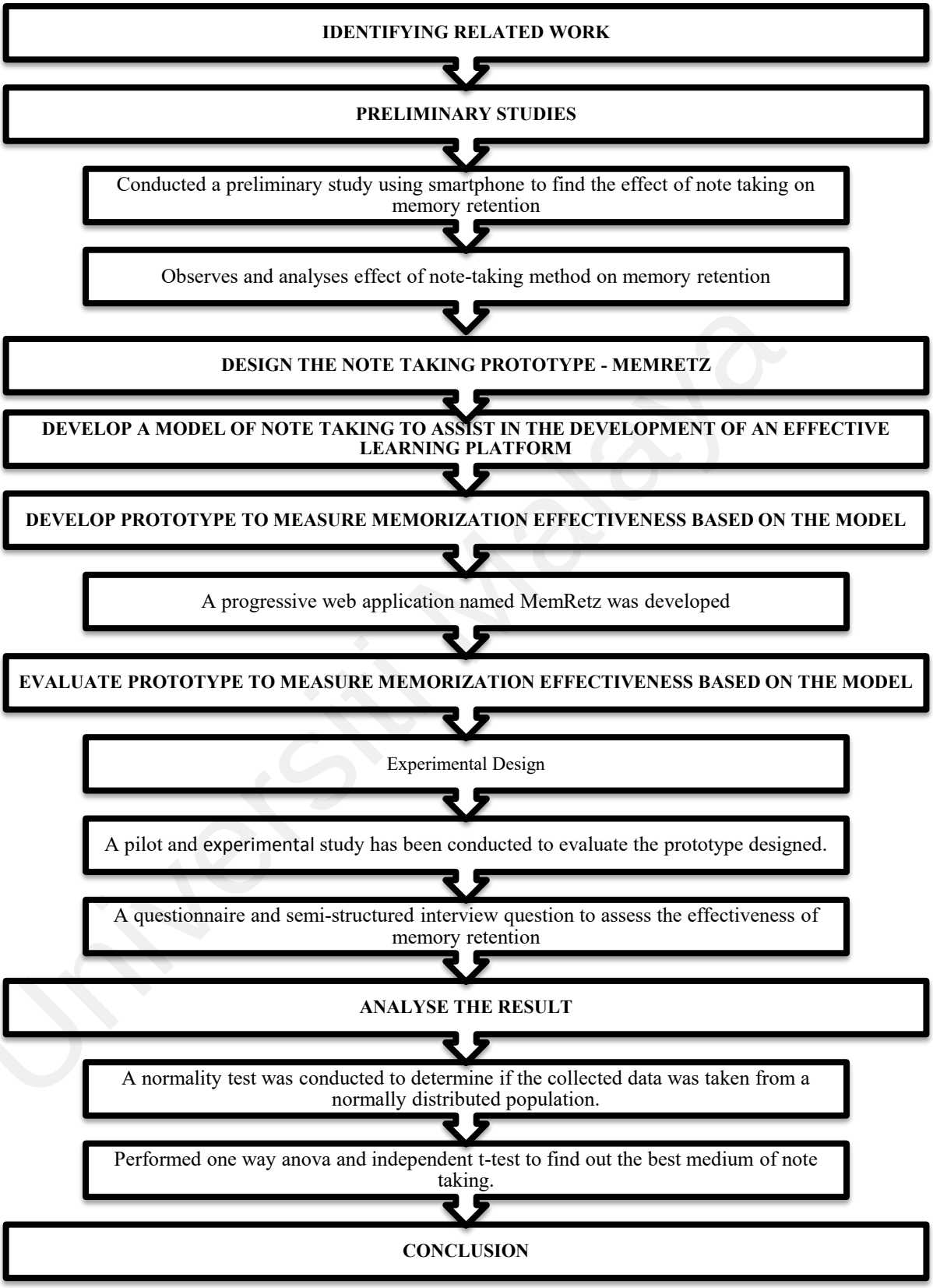


Figure 1.1: Flow chart of research methodology

As shown above on Figure 1.1, the experiment is conducted to investigate the effect of memorization retention using the pen-paper, smartphone, and laptop for memory retention. To satisfy the objectives of the dissertation, a quantitative research was held. The data used for the research production was collected from the internet, textbooks, and journals. To collect relevant information, the findings of other researchers on the topic were reviewed. Additionally, the case study provided valuable information for device growth. However the study has extensively used statistical analysis SPSS for chi square, t-tests, regression, correlation, and variance analysis on the data collected during the survey which was stored in Firebase database for MemRetz application.

A preliminary study using smartphones have been carried out in order to thoroughly resolve the first goal of this study, which is to identify issues, observe and analyze the impact of the note taking process on memory retention. A multilingual note taking e-learning platform is designed to adapt different scripts of language in Malay (Jawi Script), English (Latin Script), Chinese (Hanzi script) and Tamil (Tamil script). A note taking model was designed and developed to assist in the development of an effective learning platform. The note taking model is developed in a way that can be written, drawn with a rich text editor which helps in memory retention and is compatible with all devices.

A progressive web application named MemRetz is developed to fulfill the fourth objective of the study which is to develop and evaluate prototypes to measure memorization effectiveness based on the model. A pilot study has been conducted to evaluate the prototype designed as well as to examine the feasibility of an approach that is intended to be used in an experimental study. An experimental study was conducted using different mediums of note taking (pen-paper, smartphone, and laptop) with 30 participants for each language which is in Malay (Jawi Script), English (Latin Script),

Chinese (Hanzi script) and Tamil (Tamil script). A pre-test questionnaire has been prepared and circulated before starting the test through pen-paper, smartphone and laptop to find out the effectiveness of memory retention. In addition, interview questions were created and circulated after the study to assess the effectiveness of memory retention.

All the data collected throughout the survey was tested by performing a normality test to determine whether the data collected has been drawn from a normally distributed population. During the result analysis, the memory retention score and note taken are recorded and measured using one way Anova and independent t-test to find out the best medium of note taking. In conclusion, the main findings have been summarized, conclusions have been drawn and recommendations for future research were proposed.

1.9 Purpose of the study

The purpose of this study is to find the effect of memorization retention using pen-paper, smartphone and laptop on multilingual note taking. Other than that, this study is to design multilingual note taking in E-learning platform to support memory retention and to develop a model of note taking to assist in the development of an effective learning platform. Last but not least, the study goal is to develop and evaluate a prototype to measure memorization effectiveness based on the model.

1.10 Target Group

The target population for this research is defined to include the school and university students from all over the country to study their memory retention. A wide range of different participants has been included since the intended group of pen-paper, smartphone and laptop users was not set on to any mediating variables such as age or ethnographical groups. Despite the limitations of a small-scale study, 120 participants from different age groups and countries formed the foundation for this research.

1.11 Significance of the Research

The importance of this study is to extend the existing knowledge about the effect of memorization retention in classroom by exploring three different medium of note taking (pen-paper, smartphone and laptop) and multilingual scripted languages (Malay (Jawi Script), English (Latin Script), Chinese (Hanzi script) and Tamil (Tamil script)) Moreover, this finding highlights the importance of research on how note taking medium may affect student performance in class and suggest that school and administrators seek to coordinate and standardize the use of assessment and note taking medium where possible.

As past study focused on the e-learning advantages in general, the addition of memory retention on note taking will bring adequate understanding of the importance of note taking in the classroom. Study needs to be extended to a meaningful comparison and extended work. By incorporating suitable usability goals in Human Computer Interaction requirements, a specific progressive web application will be develop to provide better insight of memory retention ability of a given article or video in multilingual scripted languages after the video is viewed or article is read as well as take note using pen-paper, smartphone and laptop. Finally, develop a model of note taking to assist in the development of an effective learning platform. Encourage me to add a note taking feature in the e-platform that allows the students to take note and refer whenever needed.

1.12 Summary

This section addresses the literature review, research methodology, preliminary study, model design for note taking in E-learning, implementation and evaluation of the prototype, testing, conclusion and results, and discussion and recommendations for future research. Chapter one contains the general overview on the research conducted, motivation of this study, problem statement, objectives, research questions, hypothesis,

methodology summary, purpose of the study, target group and research significance. Chapter two described the literature review of the study finding relevant works, gaps of the research, and discussion on related issues on teaching methods in class, note taking method as well as memory retention and defining memory retention. The methodology of this research has been elaborated in chapter three. A flow chart with seven steps of research methodology is shown in figure 1.1. A quantitative method research is used to conduct the data collection and analysis. In chapter four, a preliminary study was mentioned to answer the first research question (smartphone) of the thesis. Chapter five is about the model design for note taking in the E-learning platform. Chapter six presents the experimental setup and implementation. In this chapter study will elaborate about the system analysis, design, and development and the process of testing the tool. The conclusion and results of the research will be explained in chapter seven. Finally, chapter eight is the discussion and recommendations for future research.

CHAPTER 2: LITERATURE REVIEW

2.1 Related Work

Based on Statista (2019), the number of mobile phone users worldwide is expected to reach the 5 billion mark by 2019. An estimated 62.9 percent of the population around the world already had a mobile phone in 2016. In 2016, an estimated 62.9 % of the population worldwide already had a mobile phone. The mobile application market is increasing with the variety in mobile devices. Mobile phones are simple nowadays. Virtually everyone features a mobile phone. Mobile devices are on the right track to become the most technology to be used in education in the future. It has greatly modified the functioning of the globe, even the educational method. It's getting advanced, improving, and becoming increased with every generation of students learning with them.

EDUCAUSE has tracked student possession of digital technologies which may be used for educational work for nearly a decade. They have discovered however the speedy rise of laptop computer and smartphone possession has exaggerated to near-universal levels, compressing out cumbersome desktops and redundant tablets to become the foremost trend combination of digital devices used by students. Whereas device possession told them plenty concerning the devices students have at their fingertips, it introduces socioeconomic bias into the live-in favor of those with higher incomes (Galanek, Gierdowski & Brooks, 2018).

Globalization has modified lives from the age of learning with pen-paper to mobile phones and laptops. There are numerous educational benefits of mobile phone technologies that are most frequently cited as; simply accessing content, integrating a broad variety of educational activities, supporting freelance study and student organization, encouraging student enthusiasm, supporting classroom-based

collaboration and interaction also as supporting inquiry- based mostly instruction and learning (Roschelle, 2003). In fact, even preschool students are currently being expected to utilize and perceive technological ways to accomplish classroom tasks (Saçkes, Trundle and Bell, 2011).

2.2 E-Learning and Devices

Kumar and Jothi (2020) research aims to compare the positive and negative effects of various electronic devices such as mobile devices, tablets, television, radio, and e-readers during this pandemic period. Currently, via various e-learning tools, many institutions are conducting online courses. Consideration was given to the positive results, such as efficient communication, versatility and comfort. At the same time, this study also examined problems related to security, digital divisions, services, availability of data, and successful evaluations. This research clearly shows that in the current situation, the positive side of the e-learning mode is deemed successful. In addition, this study finds that the lack of protection, security, internet connectivity and storage capacity differs between students. This study shows that during this pandemic time cell phones are more powerful than the other e-devices.

The aim of this quantitative case study was to investigate the implementation in a rural high school in Mississippi of a one-to-one laptop program, focusing on policy creation and stakeholder views. The resulting themes indicated that the experiences of teachers conveyed a lack of self-efficacy linked to a reduced role in the production and training of policies. Teachers mentioned the lack of self-efficacy of some students related to using the devices in the learning environment. Administrators have recognized that teachers and students faced problems with the method of implementation. Implications for positive social change imply increased engagement of teachers/students in the process of policy making and implementation compared to

practice and implementation during the one-to-one implementation developmental stages (Hall, 2020).

In the modern times of mobile technology and their increasing accessibility and affordability, mobile devices notably android platforms play a crucial role within the field of communication, amusement, and learning. A specific type of e-learning that provides educational materials through mobile phones is mobile learning or M-learning (Samrin and Aftab, 2017). Mobile phones are increasingly one of the most popular information access devices and what stands out from the study is the high use of interactive, multi user functions which can at times be disruptive or beneficial during study (Hossain, 2019).

Mobile phones appear to be capable of contributing to learning and improved academic performance. For instance, trendy "smartphones" provide students with immediate, portable access to many of the identical education-enhancing capabilities as an Internet-connected computer, like on-line information retrieval, file sharing, and interacting with professors and fellow students. Hossain (2019) additional research has proven that mobile phones serve as distractions in classroom setting and impair learning. This research strengthens the roles that distraction from mobile phones play while causing decreased attention (Mendoza, Pody, Lee, Kim, & McDonough, 2018).

Balfagih (2017) conducted a study to find the perceptions of 1st year university students with regards to the impact of mobile devices in the classroom. The results of this study have proved that these students have largely positive perceptions of the impact of mobile devices on their academic performance. Thus, the utilization of computing devices in classrooms is heavily inspired with the hope for facilitating learning and teaching processes.

The relationships of behavioral factors and perceived quality of using the mobile application “Say Quran” for learning Quran on a student's perceived performance, satisfaction, and behavior. This study offers proof that there is a positive relationship between mobile application “Say Quran” and student’s perceived performance, satisfaction and behavior whereas engaged in learning the Holy Quran (Alqahtani, Dhegiha & Mohammad, Heba, 2015).

Both aspects of our personal and professional lives have been greatly influenced by computers and have proved to be critical in many areas of practice, including education. The rise in ownership and affordability of smartphones, tablets and laptops has increased the interest in incorporating computer technology into teaching and learning strategies. Digital education is increasingly common. The learning environment can be greatly enhanced by modern immersive multimedia applications in conjunction with conventional in-class teaching and learning methods. The way students learn is fully changed by interactive resources used in or outside the classroom, before or after lecture, online or off-line. Their successful use in the teaching process catches the attention of students, promotes dynamic interaction, increases the motivation and interest of students in the subject field, and enhances the level of comprehension of subjects and the efficiency of learning. Computer-enhanced teaching and learning allows students to develop their own information and meaning on the basis of their experiences in order to be productive agents in the process of acquisition of knowledge (Gordon, 2014).

Mobile phone usage distracts students of Ghanaian’s attention during lectures and hence leads to a decline in GPA since these distractions were in the form of visiting social media sites, text messages and receiving calls instead of concentrating on on-going lectures. The study also proved that youth have a “symbolic and affective

investment" in mobile phones and some even prefer their mobile phone and sees it to be a status symbol for young people (Frimpong, Asare, & Otoo-Arthur, 2016).

During a neuroanatomical practical session, students used programs on a preconfigured tablet device, and their views of this, as well as the impact of the intervention on learning outcomes, utilizing data obtained from three cohorts of students between 2011 and 2013 has proven that very minimum support and instruction required in adding mobile learning opportunities into the curriculum to improve students' perceptions of their learning and satisfaction in class (Morris, Lambe, Ciccone, and Swinnerton, 2016).

2.3 E-Learning and Technology

Technology now plays a larger part in schooling than in past years. In 2017, the National Center for Education Statistics found that in 18 school years, about 21 percent of public schools and 13 percent of private schools offered any courses entirely online. There were 6,932,074 students enrolled in degree-granting postsecondary institutions' distant education courses in the fall of 2018. Approximately ninety percent of such asynchronous online technology is used by programs to implement distance learning (Livingston & Wirt, 2004). Based on all these indications, the trend of integrating technology and education is increasing.

Some points may be made for the importance of note-taking features in these e-learning platforms. Since note-taking has been proved to aid learning in traditional settings, it is logical to assume that it will do so online as well. At the very least, this idea should be considered. Furthermore, students often need the ability to take notes online, and this unmet requirement may conflict with other e-learning platform advantages.

Students were partly printing online modules so that they could annotate printouts, according to one study analyzing the usefulness of the online learning system (Scheines, Leinhardt, Smith, & Cho, 2005). Students lost the ability to complete immersive online resources linked with higher learning outcomes as a result of this decision. The final argument in support of note taking interface evaluation is that various note taking interfaces have already been designed for instructional purposes without adequate research on their memorizing and educational outcomes.

If e-learning note-taking capabilities are developed for educational reasons, they should at the very least be designed to sustain the learning benefits that traditional note-taking provides. Few studies, on the other hand, analyses note taking in an e-learning course in a systematic way, instead focusing on satisfaction and motivation. In some circumstances, people just find taking digital notes to be inconvenient.

Anderson's Online Learning Model:

Anderson (2008) model of e-learning shown in figure 2.1 below interaction examines theoretical frameworks and models that focus on the pedagogical aspects of online education. A proposal for an integrated multimodal model for online education is given on the basis of pedagogical purposes, following a study of learning theory as applied to online education. The aim of the model is to incorporate the work of many other major theorists and model builders, including Anderson (2011). It begins with a discussion of learning theories and progresses to their use in online education. The study finishes with a suggestion for a pedagogical purpose-based integrated model for online education.

Anderson's model displays the educational flow between the two parties and, from the viewpoint of distance education, represents the beginnings of a model. Anderson concluded that his approach "will help us to deepen our understanding of this complex

context of education" (Anderson, 2011, p. 68), noting that it will better measure the direction and amount of each input variable on associated outcome variables. Anderson also considered the Internet's potential for education delivery, stating that, with the exception of "rich face-to-face interaction in formal classrooms," an online learning-based model could replace all other kinds of learning (Anderson, 2011, p. 67). In seeking to establish a popular theory of online education, this becomes a challenge for Anderson in that it does not allow for in-person, face-to-face experiences and is troublesome for those who see online education in general as a subset of education.

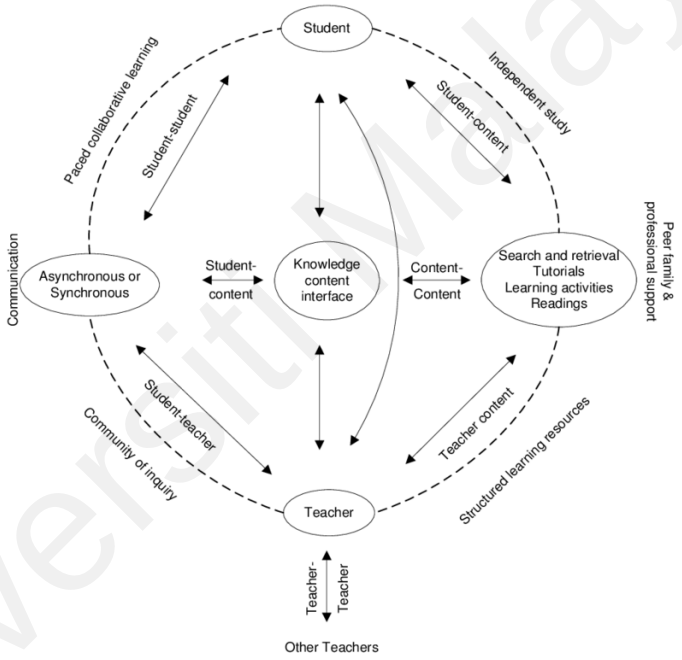


Figure 2.1: Anderson Model (Anderson, 2008)

2.4 Current E-Learning features analysis

As technology has evolved rapidly, online learning has experienced revolution since the existence of the Internet. The knowledge-based learning management system (LMS) has been transformed from a physical tool to an e-platform that has been commonly adopted nowadays. Othman, Mohamad, Yusuf, Yusof, and Suhaimi (2012) have compared Moodle e-learning system features in this study. Below figure 2.2 is the comparison of version 1.9 and 2.1 of Moodle system's features category. From what

have been analyzed, from Moodle 1.9 towards Moodle 2.1, there are missing note taking features. Is not note taking is one of the most important tools for learning? It is advantageous to ensure there is note taking feature in an e-learning platform to make the learning process more meaningful.

Features	Moodle 1.9	Moodle 2.1
Communication tools		
Discussion forum	Yes	Yes (comment display throughout Moodle)
Discussion management	Yes	Yes
Email	Yes	Yes (treated more as message-more engaging)
Blog	Yes	Yes (improved with support comment for each entry)
Real-time chat	Yes	Yes
Video services	Yes (need to enable Youtube plugins)	Yes (features on messaging using media icon)
Course (Community hubs)	No	Yes
Group (Cohorts)	No	Yes
Materials and content tools		
File exchange	Yes	Yes (existence of file picker ease file selection)
Group work	Yes	Yes (improved interface on some modules)
Community	Yes	Yes (new block to keep track course)
Student portfolio	Yes	Yes (supported more format and plugins)
Other application integration		
Plugins	No	Yes
Customize tools		
Users profile	Yes	Yes (can be customised with blocks, news, feeds, info)
Language	Yes	Yes (New web portal for groups to collaborate on translating Moodle)
Security	Yes	Yes (enhanced and recommendation settings)
Appearance	Yes	Yes (new themes, core support for custom menus in all themes)
Front page	Yes	Yes (more option for info and structured)
Notification	No	Yes
Advanced features	No	Yes
Registration	Yes (self-registration)	Yes (self-registration + register to specific hub)
Total features	**21**	**21**
Total available	**16**	**21**
Total missing	**5**	**0**

Figure 2.2: Comparison between Moodle 1.9 and Moodle 2.1 features (Al-Ajlan, Zedan, 2008)

This article explores e-learning as an open, flexible, and distributed learning environment and how different learning features can be built to solve crucial issues in the e-learning platform. Khan, (2005) has found numerous factors that can help to create a meaningful learning environment as in table 2.1. This paper identifies seven categories of e-learning components or tools that can be used in e-learning programs to provide various features conducive to learning.

Table 2.1: Features and Components Associated with E-Learning Environments

(Khan, 2005)

E-Learning Features	E-Learning Components	Relationship to Open, flexible, and Distributed Learning Environments
Ease of Use	A standard point and click navigation system. Common User Interface, Search Engines, Browsers, Hyperlinks, etc.	A well-designed e-learning course with intuitive interfaces can anticipate learners' needs and satisfy the learners' natural curiosity to explore the unknown. This capability can greatly reduce students' frustration levels and facilitate a user-friendly learning environment. However, delays between a learner's mouse click and the response of the system can contribute to the frustration level of users. The hypermedia environment in an e-learning course allows learners to explore and discover resources which best suit their individual needs. While this type of environment facilitates learning, it should be noted that learners may lose focus on a topic due to the wide variety of sources that may be available in an e-learning course. Also, information may not always be accessed because of common problems related to servers such as connection refusal, no DNS entry, etc. (Khan, 2001).
Interactivity	Internet tools, hyperlinks, browsers, servers, authoring programs, instructional design, etc.	Interactivity in e-learning is one of the most important instructional activities. Engagement theory based on online learning emphasizes that students must be meaningfully engaged in learning activities through interaction with others and worthwhile tasks (Kearsley & Shneiderman, 1999). E-learning students can interact with each other, with instructors, and online resources. Instructors and experts may act as facilitators. They can provide support, feedback and guidance via both synchronous and asynchronous communications. Asynchronous communication (i.e., e-mail. listservs, etc.) allows for time-independent interaction whereas synchronous communication (i.e., conferencing tools) allows for live interaction (Khan, 2001).
Multiple Expertise	Internet and WWW	E-learning courses can use outside experts as guest lecturers from various fields from all over the world. Experiences and instruction that come directly from the sources and experts represented on the Internet can tremendously benefit learners.
Collaborative Learning	Internet tools, instructional design, etc.	E-learning creates a medium of collaboration, conversation, discussions, and exchange and communication of ideas (Relan & Gillani, 1997). Collaboration allows learners to work and learn together to accomplish a common learning goal. In a collaborative environment, learners develop social, communication, critical thinking, leadership, negotiation, interpersonal and cooperative skills by experiencing multiple perspectives of members of collaborative groups on any problems or issues.
Authenticity	Internet and WWW, instructional design, etc.	The conferencing and collaboration technologies of the Web bring learners into contact with authentic learning and apprenticing situations (Bonk & Reynolds, 1997). E-learning courses can be designed to promote authentic learning environments by addressing real world problems and issues relevant to the learner. The most significant aspect of the Web for education at all levels is that it dissolves the artificial wall between the classroom and the "real world" (Kearsley, 1996).
Learner-Control	Internet tools, authoring programs, hyperlinks, instructional design, etc.	The filtered environment of the Web allows students the choice to actively participate in discussion or simply observe in the background. E-learning puts students in control so they have a choice of content, time, feedback and a wide range of media for expressing their understandings (Relan & Gillani, 1997). This facilitates student responsibility and initiative by promoting ownership of learning. The learner-control offered by e-learning is beneficial for the inquisitive student, but the risk of becoming lost in the Web and not fulfilling learner expectations can be a problem and will require strong instructional support (Duchastel, 1996).

Samaila, Abdulfattah, and Amir (2017) has investigated the interrelation between factors selected (performance and effort expectancy, social impact and conditional facilitation) and the intention of the student to use LMS and factors influencing intention of students to use LMS were determined. This study mentioned that University Putra Malaysia has an LMS called Putra Blended Learning Assistive System and Technology (PutraBLAST). PutraBLAST has features such as the lecturers able to create their own course information, as well as lecturers able to share class materials and activities easily.

It is challenging for the educators and researchers to be able to encourage student activities during the study in traditional LMS. Therefore, Al Nejam, Tang, Ahmad, and Ahmad (2013) proposed a Learning Management System, which empowers software agents to track and monitor participation and progress of learners, managing the profile of learners and access the learners on basis of their interactions with the system. It is expected that the proposed methodology would simplify the complexity of monitoring problems and resolve some challenges within the current LMS.

The study by Baharom (2014) is to discuss the e-learning strategy of UNITAR called Uniec Virtual. Uniec virtual has features such as discussion forum: asynchronous online discussion, assignments – for online submission of work includes ability to give feedback, Turnitin report, and display and search a bank of record entries about a topic and online quiz & poll.

The aim of this research was to identify the efficacy of a learning management system called the eLearn@USM used by Universiti Sains Malaysia (USM) through usability testing. This e-Learning system, eLearn@USM is found to be a medium for an

online interaction with features like downloading information and the ease of communicating among students and lecturers (Masood & Musman, 2015).

Based on the study by Surarajah (2015) the eLearn of Sunway University's elearning platform allows students to doenload from tablets and mobile to enable smart accessing for better online teaching and learning. However, most of the students are using eLearn only to download and access lecture, lab and tutorial notes. Academicians must play a vital role in improving two-way communication through eLearn.

According to Wong, Tee, & Lim (2015), the Taylor's University's elearning platform called TIMeS is designed mainly to facilitate the teaching by enabling learning materials and activities to be delivered through a single point access. TIMeS offers a variety of interactive activities, such as quizzes, surveys, and chatting, that allow learners to collaborate, exchange materials, and learn together. Its learning content includes a variety of media such as text, video, and interactive learning objects that will keep students engaged in their studies.

Google Classroom is widely regarded as one of the most effective tools for improving teachers' productivity. It is widely used in many public schools of Malaysia as a learning platform. Classroom assists teachers in saving time, keeping courses structured, and improving student communication. Google Classroom is designed to assist teachers in managing the development and collecting of student assignments in a paperless environment by utilizing the Google Docs, Drive, and other Apps framework (Iftakhar, 2016).

i-LEARN Ace developed by Sasbadi is a well-known e-learning platform for primary school and secondary school, starting from standard 4 up to Form 5 students in Malaysia. I-LEARN Ace have a small element of note taking function called Mind Maps and i-Think Maps. Malaysian government schools are practicing mind map

mechanisms where teachers assign mind map activities for students to enhance memory and retention. The e-learning platform has 11 templates for students which allowed them to create and customize own mind maps (I-LEARN Ace, n.d.).

