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**Factors Influence Reading From Screen of Arabic  
Textbook for Learning by Children Aged 9 to 13**

**By  
Azza A. Abubaker**

A Thesis Submitted to the University of Huddersfield  
in Partial Fulfilment of the Requirements for  
the Degree of Doctor of Philosophy

**School of Computing and Engineering  
The University of Huddersfield**

**August 2013**

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## **List of Acronyms:**

- (A) Arial
- (AC) Action
- (AL) Arabic language
- (CN) Courier New
- (DOP) Date of publication
- (DL) Double column
- (E) Electronic
- (eBook) electronic book
- (EBONI) Electronic books on screen interface
- (EL) Education Level
- (ENL) English language
- (ETB) Electronic textbook
- (IT) Information technology
- (N) Number
- (P) Paper
- (PE) Paper Education
- (PBT) Planned behaviour theory
- (Pdf) Portable Document Format
- (PF) Paper format
- (PS) Primary school

- (OQ) Open question
- (MAC) Multi answer choice
- (MOPTAM) Mobile Phone Technology Adoption Model
- (TA) Traditional Arabic
- (TAM) Technology Adoption Model
- (TOC) Table of content
- (TFQ) True/ false question
- (TNA) Times New Arabic
- (SCT) Social cognitive theory
- (SL) single column
- (RAT) Reasoned Action Theory
- (RRT) Reader response theory
- (RST) Rhetorical structure theory
- (RSVP) Rapid Serial Visual Presentation
- (UTAUT) Unified Theory of Acceptance and Use of  
Technology Model
- (VAT) Visual attention theory
- (VSTF) Visual-Syntactic Text Formatting Theoretical

## **Abstract:**

The problem with e-texts are related to the way texts are displayed on a screen, with multiple and different aspects that affect legibility, making readers prefer to read a paper format rather than e-resources. This research describes the factors that affect the legibility of online texts aimed at obtaining a better understanding of the usability of electronic Arabic texts for learning purposes within the field of electronic reading; mainly reading Arabic texts for students aged 9 to 13. This study sets out three particular aims: (1) building a reading strategy for Arabic schoolbook in both formats electronic and paper format based on users' cognitive and behavioural processes; (2) defining the influence of three typographical variables that affect reading Arabic texts on a screen (font size, font-type and line length); and (3) studying the efficiency of reading Arabic texts and the related factors impacting the efficiency of reading and comprehension.

Based on the nature of the research questions and objectives, positivism and phenomenology are adopted as the underlying philosophy for this research. The empirical research was divided into three phases; the first phase focused on collecting data about using the internet among students in primary schools by means of a questionnaire. This has helped in the selection of samples and determined the extent of the students' reluctance to read from a screen. The second phase was to investigate the reading process of school book in two formats [ paper and electronic format] to build reading model based on users' cognitive and behavioural processes. The third phase was to examine the factors that affect negatively the usability of electronic texts by examining three issues: font size [10, 14, 16 and 18], font type [Arabic traditional, Arial, Times New Roman, Simplified Arabic, and Courier New], and line length [single column and double columns]. Observation was applied as a tool to collect the data.

The study has made a significant contribution to the understanding of electronic reading of Arabic language. This contribution addressed five aspects: (1) Two models of reading process for schoolbook using Arabic language were built according to users' interaction with the school textbook in two formats ( electronic and paper). These models will not only help define the interaction amongst users and e-books, but will also help designers to understand user behaviour of e-books and thereby to establish the most appropriate functions/features when building an e-book interface. (2) Identify the optimal font size for reading an Arabic script from screen by children aged 9 to 13. (3) Based on collecting data from experiments (2) and (3) and comparing this date with other researches that have done in the same field, new model explains the interaction between three topographical variables [font size, font type and line length] and their relationships with independent variables were provided. (4) Test a new display technique to improve the legibility of reading Arabic online texts by using colour to increase the ability to focus vision when moving from one line to another so as to improve the screen display. And (5) according to quantitative and qualitative several of the rules were recommended for designers and educators to follow when designing and presenting Arabic text on screen.

On the other hand, some recommendations for future research have been derived from this thesis, such as the following. (1) Investigating the effect of the colour factor on improving the legibility of Arabic texts on screen for children, e.g. using different colours to distinguish between dots and vowels. (2) Exploring and developing an e-reading model based on all the factors recorded in the empirical studies in the reading field which will lead to building a theory on e- reading. (3) Investigating the influence of a variable effect reading process and the variables that have a positive or negative impact on it. (4) Applying a model

that used colour to increase the ability to focus using different age-range and type of information such as journals or books.

## LIST OF PUBLICATIONS

- 1) Abubaker, A, Lu, Joan and Yip, Yau Jim (2008) Framework to design new model of E-journals. In: Proceedings of Computing and Engineering Annual Researchers' Conference 2008: CEARC'08. University of Huddersfield, Huddersfield, pp. 93-99. ISBN 978-1-86218-067-3. <http://eprints.hud.ac.uk/3687/>
- 2) Abubaker, A., Lu, J. and Yip, Y. (2009). New Model of Web Information Retrieval: [International Conference on Internet Computing - ICOMP](#) , pp. 277-282.
- 3) Abubaker, A., Lu, J. (2011). Model of E-Reading Process for E-School Book in Libya. International Journal of Information Retrieval Research, 1(3), 35-53. <http://www.irma-international.org/viewtitle/64170/>
- 4) Abubaker, A. and Joan, L. (2011) '[E-reading strategy model to read E-school book in Libya](#)'. In: *Proceedings of the International Conference on Internet Computing*. : ICOMP.
- 5) Abubaker, A., Lu, J. and Wilkinson, J. (2011) '[Measuring typographical variables in Arabic script in Reading](#)'. In: *International Conference on Education and Learning in Mobile Age 2011, 1-2 June 2011*, Lake District, UK.
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- 7) Abubaker, A. and Joan, L. (2013). Optimal Line Length for Reading SchoolBook on Screen; *International Conference on Education and New Learning Technologies*: EDULEARN13 Session: **e-Learning Projects and Experiences**. Session type: VIRTUAL: Barcelona: Spain. 1<sup>st</sup> – 3<sup>rd</sup> of July 2013. 5<sup>th</sup> edition. <http://library.iated.org/publications/EDULEARN13/start/475>

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# Chapter one: Introduction

Day after day, interest in the way of displaying data on screen has continued to increase, especially with the rise in the number of people who now use electronic texts for learning purposes. So, this requires more focus on factors that affect legibility on screen such as text format and user requirements. In addition, the number of previous attempts such as (Lee, Shieh et al. 2008, Patrick Rau et al. 2009) that cover all these factors affecting electronic reading are notably limited. One likely reason is that many researchers have concentrated their work on designing issues more than the analysis of the impact of these factors on display and reading electronic texts by children for learning. Another reason is that much of the research has focused on the effect of reading electronic text by examining the factors without grading or defining the relationship between these factors (Hartley 1977; Dillon, Richardson et al. 1990; Lee, Shieh et al. 2008; Huang, Patrick Rau et al. 2009).

In addition, most of these researchers have focused merely on multimedia features such as sounds, animation and dictionary option, with little focus on the format of electronic texts. Moreover, most of the reading theories are merely concerned with paper texts, without examining if they are suitable also as e- texts. However, issues related to this situation will be considered in the next chapter in more detail.

Additionally, The reading topic has become more interesting for many researchers in different areas of research such as information science, computing science, and human science. Thus, there are three categories of digital reading studies:

- I. Researchers focused on the usability of e-texts, e.g. comparing reading electronic to paper reading; measuring the legibility and comprehension of texts (Dillon, 2001, Noorhidawati and Forbes, 2008,)(Davis, Tierney et al. 2005); and examining user behaviours in digital environments.

- II. Researchers presented a ‘new approach using technologies to support reading electronic that concentrates on new software and hardware, hypertext, and interface design such as (Scane 2003; Godoy 2004; Thissen 2004; White 2007).
- III. Finally, researchers focused on the phenomenology of reading, as in studying human interaction with e-resources and reading process in both linear texts and hypertexts such as (Miall 2001; Liu 2005; Carusi 2006).

This research could not be included within any of these classifications to avoid falling into the same shortcomings of other research but aim to connect different aspects from different areas to provide a model that encompasses all the factors that affect legibility of e-texts according to the qualitative data and statistical analysis from several experiments.

However, the critical issues of how to increase usage of e- text are national concerns in developing countries. Although some Arabic countries have various national plans and policies to increase the use of e- text among children such as the ‘Report and Recommendations of the Fifteenth Meeting of the Group’ to develop a strategy of Arab telecommunications and information (Information 2005) which aims to activate the role of communication technology, and to employ such technology in the Arab world. But unfortunately, the average reading of electronic text is still low; therefore, there are questions to be dealt with such as the following: (1) how to motivate more children to read e- text; (2) how to stimulate teachers to use online material in class; (3) how to motivate readers to modify their reading behaviour, from reading paper to reading e- text; (4) how to stimulate designers to display e-texts on screen in a way that encourages readers to read online. Part of these questions will be answered in this research thorough following different methods.

Thus, this research will focus on the text as the main tool for learning and addressing the effect of the reading process in the design online academic text by developing a model that explains the relationship between the variables. It will also show the average effect by using students from primary schools in Libya as subjects. In addition, the results of this study have the potential to impact the future of web-based testing; online publications, e- learning, and other electronic document formats. Research problem was presented in detail in section 3.8 in the third chapter.

## **1.1. Research objects.**

This thesis is an attempt to examine the three factors that affect reading and designing of e-texts for children using Arabic script. In addition, it aims to develop a model for designing acceptance that will have the power to demonstrate acceptance and usage behaviour of the e-school text using a schoolbook for primary schools in Libya. Alternatively, dealing with the research problem led to the specification of the following research objectives, which were achieved through four inter-related surveys:

- To build an e-reading strategy for a schoolbook based on users' cognitive and behaviour processes.
- To test the effect of three typographical variables that affect reading electronic Arabic texts (font size, font type, and line length). These three factors were defended by the majority of researchers as the most influential.
- To provide a standard that can help keep children's concentration on the e-text.
- To create a guideline that could help designers when designing e-academic Arabic texts for children.
- To examine in-depth the challenges of reading Arabic e-texts.
- To study the efficiency of Arabic text reading and the factors impacting the efficiency of reading and comprehension.
- To understand children's behaviour when reading Arabic electronic text.

## **1.2. Research questions**

In order to investigate the effect of using e-resources, we need to develop a model which can present a user reading strategy and help define the behavioural processes of users. However, answering the following questions were needed in order to be sure that the level of legibility of e-texts in early education can be improved. Questions were divided into three groups based on research objectives:

### ***First group: "using internet and e-book"***

- Do students in primary schools in Libya use the internet and eBooks?
- For what purpose do students in Libya school use the Internet and eBooks?

- Which factors affect the use of the Internet and eBooks among Libyan primary school children?

***Second group: “reading process”***

- Is there a difference in the reading process between e-school textbook and p-school text-book?
- What are the existing prototypes of schoolbooks in primary education (PE)?
- How are students interacting with schoolbooks in two formats (electronic and printed format)?
- Is there a significant relationship between human information processing and text layout?

***Third group: “typology factors”***

- Is there a statistically significant difference between the means in the reading speed and word errors for each font size?
- Does the difference between the Arabic written system and other languages have an effect on designing standards?
- In which font size is the Arabic text read most effectively?
- Is there any correlation between age of the reader and font size?
- Which font type is more readable?
- Which Line Length is more readable for Reading Schoolbook on Screen?

### **1.3. Methodology:**

It is important to determine a research paradigm that is dependent on the principles of methodology before constructing a research design (Collis 2009). In this context, several researchers such as (Easterby-Smith 2002; Tillal Eldabi 2002) consider it essential to have a proper understanding of the philosophical issues behind any methodology, because it can assist in defining research designs, recognising which designs will and will not be produced, showing designs that may be beyond one’s past experience, and finally, being able to indicate the limitations of the research.

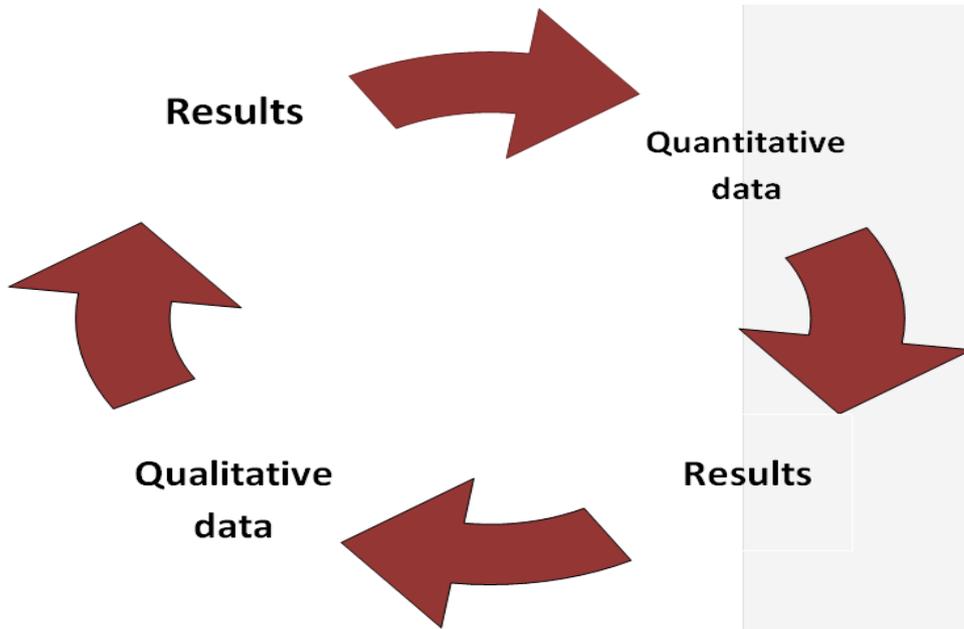
Furthermore, building a research philosophy should be based on the way the researcher thinks about the development of knowledge. Usually, research philosophy points to the way the researcher thinks about the improvement of knowledge which falls within one of two classifications: positivism or phenomenology. Selecting the more suitable one will be made in terms of the research questions and objectives.

In addition, Hussey and Hussey (1997) draw up a clear picture on how to distinguish between these two philosophies. The phenomenological approach deals with the measuring of social phenomena by focusing on the subjective aspects of human activity (Saunders, Lewis et al. 2007). Whereas positivism can be described as quantitative, objectivistic, scientific, experimental or traditional. From researcher point of view, each approach works effectively when connected to the appropriate variables. Therefore, the investigator must be aware of the need to select an approach that can achieve the research objectives and provide accurate data. For example, researchers such as Collis (2009) see quantitative research as unconvincing for recognising the context or setting in which people talk; whereas, a qualitative approach allows researchers to understand people's meaning. This may not be a weak point if the researcher is not looking to investigate or understand human performance.

Based on the nature of the research questions and objectives, positivism and phenomenology philosophies have been selected as a research philosophy for this study. The rationale for this combination is that each philosophy works successfully under specific circumstances. Thus, using a combination of philosophies would take advantage of their strengths and make up for their disadvantages. E.g., using a phenomenological philosophy will allow us to investigate in-depth the reader's behaviour and its relationship to text structure; on the other hand, a positivist philosophy will be able to deal with a larger sample. For a long time, researchers simply make use of quantitative and qualitative research approaches when doing research, but they also note that there are a weakness in both approaches as has been outlined above. Therefore, a multi-faceted methodology (quantitative and qualitative) has been used in this study in order to meet its main objectives and to highlight different aspects related to the effects of usability of electronic Arabic texts in Primary education (PE). In addition, multi-faceted methodology focuses on collecting, analysing, and mixing both quantitative and qualitative data into a single whole which should provide a better understanding of research problems than either approach alone (John W. Creswell 2007; Saunders, Lewis et al. 2007). Figure (1) shows the strategy of mixing

quantitative and qualitative approach in this research, starting with the quantitative approach to collect data for the next stage of building on the qualitative data.

**Figure 1: Mixing both quantitative and qualitative data.**



Due to the aim and objectives of this research, this study is divided into three stages, with each stage requiring different tools and techniques. The following are some of the justifications for selecting a mixed-methodology for this research:

- A quantitative research philosophy is adopted for this study in the first stage in order to expand on the general statement about the phenomenon being researched (i.e. “Using computer and accessing the internet in Libyan primary schools”) which should be based on data collected from a large number of students over a short period of time.
- Because a quantitative approach cannot consider the manner that humans interact with a phenomenon and it is not very effective in understanding processes of significance that people attach to actions, therefore, a qualitative approach was applied in the second and third stage of the research to define the manner of reading a school textbook in electronic and paper formats in order to build an e- reading strategy model for Arabic language that will support the designing of eBook and to examine students’ behaviour and attitudes towards the phenomenon through the use of different techniques.

- For measuring the factors that affect reading electronic texts, the phenomenological paradigm was applied to examine students' behaviour and attitudes towards the phenomenon using different techniques.
- A mixed-methodology will offer a better understanding of the topic under examination, where statistical analysis of the quantitative data will make abstracts, evaluations and generalisations easy and accurate, whereas qualitative records will offer a method for explanation, justification and description of measures, actions, approaches, and behaviour. This would lead to more meaningful philosophies from the standpoint of the subjects being explored.
- An exploratory design was applied to acquire quantitative participant characteristics so as to guide a purposeful sampling for the qualitative phase. In addition, an exploratory design does not require a guiding framework or theory which commensurate with the nature of this research, especially with the lack of comprehensive theories in the field of e-reading as mentioned in chapter two.
- As mentioned in this chapter and again in chapter three, there are a few empirical studies (Yolanda Jacobs, 2009, P et al., 2009, Asmaa and Asma, 2009, David Nicholas, 2008, Lee et al., 2008)(Korat 2010; Sofiene Haboubi, Maddouri et al. 2010) which have been conducted in the field of electronic reading, designing electronic Arabic texts, and the lack of studies examining the factors that affect the reading of an Arabic script. But generally, these studies only applied one approach [either quantitative or qualitative] which is a clear limitation of these studies.

Alternatively, an inductive approach was used in this research as a strategy, because it provides more flexibility to weaving back and forth between theory and data for linking theory to the research. The process is different in each strategy. E.g., a deductive process starts by investigating the existing theory via observations to derive a set of propositions. Whereas, an induction process starts with observing any phoneme to find material for building a new theory.

## **1.4. Ethical issues**

In this research, ethical issues have been taken into account at all research stages since the beginning, as Silverman has recommended (Seale, Gobo et al. 2006). In addition, because the research deals mainly with children and teachers during teaching hours, ethical issues

should be a concern in all research stages. Those who volunteered to take part in the collection of data were made aware that they had a right to withdraw from the research process at any time. Particularly in this study, due regard was given to protecting the identity of those involved and all efforts were made to ensure that their taking part would not adversely affect in any way their sense of privacy. Some of these concerns are noted and debated below.

#### **1.4.1. Benefit and risk**

This research will be beneficial to education in schools with its contribution to knowledge. In addition, this research offers opportunities for participants to discover a new learning style [eBook]. Students showed great interest in eBook through the questions they raised after finishing the observation. When they asked about the change that could happen in the way of learning, special students made complaints about this way of learning, with some describing it as boring while others found it difficult.

Furthermore, students taking part in the observation learned how to use the e- content available in the skool.com website, which presents the Libya schoolbook and starts comparing differences in each format. In addition, students get a list of the useful websites that support learning as an initial step in assisting them, especially in the absence of direction from the teacher.

As for the risks, it is clear that there would be no health and safety risks. But at the same time, this research was concerned at the beginning about wasting the students' time. And so, tests were done in class to reduce this risk and lessons were taken from the schoolbook. In the third and fourth experiments, students were tested outside school time.

### **1.5. Thesis' scope**

This thesis is structured into nine chapters that cover the complete research procedure, the assumptions and contributions, as well corroborating the main conclusions.

Chapter one raises research questions, introduces the research objectives, discusses the significance of the study, and draws up the structure of the thesis. In addition, this chapter

aims to describe the methods that were used during the research in order to meet its main objectives. Finally, the chapter outlines the potential benefits and risks that could be caused.

Chapter two provides the literature review in relation to reading electronic texts. This chapter examines the definition of online reading, reading process, and reading theories. The chapter also looks at the factors that affect reading online text to ascertain which factors have the most significant impact on reading online text. At the end of the chapter, a framework for factors that influence reading electronic context was built based on the analysis of previous research.

Chapter three addresses the context considered significant and pertinent to this research including: definition of e-document, structure of e-document, history of eBook, and the contribution of textbooks on education and eBook guideline. The aims of this chapter were to analyse different standpoints on eBooks and research related to them, to inspect what new meanings eBooks can have for academic studies, and to determine the roles that an eBook has in an e-environment. In addition, in this chapter some attention is given to using the Internet at both home and school. Finally, the chapter gives an outline of the problem in relation to the research

Chapter four presents the data analysis and findings from the first study – a paper questionnaire – which was designed to investigate eBook and internet usage patterns in a PE environment (based on five primary schools in Benghazi in Libya as a sample population). The findings indicated low eBook awareness and usage levels and that eBooks were not used in primary schools in Libya and that the Internet was not used for teaching reading either. Based on this result, a follow-up study was designed to investigate in more depth users' perceptions and reactions towards eBooks, particularly focusing on the general reading process.

Chapter five displays the data examination for the second study which was conducted in this research. This study was carried out as a follow-up study to a previous questionnaire survey (in Chapter 4) and was designed to investigate students' opinions, attitudes and reactions towards eBooks in more depth. This study was significant in terms of exploring how students in a Libyan school interact with eBooks for the purpose that was highlighted in the questionnaire survey findings. The outcomes of these findings were used for building two reading models for Arabic text. Therefore, an experiment to investigate the factors that affect

reading electronic Arabic text was designed in order to study users' interactions based on that purpose in greater detail.

Chapter six provides the analytical data of experiment (2) which tests the optimal font size and types for presenting Arabic script. The chapter begins with an introduction to the experiment's goal, followed by the data collection method used to achieve the objectives of this phase. In addition, a thorough analysis of the data was provided on the basis of five font types being applied with four different sizes. The chapter was drawn to a close by a summary of the main findings.

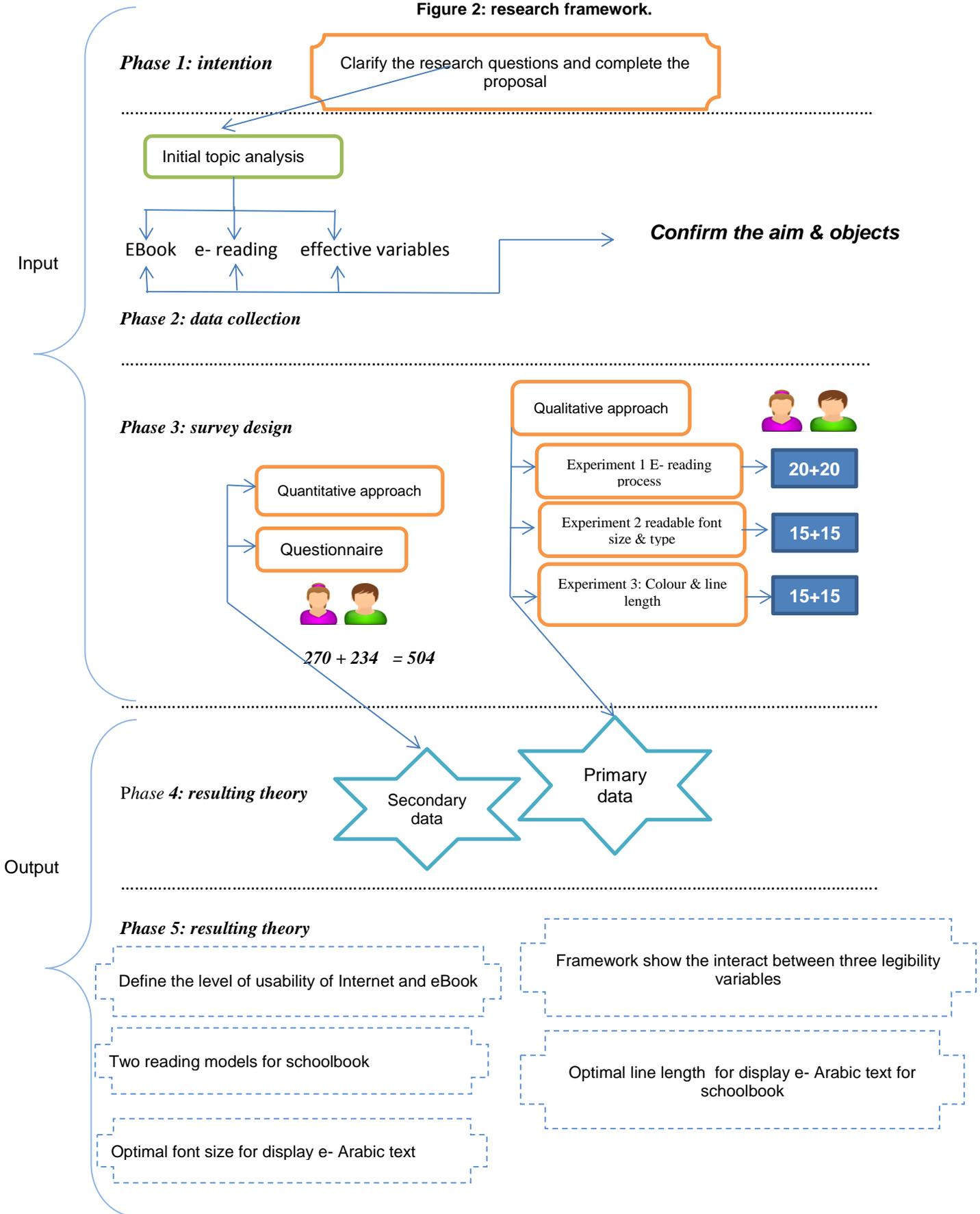
Chapter seven presents the data analysis for the third study which looked into the effect of line length on the reading speed and accuracy of Arabic e-text. This phase of the research was significant in terms of exploring which optimal line length for display electronic Arabic text to read by students aged 9 to 13.

Chapter eight provides a concluding discussion of this research based on the three interrelated studies that were conducted. It also highlights some difficulties and barriers faced when conducting the studies and further research that could be undertaken within the context of e-book usage as well as factors that affect reading texts online.

Chapter nine provides a significance of the study, contribution to knowledge, in addition, it lays out the limitations of the research finally the chapter provides several recommendations for further researches.

Finally, Figure (2) presents a research framework where the research was divided into five phases; in the first and the second phase of the research the aims and research questions were confirmed through reviewing research on the topic of electronic reading, eBook and usability. The third phase of the research includes survey design and implementation. The output of the early three phases are two types of data [ secondary and primary data]. The secondary data used to clarify some issues is not addressed in previous research, while the primary data provide answers to research questions. Finally, phase five provides the contribution of the research which come in four main areas.

Figure 2: research framework.



# Chapter two: Reading From Screen: theoretical and empirical background

## 2.1. Chapter Overview:

This chapter aims to deliver the fundamental, theoretical and empirical background surrounding electronic reading. It is structured into five sections starting with a reading definition, reading process, and a comparison between reading from paper and from an electronic format. The fourth section discusses the variables that influence reading electronic texts. These variables are classified into three categories: the individual or user variables (age, gender, experience and educational level); the text layout variables (font type and size, line length, spaces between lines of text, colour); and the applied technology (hardware and software). In the fifth section, a summary of previous studies is given and a framework for these variables is suggested based on the previous surveys.

## 2.2. Reading definition

From the history of research on the topic of reading, researchers put forward a set of definitions, but it is to be noted that the majority of them focused on one concept without providing a clear definition of the concept of reading to make it incomprehensible to all elements that related to reading . One of these definitions classified reading as an active process, self-directed by the reader in many ways and for different purposes (Gibson and Levin 1976). Others believe it is a complex, rule-based system that must be imposed on biological structures that were designed or evolved for other reasons (Malicky, Grace; Norman, Charles A 1989) . Still, others consider reading as extracting information from the text. Furthermore, children's reading is usually defined according to the brain structure (Frey and Fisher 2010), where the brain is divided into three areas in the early stages of learning: the prefrontal cortex, the parietal cortex, and the cerebellum (Kosslyn and Rosenberg 2004). Therefore, reading occurs only through the intentional appropriation of existing structures within the brain.

Generally, reading aims to create a comprehensive understanding of the text. This requires from the designer of the text a good organised text, with a clear structure and clear links between words (Malicky, Grace; Norman, Charles A 1989). In addition, Kenneth Moorman and Ashwin Ram ( 1994) defined reading as the cognitive task of understanding a text.

Based on the above, reading is both a bodily and mental process, and it is difficult to describe it because it is one of those deep and complex phenomena involving the human brain. Moreover, it is a complex interaction between the text and the reader, shaped by the reader`s prior knowledge, experiences, attitude, and language community which is culturally and socially determined. The complexity of the process of reading can be attributed to the absence of a comprehensive definition and that each definition focuses only on one side, perhaps because of the complexity of the reading process.

In addition, Beverly L. Harrison (2000) classified reading into six types: (1) skimming through the content; (2) reading to answer a specific question; (3) reading to learn; (4) reading to critique; (5) reading to cross-reference; (6) reading to support listening. From the above, it can be concluded that the reading process goes through several stages, making it difficult to narrow it down to a single definition or model of reading, as we shall see in the next section.

### **2.3. Reading process:**

Before describing and discussing the process of reading, it is important to give a brief definition of the reading process by referring to it as a manner of reciting or acting with the text. In other words, it is a method that the reader follows when reading any type of material. However, the reading process varies according to the type of information and other factors such as the text size, organization, and search tools. For example, the organization of an article is different from that of a book, conference paper, or report. Therefore, we must investigate the reading process for each type and genre of information by defining the differences between them, which will help outline the requirements of each type.

On the other hand, many would think that reading online is similar to reading from paper but looking at it more deeply from a transactional perspective, electronic reading is

actually more complex as it imposes on readers to learn reading skills such as decoding, fluency and synthesizing.

Discussing the reading process can have two dimensions. The first dimension focuses on investigating how readers create sense when reading electronic or a paper text, where in researchers apply different theories such as the cueing system theory or the transactional theory to define reading strategies and good reading skills. In the second dimension, which is applied in this research, the reading process is examined to define how readers deal with the physical entity of information (Eagleton and Dobler 2006).

In addition, asking questions like “why, what and how people read a document” have been made by several researchers in different fields of research such as psychology and education whose concern is building theories on how a child learns to read and develop cognitive and linguistic skills; whereas, linguistics has been concerned principally with the analysis of speed and only give passing mention of writing systems and reading. Meanwhile, researchers in the field of usability are focused on addressing these questions which are used in the first stage of any research into the reading generally and e-reading specifically. Moreover, focusing attention on cognitive and behavioural aspects of the reader by asking why and how the reader reads a text brings forth issues related to the context which affects the presentation. From previous research, there are different reading processes which will be classified into:

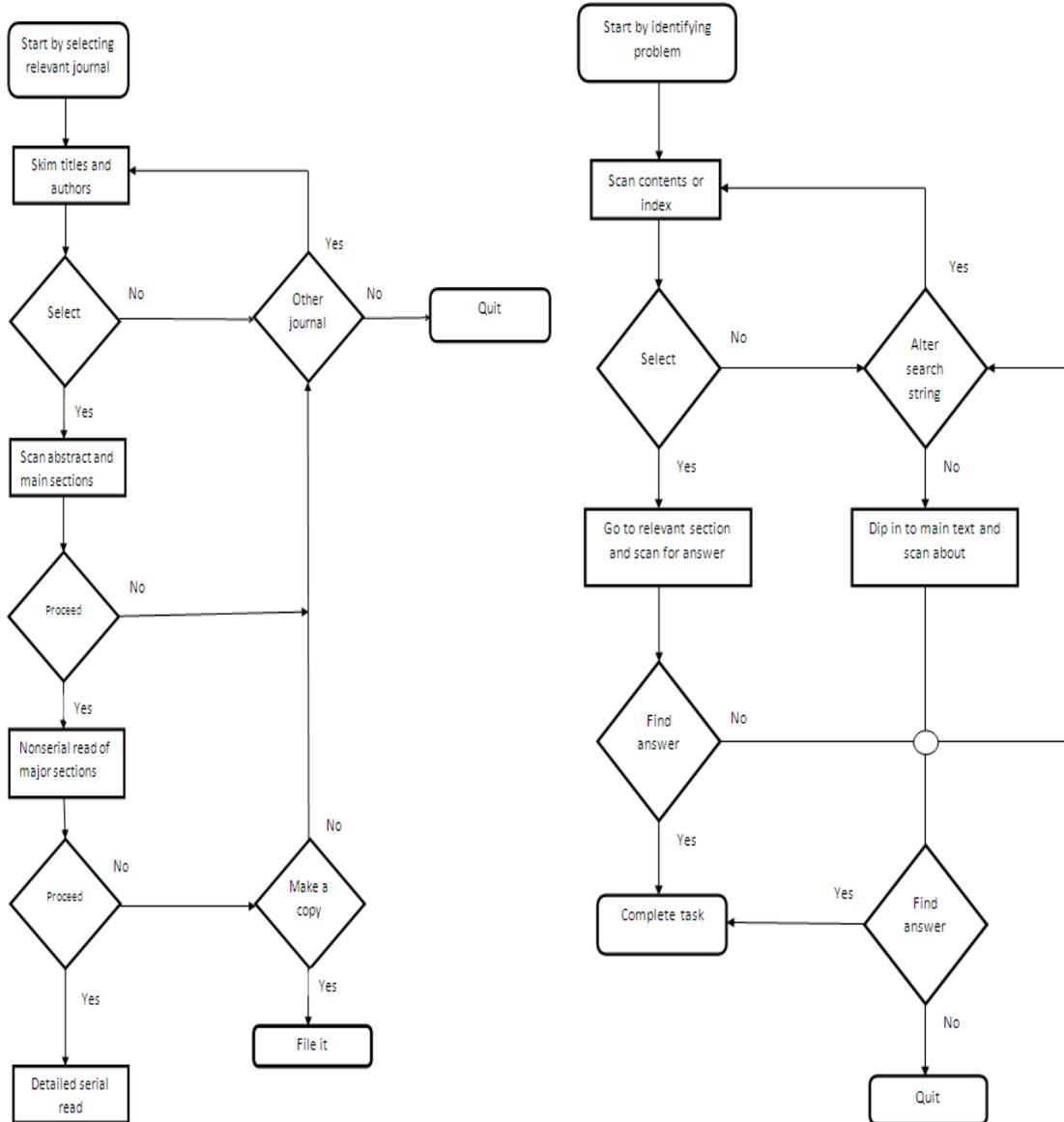
- Reading process according to the type of sources.
- Reading process according to ways of designing and presenting the text.

### **2.3.1. Reading process according to the type of sources**

The reading process differs on the basis of the type of information resources as mentioned by many researchers. For example, Andrew (Dillon 2001) investigated the reasons for people wanting to access journals, and the author reported that students access journals for numerous reasons such as: answering a particular question (73%), keeping up with developments in an area (46%), or for personal interest (20%). Moreover, Figures (3) and (4) present the reading process in two different types of material, providing clear evidence that the reading process changes according to the type of reading material. For example, readers

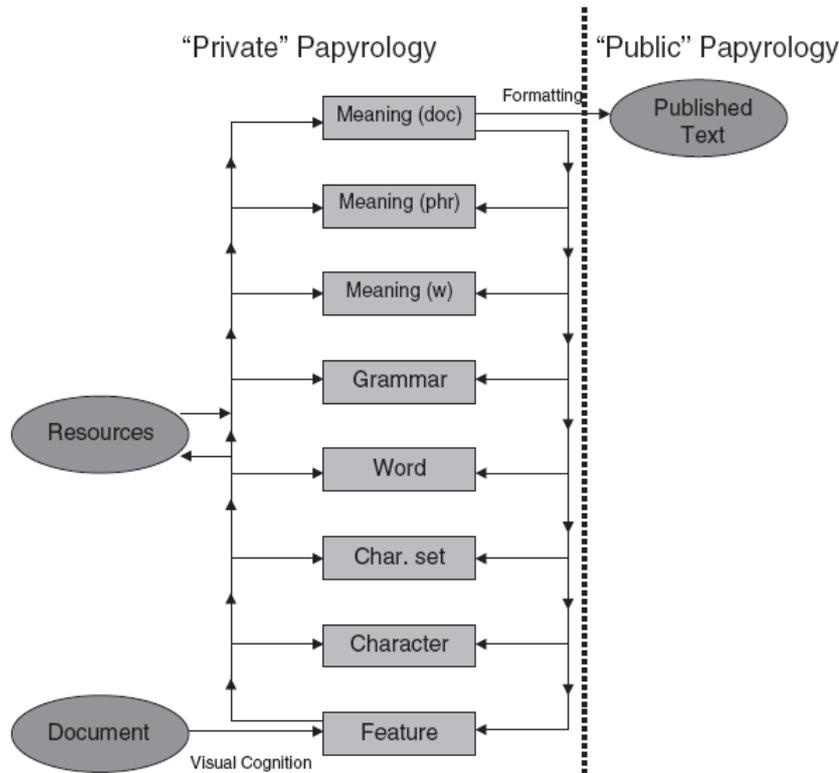
only skim through the titles when reading journals, while they scan the contents or index to get a general idea of the work rather than select related sections and scan for answer.

**Figure 3: Generic model of journal usage(Dillon 2001). Figure 4: Generic model of manual usage.**



Alternatively, Meliss Terras ( 2005) provided a model to explain how experts read ancient texts, using a qualitative method [content analysis, focused interviews and think aloud protocols] to build their model. Researcher found that three experts use different methods to examine the document; they also spent a long time checking the text and the word in a different order. In addition, they deal with visual features and then build up knowledge about the document (see Figure 5).

Figure 5: A model that explains how experts read ancient texts (Terras 2005).



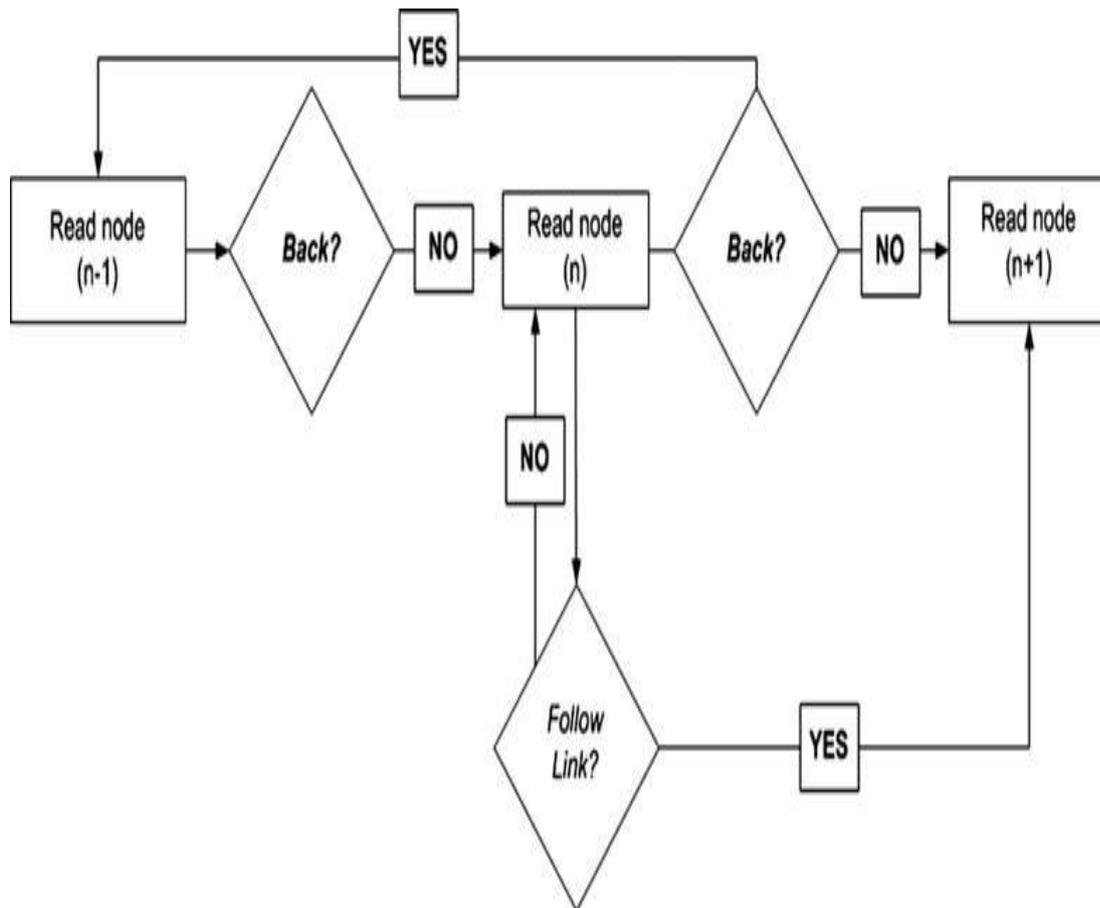
These two studies provided strong evidence that the reading process differs according to the type of information resources and the reading’s aim. To be sure, the reading process is quite different, from a child who reads a picture book to the mature reader who extracts information from highly specialized texts in mathematics, logic or physics. Thus, the researcher expects that the reading process for a schoolbook should also be different (Dillon 2001; Terras 2005; Abubaker and Lu 2011 ).

### 2.3.2. The reading process through linear and non-linear design

The other issue that drew the attention of researchers in the field of e-reading is the reading process in terms of the text design which may be classified into two categories: linear and non-linear (hypertext) design. Presenting text using linear design allows reader starting at the beginning and reading to the end while nonlinear design ( hypertext) design allows reader browse through the sections of the text, jumping from one text section to another and so on.

For example, D. DeStefano ( 2005) presented a model showing the steps followed by the reader when reading a hypertext as seen in Figure (6) where the amount of nodes and the reading process are distinct when reading a hypertext structure. As can be noted, the reading process in this format is not under control and can change according to the readers' prior knowledge and skills.

**Figure 6: Process model of hypertext reading (De Stefano and LeFevre 2005).**



There are different types of hypertext: (1) Hierarchical hypertext (2) Additional links; (3) Semantic links and (4) Networked hypertext. Each type has a different effect depending on the type of text and the purpose of reading. For example, hierarchical is better for the readers' memory than network.

In addition, researchers on non-linear structure have focused on the effect of the reader's navigation path by exploring the relationship between reading method and comprehension, and reported different strategies of navigation used by readers according to users, knowledge seekers, features, and apathetic hypertext (Dillon 2001). In addition, changing the order of the text could influence comprehension in a liner text which is affected

by different criteria such as the logical order versus random. More research needs to be done to cover this area in order to determine the difference as well as the negative and positive impacts.

However, the debate about factors affecting the reading process is extended to investigate the readers' cognitive process. For instance, Panayiota et al. (2007) examined the impact of epistemic beliefs and on-line text structure by reading refutation and non-refutation scientific text using the think-aloud method. They reported a significant impact of text structure on reading comprehension. On the other hand, there is no difference in the total amount of information recalled between students who have more or less prior knowledge.

In addition, numerous studies in visual research that investigate the effect of the number of links on the process of browsing, reading and learning by measuring the speed of the search for information or word such as (Cress and Knabel 2003; Lin 2004; DeStefano and LeFevre 2007) concluded that there is an inverse relationship between the number of links and cognitive.

Moreover, the construction integration model has received much attention among researchers on hypertext comprehension. The model pointed to several elements that affect text comprehension, with an emphasis on prior knowledge and coherence as a key element affecting comprehension (Yoh, Damhorst et al. 2003). However, most research used these two models to define reading stages on hypertext by analysing the navigation path, order of reading, and the number of nodes that the reader followed to access the information. These reported a significant effect of prior knowledge, reader skills and education level on the path of reading (W Kintsch 2004. Ajzen 2011).

Alternatively, in the case of reading to learn learners are more positive with fewer nodes in comprehension reading (Ajzen 2011). On the other hand, the reading time is not affected by the number of links. Such findings assist designers to create the tool that commensurate with the requirements of readers, for instance, create a map illustrating the path of the reader in the text or determine the strength of the relationship between text and links.

## **2.4. Theories being applied in the reading field**

Examining previous studies shows a mixture of theories being applied by researchers and are related to using technology such as the eBook and the Internet. These theories could be classified according to the aspects that deal with it or even by the methods used to achieve their goals. In this context, it can be classified into three perspectives;

### ***Theoretical perspectives on ( dealing with ) human behaviour:***

This type of theories is for the reader in the sociology and psychology field which focused on understanding and analysing user behaviour and attitudes generally. It focuses attention on the behavioural aspects of the reader and studies its interaction with the different types of information technology. Looking at previous research shows that there are three theories that have been used before in the analysis of human behaviour in terms of using information technology (e.g. using the Internet).

We may begin with the social cognitive theory (SCT) which was provided by Bandura (A. 1986). It is used in different fields such as psychology, education and communication. It focused on three aspects: behavioural, personal, and environmental factors. It stemmed from the area of social learning. Alternatively, according to this theory, human behaviour has an impact on the environment and thus must be studied and understood in order to determine the extent of its impact on the environment. This can help create a synergy ( balance) between the user and the product, and can also deliver a product that takes into account the nature of human behaviour. In the same context, the theory proves that a large part of human behaviour is acquired. On the other hand, some have argued that the theory is always applied to studying self–efficiency.

From our standpoint, it is difficult to accept that only this theory can activate the use of electronic texts. And that is because there are various aspects affecting the reading process such as language, text structure, technology, and so on. In addition, the theory refers to human behaviour without providing explanations as to the effect of the product on user behaviour. This could be adjusted or linked to other theories that could be used in determining the student's interaction with the text in a hard or e-copy. Defining this interaction will differ depending on the type of reading media as well as the factors that caused those differences.

The second is the Reasoned Action Theory (RAT) which concerns understanding and explaining human behaviour in different areas, where it is assumed that behaviour is affected by other opinions either negatively or positively. In addition, it is based on two aspects: attitudes and norms (to predict behavioural intent) (Hausenblas, Carron et al. 1997). Theoretical perspectives illustrate that research connected to IT begins with this theory to understand the effect of the opinion of others who are considered as part of the users' surrounding. In this study, the student is usually influenced by the information types and education system. Each one requires different skills, abilities and influence.

Davis first proposed the technology acceptance model based on (RAT). The model has been applied to expound or inspect individual behaviours by focusing on two theoretical constructs: perceived usefulness and perceived ease of use. It is provided with strong behavioural elements and allows the person to act without limitation. Venkatesh and Davis then developed the model and introduced it for the first time into management science (Venkatesh and Davis 2000). It covers extra strategic elements that concern social influence and cognitive instrumental processes for recognizing their effect on the target system.

Because of the limitations of the reasoned action theory (RAT) in dealing with behaviour, Ajzen (1991) proposed a planned behaviour theory (PBT) by introducing a third independent determinant of intention. According to the PBT, human activities are dictated by three types of attitude: behavioural beliefs, normative beliefs, and control beliefs. These three elements give additional opportunity to the person for more action and thus will increase the person's chance of delivering a desired action.

However, several researchers have effectively applied this theory in IT acceptance, e.g. (Bobbitt and Dabholkar, 2001, Yoh et al., 2003)(Truong 2009). These theories all agree on being designed to study human behaviour, but they differ in the comprehensiveness of certain elements; for example, the theory of reasoned action focused only on two elements; attitude [*the main predictor of behavioural intention when self- influence is stronger than perceived subjective norm*] and subjective norm [*the main predictor of a behavioural intention for behaviours in which normative implications are dominant*], while the planned behaviour theory adds a third element: perceived behavioural control (Icek Ajzen 1991). In addition, the decomposed theory of planned behaviour adds a new branch for each element of the preceding ones; for instance, it defines three antecedents of attitude, namely, perceived ease of use, perceived usefulness, and compatibility.

### ***Text-focused, theoretical perspectives classified into two categories***

The first category consists of theories that emphasise on structure of the text such as rhetorical structure theory (RST) , computational or natural language generational. These types of theories are usually built on the perspective of linguists who are not considered in this research. The second category focuses on the text format such as the linear and non-linear system theory (see reading process section).

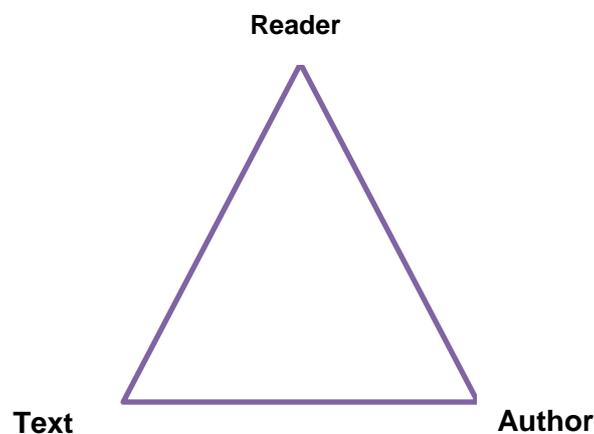
The visual attention theory (VAT) aimed to understand and explain the visual process and identify the factors that affect visibility. It was first presented in 1990 by Bundesen (Bunden 1990); according to this theory, it aims to analyse two aspects (recognition and access), an any object recognized at the same time was picked or selected. This is contrary to the previously reported theory by Broadbent ( 1958) who thought that selection occurs prior to recognition, while J.A. Deutsch & D. Deutsch ( 1963) provided just the opposite. It is notable that the theory did not address the factors associated with visual recognition, while Vidyasagar (TR and K 1999) highlighted part of these factors such as colour, texture and form but it concerned with determining the visual process without addressing the factors that impact visibility. In spite of many barriers to online reading, the visibility problem is defined as an initial hypothesis for reading difficulty. This thought was based on several experimental researches concerning the reasons that cause visual deficit. These agreed that unstable visual display of words or characters is one of many reasons that causes reading difficulty such as a dorsal stream deficit (de Boer-Schellekens and Vroomen 2005).

### ***Theoretical perspectives dealing with the reading process***

Previous studies show that there is limitation in the studies that focused on explaining the reading process. Ingrid Fontanni ( 2004) provides a good and clear overview of reading theories that aim to explain the transformation of information. The study concluded that reading is a complex cognitive process that goes through various steps such as reorganizing a text and linking information. These processes are influenced by several factors related to the reader and text. In addition, Gernsbacher provided a framework (structure building) that describes the cognitive process. The model considers the new input as a fundamental stage where the reader in this stage may slow down but then in the next stage the memory maps it (Fontanini 2004).

In addition, the landscape model was used to provide a conceptual framework of the reading process, as it helps to understand the complex factors that impact the reading process. This model is just focused on the cognitive process that occurs during reading and directs readers' attention to specific textual content and their effect on memory without considering the effect of typographic factors in reading such as font type and size (Linderholm 2004) because of their ability to show the readers' purpose for reading and their background knowledge during the reading process. Information processing theory suggested that the human mind works as a computer system through following logical rules and strategies when processing information. The theory confirmed that changes made in the hardware will improve the computer's processing of information, so, changing the reading rules and strategies they have learned will lead to improving the reading of online texts (Swanson 1987). On the other hand, the reader response theory (RRT) has been applied in several studies to understand the action of the reader, showing clearly the relationship between three elements that are basic to any reading process: text, author and reader, as seen in Figure (7) (Swanson 1987).

**Figure 7: The element of the reading process based on Reader Response Theory (Swanson 1987).**

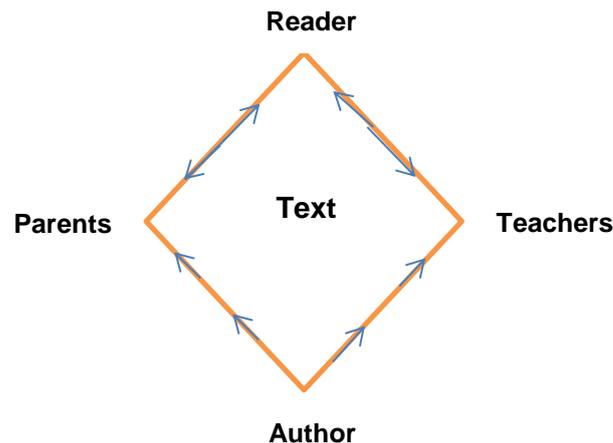


In addition, the related literature shows that there are two approaches to (RRT): the phenomenological approach and epistemological approach. According into Fish (Hirvela 1996), the theory is focused on the reader's response where the readers control their reactions to the text, while Iser (1978) thinks that the reader is free to make a response based on the text where there is no right or wrong way.

Applying this theory to explain the reading process of a schoolbook shows the missing elements that play a significant role in reading schoolbooks. Where two elements should be added [ teacher and parent] when dealing with schoolbook. These two elements

cannot ignore in this study where students usually get support from their parents at home and teachers at school; therefore, modification has been made on the basic theory ( RRT) in this research by adding two elements: teachers and parents, as seen in Figure (8). Data Collected on experiment (1) conformed the importance of the role of these two elements as a presenter in chapter five.

**Figure 8: The relationship between the five elements in the reading process of school textbook.**



In this model, the text is presented in the middle of the reading process wherein all the other elements deal with the text at different levels with different methods. However, the reader comes in at the top of the diamond shape while parents and teachers are found at the same level.

## **2.5. Factors affect the reading performance**

Based on analysis of more than 89 studies concerned, an investigation into the variables affecting usability of electronic content framework was suggested. 67.5% of these studies were carried out in the 1990s. An overview of these studies shows a good number of factors that affect reading generally. The average effect of these factors differs, however. For example, Dillon (1992) at the end of an empirical research that investigates differences between reading electronic text and paper text concluded that no one variable is likely responsible for the difference in reading performance between the two formats, and identifying a single factor without identifying all the relevant issues will only lead to misunderstanding. Dyson (2004) defines the text layout variables in terms of line length, columns, window size, and interlinear spacing. This attempt cannot be considered as an integrated variable that covers all the factors for it neglected other variables as font size that

was considered very influential, whereas the study confirmed the relation between variables through reviewing other works such as (LUND 1999).

From our standpoint, the factors could be classified into two groups: factors related to the usability of e-content, and legibility factors related to reading online texts. A third group is related to users or readers included in demographic characteristics, educational levels and experiences.

### **2.5.1. Individual variables**

Firstly, age has been reported in most usability empirical studies than any other demographic variable. Although more research are related to age difference in using e-content have reported mixed results, other studies have also shown that older users are expected to deal with electronic text more effectively than younger users (Cheyne 2005). Unfortunately, differences in age have not been theoretically discussed to clarify causes of such differences. Alternatively, understanding age difference in reading from a screen will help define difficulties, requirements and the nature of the use which will lead to an enhanced higher level of usability of e-content than ever before. There are 132 studies in reading from screen which could be classified into different categories such as factors affecting reading, reading process and application. These studies did not focus on the relationship between the reader's age and reading from a screen. In the same perspective, some studies revealed that age had a significant impact on the usability of e-text. The significant differences concern types of material, text format, line length and window size. Therefore, more research still needs to be done to clarify the effect of this variable on reading online. Generally speaking, findings of empirical studies across many countries clearly show that age is the most researched variable more than any other demographic variables (12 studies). This clearly indicates that age ought to be considered as a key demographic variable (e.g. Miller and Gagne 2008).

Secondly, the relationship between gender and reading from screen has been investigated in the literature on human-computer interaction by many researchers such as (Cheyne 2005). Mixed results have shown that while some (Liu and Huang 2007) have indicated that gender is positively and significantly correlated with reading from screen, others have found no such significant relationship. For example, 3 studies (Sellen and Harppter 2002, Liu 2006, Liu and Huang 2007) reported few significant results as to the effect of

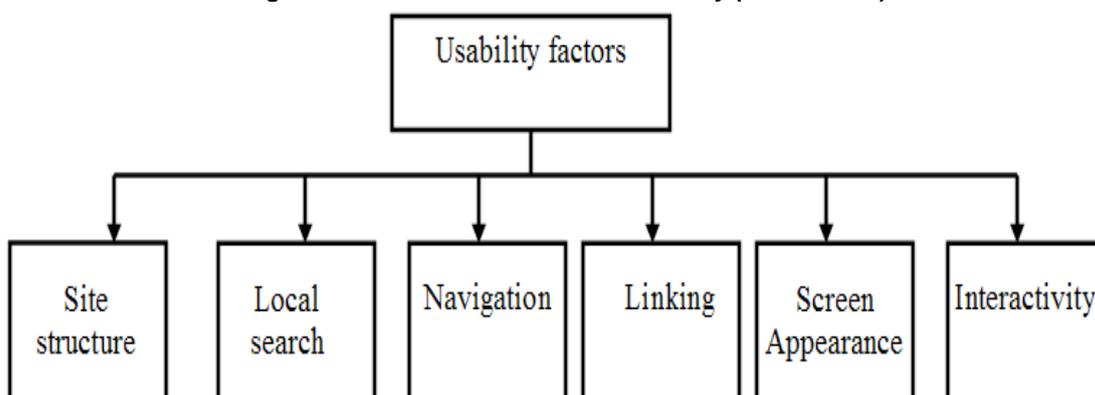
gender on online reading, whereas three other researchers indicated significant findings. Overall, empirical studies regarding the role of gender in reading from screen have continued to produce inconsistent and mixed results. Of the 123 studies reviewed, none or few pointed to any significant impacts or relationship.

In addition, the educational level and use of e-text have been studied in the literature on human computer interface to define their influence on reading from screen. In early research, some researchers argued that educational level does not appear to have an impact on reading online, whereas others have suggested that a significant relationship between the two exists. On the other hand, some researchers found online reading to be positively impacted by educational level and these researchers argued that educational level is one of the crucial variables. Some did not consider educational level at all such as Noorhidawati (2008). Finally, in the current review, it is clear that educational level had no significant relationship with reading online. The remaining three showed some statistical difference in reading from screen based on educational level.

### 2.5.2. Usability factors affecting the use of e-content

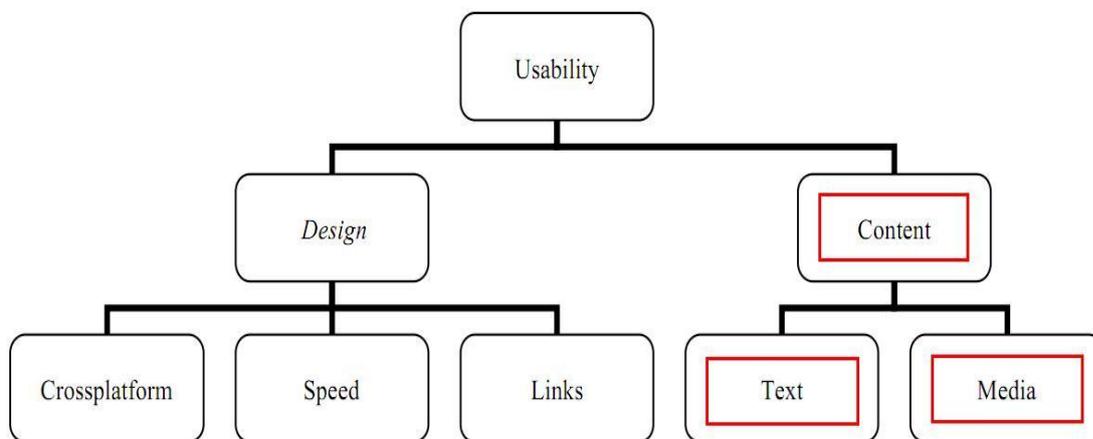
Several researches try to address the factors that affect the usability of electronic Book by comparing it with paper book using different theories and methods, some of which merely focus on general aspects while others go into it more thoroughly. For example, the main web design guidelines (Powell 2000) classify usability factors into six categories (as seen in Figure 9), where the logical structure and navigation were outlined as important factors affecting usability with more emphasis on navigation as the main factor that affects the content structure. These six factors could be accepted as general factors, but defining the elements of each factor is needed.

Figure 9: Powell's factors of Web usability (Powell 2000).



