Segmenting Principle Engages Pre-School Children with Multimedia Learning Material

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Abstract

Segmenting principle promotes designers to chunk contents into small structured pieces. It sounds helpful for users, but literatures reporting its application in multimedia application is scarce. As a response to that, this study applies it in a multimedia learning material for pre-school children, called Dr.Beary’s. The aim of this paper is to describe the elements of segmenting principle applied in Dr. Beary’s, and to illustrate users engagement with Dr. Beary’s. This study involves various techniques including walkthrough, design and development, and user observation and interview. In the end, a user experience study was carried out involving 32 pre-school children from three primary schools. They were first let to experience the application, in which the sessions were video recorded, followed with an interview. Data were recorded using video recorder and diary. It has been discovered that users interact actively with the application and with their peers. They are also able to practice what they have learned confidently. These are some demonstrations of engagement with Dr. Beary’s.

Keywords: Segmenting principle; Multimedia principle; Interactive learning content; User engagement.

1. Introduction

Developing interactive multimedia learning materials is easy. However, ensuring users engage with the developed multimedia learning materials is another story (Clark and Mayer, 2016; Zhou and Yadav, 2017). If they are not well designed, users may feel unhappy to use the learning materials and eventually will neglect using them (Brünen et al., 2003; Preece et al., 2007).

An interactive learning material is formed by its content and user interface. The user interface part is the one that connects users with the content. It also the one that determines the way users interact and experience the learning material. In ensuring that users feel happy using the learning material,

designers have to always consider users needs in their design (Lee et al., 2006; Low and Sweller, 2014; Lusk et al., 2009). Regarding this, Lawrence and Tavakol (2006) recommends designers to carefully consider usability and aesthetic aspects. Both aspects work hand-in-hand in satisfying users (Cox and Dale, 2002; Flavin et al., 2009). In contrast, when stressing too much on usability and leaving aesthetic unattended, it may impact in unhappy experience, and vice versa (Cawthon and Moere, 2010; Sonderegger and Saucer, 2010; Tractinsky, 2006). They have to be well-considered, appropriate for the purpose of the learning material, including the users, contents, and context of use (Duarte, 2008; Ginns, 2005; Preece et al., 2007).

In supports of satisfying both usability and aesthetic aspects, (Mayer, 2009) proposes that designers could consider applying multimedia principles. Generally, multimedia principles consists of twelve principles (Mayer, 2014).

One of the principles designers could apply in their design is segmenting principle. This study believes, the segmenting principle is able to cater the needs of both usability and aesthetic aspects, so that users’ cognitive load is minimized (Hasler et al., 2007; Hassanabadi et al., 2011).

The education sector has been affected by computers greatly. At all levels, from pre-school to higher learning institution, the society has absorbed technology-enhanced elements into learning process. In fact, learning contents have been widely developed for use in schools. At the same time, computer technology has been commonly used by children at home. Besides playing games, they also watch videos on YouTube.

However, their engagement with the contents while dealing with non-learning and learning materials is different. This study observed that through a study in three pre-schools. Particularly, it involved a pre-school in Kuala Lumpur (21 children), Penang (18 children), and Kedah (23 children). In the study, each child in every pre-school, who was good at reading, was given a computer with the Internet. They were asked to browse the Internet and play with it, with helps of their teachers. It was observed that everyone was deeply engaged with the contents, which among others were online games, movies in YouTube, and Instagram. Their engagement with the contents was obviously seen through their facial expressions and body languages. Obviously, they also involved peers in their experience. The session was lively. The next day, they were asked to read any ebook from the Internet. This study
did not specify any book for them, to let them decide one that they are happy with. With help of their teachers, everyone was able to find a book of their interest. They did read-aloud the books.

However, their reading was not conveyed appropriately through intonation, emphasis, and stress. Of course, there was a variation in their performance, depending on the book they read. When asked about the story they read, the children did not enthusiastically answer. In fact, after they read the book, they quickly asked for permission to dismiss.

Based on such scenario, this study believes that the way information is designed for the children really matters. Through the observation, it was found that children are more engaged with contents when the contents are not too bulky. Also, it was observed similarly when contents are grouped according to themes or point of discussion. Such finding is very interesting, and therefore, this study believes that applying segmenting principle in learning content for children in pre-school could make them engaged with learning contents.