Table 2.2: List of current e-platform without note taking features.

SYSTEM	**The system has note taking features.**				
	Strongly Agree - 1	Agree - 2	Neither Agree nor Disagree - 3	Disagree - 4	Strongly Disagree – 5
eLearn@USM					5
Uniec virtual – UNITAR					5
Moodle@Uniten					5
PutraBLAST – UPM					5
Spectrum – UM (Moodle)				4	
Limkokwing.net					5
eLearn – Sunway University					5
TIMeS- Taylor's (Moodle)				4	
Google Classroom					5
I-LEARN Ace				4	

Based on a few e-learning systems used in government and private universities mentioned in the few studies above, table 2.2 of analysis on current e-platform note taking features was tabulated. Unfortunately, none of the system mentioned below has note taking features. The open-source learning management system called Moodle which is used in Taylor and University of Malaya for their E-learning platform is the closest to be related with the note taking features. The Moodle is a tool which is designed to facilitate teachers to enhance teaching. Moodle consists of common features and plug-in such as database activities, glossaries, support systems enabling the functioning in multiple languages, content management, graphical themes and content filters which can be utilized for note taking feature (Rice, & William, 2006). Besides

that, i-LEARN Ace by Sasbadi has mind map features which can be utilized as note taking features.

As the pedagogical dimension of e-learning refers to teaching and learning, does a system without note taking features can create a meaningful learning platform? According to my view on this, every e-platform should have note taking features. Currently, users have to minimize the e-platform tab in order to take note separately via another platform such as Word documents, PowerPoint and etc. as most of the users used to have one screen medium like laptop, tablet or computer.

In addition, having note taking features on e-platform secures the notes as it's saved online rather than saving it on a physical medium where anything might happen to the medium and cause the notes saved to corrupt or damage. Moreover, it is easy to manage the notes as it is on one platform. It will be an easily accessible note where it can be used anywhere and can be viewed on every platform as well as via the Web. Finally, the note taking feature on the e-platform allows notes to be easily organized or searched.

2.5 E-Learning and Resources

Using online resources for e-learning has brought benefits such as improved access to high-quality educational materials during the Covid 19 lockdown period (Ally 2008). Besides, simulations, presentations of multi media, as well as internet communication and cooperation, provide learning opportunities (Guri-Rosenblit 2009). Moreover, learners have control over the content, learning sequence, and pace of learning when they have learning flexibility (Bhuasiri, Xaymoungkhoun, Zo, Rho, & Ciganek, 2012).

E-learning activities in schools are expected to benefit from online resources. As the Covid 19 shutdown continues, many educational institutions' libraries have converted their traditional collections into digital and virtual libraries, with books, journals, and magazines being replaced by e-books, e-journals, and e-magazines. Therefore, E-learning for schools

should contain a significant amount of online resources that may be used for teaching and learning (Odili, Adetona, & Eneh, 2020).

Online learning material is available through many types such as text, pictures, audio, and artefacts (Moore & Kearsley, 2012) and media forms like narrative, adaptive, interactive and productive (Laurillard, 2002). According to Kenchakkanavar (2014), online resources such as e-Databases, e-Magazines, e-Books, e-Journals, e-Audio, e-Images, e-Subject Guides, e-newsletters, E-conferences proceedings, Digital Library Projects, Electronic Exhibitions, and Web search tools on a variety of topics have provided students with quick and equitable access to support their learning processes.

Study by Alenezi, (2020) the more e-learning materials and tools used in an educational context, the higher the students' performance and the efficiency of teaching methods. Due to their portability and capacity to incorporate more than one book into a single hand held device, online resources have proven to be particularly useful for e-learning activities. They are also published on an open access platform.

With the rise of online learning, video lectures have become more important as a method of material delivery. Students can use viewing strategies in online video lectures by interacting directly with the e-learning interface. Splitting attention across source of media, rewatching bits of the video lecture, pausing the video lecture, and redirecting focus to gain greater audio or visual clarity are all examples of viewing strategies (Costley, Fanguy, Baldwin, Lange & Han, 2018).

For many years, videos have aided education. Learning is much easier with video tutorials than with printed material. They've become an important element of our learning process, since they aid in the transmission of information via aural and visual channels, resulting in a multimodal learning environment. Videos may be a powerful

method to engage students with course content and increase learning when used correctly (Uukkivi & Labanova, 2018).

Xingeng & Jianxiang (2012) summarize the advantages of lecture slides include improved visual effects, high information transfer efficiency, and a precise and systemic knowledge structure. Lecture slides are a well-known and effective method for improving students' preview efficiency and topic comprehension during class. The teacher can offer more information and present more exact elements in a PowerPoint presentatio. The lecture slides which is prepared in a systematic way with a clear framework that will aid students in constructing right knowledge in their minds.

According to Marsh & Sink (2010) Receiving lecture slides prior to the lecture assisted in successful lecture encoding. Usually its a common practice to expect students to read lecture materials in advance of a class. Students who previewed the summary slides performed higher on pre-lecture quizzes, according to Shimada, Okubo, Yin, and Ogata (2017), despite spending less time previewing the material.

2.6 Memory and Retention

Omotayo (2013) said that the memory in the human brain is capable of processing, storing, maintaining, and then recalling information and past experiences. From previous experience, people can learn and adapt and build relationships from what they remembered. The power of memory allows us to remember past experiences, recalling previously learned facts, experiences, impressions, skills, and habits. Memory is the place where things learned and retained from one’s activity or experience is stored, as evidenced by structural or behavioral modification, or by recall and recognition.

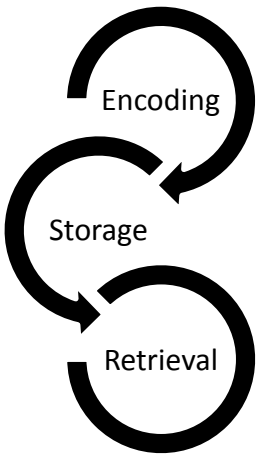


Figure 2.3: Stage of Memory (McLeod, 2007)

Encoding is the first stage of memory where all the information is encoded or stored in one's brain. Storage is the second stage that works with the existence of the memory where the information is stored, the memory time, the amount of information that can be stored, and the memory type. The way information is stored directly impacts the way it is retrieved. Retrieval/recall or collection is the collection of information from our memory storage. Unable to remember or recall the information is understood as failure to retrieve information (Shrestha, 2017).

The process of encoding, storing, and retrieving information as figure 2.3 above and material in the brain is called human memory. Short-term, long-term, and sensory memory are the three categories of memory in the central nervous system, each with its own set of functions and importance in memory processes. Since all saved information is kept in human memory stores, data retention would be impossible without the use of human memory processes. The learning and memory retention processes are intertwined. Memory (Figure 2.4) is a storage site that allows knowledge to be retrieved and stored, which is important for the learning process.

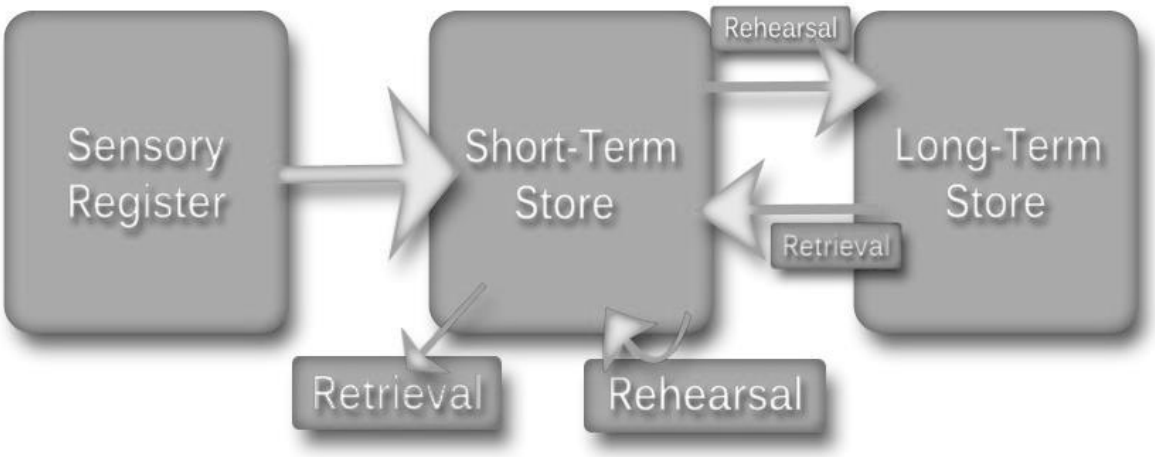


Figure 2.4: Atkinson & Shiffrin Model of Memory (McLeod, 2007)

Many students have problems with their memory. Students with short-term memory recording deficits frequently find it difficult to remember the instructions or directions they have just been given, what has just been said during conversations and lectures and discussions, and what they have just read. Students who have difficulty with working memory often forget what they are doing while doing it.

2.7 Memory Retention and Learning Method

Lin and Bigenho (2011) research is to analyze the capacity of students to remember words and explore the positions that note taking devices perform in these settings – no note taking, note-on-paper, and note taking on a computer. Results indicated significant interactions with note taking tools between environments. The participants performed better while taking notes on paper compared to taking notes on the computer, and not taking notes in the no-distraction environment. However, the participants performed word recall best while not taking notes compared to taking notes on the computer, and while taking notes on paper in the auditory-visual distraction environment. The results suggest that notes should be made by hand on paper in a non-destructive setting. When both auditory and visual inputs are likely to distract the environment significantly, the best choice is not to take notes, but to concentrate on the task.

Recent study examined test scores of a small group of pharmacy students using longhand to take notes versus the remainder of course enrollees taking notes using a laptop computer, noting results that merit further investigation. It's proven that the longhand note has fewer distractions and temptations, having high-quality notes as well as producing improved test scores than those who take notes using a laptop (Desselle, and Shane, 2018).

Previous studies have attempted to establish the impacts of students' note taking behavior, the context of how they learn, and their individual differences on how they retain information. This research indicated that the context in which a student learns the material and the context in which they are tested on the material do not significantly impact their retention of the information. However, it was found that students who took notes, regardless of their method, performed better on this task than students who did not take notes (Eason, 2017).

This research was to investigate the effects of method of note taking and context on memory retention. This research proved that memory retention and information processing was better for those typing than handwriting notes because typing promotes a high degree of transcription fluency that can reduce cognitive load, providing more time for current information to be encoded when note taking. This finding implies that typing, particularly in a lecture context, will become the preferred method of note taking and will be established as the better method of note taking compared to handwriting (Schoen, 2012).

According to Ward and Tatsukawa (2003), paper and pencil has its benefits; however, there are connected tasks wherever digital devices, like laptop or computers, have recently returned to exchange paper and pencil. They foretold that within some years, as the population of students continues to boost in computer skill and typing

speed, and as hardware improves and becomes cheaper, taking class notes with computers will become common.

A study by Santa, Abrams, and Santa (1979) noted that the results of study and therefore the external storage function of note taking are extremely supported by the good reader conditions. They additionally said that taking notes is a common activity among college students and taking notes did exert an influence for poor readers as proven by the very fact that the majority poor reader note taking conditions were higher than the "no-notes" control groups.

A study by Horwitz (2017), showed no difference between factual questions. However, for conceptual questions, the longhand subjects had higher test scores compared to the laptop note takers. The study focused on the impact of the note taking medium on studying an educational text and the different effects on test performance for longhand notes versus typed notes of a textbook.

The research was to describe the effect of simultaneous note taking on the immediate understanding of English-language lecture knowledge by both native speakers and non-native speakers, investigate the influence of short-term memory duration on the encoding of English-language lecture material by both groups of listeners, and assess the impact of English-language learning skills on English-language lecture content. The study suggests that for American and an international college student, studying lecture details includes much more than taking notes. It may also include their short-term memory and language skills, as well as several other individual differences that have not yet been studied (Dunkel, Mishra, and Berliner, 1989).

The research is to determine the impact of exposure to slide copies during lectures using PowerPoint on their learning outcomes for undergraduate students based on the

quantity of notes they take and immediate versus delayed testing. The results revealed that their learning outcomes were predicted by accessibility to slide copies and note taking by students. In both short and long-term memory settings, the effects of no slide copy were significant compared to those of access to full and partial copies (Kim, 2018).

The goal of Joseph Siegel's research is to look at a step-by-step scaffold instructional cycle for EFL (English as a Foreign Language) note taking, starting with decisions about what to record, when to record it, and how to record it during lecture listening using a formal outline structure. The research is intended to address the volume and type of notes and pedagogical views of the student. The quantity of notes on the post-instruction task was significantly higher than on the pre-task, indicating that there was some positive effect on the pedagogical process being staged (Siegel, 2016).

According to Liu, Schallert, & Carroll (2004), a consecutive interpretation process involves five stages which are hearing and listening, analysis and comprehension, memorizing and note taking, loading from memory and notes and delivery. Based on this point of view, note taking is a great sidekick to memory as it's a good helper for analysis and comprehension (Meifang, 2012).

To encourage and boost the retention of knowledge, note taking is one in every of the necessary skills a student can possess and refine. Effective note taking in future applications allows students to retain and review information which seems to be helpful on assessments. It can also reveal clues on what the lecturer views as necessary and what material could also be enclosed in test questions. Research has shown that retention of knowledge decreases over time.

2.8 Memory Retention and Teaching Method

The way teachers engage in teaching methods will have a direct impact on their pupils. There are two types of methods of teaching. They are an approach centered on teachers and an approach centered on students. The teacher is the main focus of the classroom and the only figure of authority in the room in the teacher-centered approach (Teach.com, 2019).

Worthington, Debra & Levasseur, David (2015) study has aggregated proof that giving students teacher-prepared notes or PowerPoint slides does not improve their performance. PowerPoint has plagued the present classrooms. It's a struggle for the teachers to make up their mind whether or not to provide PowerPoint slides to their students. Students need to take notes in ways that are significant to them. Students should discover that they don't always get what they want. They have to take their own notes and not presume that they are excused because they have notes from the teacher.

Inside the classroom, teachers and educators are constantly finding new ways to reach students. The primary purpose of this study is to establish if children can remember information more reliably by electronic medium or methods of teaching general education. The optimal method of teaching has been developed to help children remember knowledge at the elementary level. This study suggested that there is no significance in the methods of teachers and the ability of the students to remember information (Ross, 2017)

According to Namasaka, Fred & Mondoh, Helen & Wasike, Chrilukovian (2017), the purpose of this study is to allow curriculum developers and teachers to select the most suitable sequence to be used in biology. The goal of this study was on comparison of the differential efficacy of Sequential Teaching Methods (STM) on the information retention by secondary school students in Biology. The results and findings of the study

indicate that STM, when efficiently used in instruction, improves immediate retention of information in Biology more effectively than the oratory lecture method predominantly used in Kenyan Secondary schools. Using STM has resulted in improved knowledge retention compared to oral lecture-only use.

2.9 Importance of Note taking

A case study by Islam (2017), found 4 aspect of note taking which is the note-taking strategies used by students, note taking's principle of function, various approaches of note-taking that benefits the students and lastly, the effort to enhance the note taking as a useful tool for studying the subject matter. Programs to teach and emphasize the relevance of academic study skill can be implemented in student learning units to improve students' academic proficiency levels, as most Bangladesh universities lack the resources to develop such study skill.

Note-Taking technique in teaching reading skill can improve the students' skill of reading. Note-taking was interesting and beneficial for the students who studied English as foreign language because can improve the students' reading skills. It's caused by the involvement of the students' during the process. It also made English became joyful subject to be learnt. Nurmila (2020) found improvement of the students' reading achievement in Creative Comprehension after using Note-Taking technique.

Taking notes has numerous advantages, the most important of which is that it relieves students of the burden of reading the entire text. It enhances pupils' cognitive skills by drawing their attention to the material being read or heard. It keeps pupils from forgetting what they learned in class. (Pyörälä, Mäenpää, Heinonen, Folger, Masalin & Hervonen, 2019).

Taking notes from lectures (Kiewra, 2002) or reading (Rahmani & Sadeghi, 2011) will enhance learning for students. Apart from remembering more about what learnt in

classes, taking notes is better than not taking notes. The reasoning behind this is that taking a note requires effort. More than passively encoding information into words or pictures, the encoding information process creates fresh pathways in the brain that store it in long-term memory more deeply. In fact, students get the opportunity to revisit and reinforce the learning that happened the first time around by getting the information stored in a place.

Studies indicate that the review of notes following a lecture results in better recall of lecture material (Howe, 1970) and that better note taking contributes to higher test scores (Titsworth & Kiewra, 2004). Moreover, the quality of note taking predicts academic performance among students (Peverly & Sumowski, 2012). The importance of training on how to take notes, which enhances performance on understanding and retention tests, has been demonstrated (Rahmani & Sadeghi, 2011).

Carrier (1983) presented five general conclusions that help to summarize what note taking research has discovered. These conclusions are note taking promotes learning better than listening alone as well as taking and reviewing notes enhances learning. In addition, the analysis of notes facilitates learning, identifying, and organizing information aids note taking and students require different note taking techniques.

Students who take notes during a lecture will learn more than those who simply listen. Note taking enables the processing of information by actively involving the learner (Ladas, 1980). In general, students can learn more from a lecture if they record and study their own notes. Personalized recording and analysis of notes allows for specific coding and rehearsal of information and produces cues that serve to trigger retrieval strategies (Thomas, 1978).

According to Williams & Eggert (2002), note taking plays an important role in formal learning environments. In learning, note taking is very important. Many instructors do not go over the importance of taking notes during lectures at the college and university level (Grabe & Christopherson, 2005). Proper note taking is an ability that a lot of students' neglect. Students take poor notes, particularly in lectures, as only about 25 percent of lecture notes would be recorded (Boyle, 2011).

Jones (2002) said the process of note taking is to boost the output of the consecutive interpreter. Three basic questions an interpreter must ask himself/herself before embarking the interpreting process is when to note, how to note and what to note. A set of symbols, abbreviations and verb tense which are familiar can be used to take notes by a consecutive interpreter as it is very crucial to understand the ideas.

Students' performance on exams shows a positive impact on strategic note taking and prior knowledge more than self-regulatory skills (Peverly, 2003). It is discussed that, although note taking is a linguistic activity, it involves visual and spatial activities through the use of the eyes and text organization on the page and the organization of the text in accordance with a specific semantic structure (Olive & Passerault, 2012). The spatial and visual working memory is enhanced by these spatial and visual activities which improve teaching (Olive, 2012). Thus, a key strategy used to increase the attention of learners to the lecture and to support its content is taking notes. In listening to understanding, note taking can play a crucial role. As a strategy to intensify their attention on what they hear and remember for later use, learners take notes while listening (Zohrabi & Esfandyari, 2014).

Kiewra (1985) argues that, for at least two reasons, taking notes is advantageous. First, taking notes helps lecture learning by activating the attention of students and engaging the cognitive processes of coding integrated, synthesized, and transformed

into a personally meaningful form of aurally received input. Second, it is very useful to take notes as the notes taken serve as an external source of information that provides later revision and review to reassure the information heard is remembered. Cottrell (2019) explains that taking a note can be done for a variety of reasons and different outcomes. In response to the question, ‘‘Why are you taking notes?’’ Cottrell (2019) says that a note taking can create a useful record of important points for future use or where the information comes from.

Table 2.3: Importance of Note Taking

Importance of note taking	By
Helps to review materials for re-use in revision and assignments	Nurmila (2020)
While taking notes, learners interpret, filter and process the information at hand, make connections between new information and their prior knowledge and produce a format that enables them to retrieve information later.	Pyörälä, Mäenpää, Heinonen, Folger, Masalin & Hervonen (2019)
Helps students recall the important information they learnt and makes them independent.	Bahrami and Nosratzadeh (2017), Saravani (2019), Umaadevi and Rekha, (2019)
Note-taking reduces the pressure on the working memory of the students, and helps them to resolve difficult problems.	Islam (2017)
Increase the attention of learners to the lecture and to support its content. Intensify their attention for later use on what they hear and recall.	Zohrabi & Esfandyari (2014)
Enhances performance on understanding and retention tests.	Rahmani & Sadeghi (2011)
Enhance student learning and remember more about what is learned in classes.	Kiewra (2002), Rahmani & Sadeghi (2011)
Contributes to higher test scores.	Titsworth & Kiewra (2004)
Improves students’ performance on exams shows a positive.	Peverly (2003)
Note taking creates a useful record of important points for future use or where the information comes from.	Cottrell (2019)
Boost the output of the consecutive interpreter.	Jones (2002)
Note taking helps in lecture learning by activating students’ attention and engaged students’ cognitive processes.	Kiewra (1985)
Note taking promotes learning better than listening alone.	Carrier (1983)
Enables the processing of information by actively involving the learner.	Ladas (1980)

One thing that most successful students have in common is that they use a specific note-taking method. It is vital for each student to actively take notes during class as it can help focus and better understand main concepts. A note-taking method will help one to be prepared before the lecture and to review key concepts after a class. As shown in table 2.3, various researchers found that note taking is important and it is proven that effective note-taking enhances academic success.

2.10 Note Taking-Visual and Video

Compared with writing alone, adding sketches to notes to represent ideas, words, and relationships has a major impact on learning and memory retention (Wammes, Meade, and Fernandes, 2016). The growing popularity of sketch notes in recent years suggests that teachers are well on their way to making the most of this research. Visual note taking is the strategy to improve learning, to synthesize information, to carve out the most important points and to use images to convey learning simply and efficiently. Visual notes are perfect for a visual learner who has a passion for pens and paper. The combination of traditional handwritten notes with drawings, symbols, and other creative elements is called visual notes. Visual notes can be used to improve memory retention, to keep the brain active and engaged in variety and stimulation, and to create ideas more comprehensively by creating connections between points.

Rohde (2013) found that visual note taking is rewarding for several reasons which helps focus on the topic at hand, the notes were visually appealing and finally the notes with illustrations have better memory retention. Students appeared to retain more information when given the opportunity to revise, add or rewrite their notes. And when the revision happens during deliberate breaks in a lecture or other learning activity, students remember the information better and take better notes than if the revision happens after the learning experience is finished. Ultimately, if students collaborate

with partners on this revision, they take even more complete notes and score higher on post-tests (Luo, Kiewra, and Samuelson, 2016).

2.11 Existing Note taking application

Google Keep is a Google-developed note taking service. Google Keep, which was released on March 20, 2013, is available on the web and has mobile applications for Android and iOS mobile operating systems. A variety of tools such as taking notes, including text, lists, images, and audio offered by Keep. Google Keep allows users to make various types of notes, including text, images, and lists. Users can set up reminders with time or location options, which will deliver small pop ups and are integrated with Google Now. Keep has a variety of features but creating 'to do' lists is the most useful. It allows capturing what is on one's mind quickly and sharing. Speak on the go with a voice memo and get it transcribed automatically. Lastly, allows taking photos of a poster, receipt or document and easily organizing or finding it later in search (Dutton, 2015).

Evernote is a note-taking, organizing, task-management, and archiving app created by the Evernote Corporation, based in Redwood City, California. Users can create notes on the app using text, doodles, photos, audio, or saved web content. Notebooks hold notes, which can be labelled, annotated, modified, searched, and exported as attachments. Evernote is a cross-platform app that works on Android, iOS, macOS, and Windows (Hine, 2014). A comparison of existing note-taking software can be found in table 2.4.

Table 2.4: Comparison of existing Note Taking software

Features/Software	Microsoft OneNote	Evernote	Simplenote	Google Keep	Ideal note taking software

Free to use	✓		✓	✓	✓
Record Audio	✓	✓		✓	✓
Text Notes	✓	✓	✓	✓	✓
Visual Notes	✓	✓		✓	✓
Text and paragraph formatting	✓	✓			✓
Cross-platform	✓	✓	✓	✓	✓
Export/ Import image		✓			✓
Insert video	✓	✓			✓
Reminder		✓		✓	

According to the table above, an ideal note taking software requires features such as free to use, support cross platform, text and visual notes, text and paragraph formatting, able to record audio, upload video and lastly to export and import images. However, the MemRetz app does not have audio recording and templates or plugins of SmartArt, shapes and charts since this study is only concentrating on text notes, visual notes, export or import image, insert video, formatting of text and paragraph, free to use and cross platform features of note taking. In order to spice up the note taking process, rich text editor is a must as it adds colors (Purdy, 2013), formatting the text and organizing notes (Evans & Shively, 2019) which enables students to read in the future and aid the brain in understanding the content.

The growing popularity of sketching or visual notes in recent years proved that adding drawings to notes to represent concepts, term and relationships has a significant effect on memory and learning (Wammes, Meade, & Fernandes, 2016). Studies states that “People learn more deeply from words and pictures than from words alone” (Mayer, 2014, p. 43). When students use images and text in note taking, it gives them two different ways to pull up the information, doubling their chances of recall (Paivio & Clark, 2006). According to Wilson, Park, Curtis, Cameron, Clayman, Makoul, & Wolf (2010) Review the video by reading and clicking on the notes at the same time is beneficial for short-term recall. The audio recording and templates or plugins can be added as future study.

The traditional way of taking notes can be frustrating if there is no storage and filing system and it is an obvious waste of paper. It is possible to do this on a laptop, but with every note, there always needs to be a place and then you need to remember the place for future reference. Along comes apps specifically created for remembering what to do, a task that many of us struggle with when our days become busy and frantic. Although Evernote. Simplenote, Google Keep and Microsoft OneNote are available note-taking tools online; none of these notes are used in the E-learning platform.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a description of the research methods used in the study to gather and analyze the data needed to address the research questions. The chapter starts with a review of the methodology of research, followed by research participants, target users and user type. The chapter then continues with descriptions of the tool development, tool selection, module development and design languages. Next, the discussion centers on pilot study and data collection methods. Finally, the choice methods of data analysis are discussed.

According to Figure 3.1, the literature review and preliminary studies have been carried out using smartphones in order to thoroughly resolve the first goal of this study, which is to identify issues, find the effect of note taking on memory retention, observe and analyses the effect of note-taking method on memory retention. Furthermore, a multilingual note taking in an e-learning platform is designed to support memory retention as well as to adapt different scripts of language in Malay (Jawi Script), English (Latin Script), Chinese (Hanzi script) and Tamil (Tamil script). Besides, a note taking model in an E-learning platform is developed to assist in the development of an effective learning platform for the students to take notes during reading slides and viewing videos shared in the platform. A progressive web application is developed to fulfill the fourth objective of the study which is to develop and evaluate prototypes to measure memorization effectiveness based on the model. Finally, during the result analysis, the note taken and the memory retention score are recorded and measured using Anova and independent T-test to determine the effect of memorization retention using different medium of note taking and to find out the best medium of note taking.

