A Comparative Study of Children's eHealth Design between East and West: A Case Study of Children's Health Websites in China, Taiwan, the UK, and the US

Yah-Ling Hung[1] and Catherine Stones[2]

[1] Department of Communication arts, Fu-Jen Catholic University, Taiwan
[2] School of Design, University of Leeds, UK
`030872@mail.fju.edu.tw`

Abstract. A good developing model of children's health could reduce health care costs and improve quality of life across the children life span. What are the key communication issues and technology concerns involved in the design of children's health websites? When parents evaluate a children health website, they always have some concerns: Is the health information credible? Is the interpretation clear and adequate? Is the media application suitable? Is the interface design user-friendly? With recent advances in computer technology, its impact on health communication is continually increasing. However, how to design an effective children's health website to enhance parents' cognition, to promote their active processing, and to increase their interaction frequency, is still very much a question that remains unanswered. This research was implemented in three stages. Firstly, the Chinese keywords, "兒童保健網" and the English keywords, "children's health website" were entered into Google to search for the 20 most popular Chinese and English-speaking websites. Secondly, existing literature was reviewed to ascertain the critical category and evaluation guidelines for designing children's eHealth. Thirdly and finally, a selection of these websites from China, Taiwan, the UK, and the US were evaluated by using a content analysis methodology, applying the criteria developed from the literature review. This study finds that in terms of information design, credibility is better presented in the West than in the East, whereas users' needs are better presented in the East than in the West. In terms of multimedia design, demonstrations and humanity are better presented in the West than in the East, and the segmentation of demonstrations is valued by both the East and the West. In terms of interface design, the West presents a better appearance than the East, and methodology is valued by both the East and the West.

Keywords: eHealth Evaluation, Information Design, Multimedia Design, Interface Design.

1 Introduction

Research Background. With the rapid development of computer technology and growing demand for health information, health websites are emerging as one of the

most effective media to meet the public's needs for health information. Fox & Jones (2009) stated that 61% of American adults go online to locate health information, and the results of online health information searches had a strong effect on how they managed their own health or the health of someone else. There has been a great proliferation of research into eHealth evaluation during the past decade. For example, Oermann et al. (2003) assess the quality of the ten best websites for patient and parent education on asthma. Seventy websites were evaluated based on the criteria set by the Health Information Technology Institute (HITI), namely, credibility, content, disclosure, links, design, interactivity, caveats, and readability. Dansky et al. (2006) also address four dimensions of eHealth evaluation as follows: (1) design and methodology issues; (2) challenges related to the technology itself; (3) environmental issues which are not specific to eHealth but pose special problems for eHealth researchers; and (4) logistical or administrative concerns of the evaluation methodology selected. Hsu & Chang (2007) set up the following evaluation guidelines for eHealth design from the perspective of users' demand: (1) items of operating interface: layout design, clear links, visual identification, interactive process, easy to control, clearly presentation, fast feedback, user-friendly, repeat practice, search confusion; (2) items of valuable results: useful information, whole concept, multi-search path, easy interactive function, reduction of search time, decrease of articles with no demand, clear results, explanatory accompanying text, helps understanding, ease of learning new information. Nevertheless, the researches related to the evaluation of children eHealth design are seldom seen. Health in childhood is regarded as the foundation of lifelong well-being. Many parents search for health information online to manage their children's health. Before seeing a doctor, they often search for related medical information in advance and try to acquire the opinions of other patients with the same disease. Internet-based health information seems to have a positive effect on their health knowledge, treatment decisions, and attitude toward maintaining health. How to design an effective children's health website to enhance parents' cognition study, to promote their active processing, and to increase their interaction frequency, is still very much a question that remains unanswered.

