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## Review of the Presentation of the Qur'anic Text Up To the Qur'anic Maps

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### ABSTRACT

Efforts that make a difference in the way people read, recite, memorize, understand the Holy Qur'an, and absorb the great teachings it contains are usually welcomed by millions of Muslims worldwide. This proposed study aims to provide a historical review of the enhancements which have been made to the Qur'anic text, both in the textual and technical levels. It covers the development that took place in four presentation areas: the initial text presentation, development in text-decoration, computation and digitization, and the uses of graphic organizers and concept and mind maps.

**Keywords:** Qur'an, Concept maps, Qur'anic mapping, Qur'anic computation, Topical classification.

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### 1. Introduction

Efforts that make a difference in the way people read, recite, memorize, and understand the Holy Qur'an, and absorb the great teachings it contains are usually welcomed by millions of Muslims worldwide. Consequently, numerous benefits can be gained when instructional texts are illustrated (Carney & Levin, 2002). For instance, text illustrations can add to readers' enjoyment and interest, arouse their emotional response, affect their attitudes, and be efficient in communicating information difficult to express in words (Levie & Lentz, 1982).

Our recent realm of Qur'anic sciences is rich in multimedia web resources (Abdelhamid, Mahmoud, & El-Sakka, 2013). Additionally, natural language processing leads to the invention of Qur'an ontologies due to the continuous demand for Islamic knowledge where the system developed by Yauri, Kadir, Azman, and Murad (2012) represents a modern example. Ultimately, numerous successful efforts

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have been made to build ontologies (Alqahtani & Atwell, 2016) which help users understand language structure easily and assist in knowledge sharing (Elyana, 2009).

The current study aims at reviewing, in a chronological manner, three broad categories of literature: history and development of the Qur'anic text, Qur'anic computation, and Qur'anic digitization. Based on that, it provides a review of the literature related to the use of concept and mind maps and how it contributes to the representation and understanding of the Qur'anic text. It is noteworthy here that each one of the four categories gives the impression of a refining development and an essentially complementary aspect to the other.

Moreover, this study provides an attempt to review the literature that adopts the use of graphic organizers, Qur'anic computation, and Qur'anic language processing. It is then very surprising that the aspects of the said Qur'anic fields of study do not appear as have been reviewed in such an inter-related and interdisciplinary manner all through their appearance in the science. So, this review of literature will work as a distinguished attempt to cover that highly remarkable advancement in the field of Qur'anic computation and Qur'anic digitization studies. The current review was planned to explore the quality, nature, and extent of the specific literature up to this date.

## 2. Methodology

The current study built its search methodology on tracking the development of the presentation of the Qur'anic text and the way it is being displayed throughout history. The study benefitted from the results of a comprehensive traditional internet-based search including Google Scholar, Google, etc. Regarding the development in the technical development of the use of visual aids in presenting the Holy book, a parallel search covered the production of the Mushaf in a chronological manner. The third theme of the study which cares for the development of the digitization of the Qur'anic text and the related sub-fields such as the use of visual aid, graphic organizers, and mind maps and concept maps in presenting the Qur'anic text. The search results encompass the related literature as well.

## 3. History of the Qur'anic text

This part of the current study is a diachronic approach that studies the historical development of the presentation of the Qur'anic text through time. Furthermore, it is a paleographic follow-up that reviews models of the ancient writings and scriptures of the Qur'anic Mushaf. It also is a comparative approach that focuses on similarities and differences of the different schools that worked on the Qur'anic text and scripture representation and the meant objectives and the specific Muslim communities targeted by Mushaf printing.

A widespread report states that at the time of Prophet Mohammad's death, the Qur'anic text was written only upon primary animal and plant materials such as "leafless palm-branches and stumps of palm-branches, or other material support such as the shoulder-blades of camels, ribs of animals, white or flat stones, pieces of cloth or of skin, or papyrus, or wooden boards, etc." (McAuliffe, 2006, p. 44). Ultimately, it has been related to numerous narratives that the Qur'anic text was collected from the materials mentioned above. Moreover, the only reason behind writing down the Qur'anic text was the preservation and protection of it from loss or falsification. It is also worth mentioning here that, most of today's objectives were not among Uthman's list of goals; being the first Islamic Caliph to order the collection of the Holy Qur'an. Obviously, today's objectives of Qur'anic text representation look diverge and range between comprehension, memorization, recitation, translation, etc.

### 3.1 Visual Aids of the Qur'anic text

Efforts that make a difference in the way people read, recite, memorize, understand the Holy Qur'an, and absorb the great teachings it contains are usually welcomed by millions of Muslims worldwide. Consequently, numerous effects can be gained when instructional texts are illustrated according to Levie and Lentz (1982) who argue that text illustration can add to readers' enjoyment and interest, arouse their emotional response, and affect their attitudes. Likewise, they - text illustrations - might be efficient in offering spatial information and descriptions that are difficult to be expressed in words.

The current domain is limited to the reflection of the Qur'anic features in a visual way. This category encompasses a variety of works such as printed paper formats of the Holy book. Historically, the competition took place in demonstrating the Qur'anic text in attractive ways benefiting from the most advanced and state-of-the-art writing and printing technologies available at each specific time and place in the world.

Interestingly, the relationship between the representation of the Qur'anic text - which was first an oral text (McAuliffe, 2006, p. 146) - and graphic organizers have emerged since the first calls for the collection of the Holy Qur'an during the Prophetic era. That could be clearly observed in the use of wonderful calligraphy and penmanship on the first Qur'anic manuscripts. Building on (Figure 1), the parchment folio is extracted from a Qur'an manuscript written in the seventh or early eighth century in the Hijazi script (McAuliffe, 2006, p. 41).

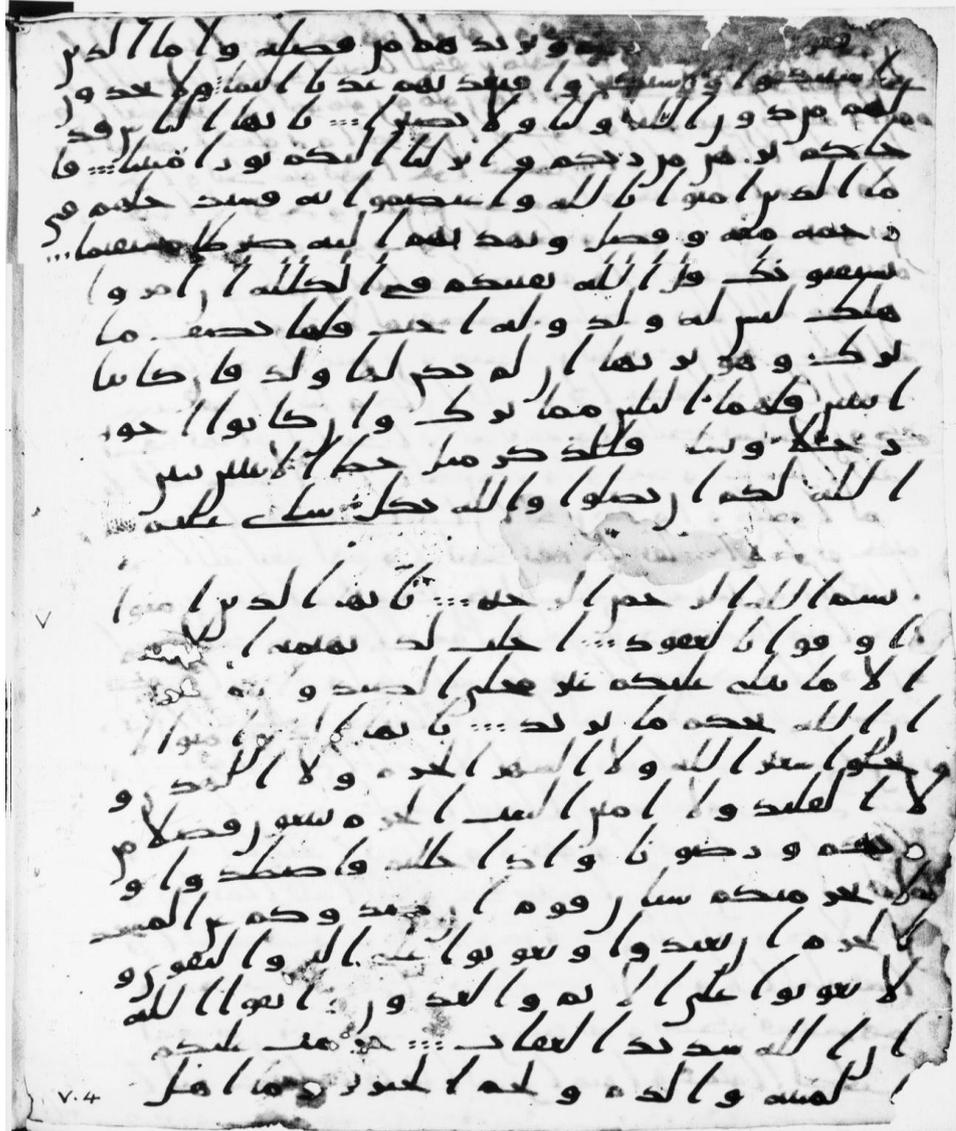


Figure 1. Parchment folio from a 7th- or early 8th- century Qur'an manuscript in Hijazi script (McAuliffe, 2006, p. 40)

Historically, chronological efforts to represent the Qur'anic text for linguistic and comprehension purposes such as clarity, better understanding, beautifying, recitation, exegesis, translation, and finally topical classification have never stopped since the first days of the nascent Islam. This fact is inescapable and proved by the extraordinary development of Mushaf throughout Islamic history. The following selective set of images could better tell the technical and graphical development of the representation of the Qur'anic text.

This parchment folio reveals a set of early Qur'anic text presentation features such as the absence of dots on the Arabic letters. Additionally, names of the Qur'anic surahs (Surat An-Nissa followed by Surat Al-Ma'da are included in Figure 1) are not included at the beginning of each surah, whereas albasmalah “الرحمن الرحيم الله بسم” is obviously listed before the first ayahs. Similarly, no decoration system is adopted here, like any other Qur'anic manuscript found in that era, of which no paleographical evidence to prove its relation unequivocally to an exact period before the ninth Hijri century, according to (McAuliffe, 2006, p. 147).

It is obvious in (Figure 2) the Mushaf which was scripted in the eighth Hijri century on a gazelle's leather that some advanced features have been added to the way the Qur'anic text used to be

presented. Apparently, a brief comparison between (Figure 1) and (Figure 2) will reveal a remarkable change in numerous features in (Figure 2) such as upgrading of the material of scripture, use of dots on letters, use of diacritics, enlisting of names of Qur'anic surahs, change of fonts, and use of Islamic ornamentalations and decoration.

Considering that “visualization is a human cognitive activity” and “act or process of interpreting in visual terms”, Aida Mustapha (2009) argues that a well-visualized Qur'anic text enables readers to clearly, precisely, and efficiently communicate content. Additionally, she believes that the Holy Qur'an is a “large information system” that requires suitable visualization of its text.