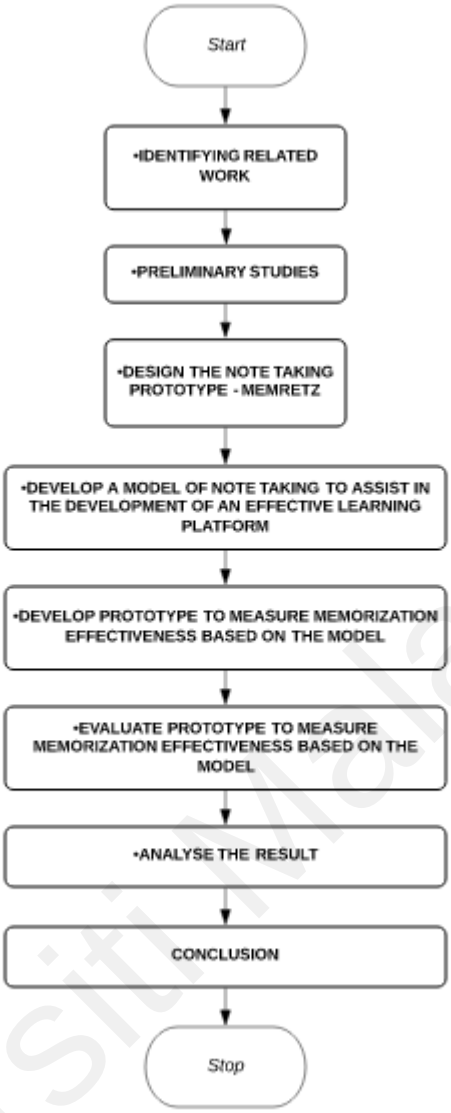


Figure 3.1: Flow Chart of Research Methodology

3.1.1 Identifying related Literature

A brainstorming session is conducted to identify the content of this study. First, journal articles published during the period 1970-2020 were searched electronically and manually, and the related literature was retrieved through reference list checking. For electronic searches, the main databases were the University of Malaya Digital Library and IEEE Xplore Digital Library. For journal searches, the main journal were Journal of Systems and Software, ACM Transaction on Software Engineering and Methodology and Advances in Engineering Software. Four sets of keywords were searched:

1. Learning through a computer, laptop and mobile phones / apps related keywords including e-teaching, e-learning.
2. Memory retention related keywords, including method, effect.
3. Learning and teaching methods in classrooms.
4. E-platform related keywords, including note taking.

When searching the electronic database, the four sets of keywords were merged. After collating all the related literature, another round of searches was conducted using the references lists found in the literature yielded by the electronic search to find any omitted but relevant works. The research problem was identified through this literature study stage. After the research problem and solution was determined, the research objectives and research questions were derived to address the research problems.

3.1.2 Preliminary Study (Smartphone)

The preliminary study is on the smartphone where about 250 the participants will be given a set of articles which consists of different length of character for each article. The length of the characters of each article will increase gradually from 50 characters up to 800 characters. Participants are required to read the article and then answer a few questions related to the article. The memory retention score, medium used (smartphone) and the note taken will be recorded to determine the memory retention. Relative to the latter, the study also developed a model for note taking in an E-learning platform for the students to take notes during reading slides and viewing videos shared in the E-platform.

3.1.3 Design the note taking prototype - MemRetz

The note taking is designed in a way that can be written, drawn as the study believes that compared to writing alone, incorporating sketches to notes to reflect ideas, words, and relationships has a major impact on memory and learning (Wammes, Meade, &

Fernandes, 2016). Few complications faced during this study to incorporate the note taking features into a third party's E-Learning platform as listed below:

- In order to add the note taking component to an existing system, need to discuss, convince and implement with third party.
- Since the third party have their own roadmap it's difficult to get the access to the system.
- Obtaining permission from another party would take time and this would prolong the research timeline.
- Completing the thesis then would be depend on the third party.

Therefore, instead of proposing and creating a component or API that can be integrated into those existing platforms, this study developed own platform called MemRetz and incorporated note taking features to stimulate, show and prove that it is possible to add a note taking features in e-learning platform. Moreover, the MemRetz was created to ease the research finding and testing of the note taking features in e-learning platform. The model design which is compatible for all devices is designed in such a way to allow access in multi devices such as smartphone, laptop, computer and etc. as well as it is as easy accessible as it can use anywhere. Everyone is aware of different note taking methods, but its application using multi-languages is something new that was brought into study. Also, the acquisition of language skills is highly imperative for memory retention. Note taking is a personalized ability and hence a person's priority of language should be heeded before proceeding to its method.

3.1.4 Develop a model note taking to assist in the development of an effective learning platform

A note taking model in an E-learning platform is developed as note taking has been proven to improve student learning while taking notes from lectures or from reading. Based on previous study, there is a lack of note taking features in an E-learning

platform. The E-learning program with note taking features is useful because it has note taking features where we actually have to minimize one screen in order to take note separately via word documents, PowerPoint and so on, because most students typically have one screen that would be their laptop or smartphone. In addition, it also helps to store notes online rather than taking risks by saving it on a physical device where anything might happen and cause the file to corrupt or damage.

3.1.5 Develop Prototype to measure memorization effectiveness based on the model

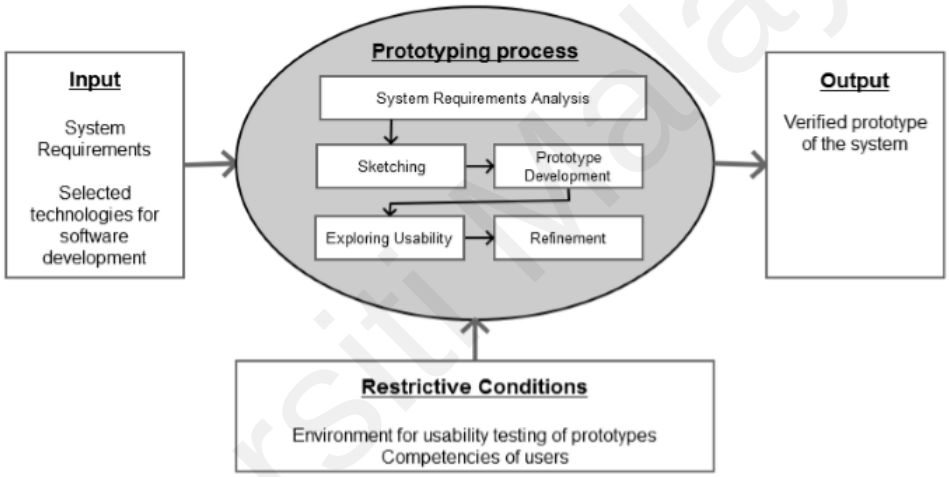


Figure 3.2: Prototyping model based on process approach (Nacheva, 2017)

The model proposed in Figure 3.1 is viewed as an iterative evolutionary prototyping mechanism as shown in Figure 3.2 that receives some inputs, performs a few steps, and delivers artifacts of output. The present study offers the following prototyping stages, based on generalized phases of problem solving in literature review: examination of system requirements, sketching, development of prototypes, exploration of usability and refinement.

Following that, a prototype was designed to analyses participant's memory retention using various note taking mediums (pen-paper, smartphone and laptop). A progressive web application named MemRetz was developed by providing 4 different scripted

languages (Malay (Jawi Script), English (Latin Script), Chinese (Hanzi script) and Tamil (Tamil script)) of articles and lecture videos for the participant to choose suitable note taking method (pen-paper, smartphone and laptop) for them to read the articles and view the videos as well as taking notes while reading and viewing before start answering the questions. At the end of the test participants activities during the test will be observed to identify elements and infer which aspects of the design are problematic and which work well.

3.1.5.1 Research Participants

Participants for the preliminary study is 250 participants and for the experimental study included 120 participants from various languages which are in Malay, English, Chinese and Tamil. The Participants in this research were from one single location, Malaysia. Participant's included females and males between all age ranges of 20 to 29, 30 to 39 and 40 to 49. The targeted participants were students as this study is focused on method of note taking. This will give a clear picture on the method and practice of note taking.

3.1.5.2 Material

Below table 3.1 shows the tools used during this study.

Table 3.1: Experimental Tools

Tools	Version
Questionnaire, Semi Structured Interview questions.	
Firebase Firestore (Cloud Firestore)	8.19.0
Ionic Framework	5.2.1
GitLab GIT	2.21.0.windows.1
NPM	6.9.0
Node	12.3.1
Highcharts	8.2.2
Quill Editor	1.3.7
Visual Studio	1.52.1

3.1.5.3 Procedure

MemRetz app is a simple test to measure memory retention. In pre-test, participants will be presented with a questionnaire to identify their perspective on memory retention during note taking in the classroom. This test targeted ten participants in three different mediums (pen-paper, smartphone, and laptop) for each language which is in Malay, English, Chinese and Tamil. The test consists of two forms of tests which is article, and video. A collection of articles with a different length of characters will be shown, increasingly each from 50 characters to 800 characters. Participants are required to read the article and, if needed, make their own notes. A set video length of less than 10 minutes and 20 minutes respectively will be provided. Participants are required to watch the video and, if needed, make their own notes. Then participants can start answering questions. On completion, participant's results for all the answers will be revealed with a memory retention score and notes taken by the participants will be saved to be referred later. In the post-test, participants will be given semi-structured interview questions to identify their experience on method of note taking and to find out the best emphasis method of note taking. The risks that participants may incur throughout this study are the size of the screen which can have an effect on the amount of time invested and also the number of mistakes done by the user of the test to determine the foremost effective emphasis method. To minimize these risks, this study prepared a set of smartphones with the same screen size for the participants to use during preliminary study. However, pilot and experimental study was done online and could not control the screen size throughout the research caused by the pandemic of coronavirus COVID-19. Below table 3.2 shows the steps of the procedures used in this study.

Table 3.2: Procedure Steps

Procedure	Steps
1	Participants are explained on the experiment to be carried out.
2	Participants are being given medium (smartphone/tablet/laptop) and the written paper before the experiment is started.

3	Participants are then needed to read the article and view the video on the medium and the written paper.
4	Participants may opt to take note during reading the articles or viewing videos.
7	The participants are then required to answer questions based on the article given.
8	The note taken of the participants and the medium used during the test will be recorded.
9	The memory retention score (percentage of correctness × time taken to complete the test) will be recorded to find out the memory retention of each participant.
10	Participant's results for the entire test will be revealed with the memory retention score and notes taken by the participants will be saved.

3.1.6 Evaluate Prototype to measure memorization effectiveness based on the model

3.1.6.1 Experimental Setup

A note taking application named MemRetz was developed to find the effect of memorization retention using pen-paper, smartphone, and laptop. The prototype is designed based on the model. The model has been implemented into a prototype with features such as multilingual articles and videos, article-based and video-based questions, recording the memory retention score that is not within the model to help find the impact of memory retention in multilingual note-taking focusing on various mediums. The MemRetz app consists of two forms of tests, the article and the video. A series of articles with varying lengths of characters will be displayed, ranging from 50 to 800 characters each.

The topic and content of each article (Malay, English, Tamil, Chinese, and Jawi) are different. However, the level of difficulties and number of characters are the same. Each article focus on explaining one concept. Bloom's Taxonomy, which was created by psychologist Benjamin Bloom contained six developmental categories knowledge, comprehension, application, analysis, synthesis, and evaluation as shown in figure 3.3 below. The taxonomy's first stage concentrate on knowledge acquisition where students

memories, retrieve, list, and repeat information they learned earlier. Knowledge can be measured using simple methods such as multiple choice or short-answer questions that involve information retrieval or recognition (Adams, 2015).

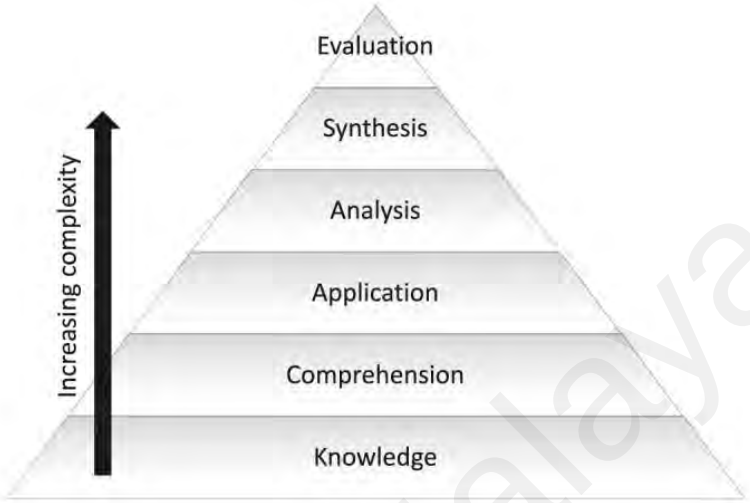
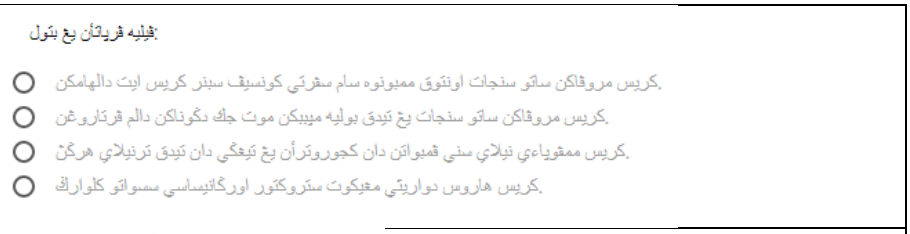


Figure 3.3: Bloom's Taxonomy (Armstrong, 2016)

The purpose of this study is to determine the participants' memory recall by measuring their Bloom's taxonomy knowledge level. The taxonomic knowledge level is listed, along with the topic and questions for each article in table 3.3 below. Essentially, participants will be asked to choose an option that summarizes or presents the ideas in a paragraph that follows Bloom's taxonomy's first level, which is concerned with retaining basic facts.

Table 3.3: Topic and Questions based on taxonomic knowledge

ARTICLE TYPE	TOPIC	QUESTIONS
English	Bank Online Services	Which of the following is the impact of service on loyal customer? ○ Damage on the bank reputation ○ Employees satisfaction ○ Service opening hours ○ Employee loss
Tamil	Database Security - Risks and Control Methods	கீழ்காணும் சேவைகளில் எது விசுவாசமான வாடிக்கையாளர்களின் தாக்கமாகும்? ○ அ. வங்கி நற்பெயருக்குக் கலங்கம் விளைவித்தல் ○ ஆ. ஊழியர்களின் திருப்தி ○ இ. வேலைகளின் கால நேரம் ○ ஈ. ஊழியர் இழப்பு

Arabic	Al – Jazeera(War News)	
Chinese	China is sorting its household waste problem	

Participants are required to read the article and, if needed, make their own notes within a given time frame and answer questions based on the article. Besides, a set of video length of less than 10 minutes will be provided. Participants are required to watch the video and, if needed, make their own notes within a given time and start answering questions. Participants will be given text and visual note taking options to take notes during the test. MemRetz App will capture the memory retention score and notes taken by the participants. Each note taken will be saved to identify if the notes taken are valid or not. Study also collects the medium used by the participants during the memory retention test. The memory retention score, medium and note taken information gathered for each language was then used to do analysis.

3.1.6.2 Experimental Design

This experiment is done using quantitative research design and statistical analysis to measure results. The method of questionnaire and semi-structured interviews was used for this study, consisting of several main questions that help define the areas to be explored, but also allow divergence in order to investigate an idea or response in more detail. The rationale for using the semi-interview methods is to find out what is on the participants mind, what they think and how they feel about the survey conducted. Besides, the questionnaire is used to address as many issues relating to the strategies and physical aspects of note-taking as possible. The study, which gathered data over a

six-month period, uses statistical testing to compare the variation in quantitative responses between equivalent open cohorts; this is a common type of action research used to evaluate practice amendments and advocate for change, taking into account existing literature, practitioner experiences, and input from others (in this case, students).

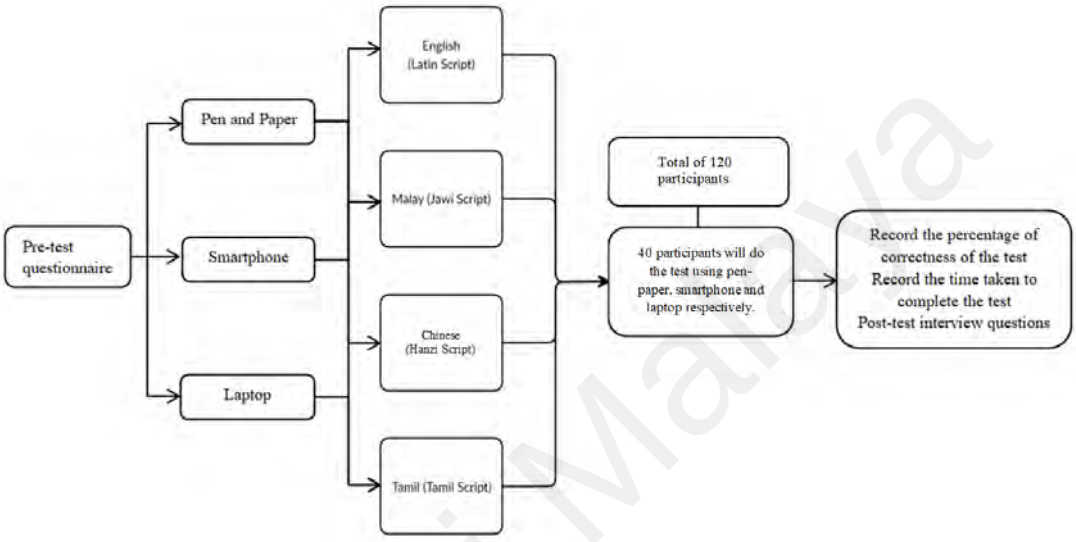


Figure 3.4: Quantitative Demographic Data Research Design

Selecting a research design depends on many factors, such as research questions, the researcher's expertise, cost, time and latency (Saxena, Prakash, Acharya, & Nigam, 2013). The research method used in this project is by prototype design. Quantitative demographic data in Figure 3.4 above is designed as a prototype to quickly and cheaply test or verify concepts, design assumptions and other aspects of its conceptualization, so that necessary refinements or possible changes in direction can be made (Dam and Siang, 2019). Prototype is a useful aid when discussing ideas and an effective way to test out ideas. Below table 3.4 shows the variables used in this study.

Table 3.4: Variables

Variables	
Manipulated	**Fixed**
Age group	App used

Variables	
Manipulated	**Fixed**
Gender	Types of smartphone, laptop used
Race	Length of articles used
Language of the articles	The screen size in each laptop and gadget
Method of note taking	The screen size in each laptop and gadget

3.1.6.3 Pilot Study and Experimental Study

In this research, a pilot study was conducted to evaluate the prototype designed as well as to examine the feasibility of an approach that is intended to be used in a experimental study. Moreover, pilot study was done to replicate the finding of the best emphasis method among three methods – pen-paper, smartphone and laptop for memory retention. The pilot study target is about 6 participants for Chinese language in Malaysia during the semester, 2020. Thus, the data from the pilot study were analyzed with regression analyses and minor refinements or possible changes in direction were done for the experimental study to improvise the study based on the results of pilot study. The experimental study target is about 120 participants for various devices in multilingual language.

3.1.6.4 Research Data Collection Method

Method of data collection involves researching the current program performing questionnaires, semi-structured interviews, and consigning the subject to online analysis. The field research for data collection was performed between February 2020 and mid-November 2020 with a sample size of 120 participants. A structured questionnaire was created and distributed for the students (both males and females) who study in school, college, and universities to find out the effectiveness of memory retention before starting the test through pen-paper, smartphone and laptop. The

questionnaire contained a few questions on learner's performance, satisfaction, motivation, behavior: perceived usefulness, content quality, ease of use and layout/graphic design during learning using three different methods (pen-papers, smartphones, and laptop). In addition, semi structured interview questions were created and circulated after the study to assess the effectiveness of memory retention. Semi-structured interview question was developed to collect a richer source of information from a small number of people. The semi interview questions were designed to collect in-depth information on participant's opinions, thoughts, experiences, and feelings. During the test, the percentage of correctness and time taken to complete the test was recorded to find out the memory retention of each participant.

3.1.7 Analyze the Result

Data was verified and analyzed using the IBM SPSS Statistics version 21.0 for Windows (IBM Corp) Variables were viewed as proportions, and using Pearson's chi-square test, the differences were tested. The associations between independent and dependent variables were tested using Pearson’s chi-square test. The odds ratio (OR) and its 95 % confidence interval (CI) were also reported. Variables with P-values less than or equal to 0.2 were further analyzed by multivariable analysis using a forward conditional stepwise logistic regression model.

Concerning the source of information, which was a matrix, open ended, demographic questions, Likert scale and rating scale questions, a multiple-variable set was created for analysis and was later used for further analysis.

3.1.7.1 Memory Retention Score

The participant’s memory retention score will be examined and statistical one-way analysis of variance test Anova, two-way analysis of variance test Anova and independent t-test will be done on their score on the article and video test during the

MemRetz test to find if there is any significant difference between more than two groups. Sir Ronald Fisher invented Anova to compare results from multiple groups at the same time. Anova's most basic version compares groups varying in a single dimension, or element. It is known as one-way Anova. The two-way Anova compares the mean differences between groups that have been split on two independent variables (called factors). The primary purpose of a two-way Anova is to understand if there is an interaction between the two independent variables on the dependent variable. The independent t-test is an inferential statistical test that determines whether there is a statistically significant difference between the means in two unrelated groups. Normality test was conducted to determine whether data collected has been drawn from a normality distributed population. Test of the normality is an important step for deciding the measures of central tendency and statistical methods for data analysis.

3.1.7.2 Feedback

Feedbacks were taken from the participants using questionnaire to gather information on the effect of memorization retention using the pen, the laptop, and the smartphone on multilingual note taking which is in Malay (Jawi Script), English (Latin Script), Chinese (Hanzi script) and Tamil (Tamil script). To elaborate the participants' understanding on the effect of memorization retention using the pen, the laptop, and the smartphone on multilingual note taking, a thematic analysis has been done.

3.2 Conclusion

This project focuses on progressive web application (PWA) for mobile and laptop respectively which will be able to find the effect of memorization retention using pen-paper, smartphone, and laptop. This PWA is proposing to investigate memory retention ability of a given text in multilingual after the text is written, read, and video is viewed using pen-paper, smartphone and laptop. A quantitative research study is proposed. A

prototype is developed and evaluated for measuring the effectiveness of the three input styles for memorization through writing.

3.3 Summary

The chapter provides an overview of the design of the system and the overall research process, it is important to note that a badly designed system can produce similarly incorrect results as this chapter introduces a schematic approach to the design of the whole system. It shows that all four steps are accomplished one after the other while back and forth preliminary study and literature review. Then, through literature reviews, it attempted to relate methods of note taking. A pilot study with six participants at the first was initiated prior to scaling for complete research. The pilot study was undertaken with the studying participants from various language preferences. The questionnaire collected was analyzed to determine whether the data collected enabled the researcher to achieve the objectives of the study apart from testing the reliability and validity of the questionnaire distributed to the target group. A prototype tool is instead built to produce note taking methods and measure a class's mean score to assist teachers in selecting a class note taking method suitable for a particular group. The tool's implementation is then tested to see if the model created for it completes the task. All of the research objectives must be met by answering the research questions.

CHAPTER 4: PRELIMINARY STUDY

4.1 Preliminary Study (Smartphone)

Preliminary study is focused on smartphone methods. Participants need to choose a language they are interested in, after which they can proceed to read the sets of articles for the chosen language. Each article's length of character will gradually expand from 50 to 800 characters. Once complete the reading, participants are required to take note then proceed to answer a few questions related to the article. The language chosen, note taken and the memory retention score will be calculated for each article.

4.1.1 Objectives of preliminary study

i) To investigate the effect of note taking and memory retention using smartphones.

ii) To study the above using written text in Malay, English, Chinese, Tamil and Qur'anic Arabic.

4.1.2 Participants

Participants in this study included 250 participants from various languages which are in Malay, English, Chinese, Tamil and Quranic Arabic. The Participants in this research were from one single location Malaya. Participant's included 25 females and 25 males between all age ranges of 20 to 29, 30 to 39, 40 to 49 and 50 to 59. All participants during this study are either working or studying.

4.1.3 Materials

The material used to take notes in this preliminary study is on the smartphone (Samsung S7 Edge) with default Google Keyboard in 4 types of languages (English, Malay, Chinese, Arabic and Tamil). Besides, the article and questions for each language are shown in figure 4.1, 4.2, 4.3, 4.4 and 4.5 below.

4.1.3.1 Questions for each language

50 Char

Kebanyakan guru melaporkan stres dalam pekerjaan mereka

Soalan:

1. Buli merupakan perkara yang sering dilaporkan oleh kebanyakan guru dalam pekerjaan mereka. (Betul, Salah)

2. Stres merupakan perkara yang sering dilaporkan oleh kebanyakan guru dalam pekerjaan mereka. (Betul, Salah)

---

100 Char

Komunikasi adalah merupakan aspek dan elemen yang penting dalam kefungsian sesebuah organisasi.

Soalan:

1. Aspek yang penting dalam kefungsian sesebuah organisasi adalah dengan berdiam diri. (Betul, Salah)

2. Aspek dan elemen yang penting dalam kefungsian sesebuah organisasi adalah komunikasi. (Betul, Salah)

---

200 characters

Satu daripada beberapa cabaran yang dihadapi oleh sektor ini adalah untuk menarik minat dan juga mengekalkan golongan profesional muda dalam pasaran pekerjaan yang begitu mencabar dari segi persaingannya.

Soalan:

1. Golongan profesional tua merupakan cabaran yang dihadapi sektor ini untuk menarik minat mereka dalam pasaran pekerjaan. (Betul, Salah)

2. Golongan profesional muda merupakan cabaran yang dihadapi sektor ini untuk mengekalkan mereka dalam pasaran pekerjaan. (Betul, Salah)

---

800 characters

Keris bagi bangsa Melayu merupakan satu senjata ampuh yang boleh menyebabkan maut jika digunakan dalam pertarungan. Walau bagaimanapun, tanggapan umum yang mengatakan keris itu adalah senjata untuk membunuh adalah satu tanggapan yang tersasar dari konsep sebenarnya keris itu diilhamkan. Orang Melayu menganggap keris sebagai 'azimat'. Orang Jawa pula mengatakan keris adalah 'tosan aji' atau 'senjata yang mempunyai kuasa ajaib' dan memberikan 'kepercayaan dan keyakinan diri dalam meraih nasib baik dan keberuntungan, terlindung dan selamat' bagi pemiliknya. Oleh itu, satu kekeliruan sesuatu yang dianggap 'azimat' atau 'satu kuasa ajaib' dan 'percaya dan yakin diri' digunakan untuk membunuh, pada hal keris mempunyai nilai seni pembuatan dan kejuruteraan yang tinggi dan tidak ternilai harganya.

Soalan:

1. Pilih pernyataan yang **betul**:
   a) Keris merupakan satu senjata untuk membunuh sama seperti konsep sebenar keris itu diilhamkan.
   b) Keris merupakan satu senjata yang tidak boleh menyebabkan maut jika digunakan dalam pertarungan.
   c) Keris mempunyai nilai seni pembuatan dan kejuruteraan yang tinggi dan tidak ternilai harganya.
   d) Keris harus diwarisi mengikut struktur organisasi sesuatu keluarga.

2. Pilih pernyataan yang **salah**:
   a) Tanggapan bahawa keris itu adalah senjata untuk membunuh adalah satu tanggapan yang tersasar dari konsep sebenarnya keris diilhamkan.
   b) Orang Melayu menganggap keris sebagai 'azimat'.
   c) Orang Jawa mengatakan keris adalah 'senjata yang mempunyai kuasa ajaib'.
   d) Orang Cina menganggap keris memberikan 'kepercayaan dan keyakinan diri dalam meraih nasib baik dan keberuntungan, terlindung dan selamat' bagi pemiliknya.