Purpose of this Study. A good developing model of children's health could reduce health care costs and improve quality of life across the children life span. What are the key communication issues and technology concerns involved in the design of children's health websites? When parents evaluate a children health website, they always have some concerns: Is the health information credible? Is the interpretation clear and adequate? Is the media application suitable? Is the interface design user-friendly? With recent advances in computer technology, its impact on health communication is continually increasing. What strategies, media, and forms of communication are the most effective for health promotion and patient education initiatives? Evaluation is the crucial part of developing a healthcare application. It motivates the designer, and explains the guidelines with reference to concrete projects and problem-solving. The purpose of this study is to determine the critical category and develop evaluation guidelines for a children's health website, and further to compare the differences between children's eHealth design in the East and the West. In consideration of the issues of concern mentioned above, the primary research

objectives in this paper are as follows: to explore the strategies, media, and forms of communication of current children's health care websites; to survey current strategies, methodologies, and tools for evaluating children's health care website design; to evaluate the success of designs of children's eHealth websites in the East (China & Taiwan) and the West (UK & US).

2   Literature Review

2.1   eHealth Evaluation

Since health care website are the popular source of health information, a thorough evaluation of these sites should be made to ensure that they successfully achieve their goals. In the East, the Quality Healthcare Websites awards in Taiwan, organized by the Department of Health, Executive Yuan from 2002~2006, declared the general criteria for eHealth design as follows: (1) Credibility of the website: author's detailed data, author's professional title, modified instantly; (2) Interaction of the website: offering on-line consultation, users' feedback; (3) Maintenance management: website governor's name, website contact data, personal privacy protected; (4)Ease of browsing: ease of understanding the content, system stability; and (5) Compartment: advertisements and content are obviously compartmentalized.

In the West, the Web Health Awards, now in its 12th year in the US, organized by the Health Information Resource Center™ (HIRC), states that a health website design should contain the following elements: (1) Quality, accuracy and timeliness of online content; (2) Relevance of online information for the target audience; (3) Overall assessment of site layout and ease of use; (4) Would this online resource be something the targeted audience would bookmark for frequent review? (5) Is the online resource sufficiently interactive for the targeted audience? In addition, The Health On the Net Foundation (HON) ,which is established by ten countries and sixty professional medical institutions, promotes the Certificate of HON Code of Conduct for excellent medical and health websites, and their principles of judging are as follows: (1) Authoritative: indicates the qualifications of the authors; (2) Complementarity: information should support, not replace, the doctor-patient relationship; (3) Privacy Respect: the personal data submitted to the site by the visitor should be kept completely private and confidential; (4) Attribution: the source(s) of published information, date and medical and health pages should be clearly cited; (5) Justifiability: site must back up claims relating to benefits and performance; (6)Transparency: presentation must be accessible, and email contact accurate; (7) Financial disclosure: funding sources should be identified; and (8) Advertising policy: advertising should be clearly distinguishable from editorial content.

2.2   Information Design

Jacobson (1999) mentions that information design is about managing the relationship between users and information. Ideally the designer constructs an information platform which can be easily understood and used by most people, designs an interactive system which can be easily accessed and controlled by users, and builds a virtual space within which users can find the path quickly and will not get lost. By

amalgamating the above recommendations, a set of criteria can be established under a general heading called 'Information Design', the focus of which can be the content of these websites, particularly the text-based content.

There is a communication revolution brewing in the delivery of health care by the growth of powerful new health information technologies. For example, Lucas (2008) assesses the potential benefits of a diverse range of information and communication technology (ICT) innovations. The following four broad areas are considered: (1) Improvements in traditional health information systems; (2)Computer-aided diagnosis and treatment monitoring; (3)A range of applications generically labeled 'telemedicine'; and (4) The use of ICT to inform the general population of health and healthcare. Yusuf et al. (2008) also present an overview of the evaluation of health informatics and information systems. They undertake a critical appraisal of selected HIS and IS evaluation frameworks in order to identify HIS evaluation dimensions and measures. The frameworks are compared based on their inclusion of human, organizational and technological factor, and the results indicate that an increasing number of evaluation studies deal with two distinct trends of HIS, one of which considers human and organizational issues, while the other is concerned with the employment of a subjectivist approach.