Moreover, according to Nielsen ( 2000) there are two main factors that affect using e-content (as seen in Figure 10): page design and content design. However, there is a certain deficiency in this classification which ignores elements related to page design such as font size, margin, spaces between lines, colour and location of the text. Moreover, it included elements not strongly related to this factor such as page linking which was defined as part of page design and the speed of reading access which usually depends on the type of technology being used. In addition, content design concerns elements such as the number of words per line, sentence structure, and headings.

**Figure 10: Nielsen's factors of Web usability (Nielsen 2000).**



In the same context, IBM web guide emphasises four elements: structure, navigation, visual layout, and content (IBM 2005). The guide recommends using different structures depending on the type of information. Alternatively, the guide focused on access to technologies that use screen resolution and size. Moreover, IBM differs from previous guides in how it implements media in different content types and sizes.

Generally, these models and usability guidelines are concerned with explaining the factors that affect the usability of websites more than reading eBook and have been applied by researchers to evaluate websites such as (Chau, Au et al. 2000; Agarwal and Venkatesh 2002; First 2005; Robert, Paul et al. 2008; Nathan and Yeow 2011). Whereas, examining the usability area shows a lacuna in the literature that examines the usability and legibility of electronic texts.

The studies on technology usability models show the insufficiency in these models, although there are several studies that focused on investigating the factors that influence

using e-content through various technologies. Table (1) displays five models that are applied in the majority of usability research. As can be noted, each model focuses on one aspect. Therefore, a comprehensive model that covers all the influential factors is needed.

Table 1: Factors influencing the use of e- content based on five usability models.

<b>Factors</b>	<b>WUM</b>	<b>TAM</b>	<b>UTAUT</b>	<b>MOPTAM (Kotzé 2007 )</b>
<b>Site structure</b>	Yes	No	No	No
<b>Local search</b>	Yes	No	No	No
<b>Navigation</b>	Yes	No	No	No
<b>Linking</b>	Yes	No	No	No
<b>Content</b>	No	No	No	No
<b>Visual layout</b>	No	No	No	No
<b>Screen appearance</b>	Yes	No	No	No
<b>Interactivity</b>	Yes	Yes	Yes	Yes
<b>Social influence</b>	No	Yes	Yes	Yes
<b>Behavioural intention</b>	No	Yes	Yes	Yes
<b>Easy to use</b>	No	Yes	Yes	Yes
<b>Attitude</b>	No	Yes	No	Yes
<b>Actual system use</b>		Yes	No	Yes
<b>Personal factors</b>	No	No	No	No
<b>Facilitating conditions</b>	No	Yes	No	No
<b>Perceived usefulness</b>	Yes	Yes	No	No
<b>Demographic</b>	No	Yes	No	Yes
<b>Learning influence</b>	No	No	No	No
<b>Content language</b>	No	No	No	No

Most researchers who are interested in reading agree that there are several factors that influence reading speed, accuracy, and comprehension. In addition, there are a number of empirical studies that provide strong evidence about the effect of these factors on reading from paper media. On the other hand, there is limited research addressing all the aspects related to reading from screen. For example, the findings of Kruk and Muter (Kruk and Muter 1984) drew attention to differences between displaying a text on screen and paper, by presenting the text using the same structure of a paper book. The findings also show the difficulty of reading online texts that are presented using a paper structure. No wonder, the number of empirical studies in the field of human computer interface with focus on displaying text on screen has increased (Nai-Shing, Jie-Li et al. 2011). But at the same time, the relationship between optimising reading from screen and text layout is still unclear

(MUTER 1996). Even though there are many studies that measure the average influence of layout text on reading from screen, the picture is still relatively underdeveloped because of the limited evidence over the effect of text layout on the different methods of reading (Dyson 2004).

### **2.5.3. Legibility factors**

Several studies that focused on investigating typographical factors such as (Alotaibi 2007; Zhang, Shu et al. 2007; Der-Song Lee, Kong-King Shieh et al. 2008; Wastlund, Norlander et al. 2008; Huang, Patrick Rau et al. 2009; Shu, Zhou et al. 2010; Nai-Shing, Jie-Li et al. 2011) emphasise different factors such as font size, line length, margin, font and background colour, and line space. The majority of these researches applied using Latin or China script while in this research, three factor [ font size, font type and line length] have been studied in detail using Arabic script. Selecting these three typographical factors set depend on the findings of previous research that confirmed it as the most influential as can be noted during the presentation in the next section (Der-Song Lee, Kong-King Shieh et al. 2008; Shu, Zhou et al. 2010).

#### **2.5.3.1. Font type and size**

Font size is one of the typographical factors that have received considerable attention by researchers interested in studying displaying texts on screen through investigating their effect on reading speed and accuracy. The findings of these researchers could be classified into three groups. The first group reported a significant impact of font size and type on electronic reading (Bernard 2002; Hedrick 2002; Bernard, Chaparro et al. 2003; Maria dos santos Lonsdale 2006). The second group reported a limited effect. The third group reported no effect (Chen and Chien 2005; Shu, Zhou et al. 2010). However, the points usually used to measure the size of the letters include the cap high of the letters plus a small interval of space above and below the letters. Points are also used to measure the distance between lines.

In the same perspective, the studies that confirmed the effect of font size and type did not agree on the optimal size and type that could be considered as standards for designing e-text. For example, Bernard et al. ( 2002) tested three different font sizes (10, 12, and 14 points) with 8 font types using a sample of 20 participants aged 18 to 55. They were asked to read passages of over 1000 words. The study reported that speed and accuracy were affected

by font size, and font size at 12 point size was read faster than at 10 point and posited a relationship between speed reading and font size. This finding goes in the same line as Shurtleff ( 1967) and the National findings (National 1988). Furthermore, the findings of research by Smith ( 1996) indicated that characters' height has a significant effect on search time and accuracy, e.g. the average accuracy rate was about 91% in 2.2 mm. This average decreased to 81% in size 1.4 mm, and in 3.3 mm the search speed increased but decreased when the characters' height was up to 3.3m. Consequently, Jayeeta et al. (Banerjee, Majumdar et al. 2011) reported that there was no statistically difference in the reading speed between font size 10 and 12, while some researchers pointed out that the readable font size starts from 14 point such as (Banerjee et al., 2011)(JE 2005).

Furthermore, few researchers such as Chien and Chen ( 2005) argued that increasing the size did not necessarily improve the perception of legibility. Kolers & Duchnicky ( 1981) debated whether smaller characters with more characters per line are read faster. Also, font type was reported as influential variables but this impact is not as strong as the font size reported as the main factor affecting a reading from screen. Vrinda font size 14 was reported as the most readable font followed by Arial in the same size, while Times New Roman was the worst (JE, MV et al. 2005; Banerjee, Majumdar et al. 2011). This finding was rejected by Banerjee ( 2011) who pointed out that Times New Roman font size 10 and 12 are like size 14 of Courier New font.

Overall, it is notable that most of the studies compared just two font types (RW, HL et al. 1993; Banerjee, Majumdar et al. 2011) which makes drawing conclusion difficult and in some cases researchers did not justify their selection. A justified text can be very readable if the designer ensures that the spacing between letters and words is consistent. Italics reduced the legibility of characterise and words (Sheedy, Subbaram et al. 2005). Otherwise, other researchers in typographic literature (e.g.Banerjee et al, 2011) believed that serifs have a significant impact on the readability of texts on screen because they reckoned serifs increased letter discriminability.

In general, the findings of empirical studies across several conditions show that font size is the main typographical factor affecting the display of texts on screen. What is more, this factor is affected by other variables such as font type and line length but to draw a clearer conclusion, more research should be done to consider such relationships. Table (2) provide summary to the main findings of research that have been done in this area.

**Table 2: summary the main findings related to font size.**

<b>Findings</b>	
<b>Font size</b>	<ul style="list-style-type: none"> <li>- Use a serif for the main text ( Maria dos Santos Lonsdale, 2006)(Russell-Minda, Jutai et al. 2007).</li> <li>- Increasing size did not necessarily improve the perception of legibility (BERNARD 2002).</li> <li>- 10, 11 &amp; 12 points are readable size for Latin alphabet (Wijnholds 1997; Maria dos santos Lonsdale 2006).</li> <li>- Smaller characters with more characters per line are read faster.</li> <li>- Size 14 point is more comfortable, ease for reading and reading fatigue than size 10 (Chan and Lee, 2005, Nai-Shing et al., 2011)( Chinese language).</li> <li>- Size 10 and 12 are readable size for reading Arabic print text (Alotaibi, 2007, Bernard, 2002).</li> <li>- Font size had no effect on reading efficiency (BERNARD 2002; Chen and Chien 2005).</li> <li>- Most international standards suggest 16 &amp; 22 as minimum size for good reading of Latin alphabet (Smith 1996).</li> <li>- Creating spaces between words is more useful than increased font size of the words (Shu, Zhou et al. 2010).</li> </ul>
<b>Font type</b>	<ul style="list-style-type: none"> <li>- Times New Roman was read faster in Arabic print text (Alotaibi 2007).</li> <li>- Arab children's performance improve when using Simplified Arabic font with font size 12 point or Arial Unicode with font size 14 point (Asmaa and Asma 2009).</li> <li>- There was no difference between Arial and TNR (M, B et al. 2003).</li> <li>- Arial sans serif to be preferred over TNR serif, serif font in size 10, 12 &amp; 14 point, TNR is less time in size 10 &amp; 12 similar in size 14 Courier New (Banerjee, Majumdar et al. 2011).</li> </ul>

### **2.5.3.2. Line length**

The line length of the text was considered to be one of several typographical factors that affected reading speed and comprehension. Line length is measured in typographic units (picas), which are used to increase or reduce the amount of space between letters. Other researchers used units of inch and centimetre, while resent studies attempted to measure line length using a totally number of characters. In addition, eye movement, reading speed and average of errors are common methods used to identify optimal line length which may explain the difference in the findings. (Randolph and Anuj 2005) divided the factors affected by line length according to the analysis by several previous studies as follows: (1) subjective factors such as ease of reading and user preference and satisfaction; (2) objective factors such as comprehension and reading rate.

Looking at the related research did not provide a clear answer on this issue, upon which mix findings were reported (Randolph and Anuj 2005). For example, according to Creed et al. (1987), one column was read faster among younger readers (18-24 year olds), while there was no influence of column format on older readers (over 25 years old) and the reading rate was affected by the column format. This finding was also supported by Dyson and Kipping (1997) when they measured the effect of a three-column format on the reading rate and comprehension using texts from online magazines in which 18 participants read text in two situations (single column, about 80 characters per line; two columns; and three columns, about 25 characters per line). They also reported that comprehension was better for faster readers in the three-column page format. This means that a faster reader may be able to scan a short column easily. In the same context, Dillon et al. (1990) measured the comprehension and reading rate on screen using different sizes of screen [ 20 & 60 line]. They pointed out that there was no difference in the performance of readers. According to Duchnicky and Kolars ( 1983), whose experiment investigated the reading speed of text on screen, a text with 80 characters were read faster than one with 40 characters.

In addition, Youngman and Scharff ( 1998) calculated the optimised line length to be 100 letters and is unlikely to be as long as 123 letters. On the other hand, Dyson and Haselgrove (2001) estimated that the line length with 55 characters produces better comprehension scores than the longest line in the case of multiple choice questions. This finding was rejected by Chaparro, Shaikh et al.( 2005)who claimed no significant effect of text layout on comprehension performance. And when using a comparison method between screens to measure readers' perceptions, they reported that the line length with 55 characters reads easily but were not the fastest.

Moreover, Landoni and Diaz. ( 2003) provide different outcomes from reading online. Based on designing two difference models, 15 inches display 60 lines and 12 inches display 23 lines. 56 participants were asked to read a "legal-sociological discourse" of around 1900 words and remember the text. They pointed out that the screen containing 23 lines were better for learning time than the one with 60 lines. Moreover, Kruk and Muter Landoni and Gibb ( 2000) compared three situations, two in print and one on screen. To explore reasons for the slower reading of text from screen, the survey indicated that 40 lines were read faster than 20 lines in both print and on screen. Some researchers downplayed the significance of this study

because its main focus was on the print text, and is therefore not suitable for collecting empirical evidence for reading online (Dyson 2004).

Furthermore, Yi, Park et al.(2011) surveyed the affected number of columns in the readability, comprehension and satisfaction of e-book. English is a second language for participants (22-26 year old). They were asked to read a text with 400 words (2000 to 2010 characters) and answer five questions in one minute. The survey reported that participants prefer reading one column. Table (3) summarised the main findings for line length.

**Table 3: Summary of the main recommendations of studies that focused on line length**

Line length	<ul style="list-style-type: none"> <li>- <b>Between 60- 70 characters and additional interlinear space of 1 to 4 points (Maria dos santos Lonsdale 2006).</b></li> <li>- <b>Long line lengths need more interlinear spacing to ensure that the eyes locate the next line down accurately (Bouma 1980).</b></li> <li>- <b>132 characters per line give faster reaction time (Youngman and Scharff 1998).</b></li> <li>- <b>Using 2/3 screen line length improves reading speed for Arab children (Asmaa and Asma 2009).</b></li> <li>- <b>If the text requires headings, a single column is advisable (Hartley 1977; Southall 1984).</b></li> <li>- <b>For scientific journals, a single column layout with wide margins is read more quickly (Simmonds 1994).</b></li> <li>- <b>More target words are located with a double column (Foster 1970; Hartley 1978), a speed- accuracy trade- off with double columns (Creed 1987).</b></li> <li>- <b>People over 25 years old show no differences in reading rate across the three columns, while people aged 18- 24 years olds are faster when reading a single page column (Dyson and Kipping 1997).</b></li> <li>- <b>No difference between single column and double column (Creed 1987).</b></li> <li>- <b>Single or long column read faster. (Duchnick and Kolers 1983; Creed 1987; Dyson and Kipping 1997; Youngman and Scharff 1998; Yi, Park et al. 2011).</b></li> <li>- <b>No influence of column format on reader over 25 year (Creed 1987).</b></li> <li>- <b>No influence of column format on reader (Chaparro, Shaikh et al. 2005).</b></li> <li>- <b>Short column easy to scan by faster reader.( three column) (Dyson and Haselgrove 2001)</b></li> <li>- <b>Long line was preferred for reading from printed material (Landoni and Gibb 2000).</b></li> </ul>
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Randolph and Anuj ( 2005) provided a guideline according to the distilled studies. The guide provides general recommendations without providing explanations that show if these principles are concerned with all the differences that affect reading the text.

On the other hand, In the Chinese language, some researchers such as Nai-Shing et al. ( 2011) reported that double columns and double line spacing are read more comfortably than

the single column. While in Arabic language, there is no study providing empirical evidence for optimal line length for reading online text.

Thus, the effect of the column format still requires more thinking to cover these aspects. Most of these surveys prove the effect of scrolling on reading. And they were limited to showing just the favourite display format without providing any explanations as to why the reader prefers this and why he/she dislikes the other format. Also, could this decision be affected by the type of reading? This type of question should be asked by researchers when doing this kind of research.

### **2.5.3.3. Colour**

The other variable is colour, which has been examined to define its effect on the reading process by several researchers such as (Singleton and Henderson 2006). When colour and font are combined, the visual as well as the emotional attributes of the font are enhanced. At the same time, changing the colour of the font or background can significantly affect legibility. As defined by Alan Clarke (2001), hue is what we usually call colour. Saturation is an approach that describes the cleanliness of a colour and how it varies from grey to its most pure bright form. And intensity is a measure of the lightness of a colour.

In addition, the same colour can appear very different when placed on different backgrounds, and that different colours can appear nearly the same when juxtaposed with different backgrounds. Moreover, when working with colour and type, it is important to be aware of all the ways in which colour contrasts can be accomplished. Table 4 provides some examples showing how colours interact. E.g. using solid and contrasting colours for backgrounds behind text is more acceptable for avoiding textures which may make letterforms difficult to distinguish, while a black text on a white background offers optimal readability for texts (Gabriel-Petit 2007). In addition, according to Xue-min et al. (2007), using white with black and deep blue and blue with yellow and white were the better options for displaying Chinese text.

**Table 4: Contrast and legibility of text beads on colour theory (Gabriel-Petit 2007).**

Best	Better	Good
Black text (T) on a white background (BG).	Charcoal Gray T on a white BG.	Indigo blue T on an indigo blue BG.
Kashmir green T on a white BG.	Slate T on a white BG.	Dark grey T on a charcoal gray BG.
Midnight blue T on a white BG.	Navy blue T on a white BG.	Medium grey T on a charcoal gray BG.
Burnt umber T on a white BG.	Deep burnt sienna T on a BG.	Medium gray T on an indigo blue BG.
Peruvian turquoise T on a BG.	Indigo Blue T on a white BG.	Goldenrod T on an indigo blue BG.
Raw umber T on a white BG.	Prussian blue T on a white BG.	Blue T on an indigo blue BG.
Forest green T on a white BG.	Deep burgundy T on a white BG.	
Viridian green T on a BG.	Black T on a cyan BG.	
Yellow T on a black BG.	Black T on a pale halo yellow green BG.	
Green T on a black BG.	White T on a blue BG.	
Cyan T on a black BG.		
Magenta T on a black BG.		

However, some degree of colour blindness affects about 8% of people; e.g. they cannot distinguish between red and green. Random use of colour is not going to achieve the reader’s goals. It is likely to have the opposite effect, e.g. it can cause eye strain after they have completed using the reading material. Thus, to gain the positive advantages from using colour, it must be used in a systematic way to achieve a distinct objective. Moreover, the colour theory explains the relation between colour and how they work effectively together.

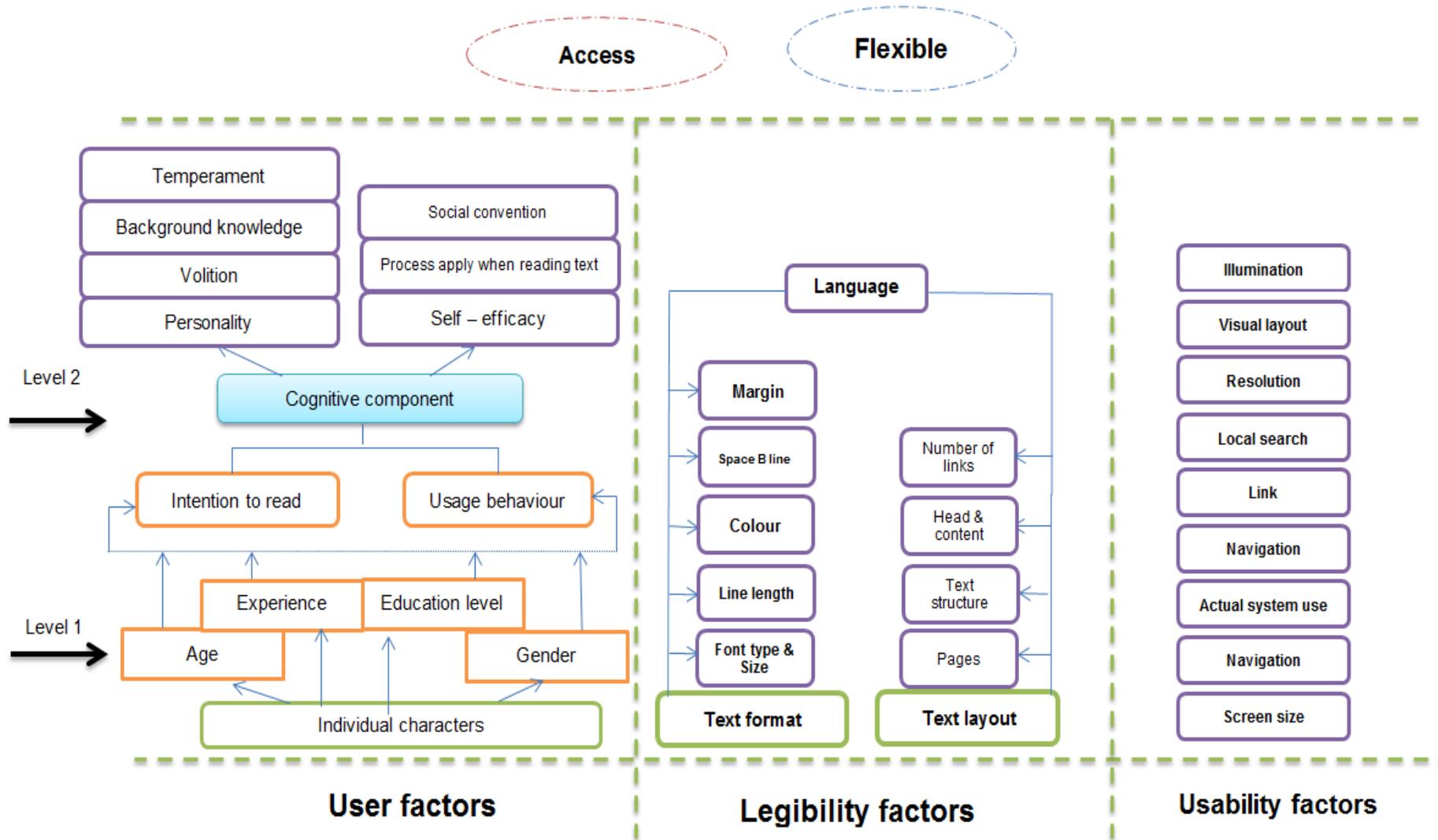
In addition, there are two studies (Bobbitt and Dabholkar 2001; Yoh, Damhorst et al. 2003) that have highlighted the important implications of colour on designing e-texts. These studies and others made it clear that a better background and font colour matching will enhance the text processing efficiency. But still, more research needs to cover issues such as the relationship between font colour, size, and type, or the relationship between the user’s age and background colour. Research like that may help designers improve the reading from screen. On the other hand, according to Xue-min (Terras 2005), a survey that examined 3-level background colours with 5 font colours, using white as a background was more effective with black and deep blue. And a blue background works more effectively with font colour yellow, white, and red green. Black should be avoided as a background. On the other hand, some researchers (Nes 1986; Rubin 1988) see that using colour may be useful in the case of emphasis or highlighting. In designing e-learning materials, text colour is normally used in (Alan 2001).

#### **2.5.3.4. proposal model:**

Based on the literature overview in section 2.5, it is clear that there is a range of factors control and affect display electronic text. The factors that most relevant to dealing with electronic text are collected according their relationships and interactions with each other. Then a factor affect interact with the electronic text model [ FAIWETM] is proposed in figure (11). The model is described by discussion the individual variables in section 2.5.1, usability variables in section 2.5.2 and legibility variables in section 2.5.3. These factors were divided into three groups; user, legibility and usability factors. Each group contains a number of elements which differ in their level of influence.

- 1) **User factors:** it is divided into two levels the first level contains four individual factors; age, gender, education level and experience which affect the intention of reading and usage behaviour. While, cognitive component set on a second level . In this research number of three of the user`s factors was considered; age, gender and education level.
- 2) **Legibility factors:** as illustrated in figure (11), a number of factors have been identified as influencing legibility of electronic text. It was classified into two groups; factors related to text format and other related to text layout. In this research, the focus will be on the three factor [ font size, font type and line length] which is related to text format. These three factors were addressed by most of the researchers as the most influential in reading. In addition, language was considered within this category, at the time that some researchers who deal with text format proved differences such as in defining the optimal font size or line length this difference go back into different in the writing system.
- 3) **Usability factors:** this group was synthesised from the factors of the web usability model by Powell (2000) and Nielsen (2000) and refined by integrating the findings of other studies on usability of electronic text that discussed in section 2.5.

Figure 11: Framework of factors that affect reading an e-text based on theoretical perspective.



## **2.6. Method for examine text layout:**

Exam the methods that used in previous studies to measure and determine the optimal design to display electronic text, showed that there are several of aspects that must be taken into account when obtaining data such as; type of collecting data, the purpose of collecting data and size of the data. Which categorizes to two parts; objective and subjective measurements as illustrated in section 1.3 (Rivera-Nivar and Pomales-García 2010).

Most of the studies expended reading performance to measure and determine optimal layout through applying several criteria such as; reading speed, comprehension, satisfaction and behaviour. Table (5) provides a summary for the methods that applied in pervious researches. It is notably that attend between researchers to define reading performance was through two criteria; reading time and error rate when testing learning material.

In addition, selecting a suitable method should related to natural of investigating variables, e.g. studies that investigate the effect of font type and size in recall information usually operate searching time as tool to determine reading speed and comprehension used (i.e. Liu and Huang 2007; Lee, Shieh et al. 2008; Wastlund, Norlander et al. 2008; Asmaa and Asma 2009; Korat 2010), While, satisfaction was achieved via a satisfaction questionnaire.

On the other hand, the majority of researches used eye movement to investigate readers` behaviour when reading text (e.g. Miller and Gagne 2008; Tzeng, Tsai et al. 2008). Other studies operated observation to exam reading process and interactive (e.g. Fisch 2002) . Because the target population in this research are students and the testing text was used for learning purpose the reading speed and accuracy have been used to measure the reading performance. While eye movement was not considered although, it is referred to how the reader navigates through the text but mainly focus on investigating cognitive processes. Thus, the study measurements produced two types of data; objective data, which resulted from observation method, and subjective data with resulted from the questionnaire to measure the satisfaction.

**Table 5: provide a summary to the methods and tools that used.**

Reading performance	Tools collecting data	Text layout			Reading process
		Font size	Font type	Line length	
References					
Reading speed	Eye movement				(Ashby and Rayner 2004; Laarnia, Simolaa et al. 2004; Siegenthaler, Wurtz et al. 2011)
	number of correct responses			(Ling and Schaik 2006; Yi, Park et al. 2011)	(Miller and Gagne 2008)
	Time to read task	(Bernard, Frank et al. 2001; Russell and Chaparro 2001; Feely, Rubin et al. 2005; Sheedy, Subbaram et al. 2005; Alotaibi 2007; AYAMA, UJIKE et al. 2007; Huang, Rau et al. 2009)	(Bernard, Frank et al. 2001; Dillon, Kleinman et al. 2004; Poole 2005; Sheedy, Subbaram et al. 2005; Alotaibi 2007)	(Shaikh 2005; Sheedy, Subbaram et al. 2005; Ling and Schaik 2006; Walker, Schloss et al. 2007; Yi, Park et al. 2011)	(Liu and Huang 2007; Miller and Gagne 2008; 2011)
	searching time	(Huang, Rau et al. 2009; Rivera-Nivar and Pomales-García 2010)	(Gasser and Boeke 2005; Rivera-Nivar and Pomales-García 2010)	(Rivera-Nivar and Pomales-García 2010)	
Comprehension	Eye movement	(Rello, Kanvinde et al. 2011)			(Nel, Dreyer et al. 2004; Rello, Kanvinde et al. 2011)
	Number of error	(Alotaibi 2007)	(Alotaibi 2007)	(Dillon, Kleinman et al. 2004; Yi, Park et al. 2011)	(Miller and Gagne 2008; 2011)
	Time to read task	(Russell and Chaparro 2001)		(Shaikh 2005; Walker, Schloss et al. 2007; Yi, Park et al. 2011)	
	searching time		(Chaparro, Shaikh et al. 2005)		
Satisfaction	Questionnaire	(Bernard, Frank et al. 2001; Russell and Chaparro 2001; F 2007; Rivera-Nivar and Pomales-García 2010)	(Bernard, Frank et al. 2001; Chaparro, Shaikh et al. 2005; Rivera-Nivar and Pomales-García 2010)	(Rivera-Nivar and Pomales-García 2010)	
behaviour	Eye movement				
	Observation				(Fisch, hulman et al. 2002)

## **2.7. Conclusion:**

From the history of research on this topic, researchers have put forward a set of definitions of reading, but it is to be noted that the majority of them incomplete and without providing a clear definition explaining the concept of reading. The reading process was classified into two types [ linear and nonlinear design] based on the type of sources and the design of information. In addition, theories that apply to the reading field were examined and divided into three categories: (1) Theoretical perspectives concerning human behaviour; (2) Theoretical perspectives focusing on the text which were further classified into two categories; and (3) Theoretical perspectives dealing with the reading process.

The reader response theory (RRT) has been applied in this research to understand the action of the reader but Applying this theory to explain the reading process of a schoolbook shows the missing elements that play a significant role in reading schoolbooks. Where two elements should be added [ teacher and parent] when dealing with schoolbook. These two elements cannot ignore in this study where students usually get support from their parents at home and teachers at school; therefore, modification has been made on the basic theory ( RRT) in this research by adding two elements: teachers and parents.

Even though the number of research investigating the relationship between variables that effect online reading was limited, the interrelationship is extremely complex (LUND 1999). Based on the literature overview a new mode illustrate factors that affect using electronic text was presented. The proposed model presents three main factors [ user factors, legibility factors and usability factors] each one is divided into several factors.

# Chapter three: Theoretical and empirical background to the eBook

## 3.1. Chapter review:

A textbook in any e-educational system is an important element that requires a closer look at its components and structure, as well as identifying the barriers that affect the level of learning. This can be achieved in different aspects such as the analysis of textual content or sentence structure which is one of the concerns of linguists. On the other hand, examining the textual content can determine the appropriateness of the education level for students. This type of assessment is part of educators' concerns and by examining and defining the factors that could affect reading a text on screen, this is usually related to the way of displaying text such as font size, colour, background colour, amount of text and the location of the text on the screen. This is a key focus of this research. In this chapter, the concern will be to define the concept and the structure of an e- document as a starting point to investigate the usability of e-texts. This chapter is organized into sections that cover the following:

- Definition of e- document.
- History of eBook.
- Structure of e- textbook.
- Contribution of e- textbook for education.
- Comparison between reading electronic and paper book.
- Young people and the use of the internet and computer.
- Statistical data for using the internet in Arabic countries.
- Designing an e- textbook.

### **3.2. Definition of e- document:**

Before discussing the factors that impact electronic display, it is important to give a brief look at the definition of digital document; this should help clarify the difference between paper documents and the electronic format, which is difficult to recognize and the underlying concept less clear.

However, the examination of knowledgeable production showed the use of multiple terms by researchers, such as visual book (Landoni, 1997, Wilson et al., 2003, Crestani et al., 2006)(M. Landoni 2000), CD- ROM book e.g.(Sally Maynard 2001), eBook (Ismail 2005; Anuradha 2006; Miguel, Pablo de la et al. 2008; Landoni 2010), e- paper (S.C. Jeng 2005) e- work (Martínez-Prieto, Fuente et al. 2008), digital book (Cavanaugh 2006; de Leeuw and Rydin 2007), web book (Van Kleeck 2003), and electronic text book (Landoni 2002; Walton 2002; Cheyne 2005).

At the same time, the studies focusing on eBook emphasize that the terms eBook and digital book are more used than other terms. For example, Vassiliou & Rowley (2008) in their study reported that 19 definitions used the term ‘digital’, while 20 definitions used ‘electronic’ and 12 others used the term ‘online’. However, using different terms when providing a definition to eBook could be attributed to the type of e- book that is used in the same period.

Alternatively, various attempts have been made to introduce different concepts to eBook according to several perspectives, such as format (Lynch, 2001, Lam P et al., 2009), media (Landoni and Diaz 2003; Cheyne 2005), goal of delivery, or benefits of use (Anuradha and Usha 2005; Connaway 2007). In this study, the focus was on attempts to define eBook within the period from 1990 to 2011, wherein the majority of definitions had become outdated due to rapid changes in the field of ICT.

In chronological order, Martin (1990) focused on the hyperlink and how this function changes the concept of eBook and made it different from a paper book. In the same line, Hamilton (2001) and Wilson et al. (Wilson, Landoni et al. 2002) focused on the power of an eBook compared to the paper version. In addition, Wilson and Landoni (2001) provided three definitions to an eBook according to different perspectives: (1) hardware devices used to read e- content such as HI eBook; (2)

software such as Microsoft Reader and Adobe Acrobat Reader; and (3) web book that can be accessed online. Whereas, Robins (2003) defined the eBook based on the benefits of using it. In addition, Barker (2005) categorized eBook into 10 types based on three aspects (publication medium, functions, and facilities), while Hawking (2000) divided eBook into four types.

Moreover, Noorhidawati (2007) defined the eBook as a package of elements. Generally, Noorhidawati's definition is acceptable to a large extent compared to previous definitions, which as noted previously, focused only on one side. And yet, we cannot say that it is a comprehensive definition that covers all aspects of the eBook even though it summarises all the elements addressed in the previous definitions without any attempt to cover the gaps in these definitions.

In 2008, Magd Vassiliou and Rowley (2008) proposed a definition combined from two parts; the first part focused on the content of the eBook while the second focused on the functionality aspect. Lam et al. (2009) defined eBook as e-formats of books that can be viewed on a computer screen or hand-held devices. On the other hand, according to the user's perspective, an eBook was known as dedicated reading (Henke 2002).

Generally, there is no universal standard definition for eBook in the literature according to the survey of the eBook field (Bennett 2005). In this research, e-textbook has been used to refer to educational materials that have been electronically published to assist with both teaching and learning. It may take different forms depending on the technology used to store content, e.g. it has an open structure which is divided into a hierarchy of physical components such as pages, columns, paragraphs, text lines, words, tables, and figures, as well as logical components such as titles, authors, affiliations, and abstracts. From Table (6), we may note that there are differences between an e-book and a website. These differences could be summarized in terms of three aspects: components, dimensions, and boundaries.

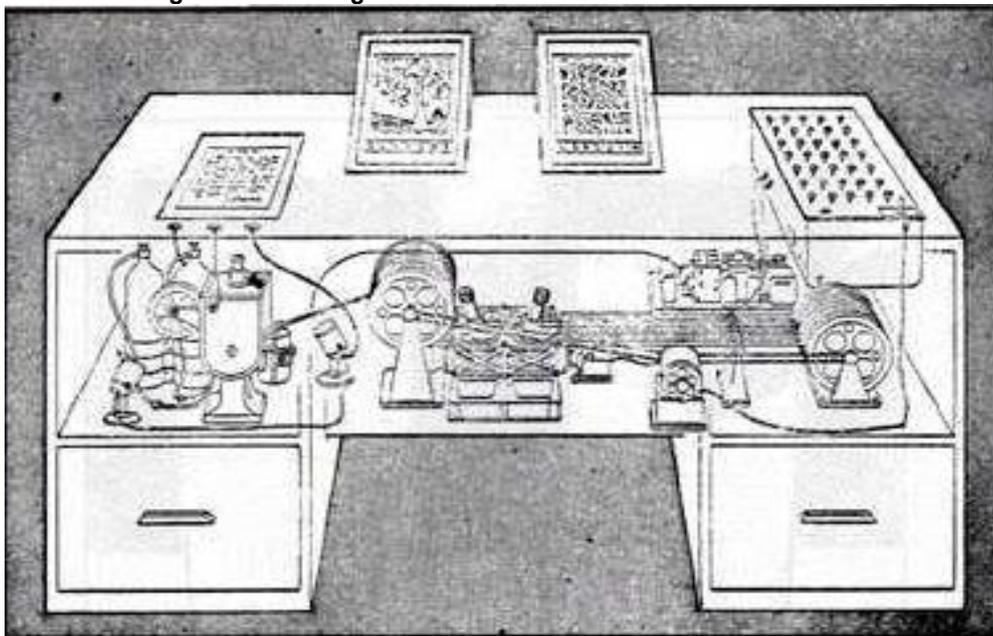
Table 6: Differences between e-books and websites (Johnston and Huczynski 2006).

Information Architecture	Books	Web sites
Components	Cover, title, author, chapters, sections, pages, page numbers, table of contents, index.	Main page, navigation, links, content pages sitemap, site index, searches.
Dimensions	Two- dimensional pages presented in a linear, sequential order.	Multidimensional information space with hyper textual navigation.
Boundaries	Tangible & finite with a clear beginning & ending.	Fairly intangible with fuzzy borders that “bleed” information into other sites.

### 3.3. Brief History of eBook:

E-text has a shorter history compared to the paper. Its history is also less clear compared with the paper document or physical environment. The concept of eBook can be traced back to Memex and Dynabook. Memex was envisioned by Vannevar Busk in 1945 to use as an information workstation in the first stage before applying it as a device to store books (as seen in Figure 12) and then used for reading and retrieving them. Dynabook was created by Alan Kay in 1986 which was envisaged for notebook PCs and laptops.

Figure 12: Drawing of Bush’s Theoretical Memex Machine<sup>1</sup>.



In 1971, the Michael Hart Project [Gutenberg Project] is seen as the first significant attempt at developing an eBook, a project that freely offers access to read and retrieve on screen currently more than 20,000 titles. In addition, in 1976, FRESS

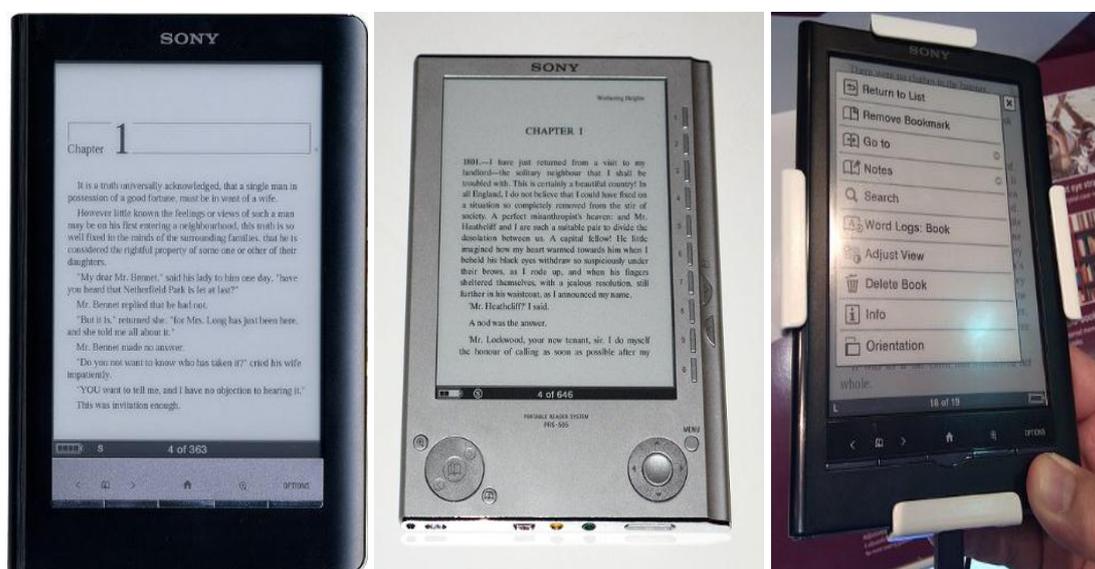
<sup>1</sup> [http://www.kerryr.net/pioneers/gallery/ns\\_bush8.htm](http://www.kerryr.net/pioneers/gallery/ns_bush8.htm)

was used by Brown University students to read poems and other critical materials on a computer. These two attempts are seen as the first significant effort in e-book development (Abdullah 2007).

In 1985, an eBook called *Superbook* was presented by the Bellcare Laboratory; the eBook was built according to a user- centre design model where the e-book has a similar structure to the paper book as in a table of contents in addition to computer-based features such as examining words. On the other hand, present reference materials such as encyclopaedias and dictionaries began to be published in digital versions during the 1980s and 1990s on CD- ROM (Egan, Remde et al. 1989).

In 1998, NuvoMedia (Anonymous 1999) introduced the Rocket eBook for reading an eBook. The number of dedicated eBook readers in the market increased after that date. For example, each year Sony introduced a number of eBook portable readers such as PRS500 in 2006, PRS- 600 and PRS900 in 2009, PRS- 350, PRS-650 and PRS- 950 in 2010, and Wi-Fi PRS-T1 in 2011. Figure (13) shows examples of eBook readers that have been produced by Sony.

Figure 13: example of the latest eBook portable readers from Sony<sup>2</sup>.

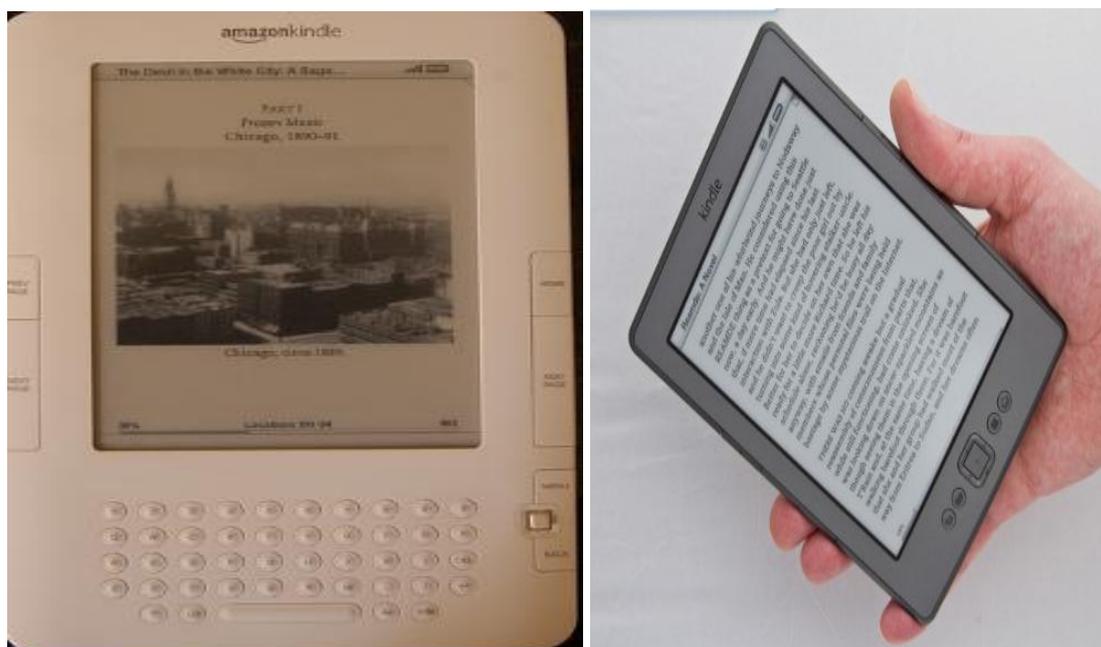


Moreover, in 2007, Amazon.com developed Amazon Kindle [eBook reader], which enables readers to download, browse, and read news and books. Each device-generation used different file formats, e.g. first generation used plain text file (TXT),

<sup>2</sup> . [http://en.wikipedia.org/wiki/Sony\\_Reader#2006\\_Model\\_.28Discontinued\\_late\\_2007.29](http://en.wikipedia.org/wiki/Sony_Reader#2006_Model_.28Discontinued_late_2007.29)

Topaz formats books (TPZ), and Amazon's proprietary DRM-restricted format (AZW), while the second generation insert Portable Document Format (PDF). The fourth generation (Kindle, Kindle Touch and Kindle Touch 3G) is able to display Kindle (AZW), TXT, PDF, unprotected MOBI, and PRC files natively. HTML, DOC, DOCX, JPEG, GIF, PNG, and BMP are usable through conversion. In addition, the Touch and Touch 3G versions are also able to play Audible (Audible Enhanced (AA, AAX) and MP3 files (as see in Figure 14) (Murray 2012).

Figure 14: first generation of the Amazon Kindle<sup>3</sup>.



A first generation Kindle

Fourth-generation Kindle

### 3.4. Contribution of e- textbook for education:

The use of electronic information has increased in various spheres of life such as the military, commercial, medical, and educational fields. In the field of education, the eBook was firstly used in higher education widely before it became popular. Limited use of eBook at the beginning could be due to the use of just a linear format of printed documents which led librarians and educators to slow down the turnout into

<sup>3</sup>.

[http://www.google.co.uk/imgres?q=A+first+generation+Kindle&um=1&hl=en&sa=N&rlz=1T4RNRN\\_enGB443GB444&biw=1821&bih=751&tbn=isch&tbnid=H0yYUD1Ck3AoLM:&imgrefurl=http://www.slashgear.com/amazon-launching-kindle-2-at-february-9th-press-conference-2732127/&docid=L2XYfSg28HouVM&imgurl=http://cdn.slashgear.com/wp-content/uploads/2008/11/amazon\\_kindle\\_2-480x360.jpg&w=396&h=480&ei=5miRT7u6L8qa0QWQ\\_5mCAg&zoom=1&iact=hc&vpx=321&vpy=122&dur=226&hovh=247&hovw=204&tx=135&ty=129&sig=105885780228660678743&page=1&tbnh=139&tbnw=115&start=0&ndsp=41&ved=1t:429,r:1,s:0,i:69](http://www.google.co.uk/imgres?q=A+first+generation+Kindle&um=1&hl=en&sa=N&rlz=1T4RNRN_enGB443GB444&biw=1821&bih=751&tbn=isch&tbnid=H0yYUD1Ck3AoLM:&imgrefurl=http://www.slashgear.com/amazon-launching-kindle-2-at-february-9th-press-conference-2732127/&docid=L2XYfSg28HouVM&imgurl=http://cdn.slashgear.com/wp-content/uploads/2008/11/amazon_kindle_2-480x360.jpg&w=396&h=480&ei=5miRT7u6L8qa0QWQ_5mCAg&zoom=1&iact=hc&vpx=321&vpy=122&dur=226&hovh=247&hovw=204&tx=135&ty=129&sig=105885780228660678743&page=1&tbnh=139&tbnw=115&start=0&ndsp=41&ved=1t:429,r:1,s:0,i:69)

eBooks. But with the rapid development in eBook technology such as addition of interactive features and dynamic tools, it has led to the widespread use of eBook for educational purposes. In addition, comparing the use of p- version and eBook showed that there were multiple factors affecting the choice of reading materials, as will be explained later in detail.

Moreover, every day new findings in the research into using eBook to develop children's learning have shown promising results in several aspects such as enhancing children's phonological awareness (Chera and Wood 2003), word recognition skills (Miller 1994) and extending verbal knowledge (Segers 2002).

On the other hand, using eBook, computer and internet in schools bring several with it several challenges to educators (Shaffer and Clinton 2006), where simply setting up computers in schools is not enough to enhance learning but suitable pedagogical tools and materials must be designed, in addition to modifying the goals of schools in keeping with the digital age (Ben-David and Kolikant 2009). For example, computer students in developed countries such as USA used to get high scores on regular quizzes (OECD 2005). Maybe this occurs because teachers do not use anymore pedagogical tools that were developed for use in traditional education.

Furthermore, educators still face the problem related to slower reading from text on screen. Part of this problem is related to screen quality and the other is related to the text format such as font size, line length, background colour, line colour, text segment, and links. For instance, Woo Park ( 2009) points out that reading eBook can be uncomfortable due to reading from a screen. In addition, adding new functions such as multimedia features may further lead to several difficulties associated with usability (Landoni, Wilson et al. 2000; Shiratuddin, Landoni et al. 2003).

However, there have recently been a certain number of research into using e-textbook among children, with the main concern being the functionality issues such as investigating reading comprehension (Greenlee-Moore and Smith 1996; Maynard and McKnight 2001), addressing the beneficial outcome for pupils' reading, examining pupils' recall (Trushell, Burrell et al. 2001; Segal-Drori, Korat et al. 2009), exploring the impact of e- textbook on reading speed (Maynard and McKnight 2001). Still, a limited number of studies were more concerned with how young readers learn from

textbooks and how they deal with information in the e- format. One of these studies by Shally Maynard and Emily Cheyne (2005) involved children aged 11- 12 in England. The study aimed to compare children`s reading and learning from eBook which combined hypertext, glossary, background music, and web links. The findings of this research showed a positive effect on learning as it helped these pupils to work effectively, making teaching and learning more fun and interactive. It also showed difficulty with navigating e- textbooks and students were more familiar with print navigating tools. But they failed to mention how students followed when dealing with e- text or define a legible format for e- educational text.

Moreover, Dong- Hee Shin ( 2011 ) has also attempted to understand the concept of e- book usability by using an empirical perspective to explore the use of gratification and expectation confirmation theory to explain the development in reader-behaviour through understanding emotional and cognitive factors. The study recorded two important elements affecting the usability of eBook: (1) ease of use and usefulness; and (2) difficulty of reading texts online. The study confirms that the most significant weakness of e-books is the lack of content.

Consistent with prior research, it is notable that these researchers were unable to provide answers to many questions such as: how children read and use the e- textbook; what affective factors are impacting e- reading; and how do children feel about e-textbook. Such questions will be considered in this research as mentioned in chapter one where we will examine e- reading strategies for reading e- textbook in a Libyan school so as to build an e-reading model and to investigate the format factors that impact reading an Arabic text on screen by examining the effect of font size and type on accuracy and reading speed. It will also define a readable font size in order to build a guideline as it were that can help designers come up with effective e-learning materials in the Arabic language that can enhance the reading of an e-textbook.

On the other hand, with the increase in studies that emphasize the importance of applying eBooks in early education since the 1990s, we must also address other aspects associated with the rates of using eBooks and related problems. Analysing the usability of the eBook within the last ten years does not resolve the situation for eBook but leave the door open to more research to clarify the situation. Table (7) provides some examples of research that addressed students` awareness of eBook in

higher education. It is notable that the average use of e- materials among university students in the U.S.A. increased from 33% in 2003 to 51% in 2006.

**Table 7: Some examples of research that addressed students' awareness of eBook in higher education.**

<b>Studies</b>	<b>Had not use eBook</b>	<b>Country</b>
Chu (Chu 2003)	67%	<b>US</b>
Ismail and Awang Ngah (Ismail and Awang Ngah 2005)	61%	<b>Malaysia</b>
Bennett and Landoni (Bennett and Landoni 2005)	61%	
Anuradha and Usha (Anuradha and Usha 2006)	66%	<b>Indian</b>
Levine-Clark (Levine-Clark 2006)	49%	<b>US</b>
Noorhidawati and Forbes (Abdullah and Gibb 2008)	60%	<b>UK</b>
Ming- der Wu and shin (Wu and chen 2011)	Use both version	<b>Taiwan</b>

Moreover, Jamali (2009) looked at 16,000 students and listed several advantages that encourage students to use eBook such as portability, cost, search ability, and so on. In addition, the same study indicated that 7.6% of respondents do not prefer using an eBook because of screen reading, while 6% of participants point out that they prefer reading printed books because of the difficulty of browsing and scrolling the text on screen.

### **3.5. Comparison between reading electronic and paper text:**

There are two thoughts on the field of reading. The first is that paper will never be replaced by e- text. This might be due to the ease and flexibility of using paper format. For instance, manipulating paper is achieved by manual dexterity, using fingers to turn pages, keeping one finger in a section as a location aid, or flicking through tens of pages, while browsing the contents of a document is either difficult or impossible to support electronically.

Although browsing through the electronic document might involve using a mouse and scroll bar in one application, one might require menu selection and page numbers, whilst another supports touch-sensitive buttons and screens. Hypertext manipulation of large electronic texts can be rapid and simple while other systems

might take several seconds to refresh the screen after the execution of another page (Dillon 2001).

Alternatively, the second thought concerns those who believe that eBook will replace paper format, and build such thought on several advantages of the eBook such as ease of storage and retrieval (Liu 2005; Carol Tenopir 2009). Also, it has the ability to use several features such as sounds, animations, less cost, ability to download and use hotspots (Robert Polding 2008). In addition, Shiratuddin et al. (2003) compared eBook with paper format based on previous studies; the summary of the comparison is found in Table (8). From the table, it can be noted that paper content is more legible than e- content.

**Table 8: Comparison of p-book and eBook (Shiratuddin, Landoni et al. 2003).**

<b>Features</b>	<b>pContent</b>	<b>eContent</b>
Tactile	Yes	No
Portable	Yes	Yes & No
Access without devices	Yes	No
Easy random access*	No	Yes
Multiple access at one time	Yes	Yes
Customisable (font size, annotations etc.)	No	Yes
Hyperlinks	No	Yes
Text	Yes	Yes
Pictures	Yes	Yes
Audio	No	Yes
Animation/video	No	Yes
Instant search facility	No	Yes
Easily and conveniently read	Yes	No
Easily damaged (i.e. tear)	Yes	No
Content updated easily	No	Yes
Go out of print	Yes	No
Highly interactive	No	Yes
Good legibility	Yes	No
Easily reproduced with the same quality	No	Yes

However, it can be observed that the arguments provided by each team to support their point of view differ; for instance, defenders of paper book consider it better in terms of ease of handling and taking notes, but is not as good when it comes to search or capacity for storage like eBook. Moreover, the other hand, supporters of the eBook see it as easy to navigate especially for academic purposes. Therefore, there must be a third approach, which, while knowing that eBook would not replace the p-book, considers the two formats as complementing each other in order to satisfy the

needs of readers. The evidence behind this belief is numerous, e.g. when university students search for specific information they prefer using e- text while they still prefer to read it as a p-version (David Nicholas 2008). But, we should be working to improve the way of displaying text on screen by defining the barriers that effect legibility on screen.

Dillon ( 2001) sets a clear mark in the field by providing a comprehensive view of the empirical literature on reading from paper against electronic. This was followed by Dyson ( 2004) who examined the relation between layout of the paper format and reading electronic text. The study reported that typographic factors have a significant impact on reading speed of electronic texts and characters per line were reported as an essential factor.

Even though reading electronically offers clear advantages to readers, there are still a lot of challenges facing the reader when using e- media. Studies comparing reading in both versions show mixed results. Most research findings from the period 1980s to 1990s (Landoni 1997; Wilson, Landoni et al. 2003; Crestani, Landoni et al. 2006) show that reading from screen takes more time, without giving any explanations about the reasons behind it.

Consequently, the electronic environment has specific characteristics that make it different from paper reading. Some researchers such as Alan (Alan 2001) reported that presenting an electronic text is broadly similar to displaying it on the page with a number of differences such as quality, size, and orientation. This might account for the poor reading on screen.

Additionally, the other hand, reviewing empirical evidence and theory on reading from screen shows there are distinctions to be made between paper and PC reading processes (Wright 1988; Dillon 2001). In addition, the study on the optimization of reading has been done with paper and then circulated on the electronic format (Frenckner 1990). On the other hand, comparison between a conventional view of the text and e- text has been used as a starting point to examine reading on screen (Dyson 2004). These researchers focused on comparisons in their research without investigating the variables that affect reading on screen. At the same time, M.C.

Dyson (Dyson 2004) focused on the typographic variables related to text formats on paper and screen such as line length, columns, and window size.

### **3.6. Young people and use the Internet and computer:**

With the increased access to the Internet at home and at school, especially in developed countries, there arises the need to investigate several issues related to users' attitudes toward ICT and their effect on people's lives. On the other hand, searching topics by using the Internet and computer from children's perspectives seems limited, although several researchers have suggested doing more examinations at different levels of using the Internet and computer among young users (Perse and Dunn 1998; Ma 2005).

Most studies reported that children used the Internet more for entertainment and social interaction. Staflerd, Kline and Dimmich (1999) reported in their survey, which examined the purposes of using the Internet, that 61% of responders used the internet for communication by e-mail. In addition, Papacharissi and Rubin (2000) explored motives of internet usage among students in college [279 students]. The study reported several motivations for using the internet such as seeking information and entertainment.

In the same perspective, the US Census Bureau (2012) reported that 24.7% of children aged 6 to 11 in the USA use the Internet, 64% have a computer at home, while 47.9% of children aged 12 to 17 use the Internet and 69% have access at home. In the Silicon Valley in the USA, the average access to the Internet was high among children aged 10- 17, where 79% have internet access, 39% have access to more than one computer at home. The same study found that schools provide access to the Internet for students. 95% of participants have access to the Internet from lab, library or their desk in the classroom (News and Foundation 2003).

In 2001, 71% of US students in public schools depended on web materials, while in 2005 95% of American public schools have access to the Internet (Eagleton

and Dobler 2006). In addition, 99% of students aged 9 to 13 in Canada use the Internet at home regularly (Gunn and Hepburn 2003).

From the same perspective, Valkensburg and Soeters (2001) did their investigation by examining 194 children aged 8-13. They found that there is not much difference between younger and older children in using the internet, where both use it for entertainment except older children who use the internet for finding information about sport. Hongyan Ma (2005) investigated using the internet at home and at school among students in middle schools in Ohio. The survey reported that Internet is used for entertainment and learning, and is used at home for doing homework, satisfy personal interest, do shopping, listen to music or watch movie clips. Still, using the internet at school was limited.

Moreover, some studies have confirmed that there is a difference between males and females in their concept of using the Internet (Tapscott 1998; Miller 2001), while others reported little difference in their attitudes toward the Internet (W. 2002; Weiser 2002). These differences could point to two aspects: type of websites, and tools. For example, Shaw and Gant (Shaw and Gant 2002) found that women mainly used the Internet for interpersonal communication while men used the Internet to collect different types of information. This finding is similar to a finding that was reported by the Technology Student Association (association 2003). The study surveyed 675 students from middle schools and high schools which showed that boys tended to use the internet to check up on sport information while girls mainly used the Internet for communicating socially. Moreover, Valkensburg (2001) found that boys enjoy sensational content like violence and pornography while girls love cartoon sites such as Disney.

The contribution of employing internet in education could be summarized in three aspects:

- Easy to access: students can access lessons anytime and anywhere.
- Communication needs: Internet plays a major role in communication between students and teachers by allowing teachers to provide lessons online and to link to different classes at the same time.

- Abundance and diversity of content: despite the lack of accurate statistics on the level of intellectual achievement, it is notable that searching the Internet it is not something small especially when presented in various visual and textual formats.

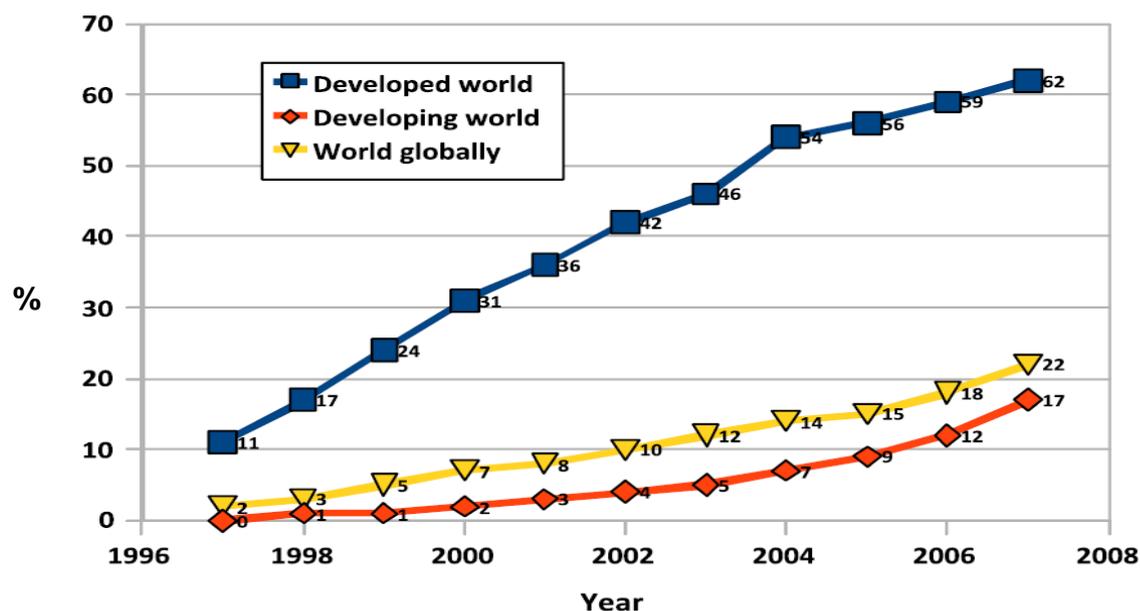
Finally, Tsai ( 2004), Chou et al. ( 2007) and Chien, Chon (2009) provided the 4T and 5T frameworks for using the computer and internet, which may be summarised as follows:

- Tool = help students in doing tasks such as homework and learning.
- Toy = enable users to play online games.
- Telephone = allow users to communicate with other users.
- Territory = assist users to present their interests and hobbies.
- Treasure = ability to browse and access a huge collection of online information.