Figure 4.1: Malay Article Question

50 Char

كبرى الفصائل العاملة فى محافظة إدلب منذ اندلاعها ليلة أمس الثلاثاء

Questions:

1. المكان المذكور فى المقال هو إدلب (صحيح/ خاطئة)
2. المكان المذكور فى المقال هو روسيا(صحيح/ خاطئة)

---

100 Char

وفى ريف حلب الشمالى تجددت الاشتباكات بين قوات ما يسمى مجلس منبج العسكرى وقوات عملية "غضب الفرات"

Questions:

1. القوات المعنية هى "مجلس منبج العسكرى" و"غضب الفرات"(صحيح/ خاطئة)
2. المكان المذكور هو ريف حلب الشمالى(صحيح/ خاطئة)

---

200 Char

وقال مصدر فى المعارضة السورية لوكالة الأنباء الألمانية إن حركة أحرار الشام سيطرت صباح اليوم الأربعاء على مدينة سره بريف إدلب والأتارب بريف حلب، بعد اشتباكات مع هيئة تحرير الشام، كما توسعت المواجهات

Questions:

1. وتحكمت حركة أحرار الشام فى صباح يوم الخميس(صحيح/ خاطئة)
2. المدينة المذكورة أعلاه هى سرمدا(صحيح/ خاطئة)

---

800 char

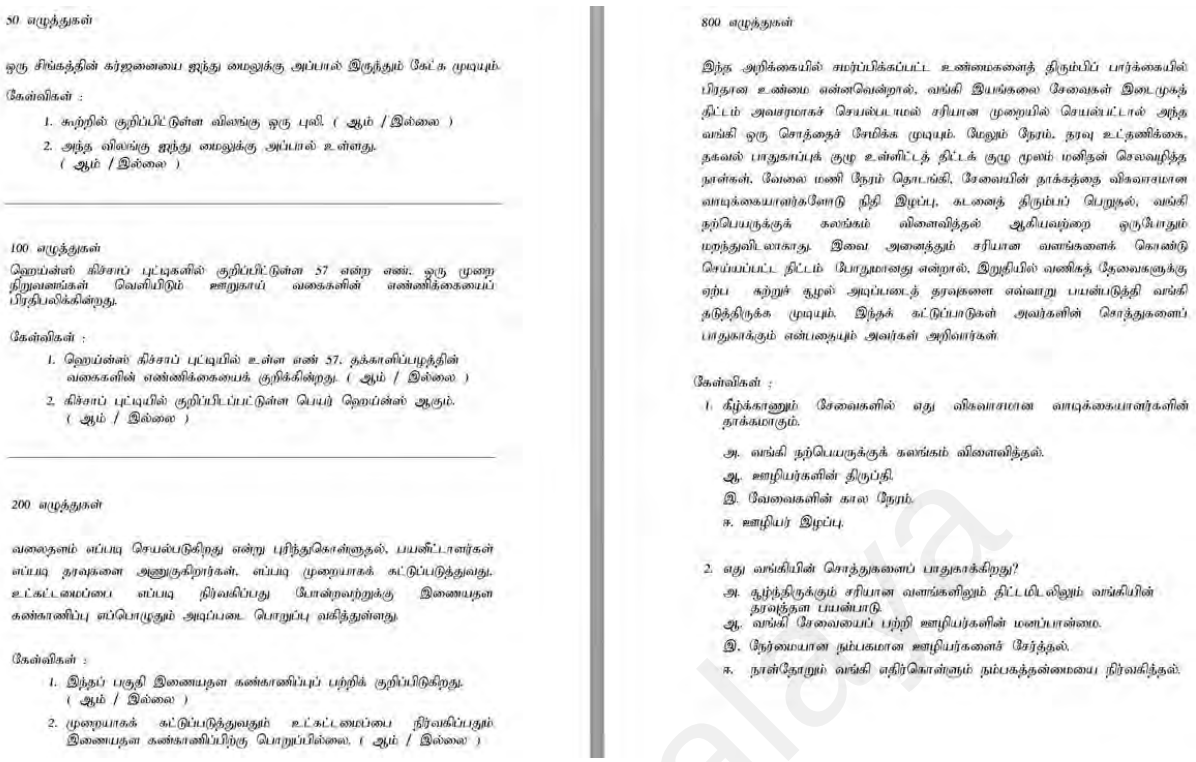
شنت طائرات النظام غارات على مناطق بالغوطة الشرقية مع استمرار الاشتباكات بالمنطقة، بينما سقط قتلى وجرحى بتفجير مفخخة ببلدة أرمناز فى ريف إدلب الغربى، وترافق ذلك مع اشتباكات بين فصائل المعارضة بريفى إدلب وحلب.

ونفذت طائرات النظام صباح اليوم أربع غارات على الأقل على مناطق فى بلدة الريحان قرب مدينة دوما بالغوطة الشرقية، فيما تدور اشتباكات عنيفة بين قوات النظام ومقاتلى المعارضة المسلحة فى محور مدينة عربين، ووادي عين ترما فى الغوطة الشرقية

Questions:

1. أين أطلق النظام الغارات؟
   a. فى مناطق أمريكا الشرقية
   b. فى مناطق شرق غوتا
   c. فى مناطق شرق روسيا
   d. فى مناطق شرق الصين
2. كم عدد القتلى فى غرب إدلب؟
   a. 1 شخص
   b. 2 شخص
   c. 3 شخص
   d. 4 شخص

Figure 4.2: Arabic Article Question



50 எழுத்துகள்

ஒரு சிங்கத்தின் கர்ஜனையை ஐந்து மைலுக்கு அப்பால் இருந்தும் கேட்க முடியும்.

கேள்விகள் :

1. கூற்றில் குறிப்பிட்டுள்ள விலங்கு ஒரு புலி. (ஆம் / இல்லை)
2. அந்த விலங்கு ஐந்து மைலுக்கு அப்பால் உள்ளது.
(ஆம் / இல்லை)

---

100 எழுத்துகள்

ஹெய்ன்ஸ் கிச்சாப் புட்டிகளில் குறிப்பிட்டுள்ள 57 என்ற எண், ஒரு முறை நிறுவனங்கள் வெளியிடும் ஊறுகாய் வகைகளின் எண்ணிக்கையைப் பிரதிபலிக்கின்றது.

கேள்விகள் :

1. ஹெய்ன்ஸ் கிச்சாப் புட்டியில் உள்ள எண் 57, தக்காளிப்பழத்தின் வகைகளின் எண்ணிக்கையைக் குறிக்கின்றது. (ஆம் / இல்லை)
2. கிச்சாப் புட்டியில் குறிப்பிடப்பட்டுள்ள பெயர் ஹெய்ன்ஸ் ஆகும்.
(ஆம் / இல்லை)

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200 எழுத்துகள்

வலைதளம் எப்படி செயல்படுகிறது என்று புரிந்துகொள்ளுதல், பயனீட்டாளர்கள் எப்படி தரவுகளை அணுகுகிறார்கள், எப்படி முறையாகக் கட்டுப்படுத்துவது, உட்கட்டமைப்பை எப்படி நிர்வகிப்பது போன்றவற்றுக்கு இணையதள கண்காணிப்பு எப்பொழுதும் அடிப்படை பொறுப்பு வகித்துள்ளது.

கேள்விகள் :

1. இந்தப் பகுதி இணையதள கண்காணிப்புப் பற்றிக் குறிப்பிடுகிறது.
(ஆம் / இல்லை)
2. முறையாகக் கட்டுப்படுத்துவதும் உட்கட்டமைப்பை நிர்வகிப்பதும் இணையதள கண்காணிப்பிற்கு பொறுப்பில்லை. (ஆம் / இல்லை)

800 எழுத்துகள்

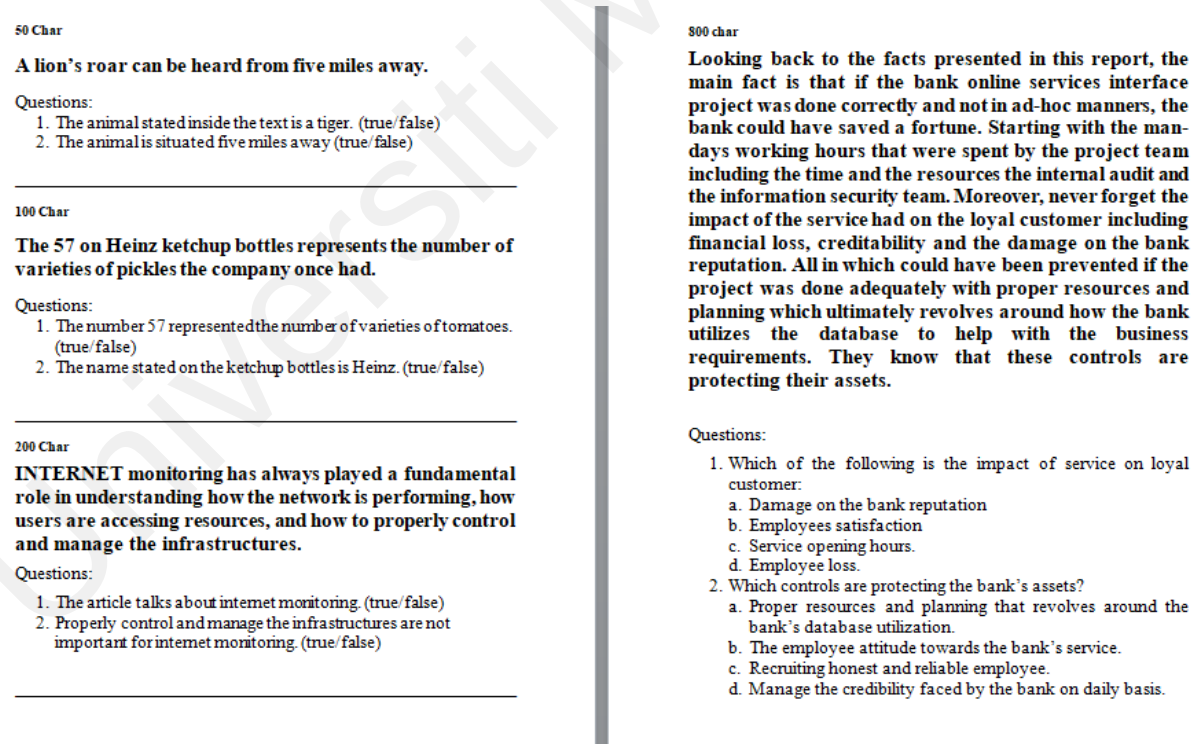
இந்த அறிக்கையில் சமர்ப்பிக்கப்பட்ட உண்மைகளைத் திரும்பிப் பார்க்கையில் பிரதான உண்மை என்னவென்றால், வங்கி இயங்கலை சேவைகள் இடைமுகத் திட்டம் அவசரமாகச் செயல்படாமல் சரியான முறையில் செயல்பட்டால் அந்த வங்கி ஒரு சொத்தைச் சேமிக்க முடியும். மேலும் நேரம், நரவு உட்கணிக்கை, தகவல் பாதுகாப்புக் குழு உள்ளிட்டத் திட்டக் குழு மூலம் மனிதன் செலவுழித்த நாள்கள், வேலை மணி நேரம் தொடங்கி, சேவையின் தாக்கத்தை விகவாசமான வாடிக்கையாளர்களோடு நிதி இழப்பு, கடனைத் திரும்பப் பெறுதல், வங்கி நற்பெயருக்குக் கலங்கம் விளைவித்தல் ஆகியவற்றை ஒருபோதும் மறந்துவிடலாகாது. இவை அனைத்தும் சரியான வளங்களைக் கொண்டு செய்யப்பட்ட திட்டம் போதுமானது என்றால், இறுதியில் வணிகத் தேவைகளுக்கு ஏற்ப கற்றுச் சூழல் அடிப்படைத் தரவுகளை எவ்வாறு பயன்படுத்தி வங்கி தடுத்திருக்க முடியும். இந்தக் கட்டுப்பாடுகள் அவர்களின் சொத்துகளைப் பாதுகாக்கும் என்பதையும் அவர்கள் அறிவார்கள்.

கேள்விகள் :

1. கீழ்காணும் சேவைகளில் எது விகவாசமான வாடிக்கையாளர்களின் தாக்கமாகும்.
   அ. வங்கி நற்பெயருக்குக் கலங்கம் விளைவித்தல்.
   ஆ. ஊழியர்களின் திருப்தி.
   இ. சேவைகளின் கால நேரம்.
   ஈ. ஊழியர் இழப்பு.

2. எது வங்கியின் சொத்துகளைப் பாதுகாக்கிறது?
   அ. சூழ்ந்திருக்கும் சரியான வளங்களிலும் திட்டமிடலிலும் வங்கியின் தரவுத்தள பயன்பாடு.
   ஆ. வங்கி சேவையைப் பற்றி ஊழியர்களின் மனப்பான்மை.
   இ. நேர்மையான நம்பகமான ஊழியர்களைச் சேர்த்தல்.
   ஈ. நாள்தோறும் வங்கி எதிர்கொள்ளும் நம்பகத்தன்மையை நிர்வகித்தல்.

Figure 4.3: Tamil Article Question



50 Char

A lion's roar can be heard from five miles away.

Questions:
1. The animal stated inside the text is a tiger. (true/false)
2. The animal is situated five miles away (true/false)

---

100 Char

The 57 on Heinz ketchup bottles represents the number of varieties of pickles the company once had.

Questions:
1. The number 57 represented the number of varieties of tomatoes. (true/false)
2. The name stated on the ketchup bottles is Heinz. (true/false)

---

200 Char

INTERNET monitoring has always played a fundamental role in understanding how the network is performing, how users are accessing resources, and how to properly control and manage the infrastructures.

Questions:
1. The article talks about internet monitoring. (true/false)
2. Properly control and manage the infrastructures are not important for internet monitoring. (true/false)

---

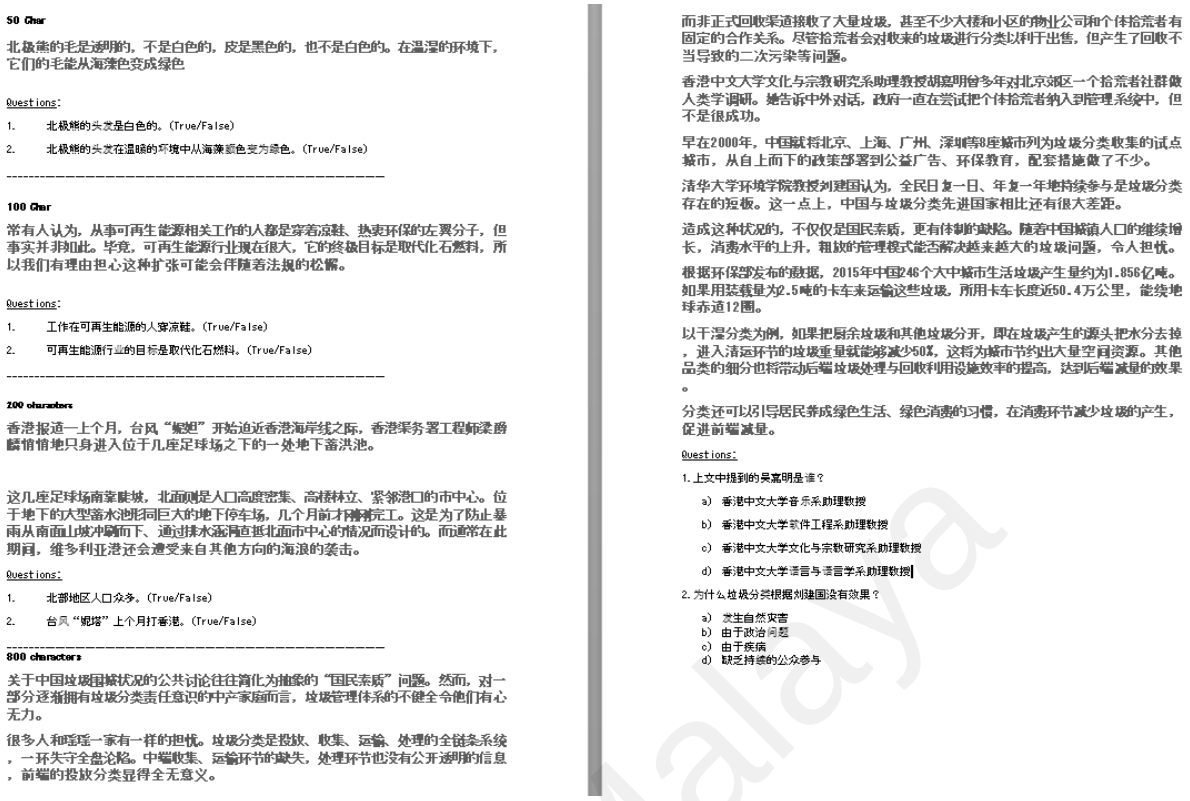
800 char

Looking back to the facts presented in this report, the main fact is that if the bank online services interface project was done correctly and not in ad-hoc manners, the bank could have saved a fortune. Starting with the man-days working hours that were spent by the project team including the time and the resources the internal audit and the information security team. Moreover, never forget the impact of the service had on the loyal customer including financial loss, creditability and the damage on the bank reputation. All in which could have been prevented if the project was done adequately with proper resources and planning which ultimately revolves around how the bank utilizes the database to help with the business requirements. They know that these controls are protecting their assets.

Questions:

1. Which of the following is the impact of service on loyal customer:
   a. Damage on the bank reputation
   b. Employees satisfaction
   c. Service opening hours.
   d. Employee loss.
2. Which controls are protecting the bank's assets?
   a. Proper resources and planning that revolves around the bank's database utilization.
   b. The employee attitude towards the bank's service.
   c. Recruiting honest and reliable employee.
   d. Manage the credibility faced by the bank on daily basis.

Figure 4.4: English Article Question



50 Char

北极熊的毛是透明的，不是白色的，皮是黑色的，也不是白色的。在温湿的环境下，它们的毛能从海藻色变成绿色

Questions:

1. 北极熊的头发是白色的。(True/False)
2. 北极熊的头发在温暖的环境中从海藻颜色变为绿色。(True/False)

---

100 Char

常有人认为，从事可再生能源相关工作的人都是穿着凉鞋、热衷环保的左翼分子，但事实并非如此。毕竟，可再生能源行业现在很大，它的终极目标是取代化石燃料，所以我们有理由担心这种扩张可能会伴随着法规的松懈。

Questions:

1. 工作在可再生能源的人穿凉鞋。(True/False)
2. 可再生能源行业的目标是取代化石燃料。(True/False)

---

200 characters

香港报道一上个月，台风“鲸鲨”开始迫近香港海岸线之际，香港渠务署工程师梁爵麟悄悄地只身进入位于几座足球场之下的一处地下蓄洪池。

这几座足球场南靠畦城，北面则是人口高度密集、高楼林立、紧邻港口的市中心。位于地下的大型蓄水池形同巨大的地下停车场，几个月前才刚刚完工。这是为了防止暴雨从南面山坡冲刷而下、通过排水涵洞直抵北面市中心的情况而设计的。而通常在此期间，维多利亚港还会遭受来自其他方向的海浪的袭击。

Questions:

1. 北部地区人口众多。(True/False)
2. 台风“妮塔”上个月打香港。(True/False)

---

800 characters

关于中国垃圾围城状况的公共讨论往往简化为抽象的“国民素质”问题。然而，对一部分逐渐拥有垃圾分类责任意识的中产家庭而言，垃圾管理体系的不健全令他们有心无力。

很多人和瑶瑶一家有一样的担忧。垃圾分类是投放、收集、运输、处理的全链条系统，一环失守全盘沦陷。中端收集、运输环节的缺失，处理环节也没有公开透明的信息，前端的投放分类显得全无意义。

而非正式回收渠道接收了大量垃圾，甚至不少大楼和小区的物业公司和个体拾荒者有固定的合作关系。尽管拾荒者会对收来的垃圾进行分类以利于出售，但产生了回收不当导致的二次污染等问题。

香港中文大学文化与宗教研究系助理教授胡嘉明曾多年对北京郊区一个拾荒者社群做人类学调研。她告诉中外对话，政府一直在尝试把个体拾荒者纳入到管理系统中，但不是很成功。

早在2000年，中国就将北京、上海、广州、深圳等8座城市列为垃圾分类收集的试点城市，从自上而下的政策部署到公益广告、环保教育，配套措施做了不少。

清华大学环境学院教授刘建国认为，全民日复一日、年复一年地持续参与是垃圾分类存在的短板。这一点上，中国与垃圾分类先进国家相比还有很大差距。

造成这种状况的，不仅仅是国民素质，更有体制的缺陷。随着中国城镇人口的继续增长，消费水平的上升，粗放的管理模式能否解决越来越大的垃圾问题，令人担忧。

根据环保部发布的数据，2015年中国246个大中城市生活垃圾产生量约为1.856亿吨。如果用装载量为2.5吨的卡车来运输这些垃圾，所用卡车长度近50.4万公里，能绕地球赤道12圈。

以干湿分类为例，如果把厨余垃圾和其他垃圾分开，即在垃圾产生的源头把水分去掉，进入清运环节的垃圾重量就能够减少50%，这将为城市节约出大量空间资源。其他品类的细分也将带动后端垃圾处理与回收利用设施效率的提高，达到后端减量的效果。

分类还可以引导居民养成绿色生活、绿色消费的习惯，在消费环节减少垃圾的产生，促进前端减量。

Questions:

1. 上文中提到的吴嘉明是谁？
   a) 香港中文大学音乐系助理教授
   b) 香港中文大学软件工程系助理教授
   c) 香港中文大学文化与宗教研究系助理教授
   d) 香港中文大学语言与语言学系助理教授
2. 为什么垃圾分类根据刘建国说有效果？
   a) 发生自然灾害
   b) 由于政治问题
   c) 由于疾病
   d) 缺乏持续的公众参与

Figure 4.5: Chinese Article Question

4.1.4 Procedure

1. Participants are explained on the experiment to be carried out.
2. Participants are given smartphones before the experiment is started.
3. Participants are then needed to copy according to the words of the first article on the smartphone.
4. The timer is started.
5. The time taken for the participants to completely copy the words are being taken.
6. The number of words missed out when the participant copying is being taken.
7. The participants are then required to answer questions based on the article given.
8. The time taken for the participants to complete the questions is being taken.

9. The percentage of correctness will be taken.

4.1.5 Result

The results collected as shown in figure 7.17-7.21 during the preliminary study were measured using one-way Anova and two-way Anova to find out the impact of memory retention using smartphones to do the test (article) as well as to take notes on different scripted languages.

4.1.5.1 One-Way Analysis of Variance Test Result

a) Note taken in different scripted languages

Table 4.1: Multilingual Note taken (Article test) Descriptives

Descriptives

Memory Retention Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
MALAY	50	373.91	36.780	5.202	363.46	384.37	186	400
CHINESE	50	391.70	3.352	.474	390.75	392.65	385	398
TAMIL	50	380.88	6.511	.921	379.03	382.73	368	393
ENGLISH	50	381.35	20.142	2.849	375.63	387.08	299	399
ARABIC	50	388.48	6.512	.921	386.63	390.33	365	398
Total	250	383.27	20.103	1.271	380.76	385.77	186	400

Table 4.2: Multilingual Note taken (Article test) Anova

ANOVA

Memory Retention Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9758.379	4	2439.595	6.577	.000
Within Groups	90872.594	245	370.909		
Total	100630.973	249			

Table 4.3: Multilingual Note taken (Article test) Multiple Comparisons

Multiple Comparisons

Dependent Variable: Memory Retention Score
Tukey HSD

(I) Language	(J) Language	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
MALAY	CHINESE	-17.787*	3.852	.000	-28.37	-7.20
	TAMIL	-6.967	3.852	.371	-17.55	3.62
	ENGLISH	-7.441	3.852	.303	-18.03	3.14
	ARABIC	-14.569*	3.852	.002	-25.15	-3.98
CHINESE	MALAY	17.787*	3.852	.000	7.20	28.37
	TAMIL	10.820*	3.852	.042	.23	21.41
	ENGLISH	10.346	3.852	.059	-.24	20.93
	ARABIC	3.219	3.852	.919	-7.37	13.80
TAMIL	MALAY	6.967	3.852	.371	-3.62	17.55
	CHINESE	-10.820*	3.852	.042	-21.41	-.23
	ENGLISH	-.474	3.852	1.000	-11.06	10.11
	ARABIC	-7.601	3.852	.282	-18.19	2.98
ENGLISH	MALAY	7.441	3.852	.303	-3.14	18.03
	CHINESE	-10.346	3.852	.059	-20.93	.24
	TAMIL	.474	3.852	1.000	-10.11	11.06
	ARABIC	-7.127	3.852	.347	-17.71	3.46
ARABIC	MALAY	14.569*	3.852	.002	3.98	25.15
	CHINESE	-3.219	3.852	.919	-13.80	7.37
	TAMIL	7.601	3.852	.282	-2.98	18.19
	ENGLISH	7.127	3.852	.347	-3.46	17.71

*. The mean difference is significant at the 0.05 level.

A one-way between subjects ANOVA was conducted to compare the effect of memory retention score on multilingual note taken for article test using smartphones as shown in table 4.1, 4.2 and 4.3 above. There was a significant effect of multilingual note taken on memory retention score at the $p<.05$ level for the four conditions [$F(4, 245) = 6.58$, $p = 0.000$]. Post hoc comparisons using the Tukey HSD test indicated that the mean score for the Chinese language (M = 391.70, SD = 3.35) was significantly different from the Malay language (M = 373.91, SD = 36.78) or Tamil Language (M = 380.88, SD = 6.51). Besides, the Arabic language (M = 388.48, SD = 6.51) was significantly different from the Malay language (M = 373.91, SD = 36.78). However, the Tamil language (M = 380.88, SD = 6.51), the English language (M = 381.35, SD = 20.14) and the Arabic language (M = 388.48, SD = 6.51) did not significantly differ

from the Chinese languages. Taken together, these results suggest that Chinese and Arabic scripted language really do have an effect on memory retention score. Specifically, our results suggest that when participants who took notes using Chinese and Arabic, they had higher memory retention score. However, it should be noted that Malay, Tamil and English do not appear to significantly increase memory retention score.