Likewise, Lubna Almenoar (2010) designed a special technique in a lesson plan setting using a selected English translation of a group of Qur'anic ayahs to promote the learning process at the undergraduate level. In her project, “Procedure with Graphics Using Quranic Verses in English”, she chose a Qur'anic text for critical reading. She considers visual aids as the skeleton of presentations, think-aloud activities, and analytical and evaluative exhibits of a researcher’s data. She also believes that many students appear as visual learners for whom a visual method for organizing information or brainstorming is the essential and valued approach. Furthermore, graphic organizers enable students to create ready-made mental images of the given information and produce graphic representations for those pieces of information.

Almenoar (2010) concluded that her set of intended learning outcomes were achieved at the end of her teaching session thanks to the integration of graphics, the English translation of Qur'anic verses, and appropriate classroom activities. For assessment, she

involved criteria of task completion, the ability of understanding, participation in brainstorming, ability to connect ideas, expression of knowledge, creativity, and the ability to make choices in tasks. Such assessment reflects learners’ performance in both the academic and social levels.

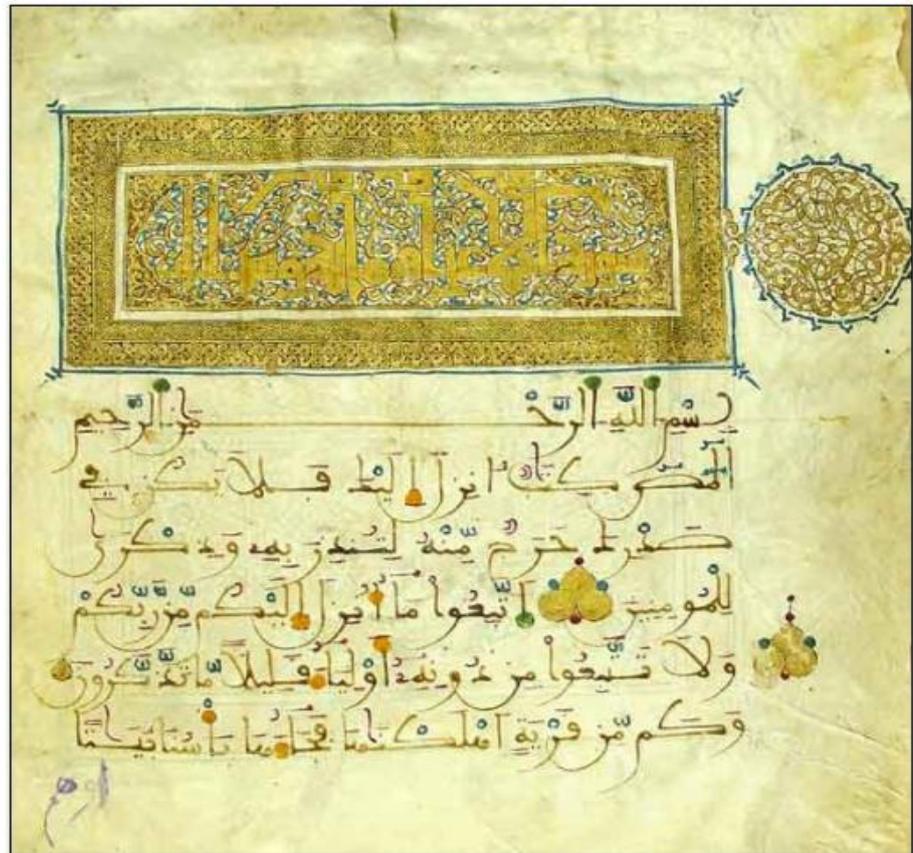


Figure 2. Mushaf scripted in the 8th century on a gazelle’s leather

Graphic Organizer 1

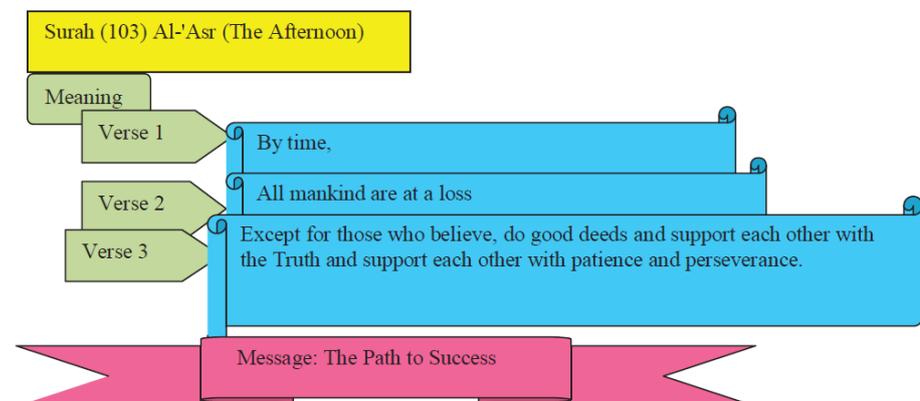


Figure 3. Graphic organizers created by students (Almenoar, 2010)

### 3.2 Qur'anic computation

Strikingly Ong (1992) counts the effects of all sorts of text production and reproduction as the main steering power that controls human's thoughts in their various formats as stating that "Writing, print, and electronic devices of various sorts are all devised to deal, directly or indirectly, with the word and with thought itself". For Ong, technologies have bodies, touchable mechanism, and psychological outputs that could be measured and evaluated. These technologies have a deeper effect and remarkably control man's psychological nature, consciousness, and the way he processes knowledge; "Indeed, in a curious way they enter into man's interior itself, directly affecting the way in which his consciousness and unconsciousness manage knowledge, the management of his thought processes, and even his personal [self-awareness]" (Ong, 1992).

The Holy Qur'an, as one of the human's vivid cultures and activities, has been affected by the technological change through history. First, it passed from its orality nature to the written script in the Prophetic era. Later, it has not stayed isolated and untouched when the shift from script to print took place in the fifteenth century. Similarly, the presentation of the Qur'anic text accepted the application of numerous beautifying aspects in its oral, scripted, printed, and digital forms. For instance, the appearance of Tajweed to care for the presentation of the oral text, ornamentations to beautify the scripted and printed texts, while the digital and e-forms worked on amplifying the use of previous beautifiers (Tajweed and ornamentations) and invented their presentational elements and even sciences such as concept and mind maps (the main issue of the current study).

So, the Qur'an, being the central religious text of Islam, ordained any effort of a computational and linguistic nature on its texture to be known as Qur'anic computation (Kammani & Safeena, 2014). Typically, Qur'anic computation is the movement of simplifying the Qur'anic text and sciences for e-learning, where there is a considerable increment in the use of the tools and software of mapping for educational purposes such as assessment and linking of related concepts (Davies, 2011). Likewise, Abdelhamid et al. (2013) state that the field of Qur'anic sciences now has a huge wealth of multimedia resources in the web platforms that include many categories such as Tafsir, recitation techniques, and the Qur'anic stories. That is in addition to a great deal of specialized audiovisual resources for children which have their obvious impact on teaching them the various introductory aspects of the Holy Qur'an such as basics of recitation, Qur'anic stories, and meanings.

Qur'anic computation is a broad term that involves the momentous change in basic assumptions in the processing of the Qur'anic text according to several linguistic sciences such as syntax, discourse analysis, digitization, and semantics. Some of these were serious attempts to provide the researchers of the Qur'an with statistical data helpful in carrying out numerical sort of research to prove the uniqueness and miraculous nature of the Qur'an as the word of Allah. Others tend to perform rhetorical research aiming at providing the Qur'anic readers as well as the Qur'anic researchers with authentic linguistic information that reflect the outstanding, miraculous, and matchless texture of the Qur'an. Ultimately, Qur'anic text processing is the linguistic business of a lot of scholars especially linguists who took the burden of investigating the Qur'anic texture for the extraction of the many textual features within the field of syntax, semantics, and ontology. The third of these domains dealt with the linguistic features using multidisciplinary tools including visual charts, concept maps, computer and internet systems in a full automotive process aimed at an authentic recognition of the abovementioned findings.

### 3.3 Concept maps and mind maps

The Qur'anic text has its educational and learning processing difficulties as expository textbooks always do when it comes to comprehension and recalling (Taylor, 1982). Griffin and Tulbert (1995) accordingly, argue that expository texts are full of complex principles and concepts, difficult vocabularies, peculiar typographical features, and unfamiliar linguistic structures. They also argue that learners should get acquainted with and integrate all the said sets of information in order to make them of sense and value. Consequently, the learner's need to manage, organize, and re-present that much of density of information and linguistic rules is driven by the necessity to utilize the concept and mind maps to perform the said tasks. Similarly, when learners attempt to construct and reconstruct

meanings they need to integrate the new knowledge with their old knowledge they have in their cognitive structure (Novak, 2002).

Novak (2002) reports that two facts are universally agreed upon: that the construction of meanings in humans takes place at their birth and rapidly accelerates as they gain the capacity of using language to code meanings for objects and events around them. The second fact is that some of the meanings they construct are limited or faulty, the thing that could impede or distort the construction of the new meanings. Furthermore, Novak describes the meaning-making process as proceeds according to the perception of new regularity in objects or events, or records of objects or events, that leads to the formation of concepts and construction of new propositions.

Ultimately, Qur'anic maps may work as facilitating tools for both regular and slow learners. Preferably, Qur'anic concept maps here are presented the way they appear to Novak (1990) as (widely applicable metacognitive strategies). Furthermore, regarding the slow learners, Udeani and Okafor (2012) argue that they may bring a deficiency of knowledge that is considered necessary for their success in reading. So, Qur'anic maps are set to assist them to acquire that missing information through suitable techniques of knowledge organization, linguistic structuring, comprehension, and recalling.

Mapping of the Qur'anic concepts without quoting the absolute text of verses in the previous literature was dominant up to this current study. Although there is extensive literature written by Muslims and non-Muslims on the Qur'an (Rahman & Moosa, 2009), only a few scattered mapping attempts were there, but they were limited to some verses and for limited purposes, such as memorization, teaching, or handling of exegetic issues. In this regard, the current study is aiming at shedding some light on giving a detailed visualization of the Qur'anic textual constructions, thematic building and diversity, and conceptual interlinks and chaining.

Therefore, tracing the output literature concerning the mapping techniques requires a careful distinction between two broad categories of approaches. These categories include those who have adopted the use of (conceptual or mind) maps for applying the Qur'anic themes or topical classifications previously existing in the Qur'anic studies on the one hand, and those who have adopted the mapping techniques - in a limited way, to visualize the construction of the Qur'anic texture on the other hand.

Alternatively, in 2012, Safiah Alsuhaibani's work "Mental Maps of Quran" (Alsuhaibani, 2012) was a quite distinguished work that succeeded in mapping all major and minor concepts of the Surahs of the Holy Qur'an. Typically, it gathered every set of verses that share one concept under a subtopic branched from the main topic of the whole surah. The main objective of her book is to provide those who want to memorize the Holy Qur'an with a concept-based manual that could change the previous way of memorization to a more organized strategy built on the topical interpretation of the Holy Qur'an (Alsuhaibani, 2012, p. 5). Her mental maps aimed at creating a new type of Qur'anic memorizers who are able to know the meaning and exegetic concepts of what they keep by heart through simple steps, (See Figure 4). The process of memorization is a two-way process that requires that the reader understands the topic of the verses they are going to memorize, then opens the Mushaf for the repetition of the selected verses in order to master their memorization.

