Developing Interactive Design for Educating Childhood Cancer Awareness

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Abstract **– Current websites specific to childhood cancer still lack approachable design. The interface and layout are unattractive with inappropriate and limited multimedia elements, making the information dissemination to the user ineffective. Hence, this study aims to develop an interactive infographic website to educate childhood cancer named i-Hope. The objectives are to identify and implement suitable multimedia and interactive features, integrate them with the appropriate interaction design and approach in producing the website. The methods comprise five phases: analysis, design, development, implementation and evaluation. This paper discusses the development and evaluation of the website in attracting users' interest in childhood cancer.**

Keywords – interaction, infographic, multimedia, online information, cancer.

1. Introduction

Nowadays, with the rapid creation of unique and innovative products, computer technologies have become more and more important in our daily lives.

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Computer technologies have reshaped the world in a new era in teaching, learning and disseminating information.

The use of various technologies is not limited to distributing information, news, entertainment, business, education and medical but also as human interaction and communication medium.

One of the engaging technologies is multimedia. Multimedia plays a vital role as its elements comprising text, graphics, audio, video and animation can produce an interesting, engaging, creative and efficient presentation of information compared to texts alone [1]. Multimedia technology has become popular and widely used to enhance learning rate and increase learner concentration, interaction and engagement in the learning activity [2] and digital environment.

From the context of computer systems, multimedia technology is a presentation tool of information such as text, image, animation, audio and video. When the mediums are integrated into a program, it will produce an interactive process based on computer technology and is very effective for use as an intermediary of communication in the delivery of information. It can transform the traditional way of delivering information and news through printed materials to digital forms such as electronic newspapers, magazines, and electronic readings readily available online today.

One example of a medium of online information delivery is a website. The website should be exciting and easy to access for providing maximum satisfaction to the users. Creative interface design with interactive features that enable users to control the movement of the website should be considered, designed and implemented. The interface design should assist users in accessing relevant information without relying on their memory and visual solid attention to the interface [3].

1.1. Childhood Cancer

One of the chronic diseases in Malaysia is cancer which is a significant cause of death [4] that

contributes to 13.02% and 25.53% of deaths in MOH hospitals and private hospitals, respectively. Several types of cancer are common to children - leukemia, brain cancer, lymphoma, bone cancer and germ cell tumors [5]. Most child cancers are caused by DNA that changes during the early days of childhood and sometimes before they are born. The lack of exposure to child-borne cancer can be harmful to children as we are less sensitive to the symptoms. This causes the failure of detection at an early stage of cancer. When a child's cancer-related illness fails to be detected in the early stages, it is hard for the parents or guardians of children to accept the fact that their child has cancer. Most families are in the denial phase of their child's illness. According to psychology, there are five phases of sadness and loss: denial and isolation, anger, supply, depression and acceptance [6]. Someone became too sad and disappointed with the news. At that point, due to emotional disturbance, the importance of information about the procedure of child care cannot be effectively communicated and delivered.

Hence parents or guardians should be provided with an alternative medium as a reference after returning home. Therefore, creating an interactive infographic website on childhood cancer could facilitate parents or guardians in enhancing their knowledge and awareness to understand the child's cancer.

The rest of the paper is organized into sections of motivation with aim and objectives; related works about the interaction design and interactive infographic; methods explaining the conceptual model and development of the i-Hope website's interfaces; results and discussions of the evaluation on the i-Hope website; and finally conclude with the future works and conclusions.

2. Motivation

Nowadays, society is more focused on the use of gadgets such as smartphones, computers and tablets. Current websites and applications, specifically on childhood cancer still lack approachable design and appropriate multimedia elements' layout. Information on child cancers is a heavy information material and needs great attention and focus in order to make the users understand the information presented and delivered. Hence, over-textual texts in today's mobile websites and mobile apps are inappropriate and make the vital information available unattractive and ineffective. The interface does not attract the interest and attention of the targeted user.