4.1.5.2 Two-Way Anova

b) Different length of the article characters and multilingual

Table 4.4: Different length of the article characters – Descriptive Statistics

Descriptive Statistics

Dependent Variable: Memory Retention Score

Language	Article Character	Mean	Std. Deviation	N
MALAY	50 char	95.4288	14.55646	50
	100 char	94.4162	10.46883	50
	200 char	94.7370	6.28913	50
	800 char	89.3306	10.31571	50
	Total	93.4782	10.99996	200
CHINESE	50 char	99.0200	.86873	50
	100 char	99.0400	.80711	50
	200 char	97.5000	1.75255	50
	800 char	96.1400	2.45789	50
	Total	97.9250	2.01237	200
TAMIL	50 char	98.3600	1.15635	50
	100 char	94.1600	2.79475	50
	200 char	94.4600	4.16109	50
	800 char	93.9000	4.09704	50
	Total	95.2200	3.74053	200
ENGLISH	50 char	97.5318	7.81625	50
	100 char	95.6382	6.87149	50
	200 char	95.7962	4.88840	50
	800 char	92.3878	7.23481	50
	Total	95.3385	6.99382	200
ARABIC	50 char	98.1600	1.87747	50
	100 char	97.3002	2.52223	50
	200 char	97.1060	1.95957	50
	800 char	95.9152	3.26942	50
	Total	97.1204	2.58003	200
Total	50 char	97.7001	7.50643	250
	100 char	96.1109	6.09662	250
	200 char	95.9198	4.33005	250
	800 char	93.5347	6.64663	250
	Total	95.8164	6.41937	1000

Table 4.5: Different length of the article characters – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: Memory Retention Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5387.918[a]	19	283.575	7.767	.000
Intercept	9180782.509	1	9180782.509	251464.012	.000
Article_Language	2439.595	4	609.899	16.705	.000
Article_Char	2212.977	3	737.659	20.205	.000
Article_Language * Article_Char	735.347	12	61.279	1.678	.066
Error	35779.143	980	36.509		
Total	9221949.570	1000			
Corrected Total	41167.061	999			

a. R Squared = .131 (Adjusted R Squared = .114)

Table 4.6: Different length of the article characters

Multiple Comparisons

Dependent Variable: Memory Retention Score
Tukey HSD

(I) Language	(J) Language	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
MALAY	CHINESE	-4.4468*	.60423	.000	-6.0981	-2.7956
	TAMIL	-1.7418*	.60423	.033	-3.3931	-.0906
	ENGLISH	-1.8603*	.60423	.018	-3.5116	-.2091
	ARABIC	-3.6422*	.60423	.000	-5.2935	-1.9909
CHINESE	MALAY	4.4468*	.60423	.000	2.7956	6.0981
	TAMIL	2.7050*	.60423	.000	1.0537	4.3563
	ENGLISH	2.5865*	.60423	.000	.9352	4.2378
	ARABIC	.8046	.60423	.671	-.8466	2.4559
TAMIL	MALAY	1.7418*	.60423	.033	.0906	3.3931
	CHINESE	-2.7050*	.60423	.000	-4.3563	-1.0537
	ENGLISH	-.1185	.60423	1.000	-1.7698	1.5328
	ARABIC	-1.9004*	.60423	.015	-3.5516	-.2491
ENGLISH	MALAY	1.8603*	.60423	.018	.2091	3.5116
	CHINESE	-2.5865*	.60423	.000	-4.2378	-.9352
	TAMIL	.1185	.60423	1.000	-1.5328	1.7698
	ARABIC	-1.7819*	.60423	.027	-3.4331	-.1306
ARABIC	MALAY	3.6422*	.60423	.000	1.9909	5.2935
	CHINESE	-.8046	.60423	.671	-2.4559	.8466
	TAMIL	1.9004*	.60423	.015	.2491	3.5516
	ENGLISH	1.7819*	.60423	.027	.1306	3.4331

Based on observed means.
The error term is Mean Square(Error) = 36.509.

*. The mean difference is significant at the .05 level.

A two way analysis of variance was conducted on the influence of two independent variables (article language and different length of character of article) on memory retention score as shown in table 4.4, 4.5 and 4.6 above. Article language included five types (Malay, Arabic Chinese, Tamil and English) and different length of character of article consists of four level (50, 100, 200 and 800 char). All effects where statistically significant at the .05 significance level except for interaction effect (article language * character of article). The main effect for article language yielded an F ratio of F(4,980)

= 16.7, p<.001, indicating a significant difference between Malay (M = 93.48, SD = 10.99), Chinese(M = 97.93, SD = 2.01), Tamil(M = 95.22, SD = 3.74), English(M = 95.34, SD = 6.99) and Arabic(M = 97.12, SD = 2.58). The main effect for article character yielded an F ratio of F(3,980) = 20.2, p<.001, indicating that the effect for article character was significant, 50 char(M = 97.70, SD = 7.51), 100 char(M = 96.11, SD = 6.09), 200 char(M = 95.92, SD = 4.33) and 800 char(M = 93.53, SD = 6.65). The interaction effect was not significant, F(12,980) = 1.68, p>.05. Taken together, these results suggest that article language and article character do have an effect on memory retention score separately. Specifically, our results suggest that interaction between article language and character does not appear to affect memory retention score.

4.1.6 Discussion

One-way Anova and two-way Anova test was conducted to find out the impact of memory retention using smartphones to do the test (article) and to take notes on different scripted languages. The 1st, 2nd, 3rd and 4th article consisted of 50 students from the respective article in Arabic, Malay, Chinese, Tamil and English. The different length of characters of an article while taking notes based on each language had a significant impact on the memory retention score regardless of the language of the article. The memory retention score drops as the length of the characters rises. Participants struggle to remember when the different length of characters increases. The different scripted languages had a significant impact on the memory retention score. The Chinese group has the highest score compared to Arabic, Malay, and English and Tamil groups in all four articles. Whereas the Malay group has the lowest score compared to Arabic, Chinese, and English and Tamil groups in all four articles. The fluency and experience of participant's on scripted languages can be the factor for the score. Even though Malay and English are very common among the participants, it's not the first language for all of the participants. The difficulties of understanding, analyzing, and reading

different scripts of language which is not the participants' first language can also cause the results of the Malay group article to be the lowest. The gender could also be a factor for the score as males and females differ in memory retention. Age should be considered as well since past research said memory capacity decreases when we age (Peters, 2006). The topic and content of the article and video for each languages also do have contibution to the results of the memory retention score.

4.2 Summary

This chapter presents the overall preliminary study as well as the results of this analysis, which were derived from the various analyses. The chapter begins with the quantitative preliminary questions based on multilingual, analysis section, normality tests were carried out to ensure sample normality, and descriptive analyses were carried out for each objective and variable. According to the data gathered from the activities conducted, fluency and experience of participant's on taking notes for different types of scripted languages can be the factor for the score. The difficulties of understanding, analyzing, and reading different scripts of language can cause the difference in the time taken to complete the test. The results can be affected if students did not fully understand the instructions of the test. Concentration, focus, and the environment are potential for distractions which may lower test results. From this chapter it has been proven that note taking methods play an important role in memory retention for the students and the importance of note taking in the classroom.

CHAPTER 5: MODEL DESIGN FOR NOTE TAKING IN E-LEARNING

The model design of note taking is developed and elaborated to assist in the development of an effective learning platform. Model design, formula design, system design, interface and component design, and interaction diagram are then used to flesh out the prototype design.

5.1 Rational of Model Design

The visual and text based note taking are to support learners in multilingual dimensions so that note taking is not only text-based since in a preliminary study found some scripts like Arabic and Chinese are slower to type and prone to error. Text note taking is common and most of the students are using this method during learning. During the preliminary study, multilingual test results show that participants have difficulties understanding, analyzing, and reading the different scripts of languages. With audio, the results are faster with improved performances. Hence, audio has been chosen for the study. Visual or drawing note taking has been proven that can help capture attention and makes the learning process more interesting and understandable.

Instead of supplying learning technology, students' increased access to devices has contributed to the proliferation of Bring Your Own Device (BYOD) strategies by educational institutions. An advantage of BYOD is that learners are likely to be more comfortable with better skills in using their own devices (Murphy, Farley, Lane, Hafeez-Baig & Carter, 2014). The use of institutional systems, networks, and services is no longer limited to students (Traxler, 2016). Further, distance students have the ease of relying on BYOD or other options to access devices for learning. In 2011, Open University of Hong Kong conducted a survey of the usage of mobile devices for learning found that 56 % of students had two or more mobile devices (Cheung, 2012). Based on the survey of the use of e-readers, tablets, and smartphones, Open University

(United Kingdom) found in 2013 that 50% of students had access to a tablet and 37% had access to an e-reader (Cross, Sharples, & Healing, 2015).

Upload features allow users to upload files from the lecture or other learning platforms into one place. Through cloud services and social networks, each individual with a medium such as laptops or smartphones and a network can create, discuss, and share knowledge, images, opinions, and ideas. However, it is not just the medium itself that is essential for learning, as it is difficult to distinguish the medium from its related services, such as instant messaging, social networking, cloud storage and other services (Traxler, 2016). Students can switch seamlessly between various learning environments with the ability of these technologies. By allowing more flexibility in physical locations and time for learning and encouraging collaborative and active learning, multiple devices can increase learning effectiveness (Cheung, 2012).

Word formatting features which helps in making a good note and increases the memory retention of the students. Study by Dzulkifli, and Mustafar (2013) found that color plays an integral role in our visual experiences. Color coding is capable of relaying information and can be very successful in the performance of learning and memory. The model is designed in a way to support color coding on notes by having font color and text highlighter color. Color-coding is a nuanced way of organizing the information that you need to learn. Some colors have been correlated in the brain with certain functions. The color green, for instance, could allow for long-term focus and clarification of certain concepts. Blue is correlated with improved efficiency. Research has been found to support the preservation of information through all these colors. In addition, bullets and numbers play an important role in note-taking as well. Notes should be taken in a manner that more explicitly conveys information in a visually pleasing way. Bullets and numbering feature assists students in concentrating, understanding the information, summarizing the ideas and arguments in the text.

Furthermore, bullets and numbering allows students to focus on the relevant points of the purpose and creates well-organized notes that help the writing process much more efficiently.

This model design is focusing on exploring how the different scripted languages could affect memory retention. Malaysia is a multicultural society. The thesis of Asaly-Zetawi and Lipka (2019) research, which claims that first-language students created higher-quality notes than second-language students, can also be used to facilitate multi-language adaptation.

Anyone would contemplate in their mother tongue, therefore feeling more at ease while speaking their language. For example, a Malaysian will be able to speak Malay more fluently than English and therefore his note taking skills are much more effective for him when he takes it down in Malay rather than English. Also, everyone is not proficient in widely spoken languages. There are even options at the school level for choosing the first language, second and third language. Moreover, in the report, it was examined that the note taking accuracy for each language is different, depending on the linguistics ability.

Okal (2014) offers a brief theoretical survey of the practices of multilingualism (speaking more than one language competently), its effects, its advantages in education and debates on the best ways to accomplish it in education. The linguistic implications include the lingua franca development, the mixed languages production in a linguistic environment, the enhancing cross-cultural strategies and communication skills for communication skills. The benefits of multilingual education activities include the development and appreciation of cultural knowledge, adding academic and educational value, enhancing imagination, social adaptation and the appreciation of local languages.

About a billion people in the world are known to speak more than one language fluently. This increased number of speakers is likely to be due to the ideals of regionalism and internationalism that many countries now adopt, especially in the fields of trade and trade, innovation, and technological advances. Multilingualism offers an insight into the comprehension of various cultures and perspectives, thereby being multicultural in nature. A study by the American Council on Education (ACE) found that speaking another language is importance in succeeding in the global economy (Barasa, 2005).

5.2 Model Design:

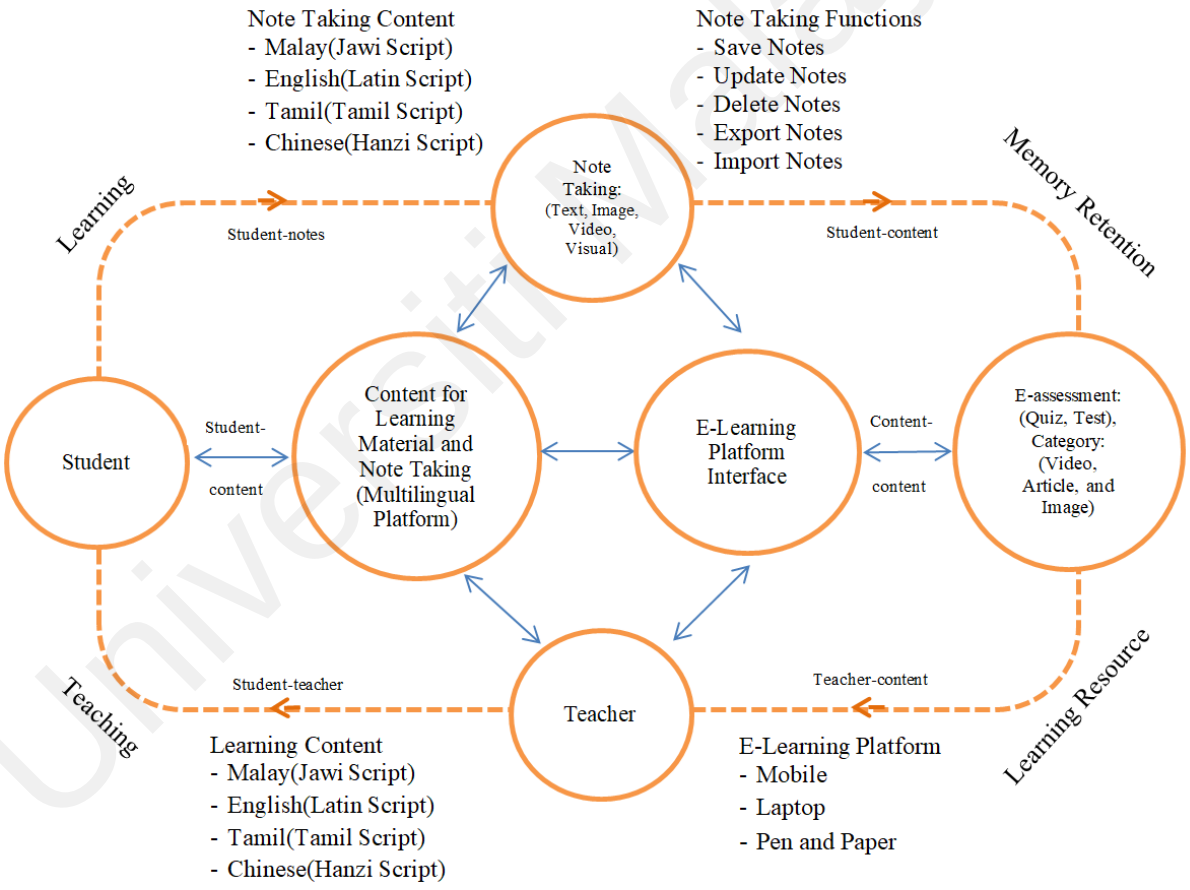


Figure 5.1: Model Design of Note Taking in E-learning platform

The model above is created based on Anderson (2008) model as shown in figure 2.1. The model of note taking in the E-learning platform as shown in figure 5.1 is designed based on the student-content where the model consists of learning resources such as lecture articles and lecture videos which is uploaded by teachers. Moreover, the model

allows students to take notes in text and visual drawing based on student-notes with a rich text editor such as headings, sub-headings, bullets, list and color to make the notes more organized. Besides, the model allows students to save the notes in text, image and video link to refer to at a later date. With the existence of online storage service, it is possible to store lecture content and student notes in one platform. Although storing on an e-learning platform is not common in recent years, the cost of online storage is expected to decrease as technology advances, allowing for larger storage and better encrypted algorithms. There are many advantages of online storage services such as invisibility with no physical presence, security wise it encrypt the data, reduce cost by providing ample storage space in the cloud for a low monthly fee, automation, accessibility, syncing, sharing, collaboration, layer of data protection and recovery (Nielsen, 2013). Furthermore, the model is designed based on the student-teacher by providing the learning resource such as article, video and test, setting the timeline, and creating the space to learn.

Teacher-content – The learning materials such as worksheets, articles, videos, e-textbooks and others resources in multilingual script such as Hanzi, Tamil, Latin and Jawi provides the core information to students which offers better experience, understanding and learning. An educational video, may bring new insights to a learner, while an appealing worksheet may provide new opportunities to practice a new skill learned in online learning platform. The lecture notes, video and slides will be uploaded by teachers as how the current e-platform works. Students will access, examine, absorb, and refer to a deliberate and full collection of teaching materials as they progress through a course on an e-learning platform. Learning materials can help learners achieve greater success by assisting them in their learning.

Student-content - The learning resources (articles, videos, assessments, evaluation and multilingual) involved in the acquisition of new skills and knowledge and how to

engage those mechanisms to encourage and facilitate learning. Students have many different learning styles and most of them can shift their styles in relation to the subject being studied but most also have a preferred style that works best in conjunction with their own talents, aptitudes and "mental wiring." The primary learning styles that exist are visual, auditory, and physical learning.

Student-notes - Information is preserved in human memory in a variety of ways, but the most common methods include active learning, repetition, and recall. Data that has been encoded and stored in memory storage is frequently forgotten. A word, key or points which is seen in lecture can be stored if it is encoded into a sound, a visual or a meaning. One can retrieve information stored in the memory if they have encoded properly. It includes scientific inquiry for collecting original information, organizing and properly storing information. Some models provide the learners with information and concept, some emphasis concept formation and hypothesis testing and still others generate creative thinking. Moreover, note-taking content contains a range of scripts, including Jawi, Latin, Tamil, and Hanzi, allowing students to take multilingual notes in using mobile, laptop and pen and paper in E-learning platform according to their preferences. Additionally, this model have save, delete, update, export and import note functions to ease the note taking process and learning in E-learning platform.

Student-teacher - The instructor set the stage by providing the connected learning resource article, setting the timeline, and creating the space to learn. Sharing ideas and resources with students during learning helps to stretch students' thinking and makes them go in one direction. The nature of the topic, learning medium and scripted language will direct the teacher to what model of teaching s/he must select for teaching the concerned topic. The studenets and teachers can access the E-learning platform using web in any platform such as mobile and laptop.

5.2.1 System Design

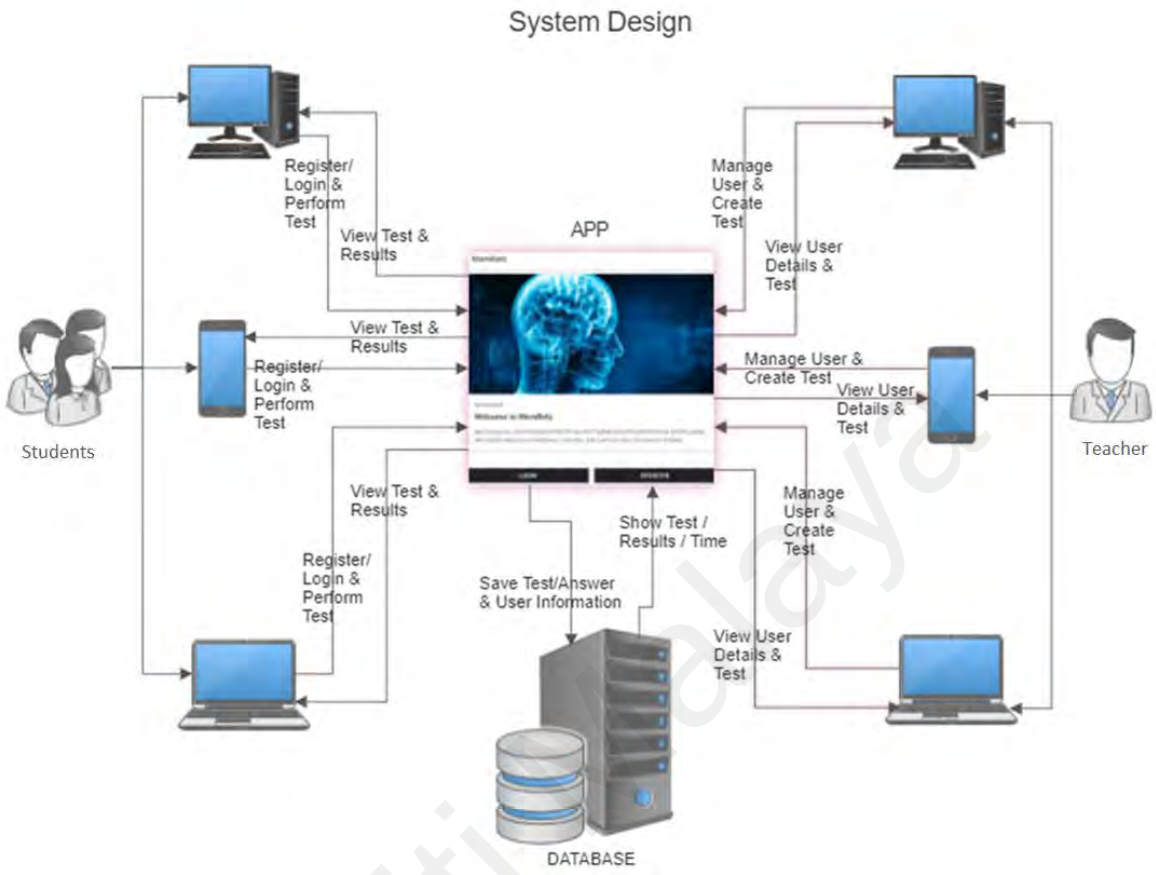


Figure 5.2: System Design

The figure 5.2 above shows the system design in e-learning platform (MemRetz App).

5.2.1.1 System Flowchart

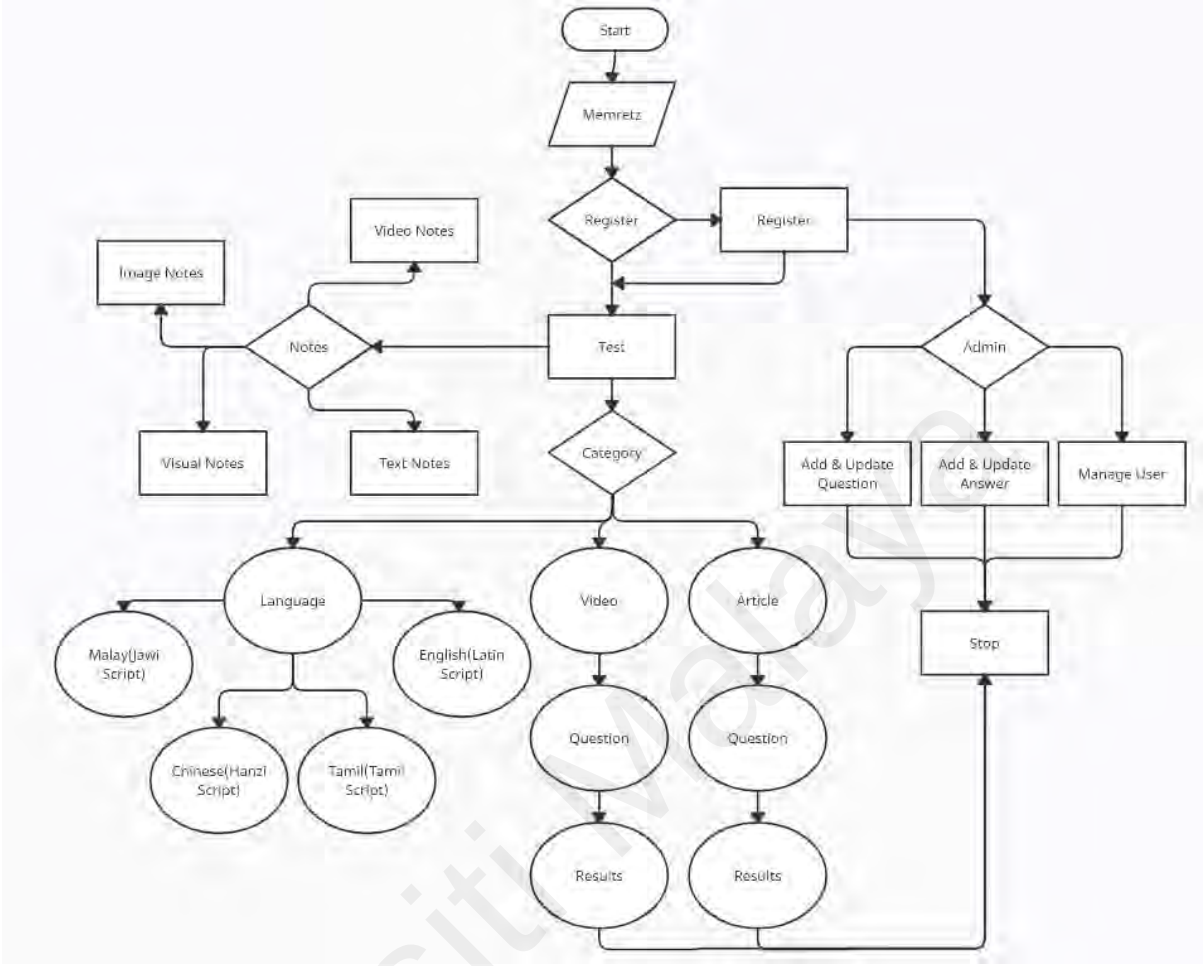


Figure 5.3: System Flowchart

The figure 5.3 is the system flowchart of note taking in E-learning (MemRetz App)

5.2.1.2 Component Diagram

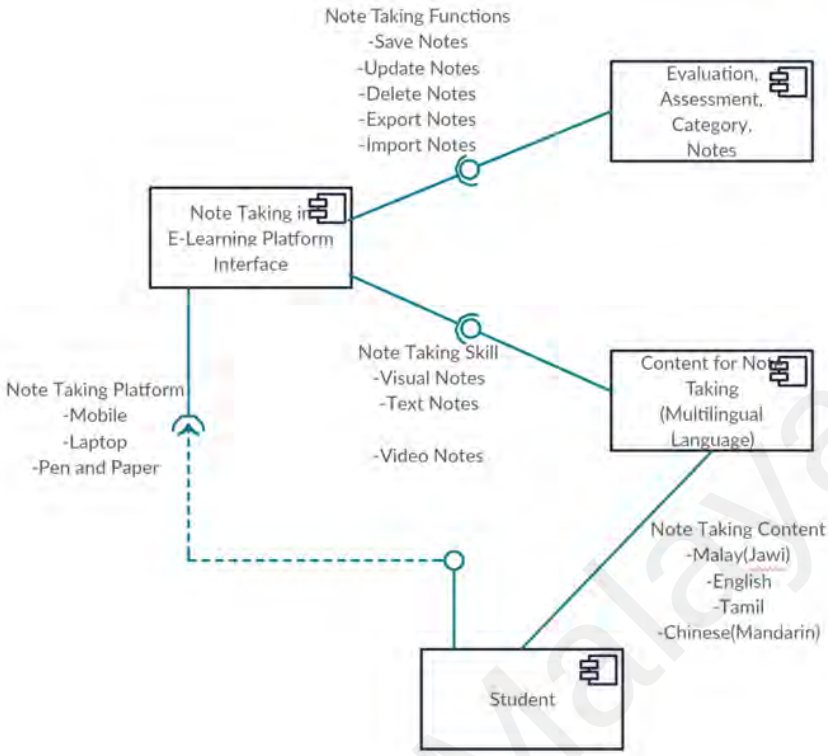


Figure 5.4: Component Diagram

The figure 5.4 above is the component diagram of note taking in E-learning (MemRetz App)