Alsuhaibani's distinguished work based on summarizing each specific surah in one simple and comprehensive mind map. An example of that, we may find Surat Al-Baqarah, the longest surah in the Holy Qur'an (286 verses) topically summarized in one mind map (Figure 4). She mentioned brief descriptions of the topics that the specific surah contains. That way of topical classification combined two key features; topics were mentioned in a very brief way allowing users to explore the very long surahs of the Holy Qur'an on one page. In addition to that, numbers of the ayahs included in the specific classified topic were mentioned as well, allowing the Qur'anic reader to be connected to the topical classification through a well-tied numeric system.

Many noteworthy differences are easily distinguished when Alsuhaibani's work is compared to the way Alajlani's Colored Topical Classification Mushaf or Swwar's Colored Topical Classification Mushaf are prepared. The reader of Alsuhaibani's maps will face the need to accompany the Mushaf while browsing the maps to imaginarily draw colorful topical classification highlights according to the grouping of ayahs set by the map (Alsuhaibani, 2012, p. 4). This process may leave Alsuhaibani's maps of no use if the reader uses a colored topical classification Mushaf that presents marginal topical classification legends.

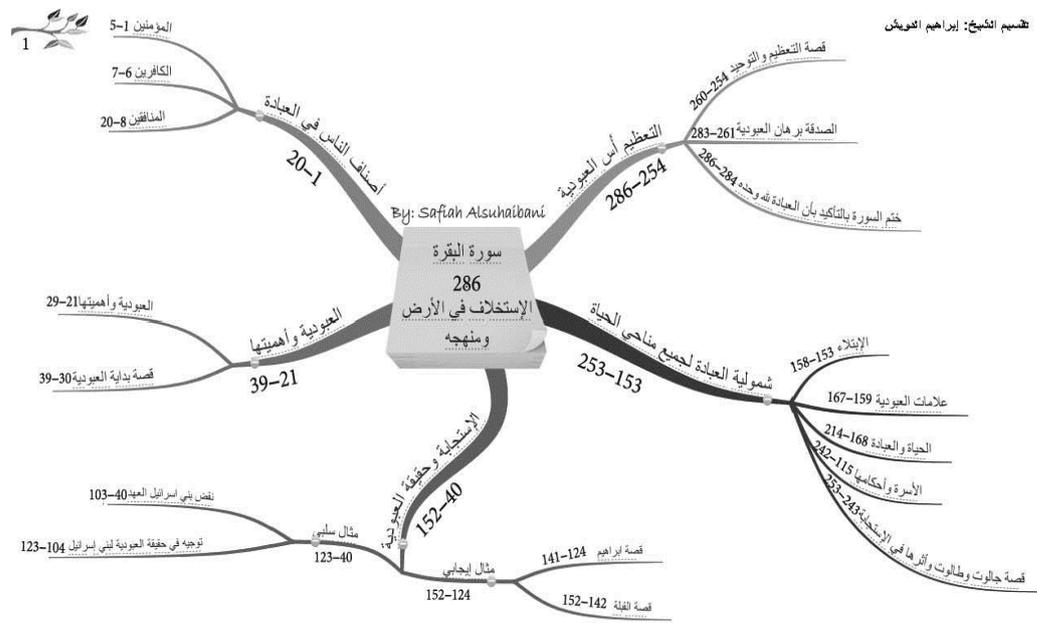


Figure 4. A model of Safiah Alsuhaibani’s mental maps: Mental Maps of Quran, (Alsuhaibani, 2012, p. 1)

A clear example for the digitization of the Qur'an is another distinguished work which utilizes visual aids to focus on highlighting the similarities in the Qur'anic texts, is exposed on a Facebook webpage entitled as

"تأملات في الأم تشابهات" "T'ammulat fil-mutashabihat". The work was established and launched in 2013 as a Facebook webpage run by a group of members who participate regularly in creating visual aids and concept and mind maps to investigate and shed light on homologues and repetition of certain words, phrases, sentences, or even complete verses all through the Qur'anic discourse (T'ammulat-fil-mutashabihat,

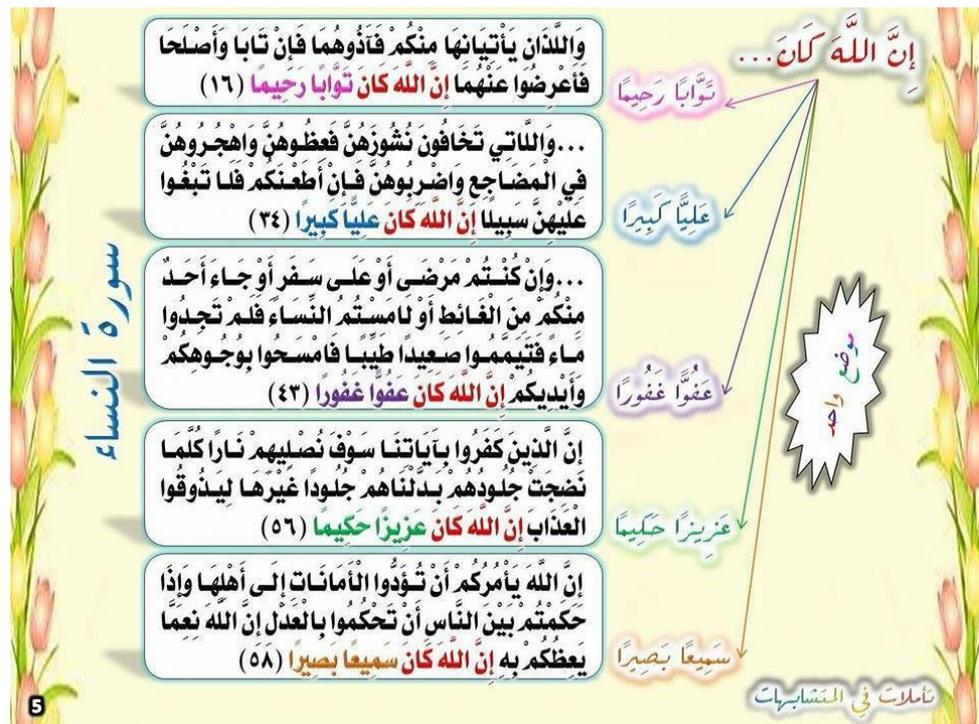


Figure 5. An example of T'ammulat fil-Mutashabihat's work (T'ammulat-fil-mutashabihat, 2016)

2013). Helping Qur'anic readers to memorize, connect ideas, and care for the many ways the Qur'an uses to tell things are among the objectives of the website.

Mohammad Allibaih’s works (Allibaih, 2019) and (Allibaih, 2020) represent a new landmark in the use of concept and mind maps in the presentation of the Qur'anic text. Technically, Allibaih’s work depended on utilizing XMind 7 (v3.6.0.R-201511090408) software for designing the concept and mind Qur'anic maps. Additionally, for the textual and conceptual levels, his study has benefitted from Ibn Kathir’s topical classification and exegetic commentaries in Al-Misbah al-Munir fi Tahdhib Tafsir Ibn

Kathir (Al-Mubarakpuri, 2013). The text Qur'anic maps consisted of the original Arabic Qur'anic text and the English translation of its meanings known as Sahih International. Both texts – original Arabic text and the translation of its meanings - have been extracted from the website <http://quran.ksu.edu.sa/> the Electronic Mushaf of the Deanship of E-Transactions and Communications, King Saud University, KSA.

Allibaih's work (Allibaih, 2019) attempts to investigate the virtual relationship between the Qur'anic maps – as a means of conveying meaning, embodying concepts, and re-presentation of the Qur'anic text - and the various linguistic theories. Whereas his second work (Allibaih, 2020) aims at providing an in-depth coverage of the nine multiple intelligences – frames of mind - theorized by Howard Gardner in his literature such as (Gardner, 1993a, 1993b, 1995, 2003). Allibaih (2020) addresses the nine types of intelligence by extracting the Qur'anic ayahs where each of the nine intelligences is the exact Qur'anic addressee. The following is an example of a related Qur'anic map showing how the existential learner's big questions are answered in the Holy Qur'an (Figure 6).

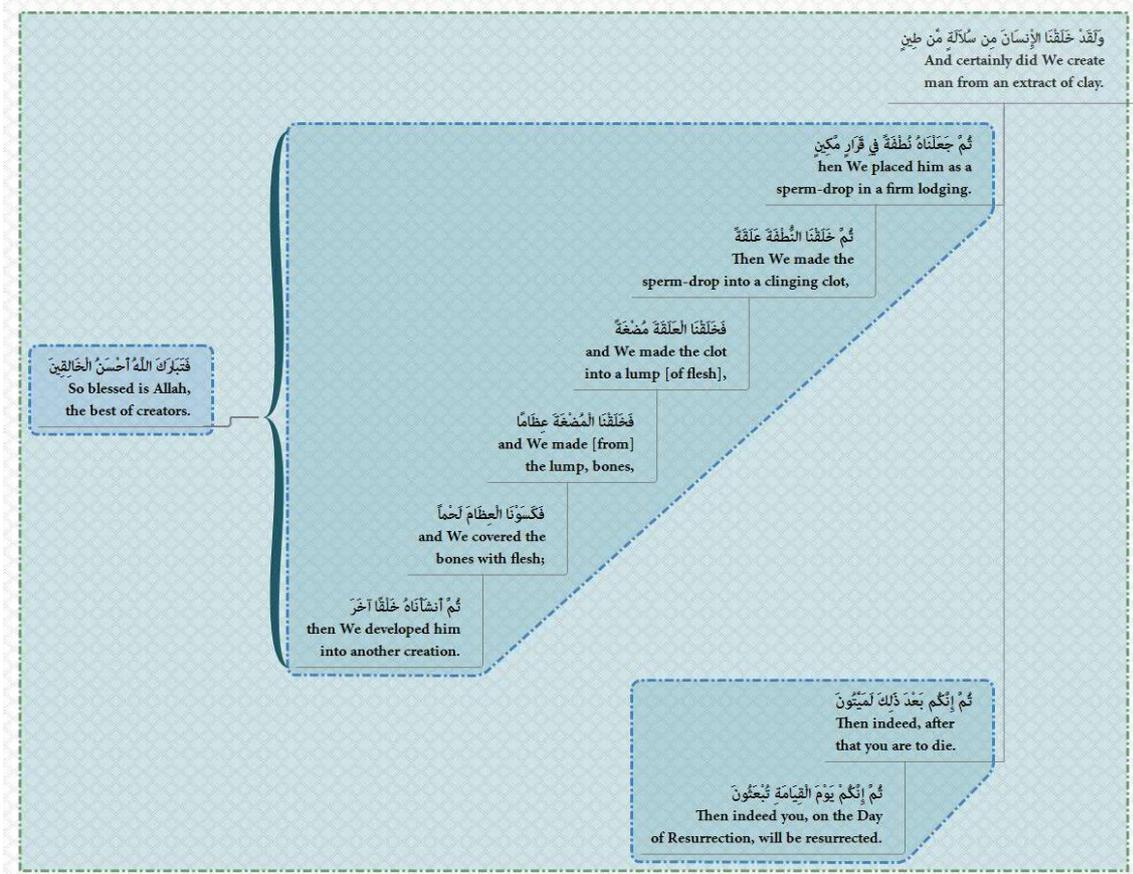


Figure 6. Surat Al-Mu'minun (Q23:12-16) (Allibaih, 2020)

### 3.4 Qur'anic digitization

The notion of the automatic processing of natural language has emerged in the 2nd half of the 20th century (Bolshakov & Gelbukh, 2004, p. 16). It has been reported by numerous studies that the development of the Qur'anic text from its common scriptural codex form to digital formats has attracted more and more Muslims to rely on the electronic versions (Khan & Alginahi, 2013; Rippin, 2013; Yauri et al., 2012). That turning point opened the door wide for a great deal of Qur'anic-related research, conferencing, software enhancement, technological advancement, and linguistic theorization and application.