### **3.6.1. Statically data of internet use in Arabic counties:**

Arabic users understand the importance of using the Internet in their daily lives as a medium for both formal and informal communication. Comparing the use of the internet in Arabic countries to the total average use in the world showed a much lower use rate in the former. For example, Figures (15) display the use of the Internet in developed countries and developing countries, where the average use in developed world is fairly high compared to the developing world. In addition, the Arabic language is only ranked seventh on the Internet, where English is first with 536,564,837 users representing 42%, while Chinese is not far behind in second place with 444,948,013 users (Union 2011).

Figure 15: The use of the Internet in developed and developing countries (Union 2011).



Utilization rates of the Internet vary among Arabic countries according to various factors (such as political, economic, social and cultural); however, the political and economic factors are more influential than others. This is seen in Table (9) which displays the latest statistics of the number of subscribers to the Internet in Arabic countries in 2010, compared to the population of each country. It is notable that Bahrain comes in first place with 3,777,900 users who represent 88% of the population, while Iraq comes in at the last place with only 325,000 users (1.1%) (Tadoz 2010).

Table 9: Statistics on the number of subscribers to the Internet in Arabic countries in 2010 (Tadoz 2010).

Countries	No of Internet users	percentage to total number of population
Bahrain	649.300	88%
Emirates	3.777.900	75%
Qatar	436.000	50%
Amman	1.236.700	41%
Kuwait	1.100.000	39%
Tunisia	3.600.000	34%
Saudi Arabia	9.800.000	33%
Lebanon	1,000.000	24.2%
Jordan	1.741.9000	24%
Egypt	17.060.000	21.2%
Syria	3.935.500	17.7%
Sudan	4.700.000	13.6%
Libya	353.900	5.5%
Yemen	420.000	1.8%
Iraq	325.000	1.1%

The use of the Internet in Libya dates back to 1998, where it was confined to only a limited segment of society. In 2000, the Internet became available for public use, which could be seen as the first real use of the Internet in Libya. At the beginning, connection was only available via telephone, but in 2005 users were able to use ADSL servers and then WiMax in 2009 (BBC 2009). In addition, Al Bayan UAE (UAE 2004) reported that the number of public centres and private Internet cafes increased to about 3000 centres throughout Libyan cities.

Alternatively, the limited number of resources shows that there is a dramatic increase in the number of Internet users despite the high costs of subscribing. A monthly subscription fee was relatively high given the low level salaries where subscribers would have to pay \$400 (700 LYD) annually to access the internet.

In addition, the average Internet use in Libya differs from year to year. For example, in 2001 the average Internet use was 300,000 users; this number increased to 850,000 then decreased again to 205,000 users in 2006. Identifying the cause(s) of this declined is yet to be made (as can be seen in Table 10)(Elmabruk 2009).

**Table 10: The number of Internet users in Libya (Elmabruk 2009).**

<b>Year</b>	
<b>1998</b>	Did not exceed one hundred
<b>2001</b>	300000
<b>2003</b>	850000
<b>2006</b>	205000
<b>2009</b>	3539000

Table (11) summarizes the studies that have addressed the use of the eBook and the Internet. Studies with vague approaches were excluded to filter findings to be considered in this research. These studies show mixed results which make drawing up conclusions fairly difficult.

**Table 11: Studies that addressed the use of the eBook and Internet.**

Authors & year	Sample, file & country	Method & statistical tests	Research Focus	Material	Findings
<b>CNN, USA Today, National Science Foundation &amp; Gallup</b>	740 children aged 13 through 17/ middle & high school	Telephone interviews	Children's familiarity with computer & Internet		55% had the opportunity to use the Internet 67% have computer at home.
<b>Perse &amp; Dunn (Perse and Dunn 1998)</b>	Adult/ 1071		Motivations for internet use		People mostly use Internet at home for entertainment.
<b>Stafford, et al. (Stafford, Lline et al. 1999)</b>		Interviews			61% use the Internet for communication 25% business reasons.
<b>National Public Radio</b>	Aged 10- 17		Internet use		Children are more positive than adults in accessing modern technology at school.
<b>Valkenburg &amp; Soeters (Valkenburg and Soeters 2001)</b>	194 children aged 8- 13/	MANOVA/	Examine motives for using the Internet & their positive and negative aspects/ use for entertainment & social interaction.		There is not much difference between younger & older children. Older children use Internet for finding information about sport and cited email more than younger children 73 % have negative experience with internet.
<b>Sally &amp; Cliff (Maynard and</b>	161 participants aged 18- 56+/ Leicestershire area	Postal questionnaire	Investigate users about		96.3% considered eBook as multimedia CD-ROM book & 68.9% thought all

<b>McKnight 2001)</b>	in the UK/ public libraries.		eBook.		texts available in the internet were eBook.
<b>US Bureau of the census (census 2002)</b>	children aged 6- 11	Questionnaire	Awareness of eBook.		64.1% have computer access at home 47.7% using internet.
<b>San Jose Mercy news et al. (Scane 2003)</b>	USA / Silicon Valley/ aged 10- 17/ 804	Randomly selected/ questionnaire	Using computer & Internet		79% have Internet access at home 39% have Internet access from more than one computer at home 95% having access to Internet at school [lab or library or their desk]
<b>Sally &amp; Emily (Cheyne 2005)</b>	60 pupils/ 12 groups/ aged 11- 12/ local schools in UK.	Experimental/ observations/ qualitative/ ANOVA test.	Comparing reading and learning from paper with reading similar electronic version.	Paper textbook & CD-ROM	Using e-textbook in learning has significant effect on pupils' learning and understanding.
<b>Buzzetto-More, N., R. Sweat-Guy et al. (Buzzetto-More, Sweat-Guy et al. 2007)</b>	261 students/ 62.2% female (157)/ nearly 74% between the ages of 17- 19/ the University of Maryland Eastern Shore USA/	One- way ANOVA test/ questionnaire	- Home internet access. - Use the Internet to gather news and information. - Comfortable reading off a computer screen.		- 92.7% have Internet access at their local residence. - 98% feel comfortable reading off a computer screen. - 22% had read an eBook. - 80% prefer to purchase their textbooks at the bookstore. - 54.8% prefer hardcopy to a digital format. - 58.6% print out a copy from digital format.
<b>Ian Rowlands et al. (Rowlands, Nicholas et al. 2007)</b>			Investigate academic users' awareness, perceptions and existing levels of use of eBooks.		
<b>Grimshaw, S et al. (Grimshaw, Dungworth et al. 2007)</b>	132 children from different primary schools in UK. Aged 9 to 11. From different ethnic and	Comprehension test/ one- way ANOVA.	Comparing between reading from paper and electronic format.	Story book, in two formats, e & paper format.	Comprehension reading affected by type of materials.

	social backgrounds.				
<b>Clare Wood (Wood, Pillinger et al. 2009)</b>	80 participants/ Children aged 5 & 6. 40 males & 40 females. UK	Experimental / read aloud / x <sup>2</sup> test/	Investigate the effect of talking book on children reading strategy	4 styles of Talking books/	Talking book has a positive effect on children's performance.
<b>Okon E. Ani (Okon, Margaret et al. 2010)</b>	Undergraduate students in public universities in Nigeria	Questionnaire			Using for academic purpose  75% for email
<b>Curtis, Polly et al. (Polly 2009)</b>	five- to 16-year-olds/ UK/	Questionnaire	Address what has been dubbed the "toxic childhood" of children living under intense media influence.		62% have profile on social networks. The number of children aged 5- 16 who read books decreased from 82% in 2006, 80% in 2007 and down to 74% in 2009. 1 in 6 use the Internet 6 hours a day Average use of the Internet: 1,7 hour a day. Use less at school.

### **3.7. Designing e- textbook [ETB] for young student:**

When discussing designing issues concerning e- textbook, two aspects ought to be looked at, structure of the text and typographical factors, both of which have a significant impact on the reading level. The structure of e- text may lead to changes in the fundamental relationship between readers and author, where the reader has control over travelling back and forth between horizontal and vertical texts. For example, using non-linear format will allow readers to control their path which is not the same in the case of a linear format that is used to design a paper text (Foltz, P.W, 1996).

In addition, it is used in at least three individual perspectives by different researchers and writers in the reading field. The first perspective determines the structure of what the reader will build through knowledge gained (conklin 1987). The second perspective defines structure as a convention representation of text which occurs according to the expected rules that a writer follows during document production (Suchman 1988). The final perspective refers to the structure based on the nature of each scientific area (Hammond and Allinson 1989). Furthermore, the concept of structure for designers refers to breaking the text down into chunks or viewed as a whole content.

A paper book`s layout generally includes front and back cover, table of contents, introductions, main body which is normally numbered sequentially and separated into sections, as well as additional material such as appendix, index or glossary, references and spine. Employing information technology has led to the advent of several types of eBooks which may be classified into 10 types according to Barker`s classifications (Barker 1992).

Generally there is not any particular order or rules to follow when designing e-text which usually depends on the subject, purpose of the text, age of reader, amount of text and screen size. Alternatively, the structure of e- learning material usually depends on what education system is aiming to achieve. In many cases, learning material may be presented as a package which relies mainly on itself to transmit understanding and knowledge to the learner. This special structure of educational

material requires from designers a method for displaying content that can help learner to access and define the content of such a learning package (P, Westwood, 2000).

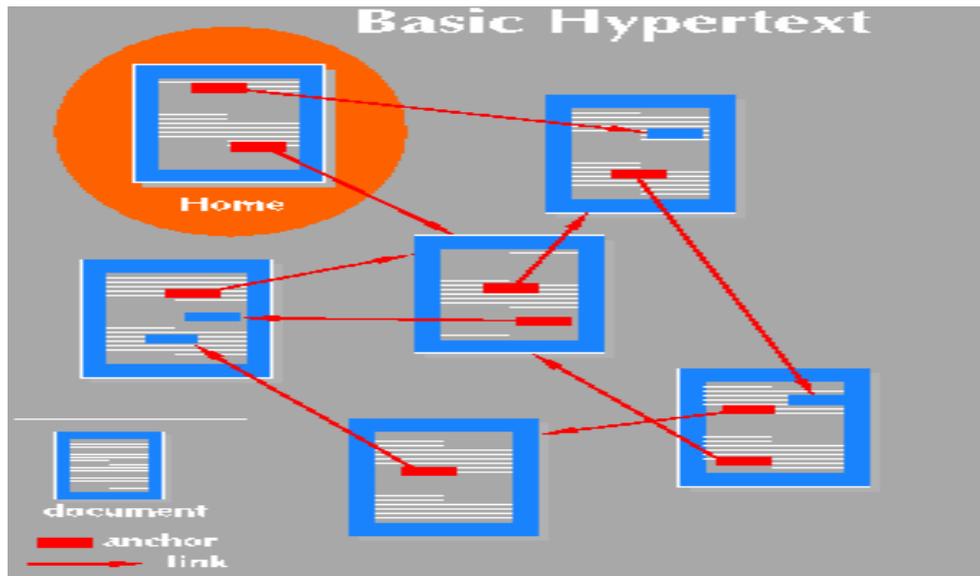
In addition, two options are available for designers of e- learning material: a deep or shallow structure. A deep structure has several levels, and complex navigation and learners have many options and potentials for full interactions. However, the user with limited experience could be disoriented and lost within this structure. Where, a shallow structure is a simple design. It is also basic and provides the lowest selection.

In the same context, Martin (1990) suggested many conceptual models of eBook such as envelope model, hierarchy model, and the network model. Selecting the most suitable model requires a thorough understanding of the learners' needs and age. The first model ("envelope model") is where information is divided into chunks and then structured before each chunk is then viewed by title. A single envelope can contain other envelopes. This model is easy to index and create; the problem with this model is the lack of links between contents within the envelopes. The second model ("hierarchy model") is similar to the envelope model except that in this model the context is organized in a hierarchical structure using Microsoft Word and World Wide Web. This model allows for connecting cross-links, seeing the structure clearly, but at the same time it lacks the flexibility of navigation. The network structure model has the ability to navigate through an e- text and access the user's needs. The idea of this model is based on adding a navigational structure to the hierarchical content, so that this model can help develop a website based on eBook.

Reviewing this variety of e-educational material shows that there are two designing styles being used:

- ***Hypertext book or non- linear***: this type of structure allows the reader to access information by linking many texts to the other. This type takes advantage of e- data processing to organize itself. Thus, it increases the ability of the readers to navigate a complex search structure, helps them to make large quantities of information accessible, and gives the reader the ability not just to read the text from beginning to the end but also to offer choices to select from among many links. Figure (16) is a diagram showing the basic structure of hypertext.

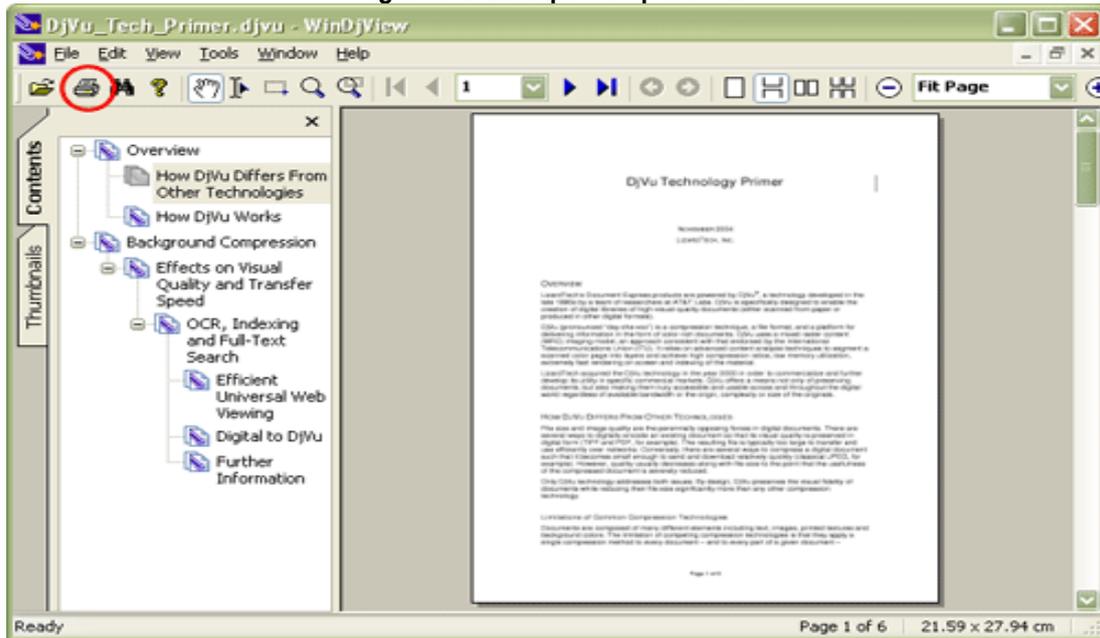
Figure 16: The basic structure of hypertext (Palmer 1993).



However, in several cases, a hypertext can confuse the reader, especially where readers need to know where they are and where to go next. Thus, some designers suggest using tools that help readers define their path in the text such as a dynamic table of contents, map of contents, or list of chapters. The effect of these tools is the focus of discussion among many researchers interested in online reading by younger pupils, and they argued that understanding navigation search when reading hypertext will provide optimal use to e- text provided in the hypertext format (Salmerón and García, 2011, Lawless et al., 2002)(Amadiou, Tricot et al. 2009).

- **Linear format:** linear refers to the text that is presented in a straight line and read from beginning to end. This is usually done by using portable document format (PDF) which offers several advantages to readers and designers such as the ability to download it install it on every PC network, and security to the text. Figure (17) presents some examples of text presented in the PDF format.

Figure 17: Example of a pdf book <sup>4</sup>

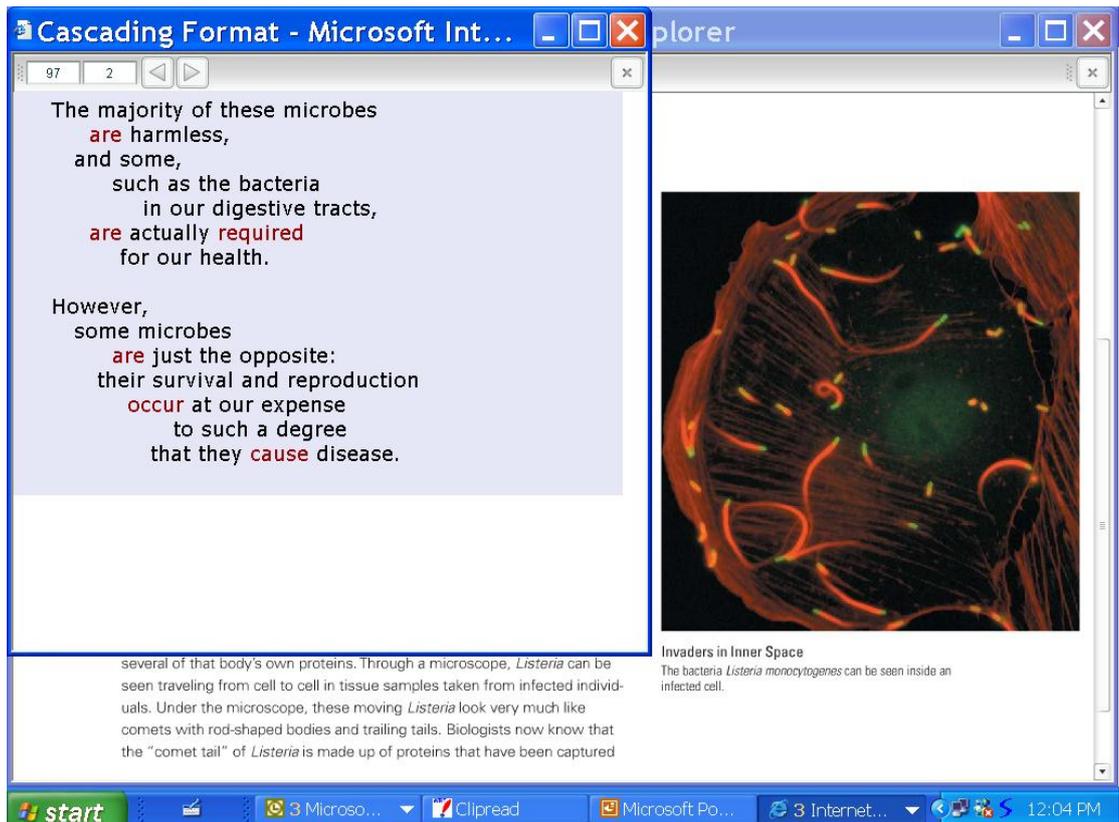


However, the impact of this style in reading for learning is not clear, and that is because most studies conducted in this regard has only focused on the designing issues. Also, the number of comparative studies is not enough. Extensively, eBook for children is used in Arabic countries due to the PDF file and its ability to be downloaded.

In addition, Gordon et al (Gordon, Fletcher et al. 2007) suggested the Visual-Syntactic Text Formatting Theoretical (VSTF) method for increasing reading comprehension as shown in Figure (18). The method has been tested with adults and students in classroom of year 10 and 11 according to UK education ( age 15 to 16). The study reported a significant improvement in reading comprehension, and score of the quizzes and retention. For example, the mean reading comprehension for control group (reading black text) was 0.225, while it was 0.235 for students who read a VSTF text.

<sup>4</sup> . . <http://www.hd-videoconverter.com/convert-djvu-to-pdf.html>.

Figure 18: : Electronic Textbooks Used in VSTF (Technologies 2001).



### eBook guideline:

Searching for an eBook guideline has unveiled that only simple and limited attempts have been made, only offering general advice without going into detail or provide any standard for use. For instance, electronic books on screen interface (EBONI) is meant to advise designers when designing material for higher education in an electronic format (Wilson and Monica 2002). The guideline is divided into 22 parts, with each part focusing on one element such as hypertext, text format or eBook technologies. In section seven (“design typographical aspects carefully”), it provided suggestions to enhance readability such as using white spaces justify the text to the left side and use line lengths of 10 to 15 words. This guide cannot be accepted as comprehension reference for designing Arabic text for a number of reasons (Haboubi, Maddouri et al. 2006):

- Different morphological structure to Latin.
- Difference in character width and position.
- Combination of seven vowels.

In the same context, W3C provided in 1999 Web Content Accessibility Guideline 1.0 (Wendy Chisholm 1999), which aims to improve the accessibility of e-content to a wide range of people with disabilities. The last version of the guideline, 2.0, contains four principles, with the third principle intended to “make text content readable and understandable”, while the section is divided into three levels. Although the guidelines deal with elements which have an effect on accessibility such as line lengths, page format, and links, there are shortcomings in these principles, e.g. the guideline does not mention the optimal size of a web page and only recommends dividing the page into parts. In addition, it does not solve the problem of using links by defining the optimal number of links

### **3.8. Identification of the research problem**

Text is still an important means of communicating with a learner and in many ways it is the most powerful. Furthermore, applying technology in education brings new issues related to visual display and how it affects the readability and legibility of e-text. In particular, when developing teaching material, it is very important to cover all these factors that may affect legibility of e-text, define the correlation between typographic variables, and see how it affects the reading process.

However, the difficulty of reading electronic texts is caused by several factors as previously reported such as display context (Wiggins 1977; Hartley 1978; National 1988; Wright 1988; Dillon, Richardson et al. 1990; Dyson and Kipping 1997; Youngman and Scharff 1998; Dyson and Haselgrove 2001; Kim 2001; Sanchez 2001; Roh 2002; Dyson 2004; Abdullah 2007; de Leeuw and Rydin 2007; Lee, Shieh et al. 2008)(Muter 1991; Marchionini 1995; Foltz 1996; Grainger 1996; Knulst 1996; Singhal 1999; H.C. 2001; Y.C. 2003; Sun 2007; Wastlund, Norlander et al. 2008).

Alternatively, empirical findings show poor reading performance compared to reading from paper. For instance, Carol Tenopir et al. (Carol Tenopir 2009) indicated that 54.4% of college students prefer reading printed articles. Also, the majority of university students are still not keen on electronic books (Rogers 2002; Mash 2003) because reading from screen was slower and less accurate. These findings encourage researchers to investigate the reasons behind poor reading from screen. Otherwise, the

average reading from screen has increased in contrast to reading printed material especially among younger readers who are more familiar with the new technology.

Moreover, there are factors that affect the legibility of e- text, which may be classified into five elements: machine aspects, designing aspects, reading behaviour, personal characteristics, and motivation of use. There is another factor that can be added to the above factors - language. As revealed by several researchers, there are differences in the way of reading and moving from one language to another, which has led to defining the effect of these variables on each language instead of using the findings of research done in different languages.

The problem that needs to be addressed in this research can be defined in two dimensions as outlined below.

### ***First dimension, how students read e-text for learning purposes***

With the growing number of pupils who read e- context for pleasure or learning, there are still deficiencies in studies that seek to understand how digital texts are read, as previous studies have shown that what have been done in the area of e-reading simply focused on comparing issues without having a clear idea of how the reader deals with e- text or whether this technology has affected the way the e-text is read.,Sara Kol & Miriam Schcolink (2000) argued that understanding the reading strategy and teaching students how to deal with e- text could help them read effectively from screen. Moreover, Melissa Terras ( 2005) suggested a model of how experts read an ancient text by understanding a complex process in humanities. This study reported that the reading process is linear and also based on the interaction of different facets in the expert's knowledge. These findings help implement a computer system that can work in several approaches.

Alternatively, the reading process differs according to the purpose of reading and the type of the material, as Dillon (2001) and Terras ( 2005) have reported. Also, the hypertext brings radical changes to the way of reading, e.g. hypertext linking allows reader to control the reading process rather than the author, and to interact dynamically with other texts. Importantly, theories and models on displaying text and reading have been developed mostly for adults and in Western languages (such as

English and French). For instance, Andrew (Dillon 2001) built two models of the reading process, one for reading academic journals and the second manual as shown in chapter two. These models cannot be applied to children because of differences in their aims, skills and requirements. Most importantly, most of the research in this area have focused on the English language in higher education and only a limited number of researchers have concentrated on the Arabic language (Elgohary 2008; Asmaa and Asma 2009). This makes it difficult to deal with the Arabic text, which is totally different.

### ***Second dimension: focusing on the variables that affect the display and reading of e- text by learners aged 9 to 13.***

In the early stages of the e- book, designers and writers attempted to create eBook using the metaphor of a paper book, while the capabilities of e- book have led to changes in the way of reading. In the same context, Kareen Coyle ( 2008) defined the reason behind failure of e- book to render the print book electronically rather than developing new standards as a guide for designers and writers to use when designing e- text. This idea was supported in many studies that examined the display of e- text; for example, Maria ( 2006) and De Stefano and LeFevre ( 2005) examined the effect of the layout of questions and answer sheet for the English language. Study findings show that text layout affects reading performance significantly.

Otherwise, searching in-depth into the reading process and usability of e- text raises new factors related to language structure, which makes comparison between English and Arabic unfair for several reasons such as the fact that these two languages have different morphological structures, e.g. English has a concatenative morphological structure, while Arabic is non-concatenative. On the other hand, 15 letters of the Arabic alphabet have dots in them, and a large number of the letters differ depending on the number of dots or where the dots are put, while in English only two letters have dots (Shahreza 2006). For example, in Figure (19) the first letter **ث** and the second one **ت** differ in the number of dots, making it difficult to differentiate between them especially by children and when the font size is small. Also, when one word containing two letters have dots and are conjoined, it becomes difficult to differentiate between them. This problem does not exist in the English



In additional, a comparison of the Arabic system to Chinese shows that the first one belongs to an alphabetic system where words are written in units, and there are salient spaces between words. Whereas, the Chinese language belongs to a logographic system, where words are written in units, and there are no salient spaces between words (Huang, Patrick Rau et al. 2009; Shu, Zhou et al. 2010). Thus, this research will focus on the language factor to determine the extent of its impact on reading, taking into account the factors that have previously been identified.

Some researchers combined a number of variables and compare these layouts with a control condition; this method is known as the “kitchen sink” method (MUTER 1996) which begins by recognizing the effect of individual typographic factors and then test the effect of one variable depending on another using systematic relations. In addition, most researchers (Muter 1991; DE BRUIJN 1992) used a well-structured text as the method to test the effect of those variables and investigate the relationship between those variables. Researchers in this field of Arabic literature are limited. A critical attempt was provided by Asmaa Alsumait & Asma Al-Osaimi ( 2009) when they opened the door towards further investigating the typographical variables that effect the readability of Arabic script. They asked 35 children aged 7 to 9 to read an e-story of ten pages. Each page of the e-story was written with various font types and sizes. Then, participants were invited to respond to 4 questions to measure their level of satisfaction regarding font type and size. According to the findings, Simplified Arabic or Unicode MS with size 14 are the most readable for Arab children. On the other hand, children were able to read faster with 2/3 screen line length. Although this study may shed light on some factors related to the readability of Arabic texts, it was not able to provide adequate answers to cover all these factors. Thus, we may consider this study as a springboard to further research in this topic for the following reasons:

- Did not address all the variables that effect e-reading of Arabic texts nor define the relationship between these variables
- Did not measure the impact of these factors on the reading process

Moreover, Abdullah Z Alotaibi ( 2007) investigated the effect of two Arabic fonts [Times New Roman, and Courier] matching to three print font size on reading

performance. Each sentence contains 16 words which were printed with black letters on white-background A4 sheets. 100 participants who were studying at university and had a distance visual of (6/6)<sup>5</sup> volunteered to do the experiment. The study shows that there was an effect on the reading speed from using two different fonts, simulated and visual impairment. For instance, the print size increases the reading speed and the rate was enhanced significantly with Times New Roman. Therefore, this study focused on the use of large print size, which is different to the screen size font. Thus, further investigation is needed for the Arabic language with variables that affect reading from a screen. In addition, both researchers did not consider the effect of all these factors on Arabic reading efficiency. Furthermore, determining the effect of the reading skills is important and has a great effect on the process of reading.

### **3.9. Conclusion:**

This chapter provided a review of the literature in relation to the theoretical and empirical background of eBook and the internet. Generally, there is no universal standard definition for eBook in the literature according to the survey of the eBook field. The review found that the term eBook is still unclear even though several terms have been used in the field such as CD-Room book, visual book, e- paper, web book, electronic text book, and digital book. . The majority of research mentioned in this chapter focused on the application aspects but with limited focus on the conception aspect.

Generally, there is no particular order or rules to follow when designing e-text which is usually dependent on the subject, the purpose of the text, age of the reader, the amount of the text and screen size. Alternatively, the structure of e- learning material usually depends on whatever the education system is aiming to achieve.

The contribution of eBook and the Internet in education has been proven by many studies and experiments that have illustrated the advantages of applying the eBook such as using it to enhance students' phonological awareness, word recognition skills, or extending their verbal knowledge. The average use of the Internet in the developing world is quite high compared to the developing world. In Libya, the

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<sup>5</sup> The standard definition of normal visual acuity.

average use of the Internet differs from year to year, from the very beginning when it was only available via telephone to the enormous improvement in Internet technology which has seen the number of Internet users dramatically increased.

# **Chapter Four: Access and Use of the Internet among Libyan Primary School Students - analysis of questionnaire data**

## **4.1. Chapter Overview:**

This part of the study aims to examine the use of the internet and eBook among students in public primary schools in Libya. The literature showed a lack of research that examines access to the Internet, students' awareness of eBook, and using the computer for learning at school as set out in chapter three. However, this type of research has been important in providing a better understanding of eBook usage and helping designers to create eBooks that meet user needs. Thus, the number of netizens determines the causes of use as a starting point for understanding and determining e-reading stages in order to investigate the factors that affect e- text reading among young people. This chapter presents the questionnaire data as analysed by the Statistical Package for the Social Sciences (SPSS) software for analysis and focuses on collecting quantitative data that can help build a clear understanding of current user behaviour. At the end of this chapter, these two objectives should be met:

- Examining the use of Internet among students aged 9 to 13 and
- Defining the awareness and aim of using eBook among students.

## **4.2. Data collection methods and research type**

In phase one as described in chapter one, a quantitative approach is employed to collect numerical data. Research questions one, two and three were concerned with determining the use of the Internet, eBook and computer among students in primary schools in Libya. Data can be collected by employing different methods such as interviews, questionnaire, observations, etc. The choice between these techniques

depends on the research philosophy and the aim of the study or research questions; thus, questionnaire was selected as the collecting method in this phase which is defined as a list of carefully structured questions (Collis 2009).

The most appropriate questionnaire type to use was a collective administration questionnaire (Kumar 2011). Collective administration questionnaire was used because it has been widely used as a primary data collecting method in usability research and applying the Internet in education process studies in particular. The opportunity to analyse a large amount of information, the limited time and resource available to the researcher, allows for personal contact with the study population. This in turn makes it easy to explain the purpose and difficult terms, to collect the completed questionnaires within a short time, and get a very high response rate wherein no one refuses to participate.

#### **4.2.1. Questionnaire design**

The design of the questionnaire can have a huge impact on many aspects of the research conducted. It provides a framework for the collection and analysis of data, while a poor design will fail to provide accurate answers to questions under investigation. Thus, several researchers recommend a number of considerations that should be taken into account when building a questionnaire such as the questions' order, type, and length (Boynton and Greenhalgh 2004; Bell 2007).

Therefore, careful attention was given in this study to improving the questionnaire through focusing on the principles of questionnaire design that are effective in the case of paper questionnaires (Phillips 2008). In addition, it was crucial to ensure that the format of the questionnaire was clear, with the use of sub-headings, clearly defined sections, and bold text where appropriate, and the use of simple language to facilitate answering. Moreover, clear instructions were given about how the questionnaire should be completed to avoid any confusion that could lead to wrong answers; thus, students answer the questionnaire in class under the teacher's control in order to clarify and explain questions to students in addition to ensuring that all students answer all questions.

In applying the feedback from the pilot study, the final version of the questionnaire was designed. This final version was divided into two main parts, the first part was designed to collect information about the participants regarding individual variables, whereas Q1 and Q2 were devoted to collecting demographic information about the students [age & gender]. While in Q3, students were asked to provide information about their level of education.

In addition, part 2 aims to addresses the use of the computer, eBook and internet by young students who study in Libyan schools, both at school and at home. Sections A involves 13 questions (7 closed questions and 6 open question), while section B focused on using e- book for learning proposes. The section contains seven questions. The final section (section D) focused on collecting data about using a schoolbook and defined the process used when reading schoolbooks (as see in table 13).

**Table 13 : constructor of the questionnaire.**

Questionnaire`s parts	Section	Address of the part	Number of questions
Part 1		Participant`s regarding individual variables	3
Part 2	Section A	the use of the computer, and internet	13
	Section B	The use of the eBook	7
	Section D	Using a schoolbook	6

However, most of the questions were closed with predetermined answers that simply required a box to be ticked or questions with two and four points, while a ranked response was avoided because of the difficulty of selection and the ability to determine the difference between those choices.

#### **4.2.2. Questionnaire translation**

The questionnaire of this study was initially drawn up and produced in English, and after all components of the questionnaire were determined, the English version of the questionnaire was prepared and then given to an independent translator to translate it into Arabic; also, the researcher has translated a copy of the questionnaire and compared it with the first copy. In addition, considerable attention was given to

eliminating any problems and difficulties that may occur during the process of developing the Arabic draft of the questionnaire used in this study. Therefore, the Arabic version of the questionnaire was passed on to another interpreter who translated the questionnaire back into English. Comparing the two versions of the questionnaires showed some changes in the meaning of the questions, which required correcting the words and the meaning of each question.

#### **4.2.3. Questionnaire piloting**

A pilot test was recommended by several researchers such as Oppenheim (2003) and Saunders et al. (2003), who argued that every aspect of the research survey should be piloted. They also argued that it can be used to help increase reliability and validity of measures and ensure that the questions' wording is clear and understood by the participants of the study.

Additionally, all aspects of the questionnaire were piloted, including question content, wording, sequence, form and layout. The first draft of the questionnaire was reviewed by the researcher's supervisor. Subsequently, an Arabic version of the questionnaire was distributed to a small sample of Libyan students studying in the UK (25 students who studied at the Libyan school in Huddersfield, UK), similar to those who were included in the actual survey, for their review and comments.

However, the feedback was very significant which resulted in reordering some sections in the questionnaire, deleting some questions from the questionnaire, dividing the questionnaire into parts to become more manageable, and rewording some of the words such as navigation التصفح where the majority of students cannot understand what it means.

Finally, part of the Arabic questionnaire was sent to a friend, who is a teacher at a Libyan primary school, to ensure that the questionnaire was not too long and without words that may be too difficult for students. Notes were received by e-mail which indicated that the questionnaire was clear and easy to complete. After taking all the comments, suggestions, and ideas, amendments were made, resulting in a final draft of the Arabic questionnaire which is presented in appendix (2) and the English version in appendix (1).

#### 4.2.4. Population and selection of the sample for the questionnaire

Research population is defined by Sekaran ( 2003) as “the entire group of people, events, or things of interest that the researcher wishes to investigate”, while sample is described as “a subgroup of elements of the population selected for participation in the study” (Malhotra, Birks et al. 2003).

The target population comprised students aged 9 to 13, attending Libyan public primary schools. Because of the large size of the study population, a sample of the study population was selected that truly represents the entire research population. However, there are several ways to determine the appropriate size of a sample, all of which depends on three factors: (1) the size of the population under study; (2) the research budget; (3) the degree of error accepted; and (4) the precision required.

The total size of the participant sample was set at 504 participants where the sampling technique is a probability technique (to select the school) and non-probability sampling technique used to select participants from students in level 4,5, and 6 for the questionnaire. This technique mainly relies on personal judgment of the researcher. The sample was distributed as follows:

- 234 males, thereby representing 46.43%; and 270 females, thereby representing 53.67%.
- The age of participants was between 9 and 13 years.
- They are distributed to the three studying stages: level 4 was 134 students, level 5 180 students, and 190 students in level 6 (as shown in Table (14)).

**Table 14: Demographic characteristics of the sample.**

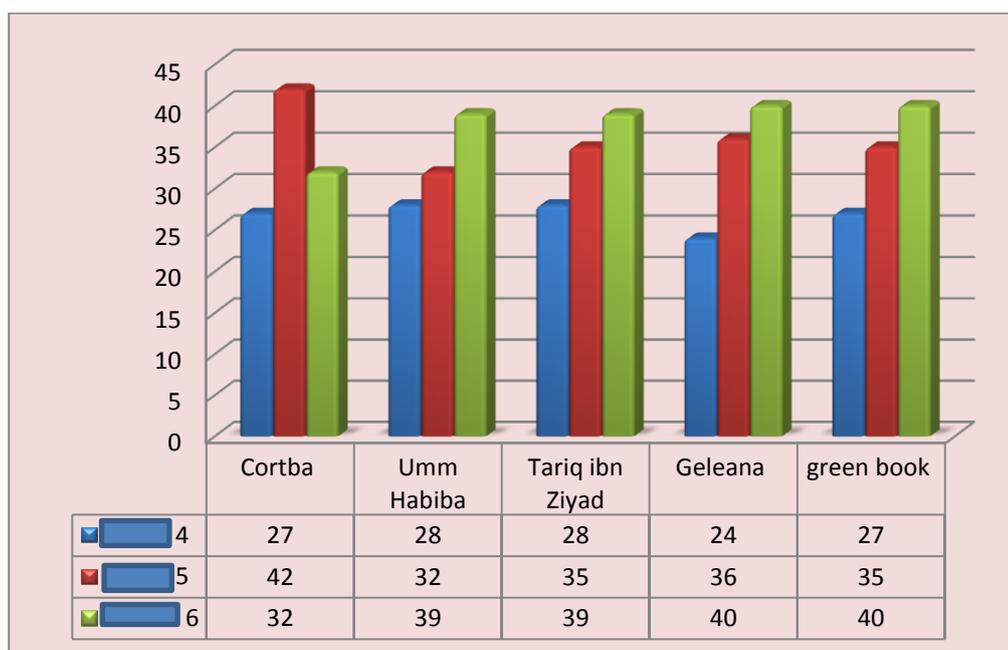
Characteristics		Frequency
Age	9	100
	10	156
	11	118
	12	110
	13	20
Gender	Male	234
	Female	270
Education level or Year of study	Year 4	134
	Year 5	180
	Year 6	190
Total		504

Table (15) and Figure (20) show the distribution of the sample based on education level in each school. All students in year 4, 5 and 6 were selected in the five schools. The number of students in the year 6 was the largest in the five schools. To avoid the impact of age difference among students, a large number of students are supposed to be in the fifth grade, but were enrolled early at age 5. In addition, the sample comprising five public schools in Benghazi was selected to distribute the questionnaire more broadly. In order to ensure that the sample includes all segments of society, schools were selected from different geographical regions. In addition, schools located in the outskirts of the city have been excluded because of the difference in patterns of living which can affect the level of computer use.

**Table 15: The distribution of the sample based on education level in each school.**

Education level				
Schools	Year 4	Year 5	Year 6	Total
Cortba	27	42	32	<b>101 students</b>
Umm Habiba	28	32	39	<b>99 students</b>
Tariq ibn Ziyad	28	35	39	<b>102 students</b>
Geleana	24	36	40	<b>100 students</b>
Green book	27	35	40	<b>102 students</b>
Total	134	180	190	<b>504</b>

**Figure 20: The distribution of the sample based on education level in each school.**



Students' gender was used as a second factor to measure the usability of eBook and Internet and to report if there is a distinction in the student's skill level where some researchers have shown that there is a difference in the usability of internet and eBook according to the gender variable.

Finally, it would be useful to justify the reasons behind choosing the participants only from Libya despite the number of Arab countries (22 countries). Importantly, Libya is the home country of the researcher, which means that the researcher is able to collect the required information without any difficulties regarding time issues, obtaining permission to distribute the questionnaire, living costs, and so on. Notwithstanding the existence of local dialects in various Arab countries, Arabic is the language used in teaching and learning in all these countries.

### 4.3. Questionnaire data analysis:

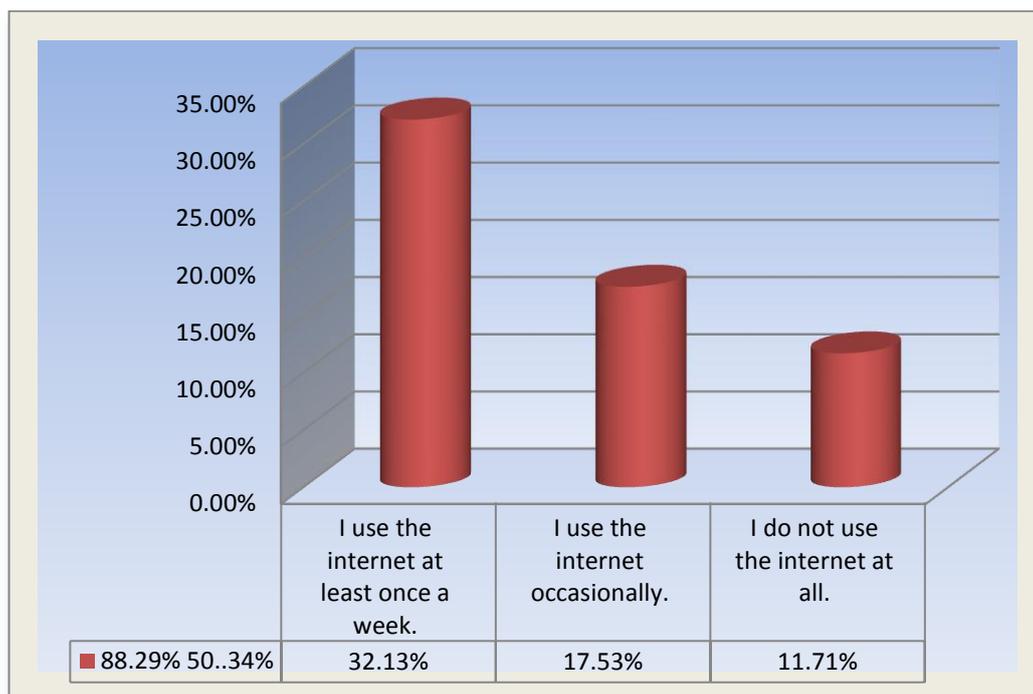
#### 4.3.1. Internet access:

As mentioned in chapter three, Internet application in Libya is quite new and limited in the education field, as Libyan primary schools still could not provide Internet access for their students. Thus, there is no tangible benefit of Internet use to students in their education activities as it is simply not available. The absence of teachers' direction reduces the scientific use of the Internet. In addition, the study reported that the total average use of the Internet among participants was high, where 86.1% of responders have access to the Internet after school time without any direction from the teacher. Participants who use the Internet are mainly divided into daily users (43.84%) and weekly users (28.37%), see Table (16) and Figure (21).

**Table 16: shows Internet use by respondents.**

	Number	Parentage
I do use the Internet.	445	88.29%
I use the Internet daily.	224	50.34%
<b>I use the Internet at least once a week.</b>	143	32.13%
I use the Internet occasionally.	78	17.53%
I do not use the Internet at all.	59	11.71%

**Figure 21: Internet use by respondents.**

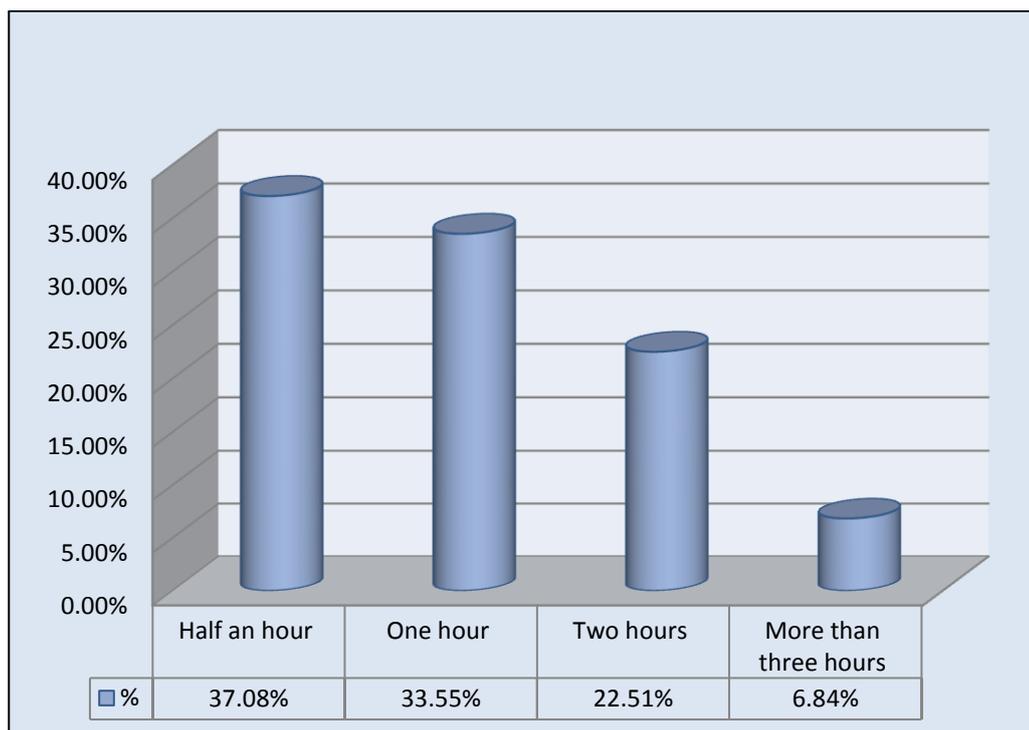


Furthermore, the hours of using the Internet daily differed among users, as seen in Table (17) and Figure (22) which show the distribution of using the internet among participants. For example, 37.10% of respondents used the internet an hour daily and 30.76% spent just half an hour daily on the internet. The high average of using the internet for only a short time highlight the need to know the reason behind this limited use by asking questions such as: is this because respondents find the internet boring or because they do not have enough skills to use the Internet? Examining the quantitative data showed that the majority of students who use the internet for a short time did not have access to the internet at home. In addition, 35% indicated that they did not have good skills to work effectively with a computer, although students start learning computer from year five. Therefore, schools should work to develop students' and parents' skills on using the internet for learning purposes effectively. Then, the designer should take the next step by providing reliable e-material that meets students' requirements and encourage them to move from using the paper book to eBook.

**Table 17: The average daily use of the Internet.**

How long students use the Internet daily?	Number	Parentage
Half an hour	168	37.08%
One hour	152	33.55%
Two hours	102	22.51%
More than three hours	31	6.84%

**Figure 22: The average daily use of the Internet.**



In developing countries there are several barriers that reduce using the Internet widely such as a lack of access and slow internet speed, but the high price of getting ITC is the main barrier between all these (Paterson 2007). In Libya, the case was different; getting a laptop or PC is not the main barrier that reduces the use of the Internet since the survey reported that 86.1% of participants had indicated that they have a laptop or PC at home and 49.08% have more than one PC at home as seen in Table (18) and Figure (23). Thus, limitation in Internet use could be due to the quality of service, the limited range of available e- Arabic books for children, the quality of eBooks, poor design of free e- Arabic books, poor Arabic children’s websites, and a lack of support from the schools.

**Table 18: The average having computer and access to the Internet at home.**

	Have a computer at home		Connect to the Internet		Have more than one computer at home	
	Number	Parentage	Number	Parentage	Number	Parentage
<b>Yes</b>	434	86.1%	316	62.7%	213	49.08
<b>No</b>	70	13.9%	174	34.5%	221	50.92
<b>Total</b>	504	100.0	504	100.0	434	100

**Figure 23: The average having computer and access to the Internet at home.**

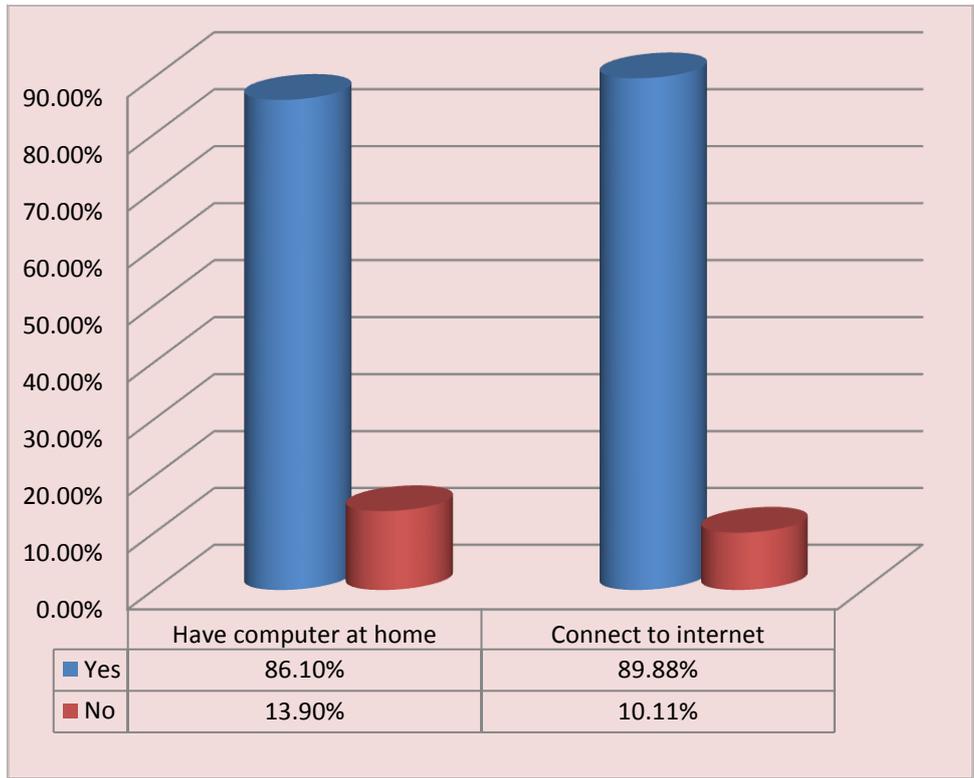
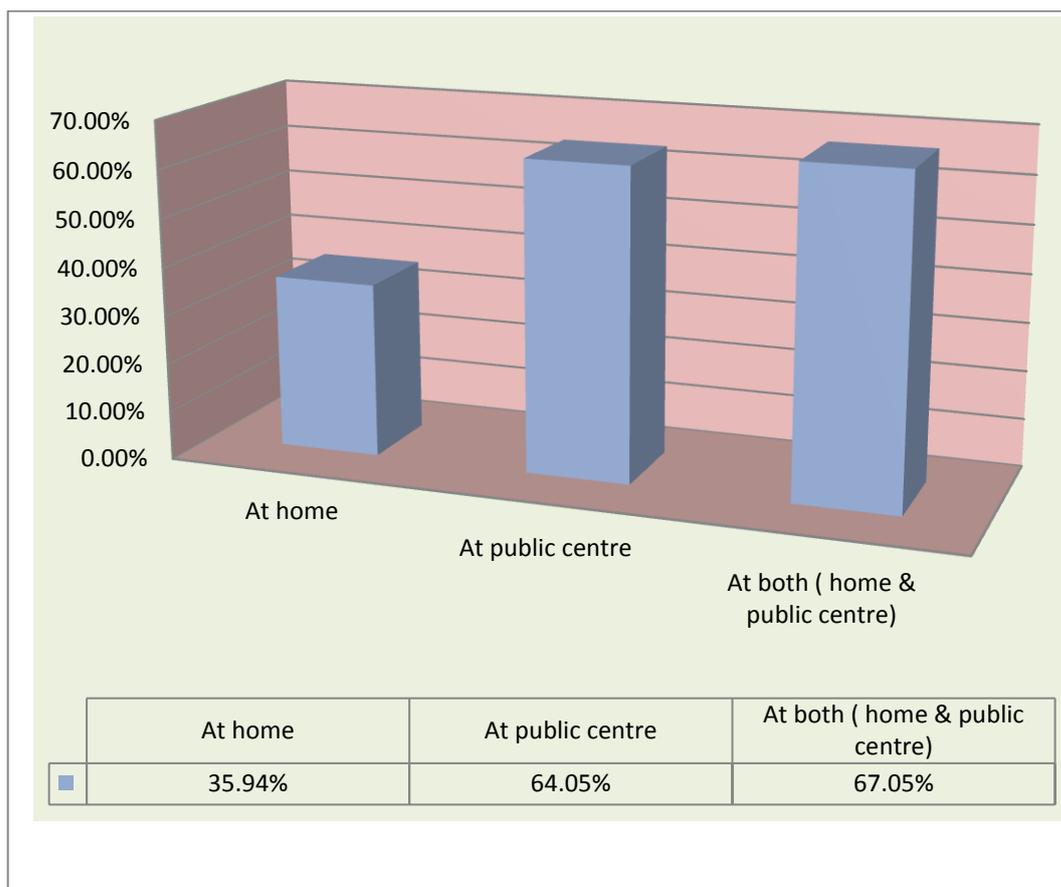


Table (19) and Figure (24) demonstrate where students usually access the Internet: at home, at school or public centre. 64.05% of students do not have access to the Internet at home and thus use it at public centres where usually a private space for children’s use costs 50p per hour. This explains the high rate of Internet use between one hour and half an hour. Still, 8.33% of students who have access to the Internet at home also go to public centres with friends and use the Internet for entertainment purposes.

**Table 19: Where students usually access the Internet.**

Access into Internet	Number	Parentage	
At school	-	-	
At home	156	35.94	
At public centre	278	64.05	
At both ( home & public centre)	291	67.05	

**Figure 24: Where students usually access the Internet.**



#### **4.3.2. Students` Awareness of eBook:**

According to previous research, there is a certain lack of awareness on eBook among students and educators especially young users, so that the field survey began by asking several benchmark questions which show whether students are familiar with eBook. The findings demonstrated that eBook is not a familiar source of information for students in primary schools in Libya. The majority of participants (71.4%) in this study pointed out that they were not familiar with the eBook, although 86.1% of participants have a computer at home and the daily average use of the internet was high. In addition, 83% of participants thought that any text on the internet was eBook, while 13.9% did not provide any answer to this question which means that they did not actually have any idea about the meaning of eBook. This finding could be summarized as follows:

- **Using the Internet randomly without support from school:** as mentioned earlier, all students use the Internet outside of school and 64.05% have access to the Internet at commercial centres; thus, they did

not get any guidance from their parents or teachers. Also, 30% of students who use the Internet at home have parents who manage their internet use but in some cases the parents do not know how to help their children use the internet safely and effectively.

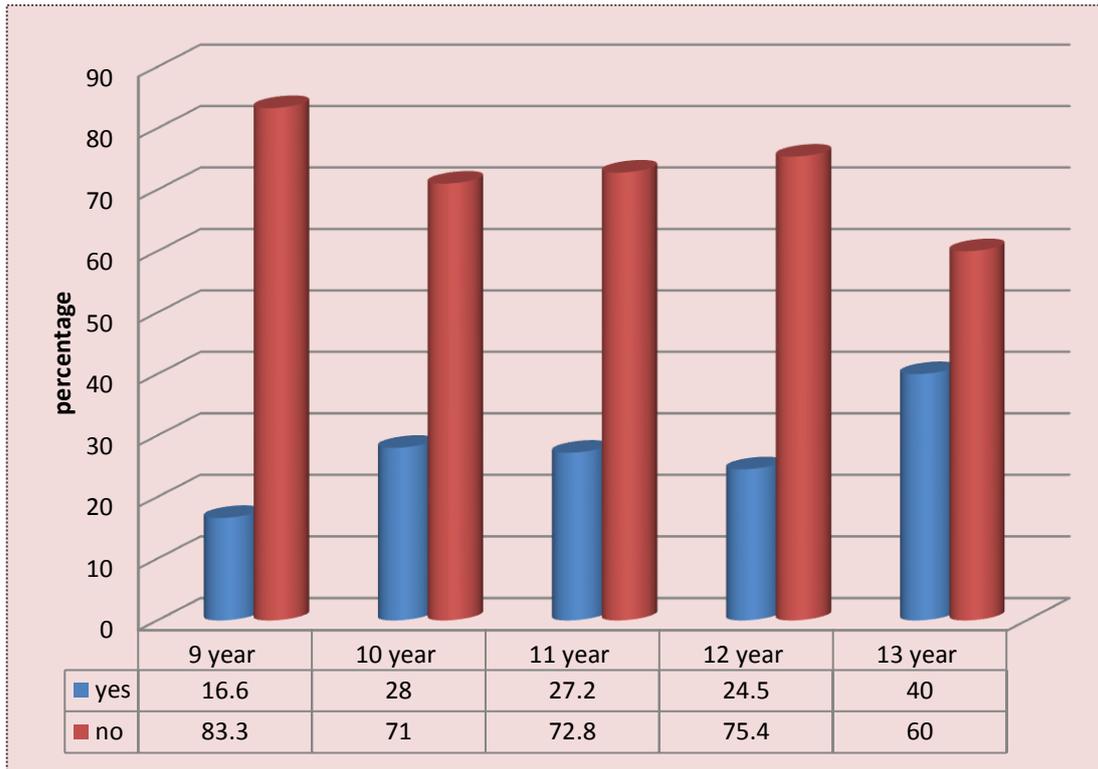
- **Lack of or poor Arabic online sources:** searching for an Arabic online book for children (35 eBooks) showed only poor quality books compared to eBooks written in English, where the majority was presented in PDF file and did not include sound and animation. In addition, 53.2% of responders pointed out that they were not aware of the availability of websites that provided electronic Arabic books.

In addition, the findings revealed that 85.11% had not used an eBook before the survey (as seen in Table 20 and Figure 25). This finding is not surprising in terms of the absence of a real understanding of the meaning of eBook and students not getting any guidance from school which could lead to misuse among students. Similar percentages were recorded in the UK and USA, although the difference is in terms of the type of respondents that were involved [e.g. students from higher education and staff]. 75 students ( 14.88%) had already used an eBook, 23 students ( 4.56%) had read or used fewer e- stories available on the internet, and 56 students ( 11.11%) used e-Quran. On the other hand, participants who had not used eBooks tended to state several reasons for this: 69.64% never heard of the term ‘eBook’, or otherwise had not seen it; 6% could not access an e-book; and 11% used it because it is as portable as the paper version.

**Table 20: Students’ awareness of eBook.**

Question	Responders	%
Were you familiar with the term eBook before this survey?		
Yes	<b>67</b>	<b>13.29</b>
No	<b>351</b>	<b>69.64</b>
No answer	<b>84</b>	<b>16.66</b>
Do you read an eBook before?		
Yes	<b>75</b>	<b>14.88</b>
No	<b>429</b>	<b>85.11</b>
No answer	-	-

Figure 25: The average use of eBook re age.