5.2.1.3 Process Model

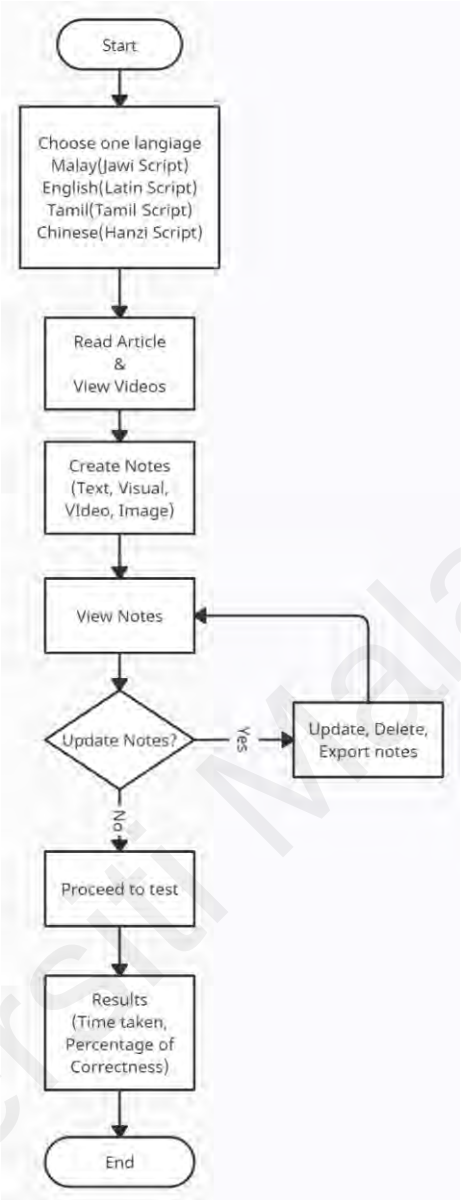


Figure 5.5: Process Model

The figure 5.5 above is the process model of note taking in E-learning (MemRetz App)

5.2.1.4 Use Case

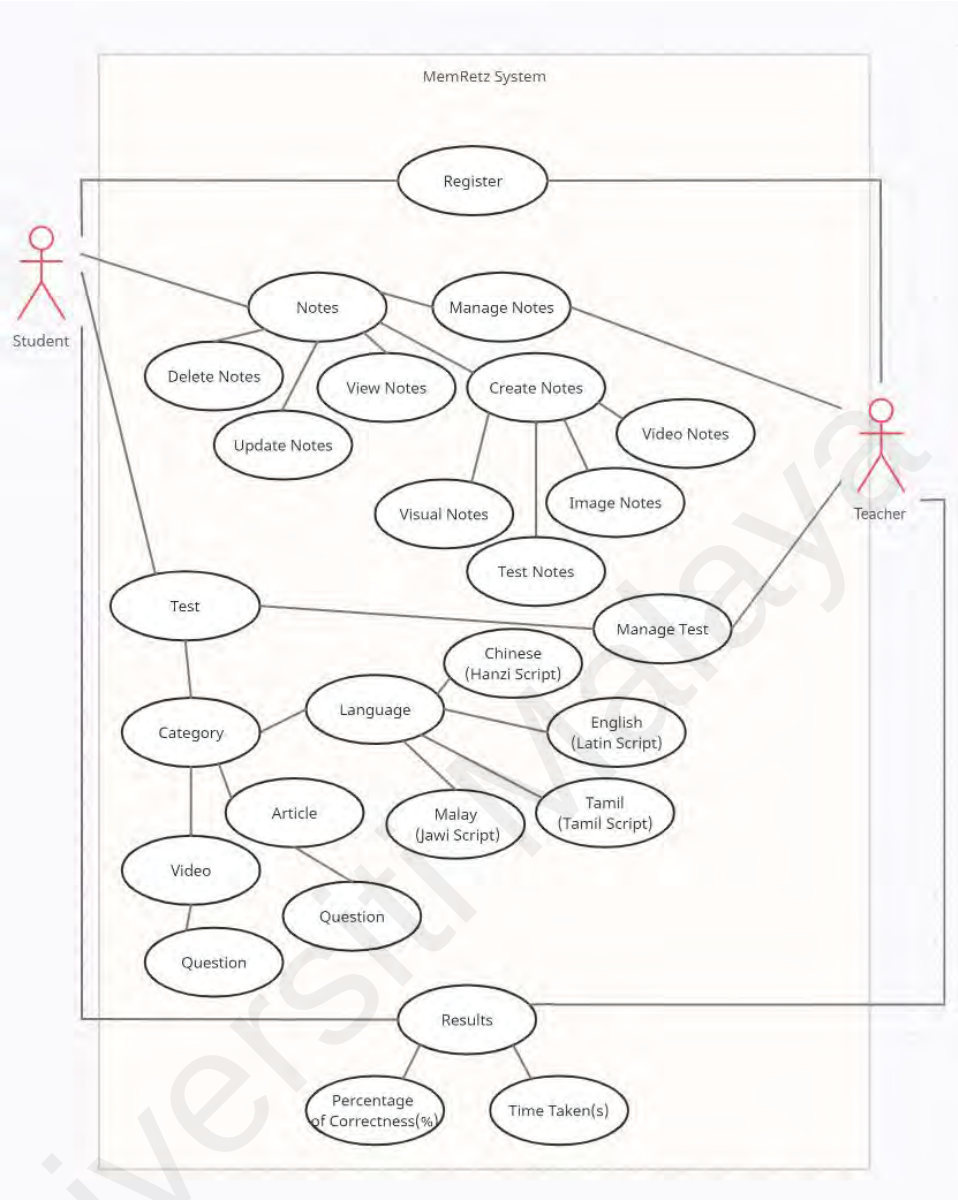


Figure 5.6: Use Case Diagram for the Model

The figure 5.6 above is the use case diagram of note taking in E-learning (MemRetz App).

5.2.1.5 Entity Relationship Diagram

Table Names which is user information, test and result information and corresponding attribute names based on the entity-relationship diagrams shown in figure 5.7 below.

Table Names and corresponding attribute names based on the entity-relationship diagrams shown above.

- Result Information – Memory Retention Score (Time Taken, Percentage of Correctness), Graph
- Notes Information – Visual, Text, Image, Video
- Test Information – Category, Language, Question, Answer
- Student Information – User ID (PK), Username, User Age, User Password, User Email, User Race, User Religion, User Education Level.

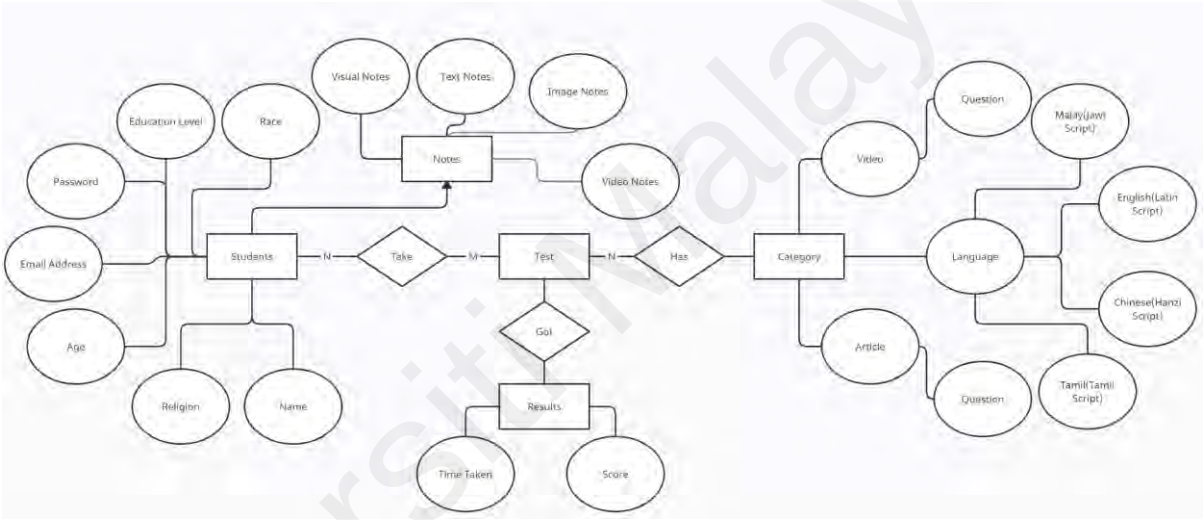


Figure 5.7: Entity Relationship Diagram

5.2.1.6 Database Overview

To manage all of the data, the MemRetz framework requires a firebase (database) with two collections: user and test. Table 5.1 shows them in detail:

Table 5.1: Database Table

User	
Name	Type
id(pk)	varchar (30)
firstName	varchar (500)
lastName	varchar (500)
age	int (2)
education	varchar (28)
email	varchar (28)

Test	
Name	Type
id(pk)	varchar (30)
Q1_Answer	varchar (500)
Q2_Answer	varchar (500)
marks	int (10)
time_taken	Time

Notes	
Name	Type
id(pk)	varchar (30)
note	varchar (5000)

5.2.2 Class Diagram

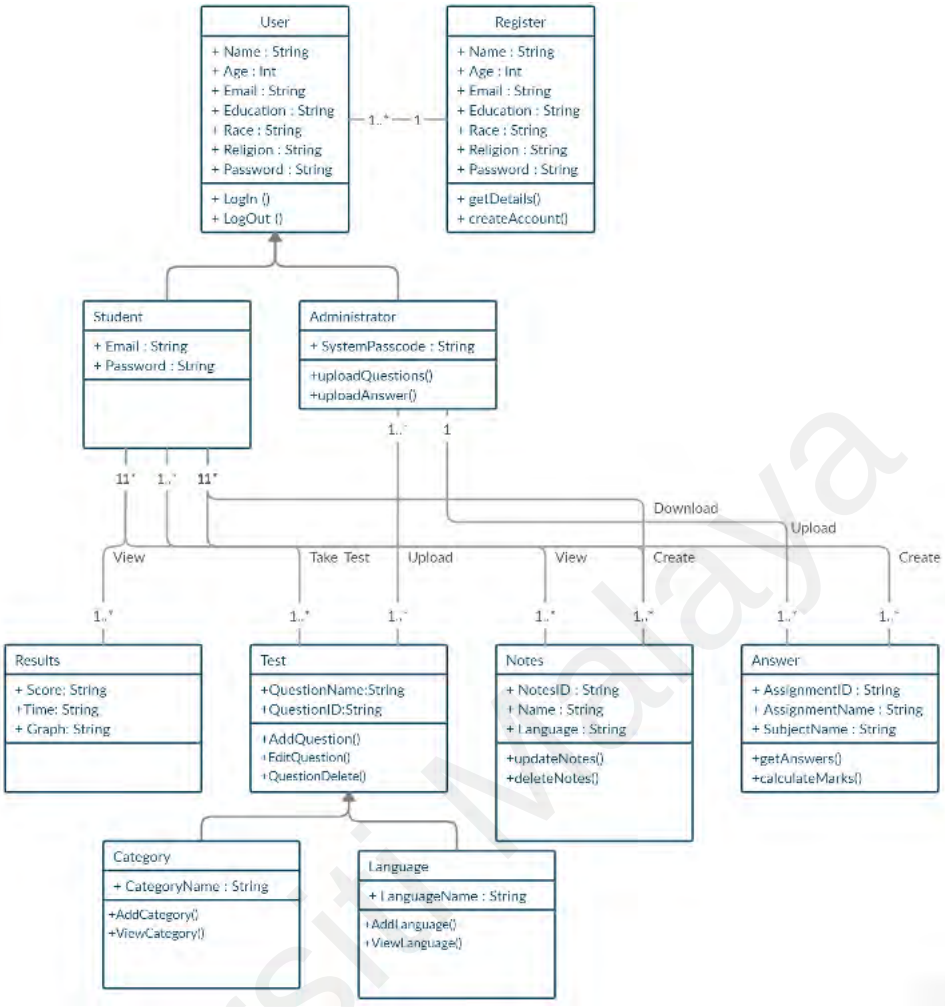


Figure 5.8: Class Diagram

The figure 5.8 above shows the class diagram of the note taking in e-learning platform (MemRetz App).

5.2.3 Interaction Diagram

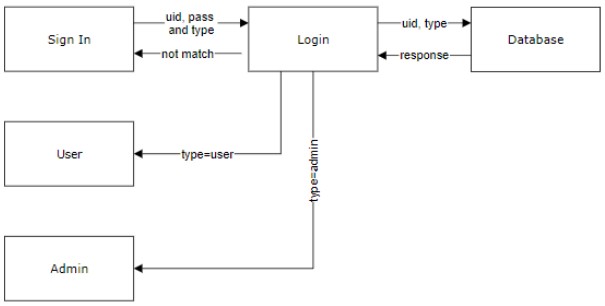


Figure 5.9: Interaction Diagram for Login process

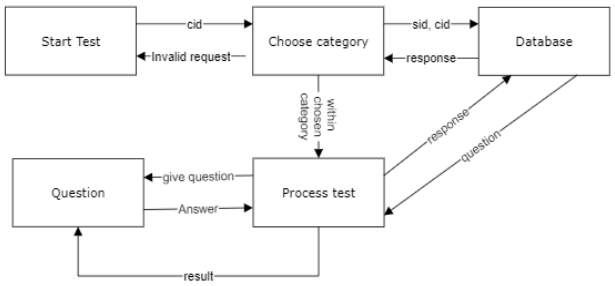


Figure 5.10: Interaction Diagram for Test process

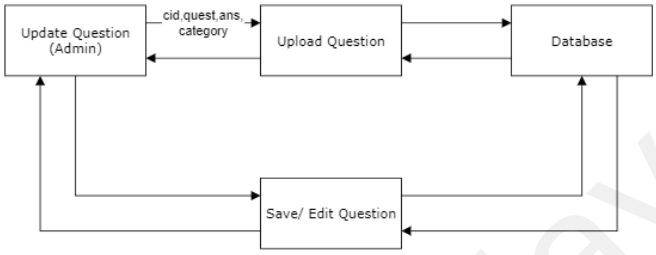


Figure 5.11: Interaction Diagram for Update Question process

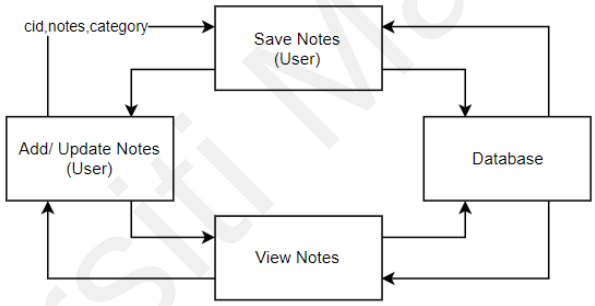


Figure 5.12: Interaction Diagram for Add/Update Notes process

The figure 5.9, 5.10, 5.11 and 5.12 above is the interaction diagram of note taking in E-learning (MemRetz App)

5.2.3.1 User Interface Component

- **Input Controls**: checkboxes, radio buttons, dropdown lists, list boxes, buttons, toggles, text fields, date field as shown in figure 5.13 below.

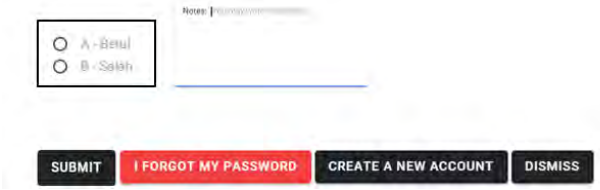


Figure 5.13: Interaction Diagram

- **Navigational Components**: breadcrumb, slider, search field, pagination, slider, tags, icons as shown in figure 5.14 below.

Figure 5.14: Navigational Diagram

- **Informational Components**: tooltips, icons, progress bar, notifications, message boxes, modal windows as shown in figure 5.15 below.

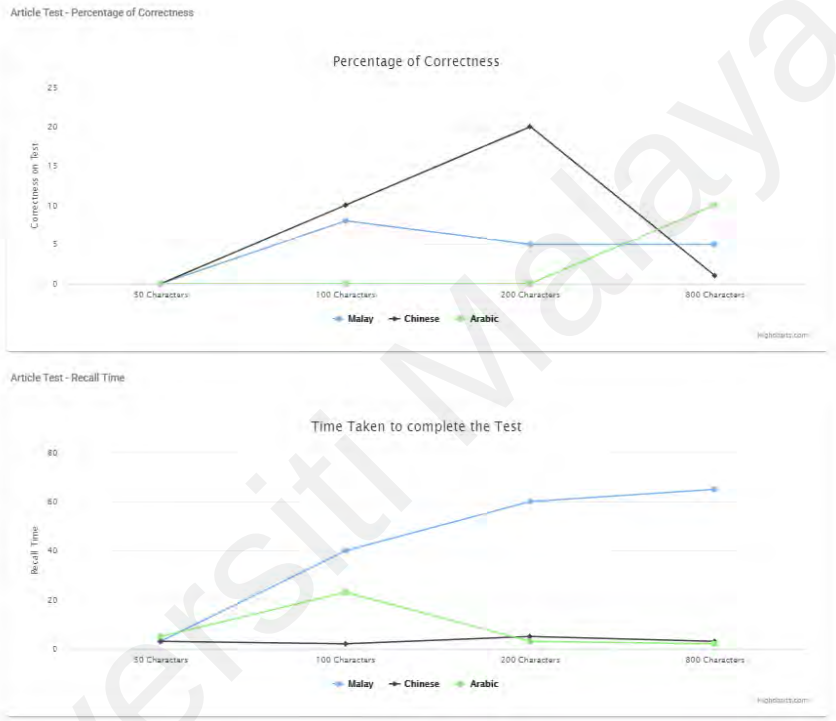


Figure 5.15: Informational Diagram

- **Containers**: Accordion as shown in figure 5.16 below.

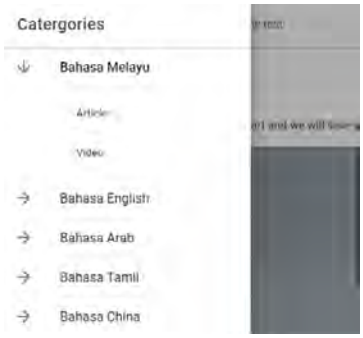


Figure 5.16: Container Diagram

5.2.4 Interface and Component Design

The interface design of the prototype created in the design phase of this chapter is presented in Table 5.2.

Table 5.2: Explanation of MemRetz App

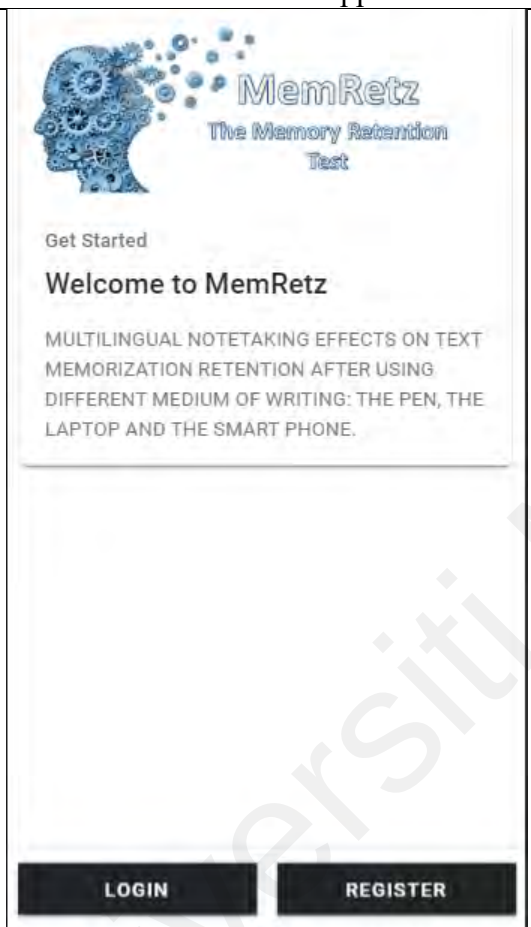
Interface of App	Explanation
	Home page where users need to login or register before using the app.
	Login page where users need to fill up email and password.

Table 5.2: Continued

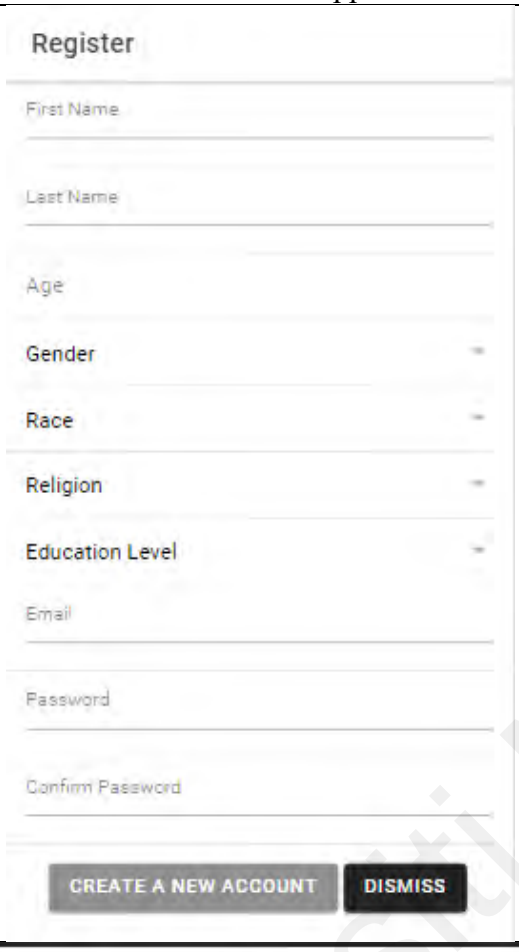
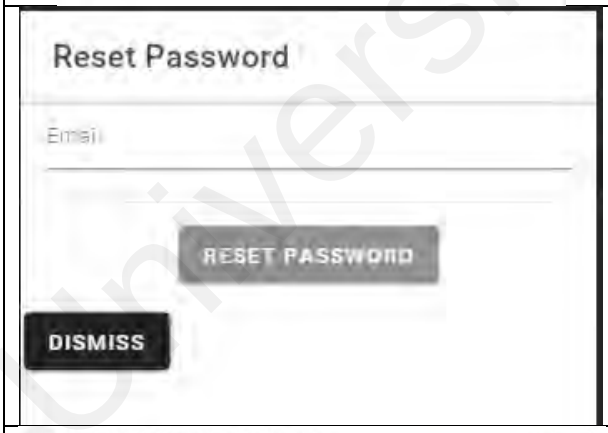
Interface of App	Explanation
	Register page where user needs to fill up user details and password. All the fields are compulsory and user are required to specify first name, last name, age, email address and password manually. User required to choose the gender, race, and religion and education level from a selection of a set of predefined values. The password format is minimum length of 6 and it will be saved in an encrypted format.
	Reset Password page where users can key in their email to get temporary code to reset their password if forgotten.
	Category page where users can navigate back to the Test Page by clicking the Go Back button. The test rules will be given here with more details regarding the test. Users need to click the category button on the top left of the screen to choose the category of the test.

Table 5.2: Continued

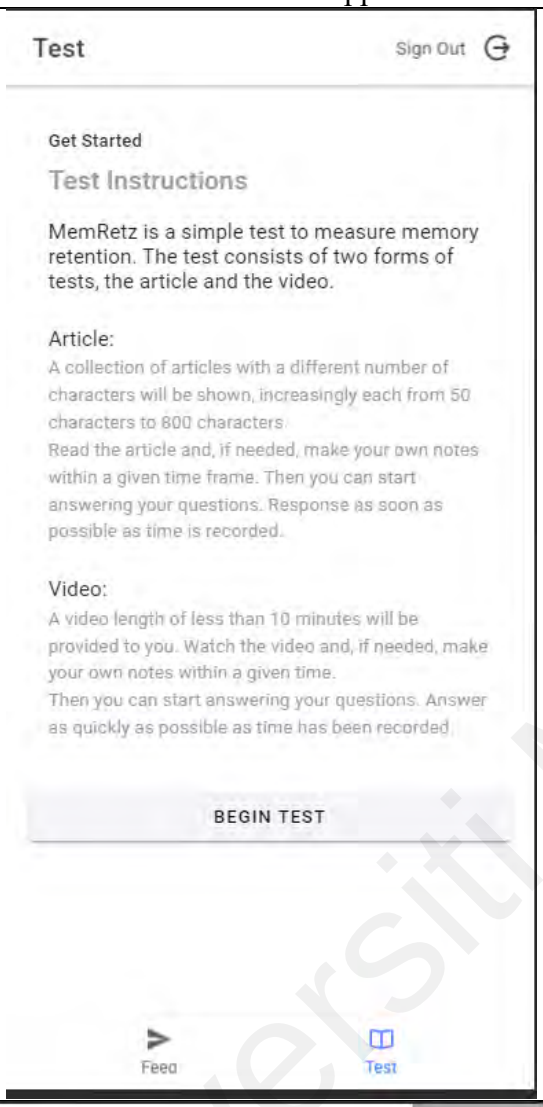
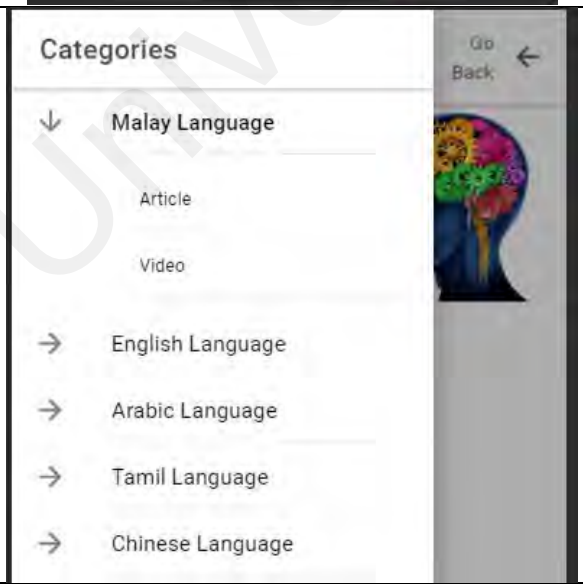
Interface of App	Explanation
	Test Page where users can see a summary of the test instruction related to the test before beginning the test. To begin the test user, need to click the Begin Test button. Users can sign out from this app by clicking the Sign Out button.
	The category tab contained 5 languages with a sub tab of article and video. Users need to click on the category they are interested in to begin the test.