While multimedia elements focus only on one or two elements, it makes information dissemination ineffective. Inappropriate use of multimedia elements will damage the system's overall function and will not benefit the user. In other cases, multimedia elements embedded in the software's interactive environment sometimes cannot provide a presentation that is interesting and motivating enough for users to use it [7]. Humans learn better using words and images than words alone. According to [1], study results show almost everyone believes interactive images and texts can improve understanding of reports made rather than text-only use. Interactive elements such as infographics allow users to feel complete control over the system, the application or the explored website. Users are free to explore according to their own will, preference and comfort.

Since parents' emotions and psychology are disturbed by news of their child's illness, important information about how to take care of their cancer children, symptoms, and taboo of a cancer sufferer cannot be conveyed because they are in denial states and emotional [8].

The usability of health websites is an important factor in the health domain. Although more and more websites are being developed in the health domain, many websites face usability issues [9]. Most existing websites do not focus on usability in terms of the design and layout of appropriate multimedia elements, which leads to difficulties for users to interact with the website. Four main issues related to the usability of websites are inconsistent, image usage, site design and inappropriate use of colors [10]. These issues may affect the design unattractive and confusing. Subsequently, this causes the diversity of information to be disseminated ineffectively. Design and layout of graphics and texts for an inappropriate website also cause users not interested in staying further to read on the website.

Therefore, this study is conducted to provide a new approach to a more efficient and effective way of educating and promoting childhood cancer awareness in health issues for the public, especially parents or caregivers of the cancers patients.

2.1. Aim and Objectives

The study aims to develop an interactive infographic website in educating childhood cancer awareness called i-Hope. The objectives are:

- To identify and integrate suitable interaction design components and multimedia elements (infographics) with appropriate approaches and principles;
- To design a conceptual model and develop a website based on the conceptual model;
- To evaluate the interaction design and interactivity of the website.

3. Related Works

This section discusses on interaction designs and interactive infographics as the focus of the paper.

3.1. Interaction Design

According to [11], interaction is a transaction between two entities, exchanging information, products and services. Interaction design is the structure and operation of an interactive system designed to support and help users learn and do their daily tasks and life.

The design is not just designed with an interface function acting on the given command, but it also works to take action as it directs users in adaptation when using a technology application. An interface that can adapt to the individual usage style is a characteristic that shows the design meets users' needs while operating the application [12]. Designers need to understand the user background of each design of the pre-generated application to identify users' expectations and the expectations of the system [13]. Hence could determine how to meet the needs of users. Therefore, every interaction needs a meaningful relationship between the user and the product and service used.

In order to ensure that the design of the interaction is successful, various disciplines need to be involved in the process of building a design. Understanding how users react when communicating and interacting with applications may include the participation of experts such as psychologists and sociologists. The element of user understanding is the ability to identify and identify metaphors [14]. While understanding how to design interactive media, the development also involves graphic designers, animators, photographers, filmmakers and product designers. Interaction design consists of five elements [15]: text communication, visual, object and space, time and behavior. Each element is discussed below:

- The first element is text communication. It is the basis for interaction as text is a significant component of ensuring communication online takes place effectively. From a design perspective, the text is often overlooked as an almost secondary element, but it affects and is influenced by the design. The text used will impact the overall effect of interaction. The use of the text should be as user-friendly and straightforward as every word brings a lot of meaning. The use of texts should be consistently applied to every display or product to avoid confusion [16]. Text is so important that it can increase or disable the basis of interaction [13].
- The second element is visual. In addition to texts, humans often interact with visuals. Visuals refer to non-word elements in a product, ad, app, diagrams, icons and typography. Visual is also an element that is as important as text where the user can process images in a short time. The use of visual elements needs to be appropriate and not excessive so that the users are comfortable and do not confused.
- The third elements are object and space. This element refers to the physical device used by the user when interacting, such as mobile devices, computers, and other systems. Other physical devices examples are keyboards, mice, touch screens, and many more. Text, visuals and objects and spaces determine user's interactions, providing tools and substantial feedback to guide their actions and enable the solution of a user's goal [16].
- The fourth element is time. Defined as the period used by the user to interact with the first three elements discussed earlier [15]. Time is crucial and needs to meet user's expectations. If interactions take a long time from anticipation, users will consider the system corrupted and question the usability of the entire system.
- The fifth element is behavior. It involves the user's behavior when interacting with the system interface. It also deals with user's experience emotions and reactions when interacting with the system. This includes how the system responds to the interaction and whether the user is happy.

