Proceedings of the 4th ITB Graduate School Conference
Innovation and Discovery for Sustainability
July 6, 2023

Mapping of Content, Visual, and Interactive Elements of Children's Mobile Apps with Theme About Disease

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Abstract. The rise in the use of electronic devices has pushed digital media to become familiar tool in children's daily lives. The flexibility of mobile devices combined with the advantages of application features make mobile apps suitable as a media to support children's learning processes, one of which is education about disease. Disease-themed children's mobile apps are interesting to be analyzed because of the possibility of particular approaches that are taken to develop and deliver disease-themed content into digital media designed for children. An analysis was carried out on contents, visual elements, and interactive elements on 43 disease-themed children's mobile apps using qualitative exploratory approach. Textual analysis method was used with the stages that includes identification, categorization, and interpretation using a mapping model made from the results of a literature study. Of the various types, there are three most common models of disease-themed children's mobile apps; role-play game models to introduce medical practice, interactive environment models to introduce health care facilities, and narrative models to introduce disease. It is hoped the research's results can provide insights regarding children's mobile apps with theme about disease and become a reference for researchers and developers of disease-themed children's mobile apps.

Keywords: *children's app; disease-themed; interactive elements; mapping; mobile apps; visual elements.*

1 Introduction

With rapid development of electronic devices and the internet globally, digital media has become a dominant tool in children's daily life, according to Dore et al. in [1], Gocheva et al. in [2], and Müller-Brauers et al. in [3]. Stated by Bus et al. in [4], kids nowadays prefer digital entertainment such as games, online streaming services, and other digital contents. Thus, Gocheva et al. in [2] and Ratri & Choi in [5] suggest that practitioners have to adapt learning styles that involve interaction with digital media. Defined by Dewi et al. in [6], mobile applications/mobile apps are applications that can be operated via mobile devices, such as smartphones, tablets, and iPads. Of all digital devices, mobile device is the most popular one among children compared to laptop and computer according

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to Papadakis & Kalogiannakis in [7] and Ofcom in [8]. Not only popular and easily accessible on the market, apps on mobile devices also have the ability to provide content that is active, fun, and engaging, with touchscreen features that have been designed to give convenience for children as users according to Papadakis & Kalogiannakis in [7], Rojo et al. in [9], Papadakis et al. in [10], and Sari et al. in [11], which is coupled with the flexibility of the device mobile that provides convenience for its users, said Ellingson in [12]. Gocheva et al. in [2] confirmed that mobile apps are suitable to be digital education platform for children, one of which is education about disease.

Accessibility for children to adequate information related to disease and health care is very important. According to Lambert et al. in [13], children often feel anxious when they come to the hospital. This anxiety relates with the unknown of their illnesses and what will happen in the hospital, according to Lambert et al. in [13], Clift et al. in [14], and Wennstrom et al. in [15]. Current information about health care for children still considered not appropriate enough, claimed by Kennedy in [16]. Children also often experience miscommunication with doctor due to difficulties in understanding the doctor's medical explanation according to Lambert et al. in [13]. Lambert et al. also suggest that providing children with tailored information related to disease and health care is very important to reduce their fear and anxiety [13]. On the other hand, disease-related education for children requires a special approach. This is because children still have difficulty understanding medical terms according to Lambert et al. in [13] so they need visual approach in learning, according to Hijriati & Rahmi in [17], and the learning style requires engagement, according to Gocheva et al. in [2]. Therefore, suggested by Lambert et al. in [13] and Tubiana-Rufi in [18], there needs to be supporting media in facilitating the teaching process about disease and health care in general for children.

More than one million mobile apps for children are available to iOS and Android users according to Lauricella et al. in [19]. Through preliminary research, more than 50 children’s mobile related with theme about disease have been found on Google Play Store and Apple App Store. These apps are interesting to be analyzed because of the possibility that there are some particular/specific approaches that are taken to develop and deliver disease-themed content into digital-based media designed for children. The differences and similarities in these characteristics can be identified through mapping method because it can show a broad overview of the classification of different types of mobile apps. There are a lot of previous researches who have studied children's mobile apps and children's applications in terms of interactive features done by Gocheva et al. in [2], Müller-Brauers et al. in [3], Ratri & Choi in [5], Neumann & Neumann in [20], Schwebs in [21], and Jarvenpaa in [22], in terms of content by Müller-Brauers et al. in [3], Stichnote in [23], and Zheng in [24], also in terms of visuals done by Müller-Brauers et al.