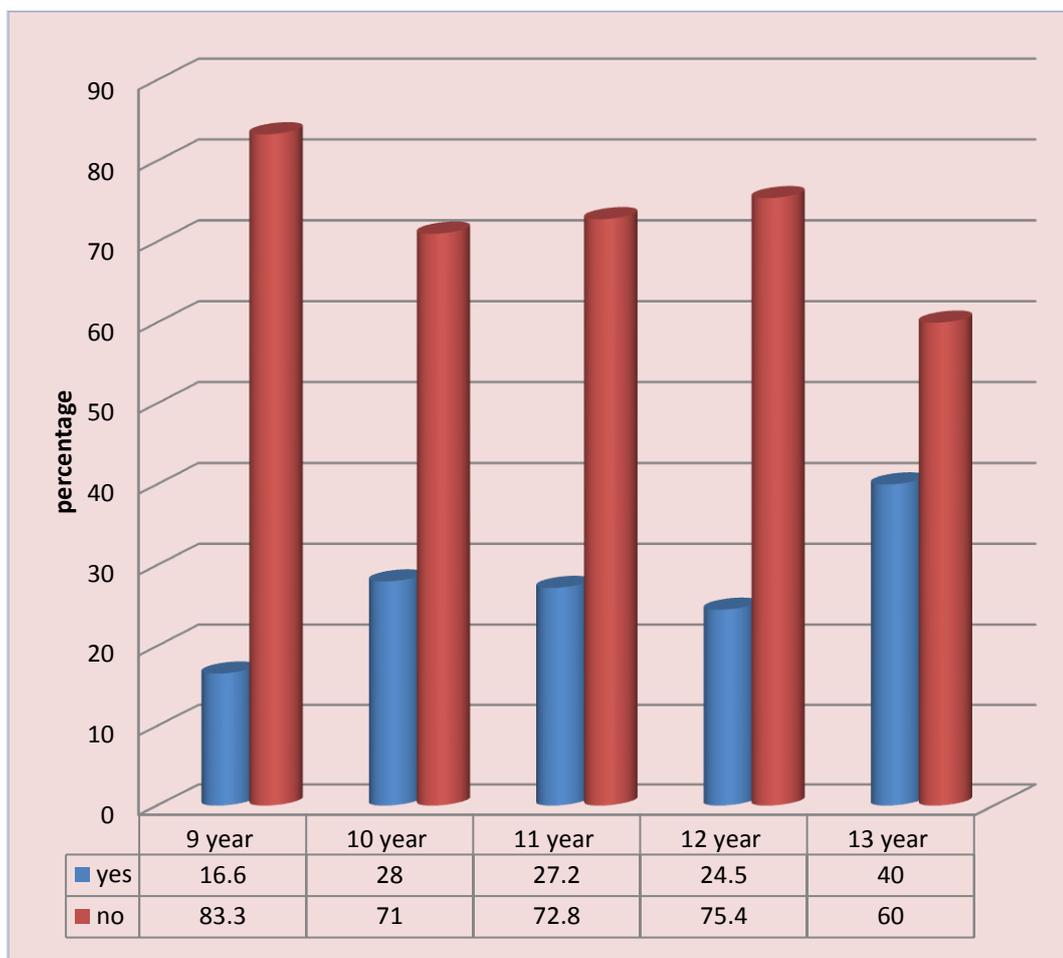


In addition, it was expected that the level of eBook usage might be affected by the participants' age, education level and gender. Consequently, a Chi-Square test  $\chi^2$  test was implemented to define whether any connection exists. The test revealed that there is no strong association between age and using eBook, and gender has little influence on the average use of eBook (as can be seen in Table 21 and Figure 26). Starting with the age variable where several previous research predicted an association between students' age and using eBook, the test found  $X^2 = 3.495$ ,  $p > 005$  (.479) which confirms that there is no association between age and usage of e- book among children.

Table 21 Association between age and usage of eBook among children using chi-Square test.

Association	No of valid	Value ( Pearson X <sup>2</sup> )	df	P
<i>Is there an association between students' age and using eBook?</i>	496	3.495	4	.479
<i>Is there an association between gender and using eBook?</i>	496	2.369	1	.124
<i>Is there an association between educational level and using eBook?</i>	496	2.615	2	.270

Figure 26: Participants' familiarity with eBook according to age.



Moreover, an association between gender and using eBook was found  $X^2 (1, N= 496) = 2.369, p >0.005$  where  $p$  – value should be  $<05$  or  $=05$  to accept the association. According into this finding there is no significant association between gender and using eBook.

#### 4.3.3. The purpose of using the Internet:

As indicated earlier, students have used the computer and Internet for various purposes such as communication, entertainment, share information, or because of their interest and hobbies. Therefore, it is necessary to identify the area where using the Internet and computer would address students' attitudes to ICT. So, a key question was asked to determine their motives for using the Internet. At this point, our survey finds that students use the Internet for two purposes: academic and non- academic purposes.

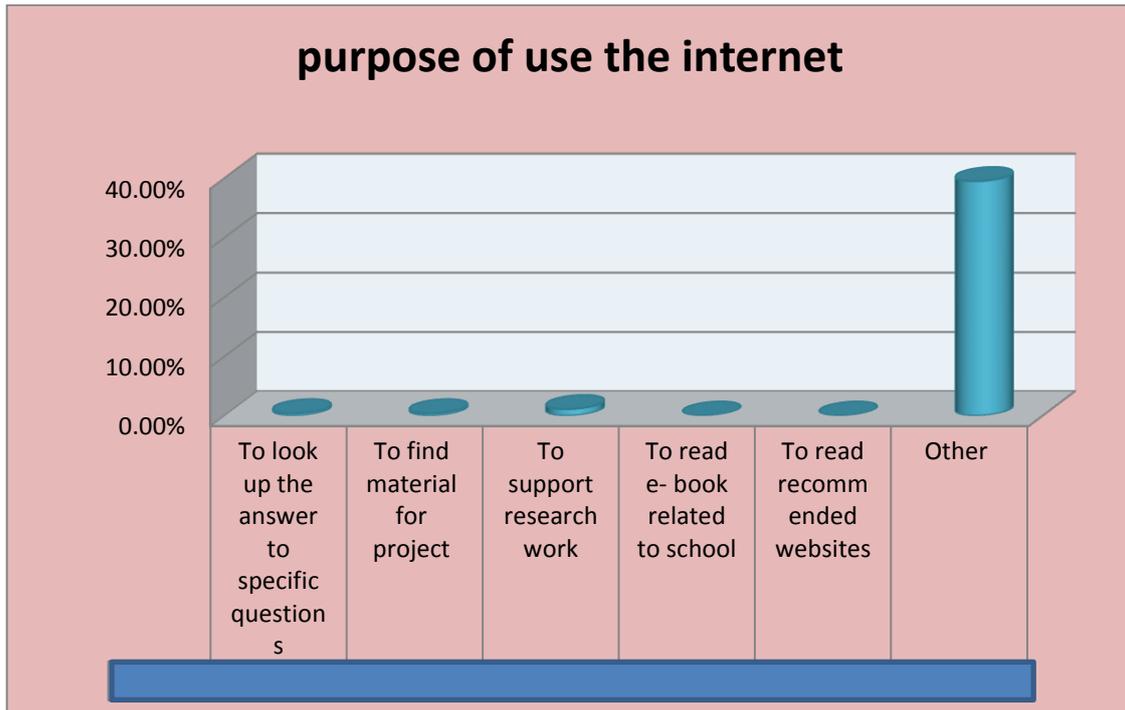
### Academic use of Internet:

Using the Internet for academic purposes has increased day after day with the improvement in learning and research tools which support students in their day-to-day learning. Consequently, participants were asked to indicate different academic purposes for using the Internet. The survey ranks five purposes for academic use to help students in their selection. The finding of the survey as shown in Table (22) and Figure (27) indicated that the majority of participants did not use the Internet for one of the five purposes suggested based on previous research in the usage of the Internet. The survey results indicate that learning comes second with 19.82%, thus, the Internet is not used by Libyan students mostly for academic activities. In addition, students who selected the “other” option provided the following two additional reasons for using the Internet: 26.2% of participants (48 students) use it for learning English, while 71% (130 students) of participants use it for learning the Quran and stories from the Quran. Another 27.3% (50 students) use it to improve their skills, e.g. to learn how to create e-mail or design websites (those students generally use English sources, studied in the UK and can speak English). Moreover, teachers in Libyan schools did not set homework to be done using the Internet because students would use it out of school rather than under the teachers` direction, and schools did not provide this service for students at school.

**Table 22: The academic purposes of using the Internet.**

Purpose of use	Number	Percentage
To look up the answer to specific questions	2	0.4
To find material for the project	2	0.4
To support research work	5	1.10
To read eBook related to school	-	-
To visit recommended websites	-	-
Other	176	39.51
Total using the Internet	453	

Figure 27: The academic purposes of using the Internet.



Furthermore, the survey reported a relationship between age and treason of using the Internet, where students in year 6 use the Internet for academic purposes more than any other groups. On the other hand, all the schools do not have a website to support home school links and to ensure that information about school Intranet is shared. Schools therefore miss out on the use of the Internet as a means of communication between staff, students and parents.

However, applying the Internet as an assisting tool in education in Arabic countries is still under investigation among several of countries such as Libya and Saudi Arabia, but more research should be done to evaluate available sources and define the types of e- sources based on education systems and learning requirements.

### Non-academic use of the internet

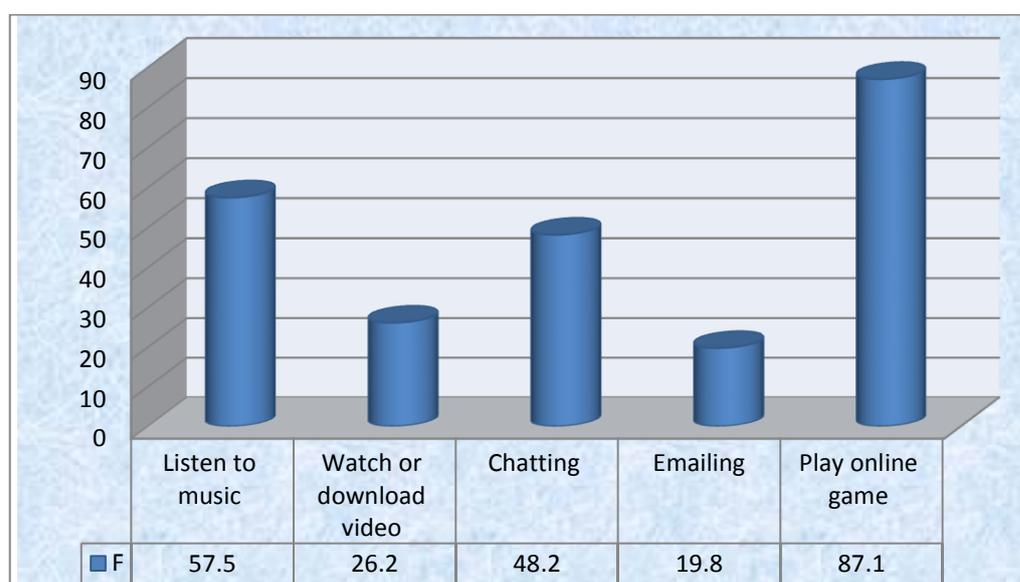
Students in this survey used the Internet after school time without any direction from teachers, so it is not surprising that the highest percentage of students who used the internet did it for entertainment. This finding is similar to other research that reported students' tendency to use the internet for multiple reasons such as (Chien Chon 2009). As shown in Table (23) and Figure (28), the most common reason for using the Internet was to “play games” (87.1%) and “chatting” (48.2). Emailing is less

popular among participants who just create an email for subscribing to a website that asks for email.

**Table 23:** Non- academic use of the Internet.

Non- academic use of the Internet	Number	Mean	%
Listening to music	290	.576	57.5
Watching or downloading the video	132	.262	26.2
Chatting	243	.482	48.2
Emailing	100	.198	19.8
Playing online games	439	.871	87.1

**Figure 28:** Non- academic use of the Internet.



In addition, because most students use the Internet without any guidance from school or parents, they may access sites that are not suitable for their age, while 43.56% of respondents who use the Internet for communication have an account on Facebook, 13% of participants have accounts on Twitter, and 22% have accounts on both.

Alternatively, students' attitudes towards the Internet differed according to gender and education level. According to the age variable, the survey shows that using the Internet among younger children was lower compared to older children. Playing online games was the first choice for using the Internet for participants aged 9 (24 participants), while watching video came in second (12 students). Older children used the internet for a variety of purposes but the majority used it to play online games (200 responders). also, playing online games and reading sports news were more popular for

males, while females spent the majority of their time online chatting. Moreover, listening to music and downloading videos were used by girls more than boys.

#### **4.4. Conclusion:**

This phase of the research was designed to investigate the use of the Internet and eBook among young children in Benghazi and whether they are similar or different to other children in the world. The investigation indicates several important findings that can be classified into two aspects: the use of the Internet, and the use of eBook. The finding of this survey showed that students are confident with using the Internet at home or at public centres for multiple purposes that may be classified into two categories: academic and non-academic use. A deeper analysis showed that boys and girls use the Internet for the same purposes such as gaming and mailing, but the average use is different where boys tend to use the Internet for gaming more than girls, and the latter tend to listen to music and download videos. Moreover, participants state several reasons for not using eBook such as the low quality of Arabic eBooks and a lack of knowledge about their existence. Moreover, the findings show that, there is no strong association between age, gender and using eBook, and there is a certain lack of awareness on eBook among students and educators especially young users.

Therefore, eBooks should be designed in order to be able to satisfy the educational requirements of students. To achieve this aim, a thorough investigation would require defining reader requirements. The next chapter will include a study of reader behaviour towards e-text in order to define the differences between reading online and reading from paper.

The collecting data helps in building up a picture about the usability of the Internet, selecting the sample for the observation of students who have experience in using the internet and e-text, defining impediments to the use of eBook, and outlining the purpose of using the internet and eBook.

# Chapter Five: Experiment (1) on Reading Process of Schoolbook in Two Formats (electronic and paper formats)

## 5.1. Chapter Overview:

In order to be sure that the level of e-text usability in early education can be improved, the following questions should be answered by the end of this chapter:

**RQ1:** What are the existing prototypes ( structure ) of schoolbooks in primary education (PE)?

**RQ2:** How are students interacting with schoolbooks in the electronic and printed version?

**RQ3:** Is there a difference in the reading process between e-school textbook and p-school text-book?

Quantitative and qualitative data were used in order to answer these three questions. The outcome was two flow charts which explain the interactions among students when reading e- schoolbook and paper schoolbook. In addition, it draws a clear picture of the design and structure of schoolbooks in Libya which are similar to schoolbooks used in other Arabic countries at the same educational level. The chapter comprises two main sections. The first section presents the data collection methods and research type. The second section displays the results of the observation. The chapter ends with a conclusion highlighting the main points that has discussed in the chapter.

## **5.2. Data collection methods and research type**

Qualitative and quantitative data collection methods were applied at this stage to address aspects of reality that are difficult, or if not impossible, to measure (as previously indicated to it in section 1.3). Observation was used to record the reading stages of both e-schoolbook and paper format of the schoolbook. In this case, it is important to describe students as a group not as individuals.

Applying the observation has led the researcher to face two problems on observing students: how to observe and how to record. To solve the first difficulty, the researcher listed several possible interactions based on previous findings (Juan and Ruiz-Madrid 2009), using left space for adding new actions that could be noted (see Appendix 3). Thus, it becomes clear which aspects should be observed which can be summarised as follows:

- What does students1 emphasises when reading a school book?
- How do students browse the text of a schoolbook?
- What options do students have when using schoolbook and how do they use them?
- How do students read a textbook?

### **5.2.1. Produce**

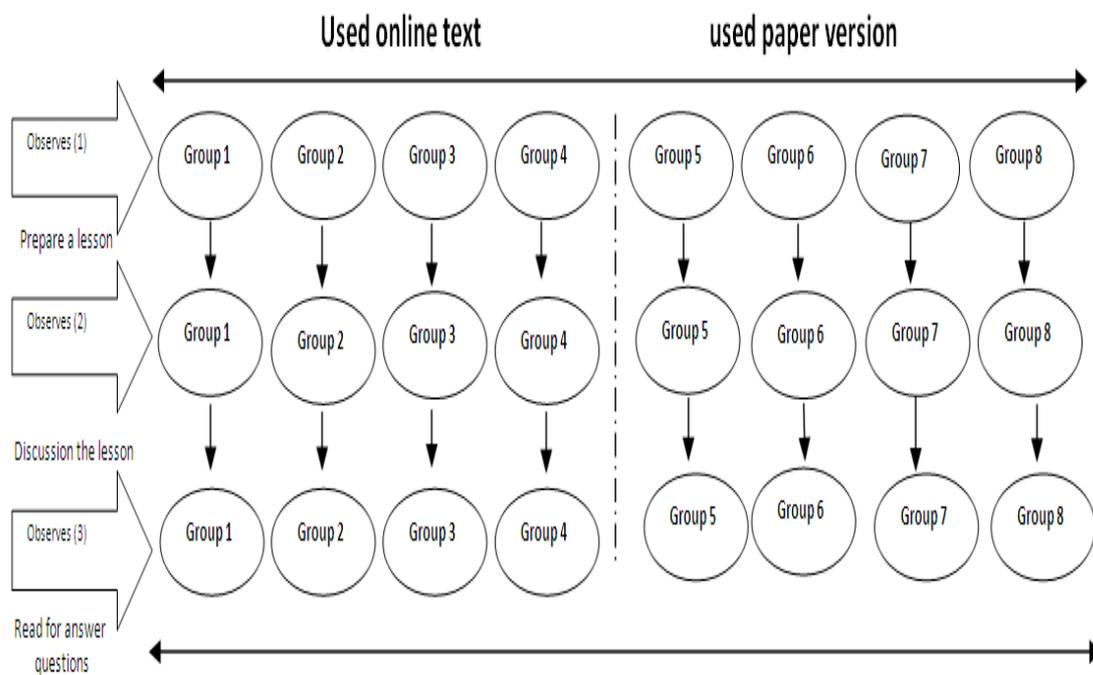
The process of observation begins by taking everything in and recording it in as much detail as possible, with as little interpretation as possible:

- Every note card is headed by the date, name of school, education level, the title of the lesson, and time of observation (as seen in appendix 3).
- Use the code for the process to save time.
- Divide the note code as a sample size to be sure the action of all students at each stage is recorded.

The participants carried out three different observations, which required dividing the participants into 8 groups, each of which comprised 5 participants. Four groups used eBooks (available at: <http://skooollibya.com/>) the website by Intel

corporation which is currently unavailable, while the other four groups used paper versions. The total number of participants was 40, 26 females and 14 males with their age ranging from 11 to 12. During the first observations, participants were asked to prepare a lesson for discussion in class. They were given an open time to complete the task. The next day, teachers discussed the lesson with the students and provided explanations, which lasted 45 minutes. Finally, the students were asked to search the text, answer the questions, and take a small quiz. Figure (29) shows the steps involved in the follow-up study. The total time takes to do the experiment was two weeks.

**Figure 29 : The follow-up survey stages.**



The talk-aloud technique was used in order to identify users' cognitive and behavioural processes, and to collect quantitative data, which could not be obtained via any other method. It was also used to obtain more in-depth details from participants, such as describing their actions and reactions to the book interface, and where students were asked to describe whatever they are reacting to, acting out, thinking about without trying to interpret their actions. In addition, students in each group sit in a straight line to facilitate the observation process. The teacher stands in front of the students, while the researcher stands behind the students. On the other hand, the teacher was informed of the observation's aims. Each student uses their own laptop brought from home,

using a laptop with the same standards is not essential because the observation aims to address the reading stages without consideration of speed.

The basic idea of the test is to observe readers' interaction with the book from the moment of first picking it up to the time of finishing it. The students' interaction had not been recorded, according to the desire of the teacher and student. In order to save time, a model for taking notes was built, which includes the expected reading process according to the related literacy in the area of online reading. Therefore, the description of the reading process is created based on these steps that students follow when reading the lesson. As mentioned earlier, the usage description in this study is made according to four principles: *why do students use a schoolbook? What type of information is in the text? How is a schoolbook organised? And how is a schoolbook read?*

The first two questions were answered using the questionnaire applied in the first phase of the research, while analysing the text was used to answer the third question. Origination of the schoolbook text differs between e- format and paper version, as seen in Table (24) and Figures (30) and (31). For example, the number of pages in the paper format was less than that of the e- format. In addition, the number of words per page in the paper version was 95 to 110 words with no images included, while in the e- format the average number of words is 20 to 33 words per window. This led to the difference in the number of pages between the two formats, e.g. the average number of pages in the paper format was 2 to 3, while in the e- format it was 9 to 17 windows.

**Table 24: Comparing the structure of textbook in the two formats.**

	Paper format	Electronic format
Number of words	60 to 74 with image 94-110 without image	18 to 27 with image 34 to 45 without image
Number of lines	8 to 11	2 to 4
Number of pages	3 to 4	9 to 17

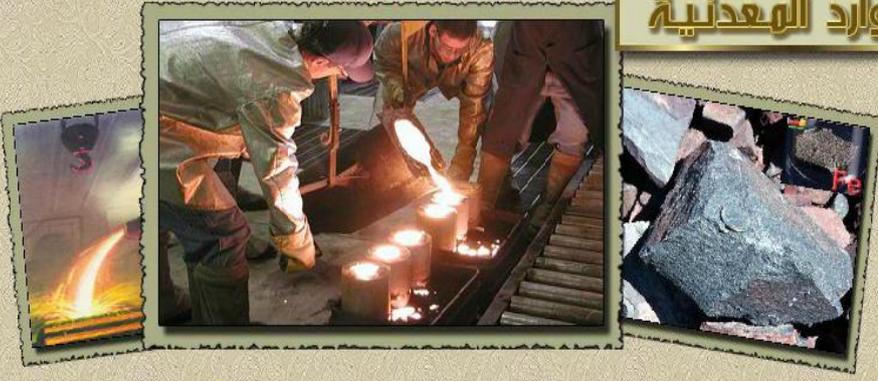
Figure 30 Text presented in the e- format of schoolbook.

skool comeg

مراجعة اختبار شرح

مشهد 3 من 7 الموارد الطبيعية في مصر - الموارد المعدنية

**الموارد المعدنية**



• **أولاً : الحديد :**  
 أهميته : يدخل في معظم الصناعات وهو أساس الصناعات الثقيلة .... يعتبر الحديد هو أهم المعادن علي وجه الإطلاق  
 وعليك النظر حولك عزيزي التلميذ فسوف تجد ان الحديد يدخل في أكثر من ٩٠٪ من الصناعات حولك  
 • أين يوجد الحديد في مصر ؟؟؟  
 • يوجد الحديد في ثلاث مناطق رئيسية وهي : - الواحات البحرية - شرق اسوان - الصحراء الشرقية  
 • ما هي أشهر مصانع الحديد في مصر ؟؟؟ -

حقوق النشر والتأليف محفوظة للتركة الدولية للنظم التعليمية

ES

Figure 31: Example of schoolbook for grade 5 in a page of the paper format.

**27 معركة القُرْضَابِيَّة**

كَانَ الْإِيطَالِيُّونَ قَدْ دَخَلُوا مَعْرَكَةَ الْقُرْضَابِيَّةِ بَعْدَ هَرِيمَةِ شَدِيدَةٍ لِحَقَّتْ بِهِمْ فِي وَادِي (( مَرْسِيَط )) سَنَةَ 1344 مِنْ مِيلَادِ الرَّسُولِ - صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ، مِمَّا جَعَلَ هَؤُلَاءِ الْمُسْتَعْمِرِينَ يَسْتَعِدُّونَ أَتَمَّ الْإِسْتِعْدَادِ، سَعْيًا وَرَاءَ اسْتِرْدَادِ مَحْدِهِمُ الْعَسْكَرِيِّ، وَكَرَامَتِهِمُ الْمَحْرُوحَةِ، وَهَيْبَتِهِمُ الَّتِي ضَاعَتْ؛ فَأَعَدُّوا حَمَلَةً كَثِيرَةَ الْعَدَدِ وَالْعَتَادِ، وَسَارَتْ مَعَ تِلْكَ الْحَمَلَةِ قُوَّةٌ لَيْبِيَّةٌ، فِيهَا بَعْضُ الرُّعَمَاءِ الْبَارِزِينَ، مِمَّنْ تَطَاهَرُوا بِالْوَلَاءِ لِلْقُوَاتِ الْإِيطَالِيَّةِ. وَعِنْدَمَا وَصَلَتِ الْحَمَلَةُ إِلَى الْقُرْضَابِيَّةِ الْقَرِيبَةِ مِنْ (( سرت )) فِي 1344 / 4 / 28، بَادَرَهَا<sup>(١)</sup> الْمُجَاهِدُونَ بِالْمُحْجَمِ، وَمَا كَادَتْ الْمَعْرَكَةُ تَبْدَأُ حَتَّى انْضَمَّتِ الْقُوَّةُ اللَّيْبِيَّةُ إِلَى قُوَّةِ الْمُجَاهِدِينَ، وَوَحَّدُوا صُفُوفَهُمْ، وَوَجَّهُوا جَمِيعًا ضَرْبَتَهُمْ إِلَى الْأَعْدَاءِ، مِمَّا أَدَّى إِلَى ارْتِبَاكِ<sup>(٢)</sup> فِي صُفُوفِهِمْ مِنْ هَوْلِ<sup>(٣)</sup> الْمُفْجَاجَةِ، وَتَلَقَّى

(١) بَادَرَهَا: عَالَمَهَا وَأَسْرَعَ إِلَيْهَا .  
 (٢) هَوْلٌ: فَزَعٌ وَأَمْرٌ شَدِيدٌ .  
 (٣) ارْتِبَاكٌ: اضْطِرَابٌ .

Moreover, a schoolbook print in two sizes, A4 [210mm (8.3in) × 297mm (11.7in)] and in mathematics and science which include a large number of images it is printed in C4 [229mm (9.0in) × 324mm (12.8in)]. However, the layout of the e- format was similar in all subjects as seen in Figure (32) which presents the layout of the main page, and Figure (33) displays the layout of the lesson's content.

**Figure 32: The layout of the main page.**

```

1 <html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">
2 <head>
3 <meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1" />
4 <title>skooool&#8482;</title>
5 </head>
6 <body bgcolor="#ffffff" style="margin:0px">
7
8 <object classid="clsid:d27cdb6e-ae6d-11cf-96b8-444553540000"
9 codebase="http://fpdownload.macromedia.com/pub/shockwave/cabs/flash/swflash.cab#version=
10 6,0,0,0" width="100%" height="100%" id="cm_standalone" align="middle">
11 <param name="allowScriptAccess" value="sameDomain" />
12 <param name="movie" value="cm_standalone.swf" /><param name="quality" value="high" /><param
13 name="bgcolor" value="#ffffff" /><embed src="cm_standalone.swf" quality="high"
14 bgcolor="#ffffff" width="100%" height="100%" name="cm_standalone" align="middle"
15 allowScriptAccess="sameDomain" type="application/x-shockwave-flash"
16 pluginspage="http://www.macromedia.com/go/getflashplayer" />
17 </object>
18 </body>
19 </html>

```

**Figure 33: The layout of the lesson's content.**

The screenshot shows the browser's developer tools with the 'Layout' tab selected. A box model diagram is displayed for an element, showing the following dimensions:

- Offset: 0
- Margin: 0px
- Border: 0px
- Padding: 0px
- Content: 1366 x 628

Coordinates: (208, 1) Z-index = 0

## **5.2.2. Population and selection of the sample for observation:**

In order to follow-up and investigate in-depth users' cognitive behaviours with eBooks, a sample of 40 participants—all of whom were considered more confident with eBooks and who answered the questionnaire—was selected and distributed as follows:

1. 14 males representing 35%; and 26 females representing 65%;
2. The age of participants was between 11 and 13;
3. The sample was distributed across the three study stages.

## **5.3. Data analysis:**

### **5.3.1. Using eBook and Paper Books in Primary Education:**

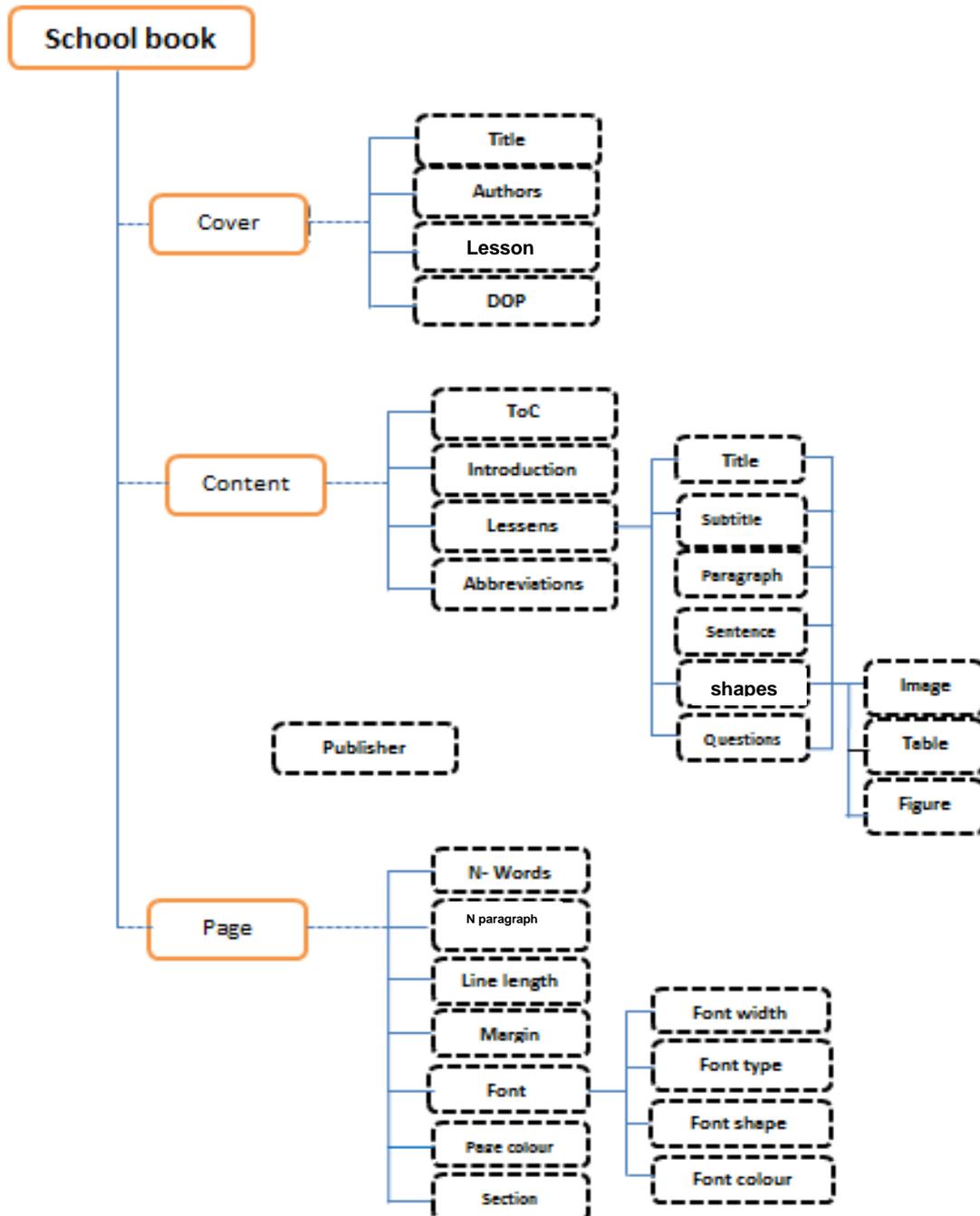
As was previously mentioned, a lot of evidence points to users preferring to use paper books rather than e- formats. There are several reasons for the low use of electronic text; one of these is the use of the same structure as the paper book. Therefore, the follow-up survey was selected to collect students' opinions and their interactions with both formats of schoolbooks, and analyse the structure of schoolbooks in order to obtain a clear understanding about the organization of such books and to identify the differences that lead to problems in the process of reading.

#### **5.3.1.1. Analysis of structure of school book:**

Schoolbooks differ from other types of resources by way of presentation of information, the amount of information, and the structure of the content. The author has examined a random sample from the schoolbook in order to identify the main combination of schoolbooks, and has provided a document model, as shown in Figure (34), which illustrates the document in a top-down method, complete with independent descriptions of the document elements. The document is expressed in a set of parts that start with the cover of the book which includes title, authors, education level (EL), and date of publication (DOP). The document's contents are divided into several parts. The text part is divided into many sections, such as the table of contents, introduction, abbreviation, and lessons. Each lesson component comprises several sections, and each section breaks down into paragraphs, with each paragraph combining sentences which

break down into words. Each lesson ends with questions that summarize the whole lesson. In addition, each document then comprises a hierarchical structure of abstraction levels, with each level representing elements in the document. The final part of the document is the back cover of the book which contains the name of the publisher.

Figure 34: The document in a top-down method.



However, the analysis of Libyan schoolbooks shows that all the schoolbooks' content, as shown in Figure (34), exhibits slight differences:

- The majority of the books' content in the first three levels comprises images, limited exercises, which mean the focus is on colour dynamics and flexibility.
- The books of years 4, 5 and 6 are completely different to those of other levels of education in many aspects, such as the technique in which information is offered and organised, the structure, and the amount and type of information.
- The number of words increases as the level becomes higher. The average text in a schoolbook for year 6 is more comparable to a schoolbook for year 4 and 5.
- There exist fundamental differences between a schoolbook and other sources of information used for academic purposes such as articles and reference books.

According to researchers, there is confirmation of the relationship between readers' attitude, reading purpose, text presentation, and reading behaviour, all of which should be defined in order to understand the way students interact with the text.

On the other hand, searching the literature on designing texts would seem to show that there is no particular order or rules to follow when designing electronic text which is usually dependent on the subject, purpose of the text, age of the reader, the size of the text, and screen size. Alternatively, the structure of e-learning material usually depends on what the education system is aiming to achieve. In many cases, learning material is presented as a package and mainly relies on such format to transmit understanding to the learner. This special structure of educational material requires from designers the creation of a method for displaying content which can help the learner access and define the relation between contents of various learning packages.

### **5.3.1.2. Students' attitudes toward the school book:**

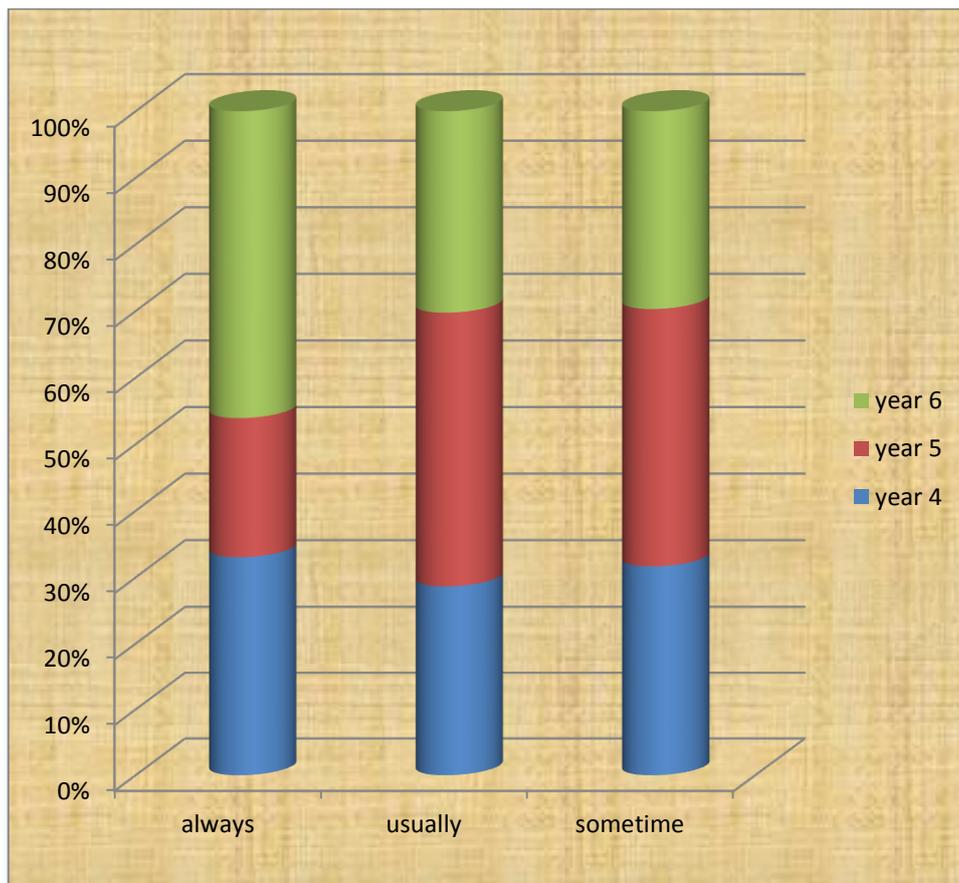
Understanding the students' attitudes towards schoolbooks and analysing their structure will lead to a good understanding of the most effective way of presenting a textbook online. Therefore, in this part of the research, students' attitudes in elementary school in Libya have been examined. Shape is one of the components of the textbook that is used as an instrument to assist in the learning process, so that the

location of the shapes should enable the reader to link texts and shapes. The quantitative data show that 42% of participants from different levels of education always use the shape in a schoolbook, whilst 15.4% of them use it only sometimes. Furthermore, there are slight differences between participants when using shapes, as participants in levels 4 and 6 (49.2%, 68%) are more dependent on shapes than students of level 5 (31.1), as can be seen in Table (25) and Figure (35).

**Table 25 : The average use of shapes in schoolbooks**

Year of education	Comparing text and shapes						Total
	Always		Usually		Sometime		
	Number	Percentage	Number	Percentage	Number	Percentage	
Year 4	66	49.2	48	35.6	20	14.5	134
Year 5	56	31.1	92	51.1	32	17.7	180
Year 6	92	68.6	72	37.6	26	13.6	190
Total	146	28.9	212	42.6	78	15.4	504

**Figure 35: The average use of shapes in schoolbooks.**

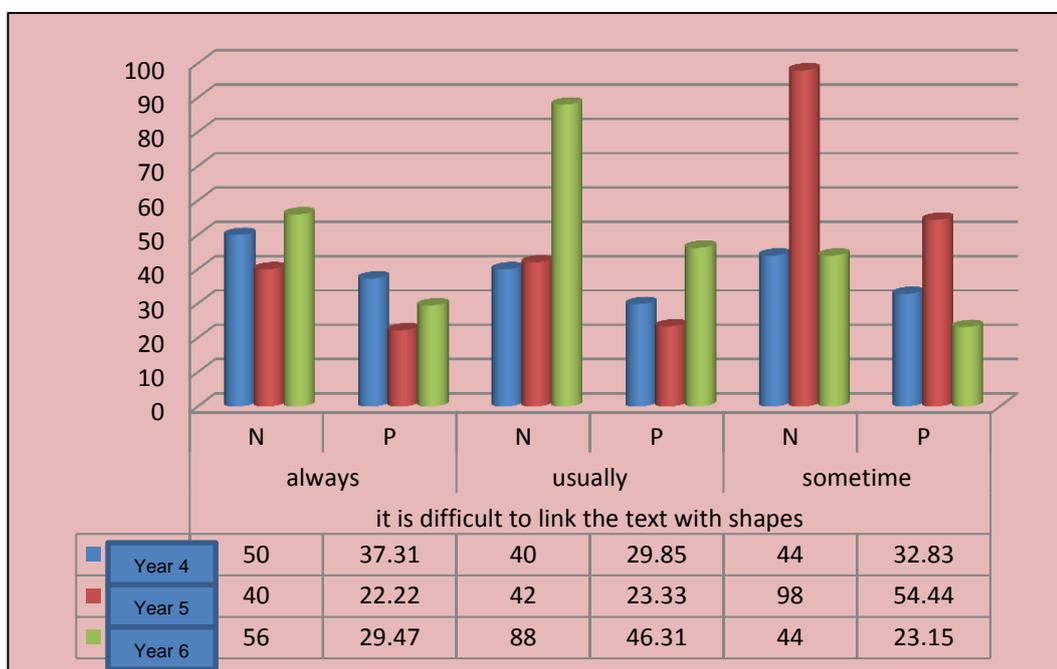


In order to define the suitability of a shape's location, participants were asked how easy it was to link the shape with a related text. 54.44% of participants in level 5 found linking shapes with text to be sometimes difficult in the paper format, while 46.3% of students in level 6 usually found it difficult to link text with shapes where the average number of words had increased in comparison with levels 4 and 5 (as seen in Tables 26 and figure 36). This difficulty appears when the graphic is located in different pages of the text. Therefore, a long line should be avoided when using graphic with texts, and pages should be divided into two parts using a short line.

**Table 26: The difficulty of making links between shapes and text.**

Year of education	It is difficult to link the text with shapes						Total
	Always		Usually		Sometime		
	Number	Percentage	Number	Percentage	Number	Percentage	
Year 4	50	37.31	40	29.85	44	32.83	134
Year 5	40	22.22	42	23.33	98	54.44	180
Year 6	56	29.47	88	46.31	44	23.15	190
Total	146	28.9	170	33.7	60	36.9	504

**Figure 36: Difficulty of making links between shapes and text.**



Moreover, students tend to write down the main elements of the lesson, which helps them remember the lesson for the next class, and this can also save up on students' time in exams, where 42.4% of participants always write down the basic elements of the lesson and 15.4% only do so sometimes. Furthermore, the survey

reports that there is a connection between the level of education and recording of the lesson's main elements, as can be seen in Table (27).

**Table 27: Writing down the main elements when finishing studying.**

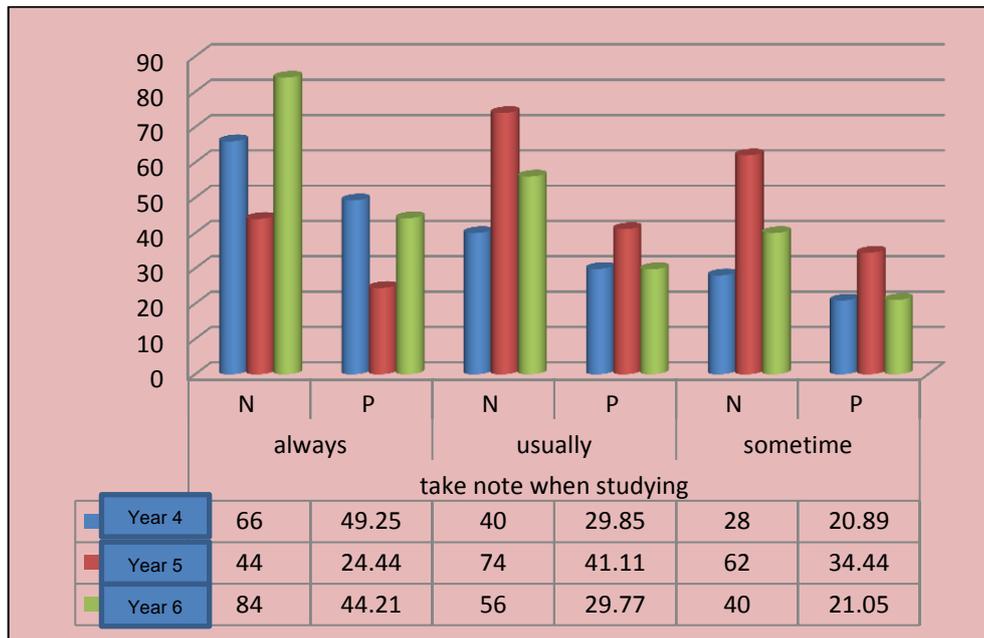
Education years	write the main element when finish studying						Total
	Always		Usually		Sometime		
	Number	Percentage	Number	Percentage	Number	Percentage	
<b>Year 4</b>	72	49.2	48	35.6	20	14.5	134
<b>Year 5</b>	126	31.1	92	51.1	32	17.7	180
<b>Year 6</b>	112	68.6	72	37.6	26	13.6	190
<b>Total</b>	214	42.4	212	42.6	78	15.4	504

In addition, taking notes was reported to be a key element in the reading process for learning. The type and amount of notes differ according to the reader's age and reading strategy. Generally, participants tend to take notes during reading schoolbooks, e.g. all participants take notes during reading with a difference in the average of the amount of notes and when they take those notes. As seen in Table (28) and Figure (37), 25.39% of students sometimes take notes while more than 70% of participants take notes. In addition, students in years 5 and 6 tend to take notes more than students in year 4. The survey also reported that 38.49% of participants always take notes when they are reading. The teacher has a significant impact in terms of encouraging students to record their observations during the lesson.

**Table 28: Taking notes when reading.**

Education levels	Take note when studying						Total
	Always		Usually		Sometime		
	Number	Percentage	Number	Percentage	Number	Percentage	
Level 4	<b>66</b>	<b>49.25</b>	<b>40</b>	<b>29.85</b>	<b>28</b>	<b>20.89</b>	<b>134</b>
Level 5	<b>44</b>	<b>24.44</b>	<b>74</b>	<b>41.11</b>	<b>62</b>	<b>34.44</b>	<b>180</b>
Level 6	<b>84</b>	<b>44.21</b>	<b>56</b>	<b>29.77</b>	<b>40</b>	<b>21.05</b>	<b>190</b>
Total	<b>194</b>	<b>38.49</b>	<b>170</b>	<b>33.73</b>	<b>128</b>	<b>25.39</b>	<b>504</b>

**Figure 37: Taking notes when reading.**



According to Table (29), the Table of Contents (TOC) is the only tool which is used to search the paper format of the school book, and the total number of students using the TOC was 54.7%, whilst 11.9% used it sometimes. Furthermore, students on Level 4 (13.4%) use the TOC less compared to students of years 5 and 6, where the teacher would tell students the page number of the lesson. Therefore, the survey reports that there is a relationship between using the TOC and the level of education, wherein the percentage increases as students increase their level of education.

**Table 29: Using TOC.**

Level of education	Using Toc						Total
	Always		Usually		Sometime		
	Number	Percentage	Number	Percentage	Number	Percentage	
Level 4	68	13.4	34	6.7	32	6.3	134
Level 5	94	18.6	78	15.4	8	1.5	180
Level 6	114	22.6	52	10.3	20	3.9	190
Total	276	54.7	164	32.5	60	11.9	504

In order to investigate the strategies of reading used by students, two questions were asked: ‘Do you read the lesson first?’ or ‘Do you read the questions first?’ Table (30) presents the reading strategy used in (PE). 65.8% of participants always read the lesson first and then answer the question, whereas 34.1% read the questions first. Usually, both strategies are used by students based on the purpose of the reading, e.g. if

the student is reading for an exam, he/ she will read just the questions, whereas if he/she was reading for understanding, s/he would then read the lesson first.

**Table 30 : Strategies of reading through a schoolbook.**

Strategies	Read the lesson first						Read the question first					
	Always		Usually		Sometime		Always		Usually		Sometime	
	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
Year 4	92	18.2	22	4.3	20	3.9	16	3.1	32	6.3	44	8.7
Year 5	104	20.6	50	9.9	26	5.1	88	17.4	60	11.9	32	6.3
Year 6	136	26.9	36	7.1	18	3.5	68	13.4	48	9.5	64	12.6
Total	332	65.8	108	21.4	64	12.6	172	34.1	140	27.7	140	27.7

Finally, students' satisfaction level is affected by several factors related to usability. Simplicity of presentation, clarity of structure, and ease of use are reported as the main factors affecting the usability of schoolbooks. In addition, students prefer viewing the text and graphics in parallel to reducing flipping between the pages which will increase their focus during the reading for this reason. Short line is the optimal line length for designing e-books for readers at this age.

## **5.4. Models of Reading Strategies**

In order to improve reading on-screen, student behaviours need to be studied at the first stage in order to define their reading process. This requires clarification of the reading stages which the student follows, and thereby to define the reading strategy used.

In this phase of the research, the Reader Response Theory (RRT) has been used to understand the interaction of students when reading school textbook in two formats (Hirvela 1996), where this theory was applied widely to exam human interaction as mention in section 2.4. Applying the theory with schoolbooks shows certain shortcomings, in that the theory mainly concentrates on three elements (text, reader, and author) while the reading process of a schoolbook includes a new element; teacher and parent. To fill this gap, a little modification was suggested by adding a new

element according to the analysis of the reader's act ( as illustrate in figure 8 in section 2.4).

Notably, it is clear that participants prefer the paper format to the e-format. For instance, 75% of participants found using the e-format very difficult, whilst 88% of participants could deal with the paper book easily. Navigation is another challenge which participants face in e-formats, with 91% of respondents finding the transition from one page to another difficulty, which in turn influenced the communication between the student and the teacher. On the other hand, 67% of participants found browsing the lesson easier in the paper version. Identifying the location of information in both versions was not easy, but was more difficult in the case of the eBook (74%) than the paper book (45%) as seen in Table (31).

**Table 31 : Participants' opinions about e- version of schoolbook compared to the paper version.**

	Electronic format		Paper format	
	Yes	No	Yes	No
Easy to use.	25%	75%	88%	12%
Can use without any help.	44%	66%	93%	7%
Easy to search.	9%	91%	67%	43%
Easy to find answers.	12%	88%	67%	33%
Sound help to learn	19%	81%	-	-
Easy to identify the location of information.	26%	74%	55%	45%

The survey reports that there are several scenarios used when reading a school book. These scenarios are based upon the purpose of using the school book: the schoolbook is always used at school or at home. In each case, the purpose of use is different.

- **Use at school:** at school, the teacher also directs students by telling them the page number, the lesson title, the number of questions, and so forth. These stages, in this case, were controlled by the teacher.
- **Use at home:** at home, some students get support from their parents, whilst others do not. In both cases, students use the schoolbook for two purposes: firstly, to memorise the lessons taught at school; or preparing for the next lesson. In the case of the latter, the teacher prefers comprehensive reading.

Notably, 34.1% of students simply read the questions when they have an exam. Thus, how students use the schoolbook changes according to where the book is read (at school or at home), and why they read it (extract information or read to learn). 15 actions (AC) were recorded on observation form, as seen in appendix (3) and as listed here below:

- **AC 1:** *Read the instructions.*
- **AC2:** *Identify a purpose for reading.*
- **AC3:** *Read through the questions.*
- **AC4:** *Skim the passage to have a general idea.*
- **AC5:** *Quickly read the whole passage.*
- **AC6:** *Read the whole passage quite slowly.*
- **AC7:** *Underline the key words in question*
- **AC8:** *Underline the key words in the passage.*
- **AC9:** *Underline the main idea of each paragraph.*
- **AC10:** *Scan the passage in order to find the key word.*
- **AC11:** *After finding the key word in the passage, read the text around it carefully.*
- **AC12:** *Connecting one part of the text to another.*
- **AC13:** *Take general notes.*
- **AC14:** *Re-reading.*
- **AC15:** *Anything else.*

Students show different attitudes when reading a schoolbook in both versions. As seen in Table (32), action 2 (AC2), action 3 (AC3), action 6 (AC6) and action 9 (AC9) were used by all students and the difference was only noted in the order of use between electronic text and paper text. For example, 95% of participants identify their aim before reading school e-textbook as searching for answers or reading for an exam. Reading through the questions is a popular action among students when reading for an exam. Students who use the e-text of a schoolbook found it is so hard to go through the text between the questions and the content of the lesson which led some of them to use a paper version to write down the questions. The left column in the table (32) presents the actions that recorded in the observation and the second column present type of the text ( electronic or paper format) while, top row of the table present the order of the step that follow when dealing with the text. For example, 16 students who read through

electronic text firstly identify a purpose for reading ( AC2) this may go back to difficulty to move from page to page in the electronic format of the text.

Moreover, it is notable that, students have more freedom when a reading paper format compared with students who read an electronic format. For instance, students cannot use their fingers or pencil when navigates electronic text as students who read through the paper where they put their fingers between page when move to a new page and return to the previous one.

**Table 32: Students' action when using a schoolbook in the two formats.**

<b>Actions</b>	<b>Type</b>	<b>Step 1</b>	<b>Step 2</b>	<b>Step 3</b>	<b>Step 4</b>	<b>Step 5</b>	<b>Step 6</b>	<b>Step 7</b>
<b>AC1</b>	<b>Electronic</b>	- <sup>6</sup>	-	-	-	-	-	-
	<b>Paper</b>	-	-	-	-	-	-	-
<b>AC2</b>	<b>Electronic</b>	<b>16</b>	-	-	-	-	-	-
	<b>Paper</b>	<b>9</b>	-	-	-	-	-	-
<b>AC3</b>	<b>Electronic</b>	<b>2</b>	<b>1</b>	<b>13</b>	-	-	-	-
	<b>Paper</b>	<b>4</b>	<b>4</b>	<b>8</b>	-	-	-	-
<b>AC4</b>	<b>Electronic</b>	-	<b>9</b>	-	-	-	-	-
	<b>Paper</b>	<b>5</b>	<b>2</b>	-	-	-	-	-
<b>AC5</b>	<b>Electronic</b>	-	<b>4</b>	-	-	-	-	-
	<b>Paper</b>	<b>1</b>	<b>3</b>	-	-	-	-	-
<b>AC6</b>	<b>Electronic</b>	-	-	<b>7</b>	<b>9</b>	<b>3</b>	-	-
	<b>Paper</b>	-	-	<b>4</b>	<b>8</b>	<b>7</b>	-	-
<b>AC7</b>	<b>Electronic</b>	-	<b>2</b>	-	-	-	-	-
	<b>Paper</b>	-	<b>4</b>	<b>2</b>	-	-	-	-
<b>AC8</b>	<b>Electronic</b>	-	-	-	-	-	-	-
	<b>Paper</b>	-	<b>2</b>	<b>5</b>	-	-	-	-
<b>AC9</b>	<b>Electronic</b>	-	-	-	-	-	-	-
	<b>Paper</b>	-	-	-	-	<b>5</b>	-	-
<b>AC10</b>	<b>Electronic</b>	-	<b>3</b>	-	<b>2</b>	-	-	-
	<b>Paper</b>	-	<b>2</b>	-	-	-	-	-
<b>AC11</b>	<b>Electronic</b>	-	-	-	<b>3</b>	<b>8</b>	-	-
	<b>Paper</b>	-	-	-	<b>5</b>	<b>5</b>	-	-
<b>AC12</b>	<b>Electronic</b>	-	-	-	<b>2</b>	-	<b>1</b>	<b>2</b>
	<b>Paper</b>	-	-	<b>3</b>	-	-	<b>6</b>	<b>5</b>
<b>AC13</b>	<b>Electronic</b>	-	-	-	<b>2</b>	-	-	-
	<b>Paper</b>	-	-	-	<b>7</b>	-	-	-
<b>AC14</b>	<b>Electronic</b>	<b>2</b>	<b>1</b>	-	-	-	<b>12</b>	-
	<b>Paper</b>	<b>1</b>	<b>3</b>	-	-	-	<b>9</b>	-
<b>Total</b>								

<sup>6</sup> Dash mean it is not use.

In addition, the survey reported that students use three strategies when reading the schoolbook: comprehensive strategy; skimming strategy; and scanning strategy. Using these strategies differs according to two elements: the aim of reading and the book type (electronic or paper). For example, using a scanning strategy in both formats is preferred when reading to extract information in order to answer questions (47%). Whereas, 80% of participants who use the eBook and 87.5% of participants who use the paper version prefer using a comprehensive strategy when reading the lesson for the first time.

Moreover, participants who used the eBook record a higher average in terms of time compared to students who used the paper book. This may be due to using a paper structured book without applying the tools to support the reading, e.g. the average comprehensive reading for the whole lesson in an eBook was 25 min. While doing the same task with a paper book would only take 15 min.

Furthermore, it is notable that using a comprehensive strategy was difficult in the case of reading an online text where the text is divided into various segments made for browsing back and forth and thus takes a longer time than the paper format. Moreover, there are no different records between the two formats when scanning or skimming the text. Table (33) shows the percentage using each strategy among students and the average time taken to read according to their selected approach.

**Table 33: The strategies used in different reading scenarios and the medium time.**

Reading strategies	e- format group						P- format group					
	Prepare lesson		Reading for discussion		Reading for answering questions		Prepare lesson		Reading for discussion		Reading for answering questions	
	Percentage	Time	Percentage	Time	Percentage	Time	Percentage	Time	Percentage	Time	Percentage	Time
<b>Comprehensive strategy</b>	80%	25M	25%	21M	10%	29M	87.5%	15M	7.5%	6M	-	-
<b>Skimming strategy</b>	7.5%	24M	32.5%	20M	42.5%	20M	2.5%	10M	37.5%	4M	32.5%	4M
<b>Scanning strategy</b>	12.5%	20M	42.5%	22M	47.5%	25M	10%	9M	55%	3M	67.5%	3M

Finally, during the reading it is noted that students used different techniques such as taking notes, highlighting text, writing the answers on the same page, or asking

questions. These techniques are affected by the reading scenario, e.g. participants using paper tended to take notes in the book when they read the lesson for the preparing the lesson or reading for discussion as seen in Table (34). In addition, highlighting words or concepts in the text is preferred by students as 89% of participants use this technique during reading. On the other hand, students who used the eBook version were not able to use this technique even though many wanted to try it. Also, the teacher tended not to let students use Microsoft Word for taking notes because this will not lead to improvement in handwriting or spelling which is necessary for students at this level of education.

**Table 34: Illustrating the techniques used by students during reading.**

Reading strategies	eBook group			P- book group		
	Prepare lesson	Reading for discussion	Reading for answering questions	Prepare lesson	Percentage	Reading for answering questions
	Percentage	Percentage	Percentage	Percentage	Percentage	Percentage
<i>Taking notes in the book</i>	-	-	-	73%	80%	3%
<i>Highlight words</i>	-	-	-	89%	89%	1%
<i>Write the answer in the school book</i>	-	-	-	10%	13%	93%
<i>Taking notes in notebook</i>	-	54%	72%	-	9%	5%

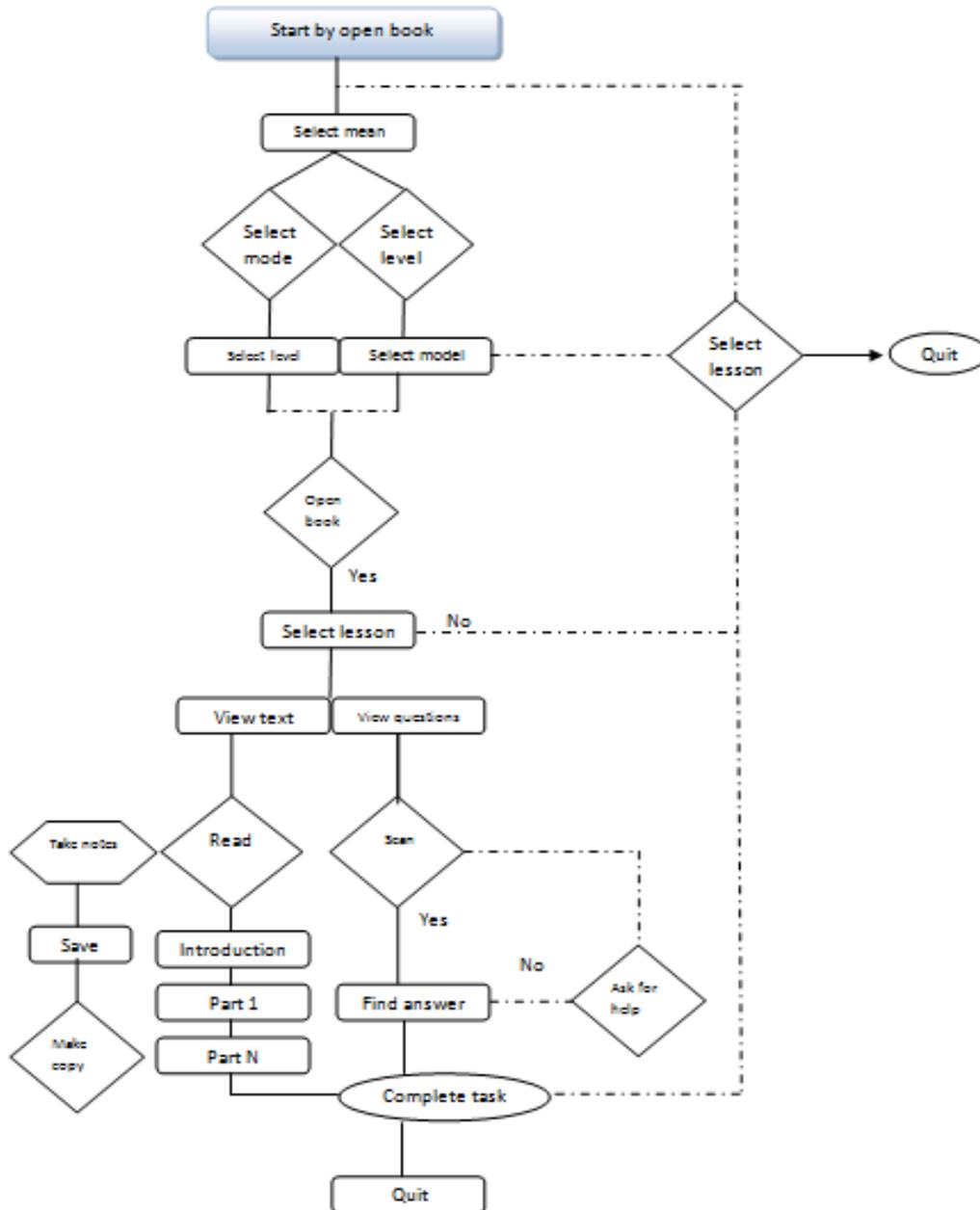
#### **5.4.1. Flow chart of reading process:**

Analysing the collecting data from the observation and that presented in section 5.4 two models for reading process were built; reading strategy for paper schoolbook format (RSPSBFM) and reading strategy for electronic schoolbook format (RSESBFM). These two models describe the student's attitude and action when dealing with schoolbook in different formats to provide formal and reusable models. Figure (38) summarises the schoolbook reading strategy used by students at school or at home, which starts with opening the book and skimming the table of contents (TOC). 54.7% of participants always use the TOC to access the lesson, whereas 11% of participants access the lesson via the page numbers when using the book at home.

