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Research paper

Interactive Digital Learning Content of Healthy Food for Children

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Abstract

Since past, parents facing difficulties in introducing the healthy food for their children. Usually, the children setting their mind that healthy food contain a bad taste. The similar situation also faces by teachers in kindergarten or child-care institution, in educating and encouraging the children to eat healthy food. Naturally, most of the children were more attracted to unhealthy food particularly junk food which contains high calories and sugar. Due to that, eating healthy food has to be taught to children since they are in young age particularly in kindergarten to ensure they are keep healthy. Thus, to overcome the problem this study proposes an interactive digital content of healthy food for children namely *Saya Sihat*. The design science research methodology which consists of five (5) phases: (i) problem identification, (ii) content analysis, (iii) design and development, (iv) evaluation, and (v) documentation have been adopted. Meanwhile, user-centered design approach has been utilized throughout the development of the proposed application since it is important for this study to obtain the optimum input from parents and teachers as well as children as the main target users. Testing has been conducted to 30 respondents in terms of the usefulness of multimedia elements integrated in the proposed interactive digital content. It was found that all the integrated elements meet the user needs and the proposed interactive digital content able to evoke the positive mindset of healthy food to children.

Keywords: *Human computer interaction; child-computer interaction; cognitive multimedia theory; interactive digital content; user-centered design approach; healthy food*

1. Introduction

Children are an important asset to the country and health is a crucial part not to be neglected. According to the report from [1], Malaysia is one of the several ASEAN countries that facing coexisting crises of over and under-nutrition among children. Some of them are overweight while the other suffers from malnutrition. The causes of overweight and under nutrition are tangled. Supportive to National Health Morbidity Survey [2], more than 7% of children in Malaysia under than five years old had been identified as overweight. The risk for being overweight derives from the excessive consumption to junk food and drinks, those with high trans-fat or sugar content and low nutritional value [1]. This growing trend significantly contributes to the rising prevalence of chronic diseases such as diabetes and heart conditions. While, malnutrition that happen due to lack of proper nutrition could delay the children development and more prone to illness [4]. Therefore, good nutrition is vital to be taught at kindergarten for children to keep healthy. However nutrition education to the children at kindergarten is still not widely exposed. Hence, an interactive digital content integrated with multimedia elements and cognitive multimedia learning theory can be one of the alternatives medium that could assist teacher to educate the children easily. It is imperative to educate children about good nutrition to prevent chronic disease from a young age.

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2. Nutritional food

In food pyramid there are five groups of food suggested by [3] that should be taken by human (Figure 1). The first groups are rice and cereal products, followed by fruits and vegetables. The third group are meats and legumes, including milk and dairy product. Meanwhile, oil, sweet and salty food is in the last group. Each group has their own of serving guideline which should be taken in a proper amount. It is stated that grains and their products, is able to provide a great source of energy, dietary fiber, vitamins, and minerals. The dietary fiber can help regulate the bowels movements and promote a good health of human body. Fruits and vegetables are a great source of vitamins and phytochemicals to maintain the overall health. In group of fish, meat, poultry, eggs and legumes, they can provide protein, which could build the body's building block as well as repair the muscles and tissues. In addition, milk and dairy product is the important source of protein and calcium which can helps in building a strong bones and teeth for children. Apart from that, oils and fats are not considered as the main food but they play an important roles to provide energy, fat-soluble, vitamins, and essential fatty acids that are needed for the development of brains and eyes for young children. However, too much fats or no fat at all is not a good practice for growing kids [3].

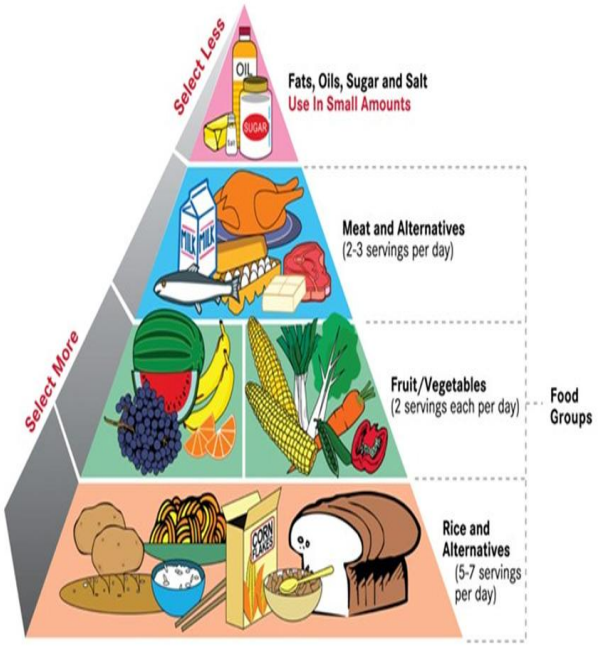


Fig. 1: Food pyramid (Source: [3])