3.2. Interactive Infographic

Infographic, an acronym for information graphic, is a complete graphic visual presentation or story in delivering complex data, information or knowledge quickly and clearly. Infographic is a computer-generated interactive visual presentation to strengthen cognitive activity [17]. The purpose of infographics is to communicate key messages engagingly [18]. Infographics should be informative, practical and functional as expected. In 1980 the infographic is used in newspapers, magazines and reports. In the development of the digital era, the use of infographics spread across multiple domains where data and information need to be processed efficiently and quickly. Users are now only reading the headlines and graphics that interest them before continuing to read the entire content. As in education and training, [19], [20] uses infographics to make learning more engaging and understandable. Similar to the medical industry, infographics are essential for attracting and raising public knowledge of health issues [21].

Infographic means simple text, attractive interface design and logical graphics that are combined to produce better information. With the advancement of

technology and access to the internet, interactivity is added to how information is delivered. There are two types of an infographic which are static and interactive. In static infographic, printed or online, the information is fixed and user's interaction is limited only to seeing and reading. In contrast, interactive infographics can convey more information as user's interaction involves which and how much information to view [22].

To design education, designers should be aware of three parts of infographics: knowledge, visuals and content [23]. Among the features of interactive infographics is that it can hide and show details of information when needed, add animated elements and information can be updated automatically to ensure that information is relevant from time to time. Furthermore, the interactive infographic also indirectly increases the user's interest in staying even longer while using the medium of information delivery.

4. Methods

The development is adapting the integration of ADDIE and Interaction Design Model, which comprises of five phases: analysis, design, development, implementation and evaluation. In order to achieve the aim and objectives, a conceptual model is designed and an interactive infographic website is developed and evaluated. The design of the i-Hope website is based on the conceptual model.

4.1. The Conceptual Model

The conceptual model is developed earlier from the literature review, the interview with families of cancer patients' and survey results from the interface experts in the preliminary study. Figure 1 shows the conceptual model of the i-Hope website.

The conceptual model integrates Gestalt Theory [24], Multimedia Learning Cognitive Theory [25] and Client-Centered Theory [26] for motivation and psychology aspect. Based on the conceptual model, the website storyboards and interfaces design are developed. Each of these elements is considered in the development of i-Hope website. In the process of designing a multimedia application, there are three main phases of work involved, namely information design, interaction design and interface design [27].

4.2. The i-Hope Interfaces

The i-Hope website is developed in Malay as it is meant for Malaysians. So all text used in the interfaces is in Malay. The main modules interface consists of:

- Cancer Information Module;
- How Cancer Spread Module;
- Common Children Cancer Module;
- Cancer's Factor and Risk Module.

The supporting modules of the i-Hope website are:

- Supporting Organizations for Cancer Module;
- Share Your Feeling Module.

