TOWARDS AUTOMATIC MIND MAPS GENERATION OF THE HOLY QURAN: THE CASE STUDY OF SURAT AL-BAQARAH

BY

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ABSTRACT

Nowadays, the need to employ a new technology to update, support education and enhance studying in general but specifically the Holy Quran is of great necessity. One of these new technologies that is often used is mind maps (mind mapping) as it has been used for decades in schools and colleges for note taking and learning. Even though mind maps are beneficial in terms of learning, creating maps after reading and understanding a text takes a long time. Mind maps were used in Holy Quran learning, but the majority of the learners use the traditional method of Quran memorization, which is based on repetition. The use of repetition in the process of memorization makes it difficult to memorize. Individuals require more time and they tend to forget what they have just memorized. In order to avoid these problems mentioned earlier, some researchers worked on creating mind maps of the Holy Quran and discussed the positive impact on using a manual drawn mind map in studying and memorizing the Holy Quran. Creating mind maps of one chapter of the Holy Quran took a long time. Researchers worked on automatic creation of mind maps for the English, Croatian and Indonesian languages but not for Arabic language. Based on the literature review of this research, there is no research emphasizing the creation of an automatic mind map of the Holy Quran. Therefore, the aim of this research is to develop an algorithm that automatically generates the topics based on the mind map of a set of verses in the Holy Quran. The general idea of the algorithm uses the frequency of the Arabic root word to find the topic of the verses. This work is significant because it will enhance the understanding and memorization of the Holy Quran by viewing the concepts in a way that is easy for the brain to perceive. Moreover, it could help extract new knowledge from the Holy Quran from the generated mind maps and facilitate the understanding of Tafsir. This research found the topics of all sets of verses based on the Topical Mushaf and Al-Duwayish mind map of Surat Al-Baqarah. The algorithm results were evaluated with topics of expert scholars and the error rate of the algorithm was 25% with the Topical Mushaf and about 35% with Al-Duwayish mind map topics. This work is limited to extract the topics from the Qur'anic verses as an input for the mind map drawing. This research contributes to the field of automatic generation of mind maps of the Holy Quran and provides the algorithm that automatically returns the topics of a set of Qur'anic verses.

خلاصة البحث

في هذه الأيام، الحاجة إلى توظيف التقنيات الحديثة لتطوير وتحديث التعليم بشكل عام والقرآن الكريم بشكل خاص يعد مطلب ضروري، والخرائط الذهنية تعتبر من أهم هذه التقنيات، فهي طريقة تساهم بشكل كبير في التعلم، ومع ذلك فإنشاءها بعد قراءة وفهم نص معين يأخذ وقت طويل، وقد استعملت من قبل الطلاب الذين يدرسون القرآن الكريم ولكن معظمهم يستعمل الطريقة التقليدية لحفظ القرآن الكريم عن ظهر قلب، والتي تعتمد على التكرار، حيث أن هذه الطريقة تجعل عملية الحفظ صعبة وتأخذ الكثير من الوقت وتؤدي إلى سرعة نسيان ما تم حفظه، وتوجد حالياً القليل من البحوث التي تناولت موضوع إنشاء الخرائط الذهنية اليدوية من القرآن الكريم والتي ناقشت التأثير الإيجابي عند استعمالها مقارنة بالطرق التقليدية، كما توجد دراسات أخرى لإنشاء الخرائط الذهنية بشكل تلقائي ولكن من نصوص للغات أجنبية مثل اللغة الإنجليزية والكرواتية والإندونيسية، وبالمقابل لا يوجد بحوث لإنشاء خرائط ذهنية بشكل تلقائي من القرآن الكريم حسب ما تم التوصل إليه من المراجعة الأدبية في هذا البحث. أن هدف هذه الدراسة هو عمل خوارزمية لإنشاء الخرائط الذهنية من القرآن الكريم بشكل تلقائي، وهي مهمة لأنها ستحسن فهم وحفظ القرآن الكريم عن ظهر قلب وذلك بعرض المواضيع الأساسية للآيات على شكل خارطة والتي ستسّهل عملية الإدراك والتذكر، وكذلك ستفيد هذه الدراسة في استخلاص معارف جديدة من القرآن الكريم من الخرائط الذهنية، كما ستسهم في فهم التفسير ومقاصد الشريعة، ومن نتائج هذا البحث أنه وجد كل المواضيع الخاصة بمجموعات الآيات حسب تقسيمات المصحف الموضوعي وتقسيمات الخارطة الذهنية للدويّش لسورة البقرة، وقد تم تقييم نتائج الخوارزمية وكانت نسبة الأخطاء بمعدل 25% لمواضيع المصحف الموضوعي و35% لمواضيع الخارطة الذهنية للدويّش، ويقدم البحث مساهمة في مجال إنشاء الخرائط الذهنية التلقائية من القرآن الكريم كما يوفر الخوارزمية التي تقوم باستخراج المواضيع منه.

