EFFECTS OF E-BOOK FORMATS ON UNDERGRADUATES’ LEARNING OF STATISTICS

Bibiana Lim Chiu Yiong

Doctor of Philosophy
(Learning Sciences)

2014
EFFECTS OF E-BOOK FORMATS ON UNDERGRADUATES’
LEARNING OF STATISTICS

BIBIANA LIM CHIU YIONG

A thesis submitted
In fulfilment of the requirements for the degree of Doctor of Philosophy

FACULTY OF COGNITIVE SCIENCES AND HUMAN DEVELOPMENT
UNIVERSITI MALAYSIA SARAWAK
2014
ACKNOWLEDGEMENTS

This PhD journey was not easy and it would have been impossible for me to see the light at the end of the tunnel without the assistance of many individuals. I can honestly say I could not have completed this journey without the continued support of family, friends and colleagues.

First, I am forever indebted to my main advisor, Professor Hong Kian Sam for taking valuable time out of his hectic schedule in order to provide meticulous guidance and feedback through the dissertation process. Thank you for pushing me to put forth my greatest effort throughout my time in UNIMAS ever since my master’s dissertation back in 2005. I also wish to express my sincere thanks to Dr. Norazila Abdul Aziz, my co-advisor, for her irreplaceable insight, consistent support and encouragement. I appreciate your sharing which gives me the inspiration to balance my life between being a researcher, an educator, as well as a working mother.

I am grateful for the motivation provided by my fellow colleagues in Swinburne University of Technology (Sarawak Campus). Their generous sharing and laughter always help to ease my stress level. Special acknowledgements of gratitude to Miss Esther Lo, for granting permissions to study her class and her fellow students for their voluntary participation and contribution in the research study. Without them, this study
would not have been possible. Additional thanks to Josh Tam for his invaluable feedback and insights during the development of the e-book formats.

My very special thanks to my parents for everything they have done for me. Their unyielding support and never ending faith helped me persevere through many difficult times. Also, I would like to express my deepest appreciation to my loving husband, Llewellyn Joseph Liu Wee Ling, who consistently believed in and supported me in my life. Without his endless love, I would never have had the courage to accomplish this journey. To my two little girls, Athena and Arielle, whose laughs and giggles helped me going on day-to-day, who give me strength and hope, mummy loves you the most!

Finally, I thank God for making this possible.
ABSTRACT

Universities are trending towards electronic books (e-books) as instructional materials, displacing the traditional printed books. However, there is an incomplete body of knowledge on which preferred presentation formats in e-books by students, particularly in statistics learning. As a result, this study was conducted to investigate the effects of three different e-book formats, namely, text and static image (T&S), text and animation (T&A), and text and multimedia (T&M) e-book formats in a first year undergraduate statistics unit. The e-books were designed according to Baddeley and Hitch’s (1974) information processing theory, Paivio’s (1986) dual-coding theory and Mayer’s (2001) multimedia principles. The Waterfall model was applied as a guide to develop and deploy the e-books into website. The e-book was based on an introductory statistics unit under the Bachelor of Commerce program in Swinburne University of Technology (Sarawak campus) in Malaysia. The experiment also assessed whether a relationship exists between the level of cognitive load, self-efficacy, statistics anxiety, individual’s learning style as well as gender and computer use experience, in which may influence the academic achievement. A quasi-experimental design was adopted where the study was conducted using Non-Equivalent Group, Posttest-Only Design. The participants were divided into three tutorial groups, with control group assigned with T&S e-book. 89 participants responded and completed all the treatments over 12 weeks. Data were gathered employing questionnaires using both quantitative and qualitative techniques. Results indicated that the T&S e-book format showed higher cognitive load and the participants obtained lower scores in examinations compared to T&A and T&M e-book formats, but no significant difference was found between the T&A and T&M e-book formats. Both self-efficacy and statistics anxiety was found to have no effect on any of the e-book format. Results from hierarchical multiple regression analysis revealed that gender, computer use experience and learning styles imposed no significant effect on participants’ level of cognitive load, level of self-efficacy, level of statistics anxiety and achievement within the control and treatment groups. Cognitive load was found to have a weak negative relationship with achievement. In addition, there was an inverse relationship between self-efficacy level and statistics anxiety. Research into the preferred e-book format and effective way of presenting information in e-book imparts instructors and e-book course designer with information to enhance students’ learning.
ABSTRAK