[3], and evaluation of its functions done by Müller-Brauers et al. in [3] and [25]. The majority of them only analyze one or two aspects of the apps. No research has been found that studies elements in children's disease-themed mobile apps in terms of content, visuals, and interactivity.

This study analyzes the characteristics of the elements in children's mobile apps with the main theme about disease. The aim of this research is to map children's mobile apps with theme about disease based on three main elements; contents, visual elements, and interactive elements. Mobile apps are analyzed using a mapping model made from the results of literature studies. The output of the research is made in the form of a descriptive table based on the classification of mobile apps elements which will be grouped based on content, visual, and interactivity aspects, ranging from the most general to the most specific classification.

2 Literature Studies

2.1 Children's Apps

There are several types of children's apps based on the aspects. Based on content, children's apps can be divided into two large types; narrative apps/reading apps that prioritize story/narration, and game apps that are more dominant in game content according to Zheng in [24]. This division supports the theory by Cohen et al. in [26] that mentioned narrative apps as a model of reading apps and game apps as models of gaming apps and creating apps. Stichnote in [23] stated that in narrative children apps, there are two types based on the options for its users. The first type, multiple fabula apps, is a type that allows users to select or change main storylines, such as role-play and simulation. The second type, alternative story/discourse, is a type that allows the selection of the way the story is told without changing the story itself, for example the read-aloud option in the children's book app. In game apps, there are two types of games based on the game model; playful play /creating games/crating apps and ordered play/game with rules/gaming apps according to Cohen et al. in [26], Milenski in [27], and Koskimaa & Lahdenperä in [28]. Gocheva et al. in [2] define playful play or creative games as a type of game that gives freedom to players, such as role-play, simulation, and drawing/painting games. While ordered play or games with rules is a type of game that implements a computer game system in the form of rules, levels, challenges, and win-lose concepts. An example is a puzzle game, memory games, and shooting games. Based on the source of adaptation, Schwebs in [21] divide children's apps into two types. The first type, digital natives, is a type of apps designed originally as digital media, while the second type is digital immigrants which are types of apps adapted from analog media, according to

Schwebs in [21] and Stichnote in [23]. Digital native applications tend to be more interactive than digital immigrants, said Zheng in [24].

The term of 'interactive' is often interpreted as various forms of reciprocal relationships between users with programs on computers, defined by Schwebs in [21]. Schwebs also mentions two types of interactivity; animation type that relates with content function and navigating types that relates with technical function [21]. Müller-Brauers et al. in [3] then divide animation type into two types based on the activation; hotspots (manual) and filmic animation (automatic). According to Bus et al. in [4], hotspots generally need to be activated gesturally through the touch of a finger in order to display animation, sound effects, music, or audio narration, while filmic animation is a moving/motion object or filmic effects such as panning or zooming effect, but it can also be background music or background sound. The second type, navigating feature, is useful for managing pages navigation, sound settings, etc. according to Schwebs in [21]. Stichnote in [23] divide this type of interactivity into two types based on navigation flow; linear navigation (rigid/fixed with the flow) and non-linear navigation (can move between scenes). From a technical point of view, it can be divided into two; gestural activation or non-gestural activation. Gestural activation uses divided body movements into two types namely Gestural User Interface (GUI) and Touch User Interface (TUI). GUIs use sensors to track body movements such as stepping, jumping, and hand movements such as tilt, rotate, and flip. Papadakis & Kalogiannakis in [7] confirmed that TUI is the most commonly used activation method for children's mobile apps with the type of activation such as tap, press, drag, swipe, drag & drop, etc. The non-gestural activation method can be seen on the mobile game "Dumb Ways to Die" which uses sound and air blowing. Based on researches done by Müller-Brauers et al. [3], Schwebs [21], and Ratri [29], children app's interactive features can be grouped based on three main types; function for story, decoration function, and navigation function. Function for story (narrative/ fragment) is a function that supports and completes the story content. The decorative function (illustrative/decorative) aims to add atmosphere, attract attention, and liven up the atmosphere without having to do with the main story. Navigation function is a functions that are outside of the story because they focus more on the technical functions, such as page settings, audio settings, language, etc. Hunicke et al. in [30] adds that the role of game can have several types; sensation-giver, fantasy immersion, storytelling, challenge-giver, self-expression platform, discovery platform, and simply as a filler in spare time.

