

Investigating the Alignments Between Scholarly and Popular Texts in Design: A  
Content Analysis

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# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

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## ABSTRACT

The purpose of this study was to investigate the alignments in the use of theory, principles and guidelines in instructional design books and popular books on design. The review of literature was conducted in three parts. The first part of the literature review was a general review of literature and it was conducted on cognitive information processing, cognitive load theory, affordance theory and text display. The second part of the literature review extracted the theories, principles and guidelines from four books on instructional design and technology. Six theories were extracted. The six theories extracted from these four books of instructional design and technology were cognitive information processing theory, cognitive load theory, multimedia theory, perception theory, minimalism theory and motivation theories. The third part of the review of literature was on content analysis, the different definitions of content analysis and the historical background of content analysis. Two sets of books were used in the study. The first set of books was instructional design and technology textbooks. These books were referred to as the scholarly books. The second set of books was selected by systematic sampling. These second set of books were the ten most positively reviewed books on web design from Amazon.com Inc. These ten books were pruned down to four books by a panel of experts. This second set of books was referred to as the popular books. A content analysis was conducted on the scholarly and the popular books. The theories, principles and guidelines extracted from the four scholarly books

were aligned with the codified themes, word phrases and word sense from the four popular books. The results were tabulated under categories identified. The results showed that two of the popular books did not address theory in their content. The two other popular books addressed guidelines and principles applicable to the theories extracted in the scholarly books. The scholarly books gave theoretical foundations for their guidelines while the popular books did not give a theoretical foundation for their guidelines.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## DEDICATION

To JEHOVAH-ALMIGHTY

I have fulfilled my vow

“Better is the end of a thing than the beginning thereof” Ecclesiastes 7:8

“...The race is not to the swift, nor the battle to the strong,” Ecclesiastes 9: 11

“...of making many books there is no end; and much study is a weariness of the flesh.”

Ecclesiastes 12: 12

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

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## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

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## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

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Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**TABLE OF CONTENTS**

|  |          |
|--|----------|
| <b>CHAPTER ONE: INTRODUCTION .....</b>                               | <b>1</b> |
| Purpose of the Study.....  | 2        |
| Research Questions .....   | 2        |
| <b>CHAPTER TWO: LITERATURE REVIEW.....</b>                           | <b>4</b> |
| Theory of Affordance .....   | 6        |
| Implications of Affordance in Web Design.....                        | 9        |
| Reading Comprehension on Paper Text Compared to Electronic Text..... | 10       |
| Reading Comprehension on Text.....                                   | 13       |
| Display rate.....  | 14       |
| Text design. ....  | 14       |
| Summary of Text on Web Design.....                                   | 16       |
| Introduction to Cognitive Information Processing .....               | 16       |
| Theory of Cognitive Information Processing.....                      | 17       |
| Sensory Memory .....   | 18       |
| Research on sensory memory. ....                                     | 20       |
| Short Term Memory .....  | 20       |
| Early research work on selective attention.....                      | 21       |
| Primacy effect.....  | 22       |

|  |    |
|--|----|
| Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis |    |
| Decay.....   | 23 |
| Long Term Memory .....   | 23 |
| Encoding.....  | 24 |
| Pattern recognition. ....  | 25 |
| Early Research Work on the Cognitive Information Processing System .....                       | 25 |
| Cognitive Load Theory.....   | 27 |
| Chunking and working memory .....  | 27 |
| Types of cognitive load .....  | 31 |
| <i>Intrinsic cognitive load</i> .....  | 31 |
| <i>Extraneous cognitive load</i> .....   | 31 |
| <i>Germane cognitive load</i> .....  | 32 |
| Implications of Intrinsic, Extrinsic and Germane Cognitive Load in Web Design .....            | 33 |
| Novices and experts .....  | 33 |
| Instructional Strategies that Reduce Cognitive Load .....                                      | 34 |
| Means end analysis converted to goal free effect.....  | 35 |
| Studies on goal free effect .....  | 35 |
| Summary on goal free effect. ....  | 37 |
| Worked example and problem completion effect.....  | 38 |
| Studies on worked examples and problem completion.....   | 38 |
| Summary on worked example .....  | 39 |

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|  |    |
|--|----|
| Split attention and split attention effect .....   | 40 |
| Studies on split attention and split attention effect .....  | 41 |
| Summary on split attention and split attention effect .....  | 43 |
| The redundancy effect.....   | 44 |
| Studies on redundancy effect.....  | 45 |
| Summary on redundancy effect.....  | 46 |
| The modality effect .....  | 47 |
| Studies on modality effect .....   | 48 |
| Summary on modality effect. ....   | 49 |
| Overall Summary of the Literature Review on Theories of Affordance, Cognitive Information Processing and Cognitive Load..... | 50 |
| Theories, Principles and Guidelines Extracted from the Four Text Books Recommended by the Panel of Experts.....              | 51 |
| Principles and Guidelines Extracted from Carroll, J. M. (1990) .....   | 52 |
| Summary of Theory, Principles and Guidelines Extracted from Carroll (1990) .....   | 53 |
| Principles and Guidelines Extracted from Clark, R. C. & Mayer, R. E. (2011) .....  | 54 |
| The Multimedia Principle: Include both Words and Graphics .....  | 54 |
| The first principle of contiguity; aligning words to corresponding graphics. ....  | 54 |
| The second principle of contiguity; synchronize spoken words with corresponding graphics.                                    |    |
| .....  | 55 |

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|  |    |
|--|----|
| The principle of redundancy; explain visuals with audio or text and not both .....                                 | 56 |
| The principle of coherence; adding material can hurt learning. ....  | 57 |
| The principle of personalization; use conversational style and virtual coaches.....                                | 57 |
| The principle of segmenting and pre-training principles; managing complexity by breaking a lesson into parts. .... | 57 |
| The principle of worked example .....  | 58 |
| The principle of effective practice .....  | 60 |
| Summary of Theories, Principles and Guidelines Extracted from Clark and Mayer (2011)....                           | 61 |
| Principles and Guidelines Extracted from Fleming, M. & Levie, W.H. (Eds.) (1993).....                              | 62 |
| Principles of Motivation .....   | 62 |
| Guidelines to stimulate epistemic curiosity.....   | 63 |
| Guidelines to improve relevance .....  | 63 |
| Guidelines to motivate the challenge level.....  | 65 |
| Guidelines to establish positive outcomes.....   | 66 |
| Guidelines to motivate using text and graphics .....   | 67 |
| Guidelines to create a positive first impression using text and graphics .....                                     | 67 |
| Guidelines to achieve a readable style .....   | 68 |
| Guidelines on using graphic illustrations .....  | 70 |
| Principles of Perception .....   | 70 |
| Guidelines to pre-attentive perceptual processing .....  | 71 |

|  |           |
|--|-----------|
| Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis |           |
| Guidelines to attentive perceptual processing: selection and organization .....                | 71        |
| Guidelines to perceive pictures.....   | 71        |
| Summary of Theories, Principles and Guidelines Extracted from Levie and Flemings (1993)        | 73        |
| Principles and Guidelines Extracted from Lohr, L. L. (2008) .....                              | 73        |
| Three Principles of Visual Literacy .....  | 74        |
| Selection principle: emphasizing figure and ground .....                                       | 74        |
| Organization principle: working with hierarchy.....  | 75        |
| Integration principle: Gestalt .....   | 76        |
| Guidelines to the principle of integration.....  | 77        |
| Summary of the Theories, Principles and Guidelines in Lohr (2008).....                         | 77        |
| Summary of the Theories, Principles and Guidelines from the Four Recommended Text Books .....  | 78        |
| <b>CHAPTER THREE: RESEARCH METHODOLOGY .....</b>   | <b>80</b> |
| Introduction to the Research Methodology.....  | 80        |
| An Overview of Content Analysis .....  | 80        |
| History of Content Analysis.....   | 83        |
| Content Analysis of Text .....   | 84        |
| Validation in Content Analysis .....   | 86        |
| Reliability.....   | 87        |
| Content Analysis in this Study .....   | 87        |

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|  |    |
|--|----|
| Content Analysis Sources.....  | 87 |
| The Four Text Books of Instructional Design and Technology .....                             | 88 |
| Selection Criteria for the Four Scholarly Books on Instructional Design and Technology ..... | 90 |
| Panel of experts.....  | 90 |
| The Authors of the Scholarly Books .....   | 90 |
| Carroll, J. M. (1990).....   | 90 |
| Clark, R. C., & Mayer, R. E. (2011). .....   | 90 |
| Fleming, M. L. & Levie, W. H. (1993).....  | 91 |
| Lohr, L. L. (2008).....  | 91 |
| Source of the Ten Most Positively Reviewed Books .....                                       | 91 |
| Systematic Selection of the Ten Most Positively Reviewed Books on Web Design .....           | 92 |
| Selection of the ten most positively reviewed books on web design.....                       | 93 |
| Steps taken to arrive at the ten most positively reviewed books on web design .....          | 94 |
| The Ten Most Positively Reviewed Books on Web Design Pruned to Four Popular Books ....       | 95 |
| The Authors of the Four Popular Books.....   | 97 |
| Freeman, E., Freeman, E., Sierra, K., & Bates, B. (2004). .....                              | 97 |
| Greenspun, P. (1999).....  | 97 |
| Krug, S. (2014). .....   | 97 |
| Nielsen, J. (2000). .....  | 98 |
| Estimate of the Number of Pages of Books in This Study .....                                 | 98 |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|  |            |
|--|------------|
| Summary of Selection of the Four Popular Books.....  | 98         |
| Recording/Coding.....  | 99         |
| Reliability.....   | 100        |
| Inferences .....   | 100        |
| Summary of Methodology .....   | 100        |
| <b>CHAPTER FOUR: FINDINGS AND DISCUSSION .....</b>   | <b>103</b> |
| Research Question One.....   | 104        |
| Response to Research Question One .....  | 104        |
| Summary of Response to Research Question One .....   | 104        |
| Research Question Two .....  | 111        |
| Response to Research Question Two .....  | 111        |
| Freeman, E., Freeman, E., Sierra, K., & Bates, B. (2004) .....                             | 111        |
| Summary of the Principles from Freeman, E., Freeman, E., Sierra, K., & Bates, B. (2004). . | 111        |
| Greenspun, P. (1999).....  | 111        |
| Summary of the Principles from Greenspun, P. (1999) .....                                  | 111        |
| Krug, S. (2014).....   | 112        |
| Summary of Principles from Krug, S. (2014) .....   | 113        |
| Nielsen, J. (2000).....  | 114        |
| Summary of the Principles from Nielsen, J. (2000) .....                                    | 116        |
| Research Question Three .....  | 116        |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|   |            |
|---|------------|
| Response to Research Question Three .....   | 116        |
| Summary of Response to Question Three .....   | 118        |
| <b>CHAPTER FIVE: CONCLUSION .....</b>   | <b>120</b> |
| <b>REFERENCES.....</b>  | <b>125</b> |
| <b>APPENDIX A: Screen Shots of Selection of The Ten Most Positively Reviewed Books on Web Design.....</b> | <b>147</b> |
| <b>APPENDIX B: List of the Ten Most Positively Reviewed Books on Web Design .....</b>                     | <b>149</b> |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**LIST OF TABLES**

|   |     |
|---|-----|
| Table 1: List of the Four Scholarly Books.....  | 89  |
| Table 2: List of the Four Popular Books .....   | 97  |
| Table 3: Summary of Theories, Principles and Guidelines from the Scholarly Books.....   | 106 |
| Table 4: Theories Extracted from the Four Scholarly Texts.....  | 110 |
| Table 5 Summary of Extracted Guidelines from Popular Books Aligned with Extracted<br>Guidelines and Theories from Scholarly Books ..... | 122 |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**LIST OF FIGURES**

|   |     |
|---|-----|
| Figure 1: Model of Information Processing System.....   | 19  |
| Figure 2: Summary of Methodology.....   | 102 |
| Figure 3: Representations of Scholarly and Popular Books According to Year of Publication.<br>..... | 105 |
| Figure 4: Summary of Results.....   | 124 |

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## CHAPTER ONE: INTRODUCTION

Bowker (2013) estimated that the number of new books published in the United States of America in 2011 was 1,532,623. Books that were listed under the computer category were 7,615 and new books that were published under education category were 10,916. Bowker is the American agency that issues the International Standard Book Numbers (ISBN). From the morass of books produced in the computer category, the number of books titles related or ascribing to teach web design is unknown. However, it is safe to assume that these books are voluminous.

A quick search on the Amazon.com web site (Amazon, 2013) with the key words *web design* under the book category would produce over 37,000 results as of today the 15<sup>th</sup> of November, 2013. I have included the date because the web is dynamic and as new books are churned every day, the search results may change in a few hours or in a few days.

Web design should be intuitive and many books have been published on designing web sites that are intuitive. It is not only the design of web pages that should be intuitive. Any design that is meant to be used by others especially when the designer is not going to be present at the time the designed product would be used should be intuitive and non-frustrating to the user.

I have merely used web design because we are in a technology-enhanced world. A tablet that was in the market in 2012 is considered an old tablet because between December 2012 and 2014, newer tablets with increased capabilities have been produced.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Words or phrases that are closely related to intuitive include enhanced usability (Nielsen, 2004), enhanced credibility (Pollach, 2005), user-friendly (Pollach, 2005) and utility-friendly. These are the keys to a customer centered web design, user-centered web design (Krug, 2006). The purpose is for the user, the customer or learner to not have to think so much in order to get his/her work done on the computer (Krug, 2006). Since there are so many books on web design, what are the merits of these books on web design?

## Purpose of the Study

The purpose of this content analysis is to investigate the differences in the use of theory, principles and guidelines common to Instructional Design and Technology in popular texts on web design. It is a cross sectional content analysis because the books that would be investigated were comprised of a “snapshot” of the ten most positively reviewed books on the web on the particular date and time that I browsed on the internet and may change in as short as two minutes, two hours or in a day. As there are positively reviewed books, there are also negatively reviewed books and the books for my content analysis would be selected from the ten most positively reviewed books. Four popular books were selected from the ten most positively reviewed books. Four scholarly books on Instructional Design and Technology were selected to extract theories, guidelines and principles common to Instructional Design and Technology.

## Research Questions

1. What are the theories and principles of design as addressed in the four scholarly books on instructional design?
2. What principles of design are addressed in the four popular books on design?

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

3. What pattern of differences or similarities occurs between the four scholarly books on instructional design text books and the four popular books on design particularly to the use of theory?

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## CHAPTER TWO: LITERATURE REVIEW

This literature review is in three parts. The first part is the one being presented here. I would present some of the theories related to web design. The second part would be the review of literature from the instructional design text books that would be used in the content analysis. The third part is the literature on content analysis that I have added under methodology.

We have an eclectic choice in the design of web pages. Web pages have been designed for advertising, for marketing, for administration, for personal use, for business, for tele-medicine and for e-learning. The purpose of this section is to explore the role of cognitive information processing in designing web pages for e-learning. In the past twenty years, e-learning has become a staple in educational institutions encompassing K-12 and through higher education and beyond. The variability in the users of e-learning include part-time students, full-time students, full-time employees taking on line classes as well as varying cultures and context. In addition, some users may be experts at a particular topic while some could be novices. Therefore, the onus is on the instructional designer to find a good fit for the different users that would access the e-learning. The process of designing a good web page goes beyond looking at the different users. It involves applying and understanding how the cognitive information process works.

The role of e-learning can no longer be ignored. In 2012, thirty two percent of higher education students were enrolled in at least one online course (Sloan Consortium: K-12 Survey, 2013a). The thirty two percent was equivalent to 6.7 million students. Also, in 2012, the number of students that enrolled in online-learning increased by six percent.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

In a 2006 survey of U.S. school administrators of K-12 schools, 63.1 % of the schools surveyed had students that were enrolled in blended or fully online courses and 57.9 % of the schools surveyed had students that were fully enrolled in online courses. The figures for K-12 schools were reported after surveying 366 school districts out of 16 000 school districts in the United States (Sloan Consortium, K-12 Online-learning, 2013b)

It is becoming increasingly obvious that e-learning is not just for higher education and K-12 education but for employees and employers. Invariably, any effort put in designing web pages for e-learning must be targeted at the learners. Web pages that are learner-centered lead to better learning outcomes (Carter, Leslie & Kwan, 2012). Learners come with different capacities and different abilities. Some learners are novices in the content areas while some are experts in the content areas to be learned. In essence, in designing effective and efficient web pages for e-learning, it is important for the instructional designer to understand the theories and principles underlying the mental processes of the learners that would be navigating through the web pages.

There are several theories related to the cognitive information processing. Some of the theories related to the mental processes are the cognitive information processing theory, the cognitive load theory, communication theory, the multimedia theory, the e-learning theory, the systems theory and the theory of affordance. In this paper, I would delve into three of these theories; cognitive information theory, cognitive load theory and the theory of affordance. I would explore the application of cognitive information processing in the design of intuitive web pages that would give learners content, structure and outcomes that are achievable and measurable. It would bring congruence between the domain of theory and research to the domain of practice. In addition, I would examine the effects of cognitive load on learners and e-leaning

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

and would consider some ways that the instructional designer can use to reduce the cognitive load on the instruction. Further, I would explore the application of affordance theory and its role in the design of intuitive web pages.

I have divided the rest of this chapter into the following sections: The theory of affordance, implications of affordance in web design, introduction to cognitive information processing, theory of cognitive information processing, early research work on cognitive information processing system, cognitive load theory, types of cognitive load, chunking and working memory, implications of intrinsic, extrinsic and germane cognitive load in web design, instructional strategies that reduce cognitive load and summary of the chapter. The bulk of this chapter would be on cognitive load because it is the implication of cognitive load that impact instructional web design for e-learning.

## Theory of Affordance

Affordance is a physical feature that allows the user to use what the product is intended for (Gibson, 1977, 1979; Kaptelinin & Nardi, 2012; Norman, 1988; Şahin, Çakmak, Doğar, Uğur, & Üçoluk, 2007; Ware, 2003).

Gibson coined the word affordance:

The affordances of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. The verb to *afford* is found in the dictionary, but the noun *affordance* is not. I have made it up. (Gibson, 1979, p. 127)

Gibson, a perceptual psychologist was the first to describe affordance as a relational capacity of the product to the user and to the environment (Gibson, 1977, 1979; Kaptelinin & Nardi, 2012). According to Gibson's definition, the affordance can be present on the product

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

without the user being aware of its presence. Norman, on the other hand defined affordance as the perceived use of the design of the product by the user. He called this the perceived affordance (Norman, 1998, 2007a, 2011). A perceived affordance is useful because the user is able to identify the clues needed to use the product unlike the Gibsonian definition where the affordance can be present but the user does not know the usefulness.

Kaptelinin and Nardi (2012) noted that Gibson's definition of affordance was not adequate. They argued that the Gibsonian definition of affordance as an interaction between animals and their environment was no longer adequate in the way affordances were used in human computer interaction today. They proposed a mediated action perspective on defining affordance. The authors suggested that affordances should be looked upon from three angles; the user, the mediator or means and the environment. They suggested different definitions of affordance based on the action. They asserted that the Gibsonian definition of affordances did not include core concepts like culture, motivation, development, communication, functionality and context. They proposed definitions for maintenance affordances, aggregation affordances, learning affordances, auxiliary affordances and other mediated actions to the affordances. Media attributes are also affordances (Spector, Lockee, Smaldino & Herring, 2013).

Technological affordance is the ability to be able to know what the product is designed for without the user getting frustrated (Norman, 1988; Ware, 2003). In designing the product, the designer must consider the product and the user because the designer would not be there when the user uses the product (Dillon, McKnight & Richardson, 1988). Technological affordances should allow the educational and social affordances to interact (Kirschner et al., 2004). In affordances, the learner must be presented with clues on the product that would make it possible to use the

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

product. In e-learning, it is the affordances that connect the learner to the technology (Kirschner, 2002). Mayes and de Freitas (2004) assert that models of e-learning are not models but are affordances of e-learning because the models aim to make the learner use the technology to learn electronically i.e the technology affords e-learning.

Kirschner (2002) defined educational affordance as the capacity of the learner to learn given the proper instruments that the learner can use without much fuss. The online Oxford dictionary (Oxford online dictionary, n.d.) defines a nomad as “a member of a people having no permanent abode, and who travel from place to place to find pasture for their livestock”. Therefore, if computers were donated to Nomadic children whose parents were moving through the Sahara Desert, electricity is not likely to be present. In essence, even though the children have been given computers that depend on electricity not the ones depending on solar power, then going by Kirschner’s (2002) definition of educational affordance, those Nomadic children do not have the educational affordance that should have been afforded by the computers.

When an e-learner can perceive the use of a design and it allows the learner to communicate, the device has afforded a social affordance (Kreijns, Kirschner, & Jochems, 2002). Social affordance and technological affordances are present in e-learning environments.

In technological affordances, a perceived affordance is preferable to the Gibsonian affordance (Bower, 2008; Kirschner, Strijbos, Kreijns, & Beers, 2004). Nielsen (1993, 2012) referred to usability as the learner knowing what the affordance is for. The technological affordance should not have to make the user exert his thinking faculties before he can figure out the use of the affordance (Krug, 2006). If the affordance is present and the learner does not know the use of the affordance or has difficulty in using the affordance, then the affordance is just there

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

as a utility. The affordance must present clues to the user. An affordance must be perceived by the user to be able to function as an affordance. The same affordance can be perceived by two different users in two different ways. As an example, a five year old child may see a wobbly table as a see-saw. An adult may see the wobbly table as an accident waiting to happen.

In the rest of this section when I use the word affordance, I shall be using Norman's definition of affordance as perceived affordance.

In situations where the perceived use of the design is not easily seen, signifiers are placed on the product. Signifiers are used by designers to let the users see the affordance. However, it is not all affordances that require signifiers. Sometimes, affordances are placed to prevent a function from being done. A metallic chain can be used to prevent a library patron from going beyond a certain point in the library. This is a forcing function (Norman, 1988, 2011). Signs can be placed in the midst of affordances to communicate their function to the user. These signs are called signifiers and communicate what the affordance may not readily communicate.