# TABLE OF CONTENTS

**ACKNOWLEDGEMENTS** ........................................................................................................ ii

**ABSTRACT** ............................................................................................................................... iv

**ABSTRAK** ............................................................................................................................... v

**TABLE OF CONTENTS** .......................................................................................................... vi

**LIST OF TABLES** ................................................................................................................... xi

**LIST OF FIGURES** .................................................................................................................. xiv

**LIST OF ABBREVIATIONS** .................................................................................................. xvii

**CHAPTER 1 INTRODUCTION** ............................................................................................... 1

1.0 Introduction ......................................................................................................................... 1

1.1 Background of the Study .................................................................................................... 1

1.2 Problem Statement ............................................................................................................. 13

1.3 Research Objectives and Research Questions .................................................................. 16

1.4 Research Framework ......................................................................................................... 18

1.5 Significance of Study .......................................................................................................... 20

1.5.1 Contributions to the Literature ..................................................................................... 20

1.5.2 Implications for Practice ............................................................................................... 21

1.5.3 Implications for Practical Guides in the Design and Development of the E-book ............ 22

1.6 Limitations of the Study .................................................................................................... 23

1.7 Assumptions of the Study .................................................................................................. 26

1.8 Definition of Terms ............................................................................................................ 28

1.9 Summary ............................................................................................................................. 32

**CHAPTER 2 LITERATURE REVIEW** .................................................................................. 33

2.0 Background ......................................................................................................................... 33

2.1 History and Overview of the E-book .................................................................................. 33

2.1.1 Definition of an E-book ............................................................................................... 35

2.1.2 E-book Research Findings in Education .................................................................... 37

2.1.3 Studies on the E-book in Malaysia ........................................................................... 41
2.2 Characteristics and Formats of the E-book ................................................................. 43
  2.2.1 Research Findings on Text and Static Image ......................................................... 45
  2.2.2 Research Findings on Animation ................................................................. 48
  2.2.3 Research Findings on Multimedia ................................................................. 52
2.3 Information Processing Models ................................................................. 54
2.4 Dual-Coding Theory ................................................................................. 56
2.5 Multimedia Principle.............................................................................. 57
2.6 Cognitive Load Theory (CLT) ................................................................. 59
  2.6.1 Measuring Cognitive Load .................................................................................. 66
2.7 Understanding the Waterfall Model for E-book Format Development .......... 68
2.8 Self-Efficacy ......................................................................................... 72
  2.8.1 Self-Efficacy in E-learning ............................................................................. 73
  2.8.2 Measuring Self-Efficacy ............................................................................. 76
  2.8.3 Self-Efficacy and Cognitive Load ..................................................................... 78
2.9 Statistics Anxiety ................................................................................. 79
  2.9.1 Statistics in E-learning ............................................................................... 82
  2.9.2 Measuring Statistics Anxiety ..................................................................... 84
  2.9.3 Statistics Anxiety and Cognitive Load .......................................................... 86
  2.9.4 Statistics Anxiety and Self-Efficacy ............................................................ 87
2.10 Achievement in E-learning ................................................................. 88
  2.10.1 Achievement and Cognitive Load .................................................................. 90
  2.10.2 Achievement and Self-Efficacy .................................................................. 91
  2.10.3 Achievement and Statistics Anxiety .......................................................... 92
2.11 Learning Styles ..................................................................................... 93
  2.11.1 Kolb Learning Styles in E-learning .............................................................. 97
  2.11.2 Learning Styles and Achievement ............................................................ 99
  2.11.3 Learning Styles, Cognitive Load, Self-Efficacy and Statistics Anxiety .......... 100
2.12 Gender in E-book and E-learning ......................................................... 102
  2.12.1 Gender, Cognitive Load, Self-Efficacy and Statistics Anxiety ...................... 104
2.13 Computer Use Experience................................................................. 106
2.14 Summary....................................................................................... 107