There are two analytical models from previous research that are considered relevant to be applied to this research. The first one is ViSA model by Müller-Brauers et al. in [3] which divides the level of analysis into two; visual level (images and context on the apps) and animation level, which is the interactive features of the apps. The visual level focuses on intermodal aspects; the

relationship between images and text (content), divided into three types; parallel (synonymous meaning with the text), contrapuntal (opposite meaning with the text), and plaited-braid (the meaning of the image complement or enrich the context of the story) [3]. The animation level dissects the interactive features in terms of form, way of activation, frequency of activation, and narrative function. Forms can be audio, visual, and audio visual. The activation method is divided into two ways, namely the manual method (hotspots) or the automatic method (animation). The frequency of occurrence is divided into three types; once, repeatable, and constant. Narrative functions describes the feature's function that relates with the storytelling. In addition, the illustrative/atmospheric function is to give atmosphere to the story. The feature's function categorization can be supported by the second analysis model, a model by Ratri & Choi in [5] focusing on hotspots which dissects features in terms of their connection to the story. This connection is divided into three kinds; decorative (attention-grabber, decorate), fragment (represent the story), and dramatizing (enrich the story).

2.2 Visual & Narration in Children's Picture Book

In children's picture books, there are three important aspects; narration, illustration, and design. Saidi in [31] divided narrative aspect in the story into two; intrinsic elements and thematic elements. Musfiroh in [32] included story plot, characters, and setting as intrinsic elements, while Saidi in [31] defined thematic elements as extrinsic aspects of a story such as the theme/ premise of the story and the value or message from the author. From the illustration aspect, there are several illustration styles based on its shape and appearance, according to Soedarso in [33] there are naturalist/realist style, decorative style, cartoon style, caricature style, comic/image-with-text style, textbook illustration style, and surreal/imaginary style. Illustrations in children's story books often bring up analogies, one of them usually in the form of metonymy (comparing two things that have a close meaning), especially when representing story characters at key moments, said Moya-Guijarro in [34]. From the design aspect, Rahimah & Izzaty in [35] stated that the characteristics of the design of children's picture books can be seen in terms of display quality including use color palette, background color, font shape and style, use of upper and lower case letters, and size letters on the book. The use of color generally uses bright colors such as yellow, pink, light green, etc. Letter shape and styles are divided into two major types; sans serif and serif. As quoted from Guntur in [40], the ratio between illustration and text is divided into 90 : 10, 60 : 40, 30 : 70 , and 20 : 80.

3 Method

This study proposes a qualitative exploratory approach using textual analysis method. Textual analysis is a method of descriptive analysis to interpret the object

of study by exploring the internal elements, according to Larasati in [36]. The stages of textual analysis start from data collection, data identification, data categorization, and context interpretation in the form of interpreting the similarities, patterns, differences, etc. The analysis is conducted on 43 children's mobile apps from Google Play Store and App Store that fall into the category of disease. The sample selection is based on several criteria; the application is intended for users aged 3 years and over, English or Bahasa Indonesia, can be found using the keywords such as illness, disease, hospital, cancer, and sickness, the theme of disease limited to human diseases, and can be operated using a smartphone, tablet, or iPad. At the stage of data identification and data categorization, an analysis model is used in the form of a mapping model as shown in Figure 1, Figure 2, and Figure 3. This mapping model is the result of a modification based on literature study on previous studies related to children's apps and children picture book. Specifically for content aspect, a preliminary research has been done in a form of survey on several disease-themed children's mobile apps to provide data for the model's classifications. For content and visual element (Figure 1 and Figure 2), the model used the theory of Saidi in [31], Musfiroh in [32], Soedarso in [33], Rahimah & Izzaty in [35], and Guntur in [40]. For interactive elements (Figure 3), the model used theories by Schwebs in [21], Stichnote in [23], Gocheva et al. in [2], and analytical models by Ratri & Choi in [5] and Müller-Brauers et al. in [3]. A preliminary survey has also been conducted to complete the classifications and check the suitability of the model when applied to the research object. The mapping model is then turned into Google Form to facilitate the data input process. The results of the data are presented in the form of tables and descriptive explanations.