3. Multimedia elements

Multimedia is a term that comes from the Latin word "multus" which means "numerous" and media which means "middle" and "centre". It is also defined as the combination of major elements of multimedia which are text, graphic, animation, video, and audio. These elements are important in education to attract students particularly in learning activity. This is because through multimedia presentation including interactive digital content, the learners are able to be encouraged to have active learning in their learning activities [5]. The elements of multimedia that are integrated in this study are discussed as follow:

3.1. Text

Text is a common tool used in delivering the information. Text acts as the keystone in tying up all of the elements of multimedia. To make the information delivered efficiently, the fonts used must be readable and understandable by the intended user [6]. The appropriate fonts that commonly used to attract the children are Comic Sans, Arial, and Calibri.

3.2. Audio

Audio is one of the attractive elements that can be utilized in delivering the knowledge successfully to the children. According to [7] states that sounds have strong benefits in presenting the material to the younger children. Fun background music and attractive sounds from the instructor could attract the children to stay focus to the learning content.

3.3. Video

Video refer to the electronic medium for the recording, copying and broadcasting the moving visual images [8]. Previous study also state that the use of video in the early childhood education can promote the strong brain development, preparing children for school, building the strong workforce, and economy.

3.4. Graphic

Graphics or images are one of the important elements in multimedia. Graphics can be used as attractive icon to replace text as it is easily to be recognized by the children [10]. In this study the home key is represented by the graphics in the form of icon.

3.5. Animation

There are two types of animation which are 2-dimensional (2D) and 3-dimensional (3D). The 2D occurred at the x-axis and y-axis meanwhile the 3D occurred at x-axis, y-axis and z-axis. These animations give the realistic figures that can be seen through eyes. According to [9], the animation used in the traditional stories can provides a huge knowledge related to actual context.

4. The cognitive theory of multimedia

The cognitive theory of multimedia which introduced by Richard E. Mayer address the issue of the structural of multimedia elements by employing effective cognitive strategies to assist the learners to learn more efficiently. It is integrated and supported with Baddeley's model of working memory, Paivio's dual coding theory, and Sweller's theory of cognitive load. The components of cognitive theory of multimedia are (i) a dual channel structure of visual and auditory channels, (ii) limited processing capacity in memory, (iii) three memory stores (sensory, working, and long term), (iv) five cognitive process of selecting, organizing, and integrating (selecting words, selecting images, organizing work, organizing image, and integrating new knowledge with prior knowledge) (Figure 2). The key element of cognitive theory of multimedia is the meaningful connection that the learners able to build between words and pictures rather that words or pictures alone. The cognitive theory of multimedia has been applied as the foundation in this study particularly in the development of interactive digital content of healthy food for children

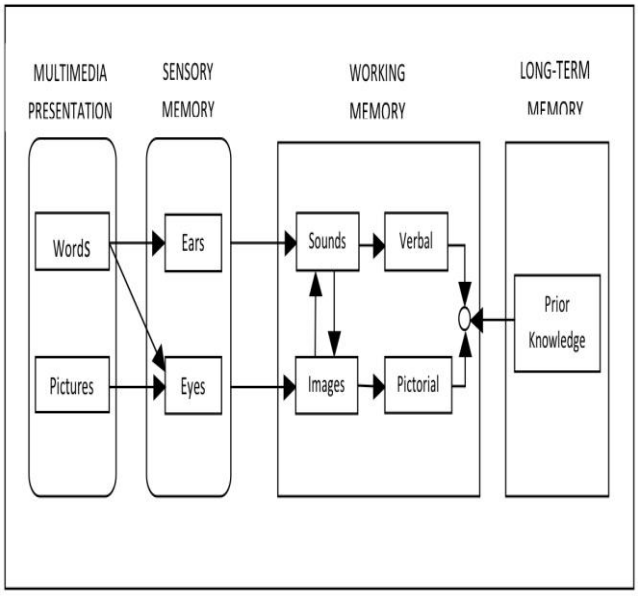


Fig. 2: Cognitive theory of Multimedia [11]

5. Methodology

The design science research methodology by [12] has been adopted in this study as it needs the iterative process particularly in phase 2 to phase 3. As illustrated in Figure 4 the methodology of this study consists of five main phases which are (i) problem identification, (ii) content analysis, (iii) design and development, (iv) evaluation, and (v) documentation. User-centered design approach also has been applied throughout the design and development process which involves teachers and children at kindergarten in phase 2.