CHAPTER 3 RESEARCH METHODOLOGY.................................................. 109
3.0 Introduction..................................................................................... 109
3.1 Research Design............................................................................. 109
3.2 Participants.................................................................................... 115
3.3 Data Collection Procedures............................................................ 116
3.4 Research Instruments .................................................................... 118
  3.4.1 Section 1 of questionnaire: Demographics................................. 119
  3.4.2 Section 2 of the questionnaire: Post-Study System Usability Questionnaires (PSSUQ) ................................................................. 120
  3.4.3 Section 3 of the questionnaire: Cognitive Load (CL) ................... 121
  3.4.4 Section 4 of the questionnaire: Learning Self-Efficacy (LSE)......... 125
  3.4.5 Section 5 of the questionnaire: Statistics Anxiety Scale (SAS) ........ 126
  3.4.6 Section 6 of the questionnaire: Learning Styles Inventory (LSI) .... 127
  3.4.7 Section 7 of the questionnaire: Open-ended questions ................. 128
3.5 Design of the E-book using Waterfall Model ..................................... 129
  3.5.1 Phase 1: Analysis ...................................................................... 129
  3.5.2 Phase 2: Design ........................................................................ 135
  3.5.3 Phase 3: Implementation ............................................................ 155
  3.5.4 Phase 4: Testing ....................................................................... 165
  3.5.5 Phase 5: Maintenance ............................................................... 165
3.6 Pilot Study....................................................................................... 170
  3.6.1 Pilot Study Results .................................................................... 170
3.7 Data Analyses................................................................................ 174
3.8 Threats to Internal and External Validity.......................................... 185
3.9 Ethical Issues................................................................................ 186
3.10 Summary..................................................................................... 187

CHAPTER 4 RESULTS ............................................................................. 188
4.0 Introduction..................................................................................... 188
4.1 Screening of Data................................................................. 188
4.2 Reliability of the Research Instruments .................................. 188
4.3 Demographics and Description of the Sample.............................. 192
4.4 Usability of E-books (PSSUQ Factors)........................................ 195
  4.4.1 Qualitative Comments on the e-books .................................. 199
4.5 E-book formats and level of Cognitive Load (CL) ......................... 205
4.6 E-book formats and level of Self-Efficacy (SE) ............................. 213
4.7 E-book formats and the level of Statistics Anxiety (SA) ................... 218
4.8 E-book formats and the students’ achievement ............................ 224
4.9 Effects of the three e-book formats on CL, SE, SA, and Achievement with Gender, Computer Use Experience and LS as the moderators. 231
  4.9.1 Predicting the level of CL from Gender, Computer Use Experience and Learning Style (LS) with three e-book formats .................. 237
  4.9.2 Predicting the level of SE from Gender, Computer Use Experience and LS with three e-book formats ...................................... 239
  4.9.3 Predicting the level of SA from Gender, Computer Use Experience and LS with three e-book formats ...................................... 241
  4.9.4 Predicting Mid Semester Test from Gender, Computer Use Experience and LS with three e-book formats .................................... 243
  4.9.5 Predicting Final Examination from Gender, Computer Use Experience and LS with three e-book formats .................................... 245
4.10 Summary ............................................................................ 247

CHAPTER 5 SUMMARY AND CONCLUSIONS .................................... 252
5.0 Introduction ........................................................................ 252
5.1 Summary of the study ............................................................ 252
5.2 Reliability and applicability of research instruments ..................... 254
5.3 Discussions of findings ......................................................... 256
  5.3.1 Usability of the e-book formats ............................................. 256
  5.3.2 Effects of the three e-book formats on the level of CL among the students in the statistics subject ............................................. 259
5.3.3 Effects of the three e-book formats on the level of SE among the students in the statistics subject

5.3.4 Effects of the three e-book formats on the level of SA among the students in the statistics subject

5.3.5 Effects of the three e-book formats on the students’ achievement

5.3.6 Effects of the three e-book formats on CL; SE; SA and Achievement with Gender, Computer Use Experience and LS as the moderators.