## **Implications of Affordance in Web Design**

There are many uses of affordances in web design. I shall restrict this section to reading textual information on a computer screen; reading comprehension on paper text compared to electronic text, the display rate of information on the screen and the text design. Several studies have shown that reading text from a computer screen is not as comprehensible as reading text from a hard copy book (Dillon, McKnight & Richardson, 1988; Mangen, Walgermo & Bronnick, 2013; Pöllönen, Järvenpää & Häkkinen, 2012). The screen should be organized and sequenced. Ausubel's theory on meaningful learning has shown that having organizers aid in learning and in understanding (Ausubel, 1960). Text should be organized with cues and relationships should be

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

visualized. Visual mnemonics should be related to the facts in the lesson. While colorful displays may be appealing, research has not supported color (Braden, 1996; Simonson, Smaldino, Albright & Zvacek, 2009). Green and red are not a good combination of colors to use. Dark colors should be used against a bright background (Simonson et al., 2009).

## **Reading Comprehension on Paper Text Compared to Electronic Text**

Several studies which I shall highlight in this section have looked at differences in the comprehension of electronic text and text on paper. A study by Schugar, Schugar and Penny (2011) showed no difference in the comprehension of students who read from a paper text and from those who read from an electronic text. This may be attributable to the web page design of the electronic texts. In some e-readers, some electronic text are now made to appear like a book and even make the sounds a paper makes when the electronic reader gets to the end of the electronic page.

However, when Kerr and Symons (2006) compared the reading comprehension of 60 fifth grade students that had been divided into groups, the group that read from paper outperformed the group that read from the computer screen. Similarly, when 72 tenth grade students were divided into two groups and given comprehension passages to read, and later tested on the passages, the group that read from paper copies outperformed the group that read from a Liquid Crystal Display (LCD) screen monitor (Mangen et al., 2013).

While some contend that discomforts from reading from a computer screen have been proven to range from eye strain, fatigue, difficulty in referencing previously read section, inability to gauge the thickness of the book, the inability to feel the eight corners of an e book, and the

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

display of printed text on a computer screen (Jabr, 2013), e-readers have been developed that simulate the affordances a book provides. Further, Jabr (2013) argues that the text on a screen is abstract. The affordances that the paper book provides add to the physical properties of the book (Jabr, 2013). While holding a paper book, one can fold it and one can feel the physical properties of the paper. Paper pages make a sound when turned. However, there are now some e-readers that imitate the sound the turning of a page makes when the e-reader gets to the end of a page.

In addition, the creation of e-ink readers by Amazon Kindle® and the Barnes and Noble Nook® that do not have a back lit screen makes them look like paper (Siegel, 2013). Historically, the first generation eReaders were not made with a multi- technology system, they could not connect to the internet and could not use a mouse. Today, eReading devices like the iPad and the Nook Color have a multi-technology system (Schugar, Schugar & Penny, 2011).

Studies conducted on the Amazon Kindle®, the Apple iPod touch® and the hard copy paper showed that for reading comprehension, there was no difference in the three formats. However, readers that had a pre conceived notion that reading from paper was better still believed that reading from paper was better even when they performed equally well on the other formats (Baker, 2012).

In contrast, eight grade students that read from an online source were unable to recall the details in the article as much as the group that read from the paper source (Fisher, Lapp, & Wood 2011). However, when the online group and the printed paper group were tested for the major gist in the article, they fared equally.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

When students in a different study were asked to suggest methods that they used to aid comprehension, students that read using the Nook® said they bookmarked the pages while students that read the traditional books folded the pages. Further, the study revealed that there was no difference in comprehending the passages read when the two groups were compared (Schugar, Schugar & Penny, 2011).

In a separate study, participants were divided into four reading groups (Nielsen, 2010). The four reading groups were the Amazon's Kindle 2®, the iPad®, a desktop computer and a traditional paper text. The reading speed was less on the Kindle® and on the iPad®. The comprehension of the passage read was not examined.

In an ethnographic study, Sellen and Harper (2003) argued that the affordances that a paper provides allows the user to grasp, to fold and to carry the book in a way the user cannot manipulate the electronic devices. Literature review of empirical articles published between 1990 and 2004 showed that students that were novices to the lessons, performed poorly on hypertext (De Stefano & Le Fevre, 2006). However, when the hypertext was organized in a hierarchical format, students that were novices improved their performances. The review also showed that learning comprehension by hypertext increased cognitive load and increased comprehension and navigation tasks.

While hypertext on the computer has shown its advantage in terms of being able to search a particular topic, when it comes to comprehension exercises, reading from a book or paper has proven to be superior. It has been suggested that the superiority is due to the linearity of the paper texts (DeDtefano & LeFevre, 2006). Hypertext has a non-linear organization and paper text has a

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

linear organization (Kerr & Symons, 2006). It has been suggested that the human brain views the text as a terrain that can be physically manipulated; there is a mental representation of the word or text (Jabr, 2013). The hanzi of the Chinese and the kanji of the Japanese are thought to stimulate mental representations. The Japanese kanji is made up of 5000 to 1000 characters (Omniglot online encyclopedia, n.d.). The Chinese hanzi depends on motor memory for writing (Nakamura, et al. (2012). The alphabet literacy depends on phonetics. Nakamura, et al. (2012) conducted experiments with native speakers of French and native speakers of Chinese. They were able to conclude that mental representation played a role in alphabetic literacy.

Payne and Reader (2006) conducted studies in which students were given on line texts to read and then examined the texts. Students that had read the text up to three times were faster at locating where the search word was than students who had read the on line text once or twice. The authors concluded that the students that were able to recall the search word were able to do so because they had formed a mental representation of the on line text.

### **Reading Comprehension on Text**

There are conflicting research on reading comprehension from text and reading comprehension from electronic devices. While some research showed that there was no difference between reading comprehension from text and reading comprehension from electronic devices, some research showed that reading comprehension was better on paper texts. Research also showed reading comprehension to be better in electronic devices. However, participants that have a bias towards a paper text or electronic text may answer their questions to favor their biases. Most of these studies were carried out on young adults who were born at the time when electronic texts was already existing and may favor the electronic texts unlike participants that

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

were born before the advent of the electronic text. Also, recent design of web pages on electronic readers is making electronic text on e-readers to look like paper text.

**Display rate.** The pace at which text is displayed on the screen may be too fast for some users and this might make them read too fast and thereby lose comprehension (Seow, 2008; Shneiderman, 1984). Shneiderman and Plaisant (2010) suggested that users should be allowed to control the display rate of the text. They further suggested that if the aim of the user was to scan for relevant material, then the screen may display the texts at a faster pace. If the task involves entering of data, then the display rate should not be fast.

**Text design.** A sans serif font should be used instead of a serif font because they are easier to read. If the text would be displayed on a regular monitor, a font size of 24 point and 32 to 36 point should be used (Hartley, 1996; Simonson et al., 2009). Sans serif fonts do not have finishing strokes at the end while text with serif has finishing strokes at the end. Capital letters take up more space than lower case letters. While television uses a centering text display, a left justified text is preferable for web pages (Simonson et al., 2009).

Pointers or arrows should be used to identify key points in pictures. A contrasting color can emphasize the area of interest. A border or a line can be used to unify the objects of interest. Word pictures can be arranged as pyramids, as maps, as hierarchies, as outlines, as cognitive maps to present the ideas or points being presented (Simonson et al., 2009).

Designers should use vertical and horizontal white space. Research in eye movement has shown that readers rely on special cues given by the white space as in paragraphs, headings, and punctuations (Hartley, 1996). Segmentation of texts and picture labeling improves

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

comprehension (Flora & Ploetzner, 2010). Graff (2003) contends that segmentation is only of advantage to people whose cognitive style is verbalizer-imager. Verbaliser-imagers are good at verbalizing, but are not good at keeping track of their spatial locations while wholistic-analytic persons are able to see things as a whole and have difficulty analyzing them in segments. Graff (2003) goes on to suggest that web designers should look at the cognitive style of the learners before designing web pages. Imagers would benefit from segmentations and less segmentation would be of benefit to analytic persons. The cognitive styles of the participants were determined through computer-based cognitive style analysis.

Text can be organized using signal phrases like therefore, secondly, because and as a result. Designers should avoid long sentences because they contain too many subordinate clauses and they would overload the memory (Hartley, 1996). The readability formula present in word processors can be used to assess the difficulty in the text (Hartley, 1996).

According to the Royal National Institute for the Blind (RNIB, 2012), when designing websites for the visually impaired the designer should make the font size readable even when the browser setting is changed to reduce the text size because some users have low tunnel vision. The Institute recommends Arial or Verdana font for text. Also, the base font chosen should be 100% so that when the visually impaired resizes the text, the text would still be displayed at 100 percent (RNIB, 2012).

Kintsch, Kozimsky, Streby, McKoon and Keenan (1975) showed that participants were able to recall from text that was uncluttered than from texts that were cluttered. Studies have also shown that when participants are given cues like topics related are put together, or text are put in bold print or in uppercase letters, the participants were more apt to recall the content in the text

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

better (Glynn & DiVesta, 1979). After analyzing some K-12 textbooks, Ambruster and Anderson (1988) concluded that content area textbooks were user-friendly because of the structure, coherence, and audience appropriateness of the text. Dillon et al. (1996) suggested that web designers should not design web pages like printed books are designed. They pointed out that web users already have a model of how printed books are organized and web designers should design web pages that would support hypertext.

Further, Lohr (2008) informs us that when a learner that reads from right to left is presented with graphically represented text that has to be read from left to right, the comprehension is less.

### **Summary of Text on Web Design**

The font of the text, the rate at which the text is displayed for the eyes to be able to read, the format in which the text is written, the mental representation of the text and the design of the text affect the comprehension of the learner. The format in which the text is written can be paper and it could be electronic. Lohr (2008) informs us that the direction in which the text is read can also affect comprehension.

### **Introduction to Cognitive Information Processing**

In Shakespeare's Macbeth, King Duncan may have been right to say "there's no art to find the mind's construction in the face" (Shakespeare, 1925, p.1103). Cognitive theorists have been able to elucidate the process of cognition through observations and experiments (Norman, 1982). There is literature on how often instructional designers use certain models (Yanchar, South, Williams, Allen, & Wilson, 2010). However, there is scant literature that describes exactly how the theory is used in the design. Gagne's theory of instruction is an exception that gives a

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

step by step instruction on how to use the theory in a lesson plan (1992). There is scarce literature on how to design web pages for e- learning based on the use of theory. This section would elucidate on the use of cognitive load theory in the design of web pages for e-learning. In this section, I shall discuss the sensory memory, the short term memory, the primacy effect, decay, long term memory, encoding and pattern recognition.

## **Theory of Cognitive Information Processing**

The cognitive information process gathers information from the environment. This information goes through the sensory memory, through the working memory and into the long term memory as depicted in Figure 1.

However, before the information can get to the long term memory, a lot of events can occur. These events can occur anywhere along the pathway of information and the information may eventually not make it to the long term memory. If it makes it to the long term memory and the person is unable to recall the format or code in which s/he stored the information, that person would not be able to retrieve it.

## Sensory Memory

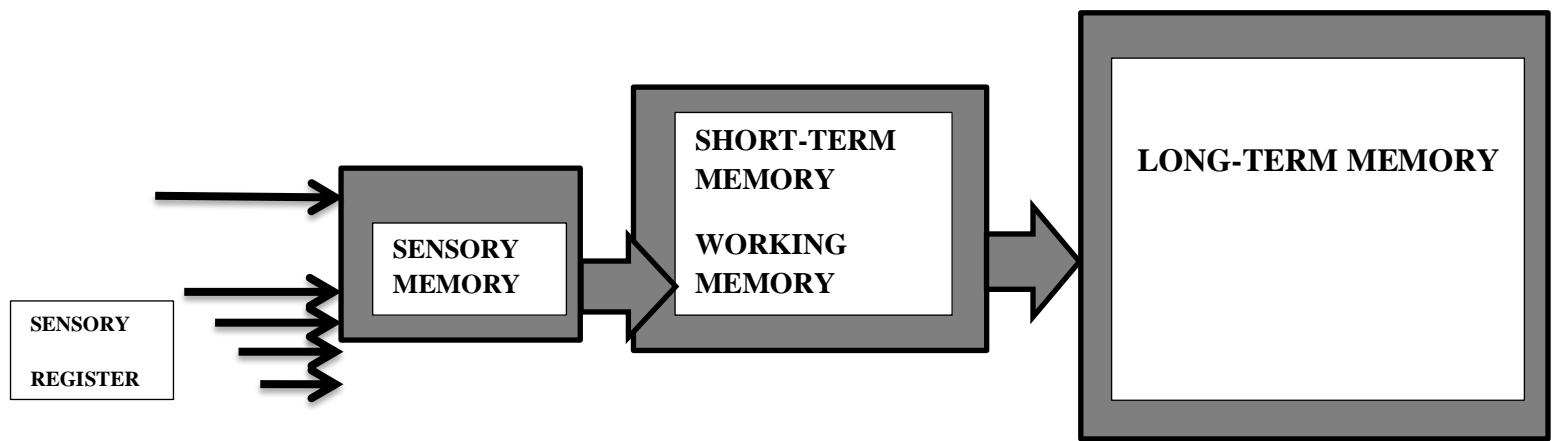
A model of how information moves from the environment through the modes of memory is shown in Figure 1. The information is the stimuli for our sense of taste, touch, smell, sight and sound. I have represented the stimuli to the five senses by five separate arrows. The stimuli from the environment are received by the sensory memory. Information comes from the environment through the five senses into the sensory memory. The sensory memory is not selective to the stimulus coming from the environment (Driscoll, 2000; Norman, 1969). Inside the sensory memory there are registers for stimuli coming through all the five senses. There are separate processors for auditory and visual information. There are separate processors for all the five senses but for cognitive load theory in this paper, I shall focus on the auditory and visual processors. In Figure 1, I have drawn the sensory memory, the short term memory and the long term memory in increasing sizes, with the long term memory having the biggest box because its memory capacity is infinite.

Auditory and visual stimuli stimulate the sensory memory. The auditory information can last for only 3 seconds and for half a second for visual information. Information in the sensory register dissipates quickly unless the person is able identify and register it within that short time. If we are able to register the information, it moves to the short term memory (G. Cooper, 1998). For the person to identify, register and classify the information, that person must have paid attention to it.

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**Figure 1. Model of Cognitive Information Processing System**

(Image drawn by Titilola T. Obilade, 2014)



# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**Research on sensory memory.** In Sperling's doctoral dissertation (1960) he was able to show that for a very brief period, the sensory memory registers information seen visually. Sperling briefly exposed his five participants to some letters for 50 milliseconds at a distance of 22 inches after which he asked them to recall the letters. Vowels were not included in the letters the participants were exposed to thereby preventing the participants from forming words from them. Although the participants were not able to recall all the letters, they were able to accurately recall most of the letters.

However, when the participants were briefly exposed to four letters or less, they were able to recall the entire letters they were exposed to. He went further by asking the participants to recall letters from a particular row and the participants were able to correctly recall letters from that particular row. By these experiments, Sperling was able to prove that the sensory memory does register some information even if the exposure is just for very brief periods.

Norman postulated that the reason the visual sensory memory retained information even after the image was taken away was probably because the brain still needed the information for pattern recognition and other processes (Norman, 1982).

## Short Term Memory

As the name implies, the information stays in the short-term memory for a short time and the information is not stored permanently. It is the place where information coming from the sensory register can be chunked, rehearsed, encoded and prepared for further storage in the long term memory (Driscoll 2000; Moore, Burton & Myers, 1996). The term working memory has

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

been used to replace short-term memory because working memory connotes a process in action (de Jong, 2009).

However, researchers like Cowan (2008) and Shneiderman (1984) separate working memory from short term memory. Cowan (2008) and Shneiderman (1984) described three types of memory; the short term memory, the working memory and the long term memory. Cowan (2008) argued that the short term memory was responsible for non-attention demanding tasks. The working memory is part of the short term memory and is responsible for attention demanding tasks. Attention demanding tasks are characterized by their intellectual aptitude. It follows that working memory is responsible for intellectual aptitude. The information in the short term memory is moved to the working memory for further processing.

The short-term memory has a limited chunk capacity (Cowan, 2008). It is this limited capacity that has been a concern of cognitive load theorists. The working memory processes the information further and it goes into long term memory. Information that is already in the long term memory assists the working memory in interpreting this information.

Shneiderman (1984) summarized the function of the short term memory as that of processor of perception and the working memory as the generator and implementer of solutions. In combination, the short term memory and the working memory are information processors and problem solvers. Having differentiated between working memory and short term memory as described by Cowan (2008) and Shneiderman (1984), for the rest of this paper, I shall use working memory to mean both working memory and short term memory.

**Early research work on selective attention.** As the word selection implies, selective attention is disregarding all other information and choosing a particular piece of information.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The cocktail problem is also known as selective attention (Norman, 1969). At a cocktail party if all the participants spoke with a similar grammatical content, it would be difficult to be selective (Norman, 1969). Colin Cherry (1953) was able to show that when participants were presented with two different messages to both ears, they were better able to distinguish the message when the messages were of different grammatical content. The messages were better distinguished if the message was prose from a novel and less distinguished if the message consisted of technical terms. However, when both ears were presented with messages of similar grammatical content, it was difficult for the subject to distinguish between the two messages.

However, the information does not go past the sensory register if the person does not pay attention to the incoming information. Information in the sensory register is only kept for about a few tenths of a second (Driscoll, 2000; Lindsay & Norman, 1977). When we pay attention, we are able to perceive, conceive, remember, distinguish and shorten the reaction time (Norman, 1969).

**Primacy effect.** The short term memory is susceptible to temporal decay and chunk capacity limits. Temporal decay occurs when the learner finds it easier to recall the object of information when it is the only object but once more objects are placed on the list, the learner finds it difficult to recall all the objects on the list.

Several studies (Lindsay & Norman, 1977; Waugh & Norman, 1965; Waugh & Norman, 1968) have shown that when learners are given a list of items, they are apt to remember the first (primacy effect) and last (recency effect) items on the list. In teaching it is important to teach the

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

important items at the start and at the end of the instruction because of the primacy and recency effect (Driscoll, 2000).

**Decay.** If the object of information in working memory is activated or refreshed by the long term memory, the object of information would not decay. The learner can increase the storage capacity of the working memory by methods of rehearsal and methods of chunking. If the information from the working memory is transferred to the long-term memory, the learner may recall the information or may forget the information in which case the information is there but the learner cannot retrieve it because information in long-term memory is not truly lost.

## Long Term Memory

Long term memory is the place where information is stored forever (Driscoll, 2000). Episodic memory and semantic memory are both forms of long term memory. Episodic memory is used in recalling specific events in life. Semantic memory is used in recalling instruction without attaching the memory to specific events (Driscoll, 2000). It is because of long term memory that we are able to remember our names, our addresses, our telephone numbers, how to read and how to write. Activities like walking and talking have become automated in us because we do it regularly (G. Cooper, 1998).

Students that had knowledge of algebra spent less time on the algebraic problems than novice learners because the students who had knowledge of algebra could draw from their schema in long term memory (Kalyuga & Sweller, 2005). Similarly, on a computer-based instruction for middle-school students, students who had a higher prior knowledge of the material performed better than students who did not have a higher prior knowledge (Kopcha & Sullivan, 2008). In designing web pages, the web designer should keep in mind whether the users would be novice

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

users or expert users. Expert users would already have a scheme of how to use the web pages unlike novice users (Chevalier & Bonnardel, 2007).

**Encoding.** When storing information in long term memory, the learner encodes it and it is in this same code that the learner retrieves it. If the learner encoded using a particular context and s/he tries to recall using a different context, the learner would not be able to retrieve the information. If while-learning the information, the learner was given some interference task, the learner would not be able to recall the information because of the interference (Driscoll, 2000; Lindsay & Norman, 1977). Therefore, a learner can forget due to failure to encode, failure to retrieve and also because of interference.

Information can be encoded through use of organization e.g. concepts and hierarchies. Mnemonics and imagery are also forms of encoding (Driscoll, 2000). Mental imagery promotes item recall when the learner is able to form an image of the item to be stored. If the learner can make a mental imagery of the items to be stored or make an association of the item to be stored, it will make recall easier (Braden, 1996; Lindsay & Norman, 1977).

Jonassen (2006) argues that concept formation help us to communicate. He further asserts that combining concepts into propositions can help learners to compare and contrast. In instructional design, concepts can be used in problem solving. The role of concepts is particularly useful if the learner forms the concept himself/herself because it improves understanding (Jonassen, 2006). Malmberg and Annis (2012) concluded that memory recognition was due to perceptual and mnemonic processes and not due to perception tasks after performing several recall tasks with undergraduate students.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Self-questioning is another strategy that can be used to encode material. The learner asks himself/herself questions on the information being studied. This self- questioning works better with high level questioning than low level questioning (Driscoll, 2000).

**Pattern recognition.** We are able to recognize objects we see by matching it with what we already hold in our long term memory. The letter A can be written as a **A** **À** **Á** **a** **á** **À** **Á** and they would all be recognized as the letter a because we already have information on what the letter A looks like (G. Cooper, 1998). If we have no information on what we see, we cannot recognize it. Similarly, the letters DEAR SON, TAKE CARE, when seen as part of a sentence can be read as DEAR SON. At first, we see DE R SON, T KE C RE but on a closer look we fill out the A in Dear and the A in Care so that we can read Dear Son, Take Care because the reader is familiar with the words, dear, son, take and care. Gestalt theory explains the reason why teenagers can send text messages to each other using incomplete words that would be understood by another teen (J. Burton, Personal Communication, January 15, 2014).

Gestalt theory explained how humans were able to perceive the environmental stimuli even without having a complete image of the stimuli. Gestalt is a German word that means a shape or form. Gestalt theory is how people perceive a whole picture from the many parts and pieces of what they see (Winn & Snyder, 1996). The perception by the learner is faster and easier if the learner knows what to look for i.e the perceptual organization of the learner.

### Early Research Work on the Cognitive Information Processing System

The Atkinson-Shiffrin model of human memory was first proposed in 1968 but it has been revised by several psychologists. Their model had a sensory register, a short-term store and

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

the long-term store. They did not have a general consensus on how information was transferred from the short term store to the long term store. “The form of the STS-LTS transfer may be probabilistic, continuous, or some combination; neither the literature nor our own data provide a firm basis for making a decision” (Atkinson & Shiffrin, 1968, p.103). Raaijmakers and Shiffrin (1981) modified the 1968 model of Atkinson and Shiffrin when they developed the Search of Associative Memory (SAM). In SAM, Raaijmakers and Shiffrin posited that the long term memory depended on cues in order to recall.