2.3 Multimedia Design

With multimedia technology, the health care application can be produced in a very interesting, entertaining, and lifelike manner. Especially, the features of internet multimedia can contribute to reinforcing visualization, arousing attention and feedback, emphasizing intensification, showcasing information, and developing visual cues. Nevertheless, what are the design modules or guidelines for a successful educational multimedia design? The guidelines provided by Huang (2005) on best practice consist of five phases: (1) Understanding the learning problem and the users' needs; (2) Designing the content to harness the enabling technologies; (3) Building multimedia materials with web-style standards and human factor principles; (4) User testing; and (5) Evaluating and improving the design. Indeed, choosing the appropriate media is critical for designing an efficient web-based learning system.

Designers make use of pictures, animations, music, and video clips to replace a great deal of text-based information. Mayer, R. E. (2005) conducted a review of research on the design of multimedia information and concluded that multimedia could have 10 beneficial effects if used correctly. These are outlined as follows: multimedia effect, modality effect, coherence effect, segmentation effect, signaling effect, spatial ability effect, temporal contiguity effect, redundancy effect, worked example effect and personalisation effect.

2.4 Interface Design

What are the key issues for effective Human-Computer Interaction (HCI)? Alison J. Head. (1999) suggests that the following three seminal HCI basics are conceptual anchors in a design evaluation template: (1) Task support: audience, user goals, functionality, control; (2) Usability: learnability, navigation, assistance; and (3) Aesthetics: appearance, interaction, enjoyment. Rajiv et al.(1997) mention that

interactive technologies share many properties with other traditional media, and they propose the key interactive technology attributes in health promotion as follows: multimodality, networkability, temporal flexibility, segmentation capability, interactivity, sensory vividness, modifiability, availability, cost, and ease of use.

On the other hand, what points should interactive designer and program developer focus on? Yamamoto & Nakakoji (2005) discuss the following four issues in support of the early stages of design based on theories in design and human–computer interaction: (1) The available means of externalisation influence designers in deciding which courses of actions to take; (2) Designers generate and interact, not only with a partial representation of the final artefact, but also various external representations; (3) Designers produce externalisations to express a solution as well as to interpret the situation; and (4)A design task proceeds as a hermeneutic circle—that is, designers proceed with projected meanings of representations and gradually revise and confirm those meanings.

3 Methods

3.1 Research Methods

This research was implemented in three stages. Firstly, the Chinese keywords, "兒童 保健網" and the English keywords, "children's health website" were entered into Google to search for the 20 most popular Chinese and English-speaking websites. Secondly, existing literature was reviewed to ascertain the critical category and evaluation guidelines for designing children's eHealth. Thirdly and finally, a selection of these websites from China, Taiwan, the UK, and the US were evaluated by using a content analysis methodology, applying the criteria developed from the literature review.(re-shown below).

Before undertaking the formal coding, this research was implemented by performing a pre-test with two encoders, which randomly drew five samples from each nation. A total of 20 websites were reviewed and critiqued in advance, and having completed the pre-test, uncommon information elements, media effects and interface elements were discussed and deleted, and critical categories and definitions were revised. In addition, the two encoders carried on formally coding, reading the 40 effective samples of the selected websites separately, and conducted the formal review, critique, and logging.

3.2 Research Criteria

The general criteria used in information design are as follows: (1) Authoritative: management data, such as the website governor's name, website contact address, website contact telephone number and the E-mail address of the managing person should be clearly recorded on the website; (2) Attribution: articles published on the website should clearly note the author's name, author's professional title, and author's service organization; (3) Advertising policy: advertising should be clearly distinguishable from the editorial content of the website; (4) Maintenance: articles published on the website should note their publication date or recently modified date

to prove that they are current and up-to-date; (5) Recognition: information provided on the website should be concise for reading and understanding; (6) Personalisation: to meet the target audience's needs, the information content should be divided into several unique classifications; (7) Discussion: the website should provide a discussion area for users to communicate with each other; (8) On-line consultation: the website should cooperate with related medical institutions or hospitals to provide professional health consultations on-line.