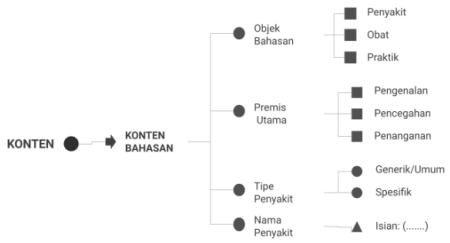

Figure 1 Mapping model for contents

Figure 2 Mapping model for visual elements

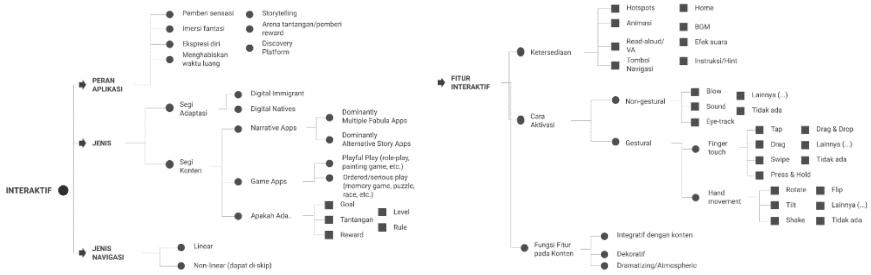

Figure 3 Mapping model for interactive elements

4 Data Results & Discussion

The following is the results data presented in Table 1, Table 2, and Table 3. The tables are divided based on the three elements; contents, visuals, and interactives. (Note: some apps can have two or more characteristic on one type of classification).

Table 1 Results of data mapping: contents.

No	Aspects	Type of Classification (numbers of apps that have the characteristics)
1	Object of discussion	Doctor/nurse practice (27 mobile apps), health care facility introduction (14 mobile apps), disease (6 mobile apps), internal organs (2 mobile apps), medicine (1 mobile apps)
2	Main premise	Disease treatment (29 mobile apps), facility introduction (14 mobile apps), disease prevention (7 mobile apps), introduction about disease (4 mobile apps), introducing organ (2 mobile apps), health check up practice (2 mobile apps), doesn't have premise (1 mobile apps)
3	Disease's category	Generic (19 mobile apps), specific (12 mobile apps), doesn't discuss disease (13 mobile apps)
4	Disease's name	Fever (17 mobile apps), flu & cough (15 mobile apps), internal/external injuries (15 mobile apps), eyesore (12

			mobile apps), skin disease (10 mobile apps), toothache (9 mobile apps), headaches (7 mobile apps), stomachache (6 mobile apps), allergies (2 mobile apps), ENT (2 mobile apps), cancer (2 mobile apps), diabetes (2 mobile apps), sleep apnea (1 mobile app), neuroblastoma (1 mobile apps), asthma (1 mobile apps), obesity (1 mobile apps).

Table 2 Results of data mapping: visual elements

No	Aspects	Specifications	Type of Classification (numbers of apps that have the characteristics)
1	Illustration	Illustration style	Cartoon style (41 mobile apps), comics (1 mobile apps), realistic/photo (1 mobile apps)
		Character design	Human (21 mobile apps), animal /anthropomorphic (13 mobile apps), mixed (7 mobile apps), monsters/things (2 mobile apps)
		Disease's analogy	No analogies (24 mobile apps), fiction creatures/monsters (19 mobile apps)
		Setting/background	Non-fiction/everyday environment (33 mobile apps), fiction (9 mobile apps), no background/plain (1 mobile apps)
		Relation between visual and content	Parallel (43 mobile apps), plaited-braid (8 mobile apps)
2	Design	Color palette style	Contrast colors (40 mobile apps), soft colors (3 mobile apps)
		Text availability	No text on main content (22 mobile apps), There is text on main content (21 mobile apps)
		Font type	Sans serif/block (19 mobile apps), serif/curved (2 mobile apps)
		Font size	Medium/25%-40% of the screen (14 mobile apps), small/<25% of the screen (5 mobile apps), large/>40% of the screen (2 mobile apps)
		Ratio of image : text	60 : 40 (15 mobile apps), 90 : 10 (5 mobile apps), 30 : 70 (1 mobile apps)