Burton and Croft (1995) asserted that there was a controversy in explaining how images were stored in memory. They believed that the dual coding theory and the cue summation theory could be used to show how images were stored in memory. The dual coding theory asserts that when a person is given some words, the more concrete the words, the more concrete the image it would evoke. “The higher the concreteness of a stimulus item, the more likely it is to evoke sensory images that can function as mediators of associative-learning and memory” (West, 1977, p.3). The cue summation theory stated that the more cues were in an image; the more likely the learner was to remember (Burton & Croft, 1995).

However, the cue summation theory did not explain the number of cues that would give maximum recall (Burton & Croft, 1995). Armbruster and Anderson (1988) observed that text books that gave cues like underlining, italics, bold face, headings and sub-headings gave structure to the text and were easier to understand. Similarly, Armbruster’s study did not indicate the number of cues that were necessary to aid recall and understanding. In web design, it is better to use icons that the learners are familiar with than to use icons they have never seen before.

## Cognitive Load Theory

The working memory has a limited capacity while long term memory does not have a limited capacity. In order to learn new information, the working memory must process the information in order to store it in the long term memory. If it happens that the information presented to the working memory is overwhelming, learning cannot occur. When the working memory is overwhelmed and learning cannot occur, the cognitive load is said to be more than the working memory can handle. There are strategies that instructional designers can use to reduce cognitive load. These strategies would be discussed in this section. In this section, I shall define learning to have occurred when the information to be learnt has been processed by the working memory, is encoded and stored in long term memory and can be recalled when needed (G. Cooper, 1998).

**Chunking and working memory.** When we are presented with a large body of information like several digits that make a phone number, it is easier to remember them when we group them together. George Miller (1956) did a phenomenal study on the working memory's ability to store items. Participants were given up to seven or more than seven different number of dots that were flashed on a screen for one-fifth of a second. Whenever the number of dots was less than seven, the participants always gave the correct answer but had to estimate whenever the number of dots was above seven. When the material to be learned is broken into chunks, a larger amount of information can be stored in the working memory. When the material is to be recalled from memory, it is easier for the learner to recall if the stored items are related (Winn & Snyder, 1977).

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The implications of Miller's findings (1956) are that since the working memory has a limited capacity, instruction to learners should be designed in a way that would facilitate learning by not overloading the cognitive load on the working memory. These implications have been applied beyond instructional design and have been used in the design of digital music in automobiles. Automobile manufacturers are now introducing voice commands to decrease the cognitive load on the driver if s/he was to manually select a music item from thousands of selections (Forlines, Schmidt-Nielsen, Wittenburg, & Wolf, 2005). Cognitive load is also an active player in the financial industry. In an experimental study, the cognitive load on numeric financial data affected the decision making process of the participants (Rose, Roberts, & Rose, 2004).

Research has shown that working memory has limited capacity when it is receiving information from the sensory memory (Miller, 1956). The working memory is not limited when it is receiving information from the long term memory (Torcario & Sweller, 2010; Van Merriënboer & Sweller, 2005).

The working memory can store a maximum of seven elements coming from sensory memory and can operate 2-4 of those elements at a time for up to twenty seconds. Cowan (2000) contests that working memory has a storage capacity limit of four chunks and not seven chunks as Miller suggested. Gobet and Clarkson (2004) contested Cowan's four as an over estimate. They conducted experiment on Master chess players that played on computer simulated chess boards and on physical boards. Their analysis revealed that chunks were reduced to three. If the information is rehearsed, the information can stay longer than twenty seconds in the working memory.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

When the working memory is able to process the information, it is able to form schemata in long term memory. The long-term memory has schemata that have within them, structures of operations of problems or tasks. While these operations may be long, they have been compacted into low order schemas and high order schemas in the long-term memory (Paas, Renkl & Sweller, 2003). The working memory can recall schemas from long term memory to working memory to solve a problem it has encountered before.

A person who does not speak the Russian language would find it difficult to remember seven Russian letters because the schema for the Russian language is not in the person's schemata of long term memory (Shneiderman & Plaisant, 2010). Studies that were done on English speaking participants showed that when they were given Italian words to learn, they were not able to recall the words because they did not have a scheme of Italian words in their memory (Hulme, Maughan & Brown, 1991).

Learners can encode information they want to remember by connecting it to information that already exists in the long term memory. If these operations were not compacted into schemas in the long-term memory, they would occupy a large amount of the cognitive load if the operations were to take place in the working memory. When the working memory encounters a similar problem over time, they are processed automatically in the long-term memory through automaticity (G. Cooper, 1998; Driscoll, 2000).

When the working memory is able to process problems automatically, the cognitive load on the working memory is reduced. When the cognitive load on the working memory is reduced, the working memory can channel its energy on learning new material. Sweller (2010) has explained this energy as interactivity elements. An element equals the amount of information

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

needed to be processed. Experts who have schemata in their long-term memory are able to complete tasks faster than novices who do not have the schemata for the tasks (Chase & Simon, 1973; G. Cooper, 1998; Sweller, 1988, 2010).

Chase and Simon (1973) observed three chess players with three skill levels. The levels were master, class A and beginner chess players. The three chess players were allowed to look at a chess board for five seconds and then reconstruct the chess pieces on another board from memory. The observers noted that the chess master was able to glance at the board, a minimum number of times before accurately reconstructing the board. The implication of this is that the chess master already had schemata of the particular chess move that he reconstructed. However, when all the players were presented with a random arrangement of chess pieces, the master chess player performed the same as the other two players because he did not have schemata of the random arrangement of the chess pieces.

De Groot, a master level chess player conducted a similar study earlier for his dissertation and he concluded that the difference between master chess players and amateurs were in their perception and memory (Buasto, 2006). Master chess players were able to hold larger chunks of chess arrangement in memory and were able to analyze chess arrangements faster than amateurs (Buasto, 2006; De Groot, 1978).

Cognitive load theory deals with the information on the working memory. If a learner is given an instructional module that would occupy all of the working memory, the learner is not able to learn the new task because the interactivity elements would be high (Sweller, 2010). The instruction can be designed in a way that the working memory is not entirely occupied by the

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

task. The information that is supporting the instruction must not be such as to overload the working memory (Austin, 2009; Ayres & Youssef, 2008; Feinberg & Murphy, 2000).

**Types of cognitive load.** There are three types of cognitive load; the intrinsic cognitive load, the extrinsic cognitive load and the germane or effective cognitive load. These three types of cognitive load form the totality of the working memory. If ninety percent of the working memory has been used up by the extrinsic load, it would be difficult for the learner to learn with the ten percent left for intrinsic cognitive load and germane cognitive load. Instructional designers should design with the intent to have more of germane cognitive load and less of extraneous cognitive load (Cierniak, Scheiter, & Gerjets, 2009; Leppink, Paas, Vleuten, Gog, & Merriënboer, 2013; Sweller, 2010; van Merriënboer & Ayres, 2005).

**Intrinsic cognitive load.** Intrinsic cognitive load refers to the level of difficulty attached to solving the task or the level of difficulty attached to understanding the problem. An increasing level of difficulty increases the level of intrinsic cognitive load on the working memory. The actions that occur in the working memory when it is confronted with a task are the interactivity elements. The more the interactivity elements in an instruction or task, the more the intrinsic load (Paas, Renkl & Sweller, 2003). Sweller, van Merrienboer and Paas (1998) argued that intrinsic load cannot be reduced. Pollock, Chandler and Sweller (2002) showed that intrinsic load can be reduced.

**Extraneous cognitive load.** If the instruction or task given to the learner has a high level of interactivity elements and it is possible to give the same instruction with a low level of

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

interactivity elements, that instruction is said to contain an extraneous cognitive load (Paas, Renkl & Sweller, 2003; van Merriënboer & Ayres, 2005).

The extraneous cognitive load is dependent on the instruction, the organization and the general layout of the problem to be solved (Feinberg & Murphy, 2000; van Merriënboer & Ayres, 2005). The actual problem to be solved is dependent on the intrinsic cognitive load. It is important to keep extraneous cognitive load low when intrinsic cognitive load is high because the sum of extraneous cognitive load and intrinsic cognitive load make up the cognitive load. However, if the intrinsic cognitive load of the problem is low, the emphasis may not be on keeping extraneous cognitive level low because the interactivity elements are low (Paas, Renkl & Sweller, 2003; van Merriënboer & Ayres, 2005). Instructional designer should design to keep extraneous cognitive load low

***Germane cognitive load.*** When the instruction is constructed in a way that encourages the formation of schemata and automaticity in the learner, then the instruction is said to have a germane cognitive load (Paas, Renkl & Sweller, 2003; van Merriënboer & Ayres, 2005). Kalyuga (2011) argues that there has been no empirical evidence of a germane cognitive load but that the germane cognitive load is part of intrinsic cognitive load.

When a learner has acquired schemata in a certain task it would no longer require a high cognitive load to perform that task. Novices have not yet developed the schemata that experts have developed and would take longer at performing the same tasks when compared to experts. If experts and novices are given the same type of instruction, the expert may find the instruction redundant (Leslie, Low, Jin, & Sweller, 2012).

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Studies conducted by Burton, Niles and Wildman (1981) on 243 undergraduate and graduate students showed that the recall of text was dependent on whether the text questions were on semantics or just orthographic tasks like spelling of words. Further, the study showed that there were different levels of processing and depending on the type of information learnt, recall could be easy or difficult. Burton, Niles and Wildman (1981) divided the participants into three reading groups. The three groups were given 10<sup>th</sup> grade reading level prose and assigned different tasks. The first group had orthographic tasks like counting the number of e's in the target word. The second group had semantic tasks like writing the synonyms and antonyms for the target word. The third group was the control group.

The results showed that the group that had orthographic tasks had a low recall of the words but the group that had the semantic tasks had a higher recall after one week and after two weeks because the semantic task group did a higher level of processing.

### **Implications of Intrinsic, Extrinsic and Germane Cognitive Load in Web Design**

The design can cause a high cognitive load. Similarly, the design of the instructional material can encourage a low cognitive load. The instructional designer can redesign a formerly high cognitive material to become a low cognitive load material. The instructional designer can design the instruction to encourage schema formation. When instruction encourages schema formation, it is said to encourage germane cognitive load.

**Novices and experts.** Learners that are expert in the domain of instruction being learnt would not need to have the cognitive load reduced because they are not at the risk of exceeding their cognitive load. They have many schemas combined into even bigger schemas. Learners

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

that are novices in the domain content area being learnt would benefit from a reduction of cognitive load. Novice learners would benefit from instruction that would encourage schema formation and automation (Trumppower, Goldsmith & Guynn, 2004). In traditional teaching methods novices spend more time-learning. The effect that the learner gets depends on whether the learner is a novice or an expert.

Experts in the content area of the material already have a schema for the information that they would be learning. Therefore, they have a lot of free space in their working memory to be able to learn the new material. The implication of this is that there would be no need to reduce the cognitive load for experts. Novices do not have the schema for the material being learnt and would therefore use up a lot of working memory space to learn the new material in order to build schemas of their own before they can encode and modify. The implication for novice learners is that the instructional designer must design the material for novices in a way that would free up space in the working memory that would facilitate learning the material.

## **Instructional Strategies that Reduce Cognitive Load**

In this section, I would be describing the effects due to cognitive load and how they can increase or decrease cognitive load. I would also include research results from studies on cognitive load theory. The effects of cognitive load are:

- Means End Analysis or Goal-free Effect
- Worked Example or Problem Completion Effect
- Split Attention Effect
- Redundancy Effect
- The Modality Effect

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**Means end analysis converted to goal free effect.** Conventional or traditional problem solving by novices is through means end analysis and it takes up a lot of working memory space thereby creating a high cognitive load. In means-end analysis problems, there is a well-defined problem, there is a current problem state and there is a goal state. The aim is to reduce the differences between the two states. The learner holds the problem, the expected outcome and the relationship between the expected outcome and the problem in memory. While holding all these in memory, there is barely enough space in the working memory to hold or learn new material or to build new schemas. In non-specific goal problems, the expected outcome is not given to the learner. In non-specific goal states, the learner works progressively forward, without being supplied an expected outcome. Since the learner does not have to hold the expected outcome in memory, there is more space in the working memory to build schemas.

**Studies on goal free effect.** An example of means end analysis is *if  $y = x + 6, x = z + 3$  and  $z = 6$ , find the value of  $y$*  (Cooper, 1998). Research has shown that means ends analysis overloads the working memory (Sweller & Levine, 1982; Sweller, van Merriënboer & Paas, 1998). In solving the equation, the learner must hold certain parts of the equation into memory when solving for  $x$ . Tossavainen (2009) also showed that an algebraic equation like  $2x = 1$ , overloads the working memory. However, in a goal free effect, the learner is told to solve what s/he can given the same problem.

*If  $y = x + 6, x = z + 3$  and  $z = 6$ , find what you can.* Transformation problems include problems like tower of Hanoi, geometry problems, maze tracing problems, river crossing problems. Transformation problems are solved by general rules which are then applied to the rest of the problems. Sweller and Levine (1982) conducted an experiment using transformation

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

problems. The non-specific location group outperformed the specific location group. Their study also supported Sweller, Mawer and Ward (1983), Paas, Camp and Rikers (2001).

An example of a specific goal is “solve for the between- groups sum of squares” and a non-specific goal is “solve for as many unknowns as possible” (Trumpower, Goldsmith & Guynn, 2004, p.4). Trumpower, Goldsmith and Guynn (2004) conducted their study using statistics. They observed that transfer was faster when novice students were given non-specific goals than novice students that were given specific goals. They found that novice participants that were trained in non-specific goal techniques solved the transfer problems in less time than participants who used the goal specific techniques. The non-specific goal technique encouraged the students to develop a schema that could be used to solve similar problems. It does not encourage them to focus primarily on the final result as in the goal state.

Vollmeyer, Burn and Holyoak (1996) disagreed with Sweller (1988) that problems with non-specific goals decreased the cognitive load although their studies showed that students who were given problems with non-specific goals were able to recall the solution steps than students who used conventional methods. They surmised that the non-specific goal group performed better, not because of a decrease in cognitive load but because non-specific goal problems prompted the activation of the rule space while problems with specific goals activated the instance space.

Sweller, Ayres and Kalyuga (2011a) agreed with Vollmeyer, Burn and Holyoak’s (1996) theory. They opined that in specific goal problems, the working memory was searching the instance space and so did not have any resources left to search for the rule space. Trumpower, Goldsmith and Guynn (2004) agreed with Sweller and Levine’s (1982) earlier explanation on

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

cognitive load. In addition, they explained that the goal-specific group was not able to build schemas because their attention was focused on the goal. The studies on cognitive load were carried out on K-12 students (Paas, Camp and Rikers, 2001; Sweller, 1988; Sweller, Mawer & Ward, 1983 & Vollmeyer, Burn and Holyoak, 1996). Trumpower, Goldsmith and Guynn (2004) carried out their research on undergraduate students. The ages of the undergraduate students were not stated.

**Summary on goal free effect.** Most of the research that was done under goal free effect did not delve into working adult learners to see if they preferred a non-specific approach to problem solving or a goal specific approach. There are many adult learners working part time and taking online course and I do not think they would appreciate being given non-specific goals. An adult learner may prefer using the conventional goal specific effect on his/her own perhaps because they are used to the conventional method of problem solving. They would not really be holding anything in memory if they are able to write out each step on paper and refer to the solutions for similar problems. In addition, because of the time factor, adult learners may not be motivated to apply the non-specific goal state.

The study reviewed showed that students who had non-specific goal problems outperformed students with goal specific problems. The authors did not suggest to the goal specific to write out their steps on paper instead of holding it in memory. My suggestion would have been to encourage the goal specific group to write out as many steps as possible on paper and not attempt to hold the goal state or the current state in memory. Writing out all the steps on paper would have eliminated holding the goal state and the current state in memory which is what the non specific goal state tries to avoid. This may be preferable than being given a non-specific

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

goal as in find as many angles as you can find in the triangle. When the solutions are infinite in number, a non-specific solution cannot be applied.

Sweller, Ayres and Kalyuga (2011a) admit that the goal free effect is not popularly used as much as other instructional strategies like worked examples. Cooper (1998) also admits that while a goal free strategy might decrease cognitive load, it would be impractical to give goal free instructions where there are many possible solutions.

**Worked example and problem completion effect.** Worked example leads to schema formation and automaticity because it encourages the identification of problems as being of a particular type (G. Cooper, 1998). It promotes recall of each step and the performance of each step without error. Worked examples give a low cognitive load because the learner focuses only on the problem state and the rule operator at a time. A partially worked example is one in which the problem is partially solved and the learner completes it. Partially worked examples also promote schema formation and automation.

**Studies on worked examples and problem completion.** When worked examples were used to teach geometry to seventh graders, the groups that were provided worked examples outperformed the groups that were not given worked examples (Retnowati, Ayres & Sweller, 2010). Earlier, Tarmizi and Sweller (1988) found that when the worked example had a split effect, the worked example group did not do better than the conventional method. When the worked example group was given problems without the split attention effect, the worked example group performed better than the group that used conventional methods. Tarmizi and Sweller (1988) carried out their experiments by asking year 9 secondary school students to solve geometry problems.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Worked example can also be used in an ill structured domain like essay writing. When Korean, French and Chinese university students learning English as a foreign language were given essays to write, the group that was given model essays outperformed students that were not given worked examples (Kyun, Kalyuga & Sweller, 2013). The study group consisted of 59 Korean students, two French students and two Chinese students. The effect of the worked example was most prominent in students who knew the least about the topic.

**Summary on worked example.** While worked example reduces cognitive load, it has a ring of passivity to it especially when the researchers have not attempted to fade the worked examples over time. Also, instead of just providing model essays as in Kyun, Kalyuga and Sweller's paper (2013) the authors did not describe if actual tutors tried to teach what was in the model essay apart from simply providing the students with a model essay. If the students merely modeled their essay paper according to the worked example, the students would have similarly modeled their behavior or essay performance according to the paper. If I go by my definition of learning as I stated at the beginning of the cognitive load theory section, learning occurs when the information to be learnt has been processed by the working memory, is encoded and stored in long term memory and can be recalled when needed. In the scenario where the foreign students were given a model essay and outperformed students that were not given a model essay, reducing the cognitive load in this case did not mean that they were learning. I do not see how the foreign language students could have encoded and stored how to write essays because they had the model essay in front of them the whole time. While worked example effect reduces cognitive load, it is uncertain to determine if these particular students learnt at the same time.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Further, practice exercises were not done in any of the research. Practice exercises can be done in subjects like Mathematics where the students work on practice questions and can check for the correct working at the back of the text book. A mathematics text book like Larcombe's Mathematics (Larcombe, 1972) gives a lot of practice questions before attempting the exercise that would be scored. The student is encouraged to practice the practice questions. In this process, the students initially looks at the worked examples, practices the worked example and gradually the worked examples are taken away through fading and then the true test of learning would be to be given a test without being given further examples. After working through many examples, by this time, the learner might have become an expert and would solve the problems with automaticity.

**Split attention and split attention effect.** Split attention occurs when two separate pieces of information necessary for the understanding of the instructional material are presented separately. These two sources of information must be combined to make sense of the instructional material. If each piece of information is taken on its own, it cannot be understood. If the two sources of information are embedded inside one another the split attention is avoided and the increase in cognitive load on the working memory is avoided. When the two sources of information are embedded and the split attention is avoided, then we have a split attention effect (Sweller et al., 2011b).

While other scholars (Mayer & Moreno, 1998) use split attention and split attention effect interchangeably to mean the separation of two sources of information that are both processed when embedded together, Sweller et al. (2011b) differentiate between split attention and split attention effect.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The working memory can use the cognitive capacity to form schemas which can be encoded and stored in the long term memory. If one of the two sources of information is sufficient by itself to make the learner understand the instructional material, then it is not a split attention problem. The addition of the second source of information will cause redundancy another cause of extraneous cognitive load (Austin, 2009; G. Cooper, 1998; Sweller, Ayres & Kalyuga, 2011b).

**Studies on split attention and split attention effect.** Austin (2009) opined that web display design could cause split attention, increase cognitive load or reduce transfer learning. Earlier in this paper, I defined learning as the ability of the working memory to be able to encode the new material and store in the long term memory. If the instructional material must have both text and graphic, then the text should be embedded within the graphic. When the text and graphic are embedded and the learner does not have to mentally integrate them, then a split attention effect has occurred.

The split attention effect is also called temporal contiguity effect or temporal split effect when the information is separated by time like when a verbal narration comes after animation (Sweller et al., 2011b). The split attention effect is also called the spatial contiguity effect when the information is separated by space (Ginns, 2006). Split attention can come in many forms; text and text, text and diagram, diagram and diagram, narrative and diagram (G. Cooper, 1998; Sweller et al., 2011b). The narrative can be a voice recording in a PowerPoint with a diagram (Feinberg, 2000; Sweller et al., 2011b). Mayer, Moreno, Boire & Vagge (1999) proved that there was no difference in temporal split presentation if the length of the animation and verbal narration

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

was as short as 45 seconds. If the narration and animation were as long as long as 140 seconds, the temporal split effect was noticed.

Instead of embedding text within the diagram, the instructor can give cues through signals, segmentation and labeling to direct the learner to important parts of the text (Florax & Ploetzner, 2010). In their study, students that were given segmented texts and labeled pictures outperformed students who were given continuous texts.

The instructional designer can design web lessons by integrating formats that would otherwise give a split format. When the formats are separated, it gives split attention. The split attention in text and text can come from cross referencing. When researchers are reading research papers and have to look for the reference inside the same research paper, it is split attention (Chandler & Sweller, 1992). Chandler and Sweller (1992) conducted two experiments in which one group had the text embedded in the diagram and a second group had the text and diagram separated. The results showed that the group that had the text embedded in the diagram performed better than the group that had the text separated from the diagram.

The split attention effect was also observed among students of English as a second language. Students that were provided with comprehension passages with embedded questions performed better than students that had the questions placed separately from the comprehension texts (Al-Shehri & Gitsaki, 2010; Chang, Lee & Tseng, 2011). Huynh (2007) tested 21 Vietnamese students of English as a second language using integrated formats and a split format. The results showed that the integrated group outperformed the split format group.