The general criteria used in multimedia design are as follows: (1) Modality effect: users learn more effectively from different media synchronously; (2) Temporal Contiguity Effect: users learn more effectively when the related picture and text are presented on the screen; (3) Segmentation effect: users learn more effectively from divided sections rather than complete information; (4) Spatial ability effect: users learn more effectively when printed words are placed near to, rather than far away from, corresponding pictures; (5) Signal effect: users learn more effectively from metaphoric signs rather than explanatory text; (6) Conversational effect: users learn more effectively when words are presented in conversational rather than formal style; (7) Coherence effect: users learn more effectively when extraneous material is excluded rather than included; (8) Redundancy effect: users learn more effectively from one medium instead of numerous media.

The general criteria used in interface design are as follows: (1) Visualisation: the appearance of the website should be aesthetic to attract the attention of potential users; (2) Cognitive Load: the classification of the content of the website should be easy to search to save users' browsing time; (3) Consistency: the style of subject, colour and background should be designed consistently on the same page to avoid users getting lost; (4) Clear links: the selection buttons should be clearly designed and aligned so that users can see where they have come from and where they are going at a glance; (5)User control: to satisfy the user's desire for control, different processing paths should be designed so that users can choose their own operation; (6) Fast feedback: the website should download quickly and recover efficiently after users' interaction to ensure that they do not give up searching; (7) Operating note: an explanation of the selection buttons should be given beside the buttons to direct users where to go; (8) Advance technology: the operating functions should use recent advances in computer technology to help users to recognise the fast-growing electronic health field.

3.3 Reliability Analysis

Scholars, Wimmer & Dominick (2000), indicate that if mutual agreement is created when independent encoders use the same encoding tools to encode the same contents, this means reliability among encoders. Kassarjian (1997) proposes that, if the reliability coefficient of the content analysis reaches 0.85, the standard is acceptable. In cases where it is less than 0.8, the reliability of the research will be doubted. This study uses the method of reliability analysis proposed by communication scholar, Yang (1993), who develops a reliability formula of content analysis from two encoders as follows:

Reliability = 2 × Mutual Agreeableness / [1 + (2-1) Mutual Agreeableness]

Mutual Agreeableness = 2 × two encoders are in agreement / [the numbers of encoder 1 should agree + the numbers of encoder 2 should agree]

There are 40 effective samples of the selected websites, which is the total number coded. 36 number two encoders agree with the testing of the information design. Therefore, Mutual Agreeableness = 2×36/ (40+40) = 0.9, reliability = 2×0.9 / [1+(2-1)×0.9] = 0.95 ; 32 number two encoders are in agreement with the testing of the multimedia design. Therefore, Mutual Agreeableness =2×32 / (40+40) = 0.80, reliability = 2×0.80 / [1+(2-1)×0.80] = 0.89 ; 33 number two encoders are in agreement with the testing of the narrative style. Therefore, Mutual Agreeableness =2×33/ (40+40) = 0.83, reliability = 2×0.83 / [1+(2-1)×0.83] = 0.91. Thus, all three kinds of testing reliability are more than 0.85, which means that the reliability of this research is confirmed.

3.4 Data Analysis

The results reflected in Table 1 indicate that, in the East, 'Authoritative' is ranked first, with a 75% frequency of use, followed by 'Advertising Policy', 'Recognition', 'Personalisation 'and 'Online Consultation', which are evenly dispersed across various websites. Nevertheless, the other information design elements are not popular, with frequencies below 50%. In the West, 'Authoritative' and 'Advertising Policy' are ranked first, with the highest frequencies of use reaching 100%. These are followed by 'Attribution', 'Maintenance', 'Recognition' and 'Personalisation', all of which have a frequency of more than 60%. However, 'Discussion' and 'Online Consultation' are never seen.