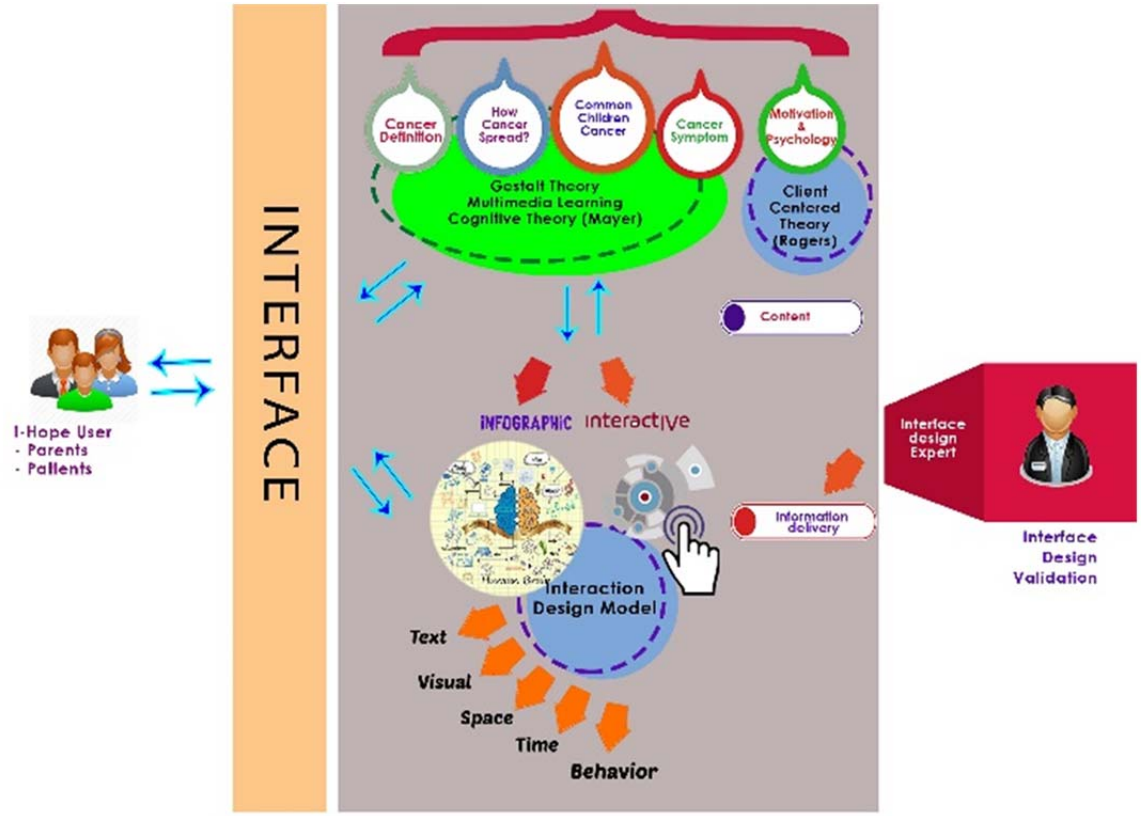

Figure 1. Conceptual Model

Figure 2 shows the i-Hope website's main interface, consisting of four main modules and two support modules. All six modules use interaction design and infographics as the method of information delivery.

Figure 2. Main page of i-Hope website

The navigation button is available in each module page to ease the user's navigation to the main page anytime they want or anywhere they are.

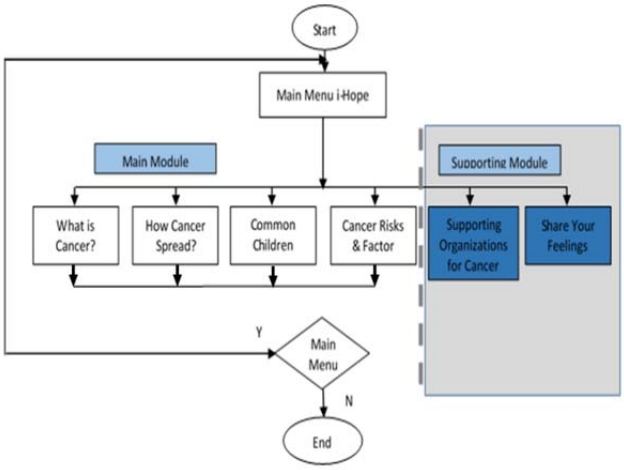

Figure 3. i-Hope Main Navigation Flow

Figure 3 shows the main navigation diagram that describes the entire flow on the i-Hope main page. It displays all modules found on the i-Hope website. Navigation can be interpreted in multiple ways and is an essential part of a website that allows the website to be organized appropriately and systematically.

Figure 4 shows the infographic in cancer information module. The language is in Malay as shown on the page which in English means – What is Cancer? The page will explain in detail the definition of cancer and how cancer can happen. The information is given in graphics and text to support the same message.

Figure 4. Infographic in Cancer Information Module

Figure 5. Infographic in Common Children Cancer Module

Figure 5 shows the infographic in the common children's cancer module. There are five types of cancer to choose from for further info. Once clicked, the infographics of related cancer will appear.