Ginns (2006) did a meta-analysis of the split attention effect from 50 studies. He concluded that the split effect was found across domains and that high effect sizes were found in

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Mathematics, the sciences, technical domains, transfer tests and various age groups. He admitted that most of the participants involved in the study were novices and that if experts had been used, they would have found the split effect redundant.

**Summary on split attention and split attention effect.** Despite the plethora of research on cognitive load theory, much of the research studies done, were done on young persons in schools perhaps because of ease of availability. The research done is lacking in older, adult participants. Although studies were done in subject areas like Geography and Technical Drawings (Purnell, Solman & Sweller, 1991), Interactive Geography (Crooks, White, Srinivasan & Wang, 2008), English as a Second Language (Al-shehri& Gitsaki, 2010; Huynh, 2007), Mathematics and Engineering (Sweller, Chandler, Tierney & G. Cooper, 1990), the researchers have not attempted to design tests for older adults, particularly working adults and retired adults who might be developing memory problems. In addition, researchers have not focused on subject areas that need precision like drivers reading to pass the Department of Motor Vehicle (DMV) tests.

The split attention effect is of more benefit to novices than experts. Experts find the split attention effect redundant (Ginns, 2006). Subsequently, instructional designers can look at designing separate instruction for novices and a different one for experts. It is possible to present in two formats and not integrate the formats and the cognitive load would not be loaded. Florax and Ploetzner (2010) presented in two formats without integrating the two formats. They avoided the use of continuous text, segmented the text and labeled the pictures. These are affordances in text design and reading comprehension which was discussed under the theory of affordance.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**The redundancy effect.** In redundancy effect, the learner is presented with more information than is necessary for understanding the context. The same information is repeated in multiple formats. When the learner's learning plummets with the addition of the redundant material, a redundancy effect has occurred. The redundancy effect shares some similarities with split attention because they both have multiple sources of information. In split attention, if either of the two formats is taken alone, it cannot be understood. The two formats must be integrated. If the integration of the two formats occurs in the working memory when the learner mentally integrates them, the cognitive load on the working memory is increased. If the integration is done by the designer embedding text within the diagram, it would reduce the cognitive load on the working memory and we have a split effect.

In the redundancy effect, either of the two sources of information can be understood without integrating them (Sweller et al., 2011c). Integrating them either mentally or embedding them as part of the instruction would increase the cognitive load on the working memory and produce less learning which produces a redundant effect. The principle of the redundancy effect is used as one of the seven principles of cognitive theory of multimedia learning. People learn better from animation and narration than from animation, narration and text (Austin, 2009).

Redundancy effect increases extraneous cognitive load. If a diagram can be understood on its own, and a text is still used to describe the diagram, that text has become redundant. Similarly, writing the text and presenting audio of the text verbatim would give a redundancy effect (Sweller et al., 2011c). Sweller et al. (2011c) contend that diagrams in geometry may be difficult to understand without text. If a geometry question poses angle ABC equals angle XYZ, it would be difficult to understand without the text. However, diagrams that show the direction of

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

blood flow of the heart can be understood by the diagram alone without adding text or audio (Sweller, 2010; Sweller et al., 2011c).

**Studies on redundancy effect.** In young children learning to read, studies have shown that presenting the text with pictures that inform the reader about the words in the text increases the cognitive load (Torcasio & Sweller, 2010). The study authors suggest that the children learning to read should be given text without informative pictures. The authors explained that since the children already know what the words mean, presenting the pictures that would illustrate what the text means would be giving the working memory an extraneous cognitive load that would not allow them to focus on the text.

In the same paper, the researchers reported that when one group of students was given a book without any illustrations and another group was given a book with illustrations that were not relevant to the text they were reading, there was no difference in the performance of the two groups. Their observations showed that illustrations that were not illustrating the text did not add an extraneous cognitive load. The participants were all beginner level readers aged 6-7 years.

In another study, when students that were experts on the lesson on magnetism were presented with a verbal lesson as well as in visual form, the visual form became redundant because the verbal information was sufficient. The participants were aged between 11 and 12 years of age. However, novices in the topic that were presented with verbal and visual forms of the lesson did not have a redundancy effect. The researchers concluded that while the addition of the visual had an additive effect on the performance of novices, for experts, it was the reverse (Leslie, Low, Jin & Sweller, 2012).

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The redundancy effect was also observed when written and spoken texts were presented simultaneously (Diao & Sweller, 2007). Native Chinese speakers of English as a second language that were presented with spoken and written texts did not do as well as the students that were presented with spoken text alone.

**Summary on redundancy effect.** In Torcasio's and Sweller's (2010) study, the students used in the study were divided based on "teacher recommendations" (p. 6). Since the researchers formed the hypothesis, it is not impossible that the teachers that divided these students into three groups divided them in a way they expected them to perform. There was no randomness in the grouping of the students. While the results may appear valid, there seems to be a bias in the choice of participants for the study.

Further, the authors surmised, they used a non-informative picture for one of the three experiments. What criteria were used to determine that the non-informative photo was not informative to the text? The authors did not give the criteria. Every photo gives some type of information. The fact that the authors can declare that the photo was not informative to the text is information by itself. Unless the researchers were clearly able to see what each child was thinking when they saw the non-informative photo, it would be a difficult matter to declare that the children were given non-informative photos.

Also, if one was to follow the authors' recommendations and produce reading books without photos for children learning to read, the motivation might be lost not to mention that publishers might be unwilling to publish a picture-less reading book for children learning to read.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

There appears to be a thin line between novices and experts with respect to redundancy.

Information that the expert may find to be redundant may not be redundant to the novice. Sweller (2010) and Sweller et al., (2011c) contend that diagrams that show the direction of blood flow of the heart can be understood by the diagram by itself without any audio or text. There are several views of the diagram of the heart and the learner would have to be familiar with the picture of the heart to understand the diagram without any text or audio describing it. Although both articles did not show a diagram of the heart, G. Cooper's (1998) article showed a diagram of the human heart with arrows indicating the direction of blood flow. These arrows are the cues that learners can use in learning about the direction of blood flow. Therefore, it is not entirely correct that a picture of the heart can be understood without text or audio. Cues were used in form of arrows to explain the direction of blood flow in the heart.

**The modality effect.** In the modality effect, it is assumed that the working memory has a separate processor for images and another processor for auditory signals. These processors are the visuo-spatial loop and the phonological loop. A modality effect occurs when a part of the information to be learnt is presented in verbal or spoken narrative and the rest is presented as text. Instead of presenting the entire information as only text, the cognitive load is shared between the phonological loop and the visuo-spatial loop. It can only be called a modality effect if the instruction cannot be understood if only one source of information was presented.

The instruction can only be understood if the two sources of information are both presented. If the same information that was presented in auditory form is presented in visual form, it would not be a modality effect (Sweller et al., 2011d). It would give a redundant effect. If information is presented in text and in diagrams, the two sources are both going through the

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

visuo-spatial loop and there is no modality effect. Similarly, if information is presented verbally and as spoken animation, it has no modality effect because they would both go through the auditory channel. The principle of the modality effect is used as one of the seven principles of cognitive theory of multimedia learning. People learn better from animation and narration than from animation and text (Austin, 2009).

**Studies on modality effect.** Historically, Paivio (1978, 1991) postulated the dual processing theory. He postulated that the visual information and the verbal information both had separate processors for processing information.

Since then, several studies have shown that the dual modality of presentation is more effective than the single mode of presentation (Chang, Lei, & Tseng, 2011 ; Leahy & Sweller, 2011; Schüler, Scheiter, Rummel, & Gerjets, 2012). Ginns (2005) did a meta-analysis on the modality effect of 43 experimental results on the modality effect. These 43 studies presented diagrams that were presented as written text and spoken text. He found that the modality effect was supported in pair-wise comparisons for the presentation modality for audiotape, computer screen and virtual reality head mounted display. The virtual reality head mounted display had the larger effect when paired with audio tape and it also had the larger effect when paired with the computer screen. Ginns (2005) suggested that students could learn more using the virtual reality media because the effect of the pairwise comparisons was strongest in learners with virtual reality media. Further, learners that were presented with graphics and spoken text (auditory) performed better than students who were presented with graphics and written text.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Contrary to the modality effects seen in studies by Austin (2009) and Mayer (2003), Tabber, Martens and van Merriënboer's (2004) study did not show a modality effect. Students that were given diagrams with spoken text had lower retention and transfer scores than those who had visual cues and diagrams. The authors opined that the reverse modality effect may have occurred because the lessons were learner-paced compared to system-paced instruction in previous studies with modality effect. In their study, the students were given a regular operating classroom condition. They had seventy minutes to read the instructional module. The noise outside the classroom was not shut off. Those that were in the audio group took some time downloading the audio file. These conditions were different from the strict system-paced conditions, previous researchers had used. They also suggested that the audio group might have gotten bored with the audio and lost motivation.

**Summary on modality effect.** The study by Tabber, Martens and van Merriënboer (2004) was carried out in a real life situation with noise going on outside the classroom as would occur in a regular setting. The authors reported that the computers were slow as could happen on some regular days. In their study, students that were presented with a modality effect actually performed poorly than those that were presented with diagrams and cues. They suggested that the modality effect group lost motivation because of the repeated audio.

Ginn's meta-analysis (2005) of 43 studies on the modality effect showed that there was a superiority in presentations that targeted the visuo-spatial loop and the phonological loop, than in presentations that targeted only one of the two loops. Ginn's meta-analysis did not indicate how many of the studies were conducted in learner-paced environments like Tabber, Martens and van Merriënboer (2004).

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The implication of the modality effect is that in presentations, presenters can present some information in audio format and some in written text so that the information is shared between the visuo-spatial loop and the phonological loop so that neither of the two loops is overloaded.

## **Overall Summary of the Literature Review on Theories of Affordance, Cognitive Information Processing and Cognitive Load**

The theory of affordance has enlarged since Gibson first defined it (1979). He defined it as a physical feature on an animal. Norman enlarged the definition to mean a perceived clue to a product (1988). Several authors enlarged the definition even further by describing different types of affordances (Kaptelinin & Nardi, 2012; Kirschner, 2002; Kirschner et al., 2004; Ware, 2003). Technological, educational, cultural, learning, social and auxiliary affordances are few of the types of affordances that have been defined since Gibson and Norman's definitions of affordance. Meyes and de Freitas (2004) described e-learning as affordances of technology. I reviewed textual affordances, the research on reading comprehension, text design and text display rate.

Next, I reviewed the theory of cognitive information processing. From this theory, we know that unless a learner pays attention to the information coming from the environment, that information could be lost. Beyond the sensory memory, information in the working memory can be chunked and encoded to increase its limited capacity storage space before sending it to the long term memory. Some authors prefer to divide the working memory into short term memory and working memory (Cowan, 2008; Shneiderman, 1998) so that they can divide the functions. The short term memory processes non-attention demanding tasks. The working memory processes attention demanding tasks and implements the solutions.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Cognitive load theory stems from working memory. In cognitive load theory, for learning to occur, the working memory must have cognitive space in which to process the instructional module. If the instructional module is constructed such that for the working memory to process it, it would take up so much cognitive space, then the learner would be unable to learn. The implications of these findings and their effects were discussed under the goal free effect, the worked example or problem completion effect, the split attention and the split attention effect, the redundancy effect and the modality effect.

Some of the findings and subsequent recommendations should be gauged against standard norms. Torcasio and Sweller (2010) recommended picture less books for children learning to read because their study showed that children that had picture books relevant to the text did not perform as well as children who had pictures that were not relevant to the text.

In conclusion, if an instructional designer is armed with the theories of affordance, cognitive information processing, cognitive load and their implications, designing intuitive web pages would bring congruence between theory and the domain of practice.

### **Theories, Principles and Guidelines Extracted from the Four Text Books Recommended by the Panel of Experts**

These four text books of instructional design and technology were recommended by the panel of experts which also doubled as my committee. The validity of these books would be discussed in chapter 3.

### **Principles and Guidelines Extracted from Carroll, J. M. (1990)**

In his book, Carroll stated that the book was a compilation of empirical research reports on how people use new technology. The book was written for practitioners in the field. He pointed out that users of new technology did not fare well using step by step instruction like the ones developed by Gagne and Briggs. Carroll advocates that instruction to the student should be such that with minimal instruction the learner can understand and perform the tasks expected of him or her. He differentiated between minimalist instruction and the systematic instructional methods. He further argued that universal principles cannot be applied in general. Rather, principles must be applied to specific domains.

Carroll disputes the usefulness of extending research studies like “--- pigeon pecking, nonsense list learning, and tachistoscopic perception to the design of computer application is hazardous at best, and often just silly” (pp. 279 para 2). Carroll used the term minimalist to describe designers who designed instruction that were minimally aversive to the learner’s ability to learn.

He further asserts that the interpretations of the inner workings of inventions like the violin and the wheel were discovered several years after the invention itself i.e. It was not the knowledge of the inner workings of the invention that led to the invention, rather, it was the knowledge already existing in the designer’s head (p.280).

- Allow the learners to put into practice what they are learning as soon as possible and not struggle to follow step by step instruction.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Make the reading material less and make learners actually perform more of the actual activity they are learning (p.7).
- Allow learners to make mistakes and to learn from their mistakes (p.7). These three guidelines are further broken down into seven principles: (pp.73-102)
  - Getting Started Fast
  - Reasoning and Improvising
  - Reading in any order
  - Coordinating System and Training
  - Supporting Error Recognition and Recovery
  - Exploiting Prior Knowledge
  - When errors occur use the situation to explore why they occurred.

### **Summary of Theory, Principles and Guidelines Extracted from Carroll (1990)**

Although Carroll's minimalism theory was based on research conducted on how to use computer technology and sound judgment, the principles and guidelines can be extended to designing instructions or message design. Carroll agrees that the prior experience of a learner should be a useful resource that can benefit both the learner and the instructor. However, Carroll disagrees with the systematic design of instructions in which the learner must follow a prior step before moving to the next one. He encourages the learner to be able to make mistakes and learn from the mistakes. He also pulls examples from the invention of the violin; that while the intricate working of the violin was not understood yet, the designers of the violin designed it any way and used it. He advocates for minimal instruction and that learners should not just follow the instruction as a dogma.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## **Principles and Guidelines Extracted from Clark, R. C. & Mayer, R. E. (2011)**

The authors described several guidelines and principles that should be considered in designing instruction for e-learning.

### **The Multimedia Principle: Include both Words and Graphics**

The basis of the multimedia principle lies in the theory of cognitive information processing which has already been discussed under cognitive information processing in the first part of this literature review. The word multimedia refers to presentations that contain both words and graphics. In describing the multimedia principle, the words could be the spoken text or the written text while graphics could be maps, charts, photos, drawing, charts, animation and videos.

The authors pointed out that instructional designers should not just add graphics for the purpose of adding graphics but rather, the presence of the graphics must be purposeful. The graphics used in the particular instruction must be the type that supports the instruction. Further, the authors posited that the functions of graphs determine their helpfulness to the learner. Six types of graphs were described; decorative, representational, organizational, relational, transformational and interpretative graphics. Decorative graphics are the least helpful in understanding a lesson while transformative and interpretive graphs are the most helpful types of graphs.

**The first principle of contiguity; aligning words to corresponding graphics.** There principle of contiguity strives for a concordance between the graphics and the words. There is a discordance when the graphics and the text are separated in time or in space. Graphics

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

can overload the cognitive capacity (Clark & Lyons, 2011). The authors gave the example of looking at the text for an instruction but the corresponding graphics explaining the text could not be seen on the same window pane. The first principle of contiguity gives rise to several guidelines:

- Place printed words near corresponding graphics.
- Avoid separation of text and graphics on scrolling screens.
- Avoid separation of feedback from questions or responses.
- Avoid separating lesson screens with linked windows.
- Avoid presenting exercise directions separate from the exercise.
- Avoid displaying captions at the bottom of screens.
- Avoid simultaneous display of animation and related text.
- Avoid using a legend to indicate the parts of a graphic.

**The second principle of contiguity; synchronize spoken words with corresponding graphics.** The second principle of contiguity points out that if there is an instruction with words and animation at the time the words are spoken, the corresponding graphics must be presented at that exact time. The second principle of contiguity gives rise to two guidelines:

- Avoid separation of graphics and narration through icons
- Avoid separation of graphics and narration in a continuous presentation

**The modality principle: present words as audio narration rather than on-screen text.** In the first part of my literature review, I elaborated on the working memory having a separate visual processor and a separate auditory processor. The cognitive load is less on the

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

learner when the information coming in is shared between these two processors. There is also less cognitive load on either of the two processors if the information coming in is shared between the two processors instead of overloading one processor. The modality principle of contiguity gives rise to two guidelines:

- Present words as speech rather than on-screen text.
- There are exceptions to presenting words as speech than on-screen text as when presenting mathematical formula or if the learner is not conversant with the words.

**The principle of redundancy; explain visuals with audio or text and not both.** The redundancy principle applies when in a singular presentation, there is an audio and in addition, there is an on-line text that is a repetition of what is in the audio narration. The redundancy principle of contiguity gives rise to one guideline and several exceptions:

- Do not add on-screen text to narrated graphics
- Exceptions to not add on-screen text to narrated graphics include instruction for learners that are not native speakers of the language.
- An exception to the redundancy principle is the addition of on screen text to a narration when the presentation does not contain any graphics.
- An exception to the redundancy principle is the addition of on screen text to the narration when the presentation is at a slow pace.
- An exception to the redundancy principle is the addition of on-screen text to the narration is when the on-screen text are few and placed next to the graphic.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**The principle of coherence; adding material can hurt learning.** The principle of coherence advocates for avoiding the addition of unnecessary fluff to the instruction. A presentation that has all the bells and whistles can actually overload the working memory.

The coherence principle gives rise to three guidelines:

- Avoid e-lessons with extraneous audio.
- Avoid e-lessons with extraneous graphics.
- Avoid e-lessons with extraneous words.

**The principle of personalization; use conversational style and virtual coaches.** The principle of personalization in e-learning systems encourages the use of first and second person pronouns i.e the use of I, me, mine, ours for first person pronouns and you, your and yours for second person pronouns. The third person is discouraged as it is formal (Pope & Fogarty, 2014).

The principle of personalization gives rise to three guidelines:

- Use conversational rather than formal style
- Use effective on-screen coaches to promote learning.
- Make the author visible to promote learning.

**The principle of segmenting and pre-training principles; managing complexity by breaking a lesson into parts.** The authors recommend breaking complex lessons into smaller parts but discourage breaking a simple lesson into even smaller parts. The guidelines to the principle of segmenting and pre-training principle:

- A segmenting guideline is to break a continuous lesson into bite-size segments.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- A pre-training guideline is to ensure that learners know the names and characteristics of key concepts.

**The principle of worked example.** The principle of worked example encourages the use of worked examples in models, demonstrations and in problem solving. The authors lists five principles of worked example and several guidelines

***First principle of worked example; fade from worked examples to problems.*** Fading from the worked example to the problem involves starting with the worked example showing the full steps to the solution to the problem and in subsequent steps, the worked examples show fewer steps until the steps are no longer shown and the learner is left to solve the problem without any worked example or with the minimum steps of the worked example.

***Second principle of worked example; promote self-explanations.*** The learner is encouraged to cognitively think over how the steps of the worked example arrived at the solution. There are two guidelines that promote the worked example principle of promoting self-explanation in the learner:

- Add self-explanation questions to your worked examples.
- Encourage self-explanations through active observation

***Third principle of worked example; include instructional explanations of worked examples in some situations.*** According to the authors, research has shown that not all worked examples should include explanations as some students might actually find the inclusion of instructional explanation to the worked example to be antagonistic to the learning situation.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

These instructional explanations could be in form of a help button that the learner might decide to activate or not. We have help buttons that come up in Microsoft Windows 2003 editions. According to the authors, research has also shown that learners solving problems in mathematics usually benefit from including instructional explanations in worked examples.

***Fourth principle of worked example: apply multimedia principles to examples.*** The principle of worked example would be made redundant once the principles of multimedia are not applied. There are six guidelines to the fourth principle of worked example with the application of multimedia principles:

- Illustrate worked example with relevant visuals; multimedia principle.
- Present steps to the worked example with audio and not audio and text; modality and redundancy principle.
- Present steps of the worked example with integrated steps; contiguity principle.
- Present steps to the worked examples in conceptually meaningful chunks; segmenting principle.
- Present the worked example with learner control of pacing; segmenting principle.
- Familiarize learners with example context; pre-training principle.

***Fifth worked example principle; support learning transfer.*** The authors differentiate between near learning transfer and far learning transfer. Near learning transfer applies to skills in which the steps are unaltered and do not vary as we see in assembly lines. Far learning transfer applies to skills that vary with each scenario as in clinical training or in combat training in the military. Guidelines that support far transfer in worked examples:

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Use varied context in the worked example.
- Include self-explanation questions.
- Require active comparison of varied context examples.

**The principle of effective practice.** The authors posit that effective practice exercises would promote learning. Further, the authors asserted that exercises can only be effective when they follow principles of cognitive information processing. The learning environment must allow the learner to be attracted to the learning material and following the processes of cognitive information flow, the prior knowledge of the learner must be incorporated with the new knowledge.

The authors call the process of the new material being incorporated with the existing knowledge in the learner as interaction. Selecting the right answer from a list of multiple choice questions, selecting the correct answer from true or false questions, simulating the correct answer and drag and drop options are some of the interactions used in practice. In addition, the authors distinguish between regurgitative interactions that involve scant processing by the learner and non-regurgitative interactions that involve deeper processing. There are six guidelines to the principles of effective practice:

- Add sufficient practice interactions to e-learning to achieve the learning goal.
- Mirror the job.
- Provide effective feedback.
- Distribute and mix practice among learning events.
- Apply the multimedia principles.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Transition from examples to practice gradually.

**The principle of learner control.** The authors affirm that research continue to support learner control for learners with a prior knowledge. The authors further assert that learner control is achieved by the presence of features that the learner can use to link to a particular topic. These features could be menus, links and sitemaps. The authors give several guidelines for the principle of learner control:

- Give experienced learners' control
- Make important instructional events the default.
- Design adaptive control
- Give pacing control
- Offer navigational support in hypermedia environments by:
  - Use of headings and introductory statements.
  - Use of links sparingly in lessons intended for novice learners.
  - Use of course and site maps.
  - Provision of basic navigation options

## **Summary of Theories, Principles and Guidelines Extracted from Clark and Mayer (2011)**

The authors elaborated on the cognitive information theory, the cognitive load theory and multimedia theory. They gave guidelines on each principle of the multimedia theory. The guidelines and principles were based on evidence from research. Further, the authors gave guidelines on how to give experienced learners control in hypermedia environments. In addition,

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

the authors posited that in hypermedia environments, links should be used sparingly amongst novice learners.