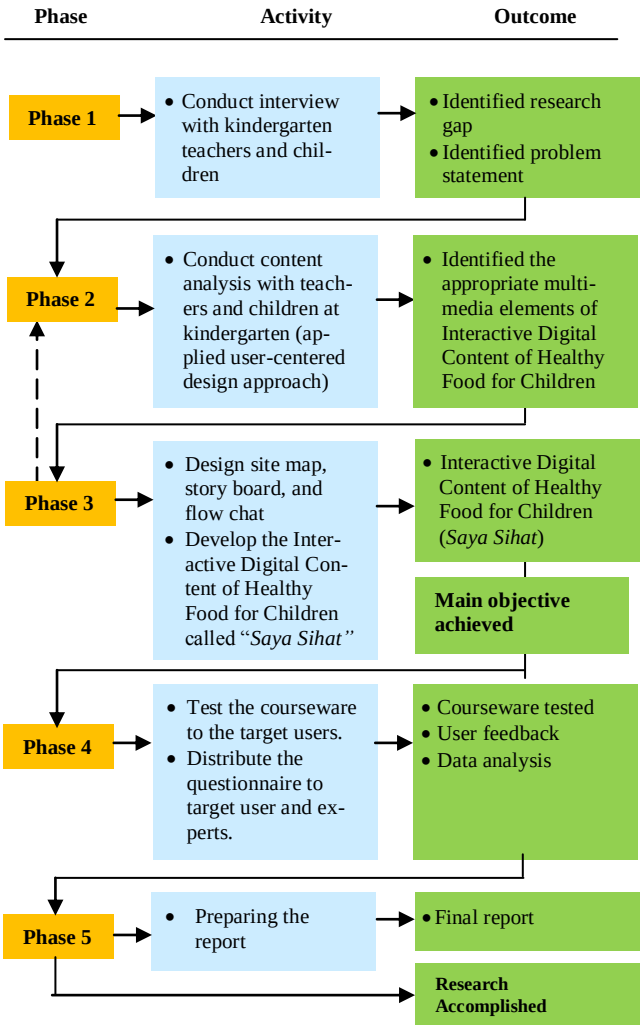


Fig. 3: Research methodology

6. The interactive digital content of healthy food for children (*Saya Sihat*)

Saya Sihat is an interactive digital content which has been developed with integration of multimedia elements to teach children about healthy food particularly at kindergarten. There are five main modules included in *Saya Sihat* which are: (i) *pengenalan*, (ii) *piramid makanan*, (iii) *jom makan*, (iv) *jom main*, and (v) *situasi*. All of the modules in *Saya Sihat* provide text, audio, graphics and animation in order to attract the children attention in learning healthy food. There are six submenu contain under menu *piramid makanan* which are: (i) *ubi-ubian, bijirin, dan nasi*, (ii) *daging, ayam, telur dan kekacang*, (iii) *susu dan produk tenusu*, (iv) *buah-buahan*, (v) *sayur-sayuran*, and (vi) *minyak, gula, dan lemak*. Meanwhile, under menu *situasi* there are two submenu which are: (i) *pasaraya*, and (ii) *rumah*. Menu jom makan provide five submenus. They are: (i) *sarapan*, (ii) *snek*, (iii) *makan tengahari*, (iv) *minum petang*, and (v) *makan malam*. The last but not least menu jom main provide games to the learners in order to motivate them to have curiosity during the learning activities. There are three submenu under jom main which are: (i) *mari makan*, (ii) *mari padankan*, and (iii) *mari mewarna*. Figure 4 demonstrates the site map of *Saya Sihat*.

Next, based on the site map, story board *of Saya Sihat* was designed. All the content gathered from the experts in phase 2 was included in the storyboard (Figure 5 and 6). After getting clear with the flow of the content, the development process took place. The screenshots of Saya Sihat are as exhibited in Figure 7, 8, 9, and 10.