Figure 6. Infographic in Share Your Feeling Module

Figure 6 shows the infographic in one of the support modules, the Share Your Feeling Module. The page shows concern with the feeling of the family or patients involved.

4.3. Evaluation Method

The purpose of the i-Hope website evaluation is to measure the degree of usability of interaction designs for interactive infographics in the delivery of information about childhood cancer. Evaluation is conducted to verify that the i-Hope website uses appropriate interaction and multimedia elements integrated with suitable approaches such as counseling and motivational elements to encourage parents and patient caregivers.

- Instruments

The evaluation used a descriptive method and the survey is constructed based on users' satisfaction in interaction design [28] and HCI usability [29]. The survey consists of three sections: A, B and C. Section A and B are formed using the Likert scale 1 - 5 as shown in Table 1. Section C uses open questions.

Table 1. The Evaluation Likert Scale

Likert Scale	Interpretation
5	strongly agree
4	Agree
3	not sure
2	Disagree
1	strongly disagree

Part A is used to evaluate the usability of system interaction design. Respondents are required to answer thirteen questions related to interaction design, infographics and multimedia. Part B measures the system interactivity. Respondents are required to answer eight questions related to the interactivity provided on the i-Hope website. And part C is a general question for future opinions and improvements. Respondents are required to answer four questions related to respondents' satisfaction and give views and recommendations on the i-Hope website.

- Sample

Based on purposive sampling, 20 respondents were involved in this study, and they were from the Kolej Kemahiran Tinggi MARA Rembau. The respondents consist of ten (10) User Interface Design students, five design expert lecturers and five persons who were associated with cancer patients.

5. Results and Discussions

The evaluation is conducted successfully and results are obtained and analyzed. This section will discuss the results and findings. The mean score interpretation are based on [30] as shown in Table 2, is used for descriptive analysis of interaction design and infographics in Table 3 and interactivity in Table 4.

Table 2. The Mean Score Interpretation

Mean Score	Interpretation
4.51 to 5.00	Excellent
3.51 to 4.50	Very Good
2.51 to 3.50	Good
1.51 to 2.50	Fair
1.00 to 1.50	Poor

5.1. Section A: Interaction Design

Table 3 shows the analysis result of the study for the i-Hope interactive design component, which includes infographics. There are thirteen items related to this component where each item shows a mean score result from 4.30 to 4.70, interpreted as very good and excellent.

Table 3. Results of the research findings on the interactive component of the i-Hope

No	Item	Cat	Mean Score	SD	Interpretation
1	The system interface helps me easily reach the desired information.	ID	4.60	0.598	Excellent
2	This system has all the functions and abilities as expected.	ID	4.65	0.587	Excellent
3	The interface layout is suitable.	ID	4.60	0.503	Excellent
4	Interface designs match the content and target users.	ID	4.50	0.513	Very good
5	I feel the color used is suitable.	ID	4.65	0.587	Excellent
6	I like to use this system interface.	ID	4.50	0.513	Very good
7	The system response to each interaction is satisfying.	ID	4.30	0.571	Very good
8	I enjoyed using this system.	ID	4.70	0.470	Excellent
9	Interface designs and icons used are consistent.	ID/ IG	4.50	0.607	Very good

10	Mixed text and visual info are suitable.	IG	4.60	0.598	Excellent
11	The graphics used are suitable and acceptable.	IG	4.65	0.489	Excellent
12	The information provided is clear.	IG	4.70	0.470	Excellent
13	All the terms used are easy to understand.	IG	4.60	0.503	Excellent
	Overall average		4.58		Excellent

As shown at the bottom of the table, the average for the overall analysis result of the mean score is 4.581 representing excellent. The analysis result is divided into two categories (Cat): interaction designs (ID) and infographics (IG).

For interaction design, the item focuses on how the interaction is done between the user and the system. It also focuses on how the system responds to the users and vice versa. The results show an excellent indicator for items 1 and 2 that the system interface has the functionality and capabilities expected by the users, which helps them easily access the needed information. The discreet and appropriate display arrangements help respondents achieve the desired information easily and quickly.