## **Principles and Guidelines Extracted from Fleming, M. & Levie, W.H. (Eds.) (1993)**

The editors assert that the book was written for teachers and instructional designers.

Apart from the two editors, there were eight contributors to the book. The book described the use of the theories of motivation, perception, cognitive information processing and behaviorism in designing instructional messages.

The contributors to this book described several principles and guidelines that are useful in designing instruction for learning.

### **Principles of Motivation**

The authors of the chapter on motivation admonish designers who consider motivation after the message design has been completed. The principles of motivation should be considered as early as the design is about to begin. The authors of this chapter argued that while motivation strategies could be entertaining, there are other important points to be considered. The guidelines for the principles of motivation were divided into two parts. The first part of the principles of motivation was devoted to the design of the instruction and the second part of the principles of motivation concentrated on the text and graphics in the instructional message.

In addition, the authors of the chapter on motivation distinguished between perceptual motivation and epistemic motivation. Perceptual motivation is able to stimulate the learners by mere perception without any significant cognitive exertion. Graphics and text would arouse

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

perceptual curiosity. Epistemic motivation is able to stimulate epistemic curiosity by exerting the cognitive processes based on the learner's prior knowledge. The organization and presentation of the content would stimulate epistemic curiosity.

### **Guidelines to stimulate epistemic curiosity:**

- Variation in sequencing of the elements or events of instruction helps maintain attention.
- Provoking mental conflict stimulates epistemic curiosity
- Introduce topics problematically to stimulate an attitude of inquiry.
- Use facts that contradict past experience, paradoxical examples, conflicting opinions or facts, unexpected opinions or non-destructive humor to stimulate curiosity.
- Invoke a sense of mystery by presenting unresolved problems which may or may not have a solution.

### **Guidelines to improve relevance:**

- Strengthen the students' motivation to learn by building relationships between the content and objectives of the instruction and the learner's needs and desires.
- People are usually most interested in things that are related to their existing knowledge and skills.
- Use explicit statements about how the instruction builds on the learner's existing skills or knowledge.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Use analogies or metaphors to connect the present material to processes, concepts, skills already familiar to the learner.
- The motivation to learn is greater when there is a clear relationship between the instructional objectives and the student's goals.
- To stimulate goal orientation, provide explicit statements describing how the given instruction is or can be related to meaningful goals in the student's future.
- Use examples and exercises that are related to the student's present or future area of application to increase the student's perception that the instruction has relevance.
- Stimulate the motivation to learn by giving students the opportunity to satisfy high-valence motives.
- Use personal language to stimulate human interest on the part of the learner.
- Improve relevance by adapting your course requirements and teaching style to the learning style of the students.
- Role modeling of the value, utility and interest of the instruction can stimulate intrinsic motivation and personal goal setting.
- The enthusiasm of an instructor or speaker can stimulate positive motivation from the students.
- Increase personal interest by including anecdotes or vignettes about noteworthy people in the area of study, the obstacles they faced, their accomplishments and the consequences.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Increase the motivation to change behavior by including the learners as role players in a role modeling episode.
- Use images, values and other features of the course materials or instructors that are similar to those of the learners to increase perceived relevance.

## **Guidelines to motivate the challenge level:**

- Design the challenge level to produce an appropriate expectancy of success.
- Give students advance notice of the skills that would be tested.
- Describe goals and performance requirements to help learners set realistic expectations for success.
- Increase self-direction by providing ways for learners to set their own goals.
- Persistence in learning activities is enhanced if learners attribute their success to their own effort and ability.
- Build confidence and persistence by using easy to difficult sequencing of content, exercises and exams especially for less able and low-confidence students.
- Use design principles of internal consistency to build learner trust and confidence.
- Provide criteria for success and answers to exercises to encourage students to use self-evaluation of performance.
- Help students build confidence by providing conformational feedback for acceptable responses and corrective feedback for responses that do not meet criteria.
- Include learner options to promote an internal sense of learner control on the part of the learner.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Allow learners to go at their own pace to increase motivation and performance.
- Develop self-direction by providing a well-defined but not rigid structure that gives learners options for assignments, modes of study and modes of testing.
- The perceived credibility of the source of information the learner is given increases the learner's confidence and it increases the learner's efforts.

## **Guidelines to establish positive outcomes:**

- Use intrinsically satisfying outcomes and positive rewards to produce continuing motivation to learn.
- Provide opportunity to apply the newly acquired skills in a meaningful way to achieve intrinsic satisfaction.
- Promote feelings of accomplishment by including in the instructional materials exercises or problems that require the application of the new knowledge or skill to solve.
- Produce a perception of natural consequences by using an exercise or simulation that resembles the real world application of the new knowledge or skill.
- Reward accomplishment by using positive feedback following success at a challenging task.
- To build learner satisfaction, use congratulatory comments for performances that meet the criteria for success.
- Stimulate the learner's feelings of pleasure by including enthusiastic comments which model positive feelings associated with goal accomplishment.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Reward self-directed actions by including statements which acknowledge actions, student characteristics, risks or challenges that were necessary for success.
- Extrinsic rewards help maintain motivation to learn repetitive material or material that is in other ways intrinsically uninteresting.
- Games with scoring systems can add an extrinsically motivating outcome to instruction.
- Use extrinsic rewards such as privileges or tokens when it is difficult to develop or sustain intrinsic motivation.
- To sustain positive feelings of satisfaction, provide an equitable relationship between learner expectancy, performance assessments and rewards.
- Exams and other performance activities should be consistent in content and level of difficulty with the objectives, instructional content and learning activities in order to confirm students' feelings of control over outcomes.

**Guidelines to motivate using text and graphics.** The guidelines that stimulate curiosity, the guidelines that stimulate relevance, the guidelines that stimulate challenge level and the guidelines that establish positive outcomes have all been based on the instructional content and the teaching methods. The guidelines for text and graphics are based on perceptual curiosity as opposed to epistemic curiosity.

### **Guidelines to create a positive first impression using text and graphics:**

- Give print courseware a comfortable image to gain and maintain learner attention and to build confidence.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Make initial perceptions of print courseware appear easy rather than difficult in order to gain and maintain attention and to build confidence.
- Use relatively short books and text segments to convey a less formidable image than long books or segments in order to maintain attention and to build confidence.
- Make the learner instructional text well-organized and explicit to maintain learner attention and to build confidence.
- Use a reasonably open text display rather than a constrained display in order to maintain learner attention.
- Make the physical attributes of the product consistent with learner experience and expectations to maintain learner attention and to build confidence.
- Use appropriate color, graphics and high-quality typesetting and printing for print products to gain and maintain learner attention.
- Use a familiar typeface and size that follow standard typesetting conventions to maintain learner attention.
- Make each line around eight to ten words and 10 to 12 point type to make text easier to read, maintain learner attention and increase confidence.

### **Guidelines to achieve a readable style:**

- Use a readable writing style to maintain learner attention and increase confidence.
- Use readable language to gain and maintain learner attention.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Use action verbs, words that are familiar, concrete and specific to maintain learner attention.
- Avoid jargon in order to maintain learner attention.
- Use a natural word order to maintain learner attention.
- Use the active voice to maintain learner attention.
- Use sentences that are of moderate length to maintain learner attention and to build confidence.
- Conjunctions and pronouns that contain words like that and which should not be omitted in sentences.
- The use of strings of modifiers to explain complex relationships should be avoided.
- Abbreviations and acronyms should not be overused.
- Make use of examples.
- Do not assume the learner can make the inference from two separate sentences.  
State the inference if an inference exists.
- Use macro signals to make it easier for a reader to understand relationships in the text which will help maintain learner attention and build confidence.
- Start sentences with a topic sentence.
- Use signal words.
- Make use of headings and write an overview of long sections.
- Vary the vocabulary and the complexity of the sentence to maintain learner attention.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## **Guidelines on using graphic illustrations:**

- Include graphics that make courseware easier to interpret and use in order to maintain learner attention and to build confidence.
- Graphs, maps, charts, graphs and diagrams should be easy to interpret.
- Separate unrelated elements by white space
- Different accents of typography like highlighting, boldface and italics can be used as cues in the instruction.
- The page layout should not be confusing.
- Use interesting pictures to gain and maintain attention.
- The use of pictures that include people would gain and maintain learner attention.
- The use of colored pictures is more interesting than black and white pictures.

## **Principles of Perception**

The author of the chapter on perception posited that perception actually occurs without the learner paying attention to the information (Winn, 1993). This is called pre-attentive perception. After pre-attentive perception, then the learner pays attention to the information. This is called attentive perception. The author gives various guidelines to assist the message designer when the learner is at the pre-attentive stages of perception. In perception, the organization of information, the contrast of color, the altering of texts and the organization of pictures and audio can bring a greater understanding to the learner.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## **Guidelines to pre-attentive perceptual processing:**

- Organize your message so that the learner can perceive your message without paying much attention to it.
- Make figure ground as clear as possible.
- Create symmetry in elements that look alike.

## **Guidelines to attentive perceptual processing: selection and organization:**

- Create a contrast in important elements.
- Make use of lines and arrows when designing messages with a time sequence.
- Make use of chunking.
- Diagrams should not be drawn with too much detail if the object in the diagram can be easily identified.
- Include a scale for comparison when your messages include items of varying sizes.
- Make use of advance organizers.

## **Guidelines to perceive pictures:**

- Use pictures when you want the information to be remembered.
- Identify the function of the picture before including it in the message.
- Use decorative pictures sparingly.
- Determine if your picture is for decoration, representation, interpretation, organization or transformation.
- When using pictures of representation, organization, interpretation or pictures of transformation, the designer should give instructions on how to read them.
- Decorative picture do not need instructions on how to read them.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- If using pictures that represent images in real life then the pictures must be recognizable as to what they are representing.
- Use thicker lines or arrows to draw attention to important items.
- Use line graphs to illustrate trends.
- Use bar charts to show comparisons.
- Use pie charts in comparing when precision is not important.
- Use graphs with the x and y axis to compare amounts.

### **Guidelines to draw attention to text:**

- Attention is drawn to words or passages that contrast to the rest of the body of the text.
- Highlight the text, alter the type size through use of a bold font or italics but do not do all on the same body of text.
- Make use of headings, annotations and paragraphs.
- Make use of line breaks.
- Text in lowercase is easier to read than uppercase.
- Black text on a white background gives maximum perception.

### **Guidelines to using illustrations and text together:**

- The picture must be close to the text it is illustrating.
- Use pictures to represent spatial information.

### **Guidelines to perception of sound:**

- Organize sounds that go together.
- Speech or audio can be used to present instructions that go in a sequence.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- When using audio and another modality, the relationship between the two modalities must be obvious.

### **Summary of Theories, Principles and Guidelines Extracted from Levie and Flemings (1993)**

The editors and contributors to this book discussed Keller's theory of motivation, Gestalt theory and perception theory. The principles extracted were perception principles and message design principles. The authors discussed how motivation can be used to stimulate epistemic curiosity by exerting the cognitive processes based on the learner's prior knowledge. In addition, the authors discussed how learners can be motivated by showing relevance in the instruction to what they already know and to what they would like to know.

In addition, the authors described how learners can be rewarded in order to maintain intrinsic motivation. Apart from guidelines which stimulate epistemic curiosity, the authors gave guidelines that would stimulate perceptual curiosity. The guidelines that stimulate perceptual curiosity manipulate the text and graphics for the instruction. The guidelines that stimulate epistemic curiosity are based on the teaching methods and on the instructional method.

### **Principles and Guidelines Extracted from Lohr, L. L. (2008)**

The author wrote the book for teachers, students and people who are involved in creating graphics to teach others. The author discussed the use of cognitive load theory, the principles of Gestalt in figure- ground perceptions, the theory of multimedia, the principles of color, the principles of typography and shape.

### Three Principles of Visual Literacy

**Selection principle: emphasizing figure and ground.** The author explained that when the human eye sees two images, the human mind combines these two objects to form a third image. The formation of this third image in the human mind can either lead to clarity of the two objects or lead to misunderstanding of the two objects. Tufte (1990) described this phenomenon as  $1+1=3$  phenomenon.

Tufte (2001) calls the use of unnecessary fluffing and embellishing of graphs with ink that is not relevant to the data as chartjunk. Deemphasizing the figure and ground in statistical graph presentation would lead to confusion. Guidelines that emphasize figure and ground:

- The text and the background should not blend in a way that the purpose of the instruction is lost.
- The text should be chunked into meaningful sizes. The instruction should be concise.
- The instruction should be meaningful to the learner.
- Graphical displays should not be cluttered.
- Avoid novelty images except the novelty image is related to the content of the lesson.
- You can create contrast by the use of headings, bold fonts, images.
- Align the text and headings.
- Repeat key words.
- Make use of the white space.
- Make use of depth by highlighting or using bold fonts to create contrast.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**Organization principle: working with hierarchy.** In the organization principle, the most important information is given the most prominence. Hierarchical display of information serves as cues that guide the eyes to the levels of importance of the information on display.

Guidelines to hierarchical organization of information:

- Be aware of the writing culture of the learners; whether it is from left to right as or from right to left.
- When making time line displays for people that write from left to right, then the timeline should begin from the left side of the page and end on the right side of the page.
- Use columns and not circles when you are displaying two separate groups.
- Place the text close to the image it is describing.
- Give the more important information a brighter color.
- Give the more important information a larger size.
- Use tables to make information containing plenty of figures easier to understand.
- Use columns and not rows when comparing information.
- Make use of rounded numbers instead of decimal points when the exact decimal points are not needed.
- When presenting numbers that are related, include an average in the display.
- In displaying tables, display the words before the numbers they are referring to.
- Meaningfully chunk large body of statistical data in a table.
- In tables, keep the words and numbers at a readable distance.
- Avoid chartjunk.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**Integration principle: Gestalt.** The integration principle incorporates the selection principle and the organization principle. The integration principle builds on the Gestalt theory that posits that a picture is the sum of all the parts. The five principles of Gestalt; closure, contiguity, similarity, proximity and previous experience rely on the movement of the eyes and the cognitive function of perception. The principle of closure is possible because the cognitive process is able to complete a picture when it has seen the incomplete picture. The contiguity principle or the direction principles relies on the fact that the human eye tends to follow a straight line in an image and if the line is interrupted, the eyes still follows the line. The principle of similarity relies on the mind automatically grouping similar things and similar shapes together.

The principle of proximity is based on how the mind sees and groups items that are placed close to each other. The principle of previous experience is the learner interpreting the new information in the context of the previous experience. The author described four instructional interface metaphors. It is the learners' previous experience that lets them understand the instructional interface metaphor. "An interface metaphor is a set of user interface visuals, actions and procedures that exploit specific knowledge that users already have of other domains" (Wikipedia free online encyclopedia, n.d). Lohr (2008) asserts that instructional interface metaphors rely on all the five Gestalt principles. The four instructional interface metaphors are;

- Outline metaphors
- Book metaphors
- Desktop metaphors

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Syllabus metaphors

## **Guidelines to the principle of integration:**

- Symbols, icons and metaphors should be used with an awareness of the meanings in different cultures.
- Colors like red, black and white should also be used with an awareness of the meanings in the cultures.
- Stick to universally accepted symbols
- Applying the rule of thirds, divide the image into thirds and place the important information where they intersect.
- Make learners use advance organizers.
- Make the learners put the problem into visual analogies.
- In designing instructional interfaces consider learners with disabilities.

## **Summary of the Theories, Principles and Guidelines in Lohr (2008)**

Lohr's book extracted the principles and guidelines from cognitive information processing theory, cognitive load theory and Gestalt theory. Some of the guidelines were based on sound judgment. Lohr (2008) was keen on the style of reading which would depend on the person's culture. If a person reads or writes from right to left, designing web pages in which the text and graphics are more concentrated on the left can make comprehension of the message more difficult. She described three principles of visual literacy. These three principles are the selection principle, the organization principle and the integration principle. In the selection principle, the designer of instruction must be able to

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

distinguish chart junk from the main message. She stressed the importance of deemphasizing the figure and ground in statistical presentation.

The second principle which is the organization principle is important when presenting information that has hierarchical organization. It is important to put the most important information first. At the same time, the designer of instruction must be aware of the direction in which the learner reads because a learner that reads or writes from left to right as in some cultures would benefit more if important objects are placed on the left. Learners who read or write from right to left would benefit when important objects are placed on the right.

The third principle that was discussed was the integration principle or the Gestalt principle. The Gestalt principle is actually a combination of the integration principle and the organization principle. As the previous three books (Carroll, 1990; Clark & Mayer, 2011; Fleming & Levie 1993) have emphasized, the prior experience of the learner is important in designing instruction. In addition, Lohr discussed the sensitivity to culture to the use of colors and symbols.

### **Summary of the Theories, Principles and Guidelines from the Four Recommended Text Books**

The four recommended textbooks are full of guidelines and principles in designing instructional messages. Carroll's book is more focused on instruction for learners on computer tasks and the minimalist theory. The other three books addressed instructional design. The theories discussed in the four books are cognitive information processing, Gestalt theory, perception theory, multimedia theory, theory of motivation and cognitive load theory. Several of

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

the principles and guidelines were from the theories and a few were based on sound judgment like being culture sensitive in the display of some icons.

In addition, some of the guidelines discussed by the authors overlapped. Lohr (2008) and the authors in Fleming and Levie (1993) discussed the perception principle. They emphasized the figure and ground principle and expanded on Gestalt principle. While Lohr (2008) emphasized the figure and ground principle from a visual literacy standpoint, Fleming and Levie (1993), addressed the figure and ground principle from a motivation standpoint.

The authors of the four books agreed that the prior experience of the learner was an important factor in designing the lesson of instruction. Carroll (1990) is the only one of the authors whose professional career is not in instructional design and technology. However, he made a strong point in his minimalist theory by advocating that in training learners, they must not be made to follow the rule by the book; that they must be allowed to make mistakes and be left to recognize their mistakes and possibly learn from them.

Overall, the authors of the four books based their principles and guidelines on theories of cognitive information processing (Clark & Mayer, 2011; Fleming & Levie, 1993; Lohr, 2008), cognitive load theory (Clark & Mayer, 2011; 1993; Lohr, 2008), multimedia theory (Clark & Mayer, 2011; Lohr, 2008), perception theory (Fleming & Levie, 1993; Lohr, 2008), motivation theory (Fleming & Levie, 1993; Lohr, 2008) and minimalist theory (Carroll, 1993).

## **CHAPTER THREE: RESEARCH METHODOLOGY**

### **Introduction to the Research Methodology**

In this chapter, I shall discuss content analysis in general and then I will hone in on the specific content analysis for my proposed study.

### **An Overview of Content Analysis**

The research method that was used in this study was content analysis. Krippendorff (2013) defines content analysis “as a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use” (Krippendorff, 2013, p. 24). In 1980, Krippendorff defined content analysis as “a research technique for making replicative and valid inferences from data to their context” (p. 21).

Krippendorff’s (2013) definition is only slightly different from his 1980 definition which shows the stability of content analysis. His addition of other meaningful matter shows the expansion of content analysis to include documents beyond text. In the evolution of content analysis some researchers have actually restricted content analysis in their definition to be only text. Palmquist (2013) illuminated the meaning of text. “Texts can be defined broadly as books, book chapters, essays, interviews, discussions, newspaper headlines and articles, historical documents, speeches, conversations, advertising, theater, informal conversation, or really any occurrence of communicative language” (Palmquist, 2013, Content Analysis, para.1). It was published as a book in 1980 and sourced online in 2013.

Further, Roberts (1997) asserts that “Whereas text analyses are only of texts or transcripts, content analyses can be performed on any symbolic material, be it visual, acoustic,

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

tactile or whatever” (p.1). Conversely, Weber (1990) defined content analysis as “a research method that uses a set of procedures to make valid inferences from text. These inferences are about the sender(s) of the message, the message itself, or the audience of the message” (p.9).

More specifically, Neuendorf (2002) defines content analysis as “---a summarizing, quantitative analysis of messages that relies on the scientific method (including attention to objectivity-intersubjectivity, *a priori* design, reliability, validity, generalizability, replicability, and hypothesis testing) and is not limited as to the types of variables that may be measured or the context in which the messages are created or presented” (p.10). Neuendorf’s definition avoids the use of text but expands content analysis to messages re affirming that content analysis is a tool for analyzing communication between the sender and the receiver. She defines content analysis as a quantitative process.

Several scholars (Berg, 2004; Palmquist, 2013; Roberts, 1997; Shapiro & Markoff, 1997 &White & Marsh, 2006) have debated that content analysis is not rigidly a quantitative process.

Shapiro and Markoff (1997) define content analysis as follows:

We regard content analysis as best defined (today) *as any methodical measurement applied to text (or other symbolic material) for social science purposes*. Put otherwise (and we believe that we are saying the same thing again) the term refers to any systematic reduction of a flow of text (or other symbols) *to a standard set of statistically manipulable symbols representing the presence, the intensity, or the frequency of some characteristics* (p.14).

In the same vein, Berelson (1954) defined content analysis as “... a research technique for the objective, systematic and quantitative description of the manifest content of

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

communication” (p.489). Consistent with Shapiro and Markoff (1997), Berelson’s definition suggests that content analysis is a quantitative study but other definitions have included data that would require qualitative analysis. In Carney’s (1971) literature review on content analysis, he emphasized that content analysis could be on a novel, on paintings, movies, music and not just written text.

In this plethora of definitions, some themes that run through them all are:

- Content Analysis is a scientific inquiry
- It must be valid.
- It is an analysis of communication that seeks to interpret the message that the sender is relaying to the receiver.
- In seeking to interpret the message, the interpreter or researcher must not interpret it with a bias.
- Content Analysis must be objective.
- Content Analysis is not only for the written word.
- Content Analysis can be done qualitatively or quantitatively.
- Content Analysis is operationalized in diverse fields today and not just in the field of communication. The definitions of content analysis that I have included in this chapter come from researchers from diverse fields. Krippendorff and Neuendorf come from the communication field, Palmquist is from the English Language department and Carney comes from the department of history. Weber, Markoff and Shapiro are from the sociology field. Berelson was a behavioral scientist.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

- Content Analysis involves a large volume of data that must be reduced to interpretable units.