5.4 Implications of the study in e-learning context

5.4.1 Implications for instructors and educational textbook publishers

5.4.2 Implications for Future Research

5.5 Conclusion

REFERENCES

APPENDIX A: QUESTIONNAIRE

APPENDIX B: HMB110 QUANTITATIVE ANALYSIS UNIT OUTLINE

APPENDIX C: LETTER FROM SUHREC

APPENDIX D: CONSENT INFORMATION STATEMENT

APPENDIX E: MID SEMESTER TEST QUESTIONS

APPENDIX F: FINAL EXAMINATION QUESTIONS

APPENDIX G: LETTER FROM SUPERVISOR

APPENDIX H: SEVEN FACTORS OF PSSUQ

APPENDIX I: THREE FACTORS OF STATISTICS ANXIETY SCALES
## LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Summary of Non-Equivalent Group, Posttest-Only Design</td>
<td>112</td>
</tr>
<tr>
<td>3.2</td>
<td>Summary of Research Design</td>
<td>113</td>
</tr>
<tr>
<td>3.3</td>
<td>Sample of PSSUQ questions in the questionnaires</td>
<td>121</td>
</tr>
<tr>
<td>3.4</td>
<td>CL questions in the questionnaires</td>
<td>124</td>
</tr>
<tr>
<td>3.5</td>
<td>Sample of LSE questions in the questionnaires</td>
<td>125</td>
</tr>
<tr>
<td>3.6</td>
<td>Sample of SAS questions in the questionnaires</td>
<td>127</td>
</tr>
<tr>
<td>3.7</td>
<td>Sample of LSI questions in the questionnaires</td>
<td>128</td>
</tr>
<tr>
<td>3.8</td>
<td>Open-ended questions in the questionnaires</td>
<td>129</td>
</tr>
<tr>
<td>3.9</td>
<td>Lists of statistics chapters and subchapters</td>
<td>133</td>
</tr>
<tr>
<td>3.10</td>
<td>Specific e-book formats and components for the statistics course</td>
<td>136</td>
</tr>
<tr>
<td>3.11</td>
<td>Participant distribution of each group for the pilot study</td>
<td>171</td>
</tr>
<tr>
<td>3.12</td>
<td>Internal Reliability of the Instruments for Pilot Study</td>
<td>172</td>
</tr>
<tr>
<td>3.13</td>
<td>Means and standard deviations for the PSSUQ factors</td>
<td>173</td>
</tr>
<tr>
<td>3.14</td>
<td>Categories, rules of inclusions, and examples for coding the participants’ perceptions towards e-book formats</td>
<td>176</td>
</tr>
<tr>
<td>3.15</td>
<td>Research Questions and Analysis</td>
<td>183</td>
</tr>
<tr>
<td>4.1</td>
<td>Reliability Coefficients of the Research Instruments</td>
<td>189</td>
</tr>
<tr>
<td>4.2</td>
<td>Reliability of the PSSUQ factors</td>
<td>190</td>
</tr>
<tr>
<td>4.3</td>
<td>Reliability of the LSE factors</td>
<td>190</td>
</tr>
<tr>
<td>4.4</td>
<td>Reliability of the SAS factors</td>
<td>191</td>
</tr>
</tbody>
</table>
Table 4.5 Reliability of the LSI subscales ................................................................. 192
Table 4.6 Participant distribution of each e-book format group ......................... 193
Table 4.7 Participant distribution of each e-book format group of the study .......... 193
Table 4.8 Means and standard deviations for the PSSUQ factors ......................... 196
Table 4.9 Results on One-Way ANOVA between three e-book formats and CL ...... 207
Table 4.10 Post-hoc differences in means of CL by e-book formats ..................... 209
Table 4.11 Means and standard deviations for the level of Cognitive Load .......... 212
Table 4.12 Results on One-Way ANOVA between three e-book formats and SE ..... 214
Table 4.13 Means and standard deviations for the LSE ........................................ 216
Table 4.14 Results on One-Way ANOVA between three e-book formats and SA .... 219
Table 4.15 Means and standard deviation for SAS factor for Examination Anxiety Factor ......................................................................................................................... 221
Table 4.16 Means and standard deviation for SAS factor for Asking for Help ....... 222
Table 4.17 Means and standard deviation for SAS factor for Interpretation ........... 223
Table 4.18 Paired t-tests of Mid-Semester Test and Final Examination Results ...... 225
Table 4.19 Summary of the posttest outcomes for different e-book format groups .... 230
Table 4.20 Distributions of participants in three different e-book formats according to Kolb categories .................................................................................................................. 232
Table 4.21 Pearson Correlation Matrix among dependent variables and independent variables .......................................................................................................................... 236
Table 4.22 Summary of Hierarchical Regression Analysis for variables predicting the level of CL ................................................................................................................................. 238
Table 4.23 Summary of Hierarchical Regression Analysis for variables predicting the level of SE……………………………………………………………………………………………………………….240