Table 5.2: Continued

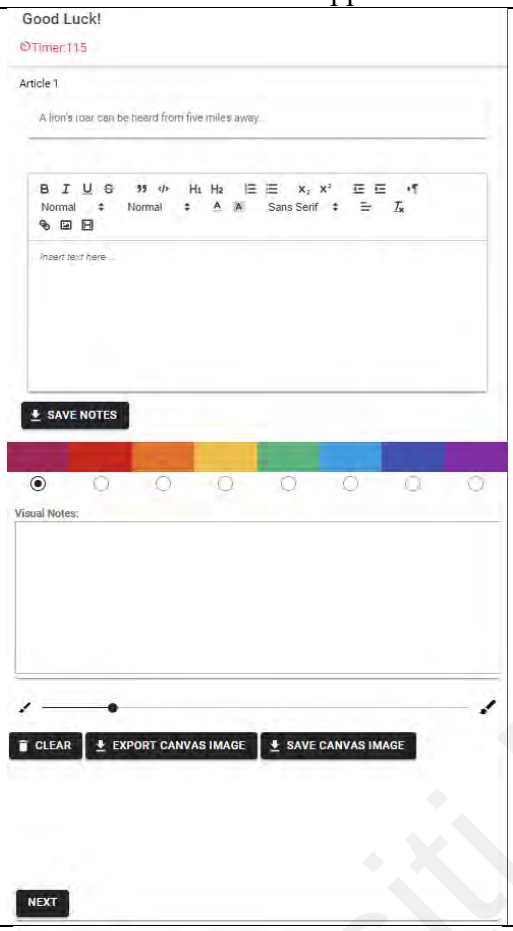
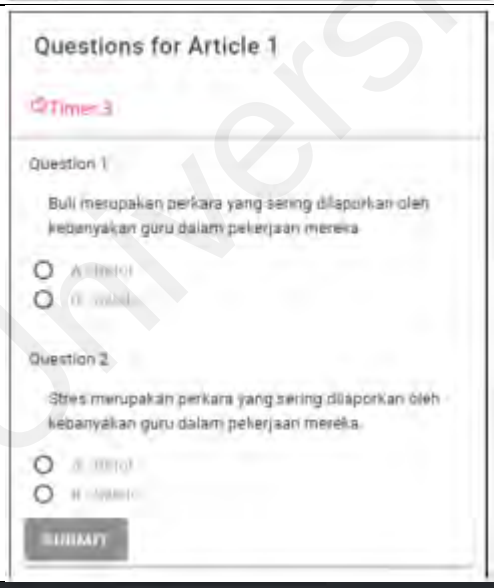
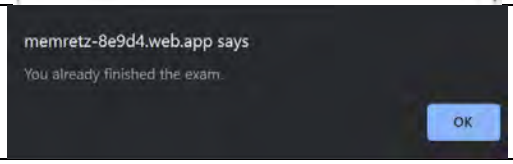
Interface of App	Explanation
	Article Category Page where an article will be displayed. Users can type their notes in the text box given. Time will start once the test begins and will end once the Next button is pressed. Next button will navigate to questions related to the article. All the notes taken will be saved in the database. Word formatting tools which is one of the features which helps in memory retention.
	Question Page where user needs to answer according to the article given on the previous page. Time taken will run and stop once the submit button is clicked. All the answers will be saved with the time taken to complete the test in the database.
	This alert message will prompt when users try to redo the exam which has been taken previously. Users are allowed to do only one category at once.

Table 5.2: Continued

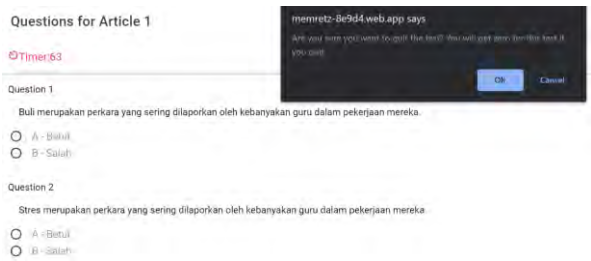
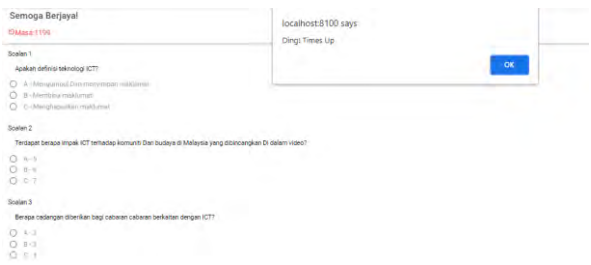
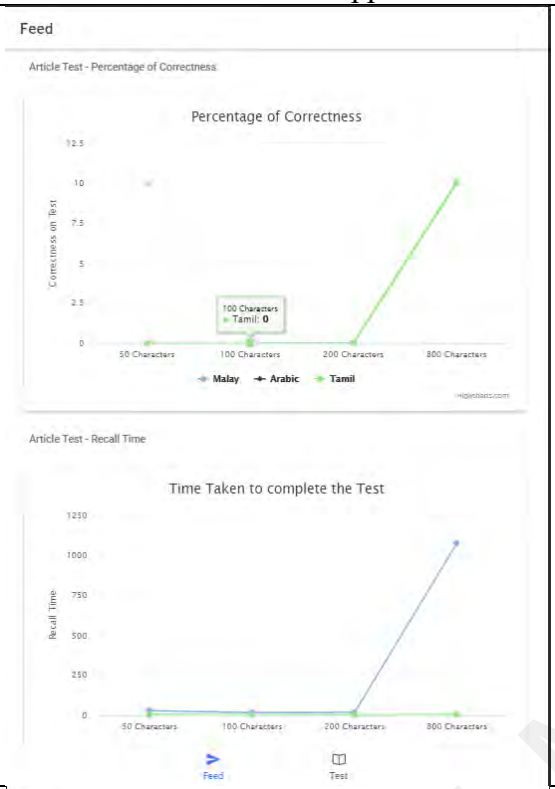
Interface of App	Explanation
	Users will get an alert message when they try to navigate to the previous page after the test begins. Users may click the cancel button and resume the test or click the ok button to quit the exam. By clicking ok the user will get 0 for the test.
	Video Category Page where the user is required to watch a video and make their own notes if required on the text box given. Once completed, users can click Ready!!! Let's Start the Test button to navigate to the question page related to video watched.
	This is an alert message which will prompt when the time is up to complete the test. The maximum duration is only 5 minutes for each test.

Table 5.2: Continued

Interface of App	Explanation
	This is the feed page where the user is navigated once the test is completed. In this page users can view the graph of memory retention score (percentage of correctness and time taken to complete the test) for each language and category.
	This is the note page where users can view the notes created during the test for chosen language and category.

5.2.5 Model Diagram

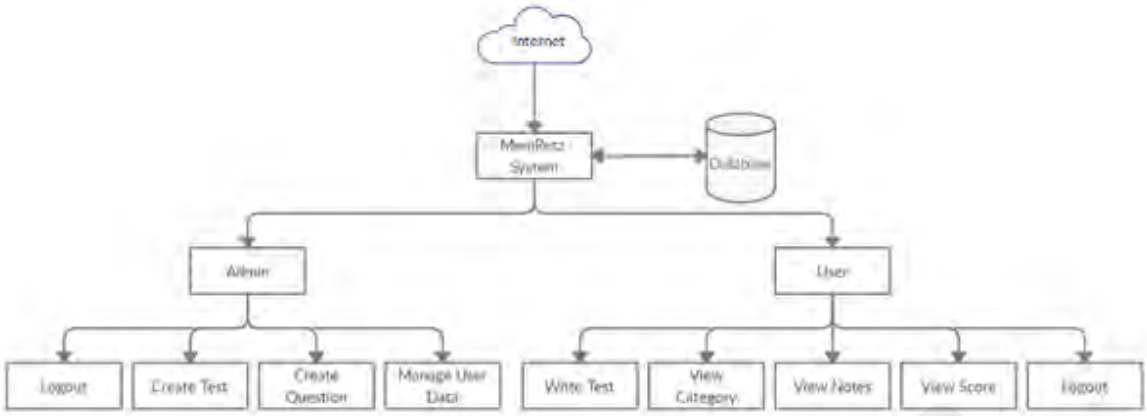


Figure 5.17: Model Diagram of MemRetz System

The figure 5.17 above is the model diagram of note taking in E-learning (MemRetz App)

5.2.6 Formula Design

The aim of this MemRetz system is to find out the best method of note taking (pen-paper, smartphone and laptop). Admin is responsible for registration of the participants. Admins define the number of questions and categories, time of the quiz, answer for the quiz, etc. Admins are responsible for adding and editing questions according to the category.

According to the category chosen the system will generate questions for participants. To generate the next question, the system will check the time taken, previous question and answer submitted by the participants. The participant is required to choose one language to do the test. Participants can appear in the quiz when his/her time slot is started. Before attending a quiz participant might be registered for that course by the admin of the institute. For the same quiz a category participant is not allowed to redo the test. The time taken to complete the test is limited to 300 seconds. The score for each test is then calculated. At the end of a quiz they can see their score on memory retention.

5.3 Tool Design

The design of the MemRetz App is based on class diagram, formula design, system design, interface and component design, user usability.

5.4 Implementation

The following steps of the implementation phase of a software development life cycle in figure 5.18 below will be followed in this project.

Figure 5.18: Software Development Process

5.4.1 Tools

For the purpose of this study, a questionnaire and semi-structured interview questions were used to observe participants' experience on method of note taking and to find out the best emphasis method of note taking. The first section of the questionnaire covered the biographical information of the participants. The second section explored about the note taking habits, method of note taking, preferred language used to take note and to find out the existence of note taking features in e-learning platform and participant's opinion on the most effective way of taking notes.

The semi-structured interview, based on a prefixed interview guide with the possibility of additional follow-up questions, helps to address both contextual and interventional variables. The semi-structured interview question consists of matrix, open ended, demographic questions, Likert scale and rating scale questions. The semi-structured interview questions covered the participant's opinions on memory retention test, the usefulness of the note taking features, issues/difficulties participants faced during the note taking session and last but not least participant's suggestion on how to improve the note taking in e learning platform.

In this study, a database is required to store data, as well as a programming language for development, a backend framework to support the application structure, user interface frontend technologies, and a server to manage user-system protocols. The prototype is made up of three modules: user interface, user type, and business logic. Firebase Firestore (Cloud Firestore) database used to produce sensitive applications that do little to manage idleness or Internet connectivity. Cloud Firestore allows users to set-up a single-page, a mobile landing page, web page or progressive web page with ease. It also helps to deliver the content rapidly anywhere.

Ionic Framework is used to build high-quality mobile and desktop applications and focuses on the front-end user interface (controls, interfaces, gestures, animations) and user communication of a device (Ionic Framework, 2019). Programming languages used are Typescript, JavaScript, Angular, HTML and CSS. JavaScript is mainly used for scripting, where content written in JavaScript is inserted into the HTML of MemRetz website and run by a JavaScript engine on the web browser. GitLab is used for a source code versioning system that tracks changes from remote resources. It helps the management system by keeping code private and allows code changes to be quickly deployed. GitLab gives full control over the databases or projects and allows deciding whether projects are free of charge public or private.

In order to develop a high-quality chart, Highcharts which is an unadulterated JavaScript diagramming item library, first published in 2009 was used. It was made by Highsoft in Vik, Norway and, for example, Finansavisen and Dagsrevyen, has been regularly introduced into national media (Highcharts.com, 2019). Languages used to build the app are Angular, Typescript, JavaScript, HTML and CSS. Furthermore, creating a note taking which helps in memory retention requires a powerful rich text editor. This study employed Quill, a free and open source WYSIWYG editor, to aid in

the building of functional learning environments that required substantial writing and reading.

Microsoft Visual Studio is used to develop the MemRetz app which is compatible with all devices. Visual Studio Code is a free coding editor that has easy-to-use interface and GIT integration. On the other hand, Visual Studio Code utilizes its impressive Typescript integration to power auto completion and other useful editing features for both JavaScript and Typescript.

5.4.2 Development

Development was achieved using the tools described above. Figure 7.3 to 7.16 in Appendix displays the main backend modules of the prototype named MemRetz application that have been designed in the design section of this chapter.

5.5 Testing

This section covers the testing of the template. It deals with unit testing, functional testing, integration testing, system testing and the testing of the software itself. Bugs in the software and errors are detected and corrected and the modified prototype is retested. Moreover, pilot study was also conducted to examine the feasibility of an approach that is intended to be used in a larger scale study later on.

5.5.1 Unit Test

During this test single components like function, method, procedure, module, or object are tested independently during the coding phase. Unit tests help to fix bugs early in the development cycle which helps to understand the code base and enables you to make changes quickly.

5.5.2 Functional Test

The functional testing was done once the application was completed. This testing is to verify that it provides all the behaviors of the software entity required of the application. The application under test is observed as a “black box”. The choice of test cases for functional testing is based on the requirement or design specification of the software entity under test.

5.5.3 System Test

System testing is the testing of the system. This testing reveals that the system works end-to-end in a production-like location to provide the business functions specified in the high-level design.

5.5.4 Integration Test

Integration testing validates that two or more units or other integrations work together properly, and inclines to focus on the interfaces specified in low-level design.

5.6 Summary

The model design, tool design, implementation, and testing were all covered and shown in this chapter. System design, class diagram, formula design, interface and component design, interaction diagram, and model design are all covered in the design part. Following that, selecting appropriate tools and technologies is the first step in tool design and deployment. Then, utilizing the Visual Studio Code framework and the Typescript programming language, development begins from the ground up. All significant aspects of the development are shown in screenshots. Last but not least, this chapter discusses testing and evaluation. The model has been tested with unit tests, functional tests, system tests, and integration tests.

CHAPTER 6: EVALUATING THE E-LEARNING PLATFORM MODEL

In this chapter, the pilot study and experimental study will be discussed.

6.1 Pilot Study

A pilot study was performed. Questionnaire and semi structured interview questions with relevant questions on the prioritized themes was identified and used for the pilot study. Appropriate statistical tools were used to arrive at results using SPSS as given in the findings.

- Random sampling technique used.
- Sample size taken was six participants in Chinese language for pen-paper, smartphone and laptop.
- The participants' age group 20 years above identified was currently studying.

6.1.1 Variable

Independent Variables:

1. Memory Retention Score (percentage of correctness × time taken to complete the test)

Dependent Variables:

1. Different length of article, duration of video
2. Medium used (Laptop, Smartphone, Pen and Paper)
3. Note taking (Yes, No)

6.1.2 Objectives of pilot study

The purpose of the pilot study was fourfold, namely:

i) To use and investigate the designed note taking model in an E-learning platform which supports memory retention based on the above input.

ii) To pilot study the different data collection instruments.

6.1.3 Participants

Participants in this study included 6 participants using Chinese language in various devices which are smartphones, pen and paper and laptop. The participants in this research were from one single location, Malaysia.

6.1.4 Materials

1. Questionnaire.
2. Semi Structured Interview Questions.
3. Pen-paper
4. Smartphone
5. Laptop

6.1.5 Procedure

1. Participants are explained on the experiment to be carried out.
2. Participants are being given medium (smartphone/tablet/laptop) and the written paper before the experiment is started.
3. Participants are then needed to read the article and view the video on the medium and the written paper.
4. Participants may opt to take note during reading the articles or viewing videos.
5. The participants are then required to answer questions based on the article given.
6. The note taken of the participants and the medium used during the test will be recorded.
7. The memory retention score (percentage of correctness × time taken to complete the test) will be recorded to find out the memory retention of each participant.
8. Participant's results for the entire test will be revealed with the memory retention score and notes taken by the participants will be saved.

6.1.6 Goal of Pilot Study

Measuring the effort involved and the benefits obtained in the MemRetz application. Research design and objectives are identified to facilitate the research on multilingual note taking effects of memory retention using pen-paper, smartphone and laptop.

6.1.7 Phases of the pilot study

- Phases of the pilot:

  The goal for the pilot study is to study and gain an in-depth understanding on the effect of memorization retention based on pen-paper, smartphone, and laptop using the designed note taking model in an E-learning platform. The procedure of the study included conducting pre-test questionnaires as shown in figure 7.1 and post-test semi-structured interview questions as shown in figure 7.2. A progressive web application is used throughout the study for the participants to do the test. Resources have been obtained to conduct the study as well as data collected. Quantitative data on issues has been collected. Those participants who used pen and paper to take notes used the laptop as a medium to view the article and video during the test.

- Execution phase:

  In this phase the execution of the defined process including data collection and analysis have been conducted.

- Post-mortem:

  In this phase a review and critique of the study process, the documentation and analysis of the engineering results, technical problems encountered, and research issues that have been identified after the investigation.

6.1.8 The key issues to be evaluated and the data needed to address

1. Address time, resources, and time used in conducting this study.
2. Review and analyze the defect data relative to the phases of the software lifecycle.
3. Based on evidence provided from this study, compose guidelines and recommendations to enhance the development process.

6.1.9 Conclusions and disscussion of Pilot Study

All 6 participants were able to understand the purpose of this study, how to use the application provided and how to answer the questions given. Small sample size used in this pilot study affects the reliability of the study's results because it leads to a higher variability, which may lead to bias. Since the size of the participants in this pilot study is small, it also affects the ability to detect an effect when there is one to be detected as small effects are not easier to notice and decreases the power of the study. To extrapolate the statistical analysis results to the overall population sufficient participants are required.

Based on the study, the valuable feedback from participants helps to revise, improve, also assess the experiment, and make necessary changes such as the instructions of the test in this paper. The note taking application has been enhanced by adding word formatting features, allowing uploading video, pictures and notes from external applications. Below table 6.1 shows few screenshots of semi interview questions of participant's feedback during pilot study.

Table 6.1: Feedback

Feedback

5. What are the difficulties that you faced when using the app? I could not find word formatting features (e.g. List bullets, table creation) in the note-taking editor which comes in handy for me to organize the note in point-form. **6. Suggestion on how to improve the note taking in e learning platform.** Include Bullets, Font Color, Text Highlight Color, Bullets, Numbering, Mind Chart / Process Flow drawing tool features. **Participant's signature** ___Eugene Liew Yao Qin_____ **Date** __July 15, 2020___	Include Bullets, Font Colour, Text Highlight Colour, Bullets, Numbering, Mind Chart / Process Flow word formatting tool features.
5. What are the difficulties that you faced when using the app? Nothing_____ **6. Suggestion on how to improve the note taking in e learning platform.** Allow uploading notes from external app so can manage all notes in one place_____ **Participant's signature** _____Kavita_____ **Date** ____080720_____	Allow uploading notes from external apps so can manage all notes in one place.
5. What are the difficulties that you faced when using the app? Found no difficulties. **6. Suggestion on how to improve the note taking in e learning platform.** Allow uploading video or pictures into the note taking platform. **Participant's signature** _____Dekai_____ **Date** ____9/7/2020_____	Allow uploading video or pictures into the note taking platform.

In addition, it also allows checking the procedures used in this study are relevant and as well as it allows the developer to see if there are any flaws in the experiment plans. In general, by carrying out this pilot study, it allows seeing the experiment from a different perspective and also allows to judge on the changes that need to be done whether it's minor, drastic or even no changes required at all. The challenges that the participants faced during this pilot study are on the features where they weren't able to find word formatting features(e.g. list bullets, table creation) in the note- taking editor which comes in handy to organize the note in point-form. In addition, participants also faced difficulties in taking/ writing then notes while watching video. The pilot study has proved that there are differences on the effect of memorization retention using pen-paper, smartphone, and laptop.

6.2 Experimental Study

MemRetz, a note-taking tool, was created to investigate the effect of memory retention on pen-paper, smartphone, and laptop. The model has been used to design the prototype.

6.2.1 Formula

The memory retention scores were calculated by recording the time taken of each participant to complete the test and the percentage of correctness based on the different length of characters for each article or duration of time for each video. The formula used to find out the memory retention for each participant in this study is as below.

Memory Retention score = percentage of correctness × time taken to complete the test

6.2.2 Normality Test

Once the data collected from the experimental study, a normality test was conducted to calculate the probability that the sample was drawn from the normal population. The hypotheses used are:

a) Ho: The sample data are not significantly different than a normal population.

b) Ha: The sample data are significantly different than a normal population.

6.2.2.1 Results of Normality Test

Table 6.2: Normality test of Article Marks vs Medium

Tests of Normality

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Medium	Statistic	df	Sig.	Statistic	df	Sig.
Article Marks	Laptop	.128	40	.098	.963	40	.218
	Smartphone	.138	40	.055	.950	40	.076
	Pen and paper	.126	40	.109	.956	40	.121

a. Lilliefors Significance Correction

Table 6.3: Normality test of Video Marks vs Medium

Tests of Normality

	Medium	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Video Marks	Laptop	.123	40	.129	.947	40	.058
	Smartphone	.125	40	.117	.953	40	.097
	Pen and paper	.128	40	.099	.950	40	.076

a. Lilliefors Significance Correction

Table 6.4: Normality test of Article Marks vs Language

Tests of Normality

	Language	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Article Marks	Jawi	.159	30	.052	.947	30	.144
	English	.142	30	.129	.954	30	.210
	Mandarin	.123	30	.200*	.943	30	.108
	Tamil	.152	30	.076	.953	30	.207

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Table 6.5: Normality test of Video Marks vs Language

Tests of Normality

	Language	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Video Marks	Malay	.184	30	.068	.938	30	.082
	English	.174	30	.062	.890	30	.495
	Chinese	.189	30	.775	.912	30	.696
	Tamil	.186	30	.944	.952	30	.195

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

6.2.2.2 Discussion

The normality test was performed on the data to be analyzed in order to verify whether or not the data was symmetrically distributed before any parametric test was applied as shown in table 6.2, 6.3, 6.4, and 6.5 above. The probabilities are greater than 0.05 (the usual alpha level) in SPSS output above so accept Ho. This data does not vary from regular data. Normally, these samples are data distributed.

6.2.3 Variable

Independent Variables:

1. Memory Retention Score (percentage of correctness × time taken to complete the test)

Dependent Variables:

1. Different length of article, duration of video
2. Medium used (Laptop, Smartphone, Pen and Paper)
3. Note taking (Yes, No)

6.2.4 Objectives of the experimental study

The purpose of the experimental study was fourfold, namely:

i) To investigate the effect of note taking and memory retention using pen-paper, smartphone, and laptop in context of an E-learning platform.

ii) To design an effective model of note taking in an E-learning platform for memory retention.

iii) To develop and evaluate the E-learning platform for memory retention based on the model above.

6.2.5 Participants

Participants in this study included 120 participants using Chinese language in various devices which are smartphones, pen and paper and laptop. The participants in this research were from one single location, Malaysia. Participant's included females and males between all age ranges of 20 to 29, 30 to 39 and 40 to 49.

6.2.6 Materials

6. Questionnaire.
7. Semi Structured Interview Questions.
8. Pen-paper
9. Smartphone
10. Laptop

6.2.7 Procedure

1. Participants are explained on the experiment to be carried out.

2. Participants are being given medium (smartphone/tablet/laptop) and the written paper before the experiment is started.
3. Participants are then needed to read the article and view the video on the medium and the written paper.
4. Participants may opt to take note during reading the articles or viewing videos.
5. The participants are then required to answer questions based on the article given.
6. The note taken of the participants and the medium used during the test will be recorded.
7. The memory retention score (percentage of correctness × time taken to complete the test) will be recorded to find out the memory retention of each participant.
8. Participant's results for the entire test will be revealed with the memory retention score and notes taken by the participants will be saved.

6.2.8 Results

All the data collected as shown in figure 7.24 - 7.27 during the experimental study have been analyzed statistically using SPSS analysis. The sample of note taken by the participants using pen-paper, smartphone and the laptop is shown in figure 7.28, 7.29, 7.30, 7.31, 7.32 & 7.33.

6.2.8.1 T-Test

a) Note Taking

Table 6.6: Note Taking (Article) Group Statistics

Group Statistics

	Article Notes	N	Mean	Std. Deviation	Std. Error Mean
Article Marks	Yes	71	50.99	16.138	1.915
	No	49	30.20	13.306	1.901

Table 6.7: Note Taking (Article) Independent Samples Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Article Marks	Equal variances assumed	1.520	.220	7.435	118	.000	20.782	2.795	15.247	26.317
	Equal variances not assumed			7.702	114.214	.000	20.782	2.698	15.436	26.127

An independent-samples t-test was conducted to compare memory retention in note taking and no note taking conditions for article test as shown in table 6.6 and 6.7 above. There was a significant difference in the score for taken notes (M=50.99, SD=16.14) than the non-taken notes (M=30.20, SD=13.31) for article conditions; t (118) =7.44, p<0.001. These results suggest that note taking really does influence memory retention. Specifically, our results suggest that when students take notes, they remember more.

Table 6.8: Note taking (Video) Group Statistics

Group Statistics

	Video Notes	N	Mean	Std. Deviation	Std. Error Mean
Video Marks	Yes	71	38.03	16.002	1.899
	No	49	23.27	13.290	1.899

Table 6.9: Note taking (Video) Independent Samples Test

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Video Marks	Equal variances assumed	2.286	.133	5.314	118	.000	14.763	2.778	9.262	20.264
	Equal variances not assumed			5.498	113.910	.000	14.763	2.685	9.443	20.082

An independent-samples t-test was conducted to compare memory retention in note taking and no note taking conditions for video test as shown in table 6.8 and 6.9 above. There was a significant difference in the score for taken notes (M=38.03, SD=16.00) than the non-taken notes (M=23.27, SD=13.29) for video conditions; t (118) =5.31, p<0.001. These results suggest that note taking really does influence memory retention. Specifically, our results suggest that when students take notes, they remember more.

6.2.8.2 One Way Anova Test

b) **Note taken in different scripted languages**

Table 6.10: Multilingual Note taken (Article test) Descriptives

Descriptives

Memory Retention Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Malay	30	38.00	19.547	3.569	30.70	45.30	0	70
English	30	45.33	19.429	3.547	38.08	52.59	0	80
Chinese	30	44.67	16.965	3.097	38.33	51.00	10	70
Tamil	30	42.00	16.484	3.010	35.84	48.16	0	70
Total	120	42.50	18.161	1.658	39.22	45.78	0	80

Table 6.11: Multilingual Note taken (Article test) Anova

ANOVA

Memory Retention Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	996.667	3	332.222	1.007	.392
Within Groups	38253.333	116	329.770		
Total	39250.000	119			

Table 6.12: Multilingual Note taken (Article test) Multiple Comparisons

Multiple Comparisons

Dependent Variable: Memory Retention Score
Tukey HSD

(I) Language	(J) Language	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Malay	English	-7.333	4.689	.403	-19.56	4.89
	Chinese	-6.667	4.689	.488	-18.89	5.56
	Tamil	-4.000	4.689	.829	-16.22	8.22
English	Malay	7.333	4.689	.403	-4.89	19.56
	Chinese	.667	4.689	.999	-11.56	12.89
	Tamil	3.333	4.689	.893	-8.89	15.56
Chinese	Malay	6.667	4.689	.488	-5.56	18.89
	English	-.667	4.689	.999	-12.89	11.56
	Tamil	2.667	4.689	.941	-9.56	14.89
Tamil	Malay	4.000	4.689	.829	-8.22	16.22
	English	-3.333	4.689	.893	-15.56	8.89
	Chinese	-2.667	4.689	.941	-14.89	9.56

A one-way between subjects ANOVA was conducted to compare the effect of memory retention score on multilingual note taken for article test as shown in table 6.10, 6.11 and 6.12 above. There were no statistically significant differences between

multilingual note taken and memory retention score as determined by one-way Anova [F(3, 116) = 1.01, p = 0.392]. Taken together, these results suggest that different scripted language do not have an effect on memory retention score. Specifically, our results suggest that students may read article and take notes using any language they prefer as it does not affect the memory retention.