## History of Content Analysis

The word content analysis was first added to *Webster's Dictionary* in 1961 (Krippendorff, 2013). Krippendorff's (2013) historical research of content analysis showed that content analysis existed in many forms as far back as the 17<sup>th</sup> Century when church scholars felt that certain objectionable, religious symbols had been sneaked into the hymn books by the opposition. Krippendorff's (2013) historical research also found that another set of scholars determined that these perceived objectionable symbols were not to be interpreted as discordant.

Further, Krippendorff's (2013) historical research found that as early as the 18<sup>th</sup> Century, content analysis was used to analyze newspapers for salacious material. The study investigated the texts of the New York Times over a period of four years beginning from 1881 and revealed that the newspaper had increased coverage of gossip and scandals but decreased the coverage of scientific and religious events (Krippendorff, 2013).

These events added to the crystallization of content analysis. Although content analysis has its roots in communication, content analysis has been used and is being used in many disciplines including political science, anthropology, psychology, management and information studies (White & Marsh, 2006). Roberts (1977) affirms that content analysis has been used in international research involving German, Spanish and Italian texts, language development research, curriculum evaluation and on event analysis.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## Content Analysis of Text

According to Palmquist (2013), “To conduct a content analysis on a text, the text is coded, or broken down, into manageable categories on a variety of levels--word, word sense, phrase, sentence, or theme--and then examined using one of content analysis' basic methods: conceptual analysis or relational analysis. The results are then used to make (sic) make inferences about the messages within the text(s), the writer(s), the audience, and even the culture and time of which these are a part” (Palmquist, 2013, Para1).

Krippendorff (2013) divided the process of content analysis into six components. He noted that these six components are not to be rigidly followed because each content analysis is unique.

### **First component: - Deciding on the unit to be analyzed.**

These units could be sampling units, recording/coding units and context unit.

### **Second component: - Sampling**

The researcher decides on a sub set of the unit that would answer the research question. I have not said the researcher would choose a unit that would represent the population because sampling units in content analysis is different from the sampling unit in a survey research. Sampling theory posits that the sampling unit must be representative of the population being studied. Krippendorff argues that context analysis rarely represents the population being studied but rather, it serves to answer the research question.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

He admits that if the sampling unit could equally represent the population being studied, then the rules of probability sampling would apply. Further, he advises that content analysis of web content should be narrowly placed in a time frame because the contents of internet websites are rapidly changing from within a few hours to within days.

**Third Component: - The recording/coding unit.** Krippendorff asserts that “The coding of text is mostly accomplished through human intelligence (Krippendorff, 2013, p.85). C. Cooper, (1998) advises that in coding “--- any information that might have the remotest possibility of being considered relevant should be retrieved from the studies. Once the literature search has begun, it is exceedingly difficult to retrieve new information from studies that have already been coded” (p. 27).

Further, the coder must have certain qualifications. The coder must understand the syntax and the semantics of the language. The coder must understand the nature and administration of records. My coding unit was words, word phrases and themes.

### **Fourth Component:-Reducing Data**

The voluminous data is reduced to manageable data quantitatively or qualitatively.

### **Fifth Component:-Abductive Inferences**

Krippendorff (2013) distinguishes abductive inferences from inductive inquiry as is obtained in quantitative research. He makes a case for abductive inferences because in making abductive inferences, the researcher answers the question beyond what inductive and deductive inferences might infer. It goes beyond what meets the eye. In his example of an abductive

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

inference, a researcher can abductively infer editorial biases by comparing the different editorials in selected newspapers. Deductive inferences follow a logic of *if A is this, then B must be so* (Blackwell's online dictionary of cognitive science, n.d.). Inductive inferences have a probability of being true (Blackwell's online dictionary of cognitive science, n.d.). If a research finding reports that drinking coffee can lead to an increased incidence of lung cancer, an abductive inference would be that it is not coffee drinking that leads to a higher risk of lung cancer but the research finding erroneously concluded that drinking coffee leads to a higher incidence of cancer. Those who drink coffee usually smoke therefore; it is not the coffee drinking that leads to a higher risk of lung cancer but smoking. The abductive inference was able to make connections beyond the research findings that coffee drinkers have a higher risk of lung cancer.

## **Sixth Component: - Narration**

This is a report of the researcher's findings. The researcher can analyze the data manually or with the aid of a computer. I analyzed my results manually.

## **Validation in Content Analysis**

Krippendorff (2013) asserts that content analysis must be validated so that persons beyond the researcher can prove their findings. He admits that validation can sometimes be impossible in the content analysis of people who have passed away and in the content analysis of future events.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## Reliability

“Reliability refers to whether scores to items on an instrument are internally consistent (i.e Are the item responses consistent across constructs?), stable over time (test retest correlations), and whether there was consistency in test administration and scoring” (Creswell, 2009, p.233). Krippendorf asserts that for the results to be reliable, “The data must be stable, reproducible and accurate” (p. 211).

## Content Analysis in this Study

The purpose of this research is to investigate the differences if any between the theoretical contents of selected instructional design text-books and selected popular books on design. Further, the content analysis would pool the themes and principles from the instructional design text-books and examine the presentation of similar themes and guidelines in the popular books on design.

## Content Analysis Sources

Two major sources of data were analyzed. These were:

- Four text books of Instructional Design and Technology that were recommended by a panel of experts. These four books were labeled as the scholarly books.
- Four books selected from the ten most positively reviewed books on web design. These four books were labeled as popular books and the appellation was for the purpose of this research. It did not diminish the scholastic nature of the books. The ten most positively reviewed books on web design were determined on the 4th of November, 2013 by a systematic sampling of books from Amazon.com Inc. The four popular books were then

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

selected from the ten most positively reviewed books on web design by a panel of experts.

## **The Four Text Books of Instructional Design and Technology**

These four books were recommended by a panel of four experts in the field of Instructional Design and Technology. This panel of experts also doubled as my committee. For the rest of this paper, I shall refer to my committee as the panel of experts. Table 1 shows the list of the four Instructional Design and Technology books recommended by the panel of experts.

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Table 1 *List of the Four Scholarly Books*

| Title of book   | Author(s)                   | Publisher              | Year of Publication | Number of Pages |
|---|-----------------------------|------------------------|---------------------|-----------------|
| The Nurnberg funnel: Designing minimalist instruction for practical computer skill.                             | Carroll, J.M.               | MIT Press              | 1990                | 340             |
| E-learning and the Science of Instruction: Proven guidelines for consumers and designers of multimedia learning | Clark, R.C., & Mayer, R.E.  | Pfeiffer               | 2011                | 502             |
| Instructional message design: Principles from the behavioral and cognitive sciences.                            | Fleming, M. L. & Levie, W.H | Educational Technology | 2005                | 331             |
| Creating graphics for learning and performance: Lessons in visual literacy                                      | Lohr, L.L                   | Prentice Hall          | 2008                | 317             |

TOTAL NUMBER OF PAGES OF THE FOUR RECOMMENDED BOOKS=1,490 PAGES

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## **Selection Criteria for the Four Scholarly Books on Instructional Design and Technology**

The four text-books on Instructional Design and Technology were recommended by a committee made up of four experts in Instructional Design and Technology.

**Panel of experts.** Dr. Burton, the chair for my committee, completed his Ph.D. work in Educational Psychology. Drs. Potter, Lockee and Brill completed their Ph.D work in Instructional Design and Technology. The four members of the committee have a combined total of over eighty years of experience in Instructional Design and Technology (Virginia Polytechnic Institute and State University, 2014).

The criteria the committee looked at before selecting these books.

- The authors of these books are seasoned instructional design technologists.
- The books speak to the core of Instructional Design and Technology.
- One of the books is by John Carroll who is from the Human Computer Interaction field. Human Computer interaction is not removed from Instructional Design and Technology (Danielson, Lockee, & Burton, 2000).

## **The Authors of the Scholarly Books**

**Carroll, J. M. (1990).** The first edition of the book was published in 1990. The book is still in the first edition. John Carroll received his Ph.D. in Experimental Psychology (Penn State, 2014).

**Clark, R. C., & Mayer, R. E. (2011).** Ruth Clark and Richard Mayer first published the first edition of the book in 2002 and it is now in its third edition. Ruth Clark earned her Ph. D in

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Educational Psychology and Instructional Technology (“Ruth Colvin Clark”, 2013). She has over thirty years’ experience in the field of Instructional Technology. Richard Mayer earned his Ph.D in Psychology (University of California, Santa Barbara, 2013).

**Fleming, M. L. & Levie, W. H. (1993).** Malcolm Fleming and Howard Levie were the editors of this book. The first edition came out in 1978. I would be using the second edition of the book. The contributors to the articles in this book are notable scholars in the field of Instructional Design and Technology and in the field of Educational Technology. The contributing authors are Anne Bednar, Ernest Burkman, Michael Hannafin, Simon Hooper, John Keller, Richard Mayer, Alexander Romiszowski and William Winn.

In 1979, the book received the 1979 Annual Achievement Award of The Association of Educational Communication and Technology (AECT) and another award was given to the book by the National Society for Performance and Instruction (Hill, 1979).

**Lohr, L. L. (2008).** Linda Lohr obtained her Ed.D in Instructional Design and Technology (University of Northern Colorado, 2014). The book is in the second edition. The first edition of this book came out in 2003.

### **Source of the Ten Most Positively Reviewed Books**

Less than fifty percent of the books published in the world are in the English Language (Whitney, 1989). In the United States of America, a large proportion of the books published are in the English Language with Spanish and French amongst the other languages (Whitney, 1989).

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Bowker is the American agency that issues International Standard Book Numbers (ISBN). According to Bowker (2013), the projected number of books published in 2011 would have been over one million. Bowker does not indicate the languages in which these books are published. However, I would be looking at books published in the English Language.

The publication of new books on computers for 2011 was projected to be 7,615 and for education, it was projected to be 13,070 (Bowker, 2013). Web design books are included in this cornucopia of books. Krippendorf (2013) asserts that content analysis is different from a survey because a content analysis would rarely represent the entire population as a survey would.

In selecting the ten most reviewed books on web design, I decided to use Amazon.com Inc. for cogent reasons. Amazon.com Inc. is a valid source because it is listed in the National Association of Securities Stock Exchange (NASDAQ) and Wikipedia lists Amazon.com Inc. as the largest online store in the world. Amazon.com, Inc. has a large share in the book market and it makes it a valid source. Amazon.com Inc. started as an online book-store before it expanded to other products (J. Burton, Personal Communication, January 15, 2014).

Further, Amazon.com Inc. has branches in Brazil, Canada, France, Germany, Italy, Japan, Mexico, Spain and in the United Kingdom (Amazon, 2013). In addition, I chose Amazon.com Inc. because of its accessibility and for ease of reproducibility by interested researchers.

### **Systematic Selection of the Ten Most Positively Reviewed Books on Web Design**

In systematic sampling, there are different levels of sampling before arriving at the desired sampling size (McMillan, 2012). My initial search term in the Amazon.com Inc. search box for

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

*10 best books on web design* displayed a listing of ten books but there was no scientific methodology to determine how the selection was made. As an example, the book that was placed on top of the list of the ten best books on web design had just 8 reviews and was not among the 100 best-selling books on Amazon.com Inc. In contrast, books that were lower down in the list of the ten best books on web design were on the 100 best- selling books on Amazon.com Inc. and they had over 100 reviews.

Since my search results using the search term, *10 best books on web design* was not reliable, then I made my selection using several steps to arrive at the ten most reviewed books on web design. I also discovered that web search results sometimes change by the hour and sometimes in a day. The results I got in one day may be different for the same word search the following day. The ten most reviewed books that I captured on the 4<sup>th</sup> of November, 2013 could be different in a matter of days or hours. It made me realize, I needed to have screen shots of my selection for good record keeping. The screen shots of the steps taken to arrive at the ten most positively reviewed books on web design are presented in Appendix A.

**Selection of the ten most positively reviewed books on web design.** The panel of experts decided on ten books so as to get a reasonable amount of data to analyze. I used the phrase ten most positively reviewed books on web design in the heading for this section because I arrived at the list of ten books by using the search phrase, web design books and sorted by most reviews as the sort by options on the Amazon.com Inc. website did not include best books. On Amazon.com Inc., there were seven sort by options and sort by most reviews was the most appropriate.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The remaining six *sort by* options were *relevance, new and popular, price low to high, price high to low, average customer review* and *publication date.*

After the books were sorted by most reviews, I then sorted by average customer reviews of *4 stars and above*. The first ten books that came up were the ones selected for the study. The seventh book that came on the list was not a book on web design. It was a book on motivation and behavior change in business (Patterson, Grenny, Maxfield, McMillan & Switzer, 2008). One of the chapters was on designing rewards. It is probable that Amazon.com Inc. misfiled the book under web design books because one of the chapters was on designing rewards or the book was misfiled for a different reason. This book was an outlier as it had nothing to do with web design. Therefore, it was omitted from the selection. The outlier can be seen on the presentation of screen shots in Appendix A.

**Steps taken to arrive at the ten most positively reviewed books on web design.** Screen shots of the selection are presented in Appendix A. In addition, the sequence of steps taken to arrive at the list of the ten most positively reviewed books is presented below:

**Step 1:-** I selected the books' section from the drop down menu in the search box and entered web design books.

**Step 2:-** On the left hand bar of the webpage, I selected web design and development from the book department menu.

**Step 3:-** On the left hand bar of the web page, I selected average customer rating of 4 stars and up from the average customer review menu.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**Step 4:-** On the right hand bar on the web page, I selected sort by most reviews from the sort by drop down menu.

This brought up over 8,000 results and I selected the first ten. I took screen shots of the entire process. A table of the list of the ten most reviewed books according to their ranking by most reviews is shown in Appendix B and the book with the highest number of reviews is on top of the list. It also lists the year of publication and the number of pages for each of the books.

## **The Ten Most Positively Reviewed Books on Web Design Pruned to Four Popular Books**

I selected the ten most positively reviewed books on web design from Amazon.com Inc. The panel of experts reviewed the ten most positively reviewed books and pruned them down to four books. The panel of experts went over the list of the ten most positively reviewed books on web design and concluded that the ten books on web design were limiting in scope and the content analysis was broadened to include texts on design and not only web design.

The list of the ten most reviewed books on web design, consisted of two books of different editions (Krug, 2000; 2006). In addition, two of the books from the list of the most positively reviewed books on web design were on JavaScript (Crockford, 2008; Negrino & Smith, 1998). Three of the books from the list of the ten most positively reviewed books on web design were on HyperText Markup Language (HTML) (Castro, 2000; Duckett, 2011; Freeman & Freeman, 2006).

Seven of the books from the list of ten most positively reviewed books on web design were pruned out of the list of the ten most positively reviewed books. The three books that made the cut were Freeman, Freeman, Sierra & Bates, (2004), Greenspun, (1999) and Nielsen, (2000).

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Further, another criterion was added to include only the most recent publication of the selected books. The latest edition of Krug's book titled, *Don't make Me Think* (Krug, 2014) was added to the new list making a total of four books.

Subsequently, for the rest of this paper, I shall be referring to this new list as the four popular books. The appellation I have ascribed to the four books as popular does not diminish their scholastic influence. I have merely ascribed the appellation for the purpose of writing this research. Table 2 shows the list of the four popular books.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Table 2 *List of the Four Popular Books*

| Title of Book  | Author(s)  | Publisher         | Year of Most Recent Edition |
|--|--|-------------------|-----------------------------|
| Head first design patterns   | Elisabeth Freeman, Eric Freeman, Bert Bates & Kathy Sierra | O' Reilly Media   | 2004                        |
| Don't make me think, revisited: A common sense approach to web usability | Steve Krug   | Pearson Education | 2014                        |
| Designing web usability  | Jakob Nielsen  | New Riders        | 2000                        |
| Philip and Alex's guide to web publishing                                | Philip Greenspun   | Morgan Kaufman    | 1999                        |

TOTAL NUMBER OF PAGES OF THE FOUR POPULAR BOOKS = 1,834 PAGES

## The Authors of the Four Popular Books

**Freeman, E., Freeman, E., Sierra, K., & Bates, B. (2004).** Eric Freeman has a Ph.D in Computer Science from Yale. Elisabeth Freeman has an M.S. degree in computer science from Yale. Kathy Sierra and Bert Bates created the Head First Series of books.

**Greenspun, P. (1999).** Philip Greenspun earned his Ph.D. in Computer Science and Electrical Engineering in 1998 at Massachusetts Institute of Technology (Yang, 1999).

**Krug, S. (2014).** Steve Krug is a usability consultant (Krug, 2014).

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**Nielsen, J. (2000).** Jakob Nielsen received his Ph.D. in Human Computer Interaction from The Technical University of Denmark and is a usability consultant (Nielsen, 2014).

### **Estimate of the Number of Pages of Books in This Study**

Not all these books have digital editions and I am unable to estimate the volume of text by the number of words. Some of the books were published before the active internet age; Carroll's book on minimalist instruction (Carroll, 1990) and Fleming and Levie's book on instructional design message (Fleming & Levie, 1993) were both published in the 90's.

Therefore, I decided to estimate the volume of text by the number of pages. The total number of pages of the four popular books is 1,834 pages. The total number of pages of the four scholarly books recommended by the committee is 1,490 pages. The grand total of the sum of pages of the scholarly books and popular books is 3,324 pages. The total number of chapters in the four scholarly books is 43 chapters. The total number of chapters in the four popular books is 53. The total number of chapters in both scholarly books and popular books is 86 chapters.

### **Summary of Selection of the Four Popular Books**

Since millions of new books are published every year (Bowker, 2013; Whitney, 1989), it would be impossible to represent all these books in a content analysis study. Therefore, it was important to select the books in the most methodological way. The search term *10 best books on web design* did not yield reliable results and so I used a systematic selection to arrive at the ten most positively reviewed books on web design.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The selection process was captured by screen shots for proper documentation. Three books were selected from the list of the ten most positively reviewed books on web design. The fourth book (Krug, 2014) that was added was the newest publication of two older editions (Krug, 2000, 2006) of the same book that were on the list.

## **Recording/Coding**

Using guidelines garnered from several scholars (C. Cooper, 1998; Krippendorff, 2013; Neuendorf, 2002; Palmquist, 2013; Weber, 1990), I used the table of contents because it provided a large database. I reviewed the table of contents for each of the four popular books. In a content analysis of academic and professional books, Henry (2002) analyzed the subject indices. However, Henry (2002) only examined the presentation of three themes in four business journals and in four recommended business text books.

I examined all the themes, principles and guidelines presented in the four scholarly books and in the four popular books. Under my review of literature in chapter two, I extracted the theories, principles and guidelines from the four scholarly books which are presented in tables 3 and 4 of chapter four.

The extracted theories, principles and guidelines from the four scholarly books were then aligned with the principles and guidelines from the four popular books. I categorized the words, phrases, word sense, sentences and themes using theories of cognitive information processing, multimedia theory, motivation theory, cognitive load theory, minimalism theory and perception theory that had been extracted from the scholarly books.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

However, some of the headings in the table of contents of the four popular books were metaphorical and allegorical and so I had to refer to the pages that the table of contents were referring to in order to understand the context which led me to read the four popular books. The four scholarly books did not make use of metaphorical or allegorical headings.

## **Reliability**

In order to test for the reliability, Harvey (1953) suggests that after the themes have emerged in a textual analysis, a random opening of 30 pages should show at least one of the themes. He did not explain how he arrived at the number 30 in his article. Perhaps, he arrived at it arbitrarily like Miller (1956) arrived at the magical seven.

In this study, after the themes emerged, a random opening of 30 pages in the popular books that contained the guidelines and principles from the extracted theories, confirmed my findings. Similarly, a random opening of 30 pages in the popular books that did not contain guidelines or principles from the theories extracted, did not reveal any of the themes, principles or guidelines.

## **Inferences**

Inferences were made after the results were analyzed using tables, descriptive words or phrases. The data generated were described using words and tables. Abductive inferences were not made for this study.

## **Summary of Methodology**

In this chapter, a brief history of content analysis was described. The sources of the scholarly books and popular books were identified and validated. The four instructional design

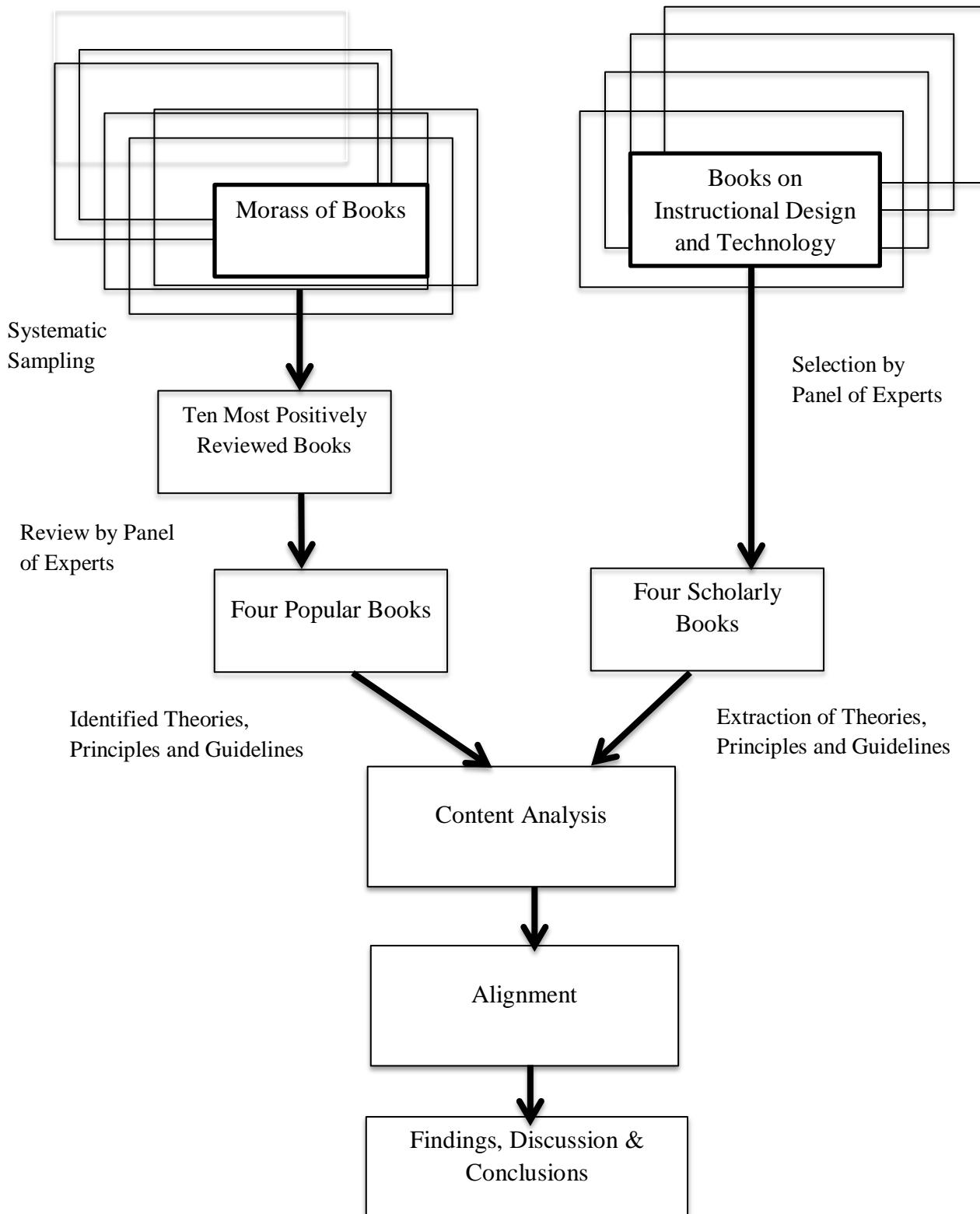
## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

and technology books were labeled as scholarly books. The ten most positively reviewed books on Amazon.com Inc. were selected through systematic sampling. Three books were selected from the list of the ten most positively reviewed books and the fourth book selected was the newest publication of two older editions of the same book that were on the list. These four books were labeled as popular books.