Table 4.24 Summary of Hierarchical Regression Analysis for variables predicting the level of SA ………………………………………………………………………………………………………………………………242

Table 4.25 Summary of Hierarchical Regression Analysis for variables predicting the Mid Sem Test scores………………………………………………………………………………………………………………………..244

Table 4.26 Summary of Hierarchical Regression Analysis for variables predicting the Final Examination scores………………………………………………………………………………………………………………………247
LIST OF FIGURES

Figure 1.1: Conceptual framework of the study ............................................................... 19
Figure 2.1: Working Memory Model (Baddeley & Hitch, 1974) ...................................... 56
Figure 2.2: The Waterfall Model (Bassil, 2012) ............................................................. 69
Figure 3.1: Sampling of the study .................................................................................. 113
Figure 3.2: A mixed paradigm of data collection methods ............................................. 114
Figure 3.3: Screen shot of the front page of the e-book (T&S) with the navigation panel on the left .................................................................................................................. 143
Figure 3.4: Screen shot of a text and static image of the e-book .................................... 143
Figure 3.5: Screen shot of the page of the e-book (T&S) ................................................. 144
Figure 3.6: Screen shot of one of the e-book pages (T&A) with the [Animation] options shown ......................................................................................................................... 145
Figure 3.7: Screen shot of the “pop-out” screen showing the e-book page (animation with text) on how to use the graphics calculator ................................................................. 145
Figure 3.8: Screen shot of text and animation e-book format with [Animation] link. 146
Figure 3.9: Screen shot of the “pop-out” screen showing the animation with text. .... 146
Figure 3.10: Screen shot of T&M e-book format with [Video] link. ......................... 149
Figure 3.11: Screen shot of the “pop-out” screen showing the introduction page of the video and audio. .................................................................................................................. 149
Figure 3.12: Screen shot showing the e-book page (text, video and audio presentation embedded with animation) .................................................................................................. 150
Figure 3.13: Screen shot of one of the e-book pages (T&M) with the [Video] options. .................................................................................................................................................. 150
Figure 3.14: Screen shot of the “pop-out” screen showing the e-book page (text, video and audio presentation embedded with animation). ................................................................. 151

Figure 3.15: Screen shot of the page of the e-book (T&S) on “Preparing the Graphics Calculator” for calculating Financial Mathematics. ................................................................. 152

Figure 3.16: Screen shot of an [Animation] hyperlink on the topic “Preparing the Graphics Calculator” for calculating Financial Mathematics. ................................................................. 153

Figure 3.17: Screen shot of a “pop-up” window on the topic “Preparing the Graphics Calculator” for calculating Financial Mathematics. ................................................................. 153