Table 1. Information Design

Category	Elements	East		West	
		Unit	Average	Unit	Average
Credibility	Authoritative	15 (75 %)	50 %	20 (100%)	90%
	Attribution	4 (20 %)		14 (80 %)	
	Advertising Policy	12 (60 %)		20 (100%)	
	Maintenance	9 (45 %)		14 (80 %)	
Users' Needs	Recognition	12 (60 %)	50 %	14 (80%)	35 %
	Personalisation	10 (50 %)		12 (60 %)	
	Discussion	8 (40 %)		0 (0 %)	
	Online Consultation	10 (50 %)		0 (0 %)	

The results reflected in Table 2 indicate that, in the East, 'Segmentation' is the most welcome effect, with the highest frequency of use reaching 100%. Nevertheless, other multimedia design effects are not popular, and have a frequency almost below 50%. In the West, 'Segmentation' is the most welcome effect, with the highest frequency of use reaching 100%, and this is closely followed by 'Signal' and 'Spatial ability', with frequencies of use of 90% and 80% respectively. Then 'Modality' and 'Temporal Contiguity' are also familiar, since their frequency of use reaches 60%. However, 'Conversational', 'Coherence' and 'Redundancy' are uncommon, since their frequencies of use are no more than 40%.

Table 2. Multimedia Design

Category	Effects	East		West	
		Unit	Average	Unit	Average
Demonstration	Modality	8 (40 %)		12 (60%)	
	Temporal Contiguity	8 (40 %)	55%	12 (60%)	75%
	Segmentation	20(100 %)		20 (100%)	
	Spatial ability	8 (40 %)		16 (80%)	
Humanity	Signal	10 (50 %)		18 (90%)	
	Conversational	8 (40%)	40%	6 (30%)	50%
	Coherence	7 (35 %)		8 (40%)	
	Redundancy	7 (35 %)		8 (40%)	

The results reflected in Table 3 indicate that, in the East, 'User Control' and 'Fast Feedback' are the winners, with the same frequency of use reaching 75%. Then 'Visualisation' and 'Consistency' are also familiar, since their frequency of use reaches 50%. Nevertheless, the other interface design elements are not popular, with frequencies below 50%. In the West, 'Consistency' and 'User Control' are the winners, with the highest frequency of use reaching 100%, and these are closely followed by 'Cognitive Load' and 'Clear links', with the same frequency of use of 90%. Therefore, 'Visualisation', 'Fast Feedback' and 'Advance technology' are evenly dispersed across various websites, while 'Operating Note' is seldom used.

Table 3. Interface Design

Category	Elements	East		West	
		Unit	Average	Unit	Average
Appearance	Visualisation	10 (50%)		16 (80%)	
	Cognitive Load	8 (40%)		18 (90%)	
	Consistency	10 (50%)	45%	20 (100%)	90%
	Clear links	8 (40%)		18 (90%)	
Methodology	User Control	15 (75%)		20 (100%)	
	Fast Feedback	15 (75%)		12 (60%)	
	Operating Note	6 (30%)	50%	4 (20%)	60 %
	Advance technology	5 (20%)		12 (60%)	

4   Discussion and Conclusion

This study finds that the content of children's health websites can change with the different motives of health councils and clinical services, strategies, and the media, and the formats of children's health websites in the East and West are different. In terms of information design, credibility is better presented in the West than in the East, since the difference between frequency of use reaches 40%. On the other hand, users' needs are better presented in the East than in the West, with a 15% higher frequency of use. In terms of multimedia design, demonstrations and humanity are better presented in the West than in the East, with a higher frequency of use of 20% and 10% respectively, and the segmentation of demonstrations is valued by the East and the West, since their frequency of use both reach 100%. In terms of interface design, the West presents a better appearance than the East, since the difference of

frequency of use reaches 45%. Methodology is valued by both the East and the West, and user control is especially ranked as the most popular methodology, both in the East and the West.

Further differences between the East and West were observed, the information and design interface produced in the East has obviously fallen behind that presented in the West because of the development of scientific technology and economic circumstances. For example, advertising text occupies almost the whole layout in China, which may increase users' cognition load and mislead patients' treatment decisions. On the other hand, Hi-Tec multimedia design also occupies the whole screen of a site from Taiwan, which may decrease the amount of explanatory text and increase the cognitive load. Also, health information on both sides similarly lacks periodic renewal, and in the West, it is probably because of concern for ethical policies and cultural competence, that the substantial evidence and on-line consultation apparently neglects users' needs. For example, the medical or health information provided in the US is too professional for the ordinary user to understand, and too much space is devoted to answering patients' questions, whereas the medical or health information given in the UK is too complex, and concentrates too much on responding to the race problem. On-line consultations and solid examples are similarly not offered by these two countries. Thus, this research recommends improvements, such as the reduction of on-line advertising space in China, and the reduction of Hi-Tec multimedia design in Taiwan. Also, general terms should replace the professional terms in the US, and simplified text-based content should be used in the UK rather than the current complex content.

