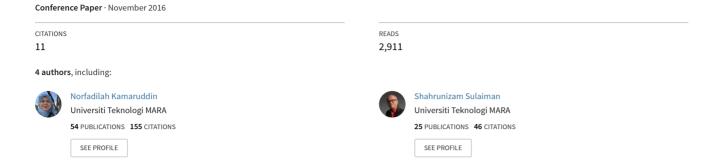# Understanding Interface Design Principles and Elements Guidelines: A Content Analysis of Established Scholars

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Understanding Interface Design Principles and Elements Guidelines: A Content Analysis of Established Scholars

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Abstract

In designing an effective teaching aid as a part of communication tool in teaching and learning process, it should be well designed and developed by the designer. Moreover, interface design as one of the important elements that contributing to teaching aid and further the effective learning experience among end-users. Between this relationship, interface design performs as a medium that communicates between user and the learning content through effective principles and elements. Toward this understanding, in developing effective teaching aids, commonly lecturers or tutors become an interface designer. By considering the important of it, extensive analysis has been carried out through 16 established scholars towards the theory of interface design by pertaining teaching and learning material (teaching aid) in education. The analysis covered what are the best principles and elements guidelines of effective interface design for a teaching aid established by international scholars

Keywords: Interface Design Principles; Interface Design Elements

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1. Introduction

The theory from visual communication describes interface design as one of the element which facilitates effective teaching and learning process, as an 'overall screen-presentation' of a product's or a "front-end" that bridging the ease of users' navigation and efficient information avenue (Kamaruddin, 2012).Commonly, in designing an interfaces, it is important for the designer to understand the needs of the audience. Thus prior to the development, designers are required to have a better understanding of interface design which accommodates the audience's view towards the quality of the content presented (Park, 2012).

The progressive development of technology and media therefore has reshaped the current learning environment, which provides educators the capabilities in expanding their attitude towards an extensible possibilities in facilitating efficiency and competency learning material (Kim et al,. 2013). Towards this, users are interacting with the learning content through interfaces. Wu & Guan (2011) described this dynamic relativity as 'behavior sequence'. Chase (2012) further supported this by emphasizing the importance of providing a well-functioned user interface design, which meets the learning curve. Faghih *et al.*, (2013) also agreed with this, which highlighted that manipulated multimedia elements such as text, graphics, images, animation, videos and audios are controlled content delivered through an interface design.

In addressing this understanding, a critical content analysis was conducted to determine what are the most principles and elements of interface design that highly recommended in the literature.

2. Interface Design

In designing an interface, it is important for the designer to understand the needs of the audience. Prior to the development, it is a required insight to have a better understanding to accommodate the audience's view towards the quality of the content presented in an interface. As reported by Kamaruddin, Park, & Nam (2012), Rogers and Sharp (2002) defined interface as 'the surface of screen facilitating certain interpretation of the medium on the way that user perceives the communication process'. They further explained that there are four types of interface as defined by Weiss (1993), which is: -

1) Presentation of interface controls, the user perceives the information (seeing the information).
2) Interface conversation controls the way system communicating with user, user and system communication (method of communication).
3) interface navigation controls the way user moves from one part of information to another (movement from one screen page to another screen page).
4) Explanation of interface controls users' controls the different activities (use of icon) including performance support.

Prior to that, interface design should not only be appealing and establish a look and feel that users will respond to positively, it must also help users to find and remember information, and support them in the tasks that they need to perform.

3. A Contextual Document Review

Across literature, numerous scholars suggested the applicability on principle and elements guidelines of the interface design fundamentals through clear and effective visual communication, reflecting the continuing evolution of interface in general and education in specific. The extensive literature is narrowed down to sixteen key texts with the objective for a comprehensive review, followed by extracting the elements and principle guidelines into a set of manageable data. The criteria of selection is based on: (1) Listing elements and principle guidelines of interface design; (2) Significantly cited as a guiding principles by numerous authors, and (3) Provides a holistic guidelines of Principles and Elements of Interface Design for Effective Teaching Aids. The included text on these grounds includes five books, three research thesis and eight scholar journals. The listed literature is show in Table 1 below.