As a response to such finding, this study designs and develops an interactive multimedia learning material for use by pre-school children. The learning material is named Dr. Beary’s, taking advantage of a common name all children know. This is one way to quickly attract their attention, in which they do not have to recall or guess what a bear is (Dix et al., 2004; Sweller et al., 2011). For the purpose of engaging the children with the contents, Dr. Beary’s applies segmenting principle. Based on the discussed background and the statement of problem, this paper aims to describe the way segmenting principle is applied in Dr. Beary’s.

Generally, this section establishes the background of study, which includes also the problem regarding user engagement. Based on the problem, the aim of this paper is stated, which is to describe the application of segmenting principle in an interactive multimedia learning material. The next section further discusses the way segmenting principle has been applied in engaging users. It is followed with a description on the research procedure. Further, the results are discussed before being concluded in the final section.

2. Methodology

This study has gone through a three stage research methodology as illustrated in Figure 1. The teachers requested that this study kicks off with English, because it is a foundation skill that children use in entire learning process. Then, the contents in Dr. Beary’s are taken from the existing books being used in pre-schools. Therefore, there is no issue regarding the selection of the contents. Referring to Figure 1, the process begins with identifying the most appropriate technique (element) in applying the segmenting principle in Dr. Beary’s. Identifying the most appropriate technique for applying segmenting principle was done through a focus group discussion.

The focus group was carried out consisting of four experts; an HCI expert, a pre-school teacher, a designer in the industry, and a children specialist; who did a walkthrough on a sample of five interactive multimedia storybooks. The objective of the focus group was to identify techniques that help segmentizing the contents in Dr. Beary’s. It was carried out in a systematic procedure: (1) this study explained the purpose of the focus group, (2) every expert explained their expertise, (3) every expert went through five interactive multimedia storybooks, (4) every expert noted down the strengths and weaknesses of every storybook, (5) all experts discussed their findings and (6) this study concluded the session with a list of techniques for segmenting principle for Dr. Beary’s.

Having carried out the focus group, this study managed to gather a set of techniques for segmenting contents in Dr. Beary’s. For this study, the techniques should be tailored for children and for self-paced learning. On that consideration, the experts have scrutinized their concerns to a narrow list. Eventually, they agree on the following techniques for application in Dr. Beary’s: (1) the canvas is segmented into appropriate panes using contrasting
colors, (2) contents in a book are chunked into several appropriate topics as necessary, (3) in a topic, contents are chunked into several modules as necessary, (4) in a module, contents are chunked into small parts, (5) every module uses standard color, (6) text changes color as being narrated (when necessary), and (7) contents are also segmented using shapes.

The findings in the first phase was utilized in designing and developing Dr. Beary’s (second phase). The objective of this phase is to apply the segmenting principle in Dr. Beary’s. The process in this phase adapted the action research method (as applied by Hayes (2011); which iterates the plan-act-observe-reflect cycle (Figure 2) (Elliot, 1991). In every cycle, in which users involved in giving recommendations and feedbacks, it begins with a storyboard. Regarding the users in this stage, a group of similar five pre-school children were involved from start to finish. They persistently involved in the study to ensure they are clear about the study, and participate well in every iteration. This ensures this study obtains reliable recommendation and feedback, as applied by Landoni et al. (2018). It was iterated with an improvement on the design in every cycle, until the reflection stage showed no more room for improvement. In the end, Dr. Beary’s has been fully developed, with a careful application of segmenting principle. Details on the elements of segmenting principles applied in Dr. Beary’s are described in the result section.

Fig-2. Adapted action research technique

Then, this study proceeded with the third phase; gathering users’ feedback; which aims at gathering users feedbacks on their experience in learning with Dr. Beary’s. This phase involved the similar schools as in the problem identification exercise, which is a school in Kuala Lumpur (11 children), Penang (10 children), and Kedah (11 children). In total, 32 users participated in the user feedback session. The number is sufficient, because this study carries out a deep study, through direct observation and interview techniques as recommended by Preece et al. (2007).

The procedure in gathering users’ feedback began with letting them deal with Dr. Beary’s. While they were experiencing Dr. Beary’s, this study recorded the session on video. With between 10 and 11 children in every school (carried out in their respective school), this study successfully managed to have everyone recorded on video, in which on top of that, manual diary was also used. The interview was carried out right after the observation. The observation was focused on three aspects, the children’s behavior, errors/success they make, and their emotion expressions.