### 3.5 The Qur'anic Arabic corpus online

Dukes and Habash (2010) provided what they called “an annotated linguistic resource” which encompasses several unique features aiming at offering an authentic linguistic resource that provides various annotation layers. The corpus uses dependency grammar for morphological segmentation,

part-of-speech tagging, and syntactic analysis of the Qur'anic corpus using dependency grammar. They admitted that “processing Quranic Arabic is a unique challenge from a computational point of view”. Their online Qur'anic Arabic Corpus was made available as an open-source at <http://corpus.quran.com> and as a multi-stage approach to solve the morphological annotation of the Qur'anic Arabic. It demonstrates the morphological analysis of every Qur'anic word by visually representing its morphological segments (Figure 7). The sort of visual presentation of the separate units of the Qur'anic text provides colorful clarification of each part of speech in the result of the searched text along with the matching syntactic annotation.

The website provides a bilingual search in the Qur'anic words through a drop-down menu as well as a search box. Other valuable facilities contain a Qur'anic dictionary, several English translations of the meanings of the Qur'an, syntactic treebank, an ontology of concepts, and an Android application for mobile phones. The website also provides an open-access forum for registered members to comment, send corrections if any, and discuss accuracy issues, ... etc. Dukes and Habash (2010) consider these suggestions and comments as beneficial in increasing annotation accuracy.

The website <http://corpus.quran.com/> has become a resource that is widely used by Qur'anic and Arabic researchers as well as the general public who seek online tools to explore and understand the Qur'an (Atwell, Brierley, Dukes, Sawalha, & Sharaf, 2011). Dukes and Habash (2010) argue that the mapping technique in the Qur'anic corpus was required for converting to the required Qur'anic tag set. Furthermore, the knowledge representation in the Qur'anic Ontology of the <http://corpus.quran.com/> is used to define the key Qur'anic concepts and embody their interrelationships using predicate logic. Their work went on toward extracting the Qur'anic named-entities and concepts and their ontological links and interrelationships to resolve the pronominal anaphoric references of the said Qur'anic concepts (Atwell et al., 2011).

The screenshot shows the website interface for the Qur'anic Arabic Corpus. At the top left is a navigation menu with options like 'Word by Word', 'Quran Dictionary', 'English Translation', 'Syntactic Treebank', 'Ontology of Concepts', 'Documentation', 'Quranic Grammar', 'Message Board', 'Resources', 'Feedback', and 'Java API'. A search bar is located at the top right. The main content area displays 'Verse (1:1) - Word by Word' and a table of morphological annotations for the opening of Chapter 1 (sūrat l-fātiḥah).

Translation	Arabic word	Syntax and morphology
(1:1:1) bis'mi In (the) name	بِسْمِ N P	P – prefixed preposition <i>bi</i> N – genitive masculine noun جار ومجرور
(1:1:2) l-hahi (of) Allah,	اللّٰه PN	PN – genitive proper noun → Allah لفظ الجلالة مجرور

Figure 7. The morphological annotation (word by word) of the Qur'anic words at <http://corpus.quran.com>

Later, Atwell et al. (2011) presented a review of several Arabic and Qur'anic research on corpus linguistics and artificial intelligence at Leeds University which was the main cause of numerous corpus datasets and software. They focused their work on “Qur'anic Arabic corpus linguistics” which was the center of obvious attraction of Qur'anic students, Arabic linguists, and the public. Interestingly, the immense potential impact of Artificial Intelligence modeling of the Holy Qur'an they saw led them to propose “the Qur'anic Knowledge Map” as a challenging computational project. It was planned as “a structured large-scale online resource” that helps in understanding the Holy Qur'an and planned as a structured database in a machine-readable form of semantic and linguistic information.

Hussein Abdul-Raof's remarkable linguistic work (Abdul-Raof, 2013, p. 72) processed models of the Qur'anic text in detailed linguistic diagrams (Figure 8) similar to the Qur'anic concept and mind maps proposed here in this study. Abdul-Raof utilized his diagrams to re-present the Qur'anic text in order

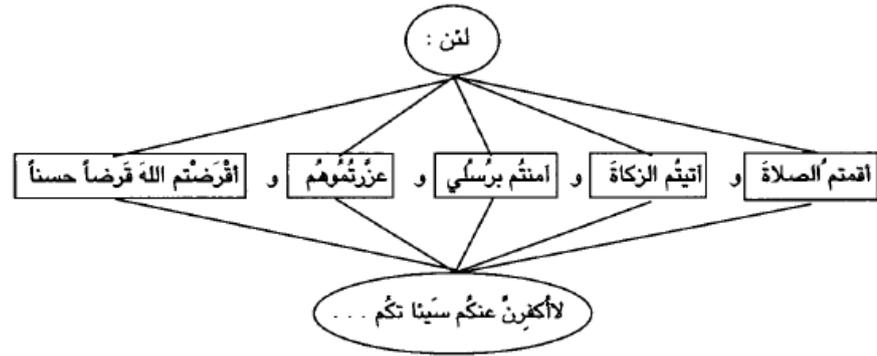


Figure 8. Linguistic diagrams (Abdul-Raof, 2013, p. 72)

to make visible the various linguistic, textural, phonetic, and rhetorical features that are not often visible in the way they are through the said diagrams. Among these linguistic features is a kind of chandelier structures, multi-tiered structures, long argumentative structures, information listing structures (details, obligations, and conditional clauses (Figure 8)), tail-head or head-tail structures, etc. as part of the Qur'anic syntactic features.

### 3.6 Topical classification of the Holy Qur'an

Talal Alajlani in 2004 presented his work; The Colored Topical Classification Mushaf (Alajlani, 2004) as the first Qur'anic publication that utilizes visual aids in highlighting ayahs of each specific topic with a distinguishing color. Alajlani adopted a colored topical classification of the Holy Qur'an, within the Surah level as a footnote legend. The work did not include any interpretations in its margins; however, it was content with the overall topical outlining of each group of verses, (See Figure 10).

Alajlani's legend of the colors used in his topical classification was decoded at the end of his Mushaf. He mentioned that each color stands for some main or sub-topic as shown in (Figure 9). Obviously, a color always represents a set of topical classifications wherever they are found all through the Holy Qur'an depending



Figure 9. Alajlani's code of colors (Alajlani, 2004)

on a dark and a light color category. For example, the blue color usually highlights Allah's signs in the universe, souls, and horizons, as well as evidence of Allah's power over the universe, and His favors to mankind. Furthermore, the green color highlights paradise and its Qur'anic descriptions, disbelievers and their descriptions, and jihad and rewards of the Muslims who perform it.



Figure 10. The colored topical classification with no marginal interpretation, (Alajlani, 2004, p. 583)

Besides, Sawwar (2007) published a truly remarkable work entitled The Colored Topical Classification Mushaf. Swwar's Mushaf was an extension of The Colored Topical Classification Mushaf in keeping the same features of the colorful topical classification and their legends in addition to a new colored marginal interpretation of the meanings of the words included on the same page. This work not only helps the readers of the Holy Qur'an in understanding the different topics while exploring the

Mushaf but also gives them detailed meanings of the difficult and problematic words included in the given Qur'anic text, (See Figure 11).



Figure 11. The colored topical classification and marginal interpretation, (Sawwar, 2007, p. 208)

Dar Ghar Hira has presented the following series of works to the Muslim community worldwide:

### 3.6.1 Al-Mushaf Al-Mufahras

Dar Ghar Hira introduced Mushafs with new features that were not available before in the re-presentation of the Qur'anic text. Al-Mushaf Al-Mufahras is designed as an easy-to-browse book with a cut in colored marginal labeling of the names of the Qur'anic surahs. That feature, although being very simple, was not experienced before (Figure 12). Regarding the body of the Qur'anic text, Dar Ghar Hira was satisfied with adding no scriptural additions, such as topical classifications



Figure 12. Al-Mushaf Al-Mufahras

or marginal meanings of the difficult Qur'anic words.

### 3.6.2 Mushaf At-Taqseem Al-Mawduei

Another distinguished work from Dar Ghar Hira is Mushaf At-Taqseem Al-Mawduei (Mushaf of Topical Classification) which was planned as a creative way to facilitate the tasks of understanding and memorizing of the Holy Qur'an. It looks similar to the Colored Topical Classification Mushaf by Alajlani (2004) (Figure 10) and Sawwar (2007) (Figure 11), in terms of keeping the same features of the colorful topical classification and their legends. It does not include a marginal interpretation of the words resembling Al-Ajlani's Mushaf.

### 3.6.3 Mushaf At-Taqseem Al-Mawduei Lil-Hafez Al-Mutqin (Mushaf of topical classification for professional memorizers)

This version of Mushaf has been being developed for ten years before it has appeared in the way illustrated in (Figure 13). It, in an unprecedented way, targets the Qur'anic memorizers' community with a set of advanced and professional features such as instances of explanatory tips, meanings of difficult words, explanations of the problematic spelling of certain words, causes of revelation, and a topical Tafseer of the ayahs included in the specific page.

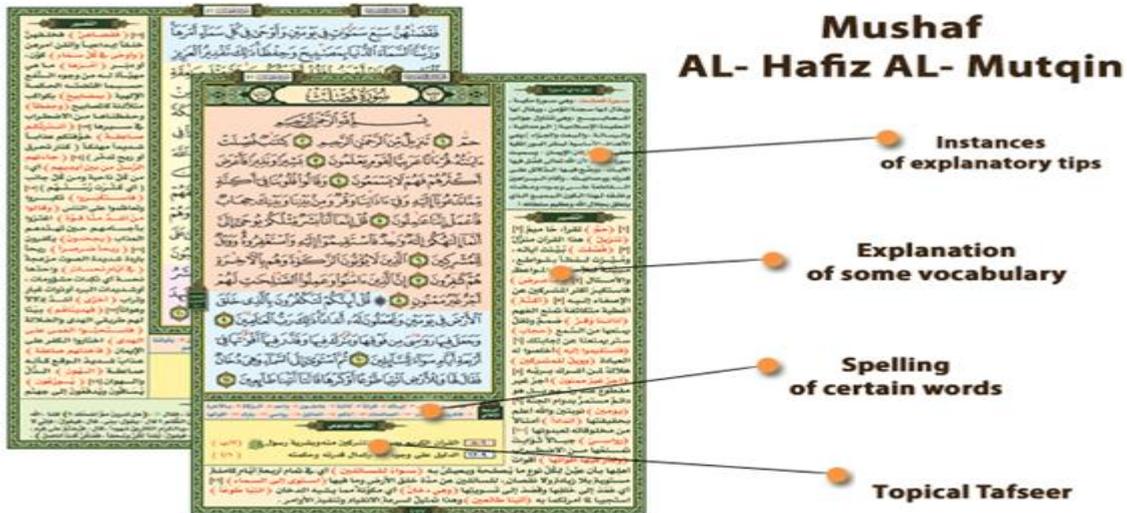


Figure 13. Mushaf At-Taqseem Al-Mawduei Lil-Hafez Al-Mutqin

It is worth mentioning here that modern technologies that took the initiative of serving the Holy Qur'an and its sciences focus on a broad range of services. Those services were set to present the Qur'anic text and its sciences in a more advanced digitized manner since the traditional printed Mushaf was the unique source of all services for the Qur'anic reader (Khan & Alginahi, 2013). More specifically, they aimed at helping the Qur'anic readers, browsers, students, researchers, or memorizers get the easiest access to their specific goals. As a result of the technological advancement, bundles of remarkable Islamic websites have rapidly burst out and spread over the internet (Khan & Alginahi, 2013).