Table 3 Results of data mapping: interactive elements

No	Aspects	Specifications	Type of Classification (numbers of apps that have the characteristics)
1	App's role		Discovery platform (35 mobile apps), challenge arena (28 mobile apps), self-expression (15 mobile apps), thrill/adrenaline (12 mobile apps), spare time filler (10 mobile apps), fantasy immersion (6 mobile apps), story-telling (1 mobile apps).
2	App's type	Adaptations	Digital natives (43 mobile apps)

		Contents	Game apps (39 mobile apps), narrative apps (4 mobile apps)
		Types of narrative apps	Alternative story/discourse (2 mobile apps), information-centered (1 mobile apps), none of them (1 mobile apps)
		Types of game apps	Playful play (35 mobile apps), ordered/ludic play (5 mobile apps)
		Types of gamification	Role-play/simulation (23 mobile apps), Interactive environment (14 mobile apps), memory game/puzzle (3 mobile apps), guide the object (3 mobile apps), shooting game (2 mobile apps), virtual pet (1 mobile apps).
		Gameplay availability	Reward (27 mobile apps), challenge (19 mobile apps), goal (15 mobile apps), levels (4 mobile apps), rules (4 mobile apps)
3	Type of navigation		Non-linear (28 mobile apps), linear (15 mobile apps)
4	Interactive feature's availability		Hotspots (43 mobile apps), filmic animation (42 mobile apps), BGM and sound effects (42 mobile apps), home page (37 mobile apps), sound setting options (31 mobile apps), game instructions (19 mobile apps), voice over (15 mobile apps), navigation buttons (14 mobile apps)
5	Activation type	Gestural/Non-gestural	Gestural (43 mobile apps)
		Types of gestural activation	Finger touch (43 mobile apps), hand movement (1 hybrid mobile apps with finger touch)
		Types of finger touch	Tap (43 mobile apps), drag (34 mobile apps), drag & drop (33 mobile apps), swipe (25 mobile apps), press & hold (14 mobile apps), circular movement (1 mobile apps)
		Types of hand movement	Shake (1 mobile apps)
6	Narrative feature's function		Integrating with the contents (30 mobile apps), decorative and/or atmospheric (14 mobile apps)

From the data shown in Table 1, Table 2, and Table 3, it can be seen that there are many types of disease-themed children's mobile apps. The mapping shows several characteristics that often appear in the majority of children's mobile apps with theme about disease. In terms of content (Table 1), as many as 27 mobile apps focus more on discussing health care practice compared to the discussion of the disease itself which is only as much as 6 mobile apps. One of the practice is

checking body temperature, applying medicine, using stethoscope, checking eyes, ENT, and teeth, etc. A total of 29 mobile apps aim to introduce procedures of how to treat the illness or injury, followed by 15 mobile apps aimed at introducing hospital facilities such as hospital areas, medical devices, and drugs. 24 mobile apps tend not to show the form of the disease directly, but instead the symptoms that are visible to the eye such as pale face, sweating, high body temperature, redness on skin, etc. while the others will use fictional characters to represent the disease's virus. This found supports the theory by Izzaty in [37] and Juwantara [38] that concepts with concrete examples (can be seen with eyes) make it easier to understand.

From visual aspect (Table 2), 21 mobile apps use human as character designs and 13 mobile apps using animal/anthropomorphic as character designs. 41 disease-themed children's mobile apps uses cartoon illustration style with contrast color palette such as bright pink, white, bright turquoise, orange, and yellow (40 mobile apps). The cartoon style in question is the shape of the character whose visual elements are simple with emphasis on a few body parts, according to Guntur's theory in [40], such as large eyes, small mouth and nose, big head, and short arms and legs. The visualization of the illness, injury, and facilities is also simplified. Cartoon style with cute designs are considered to fit with children's taste who like simple, cute, and friendly design, stated by Pratama in [41] and Azis et al. in [42]. Pratama in [41] also claimed that using human or animal as character designs along with non-fictional settings can give comfortable feeling for the users because of the familiarity with the everyday environment. Only 21 mobile apps use text in their content, 19 of which are in block type (sans serif) and the majority use capital letters. This can be driven by the tendency of children in choosing big-sized block letters, according to Rahimah & Izzaty in [35].