The use of colors applied on the website is also proper for the respondent. The mean score of 4.65 represents excellent. Respondents were also satisfied with the response given in every interaction (mean score of 4.30 represents very good). They strongly agreed to enjoy using the system, which indicates that a mean score of 4.70 represents excellent.

For the infographic category, the questions focus on whether the information delivered is understandable or not. The infographic category shows the result of the mean score of 4.50, which represents very good for item 9. The interface design and the infographic approaches with icons used in the website are consistent. Each item 10-13 with means scores of 4.60, 4.65, 4.70 and 4.60 respectively, represents excellent for each infographic design used in the website. These indicate the respondents strongly agreed with the suitability of text and visual information mixture developed, the precise information provided and the use of easy-to-understand terms, allowing information to be communicated more clearly with text and visual information delivery.

5.2. Section B Interactivity

Table 2 shows the results on the interactivity component of the i-Hope website. There are eight items involved with mean scores from 4.15 to 4.60, which indicates users' satisfaction with the interoperability and interactivity of the i-Hope website. The descriptive analysis results of the interactivity show the overall average of the mean score is 4.41 representing very good.

The respondents can reach and access the information needed in no more than three clicks. The main access is in the main view, where the respondents can get the desired information easily. The buttons provided are clear and not confusing. The website responds according to the instructions given by the respondents. At the same time, the feedback provided by the website is consistent, quick and satisfying. Each item has a mean score from 4.15 to 4.50, representing very good. The provided navigation is as expected and highly acceptable, with a mean score of 4.60 representing excellent.

Table 3. Results of the i-Hope website interactivity

No	Item	Mean Score	SD	Interpretation
1	I can achieve the desired information in no more than three clicks.	4.30	0.571	Very good
2	The key and essential access is on the main display or left side or right of the system.	4.50	0.607	Very good
3	I'm not confused with the button display provided.	4.40	0.598	Very good
4	I can interact with the system (system according to user's instructions).	4.50	0.513	Very good
5	This system gives feedback when clicked.	4.35	0.489	Very good
6	This system gives pop-up message feedback when clicked.	4.15	0.813	Very good
7	I feel the system reacts in a consistent and predictable way.	4.50	0.513	Very good
8	I am satisfied with the navigation of this system.	4.60	0.598	Excellent
	Overall average	4.412		Very good

5.3. Section C General

For this section, 2 items: 1 and 2 use the two-scale answer of the Yes or No scale, while the other 2 questions: 3 and 4 are open-ended questions. Table 4 shows the result for items 1-2. For general questions, items 1 and 2 show that all respondents answered Yes (100%) to show that they are satisfied with the system (the i-Hope website) and are interested in continually using it.

Table 4. Results of the i-Hope website interactivity

No	Question	Min Score	SD
1	I am satisfied with the system	1.00	0.002
2	I am interested in using this system always	1.00	0.003

The respondents could give comments and opinions in text for items 3 and 4. These are regarding the advantages of the website and suggestions for improvements in the future.

In conclusion, the i-Hope website has applied an effective interaction design to deliver child cancer information. The presentation of interactive infographics that combines multimedia elements such as text, visuals and video can enhance the understanding and effectiveness of the information being communicated and delivered. It also demonstrates the importance of an interaction design in ensuring the comfort and excitement of users in browsing the website.

6. Future Works

For future improvement of the i-Hope website, it is suggested to enhance the use and functionality of the multimedia elements. The target multimedia elements are graphics, animation, video and audio that could easily visualize the child-cancer illustrations. At the same time, the audio is capable of giving instruction and explanation. In conjunction with the respondents' feedback, they also suggested that the use of the graphics element is to be added more. And the majority of the respondents recommend that the sound effect elements should be enhance into the i-Hope website.

The multimedia element could enhance the effectiveness and understanding of users to receive information. In addition to the multimedia elements, the i-Hope website content module can also be improved from time to time and updated with the current treatment and discoveries in cancer research. The respondents' feedback suggested that the content modules should be expanded to make the website a one-stop center for all types of child-born cancer. Additional website modules like your feelings page can be improved by putting positive words and motivations in helping to create users' positive feelings and moods.