These were synthesized (done after the sessions completely ended) through both the recorded video and diary. While the observation was focused on those three aspects, the interview was intended to get answers on (1) their experience on using Dr. Beary’s as opposed to experience using other learning materials, (2) their willingness to use Dr. Beary’s, and (3) their willingness to promote Dr. Beary’s to their peers. Users’ feedbacks through both observation and interview are generally interesting, which are discussed in the remaining sections.

3. Result

The previous section describes the systematic process this study has gone through. This section continues with the results of phases 2 and 3. Having gone through phase 2, Dr. Beary’s that incorporates segmenting principle is obtained. Figures 3 through 9 show snapshots of Dr. Beary’s with elements of segmenting principle that support user engagement.
The main page conveys the actors in Dr. Beary’s, in their enthusiastic friendly faces. They are ready to bring users into the learning material with them.

Fig-4. Segmentation of modules

- The contents are composed in two books. Users can select any book.
- Contents in each book are divided into eight modules.
- Heading segment. Besides I can read, other books include I can Read.
- Segmentizing through contrasting colors.
For song, the lyric is not listed in full, but line-by-line. Words are segmented using colors.
Figures 3 through 9 depict the elements of segmenting principle applied in Dr. Beary’s. This paper showcases them, as representatives in the whole content. As color is used as one of segmenting strategies, the selection of colors was critically considered. Obviously, bright colors are used, ensuring contrast colors appear on every page. Although contents are segmented using buttons, the use of buttons is standardized across the whole contents. The navigation style and convention are made straightforward and simple to ensure users (pre-school children) feel confident upon their interaction with Dr. Beary’s. These are considered to support both usability and aesthetic aspects.

4. Result from Observation

The observation was focused on three aspects; children’s behavior while using Dr. Beary’s, errors/success they make, and their emotional expression while using Dr. Beary’s. Results are obtained through analyzing the video clips and diary using Grounded Theory approach (Glaser and Strauss, 1967).

4.1. Observed Behavior

Five major tasks children need to do in Dr. Beary’s are finding the main menu, locating content, reading text, interacting with interactive contents, and interacting with peers while using Dr. Beary’s. Each of the task was carefully observed.
4.2. Finding the Main Menu
The main menu is a place where users can select the main modules in a book. Hence, it is very important for users to know how to get there. Having observed all users through the recorded video and the diary, users are found uncertain in the beginning. However, after the first time getting there, they are confident already. This is because, while segmenting the navigation structure, the ‘home’ button that takes to the main menu is always made visible, and at the exactly similar location. This totally avoids cognitive load, because they do not have to recall. That makes them enjoy when shifting contents through the main menu.

4.3. Locating Content
Every book contains eight topics. They are arranged from low complexity to high complexity, according to Bloom’s Taxonomy. Contents for every topic are provided in various forms including story, song, e-book, and practices. This study segments the contents in a standard form across the topics in all books, so that users could have a transparent mental model. Through the recorded video and diary, in the beginning users are found not so sure about the location of their intended content. Obviously, because it was the first time they used the learning material. Hence, many of them clicked all modules and see the contents briefly. After that, they stick to the topic that they intend to focus. As a result, when they intend to change to another topic, they did it that very confidently.

4.4. Reading Text
There are text in Dr. Beary’s, especially at ‘story’ and ‘e-book’ modules. Through the recorded video and diary, users are found to be able to read the text confidently. Text are segmented into chunks. This makes users engaged in reading them, because in between the content, they need to click a button. Besides, the text are also segmented with different colors, in which active text are colored with red (non-active is in black). In 'story’ module, the text are read-aloud, and users read together. Meanwhile, in ‘e-book’ module, users are provided with a button to ask Dr. Beary’s reads the text for them. Otherwise, the text are not read-aloud.

4.5. Interacting with Dr. Beary’s
In ‘practice’ module, users are required to actively interact with Dr. Beary’s. Besides, in other parts, users are also required to interact with. Through the video and diary, users are found able to go through all items in the practice module easily. Although for things they first met, they know how to interact with. Dr. Beary’s segments the contents in ‘practice’ module into a few tasks, depending on the topic and level of knowledge taxonomy, to support children learning ability. With that, the children (the users) are able to associate their required actions with the visul representation.