Table 1. List of Literature Compiled and Reviewed

Name	Category	Author
1. Interface Design: An introduction to visual communication in UI design (2014)	Book	Dave Wood
2. Introduction to Digital Multimedia 2nd Edition (2014)	Book	T.M Savage & K. E. Vogel
3. Digital Multimedia (2009)	Book	Nigel Chapman & Jenny Chapman
4. Design for New Media: Interaction Design for Multimedia and the Web (2004)	Book	Lon Barfield
5. Multimedia: Making it Work (2004)	Book	Tay Voughan
6. Interface Design in Interactive Science Courseware for the Malaysian Smart School Project (2012)	Thesis Queensland University of Technology, Australia	Norfadilah Kamaruddin
7. The Effect of Closed Interactive Multimedia Learning Environments on Student Memory Retention: A Linear versus Non-Linear Approach (2009)	Thesis University of North Florida	Troy A Johnson
8. The dynamics Involved in Web-based Learning Environment (WLE) Interface Design and Human Computer Interactions (HCI): Connection With Learning Performance (2007)	Thesis West Virginia University	Ivana Schnitman
9. The Origin of Graphic Screen Design Principles Theory or Rethoric (2005)	Journal Article	Barry O Williams, Lisa R. Stimart
10. User Interface Design for E-Learning Software (2013)	Journal Article	Beghnam Faghih & Mohd Reza Azadehfare
11. Principles of Educational Multimedia User Interface Design (1998)	Journal Article	Lawrence J. Najjaar Et al
12. Screen Design Guidelines for Motivation in Interactive Multimedia Instruction: A Survey and Framework for Designers (1999)	Journal Article	Shung Heum Lee & Elizabeth Boling
13. Designing the Instructional Interface (2000)	Journal Article	L.L. Lohr
14. Guidelines for Cognitively Efficient Multimedia Learning Tools: Educational Strategies, Cognitive Load and Interface Design (2006)	Journal Article	Tiffany Grunwald & Charisse Corsbie-Massay
15. A Study of Usability Principles and Interface Design For Mobile E-Books (2015)	Journal Article	Chao-Ming Wang & Ching-Hua Huang's
16. Teaching Visual Design Principles for Computer Scince Students (2010)	Journal Article	Roymieco Carter

4. The Most Principles and Elements of Interface Design Recommended in the Literature

Overall, analysis process determines that each of the scholars has established principles and elements based on different perspectives and research frameworks. In common, most of the scholars similarly focused on understanding the function of the interface design in enhancing and facilitating learning content delivery and accommodating user engagement. These can be categorized into three main aspect comprising user-centered design, interface design applicability and interface design functionality.

Based on numerous principles and elements established by different scholars, the list of principles and elements are then categorized into a shorter list of in-common elements and principle through a thematic system. In example, for principle of hierarchy suggested by Dave Wood serves the same meaning as emphasis by Tay Voughan. Thus, a common keyword that is widely used and identified has been applied in encompassing both the terms. Outcome of the systematic analysis on the content of the sixteen authors towards the principles and elements was determined and is shown in Table 2.

Table 2. Summary of principles and elements of interface design that most frequently occurred in the literature (by keyword)