On the interactivity side (Table 3), there are 39 game-based mobile apps, 24 of which are in the role-play model and 14 others based on interactive environment. All mobile apps also play a role as a discovery platform, 28 of which add challenge features. This supports the concept of children apps by Gocheva et al. in [2] and Pratama in [41] that suggest an app to have fun features and the freedom for the users to learn through discovery. That also explains why edutainment has been widely used as an effective learning approach for children, stated by Gocheva et al. in [2]. Role-play is one of the most popular types of gamification because it gives immersion and freedom for the players, according to Gocheva et al. in [2] and Stichnote in [23]. Based on the feature, hotspots were found on all of the mobile apps, with finger touch being the common way to activate it in the form of tap, drag, drag & drop, and swipe. While being the most popular activation feature, different types of finger touch can also be applied because children are already used to it from an early age, claimed by Papadakis & Kalogiannakis in [7] and Azis et al. in [42].

From the discussion above, authors have found the three most common models of children's mobile apps with theme about disease; role play-based game apps model aimed at introducing medical practice (23 mobile apps) shown in Figure 4, interactive environment-based game apps model to introduce health care facilities (14 mobile apps) shown in Figure 5, and narrative-based models of narrative apps with additional mini games to introduce particular diseases or organs (6 apps) shown in Figure 6. These differences are assumed to exist due to differences in their premises regarding the presentation of the contents and learning experiences for its users.

Figure 4 Disease-themed children's mobile apps with role-play model (Source: "Hippo Hospital")

Figure 5 Disease-themed children's mobile apps with interactive environment model (Source: "My Town Hospital" (left), "Pepi Hospital" (right))

Figure 6 Disease-themed children's mobile apps with narrative model (Source: "Chuckwood's Sleep" (left), "I Got This" (right))

According to Misky & Putra in [43], when a game is being played, there is an interaction between mechanics (game's mechanism) by the designer with the aesthetic sense (the sensation) by the player. Thus, a different objective can

influence the whole contents of an app, because the designer will have to adjust their vision of the apps with the aesthetic and experience taste of the audiences. It can be seen on children's mobile apps with theme about disease. In mobile apps with role-play model, the main goal is giving the users an experience as a doctor, nurse, or medical practitioner through practice in the hospital in treating patients as shown in Figure 4, so that users will be introduced to the environment and activity in the hospital. As education through direct practice will be more easily understood by children, confirmed by Izzaty in [37]. In mobile apps that focus on introducing health facilities, such as hospitals and medical devices, it tend to present an interactive environment model where the users are free to interact with the tools and characters in it, as shown in Figure 5. Pratama in [41] believed that customization features can attract users in interacting with the apps, so the process of receiving the information will occur naturally. On the other hand, mobile apps that focused on introducing disease tends to have a narrative with everyday life situations, such as the lives of the patient as shown in Figure 6. Through role-play models and narrative models, children will learn the disease through other people's life scenarios, called social learning techniques. Social learning, according to psychology expert Albert Bandura, is a learning approach by observing the behavior, attitudes, and reciprocal events that experienced by other people, so that the child that act as an observer will construct their own understanding in response to similar incidents.

A large number of mobile apps that discuss more about medical practice and health facilities can be an answer to the child's need for information about health care mentioned in the introduction. The existence of these mobile apps will allow children to get to know medical procedures and the tools they use, with a playful approach along with content and visuals that have been modified according to children's tastes. The existence of various types of disease-themed children's mobile apps can also support children to learn about diseases and activities in the hospital from different perspectives. Children will have an idea about their condition when they are sick and the practices that will be carried out, therefore they won't feel fear and nervous at the hospital, as Lambert et al. said in [13]. Children can also be encouraged to be more open in their opinions when consulting with the doctor. Disease-themed children's mobile apps could have the potential to meet the educational content about hospitals that children need, with its simple and specific contents, depictions with visual analogies, and game-based communication strategies. In the future, mobile apps for children with theme about disease are expected to be more widely used to help children get to know about diseases and activities in the hospital environment.