In the case of using the book at school, usually the teacher tells students the number of the page, wherein 85% of students would not need to use the TOC. Subsequently, students usually check a lesson by identifying the subtitle, how long it

would take, and the number of questions before starting to read. This technique is also used when students read the lesson for the first time. In addition, when students decide to read the lesson, there are two ways to view the text, as the survey reports: either by viewing the text or viewing the questions. In each case, students use different reading methods. Moreover, dotted lines in the right of the figure (38) and (39) refer to return action.

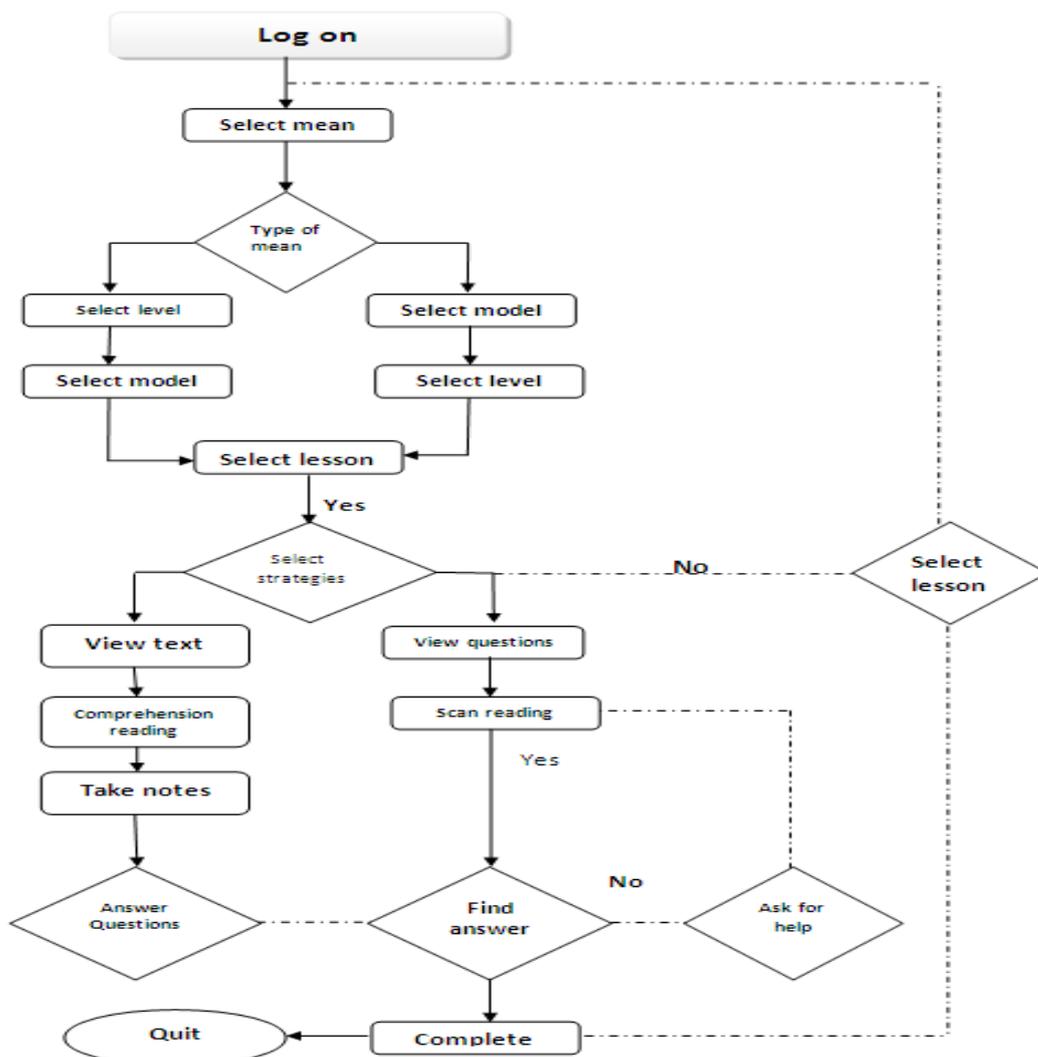
**Figure 38: model of Reading strategies for Arabic school book in paper format (RSPSBFM) (A. Abubaker & J.Lu, 2011).**



On the other hand, based on qualitative feedback, the e-reading strategy for the schoolbooks was built. Figure (39) shows a generic description of the e-textbook

reading strategy, which starts by viewing the homepage of the system. Subsequently, students can access the book by viewing the models and then selecting the level, or by otherwise viewing the education levels and then selecting the model. The first action will be opening the book. At this point, the student has two options: to view the text or to view the questions. In the case of viewing the questions, the students will have access to the questions which link the parts that include the answer rather than answering the questions, simply because the aim is to encourage students to read. Notably, if students select and view the text, they will then start with the introduction to the lesson before going through the lesson and learning the main bulk. Students can take notes and save those notes. This function was not available in the book used in this test where students used paper for taking notes during reading which confused them.

Figure 39: Reading strategy model of Arabic e-schoolbook (RSESBAFM) (A. Abubaker & J.Lu, 2011) .



Finally, there are no changes required to user needs when students read either the paper version or e-version of the schoolbook, but the change appears in the way that students interact with the material. However, the students' reading action changes in each format; this makes a difference in the overall reading process. For example, the page number is the main tool used by students to access the book's content in the paper version, but just 54% of participants use TOC, while in the eBook the number of pages does not support the reading process. On the other hand, in the case of the e-format, students' access the lesson by concept of the lesson. Thus, defining the reading process can help define searching and reading steps. During the searching stops, students frequently search for a title or subtitle, or question and answer; this requires searching the content for concepts and titles. In the reading stage, students exploit two reading strategies: scanning and comprehension strategies.

## **5.5. Conclusion:**

It is becoming clear from analysis of the quantitative and qualitative data that Libyan students' usability of schoolbook differs according to text format. This difference stemmed from the structure of the schoolbook and aims of use. In addition, these differences resulted in numerous requirements that should be understood by designers who ought to create functions that meet those requirements. The reading process is affected by the type of material and the aim of using the material, where the reading action and interaction changes in each version of schoolbook (electronic and paper format).

Generally, using the paper metaphor is not the correct way to represent the lesson in electronic format although a thorough investigation into user behaviour and the identification of their skills and requirements can ultimately help design an eBook interface which can cover all user needs. Students' satisfaction is affected by several factors related to usability. Simplicity of presentation, clarity of structure, and ease of use are reported to be the main factors affecting the usability of the schoolbook. In addition, students prefer viewing the text and graphics parallel to reducing flipping between pages which will increase their focus during the reading for this reason. A short line is the optimal line length for designing eBooks for readers in this day and age.

Finally, students use different actions when reading a schoolbook. These actions are affected mainly by the way the text is designed, while aim of use was reported as a second factor. Two models for reading process were built; reading strategy for paper schoolbook format (RSPSBFM) and reading strategy for electronic schoolbook format (RSESBFM). These two models describe the student`s attitude and action when dealing with schoolbook in different formats to provide formal and reusable models. In the next phase of study wills examine the relationship between text layout and reading strategy in order to provide principles for designing Arabic academic text online.

## **Chapter Six: Experiment (2)**

### *readable font size and type for display academic Arabic text on screen*

#### **6.1. Chapter Overview:**

The outcomes for the previous experiment in this research indicated that students' attitudes differ according to the way of presenting the text and text layout. As the aim of the study was to investigate the three main typographic variables [font size, font type and line length] we will start by font size and font type. Much research has highlighted the character size as a factor in visual display, and reported that font size has a significant effect on readability of texts in both versions. Therefore, defining a readable font size for the Arabic language is the main focus of this experiment, taking into account the effect of one dependent variable, four controlled variables and two independent variables: content length and font type. Students were required to make different judgments of letter pairs, thus indicating which letters were distinguishable. Based on the findings of this experiment, subsequent experiments were designed. In addition, the findings of this experiment will be able to address the issues related to reading Arabic text from screen by children in relation to the following:

**RQ1:** In which font size is the Arabic text read most effectively?

**RQ2:** Is there any correlation between age of the reader and font size?

**RQ3:** Which font type is more readable?

#### **6.2. Design interface:**

Taking into account the previous findings which show that there is a positive correlation between content's length and reading rate, the text used in the experiment

was divided into four parts, each part representing a separate window. In each test, different lessons were used, although all the lessons were taken from the reading school book for primary stage in Libya and the eight lessons discussed different subjects of general interest. In addition, the four windows have equal length (31 words per lines, 27 lines per text and non-margins).

The sentences were printed with black letters on white background. Four font sizes (10, 14, 16, and 18) were tested with two font types as shown in Table (35). Finally, the text in both conditions was presented in a single column..

**Table 35: show the structure of the text in each window.**

Test (1)	Test (2)	Test (3)	Test (4)
Black font	Black font	Black font	Black font
White background	White background	White background	White background
<b>Font size:</b> title : 18	<b>Font size:</b> title : 18	Font size: title : 18	<b>Font size:</b> title : 18
<b>Font size :</b> 10	<b>Font size:</b> 14	<b>Font size:</b> 16	<b>Font size:</b> 18
<b>Font type:</b> Traditional Arabic, Arial, Times new roman, Courier New and simplified Arabic	<b>Font type:</b> Traditional Arabic, Arial, Times new roman, Courier New and simplified Arabic	<b>Font type:</b> Traditional Arabic, Arial, Times new roman, Courier New and simplified Arabic.	<b>Font type:</b> Traditional Arabic, Arial, Times new roman, Courier New and simplified Arabic
<b>Display :</b> one Colum, Single space between lines	<b>Display:</b> one Column , Single space between lines	<b>Display :</b> one Column Single space between lines	<b>Display:</b> one Column, Single space between lines
<b>Word number:</b> 279	<b>Word number:</b> 191.	<b>Word number:</b> 275.	Word number: 254.

In addition, Table (36) shows an example of text layout using 10,14 16 and 18 points as font size and five font types. The total number of windows displayed in this experiment was four slides, dealing with a long text. All lessons were checked by the teacher to determine their suitability for the students' education level and all terms have been studied by students.

Table 36 Example of text layout using four different points as font size and five different font types.

Font type	Font size (10)
Simplified Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Time New Roman	أرسل الله تعالى نبيه إبراهيم إلى قومه
Arial	أرسل الله تعالى نبيه إبراهيم إلى قومه
Traditional Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Courier New	أرسل الله تعالى نبيه إبراهيم إلى قومه
	Font size( 14)
Simplified Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Time New Roman	أرسل الله تعالى نبيه إبراهيم إلى قومه
Arial	أرسل الله تعالى نبيه إبراهيم إلى قومه
Traditional Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Courier New	أرسل الله تعالى نبيه إبراهيم إلى قومه
	Font size (16)
Simplified Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Time New Roman	أرسل الله تعالى نبيه إبراهيم إلى قومه
Arial	أرسل الله تعالى نبيه إبراهيم إلى قومه
Traditional Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Courier New	أرسل الله تعالى نبيه إبراهيم إلى قومه
	Font (18)
Simplified Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Time New Roman	أرسل الله تعالى نبيه إبراهيم إلى قومه
Arial	أرسل الله تعالى نبيه إبراهيم إلى قومه
Traditional Arabic	أرسل الله تعالى نبيه إبراهيم إلى قومه
Courier New	أرسل الله تعالى نبيه إبراهيم إلى قومه

## 6.4. Experimental design:

### 6.4.1. Conditions of workplace:

The display medium was placed in a 140 cm-high table. The distance from the screen to the surface of the table was 100 mm. The distance of eye-to- screen was 500 mm. The screen inclination was 105. Moreover, participants all used the same (PE) Pavilion dv6 [Intel i5 core processors] laptop, with the choice of using a mouse

attached peripherally. The screen size of the laptop was 15.6 inches with a display setting of 1366 x 768 pixels. Internet Explorer 6.0 was used as the browser environment to present the test software and task.

#### **6.4.2. Procedure:**

Each student was tested individually, and each test lasted approximately between 30 to 40 minutes. Before starting the test, it was emphasised that participants should work as quickly and accurately as possible, and then the experimenter told them about the aim of the experiment. They were then asked to read aloud in order to measure their ability to read. The experiment was controlled using a digital watch with a precision of one second. Each lesson was timed separately using the same procedures. The experimenter noted how participants read the text and reported the difficulty faced by each student when reading. These comments were later used to interpret the quantitative data using the form in appendix (6). Following each lesson, and on a separate page, there was a question and answer sheet to test the accuracy of locating particular information. Finally, after reading and answering the task, students made their judgements about the different text layouts [different font sizes matching different font types] by answering a brief questionnaire which recorded their personal details combined with these three questions:

- Which characters are more difficult to read?
- Which font size is easier to read?
- Which font type is more legible?

Four font sizes tested; 10,14,16 and 18. The range of increase should be two and 14 was selected according to Asmaa, A. & A. O. Asma (2009) finding where she confirms that Arabic text can be read from size 14 for adult , thus, in the begging it used as the start point in test, but the researcher wanted to enrich the study by testing the difficulties that children face when reading electronic Arabic text in small size.

#### **6.4.3. Participants:**

30 students studying in a Libyan school in the UK volunteered as participants in the experiment. Their ages ranged from 10 to 12. There were 15 females and 15

males . As seen in Table (37), and 26 were studied in an English school for more than one year, and 9 were born in the UK but Arabic is their first language. Because of the cultural factor outside the scope of the study and that the most important factor is the reading level, The sample was selected from students living in the UK. Students were also classified based on education levels and reading scores which divided them into two groups; the first group included students who scored in reading course marks above 5 of 10 mean that they have a high level of reading, whilst the second group included students whose scores were less than 5 this group include students who has a low level of reading ( this is the using method to evaluate students in Libya school).

**Table 37: The sample size.**

Age	N	Total	Gender	
10	10	30	Male	15
11	10		Female	15
12	10			

Students were asked if they have vision problem when sending questionnaires to their parents, as seen in appendix (4). The questionnaire combines 6 questions which aim to make sure there are no problems with the vision of each participant.

#### **6.4.4. Study variables:**

A number of variables were recognized and outlined earlier to the implementation experiments. These variables are of three types; independent, dependent and controlled.

##### **Controlled variable:**

These variables expected to affect the experimental procedure;

- **Task and topic:** all students read the same text in both print and electronic formats of the school book in a different font size and types. The task was selected from the school book and was checked by the teacher to be sure there is no difficulties or new words.
- **Consistency:** the experiments were examined with the same students` age and education level. In addition, the same procedure was followed throughout the

process of the experiment as well using the same computer design and measurements.

- **Computer familiarity:** all the students were familiar with using the computer and were able to read online text.
- **Readers` vision:** all students did not have problems with the vision of each participant
- **Time:** in the experiment 1 student had a time range to complete each task in the classroom with monitoring from the teacher, while in experiments 2 and 3 students take as much time to finish the task.

#### **Dependent variable:**

The dependent variable was definitely at, time taken by each participant and number of correct answers.

#### **Independent variables:**

The independent variables were defined on, content length and font type.

#### **6.4.5. Statistical technique to analysis data:**

Several of the tests were used to answer the research questions of this phase:

- **Normality test:** in many statistical analyses, normality is frequently accepted before using the Friedman test. The normality test has been done using SPSS software to analyse the time and correctness of a data in this experiment, the final conclusion started here is that all variables are significantly non- normality distributed and non-parametric test Friedman test used to estimate and find out the differences in conditions ( Abuabker.A & Lu. J, 2012)..
- **Friedman`s ANOVE Test:** as mentioned in the earlier point above that all variables are non- normally distributed, the Friedman Test is used for testing differences between the four conditions. The same students have been used in all appearance using in all conditions. This test has been conducted again the time and correct answers for four conditions using the SPSS statistical software.

- **The Wilcoxon Signed- Rank Test:** this test is used in this experiment to know the condition in which the student performances are significantly better in comparison with others, where this test is based on the differences between scores in reading time and errors. Once these differences have been calculated they are ranked. For this reason, in this experiment each two condition has been tested separately.
- **Median:** it is the numerical value separating the higher half of a data sample, a population. It is used in this study because the distribution of the sample is unnormal.

## 6.5. Results:

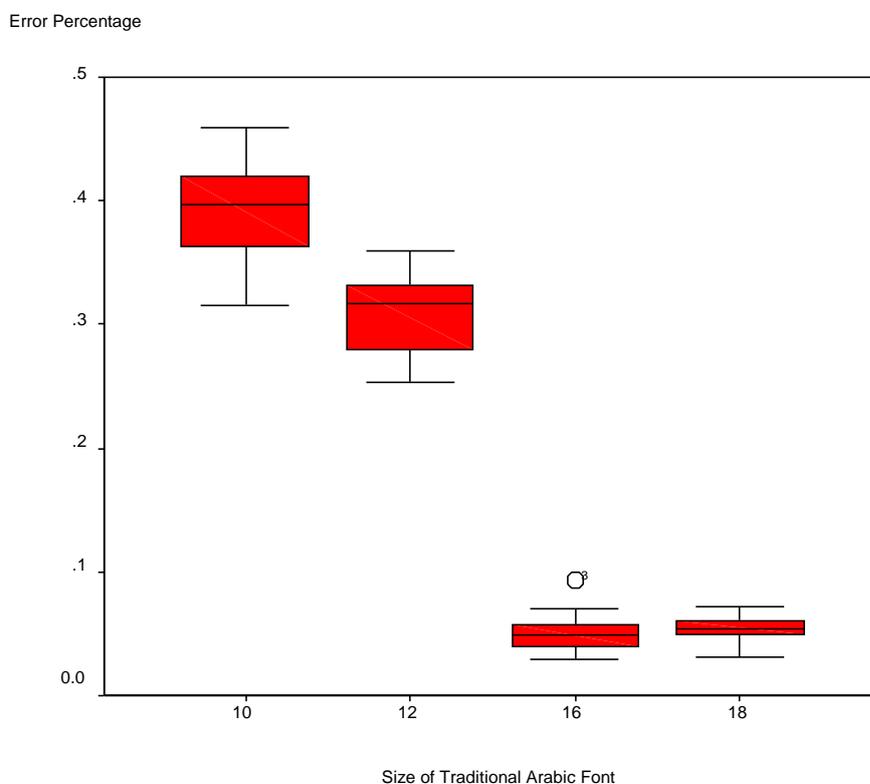
### 6.5.1. Reading performance of Arabic Traditional font:

According to Table (38), which demonstrates the results of descriptive statistics for the Arabic Traditional font in four sizes [10, 14, 16 and 18], it is obvious that the highest error is made by font size ten, and this is followed by sizes fourteen, sixteen and eighteen, respectively. Notice that since the distribution of each font group is found to be non-normal, we rely on the median as an indicator of error level. E.g., the medians for sizes ten and fourteen are .397 (about 39.7%) and .317 (about 31.7%), respectively, which are high. However, the error rate drops dramatically when the size of the font is increased to sixteen and eighteen, i.e. the errors for both fonts are .048 (about 4.8%) and .054 (about 5.45%), respectively. From Figures (40) and (41), we notice how substantial the differences between the size groups are, where it seems that the fonts of sizes sixteen and eighteen are more readable than any font smaller than sixteen. Based on the maximum values given in the table, it is worth mentioning that the error percentage in reading can reach 45.9% for size ten and 3.9% for size fourteen, which is remarkably high.

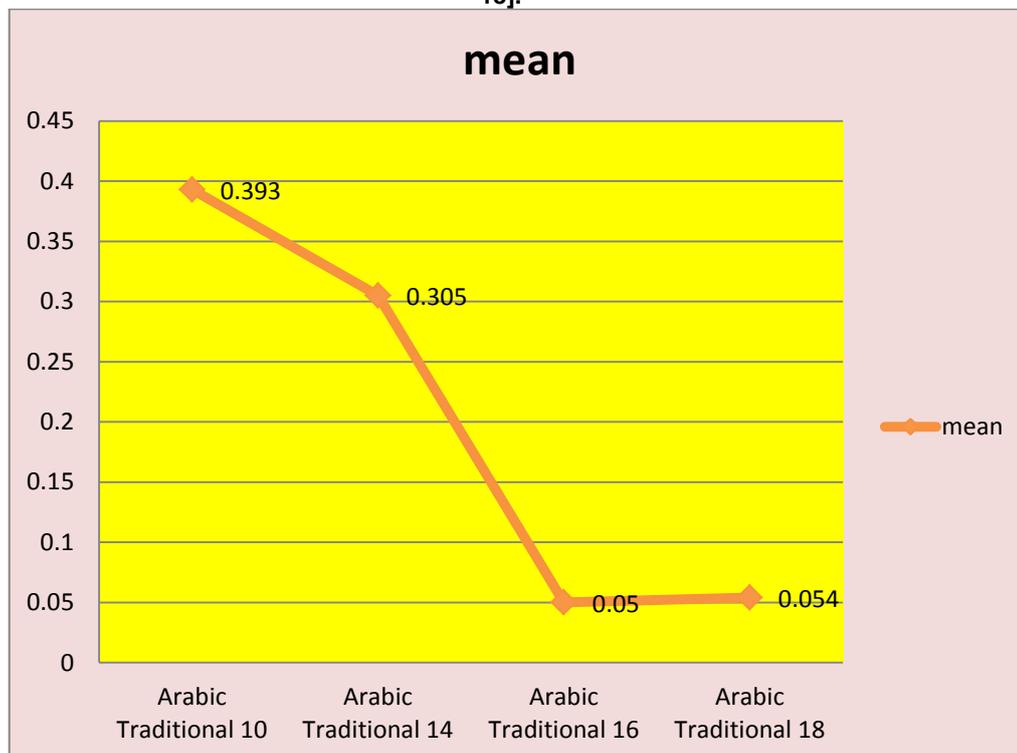
**Table 38: The results of descriptive statistics for the Arabic Traditional font in four sizes [10, 14, 16 and 18].**

Statistic	10 Traditional Arabic	14 Traditional Arabic	16 Traditional Arabic	18 Traditional Arabic
Mean	.393	.305	.050	.054
Median	.397	.317	.048	.054
Mode	.358	.322	.058	.054
Variance	.012	.001	.001	.000
Minimum	.315	.254	.028	.031
Maximum	.459	.390	.093	.071

**Figure 40** Boxplot of the error when reading the Arabic Traditional font in four sizes [10, 14, 16 and 18].



**Figure 41:** The mean error when reading the Arabic Traditional font in four sizes [10, 14, 16 and 18].



However, to investigate the relationship between the four sizes of traditional Arabic fonts and the error percentages resulting from using these sizes, the Friedman test was used to test the difference in median error for the four font sizes. The Friedman test indicated a strong difference in error percentages among the four groups ( $\chi^2= 82$ ,  $p\text{-value} < .001$ ) as seen in Table (39), which rejects the null hypotheses.

**Table 39: Error percentages among the four group font sizes using Friedman test.**

Font size	Mean rank	Chi-square	p-value
Ten	4.00	82	.000
Fourteen	3.00		
Sixteen	1.33		
Eighteen	1.67		

Next, follow-up tests will need to be conducted in order to evaluate comparisons between pairs of medians. The Wilcoxon test was applied as seen in Table (40). Using the Bonferroni adjustment for controlling adequately various types of error, the adjusted level of significance will be  $.05/6 = .008$ . Based on the adjusted p-value, the median error percentage of the Traditional Arabic font for size ten is significantly higher than the median error for sizes fourteen, sixteen and eighteen,  $p\text{-value} < .008$ . Also, the median error percentage for size fourteen is found to be significantly higher than the median error for sizes sixteen and eighteen. However, the median error percentage for size sixteen does not differ significantly from the median error for size eighteen. Notice that these two sizes show the lowest error made by the students at about .048 (4.8%) and .054 (5.4%), respectively.

**Table 40 : Pairs comparison using the Wilcoxon test in terms of the Traditional Arabic font groups.**

	10-14	10-16	10-18	14-16	14-18	16-18
<b>Z</b>	-4.782	-4.782	-4.782	-4.784	-4.782	-2.149
<b>p-value</b>	.000	.000	.000	.000	.000	.032

To measure the degree of association between age and gender with speed and error, Spearman's correlation is conducted for each font size. Based on Table (41), we observe that the age of students tends to have a negative correlation with speed; this means that as age increases, the time spent on reading decreases. The correlation becomes stronger as long as the font size becomes bigger. It is noticeable that all of the correlations are found to be significant. In terms of errors in reading, the data show that

for age the correlation is negative and significant for all font sizes. It is obvious that the correlation drops when the font becomes larger. In other words, age will have a low association with error if the font is large but one should bear in mind that this relationship is still significant, and hence should not be ignored. Alternatively, the results reveal that gender shows a very weak correlation with both speed and error. For measuring the correlation between speed and error, it is remarkable that a high speed of reading is positively combined with a high error rate. This may be attributed to the following: students who have a low level of reading will take a long time to finish the text and hence time will not lead to them reducing their error rate.

**Table 41: Spearman’s correlations between the variables using the Traditional Arabic font.**

	Ten		Fourteen		Sixteen		Eighteen	
	Speed	Error	Speed	Error	Speed	Error	Speed	Error
<b>Age</b>	-.302*	-.661***	-.603***	-.379**	-.775***	-.781**	-.664***	-.408**
<b>Gender</b>	-.055	-.127	-.019	-.402*	.070	.062	.027	.012
	<b>Speed</b>		<b>Speed</b>		<b>Speed</b>		<b>Speed</b>	
<b>Error</b>	.377*		.413**		.816**		.469**	

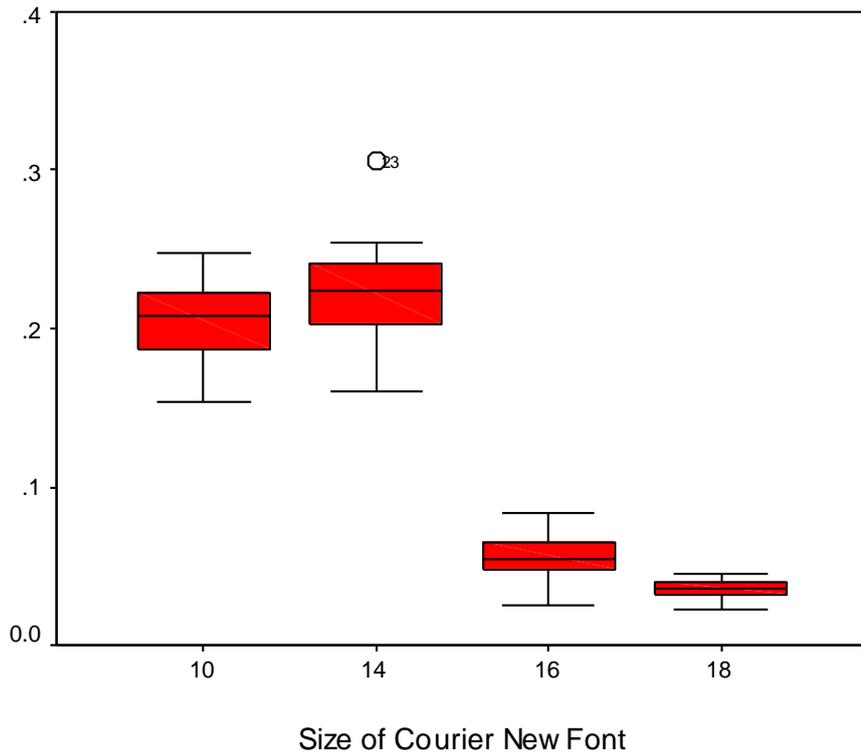
### 6.5.2. Reading performance of the Courier New font:

Courier new font was tested in 4 different sizes [10, 14, 16 and 18] wherein this font is widely used to present Arabic text. On the resulting statistics of reading in Courier New, the error in reading becomes smaller as the size of the font becomes bigger as seen in Table (42). However, the error made with size 14 is larger than that made with size 10; as mentioned earlier, this may be attributed to the relative text difficulty. The box plot given in Figure (42) indicates that fonts 10 and 14 are much closer to each other than fonts 16 and 18 which are much smaller. Also, the statistical data show that the distribution of the four sizes is somewhat asymmetric, and hence the Freedman test will be used.

**Table 42: Descriptive statistics for the reading error using four sizes of the Courier New font.**

Statistic	10 courier new	14 courier new	16 courier new	18 courier new
<b>Mean</b>	.205	.220	.0546	.0350
<b>Median</b>	.207	.223	.0546	.0350
<b>Mode</b>	.186	.202	.0482	.0370
<b>Variance</b>	.0005	.0008	.000	.0000
<b>Minimum</b>	.154	.1608	.0257	.022
<b>Maximum</b>	.247	.3055	.0836	.045

Figure 42: Boxplot shows the reading error using four sizes of the Courier New font.



Based on the results in Table (43), the Friedman test is found to be 83.84 with p-value < .000, indicating that there is a highly significant difference between the median errors of the four font sizes.

Table 43: Error percentages among the four group font sizes using the Friedman test when reading in Courier New font.

Font size	Mean rank	Chi-square	p-value
Ten	3.17	83.84	.000
Fourteen	3.83		
Sixteen	1.97		
Eighteen	1.03		

As a result, the Wilcoxon test is conducted; the results of this test are shown in Table (44). It is obvious that all pairs of font sizes result in a significant difference in reading error. We should mention that the difference between sizes 16 and 18 is noted to be highly significant here, while it is not so for the Traditional Arabic font.

Table 44: Pairs comparison using the Wilcoxon test in terms of Courier New font groups.

	10-14	10-16	10-18	14-16	14-18	16-18
Z	-3.795	-4.783	-4.782	-4.787	-4.782	-4.742
p-value	.000	.000	.000	.000	.000	.000

In terms of relationship, age supplies a good degree of significant negative correlation with error for all font sizes; namely, the older the student, the less mistakes s/he makes. Also, we notice that the speed of reading will be slower when the age is older. As a result, we can say that when a student becomes older, the concentration on reading will be better; and although taking a longer time to finish the text, the mistakes made will be lower. Gender is found to have a very weak relationship with speed and error, and hence it will be ignored when interpreting errors resulting from using the four sizes of the Courier New font. To see how speed correlates with errors, we observe from Table (45) that a high speed of reading will result in a somewhat high number of errors. All sizes of the font show a very similar degree of highly significant correlation.

**Table 45: Spearman’s correlations between the variables using Courier New font.**

	Ten		Fourteen		Sixteen		Eighteen	
	Speed	Error	Speed	Error	Speed	Error	Speed	Error
<b>Age</b>	-.781***	-.617***	-.711***	-.623**	-.692***	-.599**	-.328***	-.570**
<b>Gender</b>	.039	-.015	-.031	-.112	.004	-.193	.078	.167
	Speed		Speed		Speed		Speed	
<b>Error</b>	.674***		.688**		.618**		.651**	

### 6.5.3. Reading performance of Times New Roman font:

The Times New Roman font was the third font tested. The error percentage declined from 41.1% in size ten to 3.6% for size 18 using mean; a similar result is noted by the median. The error percentage can reach 50.5%, 28.3%, 9.7% and 5.1% for sizes 10, 14, 16 and 18, respectively, as seen in Table (46). The boxplot given in Figure (43) and Figure (44) displays how the apparent difference between the four sizes is great. According to the plot, high variability can be seen between the errors of size ten. Variability in error becomes smaller as the font size increases .

**Table 46: The results of descriptive statistics for Times new Roman font in four sizes [10, 14, 16 and 18].**

Statistic	10 times new Roman	14 times new Roman	16 times new Roman	18 times new Roman
<b>Mean</b>	.411	.257	.072	.036
<b>Median</b>	.403	.260	.069	.037
<b>Mode</b>	.358	.257	.064	.0400
<b>Variance</b>	.0028	.0004	.0001	.00007
<b>Minimum</b>	.323	.203	.055	.011
<b>Maximum</b>	.505	.283	.097	.051

Figure 43 : The results of mean for Times New Roman font in four sizes [10, 14, 16 and 18].

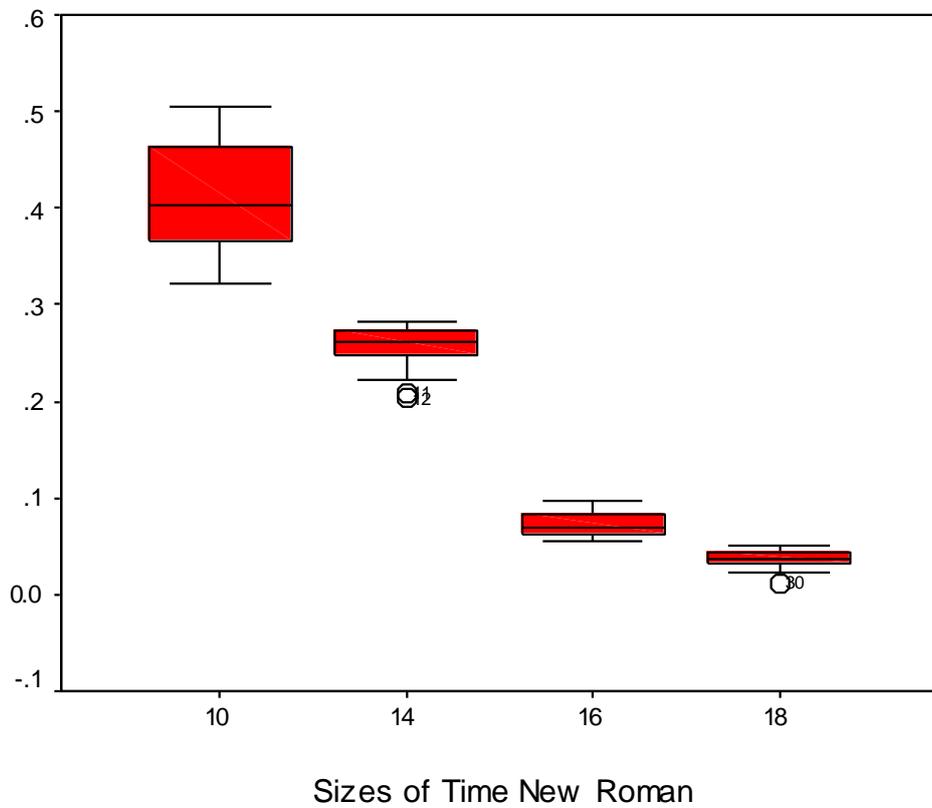
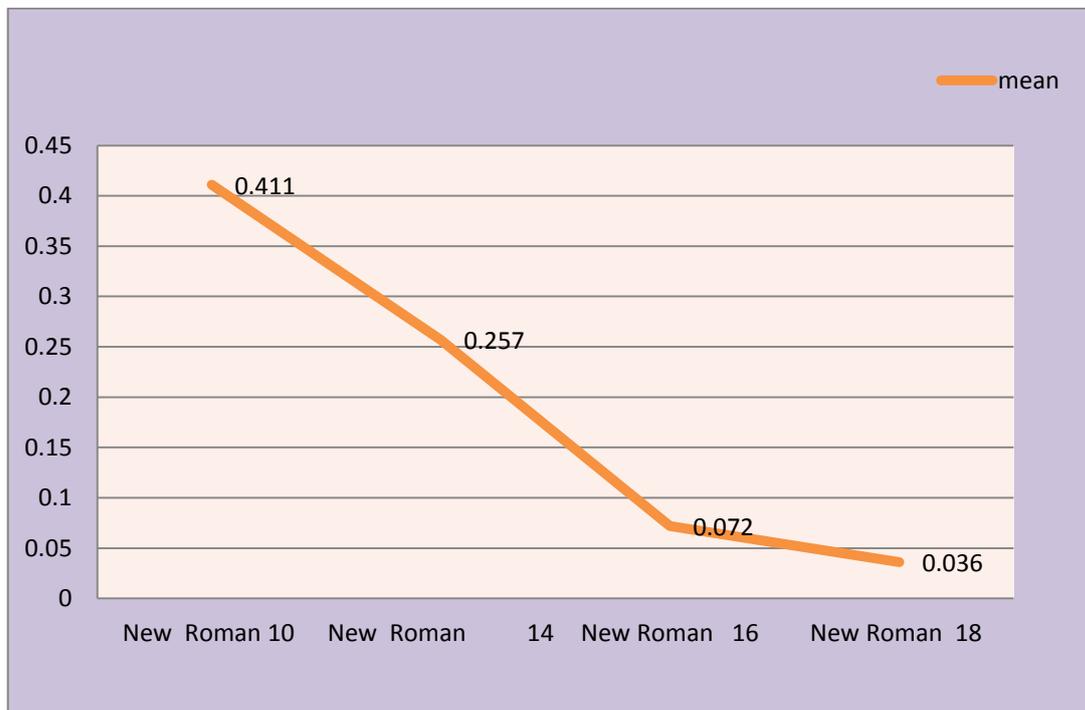


Figure 44: The results of mean for Times New Roman font in four sizes [10, 14, 16 and 18].



To determine the significant differences in errors among the four sizes, the Friedman test using mean ranks is found to be 90.00 with p-value <.0001, indicating that there is a very highly significant difference, see Table (47). Therefore, an error in reading made by the student will be highly affected by font size, namely, a low error rate can be observed by sizes 16 and 18. From the Wilcoxon test given in Table (48), we find that the difference between sizes 16 and 18 is highly significant, indicating that more significant reductions in reading errors can be achieved by size 18 than by size 16.

**Table 47: Error percentages among the four group font sizes using Friedman test.**

Font size	Mean rank	Chi-square	p-value
Ten	4.00	90.00	.000
Fourteen	3.00		
Sixteen	2.00		
Eighteen	1.00		

**Table 48: Pairs comparison using the Wilcoxon test in terms of Times New Roman font groups.**

	10-14	10-16	10-18	14-16	14-18	16-18
Z	-4.782	-4.782	-4.782	-4.788	-4.782	-4.782
p-value	.000	.000	.000	.000	.000	.000

Using Spearman's correlation in Table (49), age provides a negative association with both speed and error. The association is found to be significant for all font sizes but its degree is low for some sizes and high for others. Namely, error and speed will be low when age is older, wherein students sometimes guess the word from the order of the text. Similar to previous fonts, gender shows a very weak association and is thus not significant.

**Table 49: Spearman's correlations between the variables using the Times New Roman font.**

	Ten		Fourteen		Sixteen		Eighteen	
	Speed	Error	Speed	Error	Speed	Error	Speed	Error
Age	-.315*	-.727***	-.665***	-.501**	-.819***	-.154**	-.570**	-.494**
Gender	.090	-.104	.112	-.158	-.039	.035	.167	.252
	Speed		Speed		Speed		Speed	
Error	.455*		.554**		.218		.701**	

#### 6.5.4. Reading performance of Arial font:

Regarding the Arial font, it is clear from Table (50) that size 10 leads to the highest error rate (about 42.5% using mean) and longest time followed by sizes 14, 16

and 18, respectively. The resulting median leads to similar results given by the mean. The highest error percentage is 42.5% for size 10 whereas the lowest is 3.6% for size 18. Based on the maximum values, it is worth mentioning that the error percentage in reading for size 10 can reach as much as 54.1% while in size 14 it was 32.5%. Figures (45) and (46) show that the errors made by sizes 10 and 14 are very different from those made by sizes 16 and 18.

**Table 50: The results of descriptive statistics for the Arial font in four sizes [10, 14, 16 and 18].**

<b>Statistic</b>	<b>10 Arial font</b>	<b>14 Arial font</b>	<b>16 Arial font</b>	<b>18 Arial font</b>
<b>Mean</b>	.425	.301	.072	.036
<b>Median</b>	.434	.305	.073	.037
<b>Mode</b>	.462	.306	.061	.0370
<b>Variance</b>	.0041	.0003	.0002	.000003
<b>Minimum</b>	.326	.254	.048	.026
<b>Maximum</b>	.541	.325	.106	.046

**Figure 45: Boxplot of the errors when reading the Arabic Arial font in four sizes [10, 14, 16 and 18].**

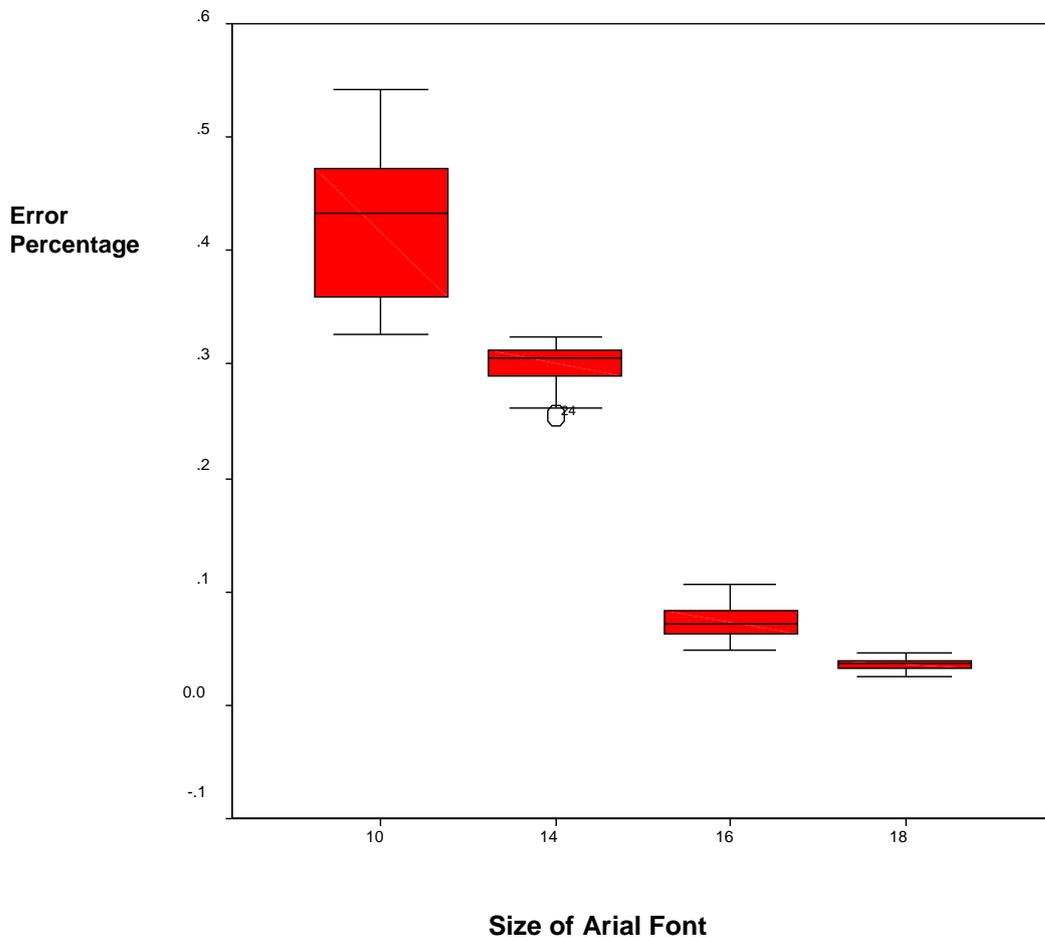
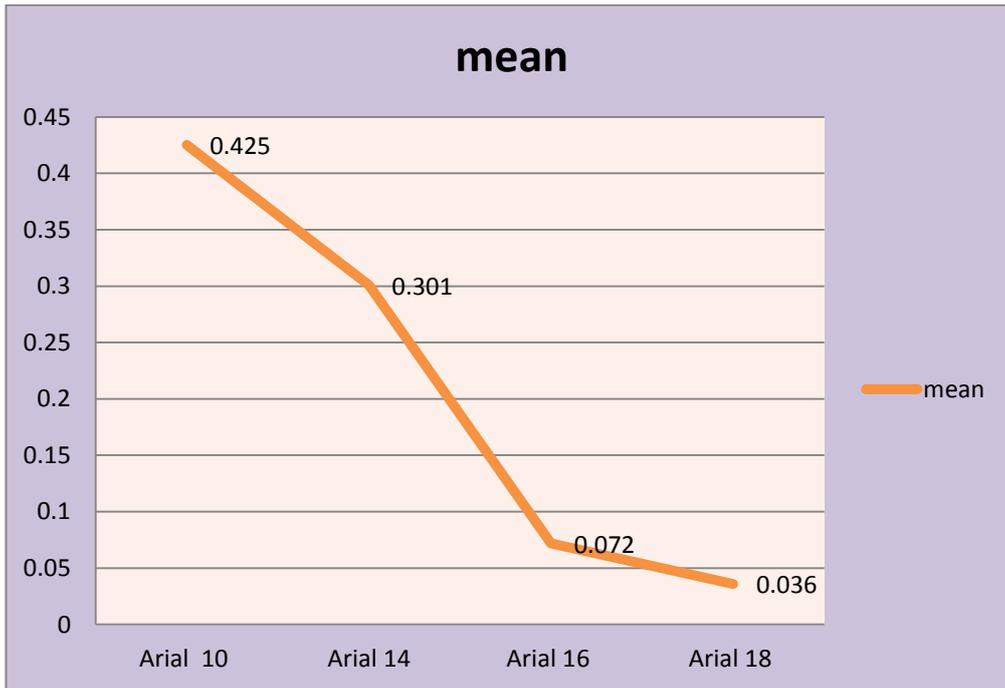


Figure 46: The means of the error when reading Arial font in four sizes [10, 14, 16 and 18.



Using the Friedman test shows that all the font sizes result in very highly significant differences in the median errors, as seen in Table (51). Comparing each two pairs of font sizes using Wilcoxon confirms that the differences between all of the pairs are highly significant which means that the reduction in errors is remarkable when the font size becomes larger, as seen in table (52).

Table 51: Error percentages among the four group font sizes using Friedman test.

Font size	Mean rank	Chi-square	p-value
Ten	4.00	90.00	.000
Fourteen	3.00		
Sixteen	2.00		
Eighteen	1.00		

Table 52: Pairs comparison using the Wilcoxon test in terms of Arial font groups.

	10-14	10-16	10-18	14-16	14-18	16-18
Z	-4.782	-4.782	-4.782	-4.785	-4.783	-4.783
p-value	.000	.000	.000	.000	.000	.000

In terms of association, Table (53), shows that speed and error for the majority of sizes are strongly and negatively linked with age. Gender does not reveal any interesting correlation with either speed or error although it shows the different directions of correlation with speed and error. For font sizes 10, 14 and 18, error is

highly and positively linked with speed, resulting in a very highly significant correlation, while for size 16 the correlation is found to be very weak. The reason for this may be attributed to the difficulty of the text. Generally, a low error rate is significantly correlated with a larger font and lower speed of reading.

**Table 53: Spearman's correlations between the variables using the Arial font.**

	Ten		Fourteen		Sixteen		Eighteen	
	Speed	Error	Speed	Error	Speed	Error	Speed	Error
<b>Age</b>	-.710***	-.760***	-.728	-.640	-.710***	-.133	-.625**	-.555**
<b>Gender</b>	.066	-.039	.008	-.046	-.116	-.182	.184	-.027
	<b>Speed</b>		<b>Speed</b>		<b>Speed</b>		<b>Speed</b>	
<b>Error</b>	.840***		.889***		.177		.765**	

### 6.5.5. Reading performance of the simplified Arabic font:

For simplified Arabic font, error seems to dramatically drop as demonstrated by the computed mean, median and mode given in Table (54). It is observed that a considerable reduction in the error percentage results from fonts of sizes 16 and 18, with mean percentages of 7.4% and 2.6%, respectively. This result is confirmed by the boxplot given in Figures (47) and (48) which present the mean reading error using four different sizes of Simplified Arabic font.

**Table 54: The results of descriptive statistics for simplified Arabic font in four sizes [10, 14, 16 and 18].**

Statistic	10 simplified Arabic font	14 simplified Arabic font	16 simplified Arabic font	18 simplified Arabic font
<b>Mean</b>	<b>.383</b>	<b>.145</b>	<b>.074</b>	<b>.026</b>
<b>Median</b>	<b>.364</b>	<b>.143</b>	<b>.075</b>	<b>.026</b>
<b>Mode</b>	<b>.358</b>	<b>.127</b>	<b>.084</b>	<b>.026</b>
<b>Variance</b>	<b>.0021</b>	<b>.0003</b>	<b>.0001</b>	<b>.00003</b>
<b>Minimum</b>	<b>.287</b>	<b>.119</b>	<b>.054</b>	<b>.017</b>
<b>Maximum</b>	<b>.484</b>	<b>.177</b>	<b>.093</b>	<b>.037</b>

Figure 47: Boxplot of the error when reading simplified Arabic font in four sizes [10, 14, 16 and 18].

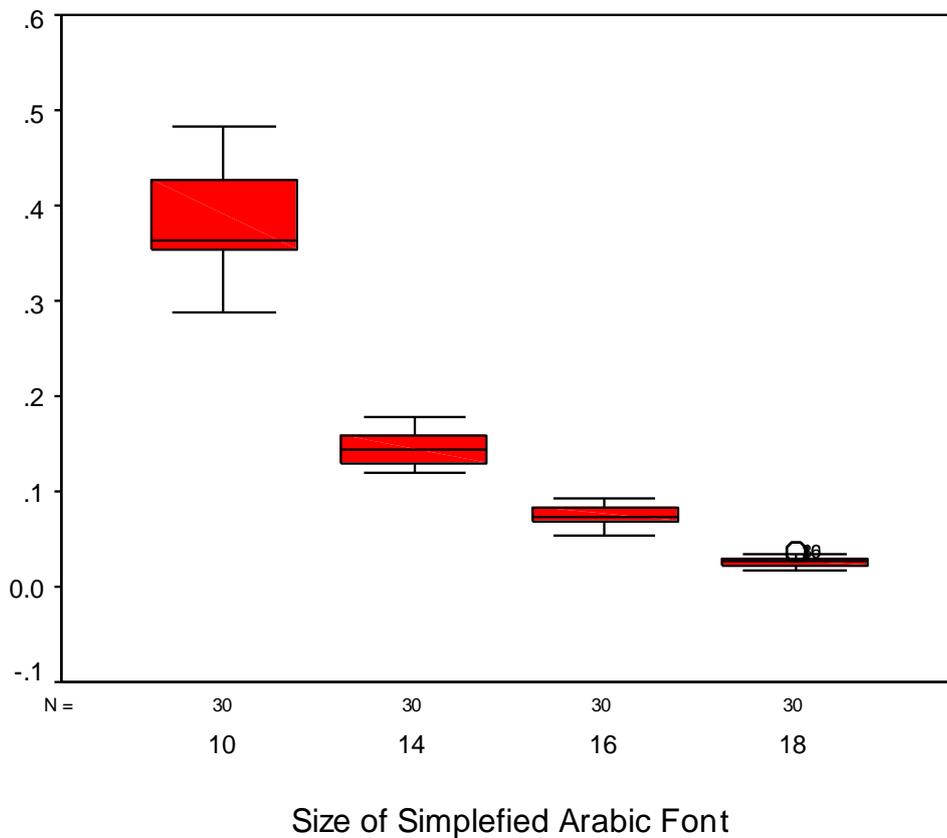
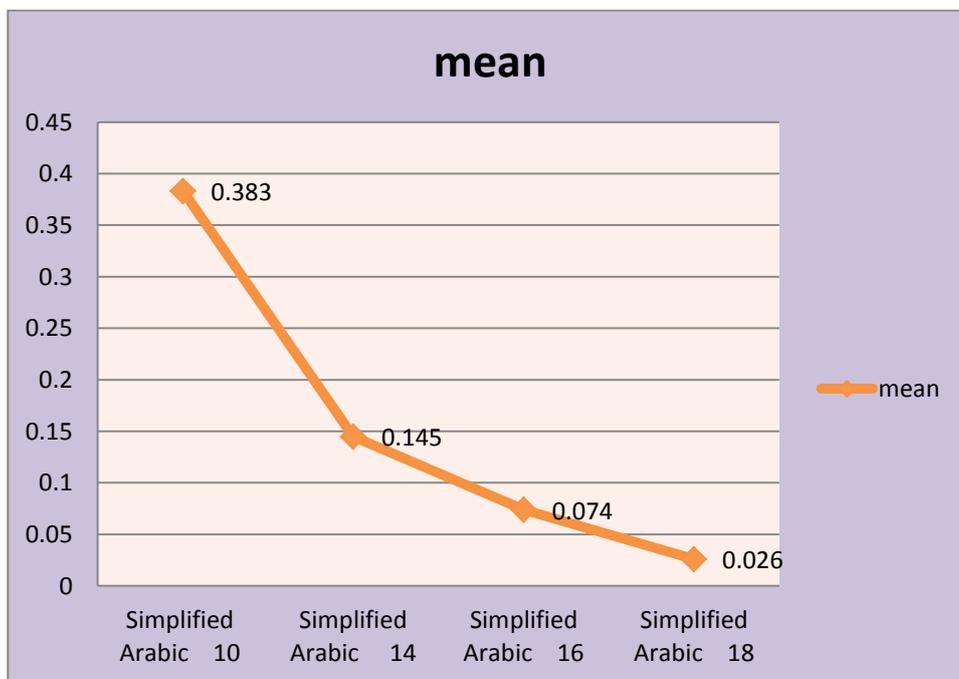


Figure 48: The mean error when reading simplified Arabic font in four sizes [10, 14, 16 and 18].



Similar to the aforementioned fonts, the Friedman test which is 90.00, as shown by Table (55), indicates a highly significant difference between errors resulting from

reading the four sizes of simplified Arabic fonts. The Wilcoxon test given in Table (56), shows a very highly significant difference is determined by each of the pairs of two font sizes. Hence, to reduce the percentage of reading error, it is better to use a larger font.

**Table 55: Error percentages among the four groups of font sizes using Friedman test.**

Font size	Mean rank	Chi-square	p-value
Ten	4.00	90.00	.000
Fourteen	3.00		
Sixteen	2.00		
Eighteen	1.00		

**Table 56: Pairs comparison using the Wilcoxon test in terms of simplified Arabic font groups.**

	10-14	10-16	10-18	14-16	14-18	16-18
<b>Z</b>	-4.782	-4.782	-4.782	-4.787	-4.783	-4.783
<b>p-value</b>	.000	.000	.000	.000	.000	.000

For Spearman's correlation, age tends to have a moderate correlation with speed and error of reading. But this correlation is highly significant and hence it is possible to say that when a student grows, the chances of reading errors occurring will be lower. By looking at gender, we do not observe any significant correlation with speed and error. In terms of the relationship between speed and error, the highest correlation which is .602, is obtained for size ten, then the correlation becomes somewhat weak for the rest of the sizes as seen table (57).

**Table 57: Spearman's correlations between the variables using Simplified Arabic font.**

	Ten		Fourteen		Sixteen		Eighteen	
	Speed	Error	Speed	Error	Speed	Error	Speed	Error
<b>Age</b>	-.488**	-.542**	-.645**	-.206**	-.580**	-.106	-.429*	-.483*
<b>Gender</b>	-.056	-.075	-.076	-.033	-.053	-.070	.204	.027
	Speed		Speed		Speed		Speed	
<b>Error</b>	.602**		.351*		.249		.471*	

### 6.5.7. Stratification of students:

At the end of the test, each student was asked to answer a short questionnaire (as seen in appendix 6) to determine whether the text is easy through answering eight questions. Finally, answering the short questionnaire shows that all students find words in the text to be easy. All mistakes that students make when reading the text are due to

a vision problem. In addition, all students do not have any problem reading from the screen or use a computer. Moreover, students aged 10 to 11 who represent 80% of the sample prefer size 18 as a readable size, while 4 students aged 12 found the text clearer to read in size 16 (20%). In addition, 30% of the participants recognized certain letters according to the position of the words. On the other hand, analysing the list of errors for each student in appendix (6) shows that the errors are mainly due to the shape of the characters. Data analysis led to the classification of these errors into four types:

- Two characters are connected in the middle and have dots at the top or bottom.
- More than two characters are connected in the middle and have dots at the top or bottom.
- Characters have dots and vowels.
- Characters without dots and with similar letters have dots.

Table (58) presents the case that readers made errors according to the shapes of the letters or words. Letters that have dot or more come on the top of the average of errors especially when the size of the words is small. Vowels also led to difficult to recognize on reading the letter that has dots, thus, test two factors recorded as main factors affected the readability of Arabic text in size 10 and 14.

**Table 58: The factors that have a negative effect on reading.**

Font size	Font type	Factors have a negative effect					
		Dots		Vowels and dots		Similarity between letters	
		N	P	N	P	N	P
<b>Test 1</b>							
10	<b>Traditional Arabic</b>	879	96.9	879	99.4	73	89
10	<b>Courier New</b>	733	88	774	92.9	65	77.9
10	<b>Times new roman</b>	820	98.3	830	99.5	78	93.8
10	<b>Arial</b>	826	99.5	815	97.8	73	87.9
10	<b>Simplified Arabic</b>	819	98.2	829	99.4	68	82.1
	<b>Total</b>	1000	100	1000	100	264	100
<b>Test 2</b>							
14	<b>Traditional Arabic</b>	618	61.8	258	25.8	56	21.2
14	<b>Courier New</b>	300	35.9	195	19.5	32	21.1

14	<b>Times new roman</b>	533	53.3	196	19.6	79	29.9
14	<b>Arial</b>	574	57.4	147	14.7	81	30.7
14	<b>Simplified Arabic</b>	605	60.5	135	13.5	39	14.8
	<b>Total</b>	1000		1000		264	
<b>Test 3</b>							
16	<b>Traditional Arabic</b>	107	10.7	79	7.9	64	24.2
16	<b>Courier New</b>	239	23.9	29	2.9	29	11
16	<b>Times new roman</b>	254	25.4	91	9.1	45	17
16	<b>Arial</b>	377	37.7	93	9.3	35	13.3
16	<b>Simplified Arabic</b>	594	59.4	87	8.7	16	6.1
	<b>Total</b>	1000		1000		264	
<b>Test 4</b>							
18	<b>Traditional Arabic</b>	39	3.9	23	2.3	8	3.03
18	<b>Courier New</b>	76	7.6	30	3	6	2.27
18	<b>Times new roman</b>	53	5.3	33	3.3	11	4.2
18	<b>Arial</b>	81	8.1	41	4.1	5	1.89
18	<b>Simplified Arabic</b>	97	9.7	25	2.5	3	1.14
	<b>Total</b>	1000		1000		264	

### 6.5.6. Reading speed:

Sequentially, age has been measured as an independent variable to define the optimal font size and type. According to Tables (59), (60), (61), (62) and Figure (50) which display the mean and standard deviation of all fonts in different sizes, a readable font size is different according to the age of the reader. E.g. the reading speed of students aged 10, when reading text presented using Arabic Traditional in size 18 ( $M=13.50/SD=2.76$ ), is longer than students aged 12 who read the same text in size 16 ( $M=8.20/SD=1.69$ ) by 55.67%. In addition, it is notable that the difference in reading performance between age groups 10 and 11 is similar in all font sizes and types. For instance, comparing the reading speed of students aged 10 in size 10 (Simplified Arabic) with students aged 11 shows a slight difference (3.6%). This convergence in the performance of students in ages 10 and 11 is clearly in sizes 10, 14 and 16. .