Figure 3.18: Screen shot of a [Video] hyperlink on the e-book........................................ 154

Figure 3.19: Screen shot of a T&M image of the e-book in a “pop-up” window ...... 154

Figure 3.20: Learning sequence from intro page to post-test ........................................... 157

Figure 3.21: Screenshot of the T&S introductory page ...................................................... 158

Figure 3.22: Screenshot of the T&A introductory page. ...................................................... 158

Figure 3.23: Screenshot of the T&M introductory page...................................................... 159

Figure 3.24: Screenshot of the main user interface of the e-book. The individual components are identified. ................................................................. 161

Figure 3.25: Screenshot of an example of an e-book with animation. Note that the hyperlinks in the learning content show the [Animation] link. ...................................................... 161

Figure 3.26: Screenshot of an example of an e-book with multimedia. Note that the [Lists and Graphs Video Tutorial] hyperlink. ................................................................. 162

Figure 3.27: Screenshot of the navigation tools of the e-book. ......................................... 162

Figure 3.28: Screenshots of the tree menu navigation...................................................... 163

Figure 3.29: Screenshot of tree-like menu on the left panel............................................. 168
Figure 3.30: Screen shot of e-book with animation with [CLOSE] “X” button at the upper right corner.................................................................169

Figure 4.1: Means plot from a One-Way ANOVA of CL and e-book formats..........208

Figure 4.2: Scatterplot between two posttests.....................................................227

Figure 4.3: Bar charts showing the posttests scores of Mid Semester Test and Final Examination across all the e-book groups. .................................................................230

Figure 4.4: Scatterplot of the level of CL and independent variables. .................237

Figure 4.5: Scatterplot of the level of self-efficacy and independent variables........239

Figure 4.6: Scatterplot of the level of SA and independent variables. .....................241

Figure 4.7: Scatterplot of the level of Mid Semester Test and independent variables.243

Figure 4.8: Scatterplot of the Final Examination and independent variables..........245
# LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC</td>
<td>Abstract Conceptualisation</td>
</tr>
<tr>
<td>AE</td>
<td>Active Experimentation</td>
</tr>
<tr>
<td>CE</td>
<td>Concrete Experience</td>
</tr>
<tr>
<td>CL</td>
<td>Cognitive Load</td>
</tr>
<tr>
<td>CLT</td>
<td>Cognitive Load Theory</td>
</tr>
<tr>
<td>CTML</td>
<td>Cognitive Theory of Multimedia Learning</td>
</tr>
<tr>
<td>E-book</td>
<td>Electronic Book</td>
</tr>
<tr>
<td>HTML</td>
<td>Hyper Text Markup Language</td>
</tr>
<tr>
<td>KLSI</td>
<td>Kolb Learning Style Inventory</td>
</tr>
<tr>
<td>LS</td>
<td>Learning Style</td>
</tr>
<tr>
<td>LSE</td>
<td>Learning Self- Efficacy</td>
</tr>
<tr>
<td>LSI</td>
<td>Learning Style Inventory</td>
</tr>
<tr>
<td>MOHE</td>
<td>Malaysia of Higher Education</td>
</tr>
<tr>
<td>OUM</td>
<td>Open University Malaysia</td>
</tr>
<tr>
<td>PPSUQ</td>
<td>Post-Study System Usability Questionnaire</td>
</tr>
<tr>
<td>RO</td>
<td>Reflective Observation</td>
</tr>
<tr>
<td>SA</td>
<td>Statistics Anxiety</td>
</tr>
<tr>
<td>SAS</td>
<td>Statistics Anxiety Scale</td>
</tr>
<tr>
<td>SE</td>
<td>Self-Efficacy</td>
</tr>
<tr>
<td>T&amp;A</td>
<td>Text and Animation</td>
</tr>
<tr>
<td>T&amp;M</td>
<td>Text and Multimedia</td>
</tr>
<tr>
<td>T&amp;S</td>
<td>Text and Static Image</td>
</tr>
<tr>
<td>UM</td>
<td>Universiti Malaya</td>
</tr>
<tr>
<td>UNIMAS</td>
<td>Universiti Malaysia Sarawak</td>
</tr>
<tr>
<td>UPM</td>
<td>University Putra Malaysia</td>
</tr>
<tr>
<td>USM</td>
<td>Universiti Sains Malaysia</td>
</tr>
</tbody>
</table>
CHAPTER 1
INTRODUCTION