5 Conclusions

From the results, it can be seen that the most common types of disease-themed children's mobile apps aims to introduce the practice in health care facility. The majority of them is a game apps with role-play game style. Almost all of them is cartoon style that shows more of visible symptoms than the disease itself, along with minimal usage of text, with large sized sans-serif style. Overall, disease-themed children's mobile apps can be grouped into three major models; role-play model for introducing health care practice, interactive environment model that introduces health facilities, and narrative model that focus on educating diseases or organs. The differences can be caused by the type of the app's premise. A different premise could require a different approach. Thus, the mapping analysis model can also be different. There needs to be a more detailed mapping of each type of mobile apps with their own classification. This also makes the current mapping classification model is still too generic and won't be fully effective and relevant to all kind of disease-themed children's mobile apps. In further research, it is recommended to make a mapping analysis model that has been adjusted to the classification and model of each mobile apps. Evaluation for the apps itself is also highly recommended in order to know its performances and the user's responds.

References

[1] Dore, R., Logan, J., Lin, T.J., Purtell, K., & Justice, L., *Characteristics of Children's Media Use and Gains in Language and Literacy Skills*. Frontiers in Psychology, 11, 2020.

[2] Gocheva, M., Somova, E., Angelova, V., & Kasakliev, N., *Types of Mobile Educational Games for Children in Primary School*, 14th International Technology, Education and Development Conference, 2020.

[3] Müller-Brauers, C., Boelmann, J.M., Miosga, C., & Potthast, I., *Digital Children's Literature in The Interplay between Visuality and Animation*, Routledge, 2020.

[4] Bus, A.G., Neuman, S.B., & Roskos, K., *Screens, Apps, and Digital Books for Young Children: The Promise of Multimedia*. Aera Open, **6**(1), pp. 1-6, 2020.

[5] Ratri, D. & Choi, Y., *An Evaluation Tool for Story-Related Interactive Features in Children Book App*. Jurnal Komunikasi Visual & Multimedia, **6**(1), pp. 1-10, 2014.

[6] Dewi, N.K.C., Anandita, I.B.G., Atmaja, K.J., & Aditama, P.W., *Design and Build of an Android-Based Siska Mobile Application*, Sintech (Science and Information Technology) Journal, **1**(2), pp. 100-107, 2018.

[7] Papadakis, S. & Kalogiannakis, M., *Mobile educational applications for children: what educators and parents need to know*, International Journal of Mobile Learning and Organization, **11**(3), pp. 256-277, January 2017.
[8] Ofcom, *Children and Parents: Media Use and Attitudes*. http://stakeholders.ofcom.org.uk/binaries/research/media-literacy/october2013/research07Oct2013.pdf [Google Scholar], 2019.
[9] Rojo, N.V.D., Bagtaso, P.D.C., Caballero, A.J.N., & Sobejana, N., *Mobile Educational Games for Toddlers and Preschoolers*, SSRN, March 2016.
[10] Papadakis, S., Kalogiannakis, M., & Zaranis, N., *Designing and creating an educational app rubric for preschooler teachers*, Education and Information Technologies, pp. 1-19, 2017.
[11] Sari, B., Takacs, Z.K., & Bus, A.G., *What are we downloading for our children? Best-selling children's apps in four European countries*, Journal of Early Child, **19**(4), pp. 515-532, 2017.
[12] Ellingson, K., *Interactive Technology Use in Early Chilhood Programs to Enhance Literacy Development & Early Literacy Development for Children with Cochlear Implants*, Culminating Projects in Child and Family Studies, pp. 3, 2016.
[13] Lambert, V., Glacken, M., & McCarron, M., *Meeting the information needs of children in hospital*, Journal of Child Health Care, **17**(4), pp. 338-353, 2013.
[14] Cliff, L., Dampier, S., & Timmons, S., *Adolescent experiences of emergency admission to children's wards*, Journal of Child Health Care, **11**(3), pp. 195-207, 2007.
[15] Wennstrom, B., Hallberg, LR.M., & Bergh, I., *Use of peri-operative dialogues with children undergoing day surgery*, Journal of Advanced Nursing, **62**(1), pp. 96-106, 2008.
[16] Kennedy, I., *Getting it Right for Children and Young People: Overcoming Cultural Barriers in the NHS so as to meet their needs*, London: Department of Health, 2010.
[17] Hijriati, & Rahmi, P., *The Learning Process of Children Aged 0 To 12 Years Based On Their Development*, 2021.
[18] Tubiana-Rufi, N., *Patient Education for Children and Adolescent with Chronic Disease*, Presse Medicale, **38**(12), 2009.
[19] Lauricella, A.R., Blackwell, C.K., & Wartella, E., *The "new" technology environment: The role of content and context on learning and development from mobile media*., Springer, pp. 1–23, 2017.
[20] Neumann, M.M, & Neumann, D.L., *Touch Screen Tablets and Emergent Literacy*, Early Childhood Education Journal, **42**(4), pp. 231-239, 2014.
[21] Schwebs, T., *Affordances of an App: A reading of The Fantastic Flying Books of Mr. Morris Lessmore*, Nordic Journal of ChildLit Aesthethics, **5**, 2014.