The Electronic Mushaf of King Saud University at <http://quran.ksu.edu.sa/> is a recent work that could be considered as a remarkable paradigm shift in the way the text of the Holy Qur'an is demonstrated. Interestingly, the website offers invaluable services for the readers, memorizers, researchers, translators, or even simple browsers of the Holy Qur'an. In that understanding, the website presents the text of the Holy Qur'an in Arabic along with translations of its meanings to other sixteen languages. In addition to that, services also include a colored marginal interpretation of the meanings of the Qur'anic text to more than twenty languages. Moreover, the website offers a bilingual audio translation, seven Tafsir books, and recitations by a group of famous reciters.

Ayat is an electronic version of the Electronic Mushaf of King Saud University created to stand as a new easy-to-use Mushaf offering its services in an unprecedented, highly colorful, and developed manner. It was set to work on a diversity of systems such as Windows Phone, Android, iOS, Windows,

Linux, and Macintosh. Ultimately, the appealing and unique features of Ayat attract the attention of millions of Muslim users who consider it as a top authentic Qur'anic text and interpretational method.

#### 4. Graphic organizers compared to other learning tools

Initially, graphic organizers are briefly translated as the graphical representation of a set of concepts included in a text (Richardson, Morgan, & Fleener, 2012, p. 52; Zaini, Mokhtar, & Nawawi, 2010) and the visual illustrations or portrayals or structured overviews that unveil relationships between concepts of given learning tasks (Hudson, Lignugaris-Kraft, & Miller, 1993; Moorf & Readence, 1984). Additionally, Darch and Carnine (1986) argued that the acquisition of information is not limited to occurring in a linear platform according to the schema theory. Furthermore, the use of graphic organizers provides a set of advantages such as a combination of verbal and visual input, easy summarization of concepts, simpler analysis of information that is not possible in linear outlining settings (Paivio, 1971) as cited in (Doyle, 1999).

Apparently, numerous recent studies in the educational field have reported their successful use of graphic organizers – including concept maps - that gave them a considerable advantage over many other learning tools. For instance, Doyle (1999) reported the advantage of graphic organizers - as visual displays in improving comprehension in disabled learners - over traditional methods of teaching (lecturing, note-taking facility, and texts). Interestingly, reports of posttests showed significant positive effects of the graphic-organizer method of teaching mentioning its advantage over the traditional methods.

Likewise, Zaini et al. (2010) consider graphic organizers as tools of modeling, illustration, and representation of information - as graphics or visual forms – targeting achieving meaningful learning. They also state that when students receive difficult concepts or written materials are expressed in visual structures, they will be able to develop their alternative structures of concept understanding. Additionally, Zaini et al. (2010) concluded that graphic organizers had improved their students' performance, motivation, and comprehension, for the fact that GOs make clearer the interrelations between concepts and work on strengthening the learning process.

Udeani and Okafor (2012) identified one hundred and twenty-four biology slow learners and randomly assigned them to two equal groups: concept mapping group (n=62) and expository group (n=62). The study aimed at investigating the efficiency of the concept mapping and expository in presenting biology concepts – photosynthesis concept - to slow learners. Both groups were tested at the end of a two-week teaching period. What is worth mentioning is that the concept mapping group performed significantly ( $p < 0.05$ ) better than the expository group.

##### 4.1 The importance of concept maps, mind maps, and graphic organizers

Computational linguistics stands for the interdisciplinary branch of linguistics that deals with rule-based and/or statistical modeling of natural language computation (NLC) or natural language processing (NLP). It is then one of the techniques used in the field of Qur'anic computation (Kammani & Safeena, 2014). While mapping techniques are found to play a significant role in almost all corpus and ontological processes set to point out conceptual linkages and relatedness, dataset building, semantic relations between concepts, and knowledge representation, etc. Their role is central in building ontologies (Su & Gulla, 2006) and handling their highly complicated linguistic and conceptual processes.

Research approaches of Qur'anic computation have underpinned its solid base in both the theory and application of the interdisciplinary realm of literature (Kammani & Safeena, 2014). Recently, Muslims and non-Muslims are paying great attention to the Islamic knowledge (Atwell et al., 2011; Yauri et al., 2012; Yauri, Kadir, Azman, & Murad, 2013). Furthermore, Muslims have the habit of reciting the Qur'an from its hard-copy version (Mushaf), nevertheless, they have recently adopted the new-tool versions of the Holy Qur'an in a significant growth (Khan & Alginahi, 2013). Apparently, that remarkable increase in Muslims and non-Muslims' use of the digital forms of the Holy Qur'an and its sciences (smart-device applications, internet websites, computer software, etc.) is due to the increased accessibility (Khan & Alginahi, 2013) and the easy retrieval of information of these tools (Yauri et al., 2012).

Graphic organizers are “visual displays of key content information designed to guide learners and enhance their comprehension” (Bishop, 2013). Moreover, Delrose (2011) and Tayib (2015) claim that the use of graphic organizers offers “concrete structural framework of information” for learners and

helps them focus their attention on key conceptions and ideas and interlinks the apparently scattered facts. Tayib (2015) continues arguing that the use of the different types of graphic organizers guarantees the enhancement of the way learners understand, organize, and reflect the idea of meaningful learning. In addition to this, non-learning, surface-learning, and deep-learning outcomes could be measured through the use of concept maps according to Hay (2007).

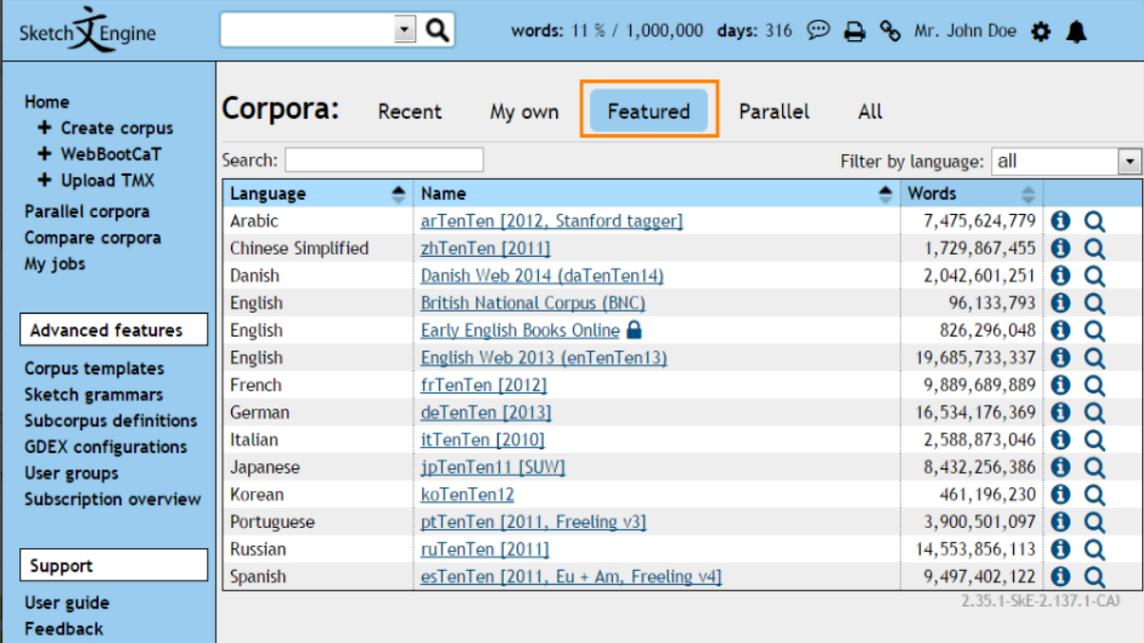
Recently, numerous studies have been conducted in the field of Qur'anic computation and Qur'anic digitizing. Although the field of Qur'anic computation and digitization concerns the use of modern technologies in natural language programming and processing, a great deal of these studies has involved the use of graphic organizers such as concept maps, mind maps, or network trees in achieving their computational and digital objectives.

## 5. Definition and typology of Qur'anic computation and digitization

The main concern of this review is to report that some of the studies adopted the creation of very intelligent computer, internet, or smart-device applications, software, and databases to serve in a way or another the various Qur'anic issues. These Qur'anic issues ranged over several services such as recitation, memorization, Tajweed, teaching, interpretation, translation, etc. Therefore, Qur'anic computation here could be defined as an interdisciplinary field of study that combines computational linguistics and statistical and/or rule-based Qur'anic natural language modeling. It is highly remarkable here that this definition involves numerous fields of study and research outputs. For instance, the foundation of Qur'anic mapping for direct digital uses or as functional aspects in the computational building of ontologies and large databases.

## 6. Concept maps and Qur'anic ontology

Ontology mapping tools for Noy and Musen (2002) are extensions of what is so-called development tools. They are the tools set to map, align, and merge ontologies and that enable users to easily get to similar and distinctive characteristics of entities between source ontologies. Furthermore, Noy and Musen (2002) went on arguing that ontology mapping tools are varied based on three main aspects: the precise tasks they perform, the inputs they process, and the outputs they produce. Ultimately, the mapping tools used in ontologies to perform these tasks seem to be more than fundamental knowledge processing and information retrieval elements. They appear to have two different personalities: when performing internal ontology tasks (input/output requirements), on the one hand, and when responding to user's inquiries (user interaction), on the other hand.



The screenshot shows the Sketch Engine Corpora interface. The top navigation bar includes the Sketch Engine logo, a search bar, and user information (Mr. John Doe). The main content area is titled 'Corpora:' and has tabs for 'Recent', 'My own', 'Featured' (highlighted with an orange box), 'Parallel', and 'All'. Below the tabs is a search bar and a 'Filter by language: all' dropdown. The main table lists corpora with columns for Language, Name, and Words. Each row also has information and search icons.