Text	Principles	Elements	Characteristics
1.	Consistency Contrast Balance Hierarchy Harmony	Text	• Consistent, Short Paragraph, Avoid Capital
		Color	• Contrast, harmony • Cultural /Work • Long text no bright colors • Don't distract • Hierarchy
		Image	• Hierarchy, Emphasize, Contrast, Harmony • Appropriate , With short text • Align left
		Icon	• Supplements • Universal, Legible Consistent • Balance • Simple • Limit colors
		Video	• Visible, min usage • For introductions • Has control button • Break sub topics
		Animation	• Assist comprehend
		Sound	• Consider impact • Consistent • Short, fragmented
2.	Hierarchy Balance Variance Contrast Consistency	Type	• Hierarchy • Headers Serif, Body San serif • No Fancy fonts • Grid column, left.
		Color	• Reflect meaning, Balanced, Contrast
		Image	• Functional, understandable • For content or navigation
		Icon	• Clear function • Text optimize use
		Video & Animation	• Draw attention • No interfere • Consistent
3.	Consistent Simplicity Contrast Harmony Variety Hierarchy	Text	• Cluster, Differ • Clear, contrast, • Consistent font
		Graphics	• Text labels icon • Identify purpose • Consistent
		Sound	• Identify purpose • Minimize usage
		Animation	• Identify user • Simple, minimal
		Video	• Contrast, clear
4.	Contrast Variety Emphasis	Text	• Readable, • Hierarchical, Consistent, Contrast & Emphasize
	Harmony Balance	Color	Contrast, Harmony & Emphasis
		Image	• Identify use, No picture background
		Animation	• Determine needs, function & format • Avoid too fast
		Graphic	• Simplify
		Audio	• Suit, synchronize • Allow disable button
5.	Hierarchy Harmony Contrast	Text Color Animation Layout Text Image/ Graphic	• Structured • Group several element same colors • Avoid align center
6.	Consistency Familiarity Flexibility Efficient Feedback Aesthetic	Color Text Animation Icon Image Layout Graphic Audio	• Relevant, Clear • Understandable • Effectively Communicates • Careful consideration to audience level
7.	Hierarchy Consistency Balance Emphasis Contrast Variety	Color Text Graphic	• Contrast, consistent & emphasize • Pleasing, appealing, appropriate • Readability and Legibility • Limit number of font type
8.	Consistence Balance Clarity	Color Text Graphic Animation Audio	• Intuitive • Relevance • Limit Redundancy • Functional
9.	Contrast Consistency Clarity Emphasize	Color Text Graphic Animation Audio	• Clarity • Avoid Clutter • Text lower case • Minimize text length
10.	Emphasize Contrast Harmony Clustering	Text Color Graphic Animation Audio	• Harmony • Short length text • Hierarchy,contrastemphasis • Appropriate • Minimize clutter • Supportive
11.	Variety Balance Emphasis Supportive	Text Color Image/ Graphic	• Harmony • Support & communicates • Integrated
		Animation	• Assist understand
		Audio/ Video	• Understandable
12.	Contrast Consistency Focus Harmony Unity	Text	• Hierarchical, Contrast • Upper lower case, limit length • Animate only for attention
		Graphic	• Assist function • Consider learner

	Color	• Contrast, Harmony, Aesthetic, logic
	Animation	• Dynamic, Facilitate & visualize tasks
	Audio	• Balance
13. Contrast Emphasize Hierarchy Unity	Text Color Graphic / Image	• Distinguish • Use clear space • Familiar structure • Gestalt • Visualize process
14. Balance Clustering Consistent Variety	Text Graphic Color Animation	• Reduce Clutter • Balance • Consistent • Consider learners • Contrast
	Audio	• Balance, Reduce redundancy
15. Visibility Consistency Ease Efficiency Enjoyment	Graphic Text Color Video Button	• Hierarchy contrast • User Accustomed • Based on User's • Aesthetically affecting
16. Balance Emphasis Movement Contrast Repetition Unity	Text Graphic Color Image Icon / Button	• Balance • Emphasize • Hierarchy • Contrast • Harmony

As shown in table 2, there are five most frequent principles of interface design identified based on their frequency occurred derived from the content analysis of the key texts (in order of frequency) namely consistency, hierarchy, contrast, balance and harmony. Secondly, there are seven most frequent elements of interface design identified base on their frequency occurred derived from the content analysis of the key texts (in order of frequency) namely text, graphic and/or image, color, animation, animation, audio, video and button or icon. The most principles of interface design established by international scholars are as outlined by frequently most identified.

4.1. Consistency within interface design

In the content analysis throughout the literature, consistency is the utmost frequently occurred as an important principle of interface design, emphasizing on the importance of consistency in the usage of all elements of interface design such as font type, size and colours, placement of contents such as title, text, image, animation, audio and navigation throughout all the pages of a multimedia content to facilitate ease of use and user understanding. Barfield (2004),

Kamaruddin (2012) and Wood (2014) emphasized that elements such as text, colour, graphic and/or mages, animation and navigation should be applied consistently throughout the interface design through their attributes and placement or layout as this will facilitate user ease of use and understanding through navigation.

4.2. Hierarchy of contents in interface design

The principle of hierarchy or emphasis, as known in some text has the second most frequently occurred principle of interface design. It is applied by clustering the interface elements such as text, images and graphics by emphasizing the level of importance towards the interface content. Almost all the eleven scholars ascertain the principle of hierarchy agrees clustering the images through level of importance and flow of structure through placement of content in an interface design. As suggested by Johnson (2009) hierarchy will adhere in human interaction by limiting redundancy towards cognitive load towards user in multimedia learning environment. This is supported by Chapman (2009) and Schnitman (2007), where structured hierarchy will facilitate Readability and legibility for a quick view.