4.6. Social Aspect While Interacting
While interacting with Dr. Beary’s, the children also interact with their peers. For groups that are on similar topics, they communicate on their topics, and discuss on the same topic. For groups on different topics, they keep inform each other about what they are interacting with. The sessions were lively, exhibiting them challenging each other, supporting each other, communicating about their experience, and other sort of social interaction. For this study, such interaction really exposes an engagement with Dr. Beary’s.

4.7. Observed Errors
This study also observed they way the users interact with Dr. Beary’s. The purpose of observing their interaction is to identify whether they make errors that crucially need improvement.

4.8. In Selecting Right Module
In Dr. Beary’s, selecting modules is important because all contents are segmented into modules. Hence, this study observes user interaction from such aspect. Through the recorded video and diary, some users did mingle around and click the buttons in the beginning. They perhaps were learning about the organization of the content structure. However, after noticing that the structure in all topics (in all books) is standard, they understand it well. As a result, having learned about the structure, it is clear that almost all users were able to very confidently select their intended contents at any time. Not only they know the module structure, getting there was also very easy for them. No matter at what point they are, getting to the right module in any topic is just easy and everyone did that very easily.

4.9. In participating in Dr. Beary’s
In Dr. Beary’s, user interaction is core. There are segments of contents, not only through modules, but also on a page. This is one way of ensuring users are engaged with the contents in Dr. Beary’s. Hence, this study also analyzes whether users interact actively or passively with the application. Obviously, through the video and diary, the users are seen very actively interacting in Dr. Beary’s. In Dr. Beary’s, this study comprises all modules with contents related to the topic, including the song. It is seen that, in ‘intro’ module, users speak together with the character in Dr. Beary’s. In ‘story’ module, the users are seen responding to the contents through their facial expression and body language. Their expressions are congruent with the contents in Dr. Beary’s. In ‘song’ module, they sing together with the character. In fact, they also make body language as the character demonstrates. Then, in ‘e-book’, the users
read the text well. In case they are stuck, they click on the speaker icon and listen to the lines read by Dr. Beary’s. In overall, the users are looking forward to continue interacting with Dr. Beary’s until they are instructed to end their sessions. This is geared by their deep engagement with Dr. Beary’s, not only through its contents, but also through the way Dr. Beary’s interact with them.

4.10. Observed Emotional Expression

Users’ interaction with Dr. Beary is a paramount observation for this study, because it reveals whether users really does the tasks or not. On top of that, analysing their emotional expression while interacting with Dr. Beary’s is also very important. Hence, through the video and diary, it is also analyzed. Obviously, they are impressed with the opening page. The color and character segments really make them positive. It is seen through the way they smile when seeing the characters. Not only they smile, but they also show off impressed hand and body gesture.

4.11. Individually

In the beginning, while learning about the structure in Dr. Beary’s, the users were quite anxious. They keep clicking the topics and return to the main menu. This study realizes that their anxious is only on identifying the contents for each topic. However, the tool-tips on the buttons help them identify topics right. Although they were anxious, when they got any answer, they celebrate it through body and oral expression. Expressions like “yeay...”, “I got it..”, and “OK, there it is..” are always heard.

When they are confident about the contents for topics, more positive expressions are seen in the sessions. Reading the text together with the characters in Dr. Beary’s is entertaining for them. It is because the way the text is segmented (with colors and chunks) enables them to express their facial and body expressions. When they sing together with Dr. Beary’s, they really enjoy it. They imitate the character in Dr. Beary’s while singing, make facial and body expressions appropriately with the content. In fact, they also make aural expressions, showing their positive emotions.

4.12. While Interacting with Peers

While interacting with Dr. Beary’s, the children also interact with their peers. Some of them are on similar topic. In this scenario, they read together, and react physically together. They connect their emotion together, sometimes seeing at each other and talk to one another.

In another scenario, they are on different topics. In this, they keep tell what they are with, sometimes they shift to their peer’s screen to see what makes the peer excited. Most of the times, they repeat a content segment to show to their peer (similarly in asking their peer to repeat for them). This is a result of segmentation, which provides high user-control over the application (Scheiter, 2014).