Language	Name	Words
Arabic	<a href="#">arTenTen [2012, Stanford tagger]</a>	7,475,624,779
Chinese Simplified	<a href="#">zhTenTen [2011]</a>	1,729,867,455
Danish	<a href="#">Danish Web 2014 (daTenTen14)</a>	2,042,601,251
English	<a href="#">British National Corpus (BNC)</a>	96,133,793
English	<a href="#">Early English Books Online</a>	826,296,048
English	<a href="#">English Web 2013 (enTenTen13)</a>	19,685,733,337
French	<a href="#">frTenTen [2012]</a>	9,889,689,889
German	<a href="#">deTenTen [2013]</a>	16,534,176,369
Italian	<a href="#">itTenTen [2010]</a>	2,588,873,046
Japanese	<a href="#">jpTenTen11 [SUW]</a>	8,432,256,386
Korean	<a href="#">koTenTen12</a>	461,196,230
Portuguese	<a href="#">ptTenTen [2011, Freeling v3]</a>	3,900,501,097
Russian	<a href="#">ruTenTen [2011]</a>	14,553,856,113
Spanish	<a href="#">esTenTen [2011, Eu + Am, Freeling v4]</a>	9,497,402,122

2.35.1-SKE-2.137.1-CA

Figure 14. Sketch Engine Corpora

For knowledge sharing and organizing according to (Coffey, Hoffman, Cañas, & Ford, 2002), it is necessary to utilize two effective methods; for knowledge and concept elicitation and a useful scheme for re-presentation. They argue that the use of concept maps in knowledge sharing provides a concise and explicit representation of the related knowledge domain. Moreover, the created knowledge models appear in an order of a semi-hierarchical structure with a top concept map and descending detailed maps at the lower levels.

It is still being argued that no single comprehensive universal ontology that could encompass all other ontologies which all users will appraise (Su & Gulla, 2006), possibly due to heterogeneity (Valente, Russ, MacGregor, & Swartout, 1999). On the contrary, several ontologies were combined harmoniously through the Sketch Engine that is managed and developed by the Lexical Computing research company, as a tool of corpus management and query to be used by linguists, translators, publishers, and lexicographers worldwide. The Sketch Engine provides data and services based on over 400 text corpora – including Arabic language and Qur'an ontologies – with a capacity of up to twenty billion words from more than ninety languages (Figure 14).

Su and Gulla (2006) state that the mapping processes included in their information retrieval approach to ontology mapping involve analyzing the different ontologies and comparing them to point out the interrelationships among concepts and distinguish conflicts if any. They present a method of heuristic mapping and a system of prototype mapping which support “the process of semi-automatic ontology mapping” aiming at enhancing “semantic interoperability in heterogeneous systems”. In other words, their approach depends on semantic enrichment benefitting from ontology instance information to intensify the other existing ontologies and calculating similarities in elements in a pair of ontologies.

The invaluable study conducted by Tayan and Alginahi (2009) investigated the use of the combination of both information and communication technologies with applications and their effect on the propagation and teaching of the Holy Qur'an. Moreover, it examined the efficiency of these digital technologies in serving the Holy Qur'an. It utilized a survey questionnaire in paper-based [n=38 out of 75]c and e-mail formats [n=6 out of 70] Although the study was planned to be a worldwide comprehensive study that surveys a large number of Muslim ICT users, the number of participants was very less compared to the targeted ones. The participants' attitudes concerning the widely used technology among over 25 diverse types including websites, videos, and applications. Suggestions from participants involved enhancement of the technical issues related to these technologies such as authentication of Islamic websites, fast setup, and installation of applications in addition to user-friendly gadgets, devices, and applications. Finally, compatibility troubleshooting was suggested for different devices and their models and makes.

Khan and Alginahi (2013) attempted to shed light on the concerns and challenges of Muslims concerning the digitization of the Holy Qur'an. Consequently, a 17-question electronic survey was administered to investigate Muslims' trends and adoption of modern technologies such as reading and learning the Holy Qur'an from digital and smart devices. It was also planned to get the participants' attitudes toward the importance of having an Islamic body to authenticate the digital versions of the Holy Qur'an. Ultimately, the study got (n=668) responses from various parts of the world. The results show that almost half of the participants prefer reading and reciting the Holy Qur'an from digital devices including mobile phones, whereas many participants never use any digital device for reading or reciting the Qur'an. Strikingly, the study reported that digital formats of the Holy Qur'an are more used among young-aged digital users and that some of them complain of issues of authenticity and forgery that may be returned to typos or other reasons.

Yauri et al. (2012) proposed utilizing the semantic web technologies (ontology) through a model to fill in the gap and lack of retrieval of the semantic information not based on the keyword-matching approach. The study depended on the Web Ontology Language (WOL) being a core element of the Semantic Web that is responsible for defining the concept, relationship, and constraints. So, ontology - in brief, is a set of statements that define concepts and their interrelationships. The study improved a ready-made ontology from the University of Leeds that was graphically represented into a set of 300 linked concepts that form 350 relations, allowing Muslim and non-Muslim users to acquire the information they need from the Holy Qur'an.

It is noteworthy here that previous attempts in the current information technology era mostly used to employ concept hierarchy described as manually built by scholars to organize or index the Qur'anic topics and concepts. In another attempt to organize Qur'anic concepts, Mukhtar, Afzal, and Majeed (2012) developed a semi-automatic method to identify important topics and concepts from six English translations of the Holy Qur'an and organize them hierarchically employing the term-head principle.

Applications continued to benefit from ontology-based information to serve the Qur'anic worldwide to understand, memorize, search, and interpret the Holy Qur'an in the most conceivable way made available by recent technologies. In that understanding, Nassourou (2012) developed a Qur'anic learning system based on the knowledge extracted from various Qur'anic sources about the dates and places of revelation. Nassourou built his hypothesis on that computer-assisted modeling, visualization, representation, and manipulation of terminological and structural scopes of religious books will enhance the comprehension and retention of their texts. Therefore, Nassourou's system was planned to provide learners with web-based interfaces and visualization techniques for querying, browsing, and examining the authenticity of the acquired information and to study the Holy Qur'an.

Nassourou's system was designed to encompass the syntactic and semantic Qur'anic structures, representation of the models using frames, and a generated XML model of the output frame. The system used machine learning algorithms and other text mining techniques to compute a set of nine important metadata. These metadata involved first, methods, causes, places, and dates of revelation. Second, topics, locations, and sizes of verses and chapters. Third, summarization, and memorizing of chapters and verses (Figure 15). The system also included another facility for analyzing and comparing verses and chapters of the Holy Qur'an.

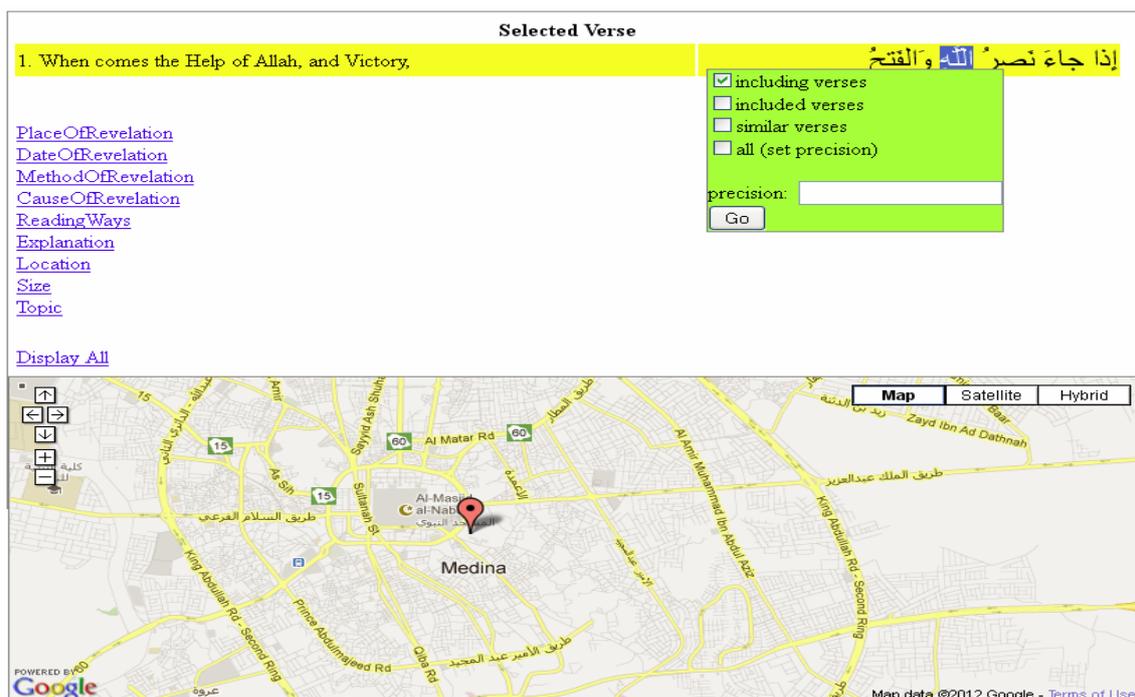


Figure 15. Interface of Nassourou's System (Nassourou, 2012)

Zameer Ahmed Adhoni, Al Hamad, Siddiqi, and El Mortaji (2013) aimed at designing and developing "a complete and comprehensive online cloud Qur'an portal" to provide all digital users with accessible multilingual reading and resource sections. It offers a diversity of features such as an e-Mushaf, authentic translation, Tajweed scholar videos, reciter, search engine, and other study materials. Other features include a kid's section, Islamic social networking, transliteration, Da'wah section, Qur'an search engine, and Ayah of the day (Figure 16).

The main screen of the portal application also includes Arabic and Urdu languages' interface. Moreover, a transliteration of the Qur'an to the Urdu language is available for non-Arabic speakers. The Qur'an Portal site also contains other features such as 'Ayah of the Day', 'Da'wah Section', 'Islamic Social Networking', and 'Kids' Section'. Furthermore, the Qur'anic data has been imported from the Tanzil Qur'an Project and fed into the Qur'an Portal system as an entity.

Ultimately, the Qur'an Portal made it easy for users – especially the Urdu speakers – to benefit from the many features available on the website to recite, memorize, search, and learn to correctly pronounce the Arabic Qur'anic version as non-Arabic users. In that concept, the Qur'an Portal is still falling under the recent domain of Qur'anic digitization motion that tends to offer the same services to a great extent.

The idea of creating this mobile application launched in 2016 (Figure 17) – الفهم آخر أسلوب – القرآن لـ (Another Way of Understanding the Holy Qur'an) - emerged from the fact that some people when reading the Holy Qur'an, they do not find it easy to understand.