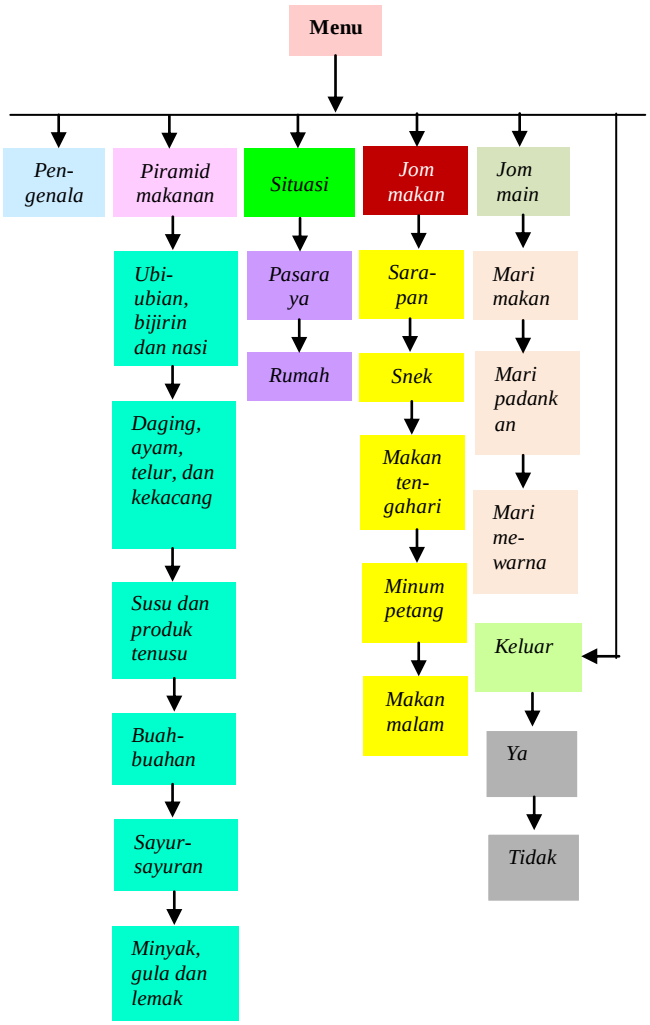
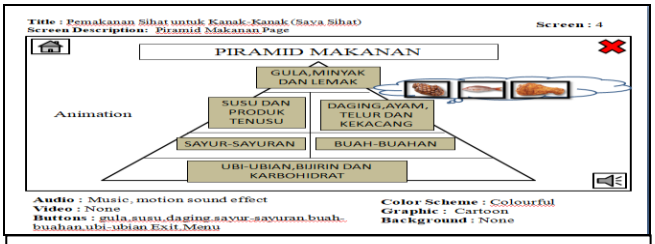


Fig. 4: Site Map of *Saya Sihat*

Description:
Homepage**:** This page contains all the menu of courseware contents.

Fig.5: Sample of storyboard for Homepage



Description:
Piramid makanan: This page contains the categories of the food pyramid

Fig.6: Sample of storyboard for page *piramid makanan*

3.4.1. Figure captions

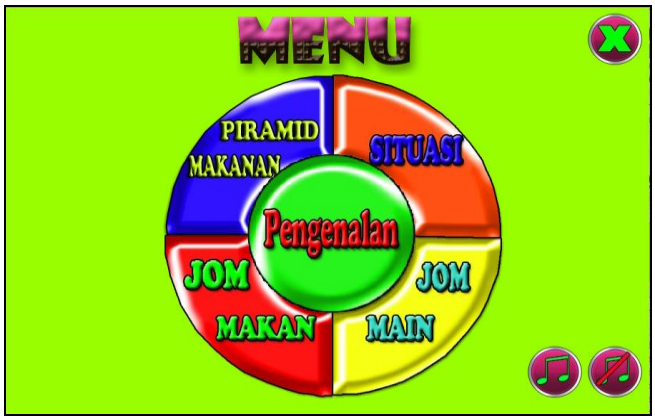


Fig. 7: Sample of screenshot of homepage

Fig. 8: Sample of screenshot for page *piramid makanan*

Fig.9: Sample of storyboard for page *jom main*

Fig.10: Sample of storyboard for page *situasi*

Having developed the *Saya Sihat*, it has to be tested to the intended users to ensure the usefulness of it. Thus, the evaluation phase was discussed in the next section.