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DECLARATION

I hereby declare that this thesis is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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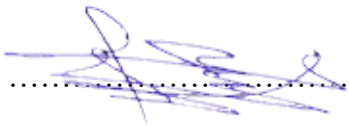
Signature:  Date: 10 March 2021

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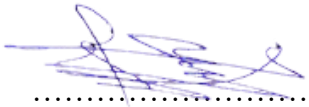

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This thesis is dedicated to my family.

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LIST OF ABBREVIATIONS

3D	Three Dimensions
5W+1H	What, When, Where, Who, Why and How
ASCII	American Standard Code for Information Interchange
AI	Artificial Intelligence
CAI	Computer-Aided Instruction
CSS	Cascading Style Sheets(Jephos, 2020)
FTP	File transfer Protocol
HTML	Hypertext Markup Language
IE	Information Extraction
IR	Information Retrieval
IT	Information Technology
JPG/JPEG	Joint Photographic Experts Group
JSON	JavaScript Object Notation
KAOS	Keep All Objects Satisfied
KB	Kilo Byte
MM	Mind Map
MWE	Multiword Expressions
MWT	Multiword Term
NER	Named Entity Recognition
NLP	Natural Language Processing
PBUH	Peace Be Upon Him
PDF	Portal Document Format
PHP	PHP: Hypertext Preprocessor

PNG	Portable Network Graphics
POS	Part-of-speech
QAC	Qur'anic Arabic Corpus
RA	Radhi Allahu 'anhu (May Allah be pleased with him)
SQL	Structure Query Language
SVG	Scalable Vector Graphics
SWT	Subhanahu Wa Ta’ala (Praise be to Allah and the Most High)
VR	Virtual Reality

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

This section of the research discussing the modern technology used in teaching and learning. It focuses on the modern technology related to education in general and specifically the new teaching technologies of the Holy Quran. Finally, it presents the mind maps technology, which is a trending technology used in enhancing the teaching and learning in relation to the Holy Quran.

1.1.1 Modern Technology

With the advancement of modern technology, it is evident that the relationship between science, education, and religion has become increasingly reliant on each other. Modern technology provides support and enhancement in many areas like employment, communication, health, education, agriculture, recreation and leisure.

Technology can save more lives by providing treatment to more sick people as the use of computers provide a big jump to the use of technology. It enhances communication, saves time and simplifies the research as this allows purchases, sales and exchanges to be implemented faster worldwide. At the industry level, modern technology increases productivity and the process of monetary transactions has been transformed to the use of digital coins like bitcoins provides us with other alternative ways of conducting business transactions compared to the traditional ways of transaction. Moreover, technology replaces the physical storage units of documents to virtual storages allowing easy access to them anytime and everywhere. With

technology, employees and workers produce more and work less. This enables them to exercise and take care of their health by working in a safer environment (Ismail, 2017).

New emerging technologies are being developed every day and some of these technologies include unhackable internet, hyper-personalized medicine, digital money, anti-aging drugs, AI-discovered molecules, Tiny AI and many more. Below are some of these novel technologies:

- **Unhackable internet** is one of the top breakthrough technologies in 2020. It enables the transmission of unhackable information between cities via fiber-optic cables using quantum technology. The connection uses entanglement of photons on quantum behavior of the atomic particles, which cannot be read without distracting their content (Juskalian, 2020).
- **Hyper-personalized medicine** are new drugs that are designed for a unique genetic mutation. The problem is that it is costly to create one drug for a single patient. This problem with the use of this novel technology is solved (Regalado, 2020).
- **Digital money** is a technology used by many big companies these days. Facebook has unveiled a new global digital currency and named it Libra. On the other hand, People's Bank of China is working on issuing a new version of its digital money to replace the physical cash (Orcutt, 2020).

There are many other new technologies in different fields, but this research has similar attributes with the latest technologies that are related to education and learning. Therefore, the next section is about these technologies.

1.1.2 Technology in Education

In every sphere of education, technology has been integrated to enhance learning efficiency and improve the learning experiences of students. As cited by Bain (Bia09), computer technologies are an important aspect of learning and teaching. They include tools such as word processing, research, multimedia projects and communication. These technologies enhance students' abilities and improve their learning process which might also boost the development of the devices that assist students with severe disabilities in terms of hearing, speech and blindness and assist them in coping with their disabilities. The integration of technology with the learning environment benefits all students.