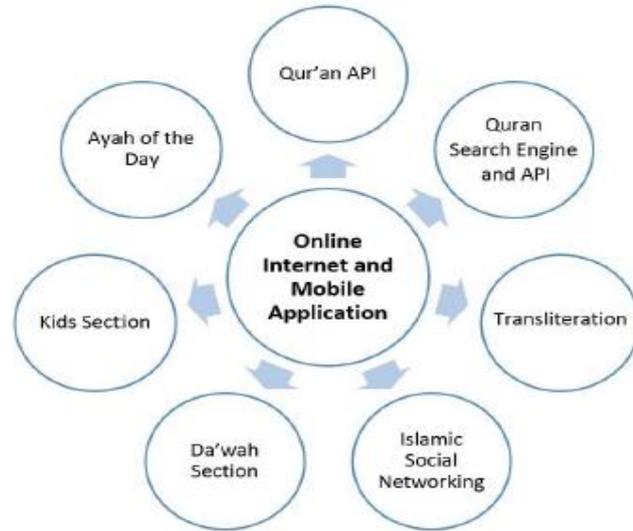


Figure 16. Basic architecture of the application (Zameer Ahmed Adhoni et al., 2013)

سورة الشعراء	
سنة الله مع البشر	
9-1	1-مقدمة
<p>طسم (1) تِلْكَ آيَاتُ الْكِتَابِ الْمُبِينِ (2) لَعَلَّكَ بَاقِعٌ نَفْسِكَ أَلَّا يَكُونُوا مُؤْمِنِينَ (3) إِنَّ نَسْأَ تَنْزِيلٍ عَلَيْهِمْ مِنَ السَّمَاءِ آيَةً فَظَلَّتْ أَعْنَاقُهُمْ لَهَا خَاضِعِينَ (4) وَمَا يَأْتِيهِمْ مِّنْ ذِكْرٍ مِّنَ الرَّحْمَنِ مَحْدُثٍ إِلَّا كَانُوا عَنْهُ مَعْرِضِينَ (5) فَقَدْ كَذَّبُوا فَسَيَأْتِيهِمْ أَنْبَاءٌ مَا كَانُوا بِهِ يَسْتَهْزِئُونَ (6) أَوْلَمْ يَرَوْا إِلَى الْأَرْضِ كَمَا أَنْبَتْنَا فِيهَا مِنْ كُلِّ زَوْجٍ كَرِيمٍ (7) إِنَّ فِي ذَلِكَ لَآيَةًٌ وَمَا كَانَ أَكْثَرُهُمْ مُؤْمِنِينَ (8) وَإِنَّ رَبَّكَ لَهُوَ الْعَزِيزُ الرَّحِيمُ (9)</p>	
التفسير الميسر	
معاني الكلمات	
68-10	2-موسى
104-69	3-ابراهيم
122-105	4-نوح
140-123	5-هود
159-141	6-صالح
175-160	7-لوط
191-176	8-شعيب
220-192	9-محمد عليه الصلاة والسلام
227-221	10-خاتمة

Figure 17. An android application for Qur'anic topical classification

The application explains in a colorful topical classification the goal and the topics in each Surah. So, it will become easy for the Qur'anic readers to understand the whole Surah, link its ideas, and easily memorize it because every Surah is normally divided in a topical manner. The application is based on At-Tafsir AL-Muyassar ready for whom would like to explore the interpretation of what they read along with the meanings of the list of words included. Additionally, the application has facilities of searching in the Holy Qur'an, changing of font, and working off-line.

The idea of this mobile application is an extension of the colorful topical classification Mushafs such as the work of Alajlani (2004), Sawwar (2007), and the alike with a classification similar to the work of Alsuhaibani (2012) Mental Maps of Quran. Moreover, there is a great similarity between the designing of this mobile application and the proposed study in the way ayas are grouped according to the classification of topics included in each surah.

Some other studies were planned to benefit from the tremendous wealth of the web resources in the field of multimedia related to the Qur'anic sciences, including Tajweed provisions, Tafseer, and the Qur'anic stories. As an example, Abdelhamid et al. (2013) state that that web resources including multimedia and audio-visuels would probably contribute to the understanding and clarification of the meaning of the Qur'anic verses and application of recitation provisions especially for young Qur'anic readers.

Ching Yee, Sudirman, Kim Mey, and Salim (2011) define ontology learning as an information extraction subtask that targets extracting relevant relations and concepts in a semi-automatic manner from a specific corpus or data set. They planned their study on providing users with a description of how the ontology is extracted from a Qur'anic text based on Yousuf Ali's translation of the Holy Qur'an. They compared two algorithms from Gupta and Alfonseca based on term, synonym, and concept layer. Ching Yee et al. (2011) built their strategy on implementing algorithms for ontology extraction analysis in their support system. Moreover, they aimed at studying the support system for a comparison of its main functions as well as the integration process. They also aimed at improving the support system by combining its algorithms considering the Qur'anic text as input. Ultimately, the results of the study revealed that the techniques used were not applicable in achieving the goal of Qur'anic text extraction due to some shortcomings in the two methods utilized (Gupta and Alfonseca algorithms) to meet the ontology learning needs.

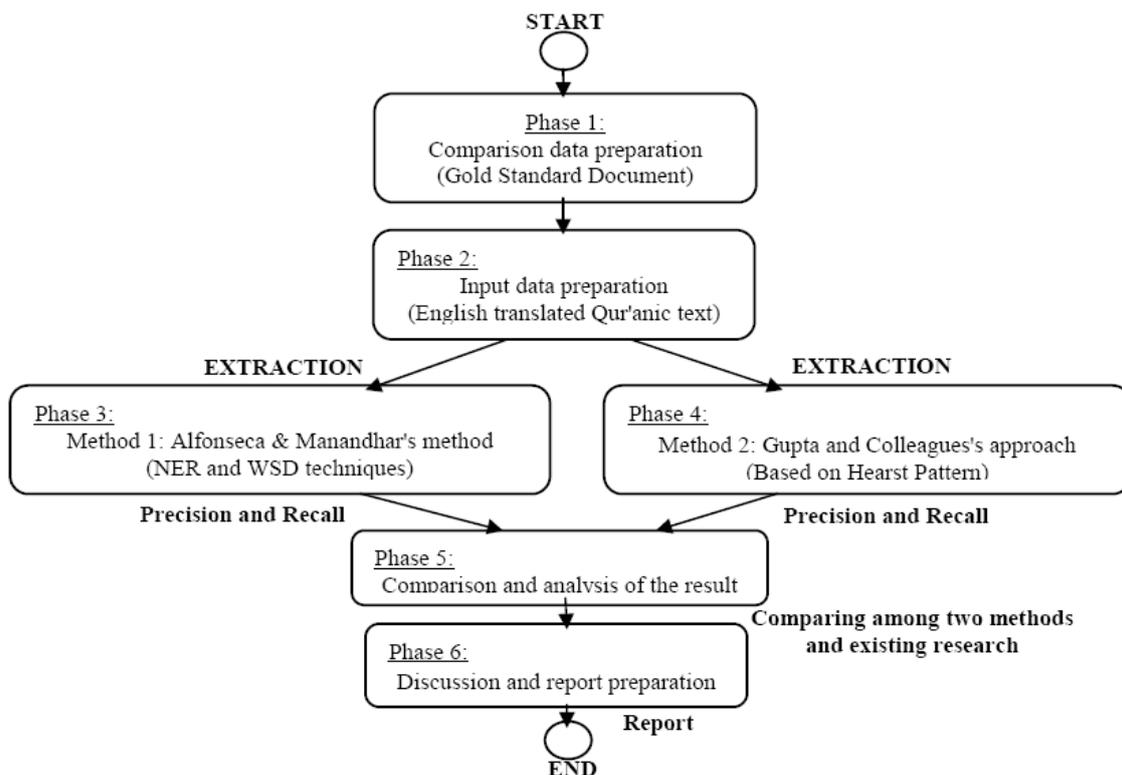


Figure 18. System flow chart (Ching Yee et al., 2011)

Saedi, Heidari, and Farhoodi (2014) proposed documents of frequently-asked questions (FAQs) in various Qur'anic websites to create a question taxonomy based on words of question nature such as WH- English question words and the like. Their question taxonomy consisted of a hierarchical structure that involves fine- and coarse-grained semantic classes. Furthermore, questions are categorized based on the semantic entity and answer types. Above it all, the Qur'anic ontology that resembles “a hierarchical concept map”, has been utilized to evaluate the question answering system to exploit the taxonomy in it.

Similarly, Z. A. Adhoni, Al Hamad, Siddiqi, and Adhoni (2014) presented “a Cloud-Based Cross LANGUAGE Search engine” aiming to provide a full-scale model of search through the Qur'anic verses in a multi-language base using Drupal 7 technology. The framework is capable of retrieving Arabic Qur'anic verses in response to non-Arabic search inputs. Interestingly, the framework also includes a cloud-based Mushaf for recitation in a multi-language format. They stated that their final portal product made it easy for digital users to access all resource sections that cover numerous Qur'anic themes such as Mushaf, translation and transliteration, reciter and bookmarks, cross-language information, study materials, Tajweed videos, search, and memorizer.

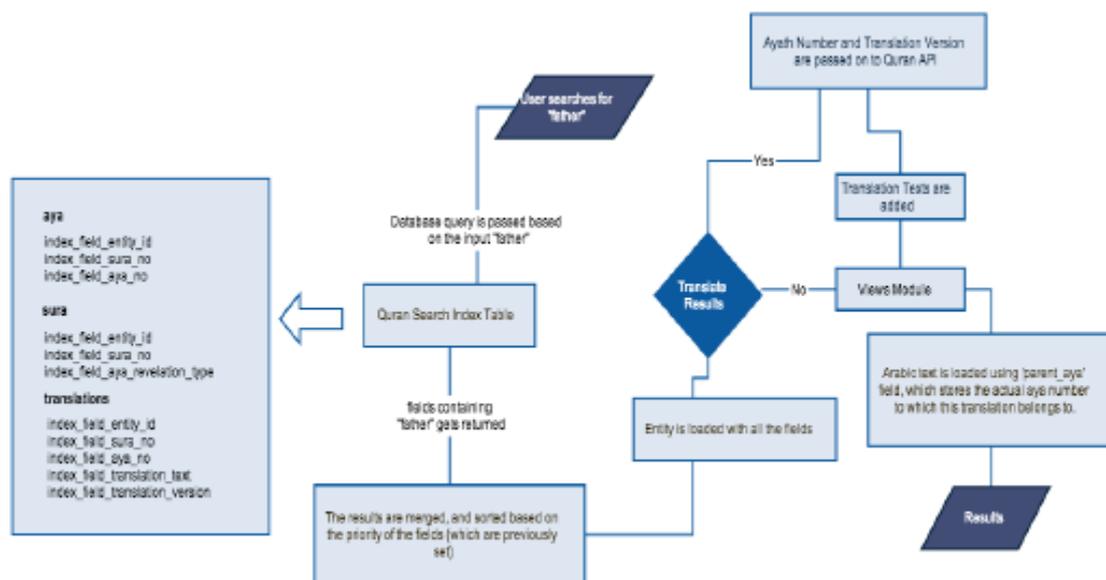


Figure 19. Search phases of the Qur'anic Text (Z. A. Adhoni et al., 2014)

Abdelhamid et al. (2013) planned their study on benefitting from ontology tagging in linking up web multimedia resources with matches from the verses of the Holy Qur'an. They built their strategy on the fact that the main themes and concepts of the Holy Qur'an are constituted by the system of the universe, history, homilies, wisdom, proverbs, laws, provisions, rules, etc.

Al-Yahya, Al-Khalifa, Bahanshal, Al-Odah, and Al-Helwah (2010) highlighted a curious paradox that even though Arabic speakers reached hundreds of millions worldwide, but very little efforts have been done regarding Arabic linguistic resources, specifically lexicons - their research field. In response to that shortage, they proposed a computational model that relies basically on the semantic field theory and uses ontologies to represent Arabic lexicons. Additionally, they got the benefit of the Qur'anic text to be obtained as data to drive the design of their suggested computational model.