4.3. Contrast within interface design

In regards to legibility and readability as an 'Overall Screen-presentation', the principle of contrast, the same level of importance as the earlier two principles, similarly found most occurred in the content analysis. Contrast of color between texts against background is the most discussed by all scholars, which facilitates visibility and readability among users. An example to this, Williams & Stimart (2005) recommends contrast in color, text and graphic, and is used to achieve clarity and readability (Faghih & Azadehfare, 2013). Significantly, contrast in foreground and background should also apply in a video element in an interface (Savage & Vogel, 2014).

4.4. Balance within interface design

It is identified that principle of balance as occurred similarly important in providing this experience where it is able to support the user positive experience (Najjar, 1998) by applying balance in text and graphic through its layout. This is supported by Massay (2006) and Johnson (2009) where both scholars ascertain that principle of balance when applied, can reduce clutter and user cognitive redundancy and further Carter (2015) emphasized that asymmetrical balance in an interface layout can create dynamic visuals.

4.5. Harmony in interface design

The fifth final principle of interface design identified most occurred in the texts is harmony or in some, it occurs as unity. Harmony is applied in an interface design to provide a pleasing aesthetic environment in facilitating learning function and functional guidance as suggested by Lee & Boling (1999), achieved by applying in the elements of graphic and color in interface design. In regards to this, it is facilitated through usage of a clear identified space area (Lohr, 2000). Harmony in audio of an interface is supportive and able to motivate, enhances message and concentration among users (Faghigh & Azadehfare 2013) identifies that.

In summary, there are thirty-eight characteristics of the six elements of interface design, which is text, colors, image and/or graphic, animation, video and audio were identified. The characteristics of each element have been identified accordingly with the characteristics for the element of text having the most characteristics and the element of sound has the least. Ten characteristics for element of text are identified, followed by six characteristics for colors, seven characteristic for image and/or graphic, seven characteristic for animation, six characteristics for video and audio.

From this outcome, it is revealed that most of the elements shares similar characteristics principle guidelines in its applicability. This can be seen for example in the principle of consistency where the elements of text, color, graphic and animation requires the consistency usage of the same types of fonts, alignment, size, color, background color, graphic, position of animation and graphic throughout the interfaces. The characteristics of the elements of interface design identified from the contextual review through the five most identified principles of interface design outline earlier is explained in Table 3 below.

Table 3: Characteristics of the five identified principles and elements interface design

Principles	Elements	Characteristics
Consistent Hierarchy Contrast Balance Harmony	Text	• Consistent font, size, placement, color • Short paragraph, Avoid all Capital Letters • San serif for body copy, Don't use decorative, script or black letter • Contrast against background • Cluster, structured and Hierarchical • Paragraphed in grid column, flush left. • Use upper lowercase, limit length line • Animate underline only for attention • Limit number of font type • Integrate – text & diagram appropriately
	Color	• Consistent throughout pages • Consider Culture, field Associate • Contrast, foreground and background • Groups contents, Hierarchical, functional • Avoid bright colors for long text • Aesthetically pleasing, appealing
	Graphic /Image	• Consistent throughout pages • Functional text & diagram appropriately • Appropriate to content, understandable • Legibility, Hierarchy, Emphasize, Contrast, Harmony • Clear, Contrast avoid clutter for visibility • Avoid picture as background • Consider audience level
	Animation	• Consistency throughout • Identify user, needs and function • For attention, comprehension & reminder • Should not interfere with other contents • Simple, minimal, speed not too fast • Aesthetically appealing, appropriate
	Video	• Visible Placement, minimize usage • Mostly used for introductions • Breakdown videos by sub topics • Contrast, clarity on background

	• Understand, simple, accompany audio
	• Incorporate user control button
Sound	• Consistency throughout
	• Pleasant, coherent and consistent
	• Suit content & atmosphere, synchronize

5. Conclusion

This paper has outlined and analyzed the information gathered through a contextual analysis from international literature such as books, research thesis and scholar journals. A set of principles and elements guidelines has been established with five most cited principles of the six elements of interface design namely text, color, graphic and/or image, animation, video and sound. The five most cited principles of interface designs namely by mostly cited are consistency, hierarchy, contrast, balance and harmony. From the established elements and principle guidelines outlined, thirty-eight characteristics of the guiding principles for the six elements is further derived and outlined. The element of text is identified to have the most characteristic in its guidelines followed by color, image and/or graphic, animation, video and finally audio having the least characteristics. The characteristics of the principle and elements are found to be significantly important as a guideline in designing an effective interface design for a multimedia teaching aid.

Acknowledgement

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