The next future improvement is developing dynamic interface designs that vary from time to time to prevent users from feeling bored with the same design. The dynamic design can make the website more interesting in the future. The cancer information may adopt virtual and augmented reality technology interaction for a suitable topic to create an interactive digital and communication environment.

7. Conclusion

This study found that people strongly agree that using the i-Hope website could increase awareness and understanding of childhood cancer information. Hence the objectives are achieved and the evaluation shows significant results. The evaluation of the i-Hope website also found that most respondents were very satisfied with the information and functionalities provided by the i-Hope website. They also agreed that the use of infographics and appropriate multimedia elements in the i-Hope website could attract users to use the website regularly.

In conclusion, using appropriate multimedia elements (infographics) and applying suitable interaction design for the i-Hope website interactive infographics can increase respondents' understanding of the knowledge of children's cancer. It is hoped that the i-Hope website will benefit parents/guardians, caregivers, the patient and the public in increasing their awareness and knowledge about childhood cancer and, at the same time, offer experts in providing information and knowledge faster, efficiently and effectively.

References

[1]. Sadigh, G., Hertweck, T., Kao, C., Wood, P., Hughes, D., Henry, T. S., & Duszak Jr, R. (2015). Traditional text-only versus multimedia-enhanced radiology reporting: referring physicians' perceptions of value. *Journal of the American College of Radiology*, *12*(5), 519-524.

[2]. Muda, Z., & Mohamed, R. E. K. (2005, November). Multimedia design and development in mathematics learning courseware for preschool education. In *International Conference on Computational Intelligence for Modelling, Control and Automation and International Conference on Intelligent Agents, Web Technologies and Internet Commerce (CIMCA-IAWTIC'06)* (Vol. 2, pp. 514-517). IEEE.

[3]. Wook, T. S., & Rahim, N. (2016). Designing Multi-Dimensional User Interaction for a Virtual Museum System. *Indonesian Journal of Electrical Engineering and Computer Science*, 4, 649-654.

[4]. Subramaniam, S. (2016). Kenyataan Akhbar Menteri Kesihatan (YBMK) Malaysia: Hari Kanser Sedunia 2016. Kami Boleh, Saya Boleh. Retrieved from: https://kpkesihatan.com/2016/02/04/kenyataan-akhbar-ybmk-4-feb-2016-hari-kanser-sedunia-2016-kami-boleh-saya-boleh/ [accessed: 05 March 2022].

[5]. Hany Ariffin. (2014). Children and Cancer How you and your family can cope with the trauma. Positive Parenting, Pusat Perubatan Universiti Malaya. Retrieved from: https://mypositiveparenting.org/wp-content/uploads/2014/03/Children_and_Cancer.pdf [accessed: 17 March 2022].

[6]. Corr, C. A. (2020). Elisabeth Kübler-Ross and the "five stages" model in a sampling of recent American textbooks. *OMEGA-Journal of Death and Dying*, *82*(2), 294-322. https://doi.org/10.1177/0030222818809766

[7]. Lubis, M. A., Ikwan, I., Sjahrony, A., Lubis, I. F., & Din, R. (2015). Development of Multimedia Supported Qur'anic Language Game Module for National Primary Schools in Malaysia. *Journal of Personalized Learning*, *1*(1), 85-92.

[8]. Corey, G. (2011). *Theory and practice of counseling and psychotherapy*. Cengage learning.

[9]. Saeed, M., & Ullah, S. (2009). Usability Evaluation of a Health Web Portal. Master Thesis. School of Computing, Blekinge Institute of Technology. Sweden.

[10]. Hasan, L., & Abuelrub, E. (2003). Common usability problems on educational websites. In *International Conference on Education and Education Technologies*.

[11]. Saffer, D. (2010). *Designing for interaction: creating innovative applications and devices*. New Riders.