5. Result from Interview

The interview was carried out to extend the findings of the observation. Findings from the interview are clustered into three.

5.1. Their Experience on Using Dr. Beary’s as Opposed to Experience Using Other Learning Materials

Obviously all children have experienced using other applications before Dr. Beary’s. Some are on CD and some are on the Internet. From their responses, this study deduces that they are happy with all multimedia learning contents they have used previously. However, they appreciate Dr. Beary’s more because it segments the contents. With that, it is easy for them to repeat any content they want to.

5.2. Their Willingness to use Dr. Beary’s

Having experienced using Dr. Beary’s, the children were happy to express that they are willing to use the application in their learning process. For them, although there are many multimedia learning applications, Dr. Beary’s is easier to use and it makes them learn swiftly. One important aspect that they are impressed is their ability to repeat desired content, which is a result of segmenting the contents into chunks. With that, they could improve their understanding and ability to practice.

5.3. Their Willingness to Promote Dr. Beary’s to Their Peers

In fact, they also expressed that they want their other friends to also learn with Dr. Beary’s. It is normal for children to promote what they feel good to their peers. For them, when there are more people using Dr. Beary’s, they will have more people to practice the skills they learn in the application.

6. Discussion

The design of Dr. Beary’s by applying segmenting principle is to satisfy the needs of usability (Nielson, 1993) and to consider the affordance (Norman, 2002). They are mixed together, to accommodate with technology advancement (Suchman, 1987) and the needs of the users (Preece et al., 2007). As a result, the observation and interview reveal that the children are able to carry out their tasks smoothly. Not only that, they also experience using Dr. Beary’s highly positively.
Their positive experience going through Dr. Beary’s means that they are engaged with the application. Besides visual consistency, the way the segmentation is made is an influential factor. This agrees with the findings by (Ayres, 2006); (Boucheix and Guignard, 2005); and Boucheix and Schneider (2009). As this was done with user engagement in the UCD process, it eventually results in a highly-desired scenario. 

Through the proper segmentation, it promotes active interactions between the users and the application, as emphasised by Mayer (2011). Such active interactions then promotes interaction among peers. In fact, such segmentation promotes users to apply what they have learned, such as asking one’s name, and introducing friends, agreeing with Mayer and Chandler (2001) and Mayer et al. (2003). They are able to do that on the effect of segmentation. Through segmentation, they can store what they learned in a block structure, which reduces their cognitive load (Moreno, 2007). As a result, it is easy for them to apply when necessary, as found by Plass et al. (2010).

The effect of color segmentation is undeniably influential for children. Careful selection of colors between foreground and background and between panes is impactful for the effect of cognitive engagement. If colors are not well segmented, it may fail in supporting cognitive ignition. This agrees with part of previous studies such as by Mayer and Fiorella (2014) and Mayer and Pilegard (2014).

The application of segmenting principle has to be carefully decided. For this study, including users in the designing process, through UCD approach is really helpful. It is troublesome, and costly, but results in a desired impact. The process although tedious and tiring especially in ensuring the children participates well, managed to outcome recommendations that meet user expectations.

7. Conclusion

This paper describes a study that observes the impact of segmenting principle upon children’s engagement towards a multimedia learning content, Dr. Beary’s. The elements of segmenting principle for Dr.Beary’s were identified through a walkthrough over five samples of other interactive learning materials. The design of Dr.Beary’s that incorporates the identified elements of segmenting principle was carried out through UCD cycles, in which users involved directly in the design process. Through a series of observations and interviews in users actual contexts, this study discovers that the application of segmenting principle in Dr.Beary’s is able to promote active interaction between users and the application. It also promotes active social interactions among peers while learning with Dr.Beary’s. Not only that, users are also able to practice what they have learned confidently. This really supports the development of children’s critical thinking skills (Djamas et al., 2018). In accordance to that, this study promotes or designers to carefully apply segmenting principle in their design. Besides, modality and redundancy principles are also impactful, as found by Liu et al. (2018). In future, this study wil analyze the impact of those principles over children’s interaction experience with Dr. Beary’s.

Regarding that, it is important to note that there is no single answer for the best design. It is highly subjected to the context of use, and the target users. The key to the design is understanding users and their needs. Based on the experience of this study, UCD is an approach that could assist in understanding the actual user desire.

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