**Table 59: Mean and standard definition of all fonts in size 10.**

Age	TA		CN		TNR		A		SA	
	M	SD								
10	21.20	3.26	18.10	1.80	19.50	2.01	22.90	3.11	22.20	2.62
11	20.20	1.81	17	2.05	18.40	2.01	19.50	2.95	21.40	2.84
12	18.80	5.73	9.70	2.31	17.50	2.46	17.10	2.03	16.70	3.40

**Table 60: Mean and standard definition of all fonts in size 14.**

Age	TA		CN		TNR		A		SA	
	M	SD								
10	18.80	1.75	18.80	1.87	18.40	2.46	18.20	1.87	17.90	2.38
11	17.40	4.01	17.50	2.64	18.30	2	17.10	2.33	17	2.11
12	12.90	2.69	12.20	2.94	11.60	3.17	12.10	2.64	10.90	1.45

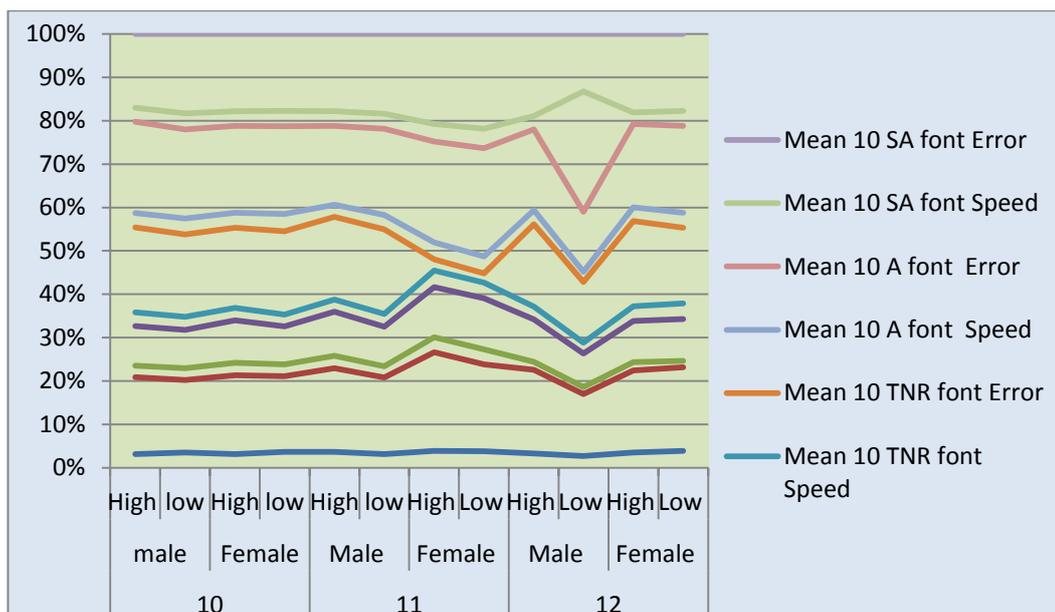
**Table 61: Mean and standard definition of all fonts in size 16.**

Age	TA		CN		TNR		A		SA	
	M	SD								
10	18	2.11	17.40	1.51	17.30	1.95	17.80	1.48	16.80	2.49
11	17.60	1.51	17.90	2.13	14.80	2.97	17.80	1.96	16.90	1.91
12	8.20	1.69	8.90	1.79	8.80	2.30	8.70	1.49	8.40	2.12

**Table 62: Mean and standard definition of all fonts in size 18.**

Age	TA		CN		TNR		A		SA	
	M	SD								
10	13.50	2.76	12.80	2.49	11.30	3.02	11.80	2.44	10.60	2.07
11	13.70	1.49	10.10	2.03	9.80	2.09	10	1.89	8.80	2.15
12	6.40	2.22	8.30	1.49	7.30	2.45	8	1.70	7.80	1.62

**Figure 49: comparing the mean reading error and speed in size 10 for the five font types.**



## **6.6. Conclusion:**

Defining a readable font size and type for the Arabic language is the main focus of this experiment. Five types (Arabic traditional, Arial, Times New Roman, Simplified Arabic, and Courier New) were tested in four different sizes (10, 14, 16 and 18). The experiment mainly reported that sizes 10 and 14 are not the best font sizes to read present Arabic characters for children aged 9 to 13, wherein the average error rate was higher. However, in font size 16, the average error rate decreased and the reading speed was also improved.

Moreover, age was reported as having a significant negative correlation with error for all sizes, while gender is found to have a very weak relationship with speed and error. On the other hand, examining the list of errors for each student shows that the difference in reading is caused by one of these reasons: (1) connecting two or more characters that have a dot at the top, bottom or middle; (2) characters have dots and vowels; and (3) characters have the same shape but some have dots others do not.

On the other hand, Gender is found to have a very weak relationship with speed and error, and hence it will be ignored when interpreting errors resulting from using the four sizes.

# **Chapter Seven: Experiment (3):**

## ***Optimal Line Length for Reading Electronic Schoolbook on Screen***

### **7.1. Chapter Overview:**

Although experimental studies have shown a strong impact of text layout on the legibility of e- text, many digital texts appearing in eBook or the Internet use different designs, so that there is no straightforward answer in the literature over which one to follow when designing e- material. Therefore, in this chapter we shall focus on the text layout, particularly the influence of line length. This experiment is divided into two parts. The first part focuses on the factor of line length by studying its effect on reading speed and accuracy using various columns [one column and two columns] with each page having the same amount of information. The second part tests a new approach which basically assumes that by using different colours for the first and last word of each line, it will improve students' reading level. This hypothesis was based on pervious findings over the difficulty of being able to immediately locate the following line (Chan and Lee 2005). In addition, this approach was based on explanation of the eye movement which, in the reading process, does not scan a line but stops for about  $\frac{1}{4}$  of a second before jumping to new place such as at the end of the line when the eye goes back to the beginning of the new line.

### **7.2. Hypothesis:**

The third experiment comprise seven hypothesis to be measured in order to define optimal line length for reading a school book using two reading strategies these hypothesis are;

H1: the efficiency of line length will be different in terms of time taken to search the same tasks.

H2: the efficiency of line length will be different in terms of number of correct answers made in each type of question.

H3: there will be a difference between the single line (SL) without colour, double line (DL) without colour, single line (SL) with colour and double line (DL) with colour in terms of the users` satisfaction.

H4: line with colour is more readable than a line without colour in terms of easy to search.

H5: line with colour will be more effective than line without colour in terms of reducing the frequency of incorrect answers.

H6: reading strategies affect the line length in terms of shortening task accomplishment time.

H7: reading strategies, readers` age and reading level are more effective than gender in terms of users` stratification.

### **7.3. Design interfaces:**

Four interfaces were designed to test. These were segmented according to the number of columns and colour. The instructional module interface was designed for experimenting using Microsoft`s expression web software. Each test had two different interfaces. Each web text module was designed in the light of the recommendations given in the literature and controlled by two independent variables: (1) line length; (2) type of questions. All the sentences were extracted from a lesson in the Libyan schoolbook. The lessons had no extremely rare words, such as names of people or exotic places, technical terms or unusual mechanisms. Table (63) shows the attributes of the experiment and the observed elements.

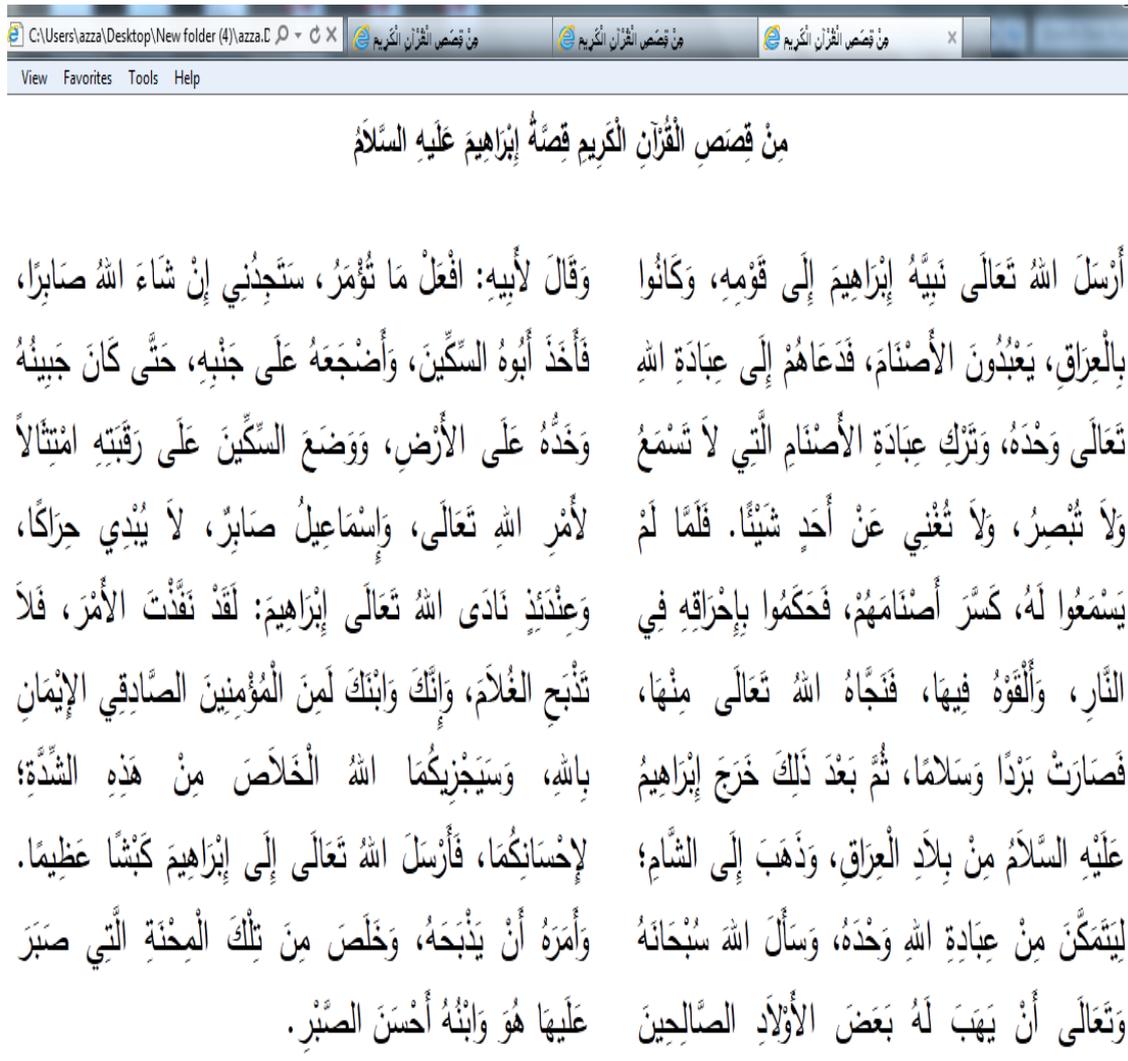
Table 63: show the experiment design.

Attributes	Observed elements	Applied to interface
Body text	Font size, line length, colour of text.	Black font+ right alignment+ two and single column+ ..... Words. Words per a line.
Background	Colour	White
Margin	Larger than 2.5 inches.	
Type of question	Information recall and reading faster.	Multi choices, open questions and true and false.

#### First text interface: double column without colour (DLWOC)

A total of 19 Arabic sentences was used in the experiment. The length of the text was between 10 to 15 words (as seen in figure 50). A total number of words approximately were 80 words using vowels.

Figure 50: The experiment interface for text display in a short line.



### Second text interface: double column with colour (DLWC)

The way of presenting the text in this interface is similar to the previous interface in the number of words and lines. But the interface provided text by using red colour for the first and last word of each line (as seen in figure 51).

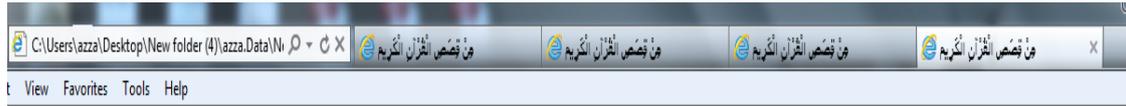
Figure 51: The experiment interface for text display in short line using red colour for increased legibility of online text.



### Third text interface:

A total of 19 Arabic sentences was used in the experiment. The length of the text was between 8 and 12 lines, the number of words per line in one column was between 23 and 26 (as seen in Figure 52).

Figure 52: The experiment interface for text display in a long line.



## من قصص القرآن الكريم قصّة إبراهيم عليه السلام

أرسل الله تعالى نبيه إبراهيم إلى قومه، وكانوا بالعراق، يعبدون الأصنام، فدعاهم إلى عبادة الله تعالى وحده، وترك عبادة الأصنام التي لا تسمع ولا تبصر، ولا تعني عن أحد شيئاً. فلما لم يسمعوا له، كسر أصنامهم، فحكّموا بإخراجه في النار، وألقوه فيها، فنجاه الله تعالى منها، فصارت برداً وسلاماً، ثم بعد ذلك خرج إبراهيم عليه السلام من بلاد العراق، وذهب إلى الشام؛ ليتمكّن من عبادة الله وحده، وسأل الله سبحانه وتعالى أن يهب له بعض الأولاد الصالحين فبشره الله تعالى بولادة ابنه إسماعيل، وقال: إنه سيكون خليماً عاقلاً .

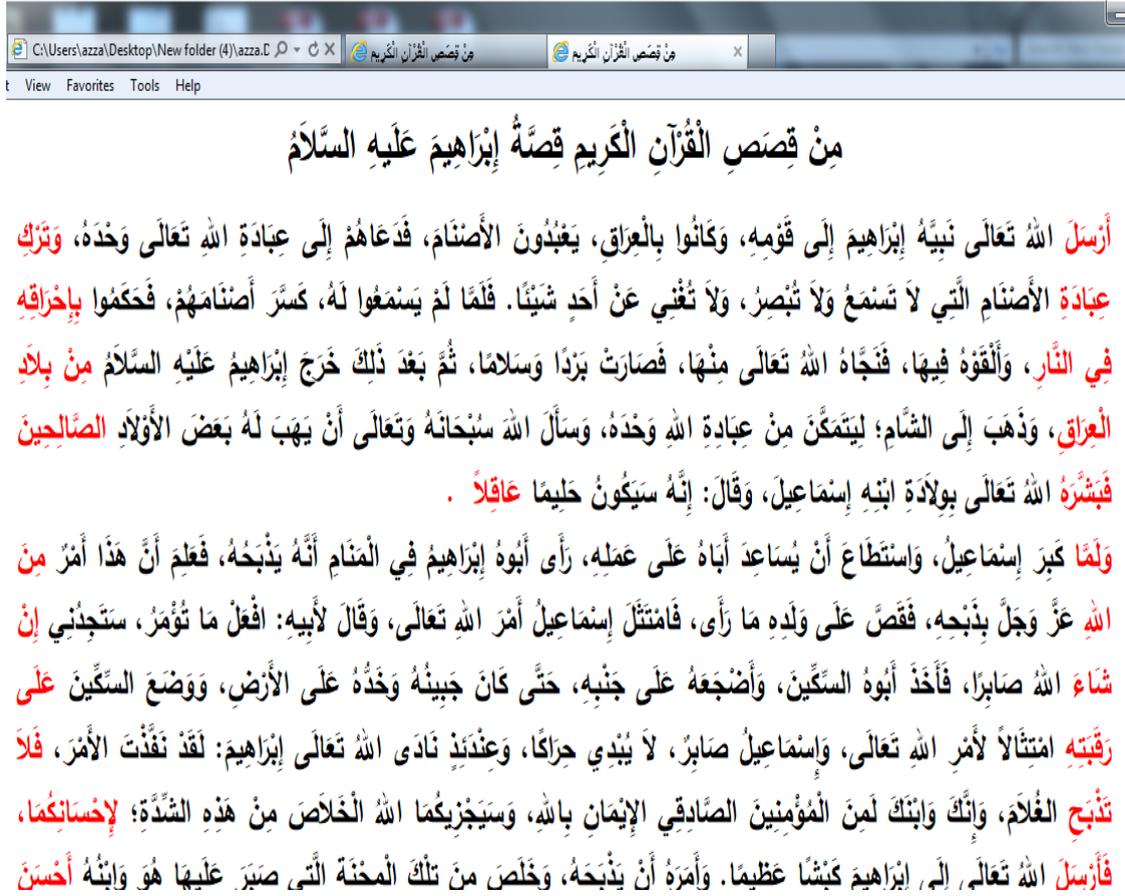
ولما كبر إسماعيل، واستطاع أن يساعده أباه على عمله، رأى أبوه إبراهيم في المنام أنه يذبحه، فعلم أن هذا أمر من الله عز وجل يذبحه، فقص على ولده ما رأى، فامتثل إسماعيل أمر الله تعالى، وقال لأبيه: أفعل ما تؤمر، ستجدني إن شاء الله صابراً، فأخذ أبوه السكين، وأضجعه على جنبه، حتى كان جبينه وحده على الأرض، ووضع السكين على رقبته امتثالاً لأمر الله تعالى، وإسماعيل صابراً، لا يبدي جراكاً، وعندئذ نادى الله تعالى إبراهيم: لقد نفذت الأمر، فلا تدبح الغلام، وإنك وابنك آمن المؤمن الصادق الإيمان بالله، وسيجزيكما الله الخلاص من هذه الشدة؛ لإحسانكما، فأرسل الله تعالى إلى إبراهيم كبشاً عظيماً. وأمره أن يذبحه، وخلص من تلك المخنة التي صبر عليها هو وابنه أحسن الصبر.

وقال إني ذاهب إلى ربّي سيهدين ربّ هب لي من الصالحين فبشرناه بغلامٍ حلیم فلما بلغ معه السعي قال يا بني إني أرى في المنام أنّي أدبحك فانظر ماذا ترى قال يا أبت أفعل ما تؤمر ستجدني إن شاء الله من الصابرين فلما أسلما وتلّه للجبين وتنادياهُ أن يا إبراهيم قد صدقت

### Forth text interfaces:

The interface was designed to present in a single column using red color for first and last word in each line ( as seen in figure 53).

Figure 53: The experiment interface for text display in a long line using red colour for increased legibility of online text.



## 7.4. Experimental design:

### 7.4.1. Procedure:

Each participant was seated in a closed room environment facing the laptop. All participants used the same PH Pavilion dv6 [Intel i5 core processors] laptop, with the choice of using a mouse attached peripherally. The screen size of the laptop was 15.6 inches with a display setting of 1366 x 768 pixels. Internet Explorer 6.0 was used as the browser environment to present the test software and task. Because of the age of the students, the observer sat behind the participants to record time and encourages them to continue with the experiment and take notes. Participants scanned the tasks in four conditions [one column with colour and without colour, two columns with colour and without colour] in looking for answers to 12 questions (Appendix 7).

Performance was assessed through two dependent variables: (1) time to complete each task; and (2) accuracy of the answers. Accuracy data were based on the

number of correct answers the students provided and the total score was 12 points. In this experiment, satisfaction was measured as a dependent variable using the questionnaire. The questionnaire has 8 questions with a response as yes or no or no difference. The satisfaction questions relate to how easy it was to read the text or recall information in it. In addition, disorientation is expected to measure user perceptions towards ease of searching the lesson, becoming lost in the text, and being comfortable with the text layout.

#### **7.4.2. Participants:**

The test sample of this experiment consisted of 48 native Arabic students (24 male and 24 female) who volunteered for this experiment. The participants' age ranged from 9 to 13. They all used the computer and the internet. Participants were divided into four groups and each group read from the same text presented in different conditions (as seen in table 64). 29 of the participants had participated in the previous experiment ( font size and type), while 19 participants taking part for the first time.

**Table 64: the size of the sample.**

Gender	One column	Two columns	Total
Female	12	12	24
Male	12	12	24

#### **7.4.3. Study variables:**

A number of variables were recognized and outlined earlier to implementation experiments. These variables are of three types; independent, dependent and controlled.

#### **Controlled variables:**

There is variable expected to affect the experimental procedure. These variables are summarised as followed;

- The tasks were the same for all users.
- The level of difficulty of the subject matter was the same.

- Reading scour; high level or low level [ student scour according to their score in reading in Libya school while low level students who get low than 5 in reading exam].

#### **Dependent variables:**

The dependent variable was defined in;

- Time spent searching for answers.
- Number of correct answers.
- Satisfactions.
- User reaction (use their fingers, scrolling....).

#### **Independent variables:**

Three types of questions were defined as independent variables [open questions, True and false questions and multi answer]. Each type used to apply to investigating the reading strategies that were used.

#### **7.4.4. Statistical technique for the analysis of data:**

The following are the results of using three types of questions with respect to the answer speed (time) needed to finish each type and the corresponding errors in the answers. Four descriptive statistics, which are mean and standard deviation (SD) as well as minimum and maximum values, are calculated. It is expected that age, reading level and gender may lead to different speeds and errors. Therefore, Kruskal Wallis' one-way analysis of variance test is used to compare ages, while the Mann-Whitney test for assessing whether two independent samples are equal is used to compare (1) gender and (2) reading levels. In addition, the Friedman test and Wilcoxon test will be conducted to test the difference between the question models. Spearman's correlation will be used to measure the correlation between the underlying measurements. The results are organized according to questions with colours and those without colours.

### **7.5. Data analysis:**

#### **7.5.1. Comparing reading performance using single and double column:**

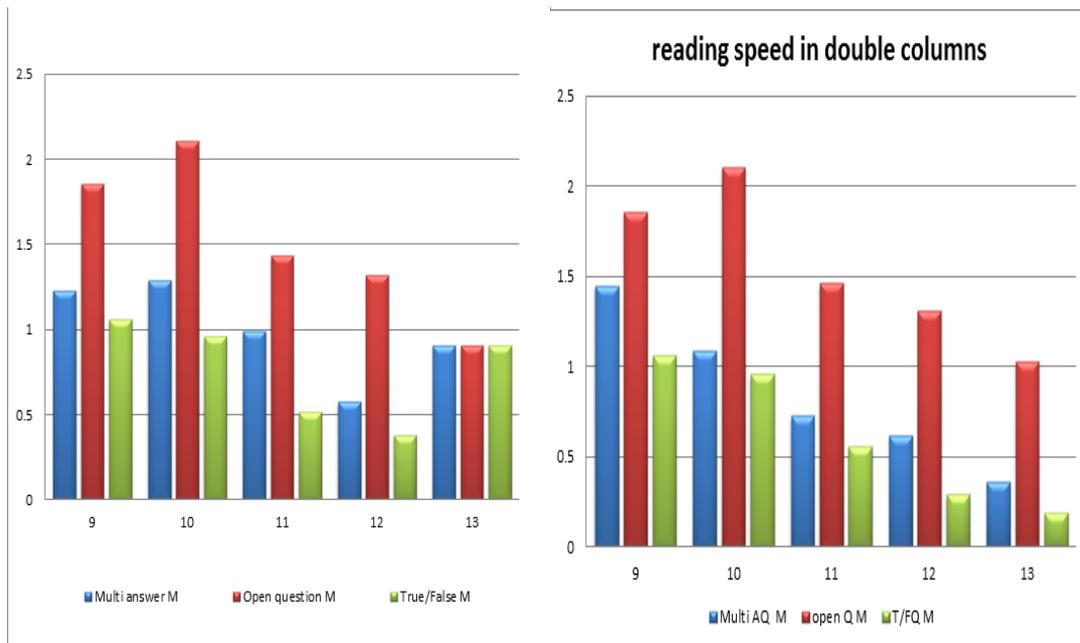
### 7.5.1.1. Reading times:

Reading times were measured for the best line length in each reading strategy, i.e. skimming or scanning. The collected data show that the computed time seems to decrease as long as students' age increases when reading through single and double columns. This finding is to be expected since age in the early stage of education affects the reading speed. Otherwise, students tend to show a different speed when answering the three types of questions. For example, the comparison between the mean reading speed to answer multi answer question [MAQ] from reading text on a single column with double line shows that the reading process is affected by the students' age, as older students were faster when reading through double lines, while students aged 9 prefer the single line in both reading processes. In addition, the mean reading time of students aged 13, 12 and 11 when reading a single line was [.905, .575, and .988] respectively, while in the double lines it was [.360, .614, and .723] in the same order. Thus, students who read the entire text searching for specific words prefer to use a double line, e.g. the mean reading speed of the entire text by older students [13 years old] was less when reading the text in a double line [MAQ/ M= .360 and true/ false question (T/FQ) M .185] and [MAQ/ M= .905 and T/FQ/ M= .905] than in double columns, as can be seen in Table (65) and figure (54).

**Table 65: The average reading time for three different types of questions in two different line-lengths according to the reader's age**

Age		Single column						Double column					
		Multi Answer		Open question		T/F question		Multi Answer		Open question		T/F question	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
9	Speed	1.226	.153	1.857	.445	1.061	.074	1.446	.338	1.858	.445	1.061	.0742
10	Speed	1.29	.157	2.105	.469	.957	.294	1.083	.165	2.105	.469	.957	.294
11	speed	.988	.325	1.432	.343	.514	.271	.723	.314	1.461	.346	.555	.313
12	speed	.575	.230	1.317	.298	.378	.363	.614	.235	1.305	.129	.290	.075
13	speed	.905	.905	.905	0	.905	0	.360	0	1.030	0	.185	0
<b>Kruskal-Wallis test</b>		Chi=10.601 p-value=.014		Chi=5.430 p-value=.066		Chi=9.292 p-value=.010		Chi= 11.443 p-value=.010		Chi= 7.703 p-value=.053		Chi= 13.193 p-value=.004	

**Figure 54: presenting a mean for testing three types of questions and reading through single and double columns**



The reading level of students, as defined by the teacher, was considered as an independent variable. The collected data shows that the reading speed of students with a low-level of reading was less when reading a single column according to the mean reading time ( $m = .921, 1.643, .726$ ) as presented in tables 66 and 67 and Figure (55). Students prefer long line because they can see a whole sentence in the same line but they face difficulty when dealing with a sentence that is broken up into two lines. Thus, displaying a complete sentence in one line is preferred by students compared to displaying it in a short or long line. In addition, short line was preferred by students with a high level of reading. This finding is in line with the findings of Dyson and Haselgrove (2001). For the multi answer model, it seems that students with low level need more time when reading a short line than those with a high level, even though according to the median test where  $Z=1.89$  with  $p\text{-value}=.068$ , the preference is statistically not accepted. The same pattern is observed for the open question model, but this difference in median between both levels is statistically significant. No obvious difference in the True/false model between the two levels needs to be mentioned. This finding confirms that reading speed is influenced by the reading strategy used by the reader.

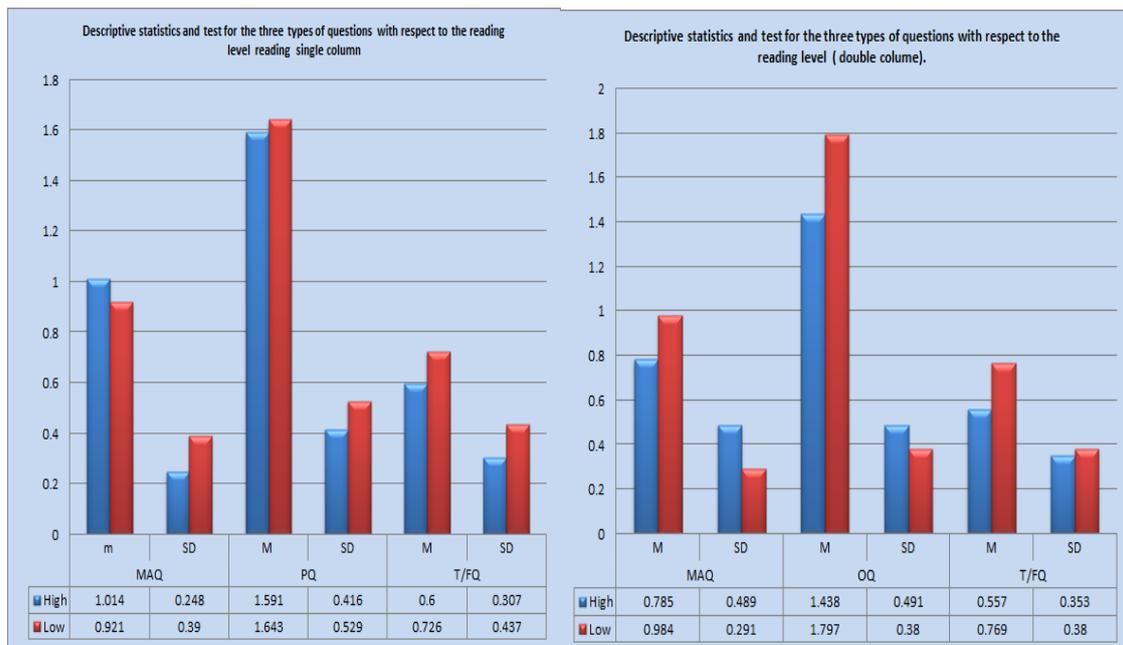
**Table 66: Descriptive statistics and test for the three types of questions with respect to the reading level (single line).**

Reading level		Multi answer (MAQ)				Open question (OQ)				True/False (T/FQ)			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
High	Speed	.515	1.380	1.014	.248	1.220	2.390	1.591	.416	.280	1.115	.600	.307
Low	Speed	.360	1.365	.921	.390	.795	2.380	1.643	.529	.180	1.220	.726	.437
Mann-Whitney	Speed	Z'=-.231 p-value=.817				Z=-.231 p-value=.817				Z= -.433 p-value=.665			

**Table 67: Descriptive statistics and test for the three types of questions with respect to the reading level (double lines).**

Reading level		Multi answer (MAQ)				Open question (OQ)				True/False (T/FQ)			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
High	Speed	.300	1.950	.785	.489	.795	2.390	1.438	.491	.180	1.115	.557	.353
Low	Speed	.555	1.310	.984	.291	1.315	2.380	1.797	.380	.280	1.220	.769	.380
Mann-Whitney	Speed	Z= -1.89 p-value=.068				Z= -2.309 p-value=.020				Z= -1.357 p-value=.178			

**Figure 55: The average reading time for three different types of questions in two different line-lengths according to the reading level.**



The number of studies which considered gender as a strong demographic variable that influences information behaviour (e.g.Hupfer and Detlor 2006; Liu and Huang 2007). Little difference in mean time was reported by testing differences in responses to question models due to gender. When looking at the differences in responses to the question models between genders reading short line, male and female tend to show very little difference in descriptive statistics. Based on average speed, males are somewhat better than females with regard to the multi answer and true/false

<sup>7</sup> - Z is scores are measures of standard deviation.

questions, whereas females are better with regard to the open question. The Mann-Whitney test does not find any significant difference, and hence both males and females are expected to share more or less the same level of performance, see Table (68 and 69) and Figure (56).

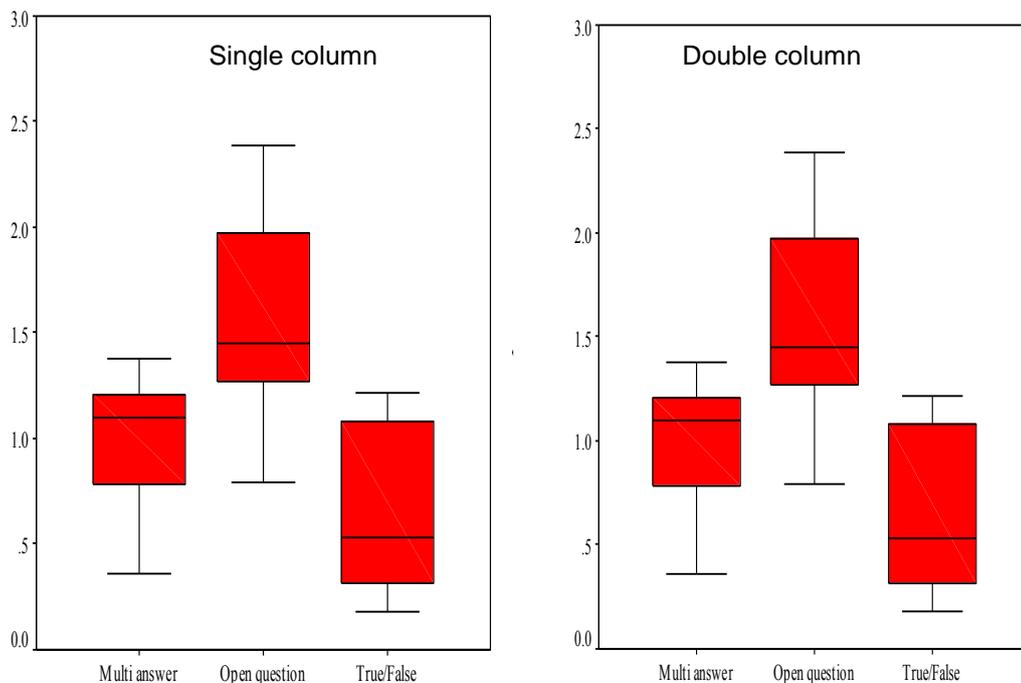
**Table 68: The average reading time for three different types of questions in two different line-lengths according to gender (single column).**

Gender		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Male	<b>Speed</b>	.415	1.380	.991	.354	.795	2.390	1.712	.551	.180	1.140	.619	.359
Female	<b>Speed</b>	.360	1.305	.944	.304	1.030	2.170	1.515	.359	.185	1.220	.707	.401
Mann-Whitney	<b>Speed</b>	Z= -.577 p-value=.564				Z= -.924 p-value=.356				Z= -.404 p-value=.686			

**Table 69: The average reading time for three different types of questions in two different line-lengths according to gender (double column).**

Gender		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Male	<b>Speed</b>	.375	1.310	.877	.356	.795	2.390	1.712	.552	.180	1.140	.619	.359
Female	<b>Speed</b>	.300	1.950	.895	.466	1.030	2.170	1.515	.358	.185	1.220	.708	.400
Mann-Whitney	<b>Speed</b>	Z= -.173 p-value=.887				Z= -.924 p-value=.378				Z= -.404 p-value=.713			

**Figure 56: Boxplot for speed using the three question models in two different line-lengths according to gender.**



### **7.5.1.2. Accuracy of reading:**

The errors made for the question models are measured to define optimal line length for the sake of obtaining a high level of comprehensibility. Descriptive statistics and test for the three types of questions in Table (70) and Figure (57) show that the error rate decreases as age increases, where it becomes .875 for age 12 compared to 1.446 for age 9. The chi-test is 9.126 with p-value=.028, indicating a significant difference. This finding supported a line of thought considered by several of researchers such as (Cheyne 2005; Salmerón and García 2011 ).

In addition, the number of errors becomes higher for the second type of question (OQ), which requires reading a whole paragraph to determine the answer. According to the chi-test which is 7.266 with p-value=.064, ages do not reduce the error resulting from the open question. It is noted that the error consistency within each age is low. In terms of the true/false question, the error drops as age goes up. Despite this difference, the chi-test is reported to be not significant. The lowest is zero for ages 11 and 12. In addition, the average error for these ages is similar but varies from age 9 to 10, and hence the Chi-square= 13.193 with p-value=.004 (highly significant).

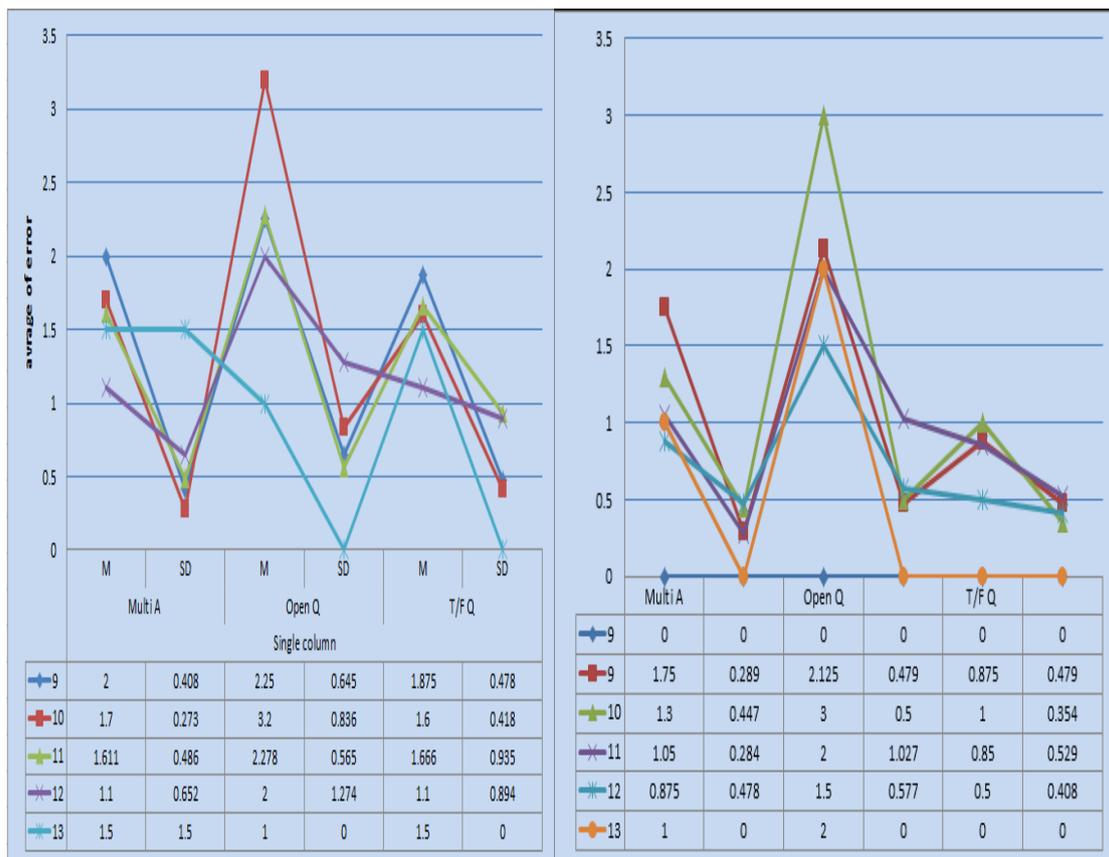
Moreover, the average error in a single column becomes .575 for aged 12 compared to 1.446 for aged 9. The chi-square is 5.673 with p-value=.129, meaning that the difference is not significant. The number of errors looks higher for the second model of questions. According to the value of chi-square which is 5.567 with p-value=.135, ages do not have any effect on the differences in errors resulting from the open question model. It is noted that the error consistency within each age group is low. For true/false question model, the errors goes down as age goes up. The chi-square (which is 2.283) is reported to be not significant (p-value=.516). The lowest error found is zero for aged 12 while the highest is 3 for aged 11. While comparing the mean of error in single and double column shows differences in students' preference, where the double column was preferred by students of all ages, several explanations are provided to explain this. Some students aged 9 to 10 prefer short line because they can move easily from line to line searching for a specific word or information, while older students can scan the whole page to get a general idea which helps in finding more than one answer at the same time. Additionally, when the eye is

fixed on the short line, the latter is higher compared to the long line. Some of the older students find the short line easier to scan and for moving from sentence to sentence.

**Table 70: Descriptive statistics and test for the three types of questions with respect to age reading through single and double column.**

Age	Error	Single column						Double column					
		Multi A		Open Q		T/F Q		Multi A		Open Q		T/F Q	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
9	Error	2.000	.408	2.250	.645	1.875	.478	1.750	.289	2.125	.479	.875	.479
10	Error	1.700	.273	3.200	.836	1.600	.418	1.300	.447	3.000	.500	1.000	.354
11	Error	1.611	.486	2.278	.565	1.666	.935	1.050	.284	2.000	1.027	.850	.529
12	Error	1.100	.652	2.000	1.274	1.100	.894	.875	.478	1.500	.577	.500	.408
13	Error	1.500	1.500	1.000	0	1.500	0	1.000	0	2.000	0	.000	0
		Chi=5.673 p-value=.129		Chi=5.567 p-value=.135		Chi=2.283 p-value=.516		Chi= 9.126 p-value=.028		Chi= 7.266 p-value=.064		Chi= 2.697 p-value=.441	

**Figure 57: show mean (M) and standard deviation (SD) of average of errors in single and double column according students' age.**



On the other hand, the outcomes of analysing reading level are demonstrated in Table (71 and 72) and figure ( 58) for reading long and short lines. The Mann-Whitney test does not detect any significant difference for all the question models. In addition, little improvement was reported when reading text in a short line by students with a low level of reading skill. The mean reading time to answer true and false question

type [T/FQ] decreased from .600 min in single column to .557 min when reading a short line. In addition, a significant difference in the mean reading time was reported when answering multi answer choices [MAC] (M= .785) from reading short lines, whereas the mean time for answering the same type of question from reading long lines was 1.014 min which is high (Abubaker,A & Lu, J 2013).

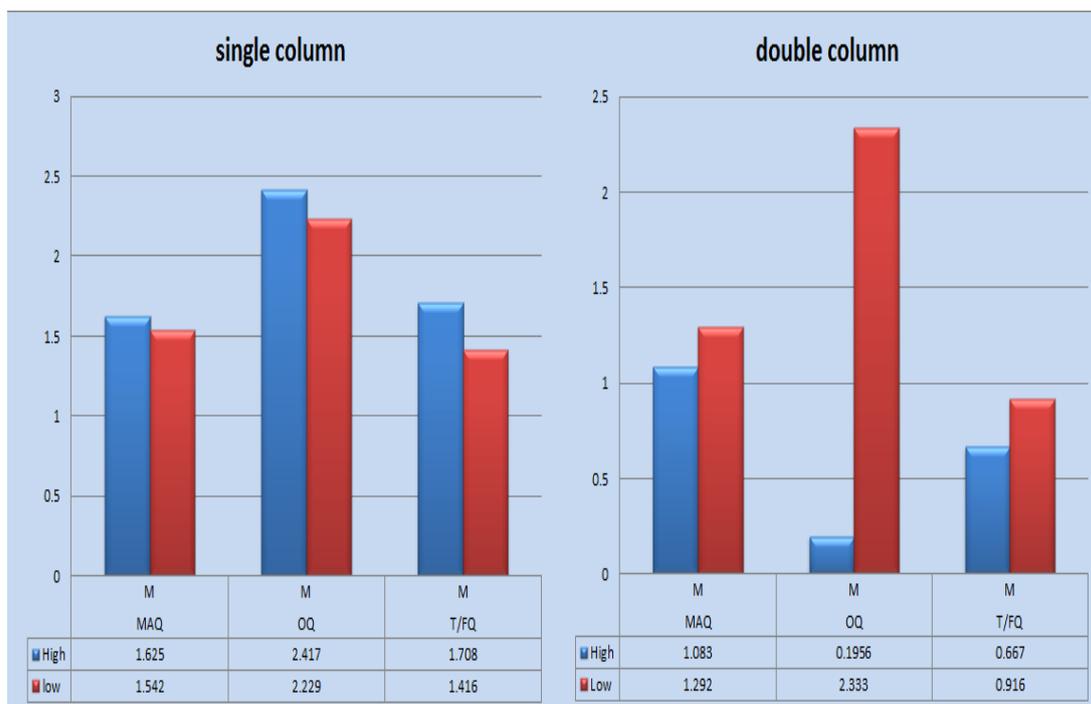
**Table 71: The average reading error for three different types of questions for single column according to the reader's reading level.**

Reading level		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
High	Error	.500	2.500	1.625	.569	1.000	4.500	2.417	.925	.500	3.00	1.708	.722
Low	Error	.500	2.000	1.542	.498	.500	4.00	2.229	.940	.000	2.500	1.416	.793
Mann-Whitney	Error	Z=-.213 p-value=.831				Z=-.088 p-value=.930				Z= -.853 p-value=.394			

**Table 72: The average reading error for three different types of questions for single column according to the reader's reading level.**

Reading level		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
High	Error	.500	1.500	1.083	.358	.500	3.500	.1956	.988	.000	1.500	.667	.443
Low	Error	.500	2.000	1.292	.498	1.000	3.500	2.333	.748	.000	1.500	.916	.515
Mann-Whitney	Error	Z= -.936 p-value=.410				Z= -1.055 p-value=.319				Z= -1.208 p-value=.266			

**Figure 58: The average reading error for three different types of questions in two different line-lengths according to the reading level.**



The errors made in all the models do not differ significantly between males and females as shown by the Mann-Whitney test in tables 73, 74 and figure 60. In general, performance in terms of finishing the answer due to gender is regarded as very similar. Also, males and females have the same error scores in all the question models. The error rate for both male and female decreased from T/FQ [M= 1.375] in a single column to [M= 0.75] in double column. Comparing students' performance in two different line lengths shows that the double column was the best for both male and female. Although some researchers such as (Hupfer and Detlor 2006; Liu and Huang 2007) reported differences in the information behaviour for the reader according to gender, our finding has rejected it.

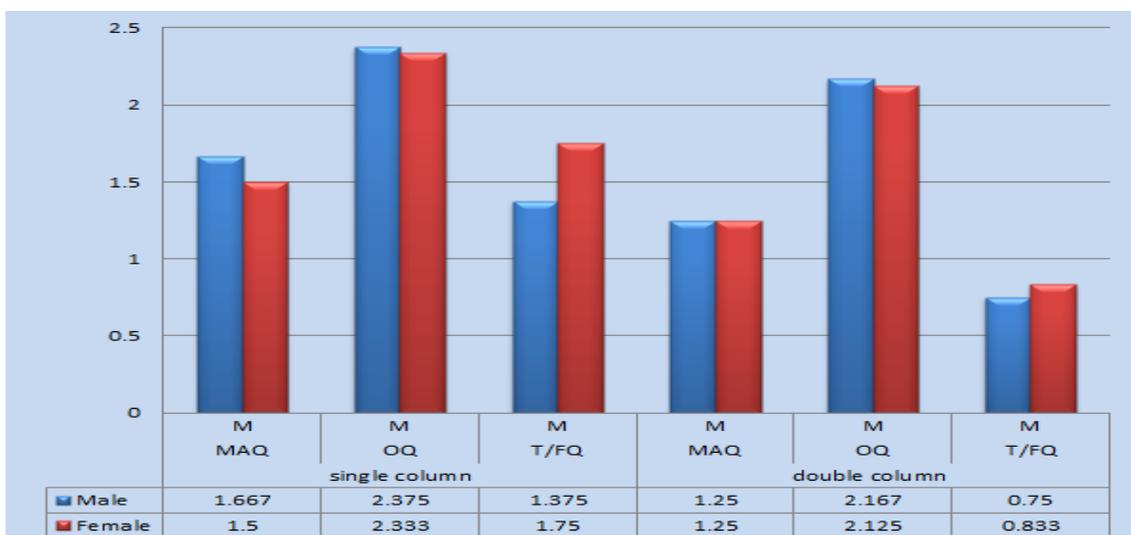
**Table 73: Descriptive statistics and test for the three types of questions with respect to gender reading through single column.**

Gender		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Male	Error	1.000	2.500	1.667	.492	.500	4.500	2.375	1.068	.500	3.000	1.375	.772
Female	Error	.500	2.500	1.500	.564	1.000	4.000	2.333	.778	.000	2.500	1.750	.723
	Error	Z= -.730 p-value=.466				Z= -.117 p-value=.907				Z= -1.530 p-value=.126			

**Table 74: Descriptive statistics and test for the three types of questions with respect to gender reading through double columns.**

Gender		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Male	Error	.500	2.00	1.250	.452	.500	3.50	2.167	.985	.000	1.500	.750	.452
Female	Error	.500	2.00	1.250	.433	1.000	3.500	2.125	.801	.000	1.500	.833	.536
Mann-Whitney	Error	Z= -.655 p-value=.551				Z= -.176 p-value=.887				Z= -.483 p-value=.671			

**Figure 59: The average reading error for three different types of questions in two different line-lengths according to the reader's gender.**



With respect to the errors in single column, the open question model shows the highest error, followed by the multi answer and true/false models, while the chi-square test is 9.379 with p-value <.009, which is a confirmation of highly significant differences between the errors of the three models. The Wilcoxon test proves that the errors in true/false questions are significantly smaller than the remaining models, and errors in multi answer questions are significantly smaller than the open question models. However, it seems interesting to discover that no significant difference is found between the multi-answer and true/false model ( as seen in table 75).

**Table 75: Pairs comparison using the Wilcoxon test in terms of speed and errors.**

	Speed			error		
	Multi-answer- Open question	Multi-answer- True/False	Open question- True/False	Multi-answer- Open question	Multi-answer- True/False	Open question- True/False
<b>Z</b>	-4.296	-3.915	-4.286	-3.165	.000	-3.041
<b>p-value</b>	<.001	<.001	<.001	.002	1.000	.002

Finally, Table 76 provides a summary of several recommendations from analysing collected statistical data through current experiments, which could be used as a guideline when designing academic Arabic online text for students aged 9 to 13. The reading strategy was considered as a strongly affected variable for selecting the perfect line length according to the reading speed. In addition, the readers' age and reading level have a significant influence on the human information process. For instance, the study has recommended double column for fast reading for students whose reading performance is satisfactory. However, long line is suggested for students with difficulty in reading.

**Table 76: optimal line length to read school book on screen according to reading strategy.**

Age	Reading strategy		Reading level	Reading strategy		Gender	Reading strategy	
	Scan	Skim		Scan	Skim		Scan	Skim
<b>9</b>	Single column	No difference	<b>High</b>	Single	Single column	<b>Male</b>	No difference	No difference
<b>10</b>	Single column	No difference		Single column	Single column		No difference	No difference
<b>11</b>	Double column	Single column	<b>Low</b>	Double	Double column	<b>Female</b>	No difference	No difference
<b>12</b>	Double column	Double column		Double column	Double column		No difference	No difference

13	Double column	Single column		e colu mn				
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### 7.5.2. Using colour to increase the ability to focus vision when moving from one line to another:

Younger students attribute the slow reading of the text displayed on screen in double column to difficulty by scrolling the text, where their experience in using computer tools especially the mouse was weak. This does not mean that students do not find it difficult to read from a long line, but students find this format similar to the print book and they deal with it by placing the finger at the beginning of each line to make it easier to move to the next line. In order to solve this problem, a new method has been proposed in this research; the method was built based on the eye movement theory. The idea assumes that using different colours for the first and last word of each line could help the eye in fixing and moving easily through the text. Reading performances of students were compared in order to define which design [single or double column] is read most effectively by students of different ages.

#### 7.5.2.1. Reading speed:

The student's performance when reading a text in two columns was tested. It is expected that students may have the ability to show a different degree of performance by using different models of questions. This performance is expressed by the time (speed) needed to complete answering each question. By comparing times obtained from reading a single column with colour and double column, it shows a significant difference as can be seen in Table (77). It is clear that the speed for students of all ages is faster when reading a double column in three types of questions. For example, the mean reading time of short line for students aged 13 when answering multi answer choices were .795 min, open question 1.070 min, and true/ false question .710 min, while of a long line the average reading speed for the three questions was 1.070 min, 2.020, .875 min, respectively.

In addition, we notice in general that more time is required than for the type one question. Likewise, with multi-answer questions, the time spent on answering becomes lower as age increases. According to the results, ages 9 and 10 had a similar

average speed, so were ages 11 and 12. This result is enhanced by the Kruskal-Wallis test, which is 9.58 with a p-value=.022, meaning that time spent on open questions is statistically different from young students to older students. Based on dispersion measures, the speed seems to be more consistent with ages 11 and 12 than with ages 9 and 10. For the true/false model, we observe the manner of speed seen in the open question model, where students aged 9 and 10 seem much closer to each other than those aged 11 and 12. The Kruskal-Wallis test is 10.48 with a p-value= 0.00, which is statistically significant denoting that age can lead to different responses in speed. The same results are observed for errors made by this type, where the value of the Kruskal-Wallis test is 15.863 with a p-value=.001 which is highly significant.

**Table 77: Comparing reading performances of students using single column and double column with colour based on students' age.**

Age		Double column						Single column					
		Multi A		Open Q		T/F Q		Multi A		Open Q		T/F Q	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
9	Speed	.956	.202	1.927	.556	.665	.1696	1.310	.561	2.075	.795	.950	.278
10	Speed	.738	.299	1.875	.499	.568	.226	.919	.260	1.987	.472	.789	.352
11	speed	.624	.351	1.320	.132	..375	.57	.771	.425	1.387	.123	.469	.061
12	speed	.431	.073	1.205	.203	.352	.101	.541	.146	1.356	.077	.472	.181
13	speed	.795	-	1.495	-	.710	-	1.070	000	2.020	0	.875	000
<b>Kruskal-Wallis test</b>	Speed	Chi= 8.378 p-value=.039		Chi= 9.58 p-value=.022		Chi= 10.48 p-value=.015		Chi=7.013 p-value=.071		Chi=6.514 p-value=.089		Chi=12.698 p-value=.005	

In addition, students in age 9 show a wider range of time using minimum and maximum values (.851 and 2.110). The difference in speed is statistically not significant where chi-square =7.013 with p-value=.071. Also, for the open question, although the increase in the age of students seems to show some influence on reducing the time for the answers, the statistical test given by Kruskal-Wallis is found to be not significant (p-value= .089). The variation in speed using SD, min and max values is noted to be lower for older students. Unlike the multi answer and open question models, the difference in speed for true/false model between age groups is highly significant where chi-square = 12.698 with p-value=. 005; this difference is in favor of older students. Based on the variation measurements, the speed seems to be more consistent than in the other models.

On the other hand, the reading performance of students with high level and low level of reading was improved when the reading text is presented in short lines. By looking at the multi answer choice model as see in table 78, the average speed for high level is .666, which is slower than students read a single column as can be seen in Table 93. In addition, when scanning the text for students with high level of reading, the reading speed is faster when reading a short line with colour [M= .518 min, SD= .229], while in long line it was M= .710 min, SD= .358] as seen in table 78.

**Table 78: Comparing reading performances of students using single column and double column with colour based on students' reading level.**

Reading level		Double column						Single column					
		M A C		OQ		T/F		M A		O Q		T/F	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
Low level	speed	.675	.304	1.411	.215	.427	.112	.815	.420	1.522	.294	.553	.156
High level	speed	.666	.323	1.630	.571	.518	.229	.898	.521	1.779	.610	.710	.358

By comparing differences in time spent on answering the three question modes due to the gender, the Mann-Whitney test is found to be not significant as given in Table (79) and (80). Based on the variation measurements, males and females show similar homogeneity.

**Table 79: descriptive statistics and test for the three types of questions with respect to gender reading single column.**

Gender		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Male	Speed	.395	1.405	.887	.367	1.185	2.445	1.651	.429	.370	1.190	.589	.272
Female	speed	.286	2.110	.825	.493	1.265	3.060	1.641	.555	.330	1.220	.674	.296
Mann-Whitney	Speed	Z= -.606 p-value= .551				Z=-.577 p-value=.564				Z= -.808p-value=.443			

**Table 80: descriptive statistics and test for the three types of questions with respect to gender reading double column**

Gender		Multi answer				Open question				True/False			
		Min	Max	M	SD	Min	Max	M	SD	Min	Max	M	SD
Male	Speed	.365	1.330	.703	.358	1.180	2.370	1.567	.400	.305	.800	.446	.171
Female	Speed	.395	1.095	.638	.258	.865	2.445	1.474	.483	.260	.830	.499	.197
Mann-Whitney	Speed	Z= .041 p-value=.840				Z= .480 p-value=.488				Z= 654 p-value=.419			

Overall, the reading performance of all students at different ages was faster when reading a short line using red colour from the beginning and the end of the line. Therefore, using a red colour for the first and last word of each line showed improvement in reading speed for all students when scanning and skimming the text. In addition, students with both high and low reading levels are faster when reading a short line. To assess whether this difference in speed is caused by the type of question,

the Friedman test given in Table (81) is 24.082 with a p-value=0.00, meaning the type of question leads to a significant difference in speed. Therefore, it is better to examine the difference between each of the question models. Based on Table (82), all the results using the Wilcoxon test confirm highly significant differences between each of the two models.

**Table 81: Friedman test for the three question models in terms of speed reading double column.**

Question type	Mean rank	Chi-square	p-value
Multi-answer	1.96	24.082	.000
Open question	3.00		
True/false	1.04		

**Table 82: Pairs comparison using the Wilcoxon test in terms of speed double column.**

	Multi-answer- Open question	Multi-answer- True/False	Open question- True/False
<b>Z</b>	-4.286	-4.172	-4.286
<b>p-value</b>	.000	.000	.000

### 7.5.2.2. Accuracy

Regarding the errors made in each question model, the only significant difference is identified in the true/false model where chi-square = 8.540 with p-value=.036. It is worth mentioning that for the true/false model, the low errors are not systematically influenced by older students. Reading speed according to the reading score shows little difference. For example, the Mann-Whitney for students with a high reading score was in the multi choices answer= .815, open question= 1.522, and true/false question= .553. This difference occurs in this type of questions ( True/False), while the Mann-Whitney for students with low scores was in multi choices answer= .898, open question= 1.779, and true/false question= .710 (as seen in Table 83). The significant difference in answering time was reported between the types of questions, where students take more time when searching for answers for the open question. In addition, the Mann-Whitney indicated a significant difference in answering time for true and false questions between students with difficulty in reading and students with high scores. The reading levels do not lead to any significant difference in errors for the three types of question models where the p-values from the Mann-Whitney test is larger than .05. Similarly, for the open model, the Mann-Whitney is -.751 with p-value=.478, while for the true/false model, the Mann-Whitney is -.520 with p-value=.603.

**Table 83: comparing reading performances of students using single column and double column with colour.**

Age		Double column						Single column					
		Multi Answer		Open question		T/F question		Multi Answer		Open question		T/F question	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
9	Error	1.625	.478	2.375	1.108	1.500	.707	2.000	0	2.625	.479	1.875	.479
10	Error	1.200	.671	2.500	.353	1.500	.612	1.600	.418	2.300	.570	2.000	.612
11	Error	.9444	.634	2.055	.882	.333	.354	1.556	.463	1.833	.500	1.166	.661
12	Error	.900	.418	1.200	1.036	.200	.273	1.700	.671	1.600	.224	1.200	.447
13	Error	1.00	-	1.00	-	0.00	-	2.50	000	1.500	0	.500	000
<b>Kruskal-Wallis test</b>	Error	Chi= 4.249 p-value=.236		Chi= 5.027 p-value=.170		Chi= 15.863 p-value=.001		Chi= 3.378 p-value=.337		Chi=9.098 p-value=.028		Chi=8.540 p-value=.036	

With respect to the errors, the lowest and largest number of errors made by the high level group is lower than that made by the lower level group. Apparently, the average number of errors for the low level group, which is 1.292, is higher than for the high level group, which is .917. By relying on the test, which is 2.041 with a p-value=.153, we reject any statistical difference and confirm that both groups are equal as seen in table 84.

**Table 84: The average reading error for three different types of questions for single column according to the reader's reading level.**

Reading level		Double column						Single column					
		M A C question		Open question		True/False question		M A C question		Open question		True/False question	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
<b>High</b>	<b>Error</b>	.917	.468	1.667	.651	.625	.569	1.708	.542	1.958	.655	1.416	.596
<b>Low</b>	<b>Error</b>	1.292	.655	2.292	1.117	.8333	.913	1.708	.450	2.042	.498	1.458	.782

By looking at the corresponding errors when reading through short line, it is observed that the number of errors resulting from using open question is highest with the biggest variation within the errors. The multi-answer model comes second and the true/false model third with a similar degree of variation. By examining these differences in error, the Friedman test, which is 31.5 with a p-value=.000, denotes a highly significant difference (see Table 85). For more details, the Wilcoxon test given in Table (86) shows that there is a highly significant difference between any two of the question models.