[12]. Ab Rahaman, N. N., Wook, T. S. M. T., & Ashaari, N. S. (2013). Reka bentuk antara muka hipermedia adaptif perpustakaan digital kanak-kanak. *Asia-Pacific Journal of Information Technology and Multimedia*, *2*(2).

[13]. Cao, J., Zieba, K., & Ellis, M. (2015). Interaction Design Best Practices: Mastering the Intangibles. *UXPin, San Francisco*.

[14]. Wook, T. S. M. T., Judi, H. M., Sahari, N., Mohamed, A. H., Noor, S. F. M., & Rahim, N. Interaction Design Model In Virtual Museum Environment. *Asia-Pacific J. Inf. Tech-Nol. Multimed*, 5(1), 71-81.

[15]. Miller, L. (2016). UX Fundamental: Interaction Design. Usabilla. Retrieved from: https://adas.az/uploads/catalog/Files/UX_Fundamentals_The_Concepts_Process_and_Proving_the_Value-min.pdf [accessed: 09 January 2022].

[16]. Smith, G. C. (2007). What is interaction design. *Designing interactions*, 8-19.

[17]. Siricharoen, W. V. (2013, May). Infographics: the new communication tools in digital age. In *The international conference on e-technologies and business on the web (ebw2013)* (Vol. 169174).

[18]. Scott, H., Fawkner, S., Oliver, C., & Murray, A. (2016). Why healthcare professionals should know a little about infographics. *British Journal of Sports Medicine*, *50*(18), 1104-1105.

[19]. Manickam, R., & Aziz, A. A. (2020). The Effectiveness of Using Infographics as an Aid for Reading Comprehension. *Asia Proceedings of Social Sciences*, *6*(3), 226-229. https://doi.org/10.31580/apss.v6i3.1224

[20]. Ishak, A., Din, R., & Mohamed, H. (2018). Usability of ReSt module using four-step approach based on case study example and infographic for SPSS novice users. *International Journal on Advanced Science, Engineering and Information Technology*, *8*(4-2), 1513-1519.

[21]. Sharudin, S. A., Mustaffa, N., & Sannusi, S. N. (2020). Peranan infografik dalam meningkatkan kesedaran kesihatan belia daripada perspektif pereka grafik. *Jurnal Komunikasi: Malaysian Journal of Communication, Jil*, *36*(1), 356-368.

[22]. Dur, B. İ. U., Filipczak-Bialkowska, A., Bresciani, S., Ge, J., Niu, Y., Othman, A., & Wils, D. (2014). Interactive infographics on the internet. *Online Journal of Art and Design*, *2*(4), 1-14.

[23]. Kaya-Hamza, A. T. O. S., & Beheshti-Fezile, F. S. M. (2017). An investigation toward advantages, design principles and steps of infographics in education. *Il Ponte*, *73*(7), 157-166.

[24]. Soegaard, M. (2012). Gestalt principles of form perception: Gestalt Theory of Perception. Interaction Design Foundation. Retrieved from: https://www.interaction-design.org/literature/book/the-glossary-of-human-computer-interaction/gestalt-principles-of-form-perception [accessed: 18 March 2022].

[25]. Mayer, R. E. (2003). The promise of multimedia learning: using the same instructional design methods across different media. *Learning and instruction*, *13*(2), 125-139.

[26]. Rowe, W. S. (2017). Client-centered theory and the person centered approach: Values-based, evidence-supported. *Social work treatment: Interlocking theoretical approaches*, 34-53.

[27]. Abd Rahman, N., & Aris, B. (2009). *Pembangunan Kamus Fizik Interaktif berasaskan Web: Askphysics* (Doctoral dissertation, Universiti Teknologi Malaysia).

[28]. Chin, J. P., Diehl, V. A., & Norman, K. L. (1988, May). Development of an instrument measuring user satisfaction of the human-computer interface. In *Proceedings of the SIGCHI conference on Human factors in computing systems* (pp. 213-218).

[29]. Nielsen, J. (1994). *Usability engineering*. Morgan Kaufmann.

[30]. Doctor, A. C. (2017). Integrated Educational Management Tool for Adamson University. *International Journal of Computing Sciences Research*, *1*(1), 52-71.