Nowadays, computers come in different shapes and sizes as they are widely used to support education and learning at schools and colleges. Teachers use them in teaching by preparing presentations, taking student attendance, entering and submitting student grades etc. Students on the other hand use them to search for information on the internet to do their assignments, download lectures, communicate with their teachers etc. Computer-Aided Instruction (CAI) is one of the available education technologies that has a positive impact on students as it has increased student's access to information. CAI enables students to visualize objects that are hard to view in a vivid form. These technologies sharpen students' skills and make them learn more in a shorter time. Moreover, CAI allows students to develop positive attitudes towards their classes and learning which in return allows teachers to be more enthusiastic in accomplishing teaching goals and in enhancing teaching cooperative group work (Jianhong, 2010).

E-learning changed the traditional teaching by using new technologies which includes telecommunication and advanced computing. It provides qualitative education compared with the traditional education by providing richer access to various types of the latest information on the internet. The information can be processed by the computer

and presented in a new graphical visualization that is easy to understand (Jianhong, 2010).

This section of the research has discussed in general the new technologies used in education which includes the hardware tools, software tools and e-learning method of teaching. Next, the research would be discussing specifically how the latest technologies are used in teaching the Holy Quran.

1.1.3 Teaching The Holy Quran

The Holy Quran is a miracle from our Prophet Mohammed PBUH, which was derived directly from Allah SWT. It consists of 114 chapters and these chapters are called surah in the Arabic language. Every chapter consists of a set of verses. Each verse is called Aya in the Arabic language. Muslims are required to understand the Holy Quran and apply it in their daily life so as to bring them success in this life and the hereafter. Our prophet PBUH encourages us to recite and memorize it to get recompensed from Allah SWT. Ibn Mas'ud RA reported: The Messenger of Allah PBUH said, "Whoever recites a letter from the Book of Allah, he will be credited with a good deed, and a good deed gets a ten-fold reward. I do not say that Alif-Lam-Mim is one letter, but Alif is a letter, Lam is a letter and Mim is a letter." (Surah, 279H)

The field of theology in general has utilized innumerable technological advancements regardless of faith, and have been embraced by religious scholars, in particular for purposes related to this current research effort in supporting Islamic Studies and the chapters of the Holy Quran. In this era of modern technology, knowledge and learning materials are transferred through the internet to anyone and anywhere.

Basuhail (2013) cited that the Holy Quran teaching and learning efforts include memorization, translation, and interpretation. All new research uses modern technologies to achieve these efforts like the computer and the internet. These technologies break the limitation of geographic location of students and enable them to be connected with teachers from all over the world. These days, instructors are empowered by software and tools that make the teaching materials active, attractive and vivid. Moreover, the use of computer graphics and animations speedup and assist the e-learning process and save the instructor and student time. Some of the efforts that describes the importance for the Holy Quran are:

- AlZoubi (2013) presented a model called the Electronic Miqrah, which is used to enable online communication between the student and teacher through images and voice of the Holy Quran recitation. This teaching method facilitates learning of the Holy Quran recitation and Qira'at science for students who cannot attend Quran schools or memorization circles especially for women in conservative societies. This model uses the traditional method of teaching the Holy Quran based on recitation and repetition via the internet, but it does not involve new technique like mind maps in teaching.
- With the growth of the new Information Technology (IT) in the Muslim world, specialized research centers have been established to serve the Holy Quran in the IT field. The NOOR research center in Al-Madinah Al-Munawwarah is one of the first research centers that is concerned with utilizing IT related sciences to serve the Holy Quran. There are many open-source, commercial applications and software that help to

propagate and teach the Holy Quran (Alsamarrai, Tayan, Abbod, & Alginahi, 2013).

- Alomary and Fallata (2013) review some electronic websites that provide the Holy Quran teaching via the internet, which provide voice chat rooms to help students correct their Quran recitation and review memorization. Most of these websites use the traditional teaching methods including mind maps technique into these websites is going to enhance student understanding and promote learning.

There are more efforts in serving the Holy Quran learning using the new technologies. Some of them involve mind maps method to enhance students' understanding of the Holy Quran verses by the students. Before presenting these efforts, the researcher starts by providing more information about the mind maps in the next section.

1.1.4 Mind Maps

There is a well-known saying that “A picture is worth a thousand words”. Mind maps are used to apply this saying by converting the knowledge of long text to a short and precise text for the brain to perceive. The coming sub-sections provide more details about the mind maps and include the definition, characteristics, types, implementations and implications.

1.1.4.1 Definition of Mind Maps

Mind maps are a trending modern technology that is used in studying and understanding information and it is the process of learning how to learn. Buzan was the first one to use mind maps (as cited in Elhoseiny & Elgammal, 2016). Buzan (1974) defines mind map

as a diagram used to outline the information visually. Selvi and Chandramohan (2018) cited that mind maps are effective in note taking which are dynamic and non-linear.