**Table 85: The Friedman test for the three question models in terms of error reading through short line.**

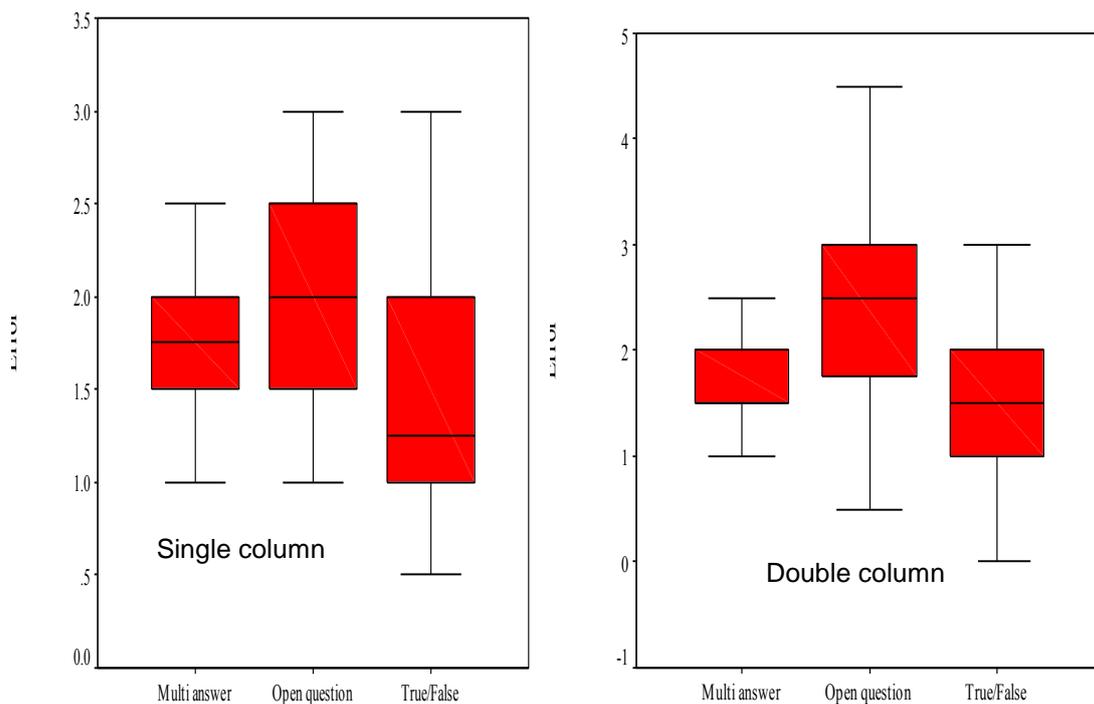
Question type	Mean rank	Chi-square	p-value
<b>Multi-answer</b>	1.88	31.50	.000
<b>Open question</b>	2.81		
<b>True/false</b>	1.31		

**Table 86: Pairs comparison using the Wilcoxon test in terms of error.**

	Multi-answer- Open question	Multi-answer- True/False	Open question- True/False
<b>Z</b>	-3.643	-2.513	-4.223
<b>p-value</b>	.000	.000	.000

According to Figure (60), it is very clear that the open questions need more time to answer than the other two models, so the multi-answer model comes second and the true/false model is third (time for writing the answer was not measured). From the figure, it is noted that a higher variation in answering speed can be observed regarding true/false questions as opposed to open questions, but more homogeneity of speed is observed within the speed for answering the true/false model.

**Figure 60: Boxplot for error using the three question models.**



### 7.5.3. Comparing reading performance using colour and without colour in two conditions:

#### 7.5.3.1. Reading speed:

Reading performances of students were compared in order to define which design is read effectively by students and which variables have negative or positive

influences using Mann-Whitney test. In Table (87), it is notable that the mean times for with and without a colour seems to be fairly close, especially for the open question and true/false models. However, since the p-value computed from the test is more than .05, using colours will not lead to any statistical difference compared to not using colours for all types of questions. Although the difference is not statistically significant, it can be seen that there is a clear improvement especially when browsing the full text. The results of comparing two columns with and without colours using the Mann-Whitney test are summarised in Table (88). The descriptive statistics summarized in Table 66 shows that the mean rank speeds for with and without colours are apparently similar. The p-value computed from the test is more than .05, and hence colours will not lead to any statistical difference from not using colours for all types of questions.

**Table 87: The Mann-Whitney test for with and without colours in terms of speed (single column).**

	Time	Mean	Median	Mean rank	z-value	p-value
<b>Multi answer</b>	<b>With colour</b>	.856	.803	21.73	-1.160	.246
	<b>Without colour</b>	.957	1.055	26.37		
<b>Open question</b>	<b>With colour</b>	1.646	1.442	24.44	-.223	.823
	<b>Without colour</b>	1.630	1.460	23.54		
<b>True/False</b>	<b>With colour</b>	.631	.515	24.17	-.085	.932
	<b>Without colour</b>	.680	.550	23.83		

**Table 88: The Mann-Whitney test for with and without colours in terms of speed (double column).**

	Speed	Mean rank	z-value	p-value
<b>Multi answer</b>	<b>With colour</b>	20.60	-1.928	.054
	<b>Without colour</b>	28.40		
<b>Open question</b>	<b>With colour</b>	23.06	-.711	.477
	<b>Without colour</b>	25.94		
<b>True/False</b>	<b>With colour</b>	21.48	-1.495	.135
	<b>Without colour</b>	27.52		

The dataset is also analyzed by comparing the performance of with and without colors for each age. Table 89 demonstrates the results from using the Mean rank test. It is clear that the speed for students who are in age 9 and 10 is statistically different in terms of the multi answer model, but for the true/false model, the significant difference is reported for age 9 only. As the sign of z-value is negative for some models, the students seem to be faster with colors than without colors. This is noted for most ages and question models. However, since we do not detect any significant results (p-value>.05), it may not be recommended to use colors, especially for those who are older than 9 years.

**Table 89: The Mann-Whitney test for with and without colours in terms of speed for each age.**

Age	Speed		Mean rank	z-value	p-value
9	Multi answer	With colour	2.50	-2.309	.021
		Without colour	6.50		
	Open question	With colour	5.00	-.577	.564
		Without colour	4.00		
	True/False	With colour	2.50	-2.323	.020
		Without colour	6.50		
10	Multi answer	With colour	3.40	-2.193	.028
		Without colour	7.60		
	Open question	With colour	4.80	.465	.548
		Without colour	6.20		
	True/False	With colour	3.80	-1.776	.076
		Without colour	7.20		
11	Multi answer	With colour	8.72	-.940	.347
		Without colour	11.15		
	Open question	With colour	8.33	-1.225	.221
		Without colour	11.50		
	True/False	With colour	7.94	-1.513	.130
		Without colour	11.85		
12	Multi answer	With colour	4.00	-1.225	.221
		Without colour	6.25		
	Open question	With colour	4.20	-.980	.327
		Without colour	6.00		
	True/False	With colour	5.70	-.861	.389
		Without colour	4.13		

The aim is to investigate the effect of using one and two columns for the time spent to answer the question models in terms of texts based on using colour or without colour. Starting with coloured text, Table (90) shows that the difference in time needed to answer the questions resulting from using one and two columns is not statistically significant. Similarly, the results are not significant for the models without colouring. Hence, using any design will lead to the same time.

**Table 90: The Mann-Whitney test for speed according to with and without colours in terms of reading score.**

Reading score	Speeds		Mean rank	z-value	p-value
With colour	Multi answer	One column	28.02	-1.743	.083
		Two columns	20.98		
	Open question	One column	26.75	-1.114	.265
		two columns	22.25		
	True/False	One column	29.71	-2.578	.010
		Two columns	19.29		
Without colour	Multi answer	one column	25.70	-.830	.406
		Two columns	22.38		
	Open question	One column	24.20	-.096	.924
		two columns	23.81		
	True/False	One column	24.33	-.601	.873
		two columns	23.69		

### 7.5.3.2. Accuracy:

By comparing errors obtained from with and without colours, Table (91) explains that for any question models, the errors for both groups do not differ significantly since the resulting p-value is bigger than .05. Using colour reduced the average error in the three different types of questions. This confirms that the use of colours reduces the proportion of errors.

**Table 91: The Mann-Whitney test for with and without colours in terms of error.**

Error		Mean	Median	Mean rank	z-value	p-value
Multi answer	With colour	1.708	1.750	25.90	-1.016	.310
	Without colour	1.543	1.500	22.02		
Open question	With colour	2.000	2.000	21.02	-1.558	.119
	Without colour	2.369	2.500	27.11		
True/False	With colour	1.438	1.250	22.40	-.839	.402
	Without colour	1.587	1.500	25.67		

By comparing errors obtained from with and without colours, Table 92 explains that for any question models, the errors for both groups do not differ significantly as the resulting p-value is bigger than .05. Although the negative sign of z indicates that the colours may lead to less time needed to answer the questions, the test says that both groups are statistically the same.

**Table 92: The Mann-Whitney test for with and without colours in terms of error.**

Error		Mean rank	z-value	p-value
Multi answer	With colour	23.44	-.548	.584
	Without colour	25.56		
Open question	With colour	23.33	-.560	.558
	Without colour	25.67		
True/False	With colour	22.79	-.873	.383
	Without colour	26.21		

In conclusion, the performance of the students is not affected by incorporating colours for designing questions, whatever the question model. Therefore, using colours will not decrease the time needed to complete their answers or lead to a reduction in errors. On the other hand, the time and errors are significantly correlated whether we use colours or not.

According to Table 93, for all question models, the test does not find any statistical difference, and hence errors from designing questions with and without colors are the same for all ages although it is noted that color may lead to fewer errors as the sign z is found to be negative.

**Table 93: The Mann-Whitney test for with and without colours in terms of error for each age.**

Age	Error		Mean rank	z-value	p-value
9	<b>Multi answer</b>	<b>With colour</b>	4.25	-.316	.752
		<b>Without colour</b>	4.75		
	<b>Open question</b>	<b>With colour</b>	4.88	-.438	.661
		<b>Without colour</b>	4.13		
	<b>True/False</b>	<b>With colour</b>	5.63	-1.348	.178
		<b>Without colour</b>	3.38		
10	<b>Multi answer</b>	<b>With colour</b>	5.30	-.216	.829
		<b>Without colour</b>	5.70		
	<b>Open question</b>	<b>With colour</b>	4.10	-1.571	.116
		<b>Without colour</b>	6.90		
	<b>True/False</b>	<b>With colour</b>	6.80	-1.469	.142
		<b>Without colour</b>	4.20		
11	<b>Multi answer</b>	<b>With colour</b>	9.28	-.567	.571
		<b>Without colour</b>	10.65		
	<b>Open question</b>	<b>With colour</b>	10.17	-.124	.901
		<b>Without colour</b>	9.85		
	<b>True/False</b>	<b>With colour</b>	7.22	-2.150	.032
		<b>Without colour</b>	12.50		
12	<b>Multi answer</b>	<b>With colour</b>	5.10	-.131	.896
		<b>Without colour</b>	4.88		
	<b>Open question</b>	<b>With colour</b>	4.20	-1.033	.302
		<b>Without colour</b>	6.00		
	<b>True/False</b>	<b>With colour</b>	4.10	-1.207	.227
		<b>Without colour</b>	6.13		

Unlike the results from the time analysis, the results of error analysis are considered interesting as seen in Table 94. In terms of using colours, the results reveal that for multi-answer and true/false models, the errors made by one column is significantly higher than those made by two columns (p-value=.001). On the other hand, using columns for open questions does not have any effect on the number of errors. Similarly, if no colour is used for designing the questions, one column is significantly different from two columns (p-values=.01) for multi-answer, and the difference is highly significant (p-value<.001) as observed from the true/false model where in both cases using one column leads to a reduction in the student's performance. For the open question, the number of errors is the same for using either one or two columns (p-value=.489).

**Table 94: The Mann-Whitney test for error according to with and without colours in terms of reading scores.**

Reading score	Error		Mean rank	z-value	p-value
With colour	Multi answer	One column	31.00	-3.308	.001
		Two columns	18.00		
	Open question	One column	24.69	-.094	.925
		Two columns	24.31		
	True/False	One column	30.98	-3.273	.001
		Two columns	18.02		
Without colour	Multi answer	One column	29.02	-2.566	.010
		Two columns	19.19		
	Open question	One column	25.39	-.691	.489
		Two columns	22.67		
	True/False	One column	31.20	-3.597	<.001
		two columns	17.10		

## 7.6. Conclusion:

This chapter mainly focuses on the layout of the text, particularly the influence of line length. This experiment was divided into two parts. The first part focused on the factor of line length by studying its effect on reading speed and accuracy using different types of columns [one column and two columns] with each page having the same amount of information. The second part tests a new approach which assumes that using a different colour for the first and last word in each line will improve the reading level of students. Generally, the findings from the result above indicate that the time needed to complete all question models is significantly lower for elder students. Errors from all the question models are apparently lower for older students in both the long and short line.

In addition, the high level of reading neither plays an important role in reducing the time needed to complete the answers nor leads to alleviating errors which could be made in answering the questions. The degree of association describing the relationship between speed and error for the true/false model is found to be the highest and most positive. Similar to models with colours, one interpretation of this relationship is that, usually, if students understand the question, then they do not need to spend more time on answering any question model; however, if they do not understand, then they need more time and hence their results will be inaccurate.

Overall, the conclusion from these results is that the time needed to complete all the question modules becomes significantly low when students are elder. Errors for all the question models are expected to be significantly lower for elder students.

For speed or errors, the reading scores show a positive correlation with all the question models but this correlation is generally weak and not significant. The highest correlation, which is .393, is seen in the errors from the multi answer. Therefore, no real association with reading scores has been detected by using Spearman's correlation.

For the double column, the degrees of association describing the relationship between speed and error are evaluated as moderately positive (around .550), and considered to be highly significant. In other words, more time spent on answering the questions will lead to higher errors. Similar to models with colours, one interpretation for this relationship is that, usually, if students understand the question, then they do not need to spend more time answering any question model; however, if they do not understand the question, then they need more time and hence their results will not be accurate.

In terms of gender, generally, a relationship does not exist between the question models. However, females seem to negatively correlate with speed errors resulting from answering multi-answer and open questions, whereas males seem to show a negative correlation with the true/false model, but we should bear in mind that these relationships are weak and not important. The degrees of association describing the relationship between speed and error are found to be moderate, positive and highly significant. Namely, a low speed is combined with high errors for all the question models.

# **Chapter Eight: Major Findings, Contributions and Areas for Future Research**

## **8.1. Chapter Overview:**

Selecting an optimal layout of academic text for display on screen was affected by several factors such as; type of material, subject or readers` age. In this study researcher assumed that each reading strategy requires a specific layout. Thus, the study starts with an understanding of the way that students interact with the text in both formats [electronic and paper]. Findings from this phase were linked with three common typography variables to provide standards for optimal design. In this chapter, the findings of this research are interpreted in the light of the theoretical perspective of the study by linking it with the objectives of the study already set out in chapter one. The first section is devoted to debating the outcomes related to the use of the Internet and eBooks by children at school and at home. This is identified as the first layer of the children`s usability of online text, suggesting a further analysis of the children`s experience of the e- text with a focus on the reading processes of the schoolbook in both versions [paper and online]. The third section is devoted to discussing the results related to readable Arabic font size and type. Section four is concerned with the findings from testing the effect of line length on reading speed and comprehension of Arabic text; whereas, the fifth section is devoted to debating the outcomes related to the new method for presenting Arabic texts.

## **8.2. Discussion of the findings in view of the research questions:**

The current research, as mentioned earlier, is concerned with the factors that affect reading online Arabic text by children aged 9 to 13. A broad analysis of the related theoretical and empirical literature was provided in chapters two and three. A few researchers seem interested in explaining the relationship between these variables. The literature on reading online has come to the conclusion that there are several factors which can be grouped into three main categories of variables (user, usability, and legibility) as seen in chapter three. The questionnaire and observations among grades 4, 5 and 6 in five schools in Benghazi and Huddersfield in the UK have generated extensive data.

### **8.2.1. Using the Internet and eBook among Libyan school children at primary level:**

Due to the lack of studies, it has highlighted the use of the Internet and eBook in Libya in particular and the Arab world in general. The study began by collecting quantitative data about the use of the Internet and eBook among school children in Libya as a starting point for investigating the factors that affect the readability of Arabic text on screen. In general can state that, the results of this study have supported the next stages of the research in various aspects. Firstly, it supported picking the sample for the research's experiments from students who have already used eBooks and the internet for learning purposes. The results as illustrated in chapter four points out the following:

- The majority of students aged 9- 13 from primary schools in Benghazi have access to the Internet at home or at commercial centres especially where schools did not provide access to the Internet for their students. This finding was similar to several previous studies that reported an increase in the number of children who used the Internet on a daily basis especially in developed countries (Ma 2005; Ma 2005; Ma 2005; Buzzetto-More, Sweat-Guy et al. 2007; Rowlands, Nicholas et al. 2007). On the other hand, several findings confirm that they use the internet at home as much as they use it at school

where they have more freedom to use it for different activities, while at school they just use it for doing research online and for a short time (Woo Park 2009). This finding is in line with that of this study, that 54% of participants use the internet at home by themselves without any monitoring by parents which can be very dangerous and unsafe.

- Use of the Internet was affected by several factors such as the high cost, poor quality of access, slow download, and control of use by the government. In Libya, the case is different where the main barrier is associated with a lack of internet skills, where students do not learn at school how to use the Internet. The survey reported another factor that influences using the computer and Internet effectively by children at home, namely, “parents’ experience with using computer and the Internet” where a majority had no experience with using the Internet and computer, and 29.3% of children get support from their older brothers and sometimes from friends. This barrier was previously defined by Tripp ( 2010), which requires schools to educate parents through training courses on the use of the Internet or publish bulletins that describes the most important educational sites on the internet. Moreover, more research should be done to evaluate the Arabic websites for children in order to determine their suitability for the purposes of learning.
- The findings indicated that most of the students use the Internet for multi activities but mostly for non-academic purposes. This was possibly influenced by the use of the Internet at home while the education system just focused on the textbook at school. At the same time, Polly et al. (Polly 2009) reported similar findings despite the fact that English schools apply technology to the education system and all schools provide Internet access for students at school, while a part of the homework requires using the Internet. However, the majority of students in the UK aged 7- 17 are more likely to socialise than doing homework online, wherein 62% of them have profiles on social networks. This case was reported for Libyan students aged 9- 13 where 78.3% have accounts on Facebook and Twitter.
- The study demonstrated that the most common reason for using the Internet was for “playing games online” and “chatting”. This is in agreement with results from Tripp ( 2010) and Curtis, Polly et al. (Polly 2009) where the participants tended to use the internet for playing games online

- Non- users indicated that they had not used eBooks because they were unaware of their availability, they did not know how to access eBooks, they had limited knowledge about eBook, and they disliked reading on screen. In previous studies in higher education, it was pointed out that an eBook was often used to search for information but students usually prefer a print copy for reading (Shiratuddin, Landoni et al. 2003; Bennett 2005; Anuradha 2006; Abdullah 2007; Milloy 2007; Noorhidawati and Forbes 2008; P, SL et al. 2009; Segal-Drori, Korat et al. 2009)
- It is notable that the majority of previous studies on applying the Internet to the education field had focused on university students (Bennett 2005; Anuradha 2006; Asmaa and Asma 2009; Carol Tenopir 2009), while little scholarly attention has been directed to studying the use of the Internet in the early stage of education. Students have no idea about the types of eBooks available and they deal with all kinds of texts available on the net as eBooks. This confusion is normal in the absence of any guidance from educators over who should be responsible for educating students on the possibilities available to them on the Internet and the quality of books and resources there that could be used.
- Finally, from what the children said about the general issues on using the Internet at home or at school, it can be concluded that using the Internet and e-resources by young people for education and in their everyday life has increased. But it is notable that the influence of the Internet and e- sources on teacher teaching and student learning is not as in other areas. For example, ICT can make education possible anywhere and at any time, and although ICT offered more flexible learning, the use of ICT by teachers is still limited and very basic. However, new generations tend to use the computer and the Internet for learning purposes more than previous generations who relied basically on a hard copy e.g. (Crestani, Landoni et al. 2006; Buzzetto-More, Sweat-Guy et al. 2007). Several researchers such as (Salmerón and García 2011 ) confirmed that digital learners are very excited about trying this new learning environment, taking into account the area of learning, education level, and learners' age.

### **8.2.2. E-reading process for schoolbook based on users' cognitive and behaviour processes:**

The literature on e-reading indicates that reading process can be significantly different depending on information sources and readers' age. From the result of this study it can surely confirm that the reading process differs according to the several variables related to the reader, the text and applying technology as shown in chapter three. In addition, theoretical perceptives into theories that related into reading online has already showed limit and gaps where the majority of the theories just focused on the psychology aspect of the readers. In this phase of the research reader response theory (RRT) was applied in order to investigate the reading process of reading a school text book in two different formats. A insignificant modification was made in the structure of the theory by putting this text in the heart of the process which helps to clarify the factors that influence the reading process and adds a new element; educator and parent as seen in figure (8) in chapter two. These elements were considered as a main element in reading process when reading an Arabic school text book. In presenting model the text is presented in the middle of the reading process where all the other elements deal with the text in different levels and methods. While, the reader comes in the top of the d shape and the parent and teacher come with the same level. Through this amendment, it can be applied this model to measure the behavior of students when reading Arabic school book.

The findings of this phase of research support the idea that the reading process is different according to the readers' characters and education level, e.g. the reading process was completely different to that presented by Dillon for using text in journal and manuals (Dillon 2001) or to that presented by Terras for reading ancient texts (Terras 2005). Table (95) provided a comparison to the reading process between four different information resources with the reading process of a school book. It is clear that there are substantial differences, for example, aim of reading for each source was differ and this led to a distinction in the method that readers follow when reading text where the presentation of the text was affected also. The second distinction noted, related to content layout according into material types [paper or electronic version] where reading processes differ between e-book and p-book, which seem to have resulted from the difference in the designing of the text and the tools that are used.

**Table 95: comparing reading process into different information sources.**

Type of resource	Aim of use	Ways of reading and searching	Organisation/ Issues related to designing
Journal (Dillon 1992)	<ul style="list-style-type: none"> <li>- Background material for work purposes.</li> <li>- Personal interest.</li> <li>- To answer a particular question.</li> <li>- To keep up with developments in an area.</li> <li>- To read an author`s work.</li> <li>- To get advice on a research problem.</li> </ul>	<ul style="list-style-type: none"> <li>- A quick scan of an abstract and major headings;</li> <li>- Non serial scan of major sections;</li> <li>- Full serial read of the text.</li> </ul>	<ul style="list-style-type: none"> <li>- Introduction- method- result- discussion/ conclusion.</li> </ul>
Manual (Dillon 1992)	<ul style="list-style-type: none"> <li>- Reference.</li> <li>- Introduction.</li> <li>- When in trouble.</li> </ul>	<ul style="list-style-type: none"> <li>- Check the contents page or index sections;</li> <li>- Dipping;</li> <li>- Scanning sections of the text;</li> <li>- Lengthy serial reading is rare.</li> </ul>	<ul style="list-style-type: none"> <li>- Contents- getting started- simple tasks- more complex tasks- index.</li> </ul>
Ancient text (Terras 2005)	<ul style="list-style-type: none"> <li>- Try to restructure past actions or to discover unidentified details.</li> </ul>	<ul style="list-style-type: none"> <li>- Experts use different methods to examine the document.</li> <li>- They spent a long time checking the text and the words in different orders.</li> <li>- They deal with visual features and then build up knowledge about the document.</li> </ul>	<ul style="list-style-type: none"> <li>- Page- text- mark- image- stamp and signature (Antonacopoulos, Karatzas et al. 2004).</li> </ul>
Siegethaler (Siegethaler, Wurtz et al. 2010)	<ul style="list-style-type: none"> <li>- Investigate e-reading process [iReyiLiad/SonyPRS,505/ BeBook/ ECTACO jet- book/ Bookeen Cybook].</li> </ul>	<ul style="list-style-type: none"> <li>- E-reading process is very similar to reading from paper.</li> </ul>	<ul style="list-style-type: none"> <li>- Eye movement method.</li> </ul>
Schoolbook	<ul style="list-style-type: none"> <li>- Learning.</li> <li>- Use at home and school.</li> <li>- Prepare for exam.</li> </ul>	<ul style="list-style-type: none"> <li>- Two strategies: skim &amp; scan.</li> <li>- View the text and then answer the questions.</li> <li>- View the questions and then search for the correct answer.</li> </ul>	<ul style="list-style-type: none"> <li>- Does not take on the electronic version.</li> <li>- Reading process changes according to the reading purpose and type of resource.</li> <li>- Students usually use two strategies; each strategy requires specific tools and techniques such as highlighting the sentence, taking notes, or using a finger when reading the text.</li> <li>- Reading processes differ between e-book and p-book, which seem to have resulted from the difference in the designing of the text and the tools that are used.</li> <li>- Dividing the text into check affects the reading comprehension process where students are not trained to manage this type of text layout and affects memory which works by the fixed relationship of a point and its location on a page.</li> </ul>

Moreover, there are several factors contributing to students' performance when reading paper versions of school books, some of which relate to technical aspects such as cohesion of content, linking, navigation and screen layout, segmentation of data, interface design and location of data.

However, Students show different attitudes when reading a schoolbook in both versions. AC2, AC3, AC6 and AC9 were used by all students and the difference was only noted in the order of use between e- version and paper version. For example, 95% of participants identify their aim before reading an e-school textbook as searching for answers or reading for an examination. Reading through the questions is a popular action among students when reading for an examination. Students who use the e-format of a schoolbook found it is so hard to go through the text between the questions and the content of the lesson which led some of them to use a paper version to write down the questions.

### **8.2.3. Design recommendations for Arabic school book:**

The view in chapter two had confirmed several factors that influence electronic reading. But drawing a clear conclusion from these studies is difficult for several reasons. For example, it is not possible to present the relationship between these variables and define the level of each factor's impact. Therefore, this study aims to highlight some of these aspects and fill part of this gap through investigating its influence on Arabic texts. In addition, because of the large number of factors that had been identified from previous studies, which are difficult to be covered in this study, three factors were selected: font size, font type, and line length.

#### ***First variable: Font size***

In experiment (2), Arabic text was tested to define the optimum font size and type to read from screen for students aged 9 to 13. Accuracy of reading was measured by the average number of errors that students made when reading the text, while reading speed was determined by the time it took students to read the text. The results of this experiment showed that the highest error is made with font size ten, and this is followed by sizes fourteen, sixteen and eighteen, which confirm the relationship between font size and word vision.

In the same perspective, previous studies demonstrate that the text is readable in font size 10 to 12 for adults using English characters (Wijnholds 1997; Maria dos santos Lonsdale 2006). This result is not consistent with Alotaibi's (Alotaibi 2007) survey which determines that the 14 point is the best font size for reading Arabic characters in print material by students aged 18 to 28. Also, it supports the finding that age tends to have a negative correlation with reading speed; in other words, when age increases the reading time decreases. This correlation is strong in Arabic texts because of the Arabic vowels which are key factors for defining the legible font size for children. Thus, the legible font should be able to show the difference between dots and vowels, and this cannot be achieved using font size 10, 12, 14 or even 16 in spite of the low rate of errors. Therefore, font sizes 14 and 16 are readable for readers aged 12 and over and can be used to display Arabic texts on screen. In the same way, font size 18 is recommended for reading Arabic texts online.

Sequentially, age has been measured as an independent variable to define the optimal font size and type. a readable font size is different according to the age of the reader. E.g. the reading speed of students aged 10, when reading text presented using Arabic Traditional in size 18 (M= 13.50/ SD= 2.76), is longer than students aged 12 who read the same text in size 16 (M= 8.20/ SD= 1.69) by 55.67%. In addition, it is notable that the difference in reading performance between age groups 10 and 11 is similar in all font sizes and types. For instance, comparing the reading speed of students aged 10 in size 10 (Simplified Arabic) with students aged 11 shows a slight difference (3.6%). This convergence in the performance of students in ages 10 and 11 is clearly in sizes 10, 14 and 16.

The effects of character size on participants were more significant with characters of the Arabic language; this is contrary to some research findings that font types impact the reading speed in different languages such as English (Feely, Rubin et al. 2005). Besides, Alotaibi (2007) investigated the effect of font size and type on reading speed in printed Arabic text and concluded that font type as well as font size impact the reading speed. Therefore, reading Arabic on screen for children aged 10 to 12 is not influenced by font types as in other languages.

In order to investigate the difference in reading performance among students based on gender, this is used as an independent variable to clarify its impact on this

type of research. Most previous research was not concerned with finding out if there was a difference in reading performance to avoid this variable in future research. However, the findings of this experiment showed no difference in reading performance between male and female students .

Analysing the list of errors for each student shows that the errors are mainly due to the shape of the characters. Data analysis led to the classification of errors into four types:

- Two characters that are connected in the middle and have dots at the top or bottom.
- More than two characters being connected in the middle and have dots at the top or bottom.
- Characters have dots and vowels.
- Characters are without dots and have similar letters with dots

Finally, the main findings are summarized in Table (96).

**Table 96: show the summary of findings.**

<i>Task</i>	<i>Measures</i>	<i>Findings</i>
<b>Font 10</b>	<b>Reading speed</b>	<ul style="list-style-type: none"> <li>- The mean time spent to read Times New Roman and Arial is similar (M= 19.83 and M= 18.47 respectively).</li> <li>- The highest mean is 20.10 m.</li> <li>- Courier New font records less time than the other fonts.</li> <li>- Reading speed is slow in all font types compared to other sizes.</li> </ul>
	<b>Word error</b>	<ul style="list-style-type: none"> <li>- The average word error is high in all font types.</li> <li>- The average error differs between font types, where the mean error in the Arial font is the highest (.424) while Courier New font records the lowest error in this size.</li> <li>- No statistically significant difference in error between students in different age groups.</li> </ul>
<b>General findings</b>		<ul style="list-style-type: none"> <li>- Arabic text in font size 10 is not readable by students aged 10 to 12.</li> <li>- There is no significant difference between readers in the five font types.</li> <li>- The average error is the highest compared to other sizes.</li> </ul>
<b>Font 14</b>	<b>Reading speed</b>	<ul style="list-style-type: none"> <li>- The average time spent in size 14 is less in all font types than size 10 with the exception of Courier New font which takes (1.84 m) more than a size 10.</li> <li>- There is no significant difference in the mean time taken to read Traditional Arabic (M= 16.37), Courier New (M= 16.17) and Times</li> </ul>

		New Roman (M= 16.10).
	<b>Word error</b>	- The median error percentage for size fourteen of Arabic Traditional is found to be significantly larger than the error provided by the median error for sizes sixteen and eighteen.
<b>General findings</b>		- Reading speed is a little faster than font size 10 but is still slow compared to sizes 16 and 18.
<b>Font 16</b>	<b>Reading speed</b>	- The average of time is reduced in all font types. - The mean time for Times New Roman (M= 13.63) is less compared to other fonts. - The mean time spent in reading is similar to Arabic Traditions (M= 14.60), Courier New (M= 14.73), Simplified Arabic (M= 14.67) and Arial (M= 14.03).
	<b>Word error</b>	- The average reading error is decreased notably in all font types. - The percentage of error in Arabic Traditional font in size 16 is less than size 14 by 61%. - Simplified Arabic font has the highest mean of the error (M= .074).
<b>General findings</b>		- It is more readable for readers aged 12 than 10 and 11. - There is no significant difference in reading speed between students aged 10 and 11 in this size.
<b>Font 18</b>	<b>Reading speed</b>	- Reading speed is improved in all font types. - Traditional Arabic has the longest time in reading (M= 11.20m) while Simplified Arabic has the shortest time (M= 9.07).
	<b>Word error</b>	- The averages of error in this size improve in all font types. - The percentage of error in Simplified Arabic font is less than Arabic Traditional font by 51.85%; the percentage of error in the Simplified Arabic font is less than the Courier New font, Arial and Times New Roman by 38.46%. - There is no significant difference in error mean between Courier New, Arial and Times New Roman (0.035, 0.36, 0.035) respectively.
<b>General findings</b>		- All students aged 10 and 11 prefer font size 18 for reading from the screen. - Age has a significant effect on reading speed. - Gender has no significant effect on reading speed. - There is a correlation between reading level and reading speed. - Fonts of sizes sixteen and eighteen are more readable than any font smaller than sixteen. - There is a strong difference in error percentages among the four Arabic Traditional groups ( $\chi^2= 82$ , p-value < .001). - The median error percentage for size sixteen in Arabic Traditional does not differ significantly from the median error for size eighteen. - A high reading speed is positively combined with a high error rate.

### **Second factor: font type**

Font type was reported by several researchers as one of the factors that has significant influence on the legibility level of online reading (Alotaibi 2007; Asmaa and Asma 2009; Banerjee, Majumdar et al. 2011). The width of the characters is not the same in all the font types which leads to a different level of vision. The average

error rate was different between the five fonts, e.g. the average error in sizes 16 and 18 in font Courier New is noted to be highly significant, more than in the Arabic Traditional font. In addition, the average error in font 10 and 14 of the same font type is much closer to each other than in sizes 16 and 18.

Courier New was reported as a more legible font for children because the space between the words is wider than in other fonts; in the same perspective, no significant difference was noted between three font types: simplified Arabic, Times New Roman, and Arial. This finding goes in the same line as Asmaa and Asma ( 2009) who recommend using Simplified Arabic font for children’s reading, while Alotaibi ( 2007) claimed that Times New Rowan was read faster in Arabic print texts.

Arabic traditional font should be avoided when designing Arabic texts for children even if the Arabic traditional font in size 16 was more readable than the Simplified Arabic font of the same size. Table (101) provides a summary for the main findings that help the designer and educator when selecting optimal font types for presenting text in a school book.

**Table 97: summary for the main findings.**

<b>Task</b>	<b>Measures</b>	<b>findings</b>
<b>Arabic traditional</b>	Word error	<ul style="list-style-type: none"> <li>- The average of error is the high between all the testing fonts.</li> <li>- There is no significant different in readability between size 16 and 18.</li> <li>- It is more readable than courier new in size 16.</li> </ul>
<b>Courier new</b>	Word error	<ul style="list-style-type: none"> <li>- The average of error between students is the best in size 10 and 14 comparing the other font types.</li> <li>- There is a significant different in reading speed and word error between 16 and 18 in the same font.</li> </ul>
<b>Times New Roman</b>	Word error	<ul style="list-style-type: none"> <li>- There is a significant different in mean of number of error between sizes 10 and 14.</li> <li>- There is no significant different in mean of error in size 16 between times new roman and Arial font (<math>M=.072</math>).</li> </ul>
<b>Arial</b>	Word error	<ul style="list-style-type: none"> <li>- Average of error in size 10 is the high comparing with other fonts.</li> </ul>
<b>Simplified Arabic</b>	Word error	<ul style="list-style-type: none"> <li>- It is the best in size 16 and 18.</li> <li>- it is the best to present Arabic text in size 18 for young children.</li> </ul>

### ***Third factor: Line length***

In chapter three, several questions related to defining the optimal length line for reading from screen was asked, and the literature on the reading area did not provide

any clear consensus in this case, with some emphasising the influence of line length on reading speed and accuracy (Creed, 1987, Dyson and Kipping, 1997, Chaparro et al., 2005, Maria dos Santos Lonsdale, 2006)(Asmaa and Asma 2009) , while others deny or at least reduce the influence of this factor on the legibility of the online text (Dyson and Kipping 1997). Examining the procedure followed by a majority of these studies showed a weak relationship between factors in the one side, and reorientation of the age-group of readers being the cause of these differences on the other. Therefore, in this research more attention was given to factors that impact the legibility of online texts in chapter 3 in order to understand the interaction between these variables and their effect. Based on previous studies that focused on children who viewed e- books (written in English language), two formats was used in this research, a single column and a double column using the Arabic script.

A further comparison of times taken to answering three different types of questions shows different reading speeds. This difference is influenced by multiple factors such as the reading process [scan or skim]. The comparison between the mean reading speed for answering multiple choices through reading texts on a single column and double columns shows that the reading process is affected by students' age, wherein older students were faster when reading through double columns, while students aged 9 preferred a single column in both reading processes.

In the same perspective, Dyson and Kipping (1997) came up with the same finding that people over 24 years old show no differences in reading rate across three columns, while people aged 18-24 are faster when reading a single page column. Simmonds (Simmonds 1994) has looked into the effect of information source types as factors influencing the optimal line length. The study suggested using a single column with wide margins for scientific journals.

In addition, the current research discovered that students who read the entire text searching for answers prefer using a single column. This finding was supported by the findings of Maria dos Santos Lonsdale (Maria dos santos Lonsdale 2006). On the other hand, Asmmaa and Asma (2009) reported different findings which suggest using 2/3 screen line length to improve reading speed for Arab children without any explanation of the factors that lead to this finding.

Moreover, the reading level was used as a second independent variable to investigate the optimised line length using different reading processes, wherein this variable was reported as significant. Students with a high reading level found a single column quicker to read when searching for answers to three different types of questions. In addition, little improvement was reported when reading texts presented in short lines by students with a low level of reading.

In general, it can be concluded that selection of the appropriate line length depends on two main factors: reader's age and reading level. The study has shown that readers who are 10 years old or less prefer to read from the long line, while older students prefer the long line in comprehensive reading and short line when searching for specific information.

#### ***8.2.4. Using colour to increases the ability to focus vision when moving from one line to another:***

Younger students' slowness in reading text displayed on screen in double column is due to difficulty scrolling the text as their experience in using computer tools especially the mouse was weak. This does not mean that students do not find it difficult when they read from a long line, but students find this format similar to print book and they deal with it by placing a finger at the beginning of each line to make it easier to move to the next one.

In order to solve this problem, new methods have been proposed in this research; the method was built based on visual theory (Bundesen 1990). The idea assumes that using different colours for the first and last word of each line would help:

- Eyes are fixed and move easily through the text which will enhance reading performance of students when reading through the school textbook.
- Increased retention of text read.
- Improved comprehension.
- Increased accuracy in reading compared with reading text using black text.

The colouring text format (CTF) group shows significant improvement in reading performance compared to the control group who read from black text. The improvement included quiz scores, comprehension and retention. For example,

students in control group were scoring less compared with those who read the (CTF) text. Students with both higher and lower reading levels had significant improvements in reading performance with (CTF) compared to the control group.

Although differences statistically are not significant, it can be seen that there is a clear improvement especially when browsing the full text presented in a single column.

In addition, the mean reading speed improved for a single column with colour too .101 min. In the case of a double column, a significant improvement was noted in reading speed by using colours in double column which also shows improvement in reading speed for younger students ( p- value= .021).

Finally, it is difficult to compare this finding with previous results because of the difference in the research conditions such as language, age, type of text, and reading process. For example, a majority of studies (Dyson and Kipping 1997; Youngman and Scharff 1998; Dyson and Haselgrove 2001; Maria dos santos Lonsdale 2006) has determined the length of the line number of characters, making it difficult to compare. On the other hand, in the Arabic language letters are related to each other and the word count is based on the number of the word.

#### ***8.2.5. Guideline for display academic Arabic text on screen:***

Analysis of the quantitative and qualitative data show several rules to recommend of designers and educators to follow when designing Arabic academic text on screen. As the summary of the result in chapters 6 and 7 points out, there was an effect of reading strategy of selecting a right font size, font type and line length. These results have practical implications for readers involved with Arabic academic text on screen for young readers.

#### **Font size:**

**R1:** font size 10 should be avoided for all students especially for younger students where they cannot distinction between the dots and vowel.

**R2:** font size 16 and 18 should be used, 18 is recommended for reader age 9 to 10.

**Font type:**

**R3:** Arabic Traditional font should be used with size 16 where it is more readable than other font type. In addition, it is a suitable with size 18 for students with difficulty in reading.

**R4:** in size 18, Simplified Arabic font should be used for to present Arabic text on screen especially for young readers.

**Line length:**

**R5:** single column should be used for young students aged 9 to 10 when text presented needs to be scanned carefully, while, there is no difference in line length when skim academic text quickly.

**R6:** there is no difference in reading performance between the two conditions according to gender.

**R7:** short line should be used when designing for students with difficulty in reading in both types of reading quickly or slowly.

**R8:** using a different colour for the first and last word of each line was strongly recommended.

**R9:** double column with using colour for the first and last word of each line should be used when presenting Arabic academic text online.

**8.2.6. Framework of reading factors considered by this research**

The literature review has already shown that there are several factors affecting the legibility of online texts. A schematic representation of the framework is presented in Figure (11) in chapter two where the factors were classified into three groups:

human factors, usability factors, and legibility factors. But the conceptual framework merely gathered these factors based on their effect, making it difficult to draw a clear conclusion that shows the relationship between these variables and the level of their effect. The variables basically were divided into three levels;

**Level one:** factors at this level have a significant effect on readability of the screen. According to previous research on reading and usability field, font size and colour have a significant impact on the readability level of e-text. The font size was reported as the main factor that affects online reading according to the majority of research (Sanocki, 1991, Feely et al., 2005, Bernard et al., 2003)(Bouma 1971; Rudnicky and Kolars 1984; Mills and Weldon 1987; Boyarski, Neuwirth et al. 1998).

**Level two:** consists of three factors: interlinear spacing (which refers to the space between two lines) and the words [single or double spacing], background colour, and finally the line length (which refer to the number of characters in a line). This latter factor is also associated with a font size. In addition, factors in this level mainly related to page design.

**Level three:** factors at this level are less influential than previous factors. These factors are: margins, image, and text location. This is generally related to the structure of the text. A small number of researchers considered the effect of these factors when designing eBook but they have to be considered when designing web pages.

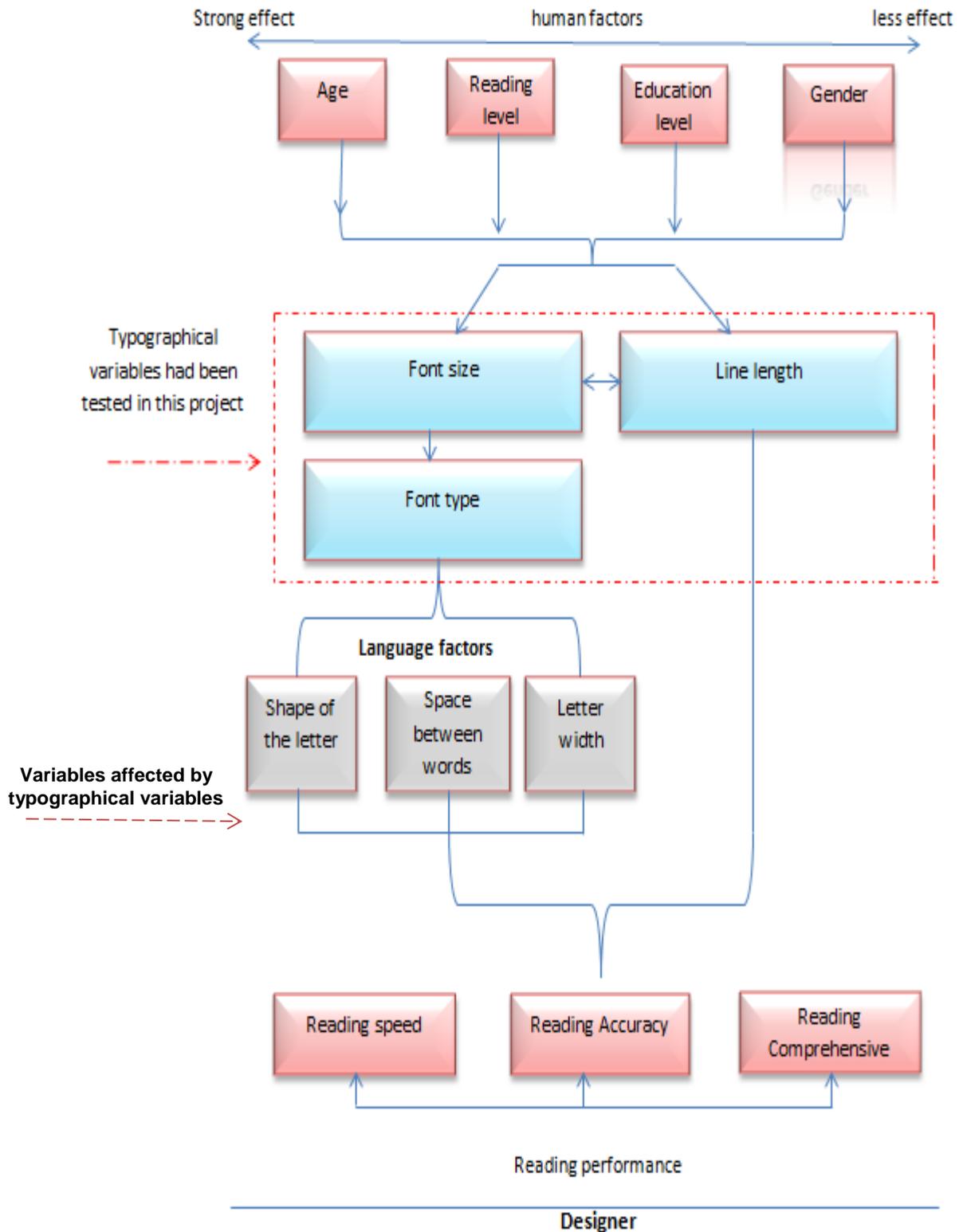
In this project, three topographical variables were measured for their effect on reading performance according to reading processes, taking into account for human variables: age, education level, gender, and reading level. Figure (64) presents a framework explaining the relationships between these three variables where the quantitative data collected in experiments (2) and (3) show that there is a significant correlation between font size and line length, especially when using a number of words or characters to define the line length. At the end of the research, it has become clear to the researcher that there is a group of elements related to each other and should be considered by designers and researchers. In addition, when a designer plans to design e- material, s/he must understand the relationship between several of these elements and consider the impact level to each other and on each variable. For example, the designer should start designing by identifying the age of the reader as the first stage

which is directly related to the size of the font, which in turn determines the size of the text on the screen. The framework aims to explore the relationship and type of interaction between elements in order to give assistance to designers; in addition, it is still able to add additional elements.

According to the framework (as seen in figure 64), there are two types of interaction between elements: direct and indirect interaction. This will now be described in detail.

- ***Direct interaction (DI)***: there are two levels of direct interaction between the variables, one between elements in the same level e.g. there is direct interaction between font size and line length where increasing the font size will decrease the number of characters per line. In addition, other direct interaction was recorded according to the analysis of qualitative data in chapter (2) between the reading strategy and purpose of reading the text. The second type of direct interaction occurs between elements from a different group, e.g. findings of experiments (3) that investigate the optimal line length for reading based on type of questions, and reported a significant relationship between the strategy of reading and line length.
- ***Indirect interaction (II)***: this type of interaction occurs during the interaction between different variables. For example, font size differs from font to font. This difference affects the size of the text and the number of characters in each line in an indirect way. In addition, the reading speed is affected by font size indirectly, making it easier to distinguish between characters and dots. In addition, factors related to reading performance are influenced by human factors such as age and reading level. These will also be affected by typographical factors.

Figure 61: Framework for interaction between three typographical variables and other factors.



### **8.3. Conclusion:**

This chapter mainly addressed the findings of this research which may be summarised into four aspects:

- Investigating the use of the internet among students in years 4, 5 and 6 in a Libyan school. The collected data was used as a starting point for next phases of research.
- Defining the reading process in terms of the schoolbook by building two reading models each model present action of students when reading Arabic schoolbook in electronic and paper format .
- Defining the factors that influence the reading of e-texts by children with focus on the effect of three factors in the Arabic text: font size, font type, and line length. Through exam the previous researches, a model show the factors affect using electronic text was built. This model has the ability to present affected factors as a group.
- Using colours to enhance the ability to focus vision when moving from one line to another.

In addition, several explanations and interpretations were made regarding the various associated factors that influence the reading of Arabic texts.

# Chapter nine: conclusion and future work.

## 9.1. Introduction:

This thesis is an attempt to examine the effect of reading processes on designing e-texts for children using Arabic script. In addition, it aims to develop a model for designing acceptance that will have the power to demonstrate acceptance and usage behaviour of the e-school text using a schoolbook for primary schools in Libya. Alternatively, dealing with the research problem led to the specification of the following research objectives, which were achieved through four inter- related surveys:

- To build an e-reading strategy for a schoolbook based on users' cognitive and behaviour processes.
- To define the typographical variables that affect reading Arabic texts from the screen such as font size, font type, background color, line length and text format from a literature survey.
- To provide a standard that can help keep children`s concentration on the text.
- To create a guideline that could help designers when designing e-Arabic texts for children.
- To examine in-depth the challenges of reading Arabic e-texts.
- To study the efficiency of Arabic text reading and the factors impacting the efficiency of reading and comprehension.
- To understand children's behaviour when reading from a screen.

The aim of this chapter is to discuss the study's contribution to knowledge and provide recommendations for future research.

## 9.2. Significance of the study:

Several studies have reported that reading electronic text leads to changes in the reading and learning processes. This calls for research aimed at understanding the

reading processes, cause of these changes, defining the requirements for meeting these changes, and then to connect it with the reading purpose. This in turn will lead to designing e-learning material that is able to meet readers' requirements and educators. This study seeks to examine the general significance of the reading process of electronic text and the factors that affect reading Arabic electronic texts for children so as to provide a standard to help the interface designer to design an interface that makes the user feel comfortable and work efficiently as well as developing a theory of presenting e-texts for children's learning.

Thus, this study will be useful for at least three aspects; designing the electronic resources, e-reading, and educational aspect. In addition, understanding the proposed model may help analyse the reasons for the resistance toward the e- text and would also help to bring about efficient measures to improve reading on screen. In the same context, highlighting the reading stage in terms of the schoolbook will help consolidate factors such as the social and learning processes.

Moreover, e-text will enable changes in the reading and learning processes. Also, reading an e-text can have several advantages over traditional reading as the reader or learner is able to apply animation in learning, and increase control and interaction with the learning material. All these will lead to improvement in the quality of learning. Thus, analysis of the text and connecting it with the reading purpose and reader's skill will help meet those requirements that should be available when displaying texts on screen. In addition, the findings of this research can help build e-curricula that are easy and effective to be read and used by all Arabic learners.

On the other hand, most of the research on reading e-texts among children have been done in the context of Western languages e.g. (Yolanda Jacobs 2009) and a few in Chinese e.g. (Tzeng, Tsai et al. 2008). This study extends the work already started by Asmaa Alsumait and Asma Al-Osaimi (NISO 2005; Asmaa and Asma 2009) using Arabic language . Both works have addressed a small part of the whole field without providing explanations to show how and when these factors can influence e- reading.

Moreover, the quality of screen display is usually discussed in terms of the resolution, that is, the maximum number of dots or pixels. In this study, we try to examine all the factors that affect reading on screen such as presentation factors, reader

factors and physical factors, but the main focus will be on factors related to displaying the text.

### **9.3. Contribution to knowledge:**

The contribution of this research is mainly in the area of reading. This contribution is related to the gap reported in this area as reviewed in chapters (2) and (3). Furthermore, many studies have demonstrated the extent of interest in measuring the effectiveness of the use of electronic text in higher education and how to employ e-material by academic libraries without giving the same attention to the use of information technology (IT) in early learning. This means that most children's e-books are not satisfactory as tools for supporting learning (Wilson, Landoni et al. 2003; Korat and Shamir 2004).

In general, the objectives of research are to bring more qualitative results into a quantitative area, drawing a balance between quantity and quality of results and developing more effective information in the legibility area. The experimental findings demonstrated that;

- The questionnaire survey has evaluated the present situation of eBook and internet usage in primary schools based on the five schools in Libya as a sample population. This is supportive in terms of achieving a good awareness of how eBooks and the Internet are being managed by students and the reasons why students do, and do not, use eBooks and the Internet. The findings are of value to educators and designers who wish to increase eBook awareness and usage amongst students.
- The follow-up study findings are useful in considering students' reactions and attitudes towards the schoolbook in two formats paper and eBooks, particularly on how students consult e-books for the learning purpose. The study is important, for designers in terms of improving eBook layout, for educators in terms of using the eBook effectively, and to school and children libraries in terms of improving e-book collection management.

- The thesis contributed to producing guideline rules that could, potentially benefit the designers of academic Arabic text for readers age 9 to 13. This need has come from the specialization of Arabic characters. However, the guideline provides to designers a package of rules such as; defining readable font size and determining the optimal font type.
- The experimental findings demonstrated that the reading process has a significant influence in designing online text. In the literature there are attending that the designing requirements are affected by several elements such as type of material (web page (Scane 2003; Hartley 2004), e- news or eBook (Dillon 2001; Dyson 2004)), readers` age (Cheyne 2005), prior knowledge (Panayiota and Paul van den 2007) or subject (history, math or story (wolf 2007)).
- The findings of experiment 3 consistently suggest that the reading strategy used by readers has a significant effect on selecting the optimal line length for reading online Arabic academic text. Thus, double column was suggested for presenting text for slow reading between students age 11,12, and 13 and a single column for quick reading, while, students` age 9 and 10 prefer the single column in both strategies.

The contributions of this project are summarised in Table (98) and may be divided into four aspects: reading process, designing e- text for children, using the internet and eBook in education, and method to increase the ability of reading.

**Table 98: The gap in the field and the contributions of this research.**

Related area	Major trends and issues	Identified gaps	This study's contribution
Reading process	<ul style="list-style-type: none"> <li>- Empirical literature present two implicit views; scanner of short texts searching out spelling mistakes, and searching for target information.</li> <li>- Most of the research on reading process is from cognitive psychology.</li> <li>- Theoretical input in reading domain commonly concerned with issues such as memory organisation or learning.</li> <li>- The majority of research focused on how humans extract information from the text</li> </ul>	<ul style="list-style-type: none"> <li>- Absence of a suitable descriptive framework of the reading process that would enable designers concerned with electronic texts to find guidance for specific design applications.</li> <li>- Psychological models of reading that consider text manipulation are limited.</li> </ul>	<ul style="list-style-type: none"> <li>- Developing more reading approaches in this area.</li> <li>- Bring more qualitative findings in the online reading area to enrich it.</li> <li>- Two models of reading process were built according to users' interaction with the school textbook. These models will not only help define the interaction amongst users and e-books, but will also help designers to understand user behaviour re e-books and thereby to establish the most appropriate functions/features when building an e-book interface.</li> </ul>
Designing e- text for children/ Factors influencing reading from screen	<ul style="list-style-type: none"> <li>- Empirical literature shows quite a number of factors that influence reading through the screen but a limited number of these research focus on explaining the relationship between these variables and provide a framework to help understand this effect when designing e-text.</li> <li>- Studying of typographical factors shows a significant influence of these factors on reading performance.</li> </ul>	<ul style="list-style-type: none"> <li>- The studies in general focus on reading a web page while few researchers focused on reading e-book.</li> <li>- Three studies were focused on Arabic script.</li> <li>- A limited number of studies concentrated on children.</li> <li>- Paying less attention to factors that affect the legibility of Arabic texts.</li> <li>- Shortage of in-depth understanding of end users' feeling, action and attitude.</li> </ul>	<ul style="list-style-type: none"> <li>- The framework can be the basis for digital document usage. It is used as a starting point and is intended to offer a conceptual aid in electronic text design.</li> <li>- Identify the optimal font size for reading an Arabic script from screen by children aged 9 to 13.</li> <li>- Producing more in-depth results to develop more effective designing principles for online texts.</li> <li>- Based on collecting data from experiments (2) and (3), the model explains the interaction between three topographical variables [font size, font type and line length] and their relationships with independent variables were also provided.</li> <li>- Framework shows the factors that influence reading, and</li> </ul>

			using e- content was suggested according to previous studies.
Using the internet and e- book in education.	<ul style="list-style-type: none"> <li>- Theoretical perspective on this subject shows an increase in the number of people who use the internet and e- book for different reasons.</li> </ul>	<ul style="list-style-type: none"> <li>- The majority of the research merely focused on defining the average use and paid little attention to issues related to the theory aspect.</li> </ul>	<ul style="list-style-type: none"> <li>- Students use the internet for multiple purposes that may be classified into two categories: non-academic and academic use.</li> <li>- Boys and girls use the internet for the same purposes such as gaming and mailing but the average use is different where boys tend to use the internet for gaming more than girls, while girls tend to listen to music and download videos more than boys.</li> <li>- Participants state several reasons for not using the e- book such as quality of Arabic e- book and lack of knowledge of their existence.</li> <li>- E- book is not a familiar source of information for students in Libya's primary schools.</li> </ul>
Increase the ability of reading from screen.	<ul style="list-style-type: none"> <li>- Focus on improving the technology such as speed and storage capacity, more than improving the way of presenting the context.</li> </ul>	<ul style="list-style-type: none"> <li>- Absence of methods that take into account the needs of each reader and information source.</li> </ul>	<ul style="list-style-type: none"> <li>- Using colour to increase the ability to focus vision when moving from one line to another so as to improve the screen display.</li> <li>- Create a new display technique to improve the legibility of reading Arabic online texts.</li> </ul>

## 9.4. Limitation

There is no doubt that in all academic research, it is impossible to be free from borders which prevent the generalization of results to other populations; consequently, this study, like all studies, has limitations. These can be summarised as follows:

1. *The study is restricted to Arabic script.* Because the studies are concerned with the structure of the Arabic language and to compare it with other languages, several differences become apparent such as the writing direction and use of vowels, which may lead to differences in the way of dealing with it.
2. Reading performance is affected by the reader's age as several researchers have reported; thus, this study is confined to children aged 9 to 13. Also, this study is focused on the development of e-Arabic literacy from the perspective of improving the way of presenting e-texts to children. However, in the current study, there was no opportunity to involve other participants from other Arab countries, even though all the participants are studying in a school in Libya and in a Libyan school in the UK.
3. The e-text legibility evaluation only focused on factors related to displaying text, with a particular focus on font size, font type, using colour and line length which have been highlighted in some studies as influential factors (Huang, Patrick Rau et al. 2009; Shu and Zhou 2010). But in this study have been tested using different methods, language, information resources and age range.
4. In this study, all materials used were taken from the Libyan schoolbook. This type of material was chosen because it has been evaluated by educators in terms of relevance to students' age and their level of education.
5. Finally, this study focused on viewing e-texts on a computer screen; it is hard to generalize the findings to other type of viewing text such as PDF files.

## **9.5. Recommendations for further research:-**

The new perspectives emerging from the investigations of this research open up the field for further studies including:

- Investigating the effect of the colour factor on improving the legibility of Arabic texts on screen for children, e.g. use different colours to distinguish between dots and vowels.
- Exploring and developing an e-reading model based on all the factors discussed in the empirical studies on the reading field which will lead to building more theories on e- reading.
- Investigating the influence of the subject as a variable affecting the reading process and the variables that have a positive or negative impact on it.
- Applying a model that uses colour to increase the ability to focus vision using different ages and types of information such as journals or books.

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# Appendixes

## Appendix (1): Questionnaire survey for e- books awareness and using the internet

Thank you for participating in this survey. This survey is being conducted to assess user awareness of e- books and to measure the level of e- book usage. Your privacy is considered to be paramount and the information you provide will be hold securely and used only for the purpose of this research. All data will be anonymous and will be destroyed at the completion of the research.

### **Part (1):**      *Participant`s details.*

1. What is your gender? Male       female
2. Age: 9  10  11  12  13
3. What is the level of your studies? Level 4       level 5  level 6

### **Part (2)**

#### **Section A:**      *“Use internet”*

4. Do you have computer at home?      Yes       no
5. If yes, do you connect to internet?      Yes       no
6. I do use internet?      Yes       no
7. I use the internet daily?      Yes       No
8. I use the internet at least once a week?      Yes       No
9. I use the internet occasionally?      Yes       No
10. I do not use the internet at all?      Yes       No
11. Where do you use the internet?