The identified theories, guidelines and principles from the four scholarly books were aligned with the extracted theories, guidelines and principles from the scholarly books. A summary of the methodology is illustrated in Figure 2.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Figure 2 *Summary of Methodology*



## **CHAPTER FOUR: FINDINGS AND DISCUSSION**

In this chapter, I have presented the results from the three research questions in this study. I have answered each research question under separate headings. Tables are used to display some of the results. I have presented my findings and discussion together because I would be discussing the textual content of my findings and I want to avoid a split effect in the presentation of results (Sweller, Ayres & Kalyuga, 2011b).

My literature review was divided into three parts. The first and second part of my literature review were discussed in chapter two. The third part of the literature review was on content analysis which was discussed under chapter three. The first part discussed a general review of literature on cognitive information processing, cognitive load, affordance and text display. The second part of the literature extracted the theories, principles and guidelines from the four scholarly texts.

Table 3 gives a summary of the extracted theories, principles and guidelines and Table 4 displays the theories addressed in each of the four scholarly texts. A total of eight books were analyzed in this study. Four of the books were on Instructional Design and Technology. These books were labeled as scholarly books. The remaining four books analyzed were popular books selected from the ten most positively reviewed books on design. These eight books were all published between 1990 and 2014. The publication of the books spans 24 years. Three of these books were published in the 90s (Carroll, 1990; Fleming & Levie, 1993; Greenspun, 1999) at the time the web was just introduced. Two of the books were in their third editions (Clark & Mayer, 2011; Krug, 2014). Two of the books were in their second editions (Fleming & Levie, 1993;

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Lohr, 2008) and four of the books were in their first editions (Carroll, 1990; Freeman et. al, 2004; Greenspun, 1999; Nielsen, 2000). Figure 3 is a graphical representation of the publication years of the books used in this study. The research questions in this study were:-

1. What are the theories and principles of design as addressed in the four scholarly books on instructional design?
2. What principles of design are addressed in the four popular books on design?
3. What pattern of differences or similarities occurs between the four scholarly books on instructional design text books and the four popular books on design particularly to the use of theory?

### **Research Question One**

What are the theories and principles of design as addressed in the four scholarly books on instructional design?

### **Response to Research Question One**

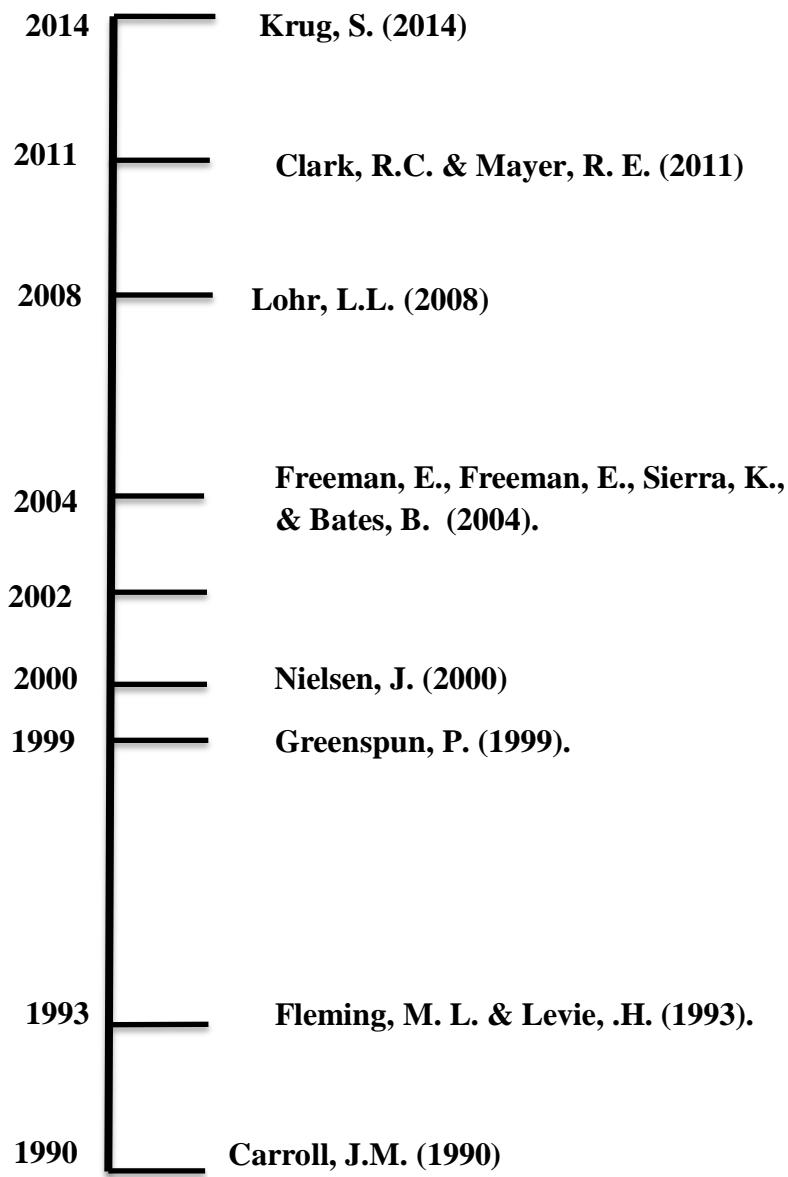
I have tabulated the results in Tables 4 and 5.

### **Summary of Response to Research Question One**

The extracted theories addressed were cognitive information processing, cognitive load, multimedia, motivation, minimalism and perception. Carroll (1990) addressed only minimalism. Lohr (2008) addressed all the theories except minimalism and motivation. Clark and Mayer (2011) addressed cognitive information processing, cognitive load theory and multimedia theory. Fleming and Levie (1993) addressed all the theories except minimalism and cognitive load.

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Figure 3 *Representations of Scholarly and Popular Books According to Year of Publication*



*Note.* 2002 is the midpoint between 2014 & 1990

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Table 3 *Summary of Theories, Principles and Guidelines from the Scholarly Books*

| Book                              | Theory/Theories   | Principles and Guidelines   |
|-----------------------------------|---|---|
| Carroll (1990)                    | Minimalism  | <ul style="list-style-type: none"> <li>▪ Allow learners to start immediately on meaningful realistic tasks.</li> <li>▪ Reduce the amount of reading material.</li> <li>▪ Allow recovery from errors to be pedagogically productive.</li> </ul>  |
| Clark, R.C., & Mayer, R.E. (2011) | Multimedia Theory, Cognitive Load Theory & Cognitive Information Processing | <ul style="list-style-type: none"> <li>▪ Multimedia Principle:-Include both words and graphics.</li> <li>▪ 1<sup>st</sup> Principle of Contiguity:-Align words to corresponding graphics.</li> <li>▪ 2<sup>nd</sup> Principle of Contiguity:- Harmonize spoken words with corresponding graphics.</li> <li>▪ Modality Principle: - Present words as speech rather than on-screen text except formulae e.g. Mathematics formulae.</li> <li>▪ Redundancy Principle: - Do not add on-screen text to narrated graphics.</li> <li>▪ Coherence Principle: - Avoid addition of unnecessary fluff.</li> <li>▪ Personalization Principle: - Use conversational style and virtual coaches.</li> <li>▪ Segmenting and Pre-training Principles:- Divide complex lessons and allow learners to know key concepts.</li> <li>▪ 1<sup>st</sup> Worked Example Principle: - Fade from worked example to problem.</li> <li>▪ 2<sup>nd</sup> Worked Example Principle:-promote self-explanation.</li> <li>▪ 3<sup>rd</sup> Worked Example Principle:-Include instructional explanations of worked example in some situations.</li> <li>▪ 4<sup>th</sup> Worked Example principle: - Apply Multimedia Principles to examples.</li> <li>▪ 5<sup>th</sup> Worked Example principle: - Support Learning Transfer.</li> <li>▪ Principle of Effective Practice:-Incorporate Prior Knowledge of Learner.</li> </ul> |
|                                   |   |   |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|                                 |  |   |
|---------------------------------|--|---|
| Fleming, M & Levie, W.H. (1993) | Motivation , Perception, Multimedia & Cognitive Information Processing | <p>Guidelines to stimulate epistemic curiosity</p> <ul style="list-style-type: none"> <li>▪ Maintain Attention by varying sequencing of instruction Introduce topics problematically.</li> <li>▪ Use facts that contradict past experience, paradoxical examples or conflicting views.</li> <li>▪ Give problems that may or may not have one right answer.</li> </ul>   |
|                                 |  | <p>Guidelines to improve relevance</p> <ul style="list-style-type: none"> <li>▪ Relate instruction to existing knowledge.</li> <li>▪ Use analogies or metaphors to connect present material to prior skills.</li> <li>▪ Introduce role models relevant to the topic.</li> <li>▪ Clarify the relationship between instructional objectives and the learners' goals.</li> <li>▪ Use personal language.</li> <li>▪ Relate the lesson to future goals of the learner.</li> <li>▪ Know the learning style of the learner and adapt your teaching style to learners' learning style.</li> </ul> |
|                                 |  | <p>Guidelines to motivate challenge level</p> <ul style="list-style-type: none"> <li>▪ Provide expectancy of success.</li> <li>▪ Allow learners to set their own goals.</li> <li>▪ Give learners advance notice of skills that will be examined.</li> <li>▪ Build confidence corresponding to the ability of the learner.</li> <li>▪ Give credible source of information.</li> <li>▪ Allow learner to have internal sense of control.</li> <li>▪ Give productive feedback.</li> </ul>   |
|                                 |  | <p>Guidelines to establish positive outcomes</p> <ul style="list-style-type: none"> <li>▪ Use intrinsically satisfying outcomes.</li> <li>▪ Allow learners to apply newly acquired skill.</li> <li>▪ Give real world applications.</li> <li>▪ Give extrinsic rewards to maintain motivation.</li> </ul>   |
|                                 |  | Guidelines on stimulate perceptual curiosity using text and   |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|                                 |   |   |
|---------------------------------|---|---|
| Fleming, M & Levie, W.H. (1993) | Motivation  | graphics  |
|                                 |   | <ul style="list-style-type: none"> <li>▪ Use appropriate color, graphics and font.</li> <li>▪ Use familiar typeface.</li> <li>▪ Organize your text for readability</li> </ul>   |
|                                 |   | Guidelines to achieve a readable style  |
|                                 |   | <ul style="list-style-type: none"> <li>▪ Avoid using jargon.</li> <li>▪ Use examples.</li> <li>▪ Use active voice.</li> <li>▪ Use signal words.</li> <li>▪ Start sentences with a topic sentence.</li> <li>▪ Avoid long sentences.</li> <li>▪ Use headings.</li> <li>▪ Write overviews of long sentences.</li> <li>▪ Use white space.</li> <li>▪ Use pictures of people</li> <li>▪ Use highlighting, boldface and italics as cues.</li> <li>▪ Use colored pictures.</li> </ul>  |
| Lohr, L.L. (2008)               | Cognitive Load , Multimedia , Perception , Cognitive Information Processing | <p>Principle of Visual Literacy Guidelines: - Emphasize figure and ground.</p> <ul style="list-style-type: none"> <li>▪ Make use of chunking.</li> <li>▪ Use uncluttered graphical displays.</li> <li>▪ Use white space.</li> <li>▪ Text and background should blend meaningfully.</li> <li>▪ Repeat key words.</li> </ul> <p>Principle of Visual Literacy Guidelines: -Hierarchy</p> <ul style="list-style-type: none"> <li>▪ Be aware of direction in which learner writes; right to left or left to right.</li> <li>▪ Place text close to the image it is describing.</li> <li>▪ Avoid chart junk.</li> <li>▪ Give the more important information a brighter color.</li> </ul> |

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

|  |  |  |
|--|--|--|
|  |  | <p>Principle of Visual Literacy Guidelines:-Gestalt</p> <ul style="list-style-type: none"><li>▪ Be sensitive to culture of your learners when using symbols, icons, metaphors and colors.</li><li>▪ Use universally accepted symbols.</li><li>▪ Use advance organizers.</li><li>▪ Consider learners with disabilities.</li></ul> |
|--|--|--|

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Table 4 *Theories Extracted from the Four Scholarly Texts*

| SCHOLARLY<br>TEXTS                       | THEORIES                               |                             |                      |                      |                      |                      |
|--|--|-----------------------------|----------------------|----------------------|----------------------|----------------------|
|  | Cognitive<br>Information<br>Processing | Cognitive<br>Load<br>Theory | Multimedia<br>Theory | Motivation<br>Theory | Minimalist<br>Theory | Perception<br>Theory |
| Carroll,<br>J.M.(1990)                   | Not<br>Addressed                       | Not<br>Addressed            | Not<br>Addressed     | Not<br>Addressed     | Addressed            | Not<br>Addressed     |
| Clark, R.C. &<br>Mayer, R. E.<br>(2011)  | Addressed                              | Addressed                   | Addressed            | Not<br>Addressed     | Not<br>Addressed     | Not<br>Addressed     |
| Fleming,M. L.<br>& Levie, .H.<br>(1993). | Addressed                              | Not<br>Addressed            | Addressed            | Addressed            | Not<br>Addressed     | Addressed            |
| Lohr, L.L.<br>(2008)                     | Addressed                              | Addressed                   | Addressed            | Not<br>Addressed     | Not<br>Addressed     | Addressed            |

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## **Research Question Two**

What principles of design are addressed in the four popular books on design?

## **Response to Research Question Two**

I would address the principles addressed in each popular book and give a summary for each book.

### **Freeman, E., Freeman, E., Sierra, K., & Bates, B. (2004)**

Freeman et al. (2004) did not address principles of designing for instruction. The book was about design patterns in object-oriented programming.

### **Summary of the Principles from Freeman, E., Freeman, E., Sierra, K., & Bates, B. (2004)**

Freeman et al. (2004) wrote on design patterns for object-oriented programming. Theories, principles and guidelines for designing for instruction were not addressed in this book.

### **Greenspun, P. (1999)**

Greenspun's (1999) book covered web publishing and web-based services. It did not cover theories, principles or guidelines.

### **Summary of the Principles from Greenspun, P. (1999)**

Greenspun's (1999) book did not have guidelines or principles on designing for instruction. His guidelines were for building websites and programming.

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## Krug, S. (2014)

Krug gave principles and guidelines from cognitive information processing theory, cognitive load theory, perception theory, motivation theory and minimalism theory. These five theories were extracted from the four scholarly books. In addition, Krug devoted a section to affordance. I addressed affordance theory in the first part of my literature review. Krug (2014) had thirteen chapters and every chapter had principles and guidelines from at least one of the theories identified. He did not give a theoretical foundation to any of the guidelines but he gave examples that showcased his guidelines. He devoted one sentence to cognitive work load. Krug (2014) wrote “The point is that every question mark adds to our cognitive workload, distracting our attention from the task at hand” (p.15). The alignments of guidelines from both popular books and scholarly books are presented in Figure 4 and Table 5.

He addressed the use of standardized conventions, which is a Gestalt principle because by prior experience the learner is able to recognize the sign symbolizing the instruction (Lohr, 2008). Krug (2014), writing on the universal use of standardized conventions like the stop sign wrote, “ The convention includes a distinctive shape, the word for “Stop,” a highly visible color that contrasts with most natural surroundings, and standardized size, height and location” (p.29). Fleming and Levie (1993) recommended that motivation of the learner can be achieved by stimulating the perceptual curiosity through the use of texts and graphics.

Krug (2014) also described visual hierarchies. He wrote, “... make sure that the appearance of the things on the page-all of the visual cues-accurately portray the relationships between the things on the page: which things are similar, and which things are part of other

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

things” (p.33). Similarly, Clark and Mayer (2011) were able to conclude from various studies that words should be aligned to the corresponding graphics.

Krug (2014) devoted a section to affordances. He wrote “Affordances are visual cues in an object’s design that suggest how we can use it” (p.151). Minimalism was implied when Krug (2014) wrote, that the learner should be given “the smallest amount of information that would help...” (p. 47). By implication, he is also applying minimalism theory when he advocates for omitting needless words because “it makes the useful content more prominent” (p. 49). In addition, he is more succinct in the use of minimalism when he wrote, “Another major source of needless words is instructions” (p.51) and “instructions must die” (p. 51). He also added another principle from the minimalism theory, “make it easy to recover from errors” (p. 171). Carroll (1990) writes, “The key idea in the minimalist approach is to present the smallest possible obstacle to learners’ efforts...” (p. 77). Similarly, Fleming and Levie (1993) gave a motivation guideline to achieve a readable style by avoiding the use of jargon.

Lohr (2008) discussed metaphors under Gestalt integration principle. Krug (2014) described the importance of having good interface metaphors. Krug (2014) wrote “web navigation had better be good” (p.63) to describe the importance of interface metaphors. Further, Krug (2014) described interface metaphors as telling us where we are on the site and how to use the site.

## **Summary of Principles from Krug, S. (2014)**

Krug (2014) made use of five of the theories extracted from the four scholarly books by giving guidelines from these theories. He also devoted a section to affordance. Apart from

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

mentioning affordance theory and cognitive load theory by name, he did not mention the names of any other theory but he gave guidelines from the theories extracted from the four scholarly books. Although he did not explain the theoretical foundations for his guidelines, he gave examples to showcase his guidelines. These guidelines were aligned with the theories and guidelines extracted from the scholarly books.

## **Nielsen, J. (2000)**

Nielsen (2000) addressed principles from the cognitive information processing theory, cognitive load theory, perception theory, minimalism theory and motivation theory. Nielsen (2000) gave guidelines on the use of white space. “White space can guide the eye and help users understand the grouping of information” (p.18). As Greenspun (1999) referred to Edward Tufte’s (1997) work on visual display, Nielsen also referred to Tufte’s work on presentation of graphs and like Greenspun (1999), he also pointed out that Tufte’s (1983) guidelines on the presentation of graphs could be applied to web design. Fleming and Levie (1993) and Lohr (2008) gave guidelines on using the white space. While Fleming and Levie (1993) advocated for the use of a white space from a motivation angle, Lohr (2008) advocated for the use of the white space from a perception angle.

In describing the response time of the computer, Nielsen (2000) noted that “ten seconds (10.0) is about the limit for keeping the user’s attention focused on the dialogue” (p. 44). Therefore, in designing for web pages, the designer must keep in mind that download times would be longer if the instruction has a lot of graphics. One of the guidelines to motivate the challenge level is to allow learners to have internal sense of control (Fleming and Levie, 1993).

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Increased download times would not allow learners to have a sense of control. It could make them lose their sense of control. In order to reduce download times, Nielsen (2000) advises that graphics should be removed. “To keep pages small, graphics should be kept to a minimum, and multimedia effects should be used only when they truly add to the user’s understanding of the information” (p. 46). A similar guideline by Carroll (1990) is to reduce the amount of reading material. Carroll (1990) writes, “A larger manual offers more opportunities for skipping, and a greater variety of information types in a manual can invite confusion” (p. 9).

Nielsen (2000) advises designers to be consistent in the use of colors that have become standard. “Although it is unnecessary to use exactly the same shade of blue as the browser default, unvisited links must unmistakably be blue and visited links must unmistakably be reddish or purple” (p. 62). The guideline is no longer being followed in 2014. Nielsen’s book was published in 2000. However, the principle is still the same; consistency is a key in keeping to standardized formats (Lohr, 2008).

Nielsen (2000) devoted an entire chapter to content design. He gave several guidelines on the text; Sentences should be short, use highlighting, break pages into sections, a scannable layout should be used and objective language should be used. The guidelines from text display rely on perception and cognitive information theory (Lohr, 2008). He also gave guidelines on the use of chunking. Chunking would reduce the cognitive load. Text display was also addressed in Fleming and Levie (1993) and in Lohr (2008). Nielsen also suggested the limited, grammatical use of metaphors. Metaphors were addressed in Lohr (2008) and in Fleming and Levie (1993) but they were referring to interface metaphors and not grammatical metaphors. Nielsen was referring to grammatical metaphors.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The minimalism theory was implied when he advocated that “error messages should always be constructive and help users overcome the problem instead of simply pointing out that there is trouble” (p. 111). Carroll (1990) writes, “... make errors and error recovery less traumatic and more pedagogically productive” (p.7). Further, more principles from minimalism were implied when Nielsen (2000) wrote, “... site design must be aimed at simplicity above all else, with as few distractions as possible and with a very clear information architecture and matching navigation tools” (p.164).