Table 6.13: Multilingual Note taken (Video test) Descriptives

Descriptives

Memory Retention Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Malay	30	29.33	17.006	3.105	22.98	35.68	0	60
English	30	31.67	18.952	3.460	24.59	38.74	0	60
Chinese	30	36.33	16.291	2.974	30.25	42.42	0	60
Tamil	30	30.67	13.629	2.488	25.58	35.76	0	60
Total	120	32.00	16.582	1.514	29.00	35.00	0	60

Table 6.14: Multilingual Note taken (Video test) Anova

ANOVA

Memory Retention Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	833.333	3	277.778	1.011	.391
Within Groups	31886.667	116	274.885		
Total	32720.000	119			

Table 6.15: Multilingual Note taken (Video test) Multiple Comparisons

Multiple Comparisons

Dependent Variable: Memory Retention Score
Tukey HSD

(I) Language	(J) Language	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Malay	English	-2.333	4.281	.948	-13.49	8.83
	Chinese	-7.000	4.281	.363	-18.16	4.16
	Tamil	-1.333	4.281	.989	-12.49	9.83
English	Malay	2.333	4.281	.948	-8.83	13.49
	Chinese	-4.667	4.281	.696	-15.83	6.49
	Tamil	1.000	4.281	.995	-10.16	12.16
Chinese	Malay	7.000	4.281	.363	-4.16	18.16
	English	4.667	4.281	.696	-6.49	15.83
	Tamil	5.667	4.281	.550	-5.49	16.83
Tamil	Malay	1.333	4.281	.989	-9.83	12.49
	English	-1.000	4.281	.995	-12.16	10.16
	Chinese	-5.667	4.281	.550	-16.83	5.49

A one-way between subjects ANOVA was conducted to compare the effect of memory retention score on multilingual note taken for video test as shown in table 6.13, 6.14 and 6.15 above. There were no statistically significant differences between multilingual note taken and memory retention score as determined by one-way Anova [F(3, 116) = 1.01, p = 0.391]. Taken together, these results suggest that different scripted language do not have an effect on memory retention score. Specifically, our results suggest that students may view video and take notes using any language they prefer as it does not affect the memory retention.

c) Medium used

Table 6.16: Medium(Article) Descriptives

Descriptives

Memory Retention Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Laptop	40	46.75	16.546	2.616	41.46	52.04	10	80
Smartphone	40	42.00	18.285	2.891	36.15	47.85	0	70
Pen and Paper	40	38.75	19.107	3.021	32.64	44.86	0	70
Total	120	42.50	18.161	1.658	39.22	45.78	0	80

Table 6.17: Medium(Article) Anova

ANOVA

Memory Retention Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1295.000	2	647.500	1.996	.140
Within Groups	37955.000	117	324.402		
Total	39250.000	119			

Table 6.18: Medium(Article) Multiple Comparisons

Multiple Comparisons

Dependent Variable: Memory Retention Score
Tukey HSD

(I) Medium	(J) Medium	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Laptop	Smartphone	4.750	4.027	.468	-4.81	14.31
	Pen and Paper	8.000	4.027	.120	-1.56	17.56
Smartphone	Laptop	-4.750	4.027	.468	-14.31	4.81
	Pen and Paper	3.250	4.027	.699	-6.31	12.81
Pen and Paper	Laptop	-8.000	4.027	.120	-17.56	1.56
	Smartphone	-3.250	4.027	.699	-12.81	6.31

A one-way between subjects ANOVA was conducted to compare the effect of memory retention score on different medium used for article test as shown in table 6.16, 6.17 and 6.18 above. There were no statistically significant differences between multilingual note taken and memory retention score as determined by one-way Anova [F(3, 116) = 2.00, p = 0.140]. Taken together, these results suggest that different medium used do not have an effect on memory retention score. Specifically, our results suggest that students may read article and take notes using any medium they prefer as it does not affect the memory retention. Despite that, it should be noted that the participants who used pen and paper to take notes viewed the article using a laptop. This finding contradicting the assertion made by Luo, Kiewra, Flanigan, & Peteranetz, 2018 that laptop note takers took more notes, recorded more verbatim lecture strings, and had a better process function than pen and paper note takers.

Table 6.19: Medium (Video) Descriptives

Descriptives

Memory Retention Score

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Laptop	40	35.00	16.172	2.557	29.83	40.17	0	60
Smartphone	40	30.00	16.641	2.631	24.68	35.32	0	60
Pen and Paper	40	31.00	16.916	2.675	25.59	36.41	0	60
Total	120	32.00	16.582	1.514	29.00	35.00	0	60

Table 6.20: Medium (Video) Anova

ANOVA

Memory Retention Score

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	560.000	2	280.000	1.019	.364
Within Groups	32160.000	117	274.872		
Total	32720.000	119			

Table 6.21: Medium(Video) Multiple Comparisons

Multiple Comparisons

Dependent Variable: Memory Retention Score
Tukey HSD

(I) Medium	(J) Medium	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Laptop	Smartphone	5.000	3.707	.371	-3.80	13.80
	Pen and Paper	4.000	3.707	.529	-4.80	12.80
Smartphone	Laptop	-5.000	3.707	.371	-13.80	3.80
	Pen and Paper	-1.000	3.707	.961	-9.80	7.80
Pen and Paper	Laptop	-4.000	3.707	.529	-12.80	4.80
	Smartphone	1.000	3.707	.961	-7.80	9.80

A one-way between subjects ANOVA was conducted to compare the effect of memory retention score on different medium used for video test as shown in table 6.19, 6.20 and 6.21 above. There were no statistically significant differences between multilingual note taken and memory retention score as determined by one-way Anova [$F(3, 116) = 1.02$, $p = 0.364$]. Taken together, these results suggest that different medium used do not have an effect on memory retention score. Despite that, it should be noted that the participants who used pen and paper to take notes viewed the article

using a laptop. Specifically, our results suggest that students may view video and take notes using any medium they prefer as it does not affect the memory retention. The finding contradicting the assertion made by Zhu, Kaplan, Dershimer & Bergom, 2011 that the laptops helped the respondent to learn more and increases their attentiveness.

6.2.8.3 Two-Way Anova

d) Different length of the article characters

Table 6.22: Different length of the article characters – Descriptive Statistics

Descriptive Statistics

Dependent Variable: Memory Retention Score

Language	Article Character	Mean	Std. Deviation	N
Jawi	50 char	14.00	8.137	30
	100 char	9.00	8.030	30
	200 char	8.00	8.052	30
	800 char	5.00	7.311	30
	Total	9.00	8.442	120
English	50 char	17.00	5.350	30
	100 char	11.00	9.229	30
	200 char	10.00	8.305	30
	800 char	7.33	7.849	30
	Total	11.33	8.495	120
Mandarin	50 char	16.00	4.983	30
	100 char	13.00	7.022	30
	200 char	10.67	8.683	30
	800 char	5.00	5.724	30
	Total	11.17	7.798	120
Tamil	50 char	16.00	6.747	30
	100 char	11.67	7.466	30
	200 char	8.67	7.761	30
	800 char	5.33	6.288	30
	Total	10.42	8.033	120
Total	50 char	15.75	6.438	120
	100 char	11.17	8.011	120
	200 char	9.33	8.172	120
	800 char	5.67	6.827	120
	Total	10.48	8.223	480

Table 6.23: Different length of the article characters – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: Memory Retention Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6966.458[a]	15	464.431	8.476	.000
Intercept	52710.208	1	52710.208	962.011	.000
Article_Language	407.292	3	135.764	2.478	.061
Article_Char	6327.292	3	2109.097	38.493	.000
Article_Language * Article_Char	231.875	9	25.764	.470	.895
Error	25423.333	464	54.792		
Total	85100.000	480			
Corrected Total	32389.792	479			

a. R Squared = .215 (Adjusted R Squared = .190)

A two way analysis of variance was conducted on the influence of two independent variables (article language and different length of character of article) on memory retention score as shown in table 6.22 and 6.23 above. Article language included four types Jawi, Mandarin, Tamil and English) and different length of character of article consists of four type (50, 100, 200 and 800 char). Only article character effects where statistically significant at the .05 significance level. The main effect for article language yielded an F ratio of $F(3,464) = 2.5$, $p>.05$, indicating no significant difference between Jawi ($M = 9.00$, $SD = 8.44$), Mandarin($M = 11.17$, $SD = 7.79$), Tamil($M = 10.42$, $SD = 8.03$) and English($M = 11.33$, $SD = 8.49$). The main effect for article character yielded an F ratio of $F(3,464) = 38.49$, $p<.001$, indicating that the effect for article character was significant, 50 char($M = 15.75$, $SD = 6.44$), 100 char($M = 11.17$, $SD = 8.01$), 200 char($M = 9.33$, $SD = 8.17$) and 800 char($M = 5.67$, $SD = 6.83$). The interaction effect was not significant, $F(9,464) = .47$, $p>.05$. Taken together, these results suggest that article character do have an effect on memory retention score. However, our results suggest that article language and interaction between article language and character does not appear to affect memory retention score.

e) Different duration of the video

Table 6.24: Different duration of video – Descriptive Statistics

Descriptive Statistics

Dependent Variable: Memory Retention Score

Language	Video Duration	Mean	Std. Deviation	N
Malay	less than 10 minutes	21.00	13.983	30
	less than 15 minutes	8.33	9.129	30
	Total	14.67	13.336	60
English	less than 10 minutes	18.00	11.861	30
	less than 15 minutes	15.00	11.671	30
	Total	16.50	11.764	60
Chinese	less than 10 minutes	21.33	11.958	30
	less than 15 minutes	15.00	12.798	30
	Total	18.17	12.688	60
Tamil	less than 10 minutes	22.33	10.400	30
	less than 15 minutes	10.00	8.305	30
	Total	16.17	11.213	60
Total	less than 10 minutes	20.67	12.074	120
	less than 15 minutes	12.08	10.916	120
	Total	16.38	12.264	240

Table 6.25: Different duration of video – Tests of Between-Subjects Effects

Tests of Between-Subjects Effects

Dependent Variable: Memory Retention Score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5796.250[a]	7	828.036	6.372	.000
Intercept	64353.750	1	64353.750	495.193	.000
Video_Language	371.250	3	123.750	.952	.416
Video_Duration	4420.417	1	4420.417	34.014	.000
Video_Language * Video_Duration	1004.583	3	334.861	2.577	.055
Error	30150.000	232	129.957		
Total	100300.000	240			
Corrected Total	35946.250	239			

a. R Squared = .161 (Adjusted R Squared = .136)

A two way analysis of variance was conducted on the influence of two independent variables (video language and duration of video) on memory retention score as shown in table 6.24 and 6.25 above. Video language included four types Malay, Chinese, Tamil and English) and different duration of video consists of two duration (less than 10 minutes and less than 15 minutes). Only video duration effects where statistically significant at the .05 significance level. The main effect for video language yielded an F ratio of $F(3,232) = .95$, $p>.05$, indicating no significant difference between Malay ($M = 14.67$, $SD = 13.34$), Chinese($M = 18.17$, $SD = 12.69$), Tamil($M = 16.17$, $SD = 11.21$) and English($M = 16.50$, $SD = 11.76$). The main effect for duration of video yielded an F ratio of $F(1,232) = 34.01$, $p<.001$, indicating that the effect for duration of video was significant, less than 10 minutes ($M = 20.67$, $SD = 12.07$) and less than 15 minutes ($M = 12.08$, $SD = 10.92$). The interaction effect was not significant, $F(3,232) = 2.57$, $p>.05$. Taken together, these results suggest that duration of video do have an effect on memory retention score. However, our results suggest that video language and interaction between video language and duration of video does not appear to affect memory retention score.

6.2.9 Discussion

In this note taking model, a growing number of tools have been developed to support student note taking in E-Learning. Therefore, based on the evidence gathered herein, it

can be concluded that the method of note taking and language do affects students' memory retention. Incorporating a review of note taking in the E-learning platform allows teachers and students to fill in gaps and helps them during studies in class. Our execution of the memory retention test is to explain note taking methods, mainly in a multilingual, the ability to pique interest, hold attention, and improve grade performance among groups of participants was convincingly demonstrated. In addition, the tool's design architecture was successfully developed, allowing it to build Human-computer interface (HCI) elements from code in percentage value and provide memory retention results. Teachers and instructors may now quickly determine which note-taking approach is best for a certain student or class in order to improve memory retention and academic success.

6.2.9.1 Questionnaire (Pre-Test)

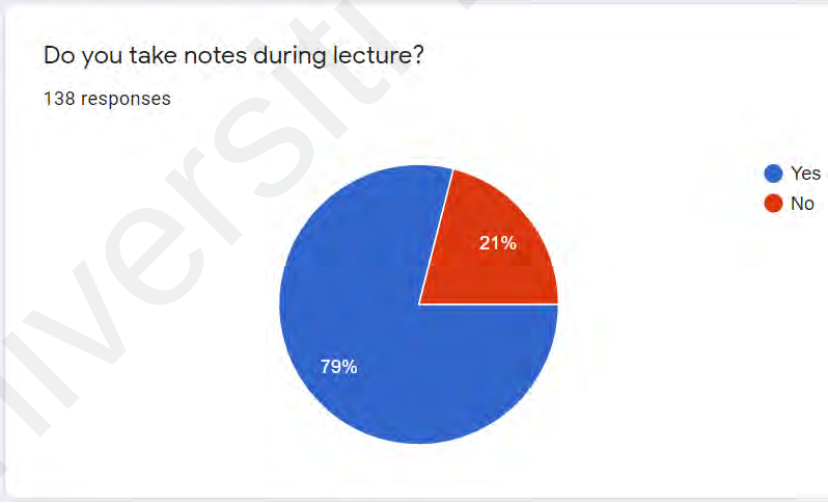


Figure 6.1: Take notes during Lecture

Most of the participants have the habits to take notes during lecture as shown in figure 6.1 above.

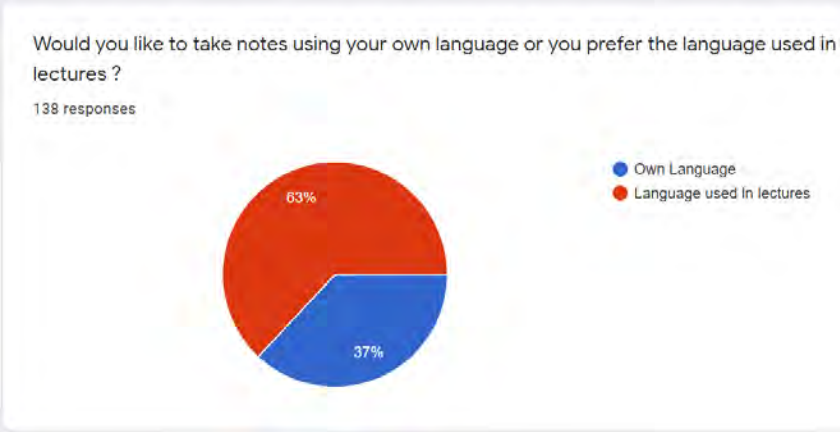


Figure 6.2: Preferred language to take notes

Most of the participants prefer to use the language used in lectures as shown in figure 6.2 above.

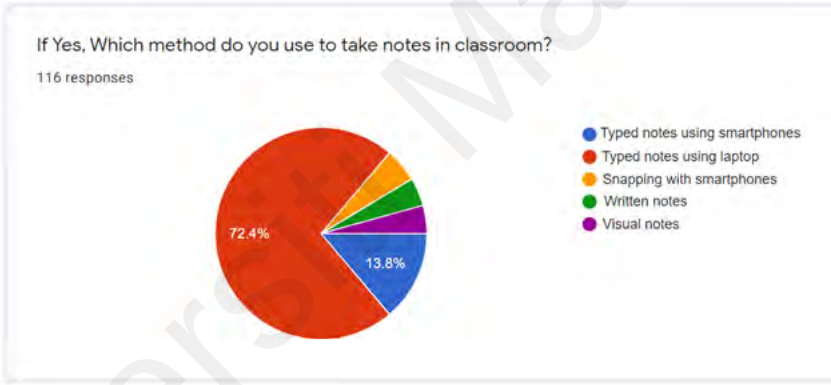


Figure 6.3: Method use to take notes

Most of the participants use laptops to take notes. Only 5.2% of participants used pen and paper to take notes as shown in figure 6.3 above.

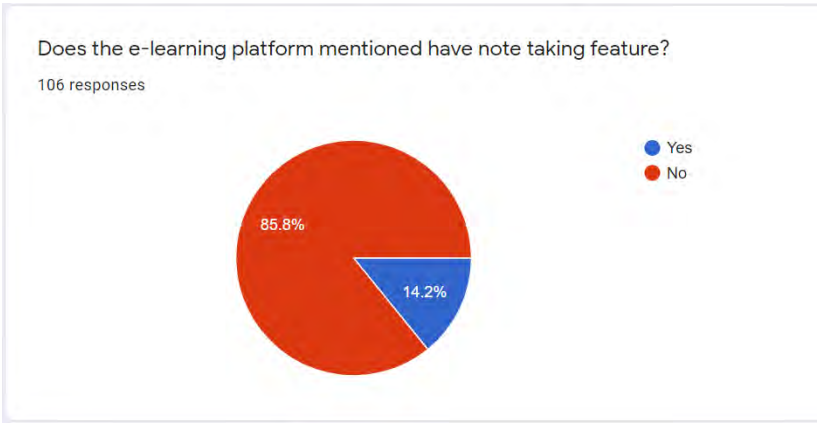


Figure 6.4: E-Learning platform have note taking feature

Based on this study, it is believed that most e-learning platforms do not have note taking features as shown in figure 6.4 above.

6.2.9.2 Semi Structured Interview Questions (Post-Test)

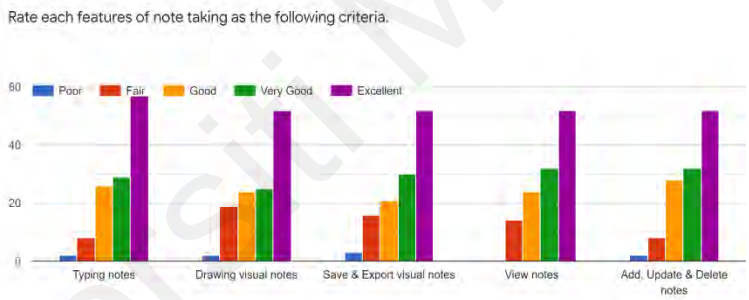


Figure 6.5: Rating of note taking features

Most of the participants are satisfied with the features in the note taking application as shown in figure 6.5 above.

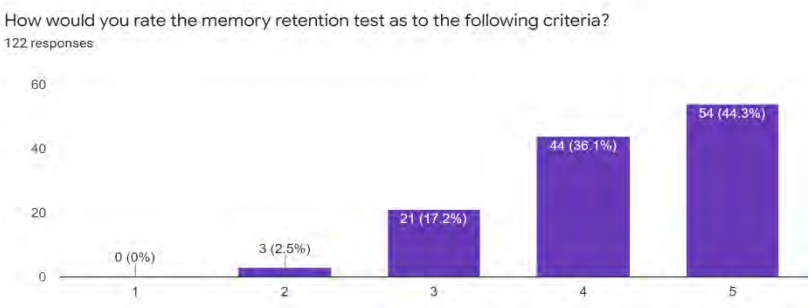


Figure 6.6: Rating of memory retention test

Most of the participants rate the memory retention test as 5/5 as shown in figure 6.6 above. No participants rate the retention test as 1/5. This proved that the memory retention test satisfied the participants.

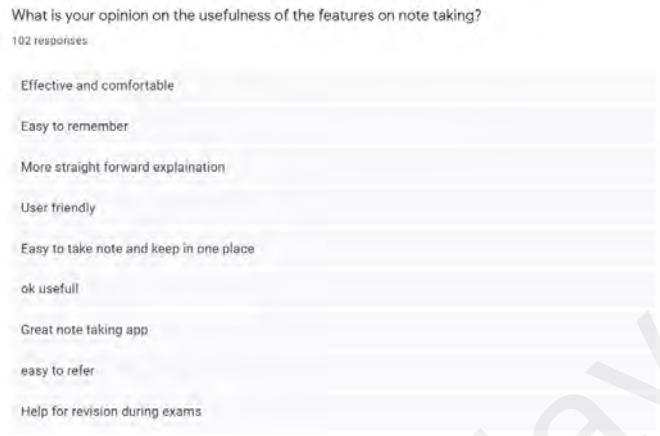


Figure 6.7: Opinion on the usefulness of note taking features

Few participants' opinions on the usefulness of the features on note taking are mostly positive such as easy to remember, refer, effective, comfortable, user friendly and more as shown in figure 6.7 above.

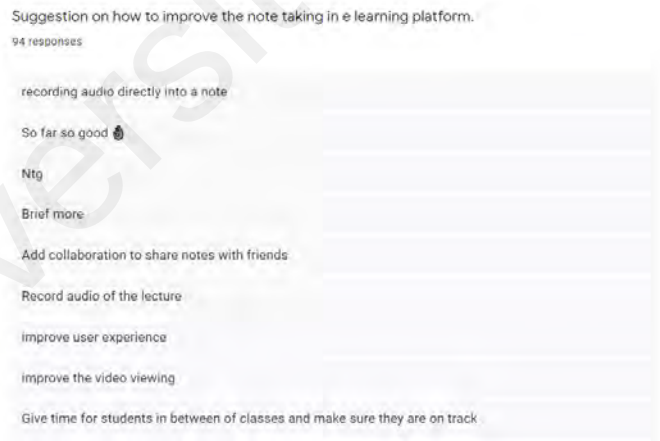


Figure 6.8: Suggestions to improve Note Taking

Suggestions on how to improve the note taking application are to allow recording audio as well as automatically convert the audio to text as shown in figure 6.8 above.

6.3 Summary

Through this chapter, experimental setup and evaluation of the model of the E-learning platform is shown. A pilot study is conducted in order to evaluate the E-

learning platform model. Then, a normality test is done to check if the data collected is normally distributed and the formula of this study is discussed. Finally the results and discussion of this study were shown in this chapter.

CHAPTER 7: CONCLUSION

7.1 Research Findings

The memory retention of a participant is affected by the type of note taking method and the language of the texts they are learning.

7.2 Achievement of Objective 1

Relevent journal articles and literature were searched, studied and analysed to identify the problem and find the effect of note taking and memory retention using pen-paper, smartphone, and laptop in context of an E-learning platform have been investigated to achieve the first objective of this study.

7.3 Achievement of Objective 2

Objective 2 have been fulfilled by designing an effective model of note taking in an E-learning platform for memory retention. A note taking model in an E-learning platform with note taking features is developed in a way that can be written, image and drawn which is compatible for laptop and smartphone.

7.4 Achievement of Objective 3

Developed and evaluated a progressive web application called MemRetz for memory retention in E-learning platform based on the model to accomplish objective 3. The independent sample t-test resulted in a statistically significant difference between notes taken and no notes taken during the analysis. Participants who take notes performed better in the test than the participants who don't take notes. Results proved that taking notes helps participants to learn and remember the information better. The result of the one-way Anova test proved that there were no significant difference between medium used for article (table 6.17) and video (table 6.20) test. However, according to the mean score in table 6.16, participants who used laptop and smartphone to take notes had better memory retention than the participants who took notes using pen and paper while

reading articles. Whereas, participants who used laptops to take notes had better memory retention than participants who took notes using smartphones and pen and paper while viewing videos based on the mean score in table 6.19. During the study, most of the participants do not prefer to take notes using pen and paper. During the semi interview question, most of the participants polled that they prefer to take note using laptop and smartphone as shown in Figure 6.3. The new era of technology revolution has altered the note taking among participants. The participants find it more convenient to read the article and view the videos on a bigger screen. Moreover, the features and resources on a laptop are far better than a smartphone. The usage of note-taking applications in an E-learning platform is beneficial since it increases participants' ability to take notes and helps them retain some details. The results of one-way Anova showed that there was no significant difference between different scripted languages for article as well as for video test. Results proved that the memory retention is not affected by the different scripted languages. This study proved that participants may take notes, read article or view video in their own preferred and comfortable languages during their studies. However, the participant's first language can be factors which cause the memory retention score to be affected. Based on the two-way Anova test, different length of characters of each article while taking notes based on each device had a significant impact on the memory retention score regardless of the different scripted languages. As the different length of characters increases the memory retention score decreases. The duration of the video 1 and 2 while taking notes based on each device had a significant impact on the memory retention score.

A semi structured interview session as shown in figure 7.2 has been conducted with few participants to find out their opinions on the note taking application in an e-learning platform. During the interview, the participants' said that this note taking app offers an easy, convenient way to store all this information in one place. Moreover, it minimizes

the time taken to write a note and can be stored via online or OneDrive rather than writing it manually. Furthermore, the word formatting features in the note taking editor is in handy for me to organize the note in point-form. Besides, the participants suggested including text search to find notes, adding record audio features and adding collaboration to share notes with friends to improve the note-taking application.

The participants generally shared positive feedback about the note taking feature in an E-Learning. Many respondents indicated that they enjoyed using the note taking app. Both participants indicated that in e-learning, the note taking app is a significant feature which is comfortable, user friendly and effective. Note taking application enhancements were also proposed by the participants. These enhancements focused largely on incorporating audio records and collaborating with friends to exchange notes while studying.

7.5 Research Limitations

As it is for every study, this dissertation had the following limitations: The size of the sample was a relatively small number of participants. Large sample sizes are needed for more accurate analysis. The results of inferential statistics can only be applied to populations that resemble the sample that was tested. Each group should have about the same number of data points. Comparing large and small groups together may give inaccurate results. All data should be independent. The scores should not be influenced by each other. The time available to investigate research problems and to measure change over time is pretty much constrained by the due date of the thesis. During the study, only two database (University of Malaya Digital Library and IEEE Xplore Digital Library) and two journals (Journal of Systems and Software, ACM Transaction on Software Engineering and Methodology and Advances in Engineering Software) which were published during the period 1970-2020 were selected and used. The

keywords selected (Learning through a computer, laptop and mobile phones / apps related keywords including e-teaching, e-learning, Memory retention related keywords, including method, effect ,Learning and teaching methods in classrooms, E-platform related keywords, including note taking) as a part of the research also can be improved. Hard to find participants who are familiar with scripted languages for multilingual studies. This also affects the ability to generalize study findings to wider populations. Throughout the research, no participants choose visual note taking to take notes during the test. Future study may look into the visual note taking to find out the memory retention.

7.6 Research Challenges

Sometimes debugging is challenging, as error messages can be unclear, it's hard to figure out where the error comes from. Build can break without any reason due to the original folder getting corrupted. The performance of an Ionic-made app is a bit worse than that of a native app. For cross-platform applications, security issues need to be considered to arise in both cloud and native mobile applications.

7.7 Recommendations for future research

Future studies should add audio recording features into the note taking application to allow users to record some part of the lecture during learning since in preliminary study, found some scripts like Arabic and Chinese are slower to type, requiring more time to decode. Students are able to play back the lecture that covers new terminology and/or complicated material which must be remembered at their own pace and look again at specific topics they may not have fully understood the first time round. Someone for whom Chinese or Arabic are an additional language might find it difficult to interpret or understand everything that is covered during a lecture. Having the ability to re-watch will give them time to look up anything they are unsure of. If a student has a disability,

they may find it difficult to listen to a lecture, process the information, and make notes at the same time. A lecture recording provides an audio and visual record which students can repeat as many times as they need. Any part of a lecture can be found easily and played back. It also means an electronic version of the lecture is stored, so it is not a problem if handwritten notes are lost. Future studies can add a plugins or templates of shapes, SmartArt or Charts to ease the note taking process.

7.8 Summary

This thesis focused on the effect of memory retention on note taking methods in an e-learning platform, which plays a big role in pedagogy. This system is designed basically for the educational institute. In this study, the t-test analysis has been conducted and it is proven that taking notes leads to a high score which means better memory retention. A student requires effort to make an effective note taking strategy. This suggests that students should also be concerned about how they are learning the material when they are learning it. Research has found that students need to do stuff with the content they are interested in reading, writing, debating, and addressing issues in order to be successful in learning. This study concluded that each e-learning platform should have a note taking feature to ease the learning process.

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