1.0 Introduction

This chapter provides an overview and introduction to the research. It describes the background of the study, problem statement, research objectives, research questions, research framework, significance of the study, limitations of the study, assumptions of the study and definitions of research terms. It concludes with a summary of the chapter.

1.1 Background of the Study

Rapid technological advancement and its applications in education over the past decade have changed the way instructors deliver and learners acquire information (Foasberg, 2011). Information is no longer restricted to only printed textbooks as in the past. Printed textbooks have been gradually replaced with electronic books (e-books).

The e-book can be defined as a book presented in electronic or digital format, either on dedicated e-book readers such as the Apple I-Pad (Smith & Kukulska-Hulme, 2012) and Amazon Kindle E-book Reader (Lebert, 2009), or undedicated devices such as a tablet PCs, laptops, desktop (Genuth, 2008; Lebert, 2009) or mobile phones (Uluyol & Agca, 2012).
The e-book is considered an emerging form of technology and is currently of particular interest to all level of education especially in the context of e-learning (Appleton, 2005; Baumann, 2010; Foasberg, 2011; Lonsdale & Armstrong, 2010; Miller, 2010; Rao, 2003; Rothman, 2006; Wong, Liong, Lin, Lower, & Lam, 2011). Appleton (2005) observed, “With printed textbooks being well integrated into traditional teaching and learning in higher education, the next obvious resource to embed into e-learning would be the e-book” (p. 56). Rothman (2006) agreed, “If ever a promising technology existed for education, and e-learning in particular, it would be e-books” (p. 1).

Major corporations and publishers have also expressed an interest in promoting and supplying electronic versions of higher education books. For instance, McGraw-Hill Education publishes 95% of their titles both in electronic and hardcopy forms (Warren, 2009). Most recently, in 2013, McGraw-Hill launched its SmartBook, an interactive and adaptive e-book for tablets, desktops and laptops with voice instruction, offering tutoring and highlighting information to ease learning (Empson, 2013). In addition, Kno (www.kno.com), an education software company, is promoting its newest software of KnoMe for e-book, where students can “check-in frequently to see near real time stats on their study behaviour, interaction levels, time management and personal progress” (Trew, 2013, para 2). This software also includes social sharing with peers to allow group sharing and discussion through e-books. Thus, e-books are positioned for
rapid growth as digital texts and software for e-books have become prevalent (Trew, 2013).

Universities are extolling the adoption of e-books, which appear to be displacing the printed textbook, most notably in e-learning. For example, Ghaebi and Fahimifar (2011) noted that there are a number of universities which undertook the initiative to move toward becoming a ‘bookless’ institution of higher learning. It helped to keep educational information as up-to-date as possible and distributed worldwide via Internet with ease. In 2002, university libraries in Malaysia began adopting e-books as part of their library collection. The first library to use e-books was the Open University of Malaysia (OUM) in June 2002, followed by Universiti of Malaya (UM), Universiti Sains Malaysia (USM), and Universiti Putra Malaysia (UPM) in 2008 (Ismail & Zainab, 2005; Letchumanan & Tarmizi, 2011). Although traditional textbooks are still currently needed by colleges and universities, the pace of change from textbooks to e-books is quickening as more university libraries start to add e-book databases; this represents a new direction in educational resources. In line with this, the Malaysian Ministry of Higher Education (MOHE) is financially supporting the subscription of university libraries to e-book providers. For example, the MOHE allocated more than RM1.04 million to help local universities to subscribe to netLibrary in 2010 (Letchumanan & Tarmizi, 2011).
Besides education, e-books have predominantly been used in the commercial sector as evidenced by the report from the International Digital Publishing Forum (www.idpf.org). The wholesale revenue of e-books in the United States increased from US$ 165.8 million in 2009 to US$ 304.6 million in 2010 (IDPF, 2012). Amazon.com, which currently dominates the e-book market, sold more e-book titles for its Kindle e-reader device compared to printed books (BBC News, 2012). The trend clearly suggests that e-books are gaining huge popularity and becoming an alternative format for information delivery.