### **Summary of the Principles from Nielsen, J. (2000)**

Nielsen (2000) addressed the principles from cognitive information processing theory, minimalism theory, motivation theory, cognitive load theory and perception theory. The guidelines he gave were aligned with the guidelines and principles from Carroll, (1990), Fleming & Levie, (1993) and Lohr, (2008). In addition, he discussed text display and he gave guidelines on the use of highlighting, chunking and breaking pages into sections.

### **Research Question Three**

What pattern of differences or similarities occurs between the four scholarly books on instructional design text books and the four popular books on design particularly to the use of theory?

### **Response to Research Question Three**

Altogether, the four scholarly books addressed the theories of cognitive information processing theory, cognitive load theory, minimalism, motivation theory, multimedia theory and perception theory. After they addressed these theories, they presented research findings

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

on the validity of the guidelines and principles derived from the theories. The four scholarly books did not mention affordance theory by name.

Cognitive information processing and multimedia theory were addressed by three of the scholarly books except Carroll (1990). Cognitive load theory was only addressed by Clark and Mayer (2011) and Lohr (2008). Motivation theory was only addressed by Fleming and Levie (1993). Perception theory was addressed by Fleming and Levie (1993) and Lohr (2008). The theories most addressed by the scholarly books were cognitive information processing and multimedia theory. The theories most addressed by the popular books were cognitive information processing theory and perception theory. Therefore, combining both scholarly and popular books, cognitive information processing theory was the most addressed theory by scholarly and popular books.

Carroll (1990) addressed only minimalism theory and it was only his book that addressed minimalism theory. He supported the minimalism theory by presenting findings from various research papers generated from training people on the computer. Clark and Mayer (2011) addressed cognitive information processing theory, cognitive load theory and multimedia theory. They supported the guidelines they presented by discussing the results of studies done in different groups of learners.

Fleming and Levie (1993) addressed motivation theory, perception theory, cognitive information processing and multimedia theory. In addressing motivation theory, Fleming and Levie (1993) discussed how the text and graphics could be used to motivate learners. In addressing perception theory, Winn (1993) one of the contributors in the book by Fleming

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

and Levie (1993) explained how Marr's theory could be used to explain perception without explaining cognition. He wrote "... it is possible to account for perceptual phenomenon without understanding how the brain works" (p.55). Motivation theory and perception theory were discussed under separate chapters with their own headings. However, cognitive information theory and multimedia theory were not given separate chapters. Cognitive information theory and multimedia theory were addressed under a chapter for learning principles. Further, multimedia theory was referred to as multi-modal instruction by the authors of the chapter on learning principles (Hannafin & Hooper, 1993). They wrote "learning via multi-modal instruction improves when there is significant conceptual and temporal overlap between the information presented in each modality" (p. 196).

Lohr (2008) described text and graphics from the lenses of the perception theory. She also addressed cognitive information theory, cognitive load theory, perception theory and multimedia theory.

Krug (2014) and Nielsen (2000) gave guidelines that could be aligned with the guidelines from the theories extracted from the scholarly books. They did not give a theoretical foundation for their guidelines.

Two of the popular books (Freeman et al., 2004; Greenspun, 1999) did not discuss theory in their content.

### **Summary of Response to Question Three**

Two of the popular books did not address theory in their content. These two books were by Freeman et al. (2004) and Greenspun, (1999). Krug (2014) and Nielsen (2000) addressed

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

guidelines that aligned with the guidelines from the theories extracted from the scholarly books. Krug (2014) and Nielsen (2000) did not discuss the theoretical foundations for their guidelines but the scholarly books gave a theoretical foundation for their guidelines. Minimalism was not addressed in any of the four scholarly books except in Carroll (1990) but its principles were seen in two of the popular books (Nielsen, 2000; Krug 2014).

## CHAPTER FIVE: CONCLUSION

This study set out to determine if the theories, principles and guidelines in scholarly books of instructional design and technology were also addressed in popular books on design. The review of literature was conducted in three parts. The first part was a general review of literature on theories of cognitive information processing, cognitive load and affordance. The second part was a review of literature on the scholarly books to extract the theories addressed. The six theories extracted from the four scholarly books were, cognitive information processing, cognitive load, minimalism, motivation, multimedia and perception theories. The third part of the literature review was on content analysis which was conducted under methodology.

The four scholarly books were selected by a panel of experts which also doubled as my committee. The ten most reviewed books on web design were selected by systematic sampling. The panel of experts selected three books from the list of the ten most reviewed books on web design and a fourth book which was the newest publication (Krug, 2014) of two older editions (Krug, 2000, 2006) that were in the list. These four selected books were labeled as popular books.

A content analysis of the four popular books was conducted so as to determine the theories, principles and guidelines addressed in these books. Initially, coding was done by codifying categories of themes, word sense and phrases from the table of content. However, the table of contents of some of the popular books contained metaphorical and allegorical headings which made it impossible to codify using only the table of contents. Therefore, I read all the popular books to ensure consistency.

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

The results showed that the scholarly books addressed theories of cognitive information processing, cognitive load, minimalism, motivation, multimedia and perception. Two of the popular books (Freeman et al., 2004; Greenspun, 1999) did not address theory. Krug (2014) and Nielsen (2000) addressed guidelines that aligned with the guidelines from the theories extracted from the scholarly books. They did not discuss the theoretical foundations for their guidelines but the scholarly books gave a theoretical foundation for their guidelines. Minimalism was not addressed in any of the four scholarly books except in Carroll (1990) but its principles were seen in two of the popular books (Krug, 2014; Nielsen, 2000).

Cognitive information processing theory was addressed by all the scholarly books except Carroll (1990) and it was the most addressed theory by both scholarly and popular books. Lohr (2008) addressed all the six theories extracted from scholarly books except minimalism and motivation. Clark and Mayer (2011) addressed three of the theories extracted except motivation, minimalism and perception theory.

Fleming and Levie (1993) addressed the theories of motivation and perception under separate chapters. However, they devoted a section to multimedia theory under the chapter on learner principles. Further, multimedia theory was referred to as guidelines of multimodal instruction. The word multimedia was not mentioned in Fleming and Levie (1993). They also addressed cognitive information processing under the chapter on learner principles. Minimalism and cognitive load theory were not addressed by Fleming and Levie (1993). I have presented a summary of the alignments between the scholarly books and popular books in Table 5 and a summary of the results in Figure 4.

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Table 5 *Summary of Guidelines from Popular Books Aligned with Extracted Guidelines and Theories from Scholarly Books.*

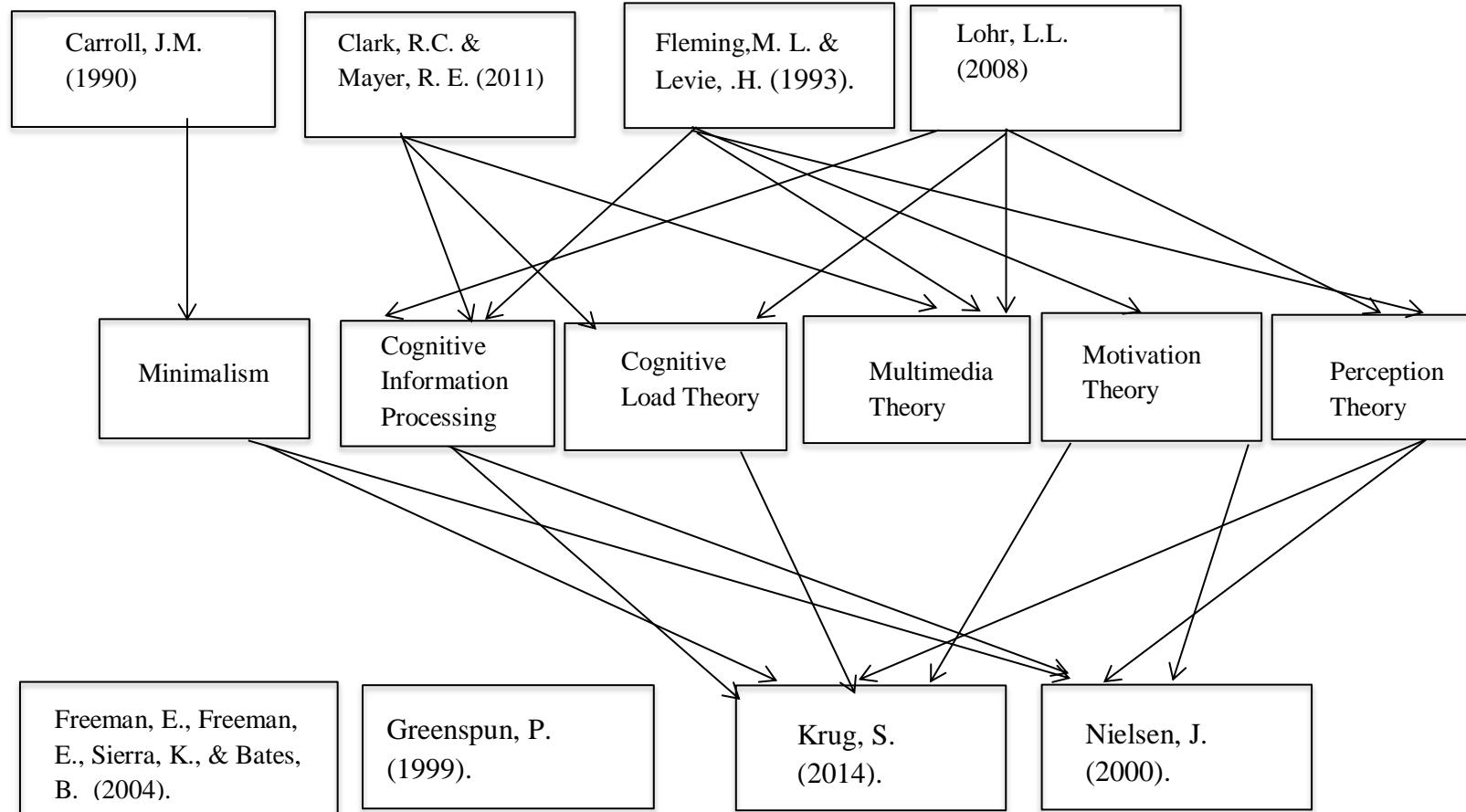
| Theories from Popular Books  | Guidelines From Popular Books                  | Theories  | Guidelines from Scholarly Books   |
|--|--|---|---|
| Nielsen (2000)<br>Motivation, Perception<br>Cognitive Information Processing, Cognitive Load Theory, Minimalism & Affordance | ▪ Decrease use of grammatical metaphors        | Cognitive Load Theory   | ▪ Be sensitive culture when using symbols, metaphors, icons and colors (Lohr, 2008).                    |
|  | ▪ Make use of white space                      | Cognitive Information Processing  | ▪ Make use of white space (Fleming & Levie, 1993; 2008).  |
|  | ▪ Use less graphics to decrease download times | Motivation  | ▪ Allow learner to have internal sense of control (Fleming & Levie, 2014).                              |
|  | ▪ Use standard conventions                     | Perception  | ▪ Use universally accepted symbols (Lohr, 2008).  |
|  | ▪ Keep sentences short                         | Minimalism, Cognitive Information Processing, Cognitive Load Theory & Motivation Theory | ▪ Reduce amount of reading material (Carroll, 1990).<br>▪ Avoid long sentences (Fleming & Levie, 1993). |
|  | ▪ Allow recovery from errors                   | Minimalism  | ▪ Allow recovery from errors (Carroll, 1990).   |
| Nielsen (2000)   | ▪ Make use of chunking                         | Cognitive Load Theory, Cognitive Information Processing                                 | ▪ Make use of chunking (Lohr, 2008).  |
|  |  |   |   |
|  |  |   |   |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

| Theories from Popular Books  | Guidelines From Popular Books   | Theories                                     | Guidelines from Scholarly Books   |
|--|---|--|---|
|  |   |  |   |
| Krug (2014)<br>Perception, Cognitive Information Processing, Minimalism, Motivation & Affordance | <ul style="list-style-type: none"> <li>▪ Decrease cognitive load</li> </ul>                               | Cognitive Load Theory                        | <ul style="list-style-type: none"> <li>▪ Make use of chunking (Lohr, 2008).</li> </ul>  |
| Krug (2014)<br>Perception, Cognitive Information Processing, Minimalism & Affordance             | <ul style="list-style-type: none"> <li>▪ Use standard conventions</li> </ul>                              | Perception                                   | <ul style="list-style-type: none"> <li>▪ Use universally accepted symbols (Lohr, 2008).</li> </ul>  |
|  | <ul style="list-style-type: none"> <li>▪ Place the most important item on top of the hierarchy</li> </ul> | Perception                                   | <ul style="list-style-type: none"> <li>▪ Give the more important information a brighter color (Lohr, 2008).</li> </ul>  |
|  | <ul style="list-style-type: none"> <li>• Use visual hierarchy</li> </ul>                                  | Perception, Cognitive Information Processing | <ul style="list-style-type: none"> <li>• Give the more important information a brighter color (Lohr, 2008).</li> </ul>  |
|  | <ul style="list-style-type: none"> <li>▪ Use visual cues</li> </ul>                                       | Perception, Cognitive Information Processing | <ul style="list-style-type: none"> <li>▪ Use highlighting, boldface and italics as cues (Fleming &amp; Levie, 1993).</li> <li>▪ Place text close to the image it is describing (Lohr, 2008).</li> </ul> |
|  | <ul style="list-style-type: none"> <li>▪ Avoid excessive instruction</li> </ul>                           | Minimalism, Motivation                       | <ul style="list-style-type: none"> <li>▪ Reduce the amount of reading material (Carroll, 1990).</li> <li>▪ Avoid using jargon (Fleming &amp; Levie, 1993).</li> </ul>                                   |

## Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

Figure 4 *Summary of Results*



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# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## APPENDIX A: Screen Shots of Selection of The Ten Most Positively Reviewed Books on Web Design

Screen Shots of search results for three- level sampling using web design books (A) under the Amazon department of web development (B) and then sorted by most reviews (C). D is the list of the choices from which web development and design was picked from. E is the date the sampling was done. (Used with permission of Amazon.com, 2014)

**B**

**A**

**C**

**D**

**E**

The screenshot shows the Amazon search interface. At the top, there's a navigation bar with links like 'Books', 'Advanced Search', 'New Releases', 'Best Sellers', etc. Below it, a search bar contains the query 'web design books'. To the right of the search bar is a dropdown menu set to 'Sort by: Most reviews'. On the left, a sidebar labeled 'D' provides filtering options: 'Departments' (Web Development & Design), 'Book Format' (Paperback, Hardcover, Kindle Edition, PDF), 'Shipping Option' (Free Shipping by Amazon), 'New Releases', 'Book Format' (Paperback, Hardcover, Kindle Edition, Audible Audio Edition, PDF, Audio CD, Board Book, Audio Cassette, MP3 CD), 'Author' (Patrick McNeil), and 'Book Language' (English, Italian, Chinese, Spanish, French, German). Red arrows point from labels B, C, and D to their respective parts of the interface.

**A**

**C**

**D**

**E**

This screenshot shows the search results for 'web design books' sorted by 'Most reviews'. It lists three books:

- Head First HTML with CSS & XHTML** by Eric T Freeman, Elisabeth Freeman and Elisabeth Robson (Dec 15, 2005)  
Price: \$8.54 (New), \$0.83 (Used), \$12.50 (Collectible)
- Head First Design Patterns** by Elisabeth Freeman, Eric Freeman, Bert Bates and Kathy Sierra (Nov 1, 2004)  
Price: \$16.83 (Prime), \$31.98 (New), \$25.86 (Used), \$18.00 (Collectible)
- Don't Make Me Think: A Common Sense Approach to Web Usability, 2nd Edition** by Steve Krug (Aug 28, 2005)  
Price: \$27.13 (New)

Red arrow E points to the date '11/4/2013' at the bottom of the screen.

**A**

**C**

**D**

**E**

This screenshot shows the detailed product page for 'Head First HTML with CSS & XHTML'. It includes the book cover, title, authors, publication date, customer reviews (4.5 stars from 434 reviews), and purchase options (Paperback, Kindle Edition, Rent, Buy, New, Used). An excerpt from the book is also visible.

**A**

**C**

**D**

**E**

This screenshot shows the detailed product page for 'Head First Design Patterns'. It includes the book cover, title, authors, publication date, customer reviews (4 stars from 396 reviews), and purchase options (Paperback, Kindle Edition, Rent, Buy, New, Used). An excerpt from the book is also visible.

**A**

**C**

**D**

**E**

This screenshot shows the detailed product page for 'Don't Make Me Think: A Common Sense Approach to Web Usability, 2nd Edition'. It includes the book cover, title, authors, publication date, customer reviews (4.5 stars from 338 reviews), and purchase options (Paperback, Kindle Edition, Rent, Buy, New, Used). An excerpt from the book is also visible.

**A**

**C**

**D**

**E**

This screenshot shows the detailed product page for 'HTML 4 for the World Wide Web, Fourth Edition'. It includes the book cover, title, authors, publication date, customer reviews (4.5 stars from 355 reviews), and purchase options (Paperback, Kindle Edition, Rent, Buy, New, Used). An excerpt from the book is also visible.

**A**

**C**

**D**

**E**

This screenshot shows the detailed product page for 'HTML and CSS: Design and Build Websites'. It includes the book cover, title, authors, publication date, customer reviews (4.5 stars from 114 reviews), and purchase options (Paperback, Kindle Edition, Rent, Buy, New, Used). An excerpt from the book is also visible.

**A**

**C**

**D**

**E**

This screenshot shows the detailed product page for 'Don't Make Me Think! A Common Sense Approach to Web Usability'. It includes the book cover, title, authors, publication date, customer reviews (4.5 stars from 261 reviews), and purchase options (Paperback, Kindle Edition, Rent, Buy, New, Used). An excerpt from the book is also visible.

**A**

**C**

**D**

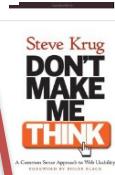
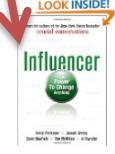
**E**

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

## APPENDIX A: CONTD.

F is the outlier

F

|              |  |
|--------------|--|
| Condition    | Collectible (678)<br>New (8,547)<br>Used (7,921)   |
| Availability | <input checked="" type="checkbox"/> Include Out of Stock (8,772)   |
| 6.           | <br><b>Steve Krug</b><br><b>DON'T MAKE ME THINK</b><br>A Common Sense Approach to Web Usability<br>BY STEVE KRUG<br>PAPERBACK \$19.96<br>See newer edition of this book   |
| 7.           | <br><b>Influencer: The Power to Change Anything</b> by Kerry Patterson, Joseph Grenny, David Maxfield and Ron McMillan (Sep 13, 2007)<br>★★★★★ (260)<br>Formats<br>Hardcover \$26.95 \$16.81 Prime \$8.66 \$0.01 \$5.99<br>Kindle Edition \$14.55<br>Other Formats: Audio CD; CD-ROM; Audible Audio Edition<br>Excerpt - Back Matter "... transform this book into a tool for ... can use to design and organize ..." See a random page in this book.<br>See newer edition of this book |
| 8.           | <br><b>Jakob Nielsen</b><br><b>Designing Web Usability</b><br>Paperback \$64.99 \$35.43 Prime \$0.01 \$0.01 \$8.95<br>FREE Shipping  |
| 9.           | <br><b>JavaScript: The Good Parts</b> by Douglas Crockford (May 2008)<br>★★★★★ (239)<br>Formats<br>Paperback \$15.10 Prime \$19.38 \$16.08 \$13.76<br>Kindle Edition \$13.49<br>Excerpt - Back Cover "... Web Authoring & Design 0 REILLY 1-1 JavaScript: The Good Parts Most ..." See a random page in this book.<br>Sell this back for an Amazon.com Gift Card  |
| 10.          | <br><b>Philip &amp; Alex's Guide to Web Publishing</b> by Philip Greenspun (Apr 29, 1999)<br>★★★★★ (232)<br>Formats<br>Paperback \$21.55 \$0.01 \$37.50   |
| 11.          | <br><b>JavaScript for the World Wide Web, Second Edition (Visual QuickStart Guide)</b> by Tom Negrino and Dori Smith (Dec 1997)<br>★★★★★ (231)<br>Formats<br>Paperback \$2.35 \$0.01 \$7.33<br>Paperback \$0.01 \$0.01 \$7.40<br>See newer edition of this book   |

# Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**APPENDIX B: List of the Ten Most Positively Reviewed Books on Web Design** (from Amazon.Com Inc.) Ranked by Most Reviews with an Average Rating of 4 Stars and Above. *Search completed on 4<sup>th</sup> November, 2013.*

| Ranking | Title of book   | Author(s)  | Number of Customer Reviews | Year of Publication | Number of Pages |
|---------|---|--|----------------------------|---------------------|-----------------|
| 1.      | Head first HTML with CSS & XHTML                              | Eric T Freeman, Elisabeth Freeman &Elisabeth Robson        | 434                        | 2005                | 658             |
| 2.      | Head first design patterns                                    | Elisabeth Freeman, Eric Freeman, Bert Bates & Kathy Sierra | 396                        | 2004                | 678             |
| 3.      | Don't make me think: A common sense approach to web usability | Steve Krug   | 388                        | 2006                | 216             |
| 4.      | HTML 4 for the World Wide Web                                 | Elizabeth Castro   | 385                        | 1999                | 384             |
| 5.      | HTML and CSS: Design and build websites                       | Jon Duckett  | 316                        | 2011                | 512             |
| 6.      | Don't Make me think: A common sense approach to web usability | Steve Krug   | 283                        | 2000                | 195             |
| 7.      | Designing web   | Jakob Nielsen  | 240                        | 2000                | 432             |

Investigating the Alignments Between Scholarly and Popular Texts in Design: A Content Analysis

**APPENDIX B: CONTD.**

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|     |   |                           |     |      |     |
|-----|---|---------------------------|-----|------|-----|
|     | usability                                 |                           |     |      |     |
| 8.  | Java Scripts: the good parts              | Douglas Crockford         | 239 | 2008 | 176 |
| 9.  | Philip and Alex's guide to web publishing | Philip Greenspun          | 232 | 1999 | 608 |
| 10. | Java script for the world wide web        | Tom Negrino and Don Smith | 231 | 1997 | 208 |

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TOTAL NUMBER OF PAGES OF THE TEN BOOKS = 4,067 PAGES