7. Results and discussion

During the last phase, user experience testing was conducted by presenting the *Saya Sihat* to the targeted users. The evaluation has been carried out based on the (i) interface of *Saya Sihat*, (ii) navigation, (iii) content, and (iv) usefulness of the multimedia elements provided in the *Saya Sihat*. The results are discussed in the next subsection.

7.1 Interface

The interface of *Saya Sihat* was evaluated in terms of understandable design, color, understandable icon, appropriate design, and interesting design. Table 1 concludes the result.

Table 1: Result of Interface

No.	Item	Low	Medium	High
1.	Interfaces are designed in an understandable and clear manner.		√	
2.	The uses of color is appropriate	√		
3.	The icon used is appropriate, understandable, synchronized and attractive.		√	
4.	The interface design is appropriate to the target users.			√
5.	The interface design is interesting.		√	

Overall, the result indicates that the target users were satisfied with the interface design except in terms of color. This means the uses of color in the *Saya Sihat* still need to be improved. The design of interface is appropriate to the target users.

7.2 Navigation

Next, the navigation of *Saya Sihat* was evaluated in terms of shape, function, synchronization, consistency, accessibility, and understandable. Table 2 exhibits the results.

Table 2: Result of Navigation

No.	Item	Low	Medium	High
1.	The shape of icon is interesting and attractive.		√	
2.	The icon is well functioning.		√	
3.	The icon is synchronizing.			√
4.	The icon is consistent at all pages.		√	
5.	The exit key is accessible		√	
6.	The meaning of the icon used is easily too understood.	√		

The users were satisfied that all of the icons provided in the *Saya Sihat* are synchronize. However, the design of icon in the *Saya Sihat* needs to be improved as it is difficult to understand.

7.3 Content

Then, the content of *Saya Sihat* was evaluated in terms of appropriate content, understandable content, content delivery, knowledge improvement, and interesting topics. Table 3 displays the results for content.

Table 3: Result of Content

No.	Item	Low	Medium	High
1.	The content is appropriate to the target learners			√
2.	The content is definite and understandable to learn		√	
3.	The content is successfully delivered		√	

	to the targets learners			
4.	The content is able to improve knowledge to the target learners	√		
5.	The topics are interesting		√	

Based on the user experience testing it was found that the content of *Saya Sihat* is appropriate to the target learners. However, knowledge provided in the *Saya Sihat* still needs improvement particularly in terms of information regarding healthy food. The target learners are satisfied with the others characteristics of content.

7.4 Multimedia Elements

The elements of multimedia provided in *Saya Sihat* were evaluated in terms of font size and style, appropriate graphics, the clarity of audio, the smooth of animation, the understandable video, and the interesting color. Table 4 demonstrates the result of multimedia elements.

Table 4: Results of Multimedia Elements

No.	Item	Low	Medium	High
1.	The appropriate font style and size		√	
2.	The appropriate graphics	√		
3.	The clarity of audio		√	
4.	The smooth and attracted animation			√
5.	The understandable video		√	
6.	The interesting color		√	

The user experience testing found that, animation obtain the highest score meanwhile graphics obtain the lowest score. This indicates that the uses of graphics need improvement in terms of clarity and graphics selection. Overall, the users were satisfied with the multimedia elements provided in the *Saya Sihat*.

7.5 Activities in *Saya Sihat*

Activities provided in *Saya Sihat* are in the form of games. As games elements could attract the learners' attention compared to conventional activities. The activities of *Saya Sihat* were evaluated in terms of understandable, interesting, challenging, knowledgeably, and enjoy. Table 5 concludes the results.

Table 5:

No.	Item	Low	Medium	High
1.	The provided games are understandable	√		
2.	The provided games are interesting,		√	
3.	The provided games are challenging		√	
4.	The provided games are knowledgeably		√	
5.	The users enjoy the provided games			√

It is reported that, the targeted users enjoy the games provided in *Saya Sihat*. However, the games related to food pyramid need some improvement to enhance to users understanding. Overall, games in *Saya Sihat* could assist the children to enjoy their learning activities.

8. Conclusion

In conclusion, the objective of this study has been achieved. An interactive digital learning content of healthy food has been developed as tested. The results indicates this supporting learning materials could assists parents and teachers particularly in kindergarten to educate children in learning healthy food as well as train them to eat healthy food in their daily eating routine practically.

Acknowledgement

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