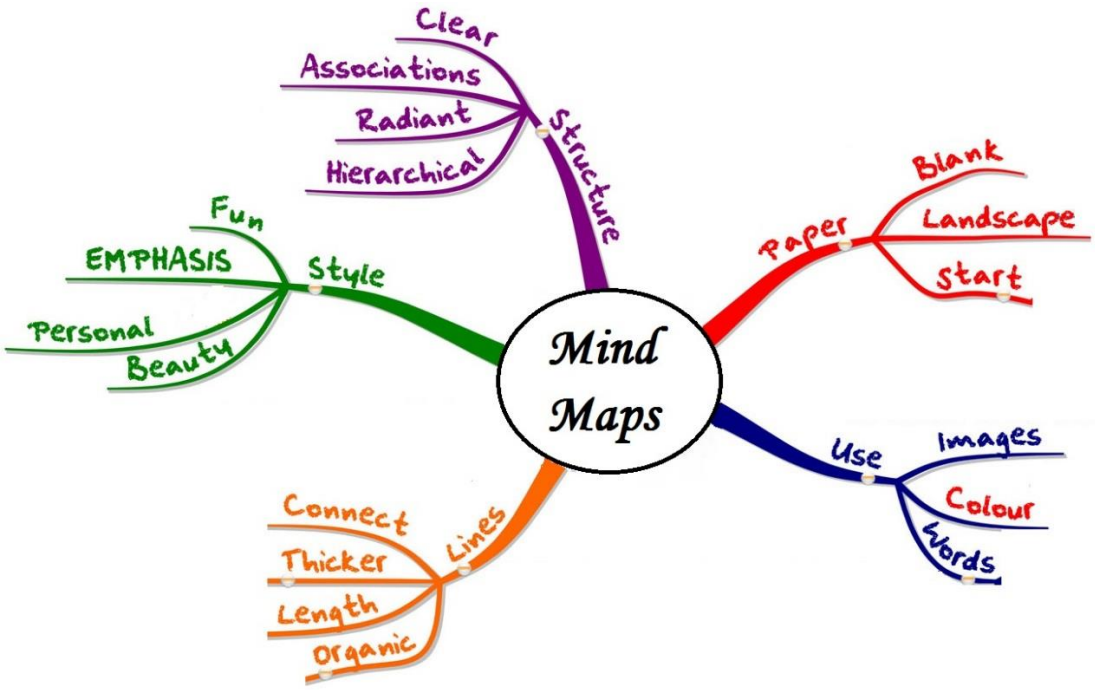

Figure 1.1: Example of a mind map (Tanguay, 2020)

The mind map starts with a main topic in the middle and has branches of main subjects of the topic. An example of a mind map is presented in Figure *1.1*. The main topic in this example is Mind Maps. The branches of this mind map explain the main topic. They explain the structure of mind map, type of paper used in mind map, things used in mind maps, lines properties of mind map and styles of mind map. It is clear to notice that all branches talk about the main topic, which is “Mind Map”. Each branch can have sub-branches. For example, the “use” branch explains the things that could be used in mind maps, which are images, colors and words. Buzan (2006) has mentioned the guidelines in drawing a mind map. He recommends using pictures, words, and colors. The relationship lines should be thicker from the central and thinner as they radiate. Every

word in the mind map should have a clear picture, and the style of the mind map can be used according to preferences.

In the past, mind maps have fewer uses for outlining information with a pen and a paper but now they can be drawn using a computer and can include more styles and images and are easily modified.

1.1.4.2 Characteristics and Types of Mind Maps

Mind maps have many characteristics that are essential in creating them. The main topic or idea is placed at the central image. The branches that radiate from the central image provide the main themes. Each branch includes a keyword or key image with twigs of lesser important topics that are relevant to the branch and these branches structure a form of connected nodes (Mind Mapping, 2020). According to Yang (2020) mind maps come in three types as follow:

i. **Library Mind Maps** used in information organizations that provide a visual and clear understanding of the topic. It is mainly used to organize and sort the information collected about a specific topic.

ii. **Presentation Mind Maps** is used to illustrate the steps of a project to the audience. It focuses more on the audience but not in the subject of the mind map. Positioning the information in it depends on the audience's understanding and this determines how well the mind map is structured. This type of mind maps is good for presenting a process of an idea, explaining a training session of activity.

iii. **Tunnel Timeline Mind Maps** or also called planning mind maps is used for program plan, project strategy or problem solving. They are designed to achieve a specific goal and visualize success. The central main subject of