At home  at school  at net café

12. How long do you use the internet daily?

Half an hour  one hour  two hour  three hour  more

13. How many computers do you have at home? One  more than one

14. Do you have account in social network? Yes  No

15. If yes which one?  Facebook  twitter  both

16. Reason of using internet:

- |  |                          |  |                          |
|--|--------------------------|--|--------------------------|
| <input type="checkbox"/> - Improve skill.      | <input type="checkbox"/> | <input type="checkbox"/> - Share information.  | <input type="checkbox"/> |
| <input type="checkbox"/> - Play computer game. | <input type="checkbox"/> | <input type="checkbox"/> - listening to music. | <input type="checkbox"/> |
| <input type="checkbox"/> - Doing homework.     | <input type="checkbox"/> | <input type="checkbox"/> - E- Mailing.         | <input type="checkbox"/> |
| <input type="checkbox"/> - Chatting.           | <input type="checkbox"/> | <input type="checkbox"/> - All.                | <input type="checkbox"/> |

**Section B: Use an e- book.**

17. Were you aware that e- book is available online? Yes  no

18. Have you used an e- book before? Yes  no

19. Were you familiar with the term e- book before this survey?

Yes  No  No answer

20. If yes, for what purpose did you use these e- books?

- To find material for project.
- To look up the answer to a specific question.
- To support research work.
- To read as a recommended course book.
- To entertainment.
- Other (please specify).

21. What of the following types of e- book for children do you use? ( please tick all which apply)

- Story books
- Reference books.
- Text books.
- Special internet books
- Other (please specify).

22. What types of e- book format have you used? ( please select all that apply)

Computer based  Device based  other

(please specify).....

23. How have you read these e- books?

On screen  downloaded file  printed out

**Section D: Using schoolbook.**

- 24. Do you use the figure and image when reading schoolbook? Yes  No
- 25. It is easy to link the shapes in the book with the text? Yes  No
- 26. Do you take note when reading? Yes  No
- 27. Do you use the table of content when searching for the lesson? Yes  No
- 28. Do you read the question first? Yes  No
- 29. Do you read the lesson first? Yes  No

Appendix (2): Questionnaire survey for e- books awareness and using the internet (Arabic version).

اعزاء الطلاب:

اتقدم لكم بجزيل الشكر والتقدير الي كل من شارك في هذه الدراسة الي تهدف الي تقييم الوعي باستخدام الكتاب الالكتروني والانترنت . المعلومات التي تقدمها سوف يتعامل معها بشكل آمن وتستخدم فقط لغرض هذا البحث. وسوف تكون جميع بيانات مجهولة المصدر وسيتم التخلص منها عند الانتهاء من البحث.

**الجزء الاول: بيانات شخصية**

1. الجنس: - ذكر  أنثي

2. العمر: .....

3. السنة الدراسية: الثالث  الرابع  الخامس  السادس

**الجزء الثاني:**

**القسم الاول: استخدام الحاسوب:**

4. هل تمتلك حاسوب في البيت. نعم  لا

5. اذا كانت الاجابة بنعم: هل جهازك متصل بالنت في البيت. نعم  لا

6. هل انت من مستخدمي الانترنت نعم  لا

7. هل تستخدمه يوميا نعم  لا

8. هل تستخدمه اسبوعيا نعم  لا

9. هل تستخدمه شهريا نعم  لا

10. انا لا استخدم الانترنت نعم  لا

11. اين تستخدم الانترنت . المنزل  المدرسة  مركز النت

12. اذا كانت الاجابة بنعم, كم حاسوب تمتلك في البيت. 1  2  3  اكثر من 3

13. هل تستخدم الانترنت في المدرسة. نعم  لا

14. اذا كانت الاجابة ب (لا) ارجو ذكر الاسباب.

15. اذا كنت تستخدم النت بالمدرسة فما هو الغرض من الاستخدام

فهم الدروس  كتابة بحوث  اداء الواجبات المدرسية

16. ما الغرض من استخدام الن

السماع الي الموسيقية  الدردشة  مشاهدة الافلام  
 تصفح مواقع مرتبطة بالمنهج الدراسي  البحث عن معلومات ترتبط بالدرس  
 قراءة كتب الالكترونية  الدردشة  العاب  مراسلة

17. اذا كنت تستخدمه يوميا بمعدل كم ساعة.

اقل من ساعة  ساعة  اكثر من ساعة  ساعتين اكثر من ساعتين  
 نعم  لا

18. هل هناك من يساعدك في اختيار المواقع.

19. اذا كانت الاجابة بنعم من يقوم بمساعدتك. احد الوالدين  احد الاصدقاء

### القسم الثاني : استخدام الكتاب الالكتروني:

20. هل تستخدم الكتاب الالكتروني قبل هذه الدراسة؟

نعم  لا

21. هل تدرك ما المقصود بكلمة كتاب الالكتروني؟

نعم  لا

22. اي نوع من المصادر الالكترونية الاتية تستخدم

- القصص .....

- الكتب المرجعية .....

- الكتب النصية.....

مصادر اخري تذكر.....

23. هل تقرأ الكتب من علي الشاشة  تنزيل  مطبوع

### القسم الثالث: استخدام الكتاب المدرسي.

24- هل تستخدم الاشكال التوضيحية الموجودة في الكتاب المدرسي؟

نعم  لا

<input type="checkbox"/>	لا	<input type="checkbox"/>	نعم	25- هل من السهل الربط بين النص المصاحب الي الشكل التوضيحي؟
<input type="checkbox"/>	لا	<input type="checkbox"/>	نعم	26- هل تقوم بتدوين ملاحظات عند القراءة ؟
<input type="checkbox"/>	لا	<input type="checkbox"/>	نعم	27- هل تستخدم قائمة المحتويات عند البحث عن درس من الدروس؟
<input type="checkbox"/>	لا	<input type="checkbox"/>	نعم	28- هل تقوم بقراءة السؤال اولا ثم تقوم بالبحث عن اجابته؟
<input type="checkbox"/>	لا	<input type="checkbox"/>	نعم	29- هل تقوم بقراءة الدرس ثم تقوم بالإجابة علي الاسئلة

Appendix (3): form for record reading process.

**Reading process**

Date:...../2/11time:.....name of school:.....Education of level: ..... Lesson title:.....

The main active	Students									
	1	Note	2	note	3	note	4	note	5	note
Read the instructions( AC1)										
Identify a purpose of reading. (AC2)										
Read through the questions. (AC3)										
Skim the passage to have general idea. (AC4)										
Quickly read the whole passage. (AC5)										
Read the whole passage quite slowly. (AC6)										
Underline the key words in question. (AC7)										
Underline the key words in the passage. (AC8)										
Underline the main idea of each paragraph. (AC9)										
Scan the passage in order to find the key word. (AC10)										
After finding the key word in the passage read the text around it carefully. (AC11)										
Connecting one part of the										

text to another. (AC12)										
General notes. (AC13)										
Rereading. (AC14)										
Anything else										

## Appendix (4): Screener questionnaire

**1) Do you wear contacts or eyeglasses in order to read the computer screen?**

Yes [  ] No [  ]

**2) Are your glasses for:**

Reading only [  ]

Seeing distant objects only [  ]

Both [  ]

**3) Can you read a computer screen and the web without difficulty with your contacts or eyeglasses on?**

Yes [  ] No [  ]

**4) Do you have cataracts?**

Yes [  ] No [  ]

**5) Do you have any eye implants?**

Yes [  ] No [  ]

**6) Do you have glaucoma?**

Yes [  ] No [  ]

=====

Appendix (5): examples of student's errors.

Personal details ( 270 )		
Name:	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time	End time
Lesson 1: 10 point. 270	05:40: 03	05:45:54
	<p>رَسَلَ اللهُ تَعَالَى نَبِيَّهُ إِبرَاهِيمَ إِلَى قَوْمِهِ، وَكَانُوا بِالْعِرَاقِ، يَعْبُدُونَ الْأَصْنَامَ، فَدَعَاهُمْ إِلَى عِبَادَةِ اللهِ تَعَالَى وَخَدَّه، وَتَرَكَ عِبَادَةَ الْأَصْنَامِ الَّتِي لَا تَسْمَعُ وَلَا تُبْصِرُ، وَلَا تُغْنِي عَنْ أَحَدٍ شَيْئًا. فَلَمَّا لَمْ يَسْمَعُوا لَهُ، كَسَّرَ أَصْنَامَهُمْ، فَحَكَّمُوا بِإِخْرَاقِهِ فِي النَّارِ، وَالْقَوْهَ فِيهَا، فَتَحَاَّهُ اللهُ تَعَالَى مِنْهَا، فَصَارَتْ بَرْدًا وَسَلَامًا، ثُمَّ بَعَدَ ذَلِكَ خَرَجَ إِبرَاهِيمَ عَلَيْهِ السَّلَامُ مِنْ بِلَادِ الْعِرَاقِ، وَذَهَبَ إِلَى الشَّامِ؛ لِيَتَمَكَّنَ مِنْ عِبَادَةِ اللهِ وَخَدَّه، وَسَأَلَ اللهُ سُخْرِيَّهَ وَتَعَالَى أَنْ يَهَبَ لَهُ بَعْضَ الْأَوْلَادِ الصَّالِحِينَ فَبَشَّرَهُ اللهُ تَعَالَى بِوَلَادَةِ ابْنِهِ إِسْمَاعِيلَ، وَقَالَ: إِنَّهُ سَيَكُونُ حَلِيمًا عَاقِلًا .</p> <p>وَلَمَّا كَبُرَ إِسْمَاعِيلُ، وَاسْتَطَاعَ أَنْ يُسَاعِدَ أَبَاهُ عَلَى عَمَلِهِ، رَأَى أَبُوهُ إِبرَاهِيمَ فِي الْمَنَامِ أَنَّهُ يَذْبَحُهُ، فَعَلِمَ أَنَّ هَذَا أَمْرٌ مِنَ اللهِ عَزَّ وَجَلَّ بِذَبْحِهِ، فَصَبَّ عَلَى وَوَلَدِهِ مَا رَأَى، فَامْتَنَلَ إِسْمَاعِيلُ أَمْرَ اللهِ تَعَالَى، وَقَالَ لِأَبِيهِ: أَفْعَلْ مَا تُؤْمَرُ، سَتَجِدُنِي إِنْ شَاءَ اللهُ صَابِرًا، فَأَخَذَ أَبُوهُ السَّكِّينَ، وَأَضْحَجَهُ عَلَى جَنْبِهِ، حَتَّى كَانَ جَنْبُهُ وَخَدُّهُ عَلَى الْأَرْضِ، وَوَضَعَ السَّكِّينَ عَلَى رَقَبَتِهِ امْتِثَالًا لِأَمْرِ اللهِ تَعَالَى، وَإِسْمَاعِيلُ صَابِرٌ، لَا يُبْذِي جِرَاكًا، وَعِنْدَئِذٍ نَادَى اللهُ تَعَالَى إِبرَاهِيمَ: لَقَدْ نَقَدْتُ الْأَمْرَ، فَلَا تَذْبَحِ الْعِلَامَ، وَإِنَّكَ وَإِنَّكَ لِمِنَ الْمُؤْمِنِينَ الصَّادِقِينَ الْإِيمَانِ بِاللَّهِ، وَسَيَحْيِيكَ اللهُ الْحَالِصَ مِنْ هَذِهِ الشَّدَّةِ؛ لِإِحْسَانِكَ، فَأَرْسَلَ اللهُ تَعَالَى إِلَى إِبرَاهِيمَ كِتَابًا عَظِيمًا. وَأَمَرَهُ أَنْ يَذْبَحَهُ، وَخَلَصَ مِنْ تِلْكَ الْمُحَنَّةِ الَّتِي صَبَرَ عَلَيْهَا هُوَ وَإِبْنُهُ أَحْسَنَ الصَّبْرِ .</p> <p>وَقَالَ إِنِّي ذَاهِبٌ إِلَى رَبِّي سَيَهْدِينِ رَبِّ هَبْ لِي مِنَ الصَّالِحِينَ* فَبَشَّرَنَاهُ بِغُلَامٍ حَلِيمٍ فَلَمَّا بَلَغَ مَعَهُ السَّعْيَ قَالَ يَا بُنَيَّ إِنِّي أَرَى فِي الْمَنَامِ أَنِّي أَذْبَحُكَ فَانظُرْ مَاذَا تَرَى قَالَ يَا أَبَتِ أَفْعَلْ مَا تُؤْمَرُ سَتَجِدُنِي إِنْ شَاءَ اللهُ مِنَ الصَّابِرِينَ فَلَمَّا أَسْلَمَا وَتَلَّهُ لِلْجَبِينِ وَنَادَيْنَاهُ أَنْ يَا إِبرَاهِيمُ قَدْ صَدَّقْتَ الرُّؤْيَا إِنَّا كَذَلِكَ نَجْزِي الْمُحْسِنِينَ إِنَّ هَذَا لَهُ الْبَلَاءُ الْمُبْتَلَى وَقَدَيْنَاهُ بِذَبْحٍ عَظِيمٍ</p>	
Lesson 2: 14 point Start time 05:47:23 end time:05:49:33 3	<p>/الشَّامِ /ثُمَّ /تَعَالَى /بِإِخْرَاقِهِ /تُعْنِي /الَّتِي /تَعَالَى /وَكَانُوا /إِبرَاهِيمَ /نَبِيَّهُ /تَلَّهُ /أَبَتِ /فَانظُرْ /فَبَشَّرَنَاهُ /شَاءَ /تُؤْمَرُ /فَامْتَنَلْ /يَذْبَحُهُ /فَبَشَّرَهُ /تَعَالَى /لِيَتَمَكَّنَ /عَاقِلًا /إِنَّهُ /بِذْبَحٍ /قَدَيْنَاهُ /نَجْرِي /الرُّؤْيَا /نَادَيْنَاهُ /الْجَبِينِ</p>	
Lesson 3: 16 point Start time: 05:49:55 End time:05:53:42 2	<p>/فَبَشَّرَنَاهُ /الْمُؤْمِنِينَ /عِنْدَئِذٍ /يُبْذِي /امْتِثَالًا /تُؤْمَرُ /فَامْتَنَلْ /بِإِخْرَاقِهِ /شَيْئًا /تُعْنِي تُؤْمَرُ</p>	
Lesson4:18 point Start time: 05:55:49 End time: 05:58:49 1	<p>فَامْتَنَلْ /فَبَشَّرَنَاهُ /يُبْذِي /تُعْنِي</p>	

Test 2: font size 14.

Personal details ( 270 )		
Name:	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time05:40: 03	End time: 05:45:54
Lesson 1: 14 point.	إِجْسُ / أَخْضَرَ / يَحْوُلُ / تُرَابًا / يَزِي / الْبُهْمَةَ / أَجْمَلُ / تُثْبِتُ / شَحْرَهُ / يَزِي / تُدَجِلُ / الْأَشْيَاءَ / أُرْوَعُ	
Lesson 2: 14 point Start time 05:47:23 end time:05:49:33 3		
Lesson 3: 16 point Start time: 05:49:55 End time:05:53:42 2		
Lesson4:18 point Start time: 05:55:49 End time: 05:58:49 1		

(1)

Personal details		
Name: اصيل	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 11:48: 03	End time: 12:06:
Lesson 1: 10 point.	فَدَعَاهُمْ / تَسْمَعُ / فَلَمَّا / يَسْمَعُونَ / وَالْقَوَّةُ / فَصَارَتْ / ثُمَّ / يَهَبُ / حَلِيمًا عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامُ / يَذْبَحُهُ / فَكُصَّ / فَاثْمَتَلَّ / إِسْمَاعِيلُ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنِيهِ، / امْتِثَالًا / يُبْدِي / تَذْبِجُ / نَفَذَتْ / وَسَيَجْزِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / كَبِشًا / يَذْبَحُهُ / فَبَشَّرَنَاهُ / حَلِيمٍ / بَلَغَ / إِيَّ / أَدْبَاحُ / وَتَلَّهُ / لِلْحَبِيبِ / بَحْرِي / يَذْبِجُ / الْمُبِينُ.	
Lesson 2: 12 point		
Lesson 3: 14 point		
Lesson4:18 point		

(2)

Personal details		
Name: ا عوئشة	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 11:18: 03	End time: 11:30:03
Lesson 1: 10 point.	تُعْطِي / لَمْ / ثُمَّ / لِإِحْسَانِكُمَا / يَهَبُ / حَلِيمًا عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامُ / يَذْبَحُهُ / فَكُصَّ /	

	فَامْتَتَلْ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / اِمْتِثَالًا / يُبْدِي / تَذْبِجَ / نَفَذَتْ / وَسَيَحْرِزُكُمْ / الْخَالِصَ / الشَّدَّةَ / كَبْشًا / يَذْخُهُ / فَبَشْرَنَاهُ / حَلِيمٍ / بَلَعُ / إِيَّيْ / أَدْحُكُ / وَتَلَّهُ / لِلْحَبِيبِ / نَجْرِي / بِذَبْحِ / الْمُبِينِ .
Lesson 2: 12 point Start time :11:24:04 end time:11:31:34	/ لِإِيْتِهَادِي وَالْبِنَاءِ / قَارِنًا / بِهَا / أَنَاهُ / اقْرَأْ / / مُجْتَمَعِهِ / وَكُلِّ / جُمُوعِهِ / لِإِيْتِهَادِي
Lesson 3: 14 point Start time: 11:32:55 End time:11:49:45	نُعِيمَ / تَرْفِيهِئَةً / اشْتَرَاكَهُمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَيِيَّةُ / الطَّبِيعَةُ / الطَّبِيعَةُ / يَبَادِلَانِ / وَيَسْتُخْتَلِفُ / يَجْعَلُهَا / نُرُوءًا // يَفْتَصِرُ / وَأَهْمِيَّتِهِ
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	اتَّفَقْنَا / الْهَيِّنِ / يَبْعَثُ / وَضَيَّعَتْ / أَسْتَفِيدَ / إِيَّاكَ / فَإِنِّي / ثَمِينُ / يَحْتَرِمُ / يَتَسَبَّبُ / التَّمِينَةَ / الْمُسْتَقْبَلِ مُحَدِّدِ

(3)

Personal details		
Name:	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 10:18: 03	End time:10:30:03
Lesson 1: 10 point.	نَبِيَّهُ / وَتَرَكَ / سَجْدِي / رَقَبَتِهِ / وَعِنْدِيذِ / وَابْنِكَ / نُعِي / لَمْ / أَمْ / لِإِحْسَانِكُمْ / يَهَبُ / حَلِيمًا عَاقِلًا / وَسَطَطَاعَ / الْمَنَامِ / يَذْبُجُهُ / فَحَصَّ / فَامْتَتَلْ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / اِمْتِثَالًا / يُبْدِي / تَذْبِجَ / نَفَذَتْ / وَسَيَحْرِزُكُمْ / الْخَالِصَ / الشَّدَّةَ / كَبْشًا / يَذْخُهُ / فَبَشْرَنَاهُ / حَلِيمٍ / بَلَعُ / إِيَّيْ / أَدْحُكُ / وَتَلَّهُ / لِلْحَبِيبِ / نَجْرِي / بِذَبْحِ / الْمُبِينِ .	
Lesson 2: 12 point Start time :10:48:04 end time:10:52:34	/ لِإِيْتِهَادِي تَسِيرُ / سَعَادَتِهِمْ وَالْبِنَاءِ / قَارِنًا / بِهَا / أَنَاهُ / اقْرَأْ / / مُجْتَمَعِهِ / وَكُلِّ / جُمُوعِهِ / لِإِيْتِهَادِي / تَنْتَظِرُ / كَثِيرًا؛ / شَرِيكَ /	
Lesson 3: 14 point Start time: 11:32:55 End time:11:49:45	نُعِيمَ / تَرْفِيهِئَةً / اشْتَرَاكَهُمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَيِيَّةُ / الطَّبِيعَةُ / الطَّبِيعَةُ / يَبَادِلَانِ / وَيَسْتُخْتَلِفُ / يَجْعَلُهَا / نُرُوءًا // يَفْتَصِرُ / وَأَهْمِيَّتِهِ اشْتَرَاكَهُمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ / تَنْفِيدُ /	
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	اتَّفَقْنَا / الْهَيِّنِ / يَبْعَثُ / وَضَيَّعَتْ / أَسْتَفِيدَ / إِيَّاكَ / فَإِنِّي / ثَمِينُ / يَحْتَرِمُ / يَتَسَبَّبُ / التَّمِينَةَ / الْمُسْتَقْبَلِ مُحَدِّدِ / يَنْتَظِرُهُ /	

	فَاسْتَقْبَلَهُ / انْتَظَرْتُكَ / ثَمِينًا
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(4)

Personal details		
Name: رومان	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 10:18: 03	End time:10:30:03
Lesson 1: 10 point.	نَبِيَّهُ / وَتَرَكَ / سَجْدِي / رَقَبَتِهِ / وَعِنْدِيذٍ / وَابْنِكَ / تُعْنِي / مُمْ / نُمُّ / لِإِحْسَانِكُمْ / يَهَبُ / حَلِيمًا عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَقَصَّ / فَاَمْتَنَلْ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنِيهِ، / امْتِنَالًا / يُبْدِي / تَذْبِحَ / نَقَذَتْ / وَسَيَّجِرِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / كَبَسْنَا / يَذْبَحُهُ / فَبَشَّرْنَاهُ / حَلِيمٍ / بَلَعُ / إِيَّ / أَدْبَحَكَ / وَتَلَّهُ / لِلْحَبِينِ / بَحْرِي / يَذْبِحُ / الْمُبِينُ.	
Lesson 2: 12 point Start time :10:54:04 end time:10:58:34	جَبْرِيْلُ / أَقْرَأُ / / وَالْبِنَاءُ / قَارِئًا / بِهَا / أَتَاهُ / أَقْرَأُ يَكُونُ /	
Lesson 3: 14 point Start time: 11:07:55 End time:11:02:45	تُعِيمُ / تَرْفِيهِئَهُ / اشْتَرَاكَهُمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَبِيئَةَ / الطَّبِيئَةَ / الطَّبِيئَةَ / يَبَادِلَانِ / وَيَسْتَحْتَلِفُ / يَجْعَلُهَا / ثَرَوَةً // يَفْتَنِرُ / وَأَهْمِيئَهُ اشْتَرَاكَهُمْ / مُبْتَهَجِينَ / تَحْتَلِفُ تَأْتِيْرُ / أَهْمِيئَهُ / تَنْفِيذُ /	
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	اتَّفَقْنَا / الْهَيِّنِ / يَبْعَثُ / وَضِيَعَتْ / أَسْتَفِيْدَ / إِيَّاكَ / فَإِنِّي / ثَمِينٌ / يَحْتَرِمُ / يَتَسَبَّبُ / التَّمِيْنَةَ / مُحَدِّدٍ / يَنْتَظِرُهُ / فَاسْتَقْبَلَهُ / انْتَظَرْتُكَ / ثَمِينًا /	

(5)

Personal details		
Name: محمد	Age:12	L of ED7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 02:44: 03	End time:02:52:03
Lesson 1: 10 point.	تَعَالَى / بِالْعِرَاقِ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتِهِ / وَابْنِكَ / تُعْنِي / مَا تُؤْمَرُ، / لِإِحْسَانِكُمْ / يَهَبُ / حَلِيمًا عَاقِلًا / بِإِحْرَاقِهِ / خَرَجَ / يَهَبُ / صَابِرًا، / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَقَصَّ / فَاَمْتَنَلْ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنِيهِ، / امْتِنَالًا / يُبْدِي / تَذْبِحَ / نَقَذَتْ / وَسَيَّجِرِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / كَبَسْنَا / يَذْبَحُهُ / فَبَشَّرْنَاهُ / حَلِيمٍ / بَلَعُ / إِيَّ / أَدْبَحَكَ / وَتَلَّهُ / لِلْحَبِينِ / بَحْرِي / يَذْبِحُ / الْمُبِينُ.	

Lesson 2: 12 point Start time :10:54:04 end time:10:58:34	جَبْرِيلُ/اقْرَأْ / وَالْبِنَاءُ/ قَارِئًا / بِهَا/ أَتَاهُ/ اقْرَأْ يَكُونُ/
Lesson 3: 14 point Start time: 11:07:55 End time:11:02:45	تُقِيمُ/ تَرْفِيهِئَةً/ اشْتَرَاكَهُمْ سَنَنْفُلُهُمْ/ مُبْتَهَجِينَ/ الْحَيِيَّةُ / يَتَبَادَلَانِ/ وَبَسَتْ تَخْتَلِفُ/ يَجْعَلُهَا/ ثَرْوَةً// يَمْتَصِرُ/ وَأَهْمِيَّتِهِ/ اشْتَرَاكَهُمْ/ مُبْتَهَجِينَ/ تَخْتَلِفُ تَأْثِيرُ/ أَهْمِيَّتِهِ/ تَنْفِيذُ/
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	انْتَقَمْنَا/ اهْتَبْنَا/ يَبْعَثُ/ وَضِيَعَتْ/ أُسْتَفِيدُ/ إِيَّاكَ/ فَإِنِّي/ ثَمِينٌ/ يَحْتَرِمُ/ يَتَسَبَّبُ/ التَّمِينَةَ/ مُحَدَّدٍ/ يَنْتَظِرُهُ/ فَاسْتَقْبَلَهُ/ انْتَظَرْتُكَ/ ثَمِينًا/

(6)

Personal details		
Name: اروي	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time13:47: 03	End time: no
Lesson 1: 10 point.	يَعْبُدُونَ / بِإِحْرَاقِهِ / لِيَتِمَّ كَنْ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتَهُ / وَإِنَّكَ / تُعْنِي / مَا تُؤْمَرُ ، / لِإِحْسَانِكُمْ/ يَهَبُ / خَلِيْمًا عَاقِلًا/ وَاسْتَطَاعَ/ الْمَنَامَ / يَذْبَحُهُ/ فَكُصَّ/ فَامْتَثَلَ / لِأَبِيهِ/ وَأَضْجَعَهُ/ حَنِيْهِ،/ امْتِثَالًا/ يُبْدِي / تَذْبِحُ/ نَقَدَتْ / وَسَيَحْزِرِكُمْ/ الْخُلَاصَ/ السَّدَّةَ / سَيَهْدِينِ.	
Lesson 2: 12 point Start time :10:54:04 end time:10:58:34	جَبْرِيلُ/اقْرَأْ / وَالْبِنَاءُ/ قَارِئًا / بِهَا/ أَتَاهُ/ اقْرَأْ يَكُونُ/	
Lesson 3: 14 point Start time: 11:07:55 End time:11:02:45	تُقِيمُ/ تَرْفِيهِئَةً/ اشْتَرَاكَهُمْ سَنَنْفُلُهُمْ/ مُبْتَهَجِينَ/ الْحَيِيَّةُ / يَتَبَادَلَانِ/ وَبَسَتْ تَخْتَلِفُ/ يَجْعَلُهَا/ ثَرْوَةً// يَمْتَصِرُ/ وَأَهْمِيَّتِهِ/ اشْتَرَاكَهُمْ/ مُبْتَهَجِينَ/ تَخْتَلِفُ تَأْثِيرُ/ أَهْمِيَّتِهِ/ تَنْفِيذُ/	
Lesson4:18 point Start time: 02:05:35 End time: 02:07:12	no	

(7)

Personal details		
Name: حارث	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	

Test : (1) font size		
time	Start time14:17: 03	End time: 14:25:54
Lesson 1: 10 point.	<p>يَعْبُدُونَ / بِإِحْرَاقِهِ / لِيَسْمَكَنَّ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتَيْهِ / وَأَيْنَكَ / تُعْنِي / مَا تُؤْمَرُ، / يَهَبُ /  خَلِيمًا يُولَدُ / يُسَاعِدُ / فَدَيْنَاهُ / عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامِ / يَذْبُحُهُ / فَفَصَّ / فَاَمْتَنَلْ /  لَأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / امْتِثَالًا / يُبْدِي / تَذْبِحِ / نَفَذْتُ / وَسَيَجْرِيكُمْ / الْخُلَاصَ / الشَّدَّةُ /  سَيَهْدِينِ .</p>	
Lesson 2: 12 point Start time :02:45:04 end time:02:59:34	<p>جَبْرِيْلُ/اقْرَأْ / / يَكُونُ لَهُ / وَازِدِهَارَ وَالْبِنَاءِ / قَارِيًّا / بِهَا / أَتَاهُ / اقْرَأْ /</p>	
Lesson 3: 14 point Start time: 02:69:55 End time:03::09:06	<p>تُعِيْمُ / تَرْفِيهِئَةً / اشْتَرَاكَهُمْ سَنَنْفُلُهُمْ / مُبْتَهَجِينَ / الْحَيْبَةَ / يَتَبَادَلَانِ / وَيَسْتُخْتَلِفُ /  يَجْعَلُهَا / ثَرْوَةً // يَفْتَنَصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكَهُمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ /  تَنْفِيذِ / بِهَا / وَلِكِي</p>	
Lesson4:18 point Start time: 03:15:35 End time: 03:23:12	<p>all the words guse by the وَضِيْعَتُ / تَمِيْنًا /  sentences .</p>	

(8)

Personal details		
Name: محمد	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time05:40: 03	End time: 05:45:54
Lesson 1: 10 point.	<p>يَعْبُدُونَ / بِإِحْرَاقِهِ / لِيَسْمَكَنَّ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتَيْهِ / وَأَيْنَكَ / تُعْنِي / مَا تُؤْمَرُ، / يَهَبُ /  خَلِيمًا يُولَدُ / يُسَاعِدُ / فَدَيْنَاهُ / عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامِ / يَذْبُحُهُ / فَفَصَّ / فَاَمْتَنَلْ /  لَأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / امْتِثَالًا / يُبْدِي / تَذْبِحِ / نَفَذْتُ / وَسَيَجْرِيكُمْ / الْخُلَاصَ / الشَّدَّةُ /  سَيَهْدِينِ .</p>	
Lesson 2: 12 point Start time 05:47:23 end time:05:49:33	<p>تَطْمَحُ / فَتَسْعَدُ / الْمُتَفَضِّلُ وَالْبِنَاءِ / قَارِيًّا / بِهَا / أَتَاهُ / اقْرَأْ / كَبَّ / / إِنَّا /  جَبْرِيْلُ/اقْرَأْ / / يَكُونُ لَهُ / وَازِدِهَارَ</p>	
Lesson 3: 14 point Start time: 05:49:55 End time:05:53:42	<p>تُعِيْمُ / تَرْفِيهِئَةً / اشْتَرَاكَهُمْ سَنَنْفُلُهُمْ / مُبْتَهَجِينَ / الْحَيْبَةَ / يَتَبَادَلَانِ / وَيَسْتُخْتَلِفُ /  يَجْعَلُهَا / ثَرْوَةً // يَفْتَنَصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكَهُمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ /</p>	

	تَنْفِيذِهَا / وَلَكِي وَفَرَانَا / الْحَبِيئَةُ
Lesson4:18 point Start time: 05:55:49 End time: 05:58:49	no

(9)

Personal details		
Name: محمد	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time05:40: 03	End time: 05:45:54
Lesson 1: 10 point.	<p>يَعْبُدُونَ / بِإِحْرَاقِهِ / لِيَسْمَكْنَ / نَبِيَّهُ / وَتَرِكْ / رَقَبَتَيْهِ / وَإِنَّا نَكُفِّرُ / مَا تُوْمَرُ، / يَهَبُ /  خَلِيمًا يُولَادَهُ / يُسَاعِدُ / فَدَيْنَاهُ / عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَصَّ / فَاَمْتَلَنَ /  لَأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / امِثَالًا / يُبْدِي / تَذْبِحَ / نَعَّدَتْ / وَسَيَجْزِيكُمْ / الْخَالِصَ / الشَّدَّةَ /  سَيَهْدِينِ.</p>	
Lesson 2: 12 point Start time 05:47:23 end time:05:49:33	<p>نَطْمَحُ / فَتَسْعَدُ / الْمُتَفَضِّلُ وَالْبِنَاءُ / قَارِنًا / بِهَا / أَنَاهُ / أَقْرَأُ / كِبَ / / إِنَّا /  جَبْرِيْلُ / أَقْرَأُ / / يَكُونُ / لَهُ / وَازِدْ هَار</p>	
Lesson 3: 14 point Start time: 05:49:55 End time:05:53:42	<p>نُقِيمُ / تَرْفِيئِهِ / اشْتَرَاكِهِمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَبِيئَةُ / يَبَادِلَانِ / وَيَسْتَحْتَلِفُ /  يَجْعَلُهَا / تَرْوَهُ // يَفْتَصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكِهِمْ / مُبْتَهَجِينَ / تَحْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ /  تَنْفِيذِهَا / وَلَكِي وَفَرَانَا / الْحَبِيئَةُ</p>	
Lesson4:18 point Start time: 05:55:49 End time: 05:58:49	no	

(10)

Personal details		
Name: محمد	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time05:40: 03	End time: 05:45:54
Lesson 1: 10 point.	<p>يَعْبُدُونَ / بِإِحْرَاقِهِ / لِيَسْمَكْنَ / نَبِيَّهُ / وَتَرِكْ / رَقَبَتَيْهِ / وَإِنَّا نَكُفِّرُ / مَا تُوْمَرُ، / يَهَبُ /  خَلِيمًا يُولَادَهُ / يُسَاعِدُ / فَدَيْنَاهُ / عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَصَّ / فَاَمْتَلَنَ /  لَأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / امِثَالًا / يُبْدِي / تَذْبِحَ / نَعَّدَتْ / وَسَيَجْزِيكُمْ / الْخَالِصَ / الشَّدَّةَ /  سَيَهْدِينِ.</p>	
Lesson 2: 12 point Start time 05:47:23 end time:05:49:33	<p>نَطْمَحُ / فَتَسْعَدُ / الْمُتَفَضِّلُ وَالْبِنَاءُ / قَارِنًا / بِهَا / أَنَاهُ / أَقْرَأُ / كِبَ / / إِنَّا /  جَبْرِيْلُ / أَقْرَأُ / / يَكُونُ / لَهُ / وَازِدْ هَار</p>	

Lesson 3: 14 point Start time: 05:49:55 End time:05:53:42	تُعِيْمُ / تَرْفِيهِمْ / اشْتَرَاكَهُمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَيِيَّةُ / يَتَبَادَلَانِ / وَيَسْتُخْتَلِفُ / يَجْعَلُهَا ثَرْوَةً // يَفْتَصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكَهُمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ / تَنْفِيذُ / بِهَا / وَلَكِي / وَفَرَانَا / الْحَيِيَّةُ
Lesson4:18 point Start time: 05:55:49 End time: 05:58:49	no

(11)

Personal details		
Name:	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 10:18: 03	End time:10:30:03
Lesson 1: 10 point.	نَبِيُّهُ / وَتَرَكُ / سَجْدُنِي / رَفِيَّتِهِ / وَعِنْدِيذٍ / وَابْنِكَ / تُعْنِي / مَمْ / أُمُّ / لِإِحْسَانِكُمْ / يَهَبُ / حَلِيمًا عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامُ / يَذْبَحُهُ / فَحَصَّ / فَاغْتَنَلُ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ / اِمْتِنَالًا / يُبْدِي / تَذْبَحُ / نَقَدْتُ / وَسَيَخْرِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / كَبَشًا / يَذْبَحُهُ / فَبَشَّرْنَاهُ / حَلِيمٍ / بَلَّغَ / إِلَيَّ / أَذْبَحُكَ / وَتَلَّهُ / لِلْحَبِيبِ / بَحْرِي / يَذْبَحُ / الْمُبِينُ.	
Lesson 2: 12 point Start time :10:48:04 end time:10:52:34	/ لِیَهْتَدِي تَسِيرُ / سَعَادَتِهِمْ وَالْبِنَاءُ / قَارِئًا / بِهَا / أَتَاهُ / أَفْرًا / / مُجْتَمَعِهِ / وَكُلِّ / مُجْتَمَعِهِ / لِیَهْتَدِي / تَنْتَظِرُ / كَثِيرًا ؛ / شَرِيكَ /	
Lesson 3: 14 point Start time: 11:32:55 End time:11:49:45	تُعِيْمُ / تَرْفِيهِمْ / اشْتَرَاكَهُمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَيِيَّةُ / الطَّبِيعَةَ / الطَّبِيعَةَ / يَتَبَادَلَانِ / وَيَسْتُخْتَلِفُ / يَجْعَلُهَا ثَرْوَةً // يَفْتَصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكَهُمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ / تَنْفِيذُ	
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	اَتَّفَقْنَا / اِهْتَدَى / يَبْعَثُ / وَضِيَعَتْ / أَسْتَفِيدُ / إِيَّاكَ / فَإِنِّي / ثَمِينُ / يَحْتَرِمُ / يَتَسَبَّبُ / التَّمِينَةَ / الْمُسْتَقْبَلِ مُحَدِّدٍ / يَنْتَظِرُهُ / فَاسْتَقْبَلَهُ / انْتَظَرْتُكَ / ثَمِينًا /	

(12)

Personal details		
Name:	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size 10		
time	Start time: 10:18: 03	End time:10:30:03
Lesson 1: 10 point.	نَبِيُّهُ / وَتَرَكُ / سَجْدُنِي / رَفِيَّتِهِ / وَعِنْدِيذٍ / وَابْنِكَ / تُعْنِي / مَمْ / أُمُّ / لِإِحْسَانِكُمْ / يَهَبُ / حَلِيمًا عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامُ / يَذْبَحُهُ / فَحَصَّ / فَاغْتَنَلُ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ /	

	امثالا/ يُبدي / تَذْبَح/ نَفَذت/ وَسَيَحْرِيكُمْ/ الحَلاصَ/ الشَّدَدَ / كَبِشًا/ يَذْبَحُه/ فَبَشَرْنَاه / خَلِيمَ / بَلَغَ/ إِيَّيْ / أَذْبَحَكَ/ وَتَلَّه/ لِلْحَجِينِ / بَجَزِي/ يَذْبَحُ/المُؤِينُ.
Lesson 2: 12 point Start time :10:48:04 end time:10:52:34	/ لِیَهْتَدِي تَسِيرُ/ سَعَادَتِهِمْ وَالْبِنَاءُ/ قَارِئًا/ بِهَا/ أَتَاهُ/ أَقْرَأُ / /مُجْتَمَعِهِ /وَكُلُّ/ جُمُوعِهِ / لِیَهْتَدِي / تَنْتَظِرُ /كَثِيرًا؛ / شَرِيكَ /
Lesson 3: 14 point Start time: 11:32:55 End time:11:49:45	نُعِیمَ/ تَرْفِیهِیَّةً/ اشْتَرَاكَهُمْ سَتَنفُلُهُمْ/ مُبْتَهَجِينَ/ الحَیْبَةَ/ الطَّیْبَةَ/ الطَّیْبَةَ/ یَبَادِلَانِ/ وَبَسَّتْ تَخْتَلِفُ/ یَجْعَلُهَا/ ثَرَوَةً// یَقْتَصِرُ/ وَأَهْمِیَّتِهِ اشْتَرَاكَهُمْ/ مُبْتَهَجِينَ/ تَخْتَلِفُ تَأْثِیرَ/ أَهْمِیَّتِهِ/ تَنْفِیذَ/
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	انْفَعْنَا/ اهْتَدَى/ یَبْعَثُ/ وَضِیْعَتَ/ أَسْتَفِیدَ/ إِيَّاكَ/ فَإِنِّي/ ثَمِينٌ/ یَحْتَرِمُ/ یَتَسَبَّبُ/ الثَّمِينَةَ/ المُسْتَقْبَلِ مُحَدَّدٍ/ یَنْتَظِرُهُ/ فَاسْتَقْبَلَهُ/ انْتَظَرْتُكَ/ ثَمِينًا/

(13)

Personal details		
Name:	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 10:18: 03	End time:10:30:03
Lesson 1: 10 point.	نَبِيَّهُ/ وَتَرَكَ/ سَجْدِي/ رَفِيعِهِ/ وَعِنْدِيذٍ/ وَإِنَّكَ/ تُعْنِي / مَ / مُ / إِحْسَانِيكُمْ/ يَهَبُ/ خَلِيمًا عَاقِلًا/ وَأَسْتَطَاعَ/ الْمَنَامَ / يَذْبَحُهُ/ فَكَّصَ/ فَامْتَثَلُ/ لِأَبِيهِ/ وَأَضْحَعَهُ/ حَنْبِهِ،/ امثالا/ يُبدي / تَذْبَح/ نَفَذت/ وَسَيَحْرِيكُمْ/ الحَلاصَ/ الشَّدَدَ / كَبِشًا/ يَذْبَحُه/ فَبَشَرْنَاه / خَلِيمَ / بَلَغَ/ إِيَّيْ / أَذْبَحَكَ/ وَتَلَّه/ لِلْحَجِينِ / بَجَزِي/ يَذْبَحُ/المُؤِينُ.	
Lesson 2: 12 point Start time :10:48:04 end time:10:52:34	/ لِیَهْتَدِي تَسِيرُ/ سَعَادَتِهِمْ وَالْبِنَاءُ/ قَارِئًا/ بِهَا/ أَتَاهُ/ أَقْرَأُ / /مُجْتَمَعِهِ /وَكُلُّ/ جُمُوعِهِ / لِیَهْتَدِي / تَنْتَظِرُ /كَثِيرًا؛ / شَرِيكَ /	
Lesson 3: 14 point Start time: 11:32:55 End time:11:49:45	نُعِیمَ/ تَرْفِیهِیَّةً/ اشْتَرَاكَهُمْ سَتَنفُلُهُمْ/ مُبْتَهَجِينَ/ الحَیْبَةَ/ الطَّیْبَةَ/ الطَّیْبَةَ/ یَبَادِلَانِ/ وَبَسَّتْ تَخْتَلِفُ/ یَجْعَلُهَا/ ثَرَوَةً// یَقْتَصِرُ/ وَأَهْمِیَّتِهِ اشْتَرَاكَهُمْ/ مُبْتَهَجِينَ/ تَخْتَلِفُ تَأْثِیرَ/ أَهْمِیَّتِهِ/ تَنْفِیذَ/	
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	انْفَعْنَا/ اهْتَدَى/ یَبْعَثُ/ وَضِیْعَتَ/ أَسْتَفِیدَ/ إِيَّاكَ/ فَإِنِّي/ ثَمِينٌ/ یَحْتَرِمُ/ یَتَسَبَّبُ/ الثَّمِينَةَ/ المُسْتَقْبَلِ مُحَدَّدٍ/ یَنْتَظِرُهُ/ فَاسْتَقْبَلَهُ/ انْتَظَرْتُكَ/ ثَمِينًا/	

	يَحْتَرِّمُ / يَتَسَبَّبُ / التَّمِينَةَ / المُسْتَقْبَلِ مُحَدِّدٍ / يَنْتَظِرُهُ / فَاسْتَقْبَلَهُ / انْتَظَرْتُكَ / تَمِينًا
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Personal details		
Name: محمد	Age:12	L of ED7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 02:44: 03	End time:02:52:03
Lesson 1: 10 point.	<p>تَعَالَى / بِالْعِرَاقِ / نَبِيَّهُ / وَتَرَكْ / رَقَبَتِهِ / وَابْنِكَ / تُعْنِي / مَا تُؤْمَرُ، / لِإِحْسَانِكُمَا / يَهَبُ / خَلِيمًا عَاقِلًا / بِإِحْرَاقِهِ / خَرَجَ / يَهَبُ / صَاطِرًا، / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَقَصَّ / فَامْتَنَلَ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنِيهِ، / امْتِثَالًا / يُبَدِي / تَذْبِجَ / نَفَّذَتْ / وَسَيَحْرِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / كَبِشًا / يَذْبَحُهُ / فَبَشَّرَنَاهُ / خَلِيمٍ / بَلَغَ / إِيَّيْ / أَذْبَحَكَ / وَتَلَّهُ / لِلْحَبِيبِ / بَحْرِي / بِذَبْحِ / الْمُبِينِ.</p>	
Lesson 2: 12 point Start time :10:54:04 end time:10:58:34	<p>جَبْرِيلُ / أَقْرَأُ / / وَالْبِنَاءُ / قَارِئًا / بِنَا / أَنَاهُ / أَقْرَأُ يَكُونُ /</p>	
Lesson 3: 14 point Start time: 11:07:55 End time:11:02:45	<p>تُقِيمُ / تَرْفِيهِئَةً / اشْتَرَاكَهُمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَيْبَةَ / يَتَبَادَلَانِ / وَيَسْتُخْتَلِفُ / يَجْعَلُهَا / تَرَوْهُ // يَفْتَصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكَهُمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرًا / أَهْمِيَّتِهِ / تَنْفِيدًا /</p>	
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	<p>اتَّفَقْنَا / الْهَيِّئِ / يَبْعَثُ / وَضَيَّعَتْ / أَسْتَفِيدَ / إِيَّاكَ / فَإِنِّي / تَمِينٌ / يَحْتَرِّمُ / يَتَسَبَّبُ / التَّمِينَةَ / مُحَدِّدٍ / يَنْتَظِرُهُ / فَاسْتَقْبَلَهُ / انْتَظَرْتُكَ / تَمِينًا /</p>	

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Personal details		
Name: عونثمة	Age: 10	L of ED: 5
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 11:18: 03	End time: 11:30:03
Lesson 1: 10 point.	<p>تُعْنِي / لَمْ / لَمْ / لِإِحْسَانِكُمَا / يَهَبُ / خَلِيمًا عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَقَصَّ / فَامْتَنَلَ / لِأَبِيهِ / وَأَضْحَعَهُ / حَنِيهِ، / امْتِثَالًا / يُبَدِي / تَذْبِجَ / نَفَّذَتْ / وَسَيَحْرِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / كَبِشًا / يَذْبَحُهُ / فَبَشَّرَنَاهُ / خَلِيمٍ / بَلَغَ / إِيَّيْ / أَذْبَحَكَ / وَتَلَّهُ / لِلْحَبِيبِ / بَحْرِي / بِذَبْحِ / الْمُبِينِ.</p>	

Lesson 2: 12 point Start time :11:24:04 end time:11:31:34	/ لِیَهْتَدِي وَالْبِنَاءُ / قَارِئًا / بِهَا / أَتَاهُ / أَفْرًا / / مُجْتَمَعِهِ / وَكُلُّ / مُجْتَمَعِهِ / لِیَهْتَدِي
Lesson 3: 14 point Start time: 11:32:55 End time:11:49:45	نُعِيمُ / تَرْفِيهِئَةً / اشْرَاكِهِمْ سَنَنْفُلُهُمْ / مُبْتَهَجِينَ / الْحَيِيَّةُ / الطَّبِيعَةُ / الطَّبِيعَةُ / يَبَادِلَانِ / وَيَسْتُخْتَلِفُ / يَجْعَلُهَا / ثَرْوَةً // يَقْتَصِرُ / وَأَهْمِيَّتِهِ
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	اتَّفَقْنَا / الْهَيِّنِ / يَبْعَثُ / وَضِيْعَتَ / أَسْتَفِيدَ / إِبْرَاكَ / فَإِنِّي / ثَمِينُ / يَحْتَرِمُ / يَتَسَبَّبُ / الثَّمِينَةَ / الْمُسْتَقْبَلِ مُحَدِّدِ

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Personal details		
Name: محمد	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time05:40: 03	End time: 05:45:54
Lesson 1: 10 point.	يَعْبُدُونَ / بِإِخْرَاقِهِ / لِيَسْمَكْنَ / نَبِيَّةً / وَتَرْكُ / رَقَبَتِهِ / وَائْتِكَ / نُعْنِي / مَا تُؤْمَرُ / يَهَبُ / خَلِيمًا بِوِلَادَةِ / يُسَاعِدُ / فَدَيْتَاهُ / عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامِ / يَدْبُحُهُ / فَفَصَّ / فَاغْتَلَّ / لَأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ / امْتِثَالًا / يُبْدِي / تَدْبِجُ / نَفَذْتُ / وَسَيَحْرِيكُمْ / الْخِلَاصَ / الشَّدَّةَ / سَيَهْدِينَ .	
Lesson 2: 12 point Start time 05:47:23 end time:05:49:33	تَطْمَحُ / فَتَسْعَدُ / الْمُتَفَضِّلُ وَالْبِنَاءُ / قَارِئًا / بِهَا / أَتَاهُ / أَفْرًا / كِبَ / / إِنَّنَا / جَبْرِيْلُ / أَفْرًا / / يَكُونُ لَهُ / وَازْدَهَارُ	
Lesson 3: 14 point Start time: 05:49:55 End time:05:53:42	نُعِيمُ / تَرْفِيهِئَةً / اشْرَاكِهِمْ سَنَنْفُلُهُمْ / مُبْتَهَجِينَ / الْحَيِيَّةُ / يَبَادِلَانِ / وَيَسْتُخْتَلِفُ / يَجْعَلُهَا / ثَرْوَةً // يَقْتَصِرُ / وَأَهْمِيَّتِهِ / اشْرَاكِهِمْ / مُبْتَهَجِينَ / تَخْتَلِفُ / تَأْثِيرِ / أَهْمِيَّتِهِ / تَنْفِيذِ / بِهَا / وَلَكِي / وَفَرَانَا / الْحَيِيَّةُ	
Lesson4:18 point Start time: 05:55:49 End time: 05:58:49	no	

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Personal details		
Name: محمد	Age:12	L of ED: 7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time05:40: 03	End time: 05:45:54

Lesson 1: 10 point.	يَعْبُدُونَ / بِإِخْرَاقِهِ / لِيَسْمَعَنَّ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتَيْهِ / وَابْنَكَ / تُعْنِي / مَا تُؤْمَرُ، / إِحْسَانِكُمْ / يَهَبُ / خَلِيمًا بِوِلَادَةِ / يُسَاعِدُ / فَدَيْنَاهُ / عَاقِلًا / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَصَّ / فَاثْمَثَلُ / لَأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / امِثَالًا / يُبْدِي / تَذْبِحُ / نَفَذْتُ / وَسَيَجْرِيكُمْ / الْخَلَاصَ / الشَّدَّةِ / سَيَهْدِينِ .
Lesson 2: 12 point Start time 05:47:23 end time:05:49:33	تَطْمَحُ / فَتَسْعَدَ / الْمُتَفَضِّلُ وَالْبِنَاءُ / قَارِنًا / بِهَا / أَنَاهُ / أَقْرَأُ / كِبَ / / إِنَّنَا / جَبْرِيْلُ / أَقْرَأُ / / يَكُونُ لَهُ / وَازِدِهَار
Lesson 3: 14 point Start time: 05:49:55 End time:05:53:42	تُعِيْمُ / تَرْفِيهِةً / اشْتَرَاكِهِمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَبِيَّةُ / يَتَبَادَلَانِ / وَبَسَتْ تَخْتَلِفُ / يَجْعَلُهَا / تَرْوَةً // يَفْتَنُصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكِهِمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ / تَنْفِيذُ / بِهَا / وَلِكِي / وَفَرَانَا / الْحَبِيَّةُ
Lesson4:18 point Start time: 05:55:49 End time: 05:58:49	no

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Personal details		
Name: محمد	Age:12	L of ED7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 02:44: 03	End time:02:52:03
Lesson 1: 10 point.	تَعَالَى / بِالْعِرَاقِ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتَيْهِ / وَابْنَكَ / تُعْنِي / مَا تُؤْمَرُ، / إِحْسَانِكُمْ / يَهَبُ / خَلِيمًا عَاقِلًا / بِإِخْرَاقِهِ / خَرَجَ / يَهَبُ / صَابِرًا، / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَصَّ / فَاثْمَثَلُ / لَأَبِيهِ / وَأَضْحَعَهُ / حَنْبِهِ، / امِثَالًا / يُبْدِي / تَذْبِحُ / نَفَذْتُ / وَسَيَجْرِيكُمْ / الْخَلَاصَ / الشَّدَّةِ / / كَبَشًا / يَذْبَحُهُ / فَبَشَّرْنَاهُ / خَلِيمًا / بَلَغَ / إِيَّ / أَدْبَحَكَ / وَتَلَّهُ / لِلْحَبِيْبِ / بَحْرِي / بَذْبِحُ / الْمُبِينُ .	
Lesson 2: 12 point Start time :10:54:04 end time:10:58:34	جَبْرِيْلُ / أَقْرَأُ / / وَالْبِنَاءُ / قَارِنًا / بِهَا / أَنَاهُ / أَقْرَأُ يَكُونُ /	
Lesson 3: 14 point Start time: 11:07:55 End time:11:02:45	تُعِيْمُ / تَرْفِيهِةً / اشْتَرَاكِهِمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَبِيَّةُ / يَتَبَادَلَانِ / وَبَسَتْ تَخْتَلِفُ / يَجْعَلُهَا / تَرْوَةً // يَفْتَنُصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكِهِمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرُ / أَهْمِيَّتِهِ / تَنْفِيذُ /	
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	اَتَّفَعْنَا / الْهَيِّنِ / يَبْعَثُ / وَضَيَّعْتُ / اسْتَفِيدَ / إِيَّاكَ / فَإِنِّي / نَمِينُ /	

	يَحْتَرِّمُ / يَتَسَبَّبُ / التَّمِينَةَ / مُحَدِّدٍ / يَنْتَظِرُهُ / فَاسْتَقْبَلَهُ / انتظرْتُكَ / تَمِينًا
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Personal details		
Name: محمد	Age:12	L of ED7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 02:44: 03	End time:02:52:03
Lesson 1: 10 point.	<p>تَعَالَى / بِالْعِرَاقِ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتَيْهِ / وَابْنَكَ / تُعْنِي / مَا تُؤْمَرُ، / لِإِحْسَانِكُمَا / يَهَبُ / خَلِيمًا عَاقِلًا / بِإِحْرَاقِهِ / خَرَجَ / يَهَبُ / صَاطِرًا، / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَصَّ / فَامْتَثَلَ / لَأَبِيهِ / وَأَضْحَعَهُ / حَبْنِهِ، / امِثَالًا / يُبْدِي / تَذْبِجَ / نَفَّذَتْ / وَسَيَجْرِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / / كَبِشًا / يَذْبَحُهُ / فَبَشَّرَنَاهُ / خَلِيمٍ / بَلَغَ / إِيَّيَّ / أَذْبَحَكَ / وَتَلَّهُ / لِلْحَبِيبِ / بَحْرِي / بِذَبْحِ / الْمُؤَيَّنِ.</p>	
Lesson 2: 12 point Start time :10:54:04 end time:10:58:34	<p>جَبْرِيلَ / أَقْرَأُ / / وَالْبِنَاءُ / قَارِئًا / مَعًا / أَنَاهُ / أَقْرَأُ يَكُونُ /</p>	
Lesson 3: 14 point Start time: 11:07:55 End time:11:02:45	<p>تُقِيمُ / تَرْفِيهِةً / اشْتَرَاكِهِمْ سَنَفُلُهُمْ / مُبْتَهَجِينَ / الْحَبِيبَةَ / يَتَبَادَلَانِ / وَبَسَّتْ تَخْتَلِفُ / يَجْعَلُهَا / تَرْوَهُ // يَفْتَصِرُ / وَأَهْمِيَّتِهِ / اشْتَرَاكِهِمْ / مُبْتَهَجِينَ / تَخْتَلِفُ تَأْثِيرٍ / أَهْمِيَّتِهِ / تَنْفِيدٍ /</p>	
Lesson4:18 point Start time: 11:40:35 End time: 11:46:12	<p>اتَّفَقْنَا / الْهَيِّئِ / يَبْعَثُ / وَضَيَّعَتْ / أَسْتَفِيدَ / إِيَّاكَ / فَإِنِّي / تَمِينٌ / يَحْتَرِّمُ / يَتَسَبَّبُ / التَّمِينَةَ / مُحَدِّدٍ / يَنْتَظِرُهُ / فَاسْتَقْبَلَهُ / انتظرْتُكَ / تَمِينًا /</p>	

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Personal details		
Name: محمد	Age:12	L of ED7
Reading score: over 5	Eye visual : 6	
Test : (1) font size		
time	Start time: 02:44: 03	End time:02:52:03
Lesson 1: 10 point.	<p>تَعَالَى / بِالْعِرَاقِ / نَبِيَّهُ / وَتَرَكَ / رَقَبَتَيْهِ / وَابْنَكَ / تُعْنِي / مَا تُؤْمَرُ، / لِإِحْسَانِكُمَا / يَهَبُ / خَلِيمًا عَاقِلًا / بِإِحْرَاقِهِ / خَرَجَ / يَهَبُ / صَاطِرًا، / وَاسْتَطَاعَ / الْمَنَامَ / يَذْبَحُهُ / فَفَصَّ / فَامْتَثَلَ / لَأَبِيهِ / وَأَضْحَعَهُ / حَبْنِهِ، / امِثَالًا / يُبْدِي / تَذْبِجَ / نَفَّذَتْ / وَسَيَجْرِيكُمْ / الْخَلَاصَ / الشَّدَّةَ / / كَبِشًا / يَذْبَحُهُ / فَبَشَّرَنَاهُ / خَلِيمٍ / بَلَغَ / إِيَّيَّ / أَذْبَحَكَ / وَتَلَّهُ / لِلْحَبِيبِ / بَحْرِي / بِذَبْحِ / الْمُؤَيَّنِ.</p>	

<p>Lesson 2: 12 point Start time :10:54:04 end time:10:58:34</p>	<p>جَبْرِيلُ/اقْرَأُ / وَالْبِنَاءُ/ قَارِئًا / بِهَا/ أَتَاهُ/ اقْرَأُ يَكُونُ/</p>
<p>Lesson 3: 14 point Start time: 11:07:55 End time:11:02:45</p>	<p>تُقِيمُ/ تَرْفِيهِئَةً/ اشْتَرَاكَهُمْ سَنَنْفُلُهُمْ/ مُبْتَهَجِينَ/ الْحَيِيَّةُ / يَتَبَادَلَانِ/ وَبَسَتْ تَخْتَلِفُ/ يَجْعَلُهَا/ ثَرْوَةً// يَفْتَنَصِرُ/ وَأَهْمِيَّتِهِ/ اشْتَرَاكَهُمْ/ مُبْتَهَجِينَ/ تَخْتَلِفُ تَأْثِيرُ/ أَهْمِيَّتِهِ/ تَنْفِيذُ/</p>
<p>Lesson4:18 point Start time: 11:40:35 End time: 11:46:12</p>	<p>اتَّقَمْنَا/ الْهَيِّنُ/ يَبْعَثُ/ وَضَيَّعَتْ/ أَسْتَفِيدَ/ إِيَّاكَ/ فَإِنِّي/ ثَمِينٌ/ يَحْتَرِّمُ/ يَتَسَبَّبُ/ الثَّمِينَةَ/ مُحَدِّدٍ/ يَنْتَظِرُهُ/ فَاسْتَقْبَلَهُ/ انْتَظَرْتُكَ/ ثَمِينًا/</p>

Appendix (6): Satisfaction questionnaire used in the end of each experiment

1. How difficult was the test?

(*Very difficult*  *not very difficult*  *very easy*  )

2. How interesting was the text?

(*Very interested*  *not very interested*  *very boring*  )

3. How easy was it to trace the information needed?

(*Very difficult*  *not very difficult*  *very easy*  )

4. How confident were you after reading the text that you could do the assignment successfully?

(*Confident*  *neutral*  *unconfident*  )

5. I do not mind reading off a computer screen.

Yes  No

6. I do not like read off a computer screen.

Yes  No

7. When reading, I prefer hard copy to digital format.

Yes  No

8. If I had the option, I would purchase an e- book over a traditional textbook.

Yes  No

Appendix (7): sheet of questions for experiment (3)

اجاب علي جميع الاسئلة:

- س1: من ارسل ابراهيم ال قومه؟ .....
- س2: ماذا كان قوم ابراهيم يعبدون؟ .....
- س3: ماذا رأي ابراهيم في منامه؟ .....
- س4: لماذا هاجر ابراهيم الي الشام؟ .....
- س5: من أرسل كبشا عظيما الي ابراهيم؟ ( الله - عمه - جاره )
- س6: من أمر بحرق ابراهيم؟ ( الله - ابنه - قومه )
- س7: يعبد ابراهيم. ( الله - الاصنام - الشمس )
- س8: كان قوم ابراهيم يعبدون. ( الله - الاصنام - الشمس )
- س9: الله ارسل ابراهيم الي قومه. نعم لا
- س10: هاجر ابراهيم الي الشام ليتمكن من عبادة الله. نعم لا
- س11: كان ابراهيم يعبد الاصنام. نعم لا
- س12: اشترى ابراهيم كبشا من السوق. نعم لا