The first discussion of e-book development as an alternative to traditional print began nearly 40 years ago, in 1971, through Project Gutenberg, a digital library for books from the public domain. At present, the project offers more than 30,000 free public domain e-books through the Internet (Foasberg, 2011; Lonsdale & Armstrong, 2010). With the development of dedicated e-book devices and the spread of the Internet in the 1990s (Baumann, 2010), more books were published in both printed and digital formats.

Given that e-books are published digitally, Clyde and Delohery (2005) indicated that e-books can be presented in different presentation formats, even though static images and text are the most frequently used presentation format in e-books. This is clarified by Ghaebi and Fahimifar (2011), who suggested that e-books could be divided into different kinds of formats, namely, electronic textbooks, electronic static picture books,
electronic animated books, electronic talking books, electronic multimedia books, electronic intelligent books and electronic space books. Among these formats, the most prevalent e-books in academic libraries are electronic textbooks, electronic animated books and electronic multimedia books (Foasberg, 2011). However, Wong et al. (2011) suggested that e-books can be customized by instructors. Ghaebi and Fahimifar (2011) supported by asserting that the use of animation and multimedia in e-books could also be an advantage.

Furthermore, the e-book could offer dynamic visual and verbal formats such as animation and multimedia instead of depending heavily only on text and static image (Li, Chen, & Sheng, 2013; Richardson, Smith, Lenarcic, McCrohan, & O’Hare, 2010; Warren, 2009). Dynamic visual and verbal formats which include static words, images, audios, videos, and animations could have the potential to encourage students to move beyond being passive learners and participating in the creative and constructive aspects of learning (Baumann, 2010; Lai & Newby, 2012; Sharp, 2005). The application of dynamic visual and verbal formats is possible in the e-book because it was created using special compiling software. For example, the Hyper Text Markup Language (HTML) compiler enables the e-book to act like a web page, making it possible for the user to click and be taken instantly to another page or section of an e-book. With the HTML compiler, various links could be created between animations, audios, videos formats to make the learning experience more comprehensive (Lai & Newby, 2012).
Empirical research has provided support for the advantages of dynamic visual and verbal formats over leaner formats such as text and static images for learning (Despotakis, Palaigeorgiou, & Tsoukalas, 2007; Guan, 2009; Kim & Gilman, 2008; Tversky, 2011) and the design rationales that conform to theories (Sweller, 2010). For this study, the underlying theories for developing the dynamic visual and verbal formats for the e-book or e-book formats include Atkinson and Shiffrin’s (1968) information processing theory, Baddeley and Hitch’s (1974) working memory theory, Paivio’s (1986) dual-coding theory, Mayer’s (2001) multimedia principles and Chandler and Sweller’s (1991) Cognitive Load Theory (CLT). The reason for choosing these related theories as the theoretical framework for this study is that information presented in text, graphic, animation and multimedia forms has a big impact on cognitive load (Lin & Dwyer, 2010; Mayer & Moreno, 2003; Meissner & Bogner, 2013).

Knowledge of the structure and functionality of the working memory increases understanding of the process and limitations of resources in cognitive load (Ayres & van Gog, 2009; Bethel & Borokhovski, 2010). Baddeley and Hitch (1974) and Paivio (1986) posited that separate channels (in the working memory) for visual and verbal information processing have limited resources to process information. When learners have a working memory with a limited capacity when dealing with new information, learning will be hindered and this is one of the assumptions of CLT (Sweller, 2010).