The eHealth Design is included in the fields of cognitive psychology, information science, health education, mass communication, and computer science. However, this study is limited to the factors of manpower, time and resources, and simply seeks to analyze the data from the most popular 20 Chinese and English-speaking websites from the provider's perspective, in order to explore the strategies, media, and forms of children's health websites. In order to present a holistic picture of children's eHealth design, perhaps future research could be extended to different issues from the user's perspective, such as a usability evaluation of children's health care websites, the ethical policies of health care application, and literacy competence in terms of children's health information. These are subjects which may benefit from an in-depth discussion in the future.

References

1. Head, A.J.: Design Wise: A guide for evaluating the interface design of information resources. Information Today, Medford (1999)
2. Brubken, R., Plass, J.L., Leutner, D.: Direct Measurement of cognitive load in multimedia learning. Educational Psychology 38(1), 53–61 (2003)
3. Dansky, K.H., Thompson, D., Sanner, T.: A framework for evaluating eHealth research. Evaluation and Program Planning 29(4), 397–404 (2006)
4. Horn, R.E.: Information design: Emergence of a new profession. In: Jacobson, R. (ed.) Information Design, pp. 15–33. MIT Press, MA (1999)

5. Hsu, C.J., Chang, P.C.: Applying the graphical relational representation technique to represent healthcare web information: taking the query and representation of SARS web information as an example. The Journal of Taiwan Association for Medical Informatics 16(3), 21–34 (2007)
6. Huang, C.: Designing high-quality interactive multimedia learning modules. Computerized Medical Imaging and Graphics 29(2-3), 223–233 (2005)
7. Jacobson, R.: Introduction: Why information design matters. In: Jacobson, R. (ed.) Information Design, pp. 1–10. MIT Press, MA (1999)
8. Kassarjian, H.H.: Content Analysis in Consumer Research. Journal of Consumer Research 1(4), 8–18 (1997)
9. Lee, Q.R., Wei, P.X., Shi, Y.F.: Human-Computer Interface Design. National Open University press, Taipei (1998)
10. Mayer, R.E., Moreno, R.: Nine ways to reduce cognitive load in multimedia learning. Educational Psychology 38(1), 43–52 (2003)
11. Mayer, R.E.: Cognitive theory of multimedia learning. The Cambridge handbook of multimedia learning. Cambridge University Press, Cambridge (2005)
12. Oermann, M.H., Gerich, J., Ostosh, L., Zaleski, S.: Evaluation of asthma websites for patient and parent education. Jour. of Pediatric Nursing 18(6), 389–396 (2003)
13. Rajiv, N.R., Flora, J.A.: Interactive technology attributes in health promotion: practical and theoretical issues. In: Health Promotion and Interactive Technology: Theoretical Applications and Future Directions, pp. 19–37. Lawrence Erlbaum Associates, London (1997)
14. Wyatt, J.C., Wyatt, S.M.: When and how to evaluate health information systems? International Journal of Medical Informatics 69(2-3), 251–259 (2003)
15. Yusof, M.M., Kuljis, J., Papazafeiropoulou, A., Stergioulas, L.K.: An evaluation framework for Health Information Systems: human, organization and technology-fit factors (HOT-fit). International Journal of Medical Informatics 77(6), 386–398 (2008)
16. Yamamoto, Y., Nakakoji, K.: Interaction design of tools for fostering creativity in the early stages of information design. International Journal of Human-Computer Studies 63(4-5), 513–535 (2005)
17. Yang, X.R.: Communication Research Methods. San-min, Taipei (1991)
18. Fox, S., Jones, S.: The social life of health information, Pew Internet & American Life Project (2009),
http://www.pewinternet.org/Reports/2009/
8-The-Social-Life-of-Health-Information.aspx? (retrieved)