In another multimedia Qur'anic field, Basuhail (2013) proposed a workable model for the design and implementation of electronic teaching objects targeting recitation, interpretation, memorization, and intonation of the Holy Qur'an (Figure 20). The proposed model was designed to work as an approach to implement the Qur'anic content using visual tools such as computer graphics and animations as tools widely used in today's educational platforms such as e-teaching, e-learning, and computer-assisted learning and teaching. Basuhail stated that integration of the said teaching objects can bring possible enhancement to the teaching of the Holy Qur'an and its related sciences.

Android devices appear as a widespread platform that reaches millions of Muslim users targeted by numerous Islamic and Qur'anic application designers. Consequently, Elobaid, Hameed, and Eldow (2014) focused their efforts on developing Noor Al-Qur'an as an application that works under the broad Android umbrella to proliferate the Qur'anic learning among non-Arabic Muslim users worldwide. Linguistically, Noor Al-Qur'an was proposed to support 25 languages in addition to the sign language. Users have the freedom to choose between the many flexible features contained in the software such as the language of interest, and sort of learning including recitation, transliteration, and Tafseer (Figure 21).



Figure 20. Project interface and sections (Basuhail, 2013)

between the many flexible features contained in the software such as the language of interest, and sort of learning including recitation, transliteration, and Tafseer (Figure 21).



Figure 21. Noor Al-Qur'an screen models (Elobaid et al., 2014)

Besides presenting the Qur'anic text traditionally with topical classification legends for each Qur'anic page as in (Alajlani, 2004; Sawwar, 2007), eFham.aya presents itself as another visual work that highlights the topical classification features of each Qur'anic surah and lists no Qur'anic text in its maps. Moreover, eFham.aya is an open-access and multi-medium source of general-concept mapping of scattered Qur'anic chapters (Figure 22). The Qur'anic maps of eFham.aya are made accessible online through Facebook, twitter, flicker, and other means such as Instagram, Telegram, etc.

Furthermore, the work aims at helping Qur'anic readers understand, memorize, and revise their memorization of the Holy Qur'an. Moreover, each Qur'anic map provides a colorful outlined topical classification of a full specific Qur'anic chapter according to the topical classification of Sheikh Ibrahim Ad-Duwayyish (eFham.aya, 2015). Additionally, each concept map includes a brief description and commentary on the specific chapter.

Interestingly, this description makes eFham.aya work similar to Safiah Alsuhaibani's work, (Mental Maps of the Qur'an (Alsuhaibani, 2012)) which requires the reader to match the extracted concepts on the map with the related ayahs on the Mushaf. Such topical classification maps of the Holy Qur'an could be considered as a Qur'anic reader's handbook helpful in simplifying the browsing of Mushaf for surahs that may extend to 286 verses as the case of Surat Al-Baqarah.

The work of eFham.aya could be considered as a big shift in the presentation of the Qur'anic text where everything was made to clarify and spot the main concepts of each surah of the Holy Qur'an. Interestingly, the ongoing work being based on a unilingual presentation of the Qur'anic concepts, it opens the door widely for future attempts to make it available in other languages in order to help the whole humanity.



Figure 22. Conceptual map of Surat An-Noor (eFham.aya, 2015)

Entesar Al-Mosallam (2013) reported that Qur'anic learners (students in Qur'anic schools) find it difficult to memorize the Qur'an because of the poor quality of memorization techniques they use. She argued that Qur'anic memorizers require innovative ways to help them to achieve the goals of understanding Qur'an, connecting Qur'anic concepts, and memorize Qur'an. Furthermore, she reported that the many existing Qur'anic applications that were set to help in Qur'anic memorization, were also limited and did not use useful techniques to help in the field because of their focus on the direct use of technology.

Considering all these reasons, Al-Mosallam proposed a promising application that could benefit from the topical interpretation of the Qur'an and the use of the mind-mapping technique. That combination of features guarantees connecting verses to each other and to their specific and general topics, achieves their orderly and visually displays, and involves all human senses (Figure 23). The well-designed interface was planned to attract learners' attention and allow them to understand and memorize the Qur'anic verses.

Al-Mosallam's work also provided a pilot study to examine the efficacy and applicability of the Qur'anic mind maps in the memorization and understanding of the Holy Qur'an. She selected four subjects of 16 to 18 years old divided into two groups of two learners each. One of the two groups was provided with the mind map of Surat Al-Baqarah and the other was exposed to the traditional repetition method. Ultimately, differences between the learners in the two groups were checked based on the time elapsed for memorizing, number of mistakes, and understanding of the meaning of the given verses. Strikingly, the group exposed to the mind map technique did better than the other group and reported that this visual method facilitated their understanding of the verses presented the Qur'anic text in an interactive way (Al-Mosallam, 2013).



Figure 23. Partial interface of Al-Mosallam's application (Al-Mosallam, 2013)

## 7. Ontology and Qur'anic computation and digitization

It is of the utmost importance here to mention the motion of making use of ontology as a ready-made technological aspect in managing the digitization of the Holy Qur'an and its sciences. It became a crucial component in the field of information technology being the principal element in information association and sharing as well as integrating applications (Abdelhamid et al., 2013). Gruber (1993) classifies ontology as “a specification of a representational vocabulary for a shared domain of discourse”, “an explicit specification of a conceptualization”, and “a systematic account of Existence”. Additionally, for Pourmahmoud and Shamsfard (2008); Yahya, Abdullah, Azman, and Kadir (2013),

ontology is a recognized, explicit description of a set of clear-cut concepts related to each other by conceptual relations. Yahya et al. (2013) went on defining ontology as a representative structure that stands as the building block of what is known as Semantic Web. In that understanding, in their cross-lingual information retrieval, Pourmahmoud and Shamsfard (2008) introduce a hybrid approach enabling users of their ontology to retrieve English documents by submitting Persian queries.

Ontology of the Holy Qur'an has been described as hard work for the fact that each Qur'anic word may have a variety of different definitions for its semantic meaning based on its use in each specific Qur'anic verse (Abdelhamid et al., 2013) or context. In principle, that point of view may be the main reason behind limiting the attempts to broaden the Qur'anic ontology concept. Coffey et al. (2002) argue that finding semantic correspondence between ontologies is one of the key challenges raised by the Semantic Web. Likewise, Abdelhamid et al. (2013) continue arguing that the multi-meaning nature of the Qur'anic words led to the diversity in Tafseer views and interpretations. In fact, this diversity in meaning also affected a great deal of Qur'anic studies and sciences including translation of the Holy Qur'an being built basically on word meanings and exegetic views.

Equally, Shoab, Yasin, Hikmat, Saeed, and Khiyal (2009) argue that information searching and retrieval issues in the Holy Qur'an require special attention thanks to the unique Qur'anic allegorical nature and style. They went on arguing that keyword search techniques stand as incapable of retrieving Qur'anic verses of semantic relevance. Furthermore, the conceptual effect of the Qur'an elaborates the definition and usage of synonym and polysemy as so many words which are not synonyms from a dictionary point of view but conceptually, they are. For instance, Al-Muddathir and Al-Muzzammil Ar-Rasoul appear as conceptual synonyms of Mohammad (Peace be upon him) and that is in addition to many other altered linguistic definitions and usages. Ultimately, Shoab et al. (2009) proposed their Qur'anic WordNet aiming at developing an ontology-based intelligent search engine of the Noble Qur'an capable of performing an accurate semantic search. They stated that they have implemented the Qur'anic WordNet on Surat Al-Baqarah and got accurate and reliable results.

## 8. Discussion

The process of Qur'anic text presentation has gone through a series of non-stop development stages since its revelation during the time of Prophet Mohammad (Peace and blessings be upon him) until it has reached the natural language processing phase in the 20th century (Bolshakov & Gelbukh, 2004). The first of those stages utilized primary animal and plant materials (McAuliffe, 2006) only for protecting it from loss or falsification. Besides protection, the objectives of presenting the Qur'anic text included clarity and organization to help Qur'anic readers achieve comprehension, memorization, translation, etc.

In accordance with the findings of various studies such as Mustapha (2009), Proaps and Bliss (2014), Allibaih (2019), and Allibaih (2020), a visualized text enables the reader to communicate it with efficacy, precision, and clarity. Similarly, information visualization encompasses various elements of imaging, scientific visualization, graphical works, human-information interactions, etc. (Robertson, Card, & Mackinlay, 1993). So, the numerous visualization effects added to the Qur'anic text such as visual aids, concept maps, Qur'anic digitization, and topical classification have helped immensely in communicating the Qur'anic concepts with a high degree of clarity and efficiency.

Ontologies enjoy a distinguished role in managing the digitization of the Holy Qur'an and its sciences. That high status is achieved because of its essential contribution to the field of information technology and specifically to the integration of applications (Abdelhamid et al., 2013; Gruber, 1993). However, the Qur'anic ontologies are faced by the variety of meanings for many specific Qur'anic words (Abdelhamid et al., 2013; Dukes, Atwell, & Sharaf, 2010), which makes its work more harder than the other ontologies. Likewise, this diversity of meaning turns the work of Qur'anic information searching and retrieval into a hard job (Shoab et al., 2009).

## 9. Conclusion

The current study puts an effort in investigating the journey of the presentation of the Qur'anic text throughout a long Islamic history of more than 1440 Hijri years. This study revealed that the Qur'anic text has undergone different phases of efforts of presentation and display starting from the

use of various means to write on such as leather of gazelle, bones, stones, cloth, stones, papyrus, or wood (McAuliffe, 2006, p. 44). Later, the presentation of the Qur'anic text has witnessed a paradigm shift during the era of the Caliph Uthman ibn Affan who started the collection of the Qur'an in one book (the Mushaf). The holy book then dressed the Islamic ornamentations and decorations which it has been preserving since the eighth Hijri century up to this moment.

The textual work on the Qur'anic text has been developing remarkably for the sake of "clarity, precision, and efficiency" (Mustapha, 2009). Therefore, a great deal of work has been done on the enhancement of Qur'anic text visualization which means combining the characteristics of imaging and graphics, human-information and human-computer interactions, scientific visualization, and information technology (Robertson et al., 1993). Consequently, efforts have been striving to provide the Qur'anic reader with the most visualized and comprehensible textual output of the Qur'anic text.

Ultimately, the conceptual work on the Qur'anic presentation has been provided as a standalone characteristic of the Holy book. Thus, the topical classification of the Holy Qur'an remains as a milestone for the contemporary consequences that lead to the emergence of the mapping of the Qur'anic text whether in ontologies or mere concept maps of the Qur'an as in the case of Alsuhaihani (2012), Allibaih (2019), and Allibaih (2020). The Qur'anic concept maps of the current study could be considered as a compendium of a long history of enhancements both in the textual and conceptual levels of presentation of the Qur'anic text. They enjoy several characteristics ranging between bilingualism (the Arabic Qur'anic text accompanied by the translation of its meanings), colorful boundaries and linear networks based on authenticated topical classification and exegetic opinions, and eye-comfort and easy-to-follow presentations.

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