[22] Järvenpää, H., *The Playful Affordances of Picture Book Apps for Children*, Eludamos: Journal for Computer Game Culture, **12**(1), pp. 149-167, 2021.
[23] Stichnothe, H., *Engineering stories? A Narratogical Approach to Children's Book Apps*, Nordic Journal of ChildLit Aesthethics, **5**, 2014.
[24] Zheng, Y., The Story, *The Touchscreen and The Child: How Narrative Apps Tell Stories*, Ph. D dissertation, College of Social Sciences, University of Glasgow, Glasgow, 2018.
[25] Müller-Brauers, C., Misoga, C. Fischer, S., Maus, A., & Potthast, I., *Narrative Potential of Picture Book Apps: A Media- and Interaction-Oriented Study*, Frontiers in Pyschology, **11**, December 2020.
[26] Cohen, M., Hadley, M., & Frank, M., *Young Children, Apps & iPad*, Michael Cohen Group, 2011.
[27] Milenski, I., *Contemporary Development and Peculiarities of Children's Play Pedagogy*, pp. 118-125, 2012.
[28] Koskimaa, R. & Lahdenperä, L., *Digitization of children's literature*, AVAIN: Kirjallisuudentutkimuksen Aikakauslehti, **3**, pp. 74-93, 2017.
[29] Ratri, D., *Improving Emotional Affordance in Negative Emotional Themed Book App through Familiar Gesture*, Ph. D dissertation, Graduate School of Visual Major, Design Ewha Womans University, Seoul, 2016.
[30] Hunicke, R., LeBlanc, M., & Zubek, R., *MDA: A Formal Approach to Game Design and Game Research*, Proceedings of the AAAI workshop on Challenges in Game, 2004.
[31] Saidi, A.I., *Recognizing Narrative in Fine Arts*, Jurnal Sosioteknologi, **12** (6), pp. 297- 302, 2007.
[32] Musfiroh, T., *Selecting, Composing, and Presenting Stories for Early Childhood*, Tiara Wacana, 2008.
[33] Soedarso, N., *Design of Illustration Book about the Journey of Mahapatih Gajah Muda*, Humaniora, **5**(2), pp. 566, 2014.
[34] Moya-Guijarro, A.J., *Visual Metonymy in Children's Picture Books*, Review of Cognitive Linguistics, **11**(2), pp. 336-352, 2013.
[35] Rahimah, F.Y. & Izzaty, R.E., *Developing Picture Story Book Media for Building the Self-Awareness of Early Childhood Children*, Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini, **2**(2), pp. 219-230, 2018.
[36] Larasati, A.C., *Textual Analysis of Representation of Social Values in the Legend of Robin Hood by Peter Holeinone (Cultural Studies Analysis Perspective)*, Jurnal Ilmu Komunikasi, **11**(3), pp. 204-212, 2013.
[37] Izzaty, R.E., *Development of Children Aged 7-12 Years*, Jurnal Pendidikan, pp. 1-11, 2008.
[38] Juwantara, R.A., *Analysis of Piaget's Cognitive Development Theory in Concrete Operational Age Children 7-12 Years in Learning Mathematics*, Al-Adzka: Jurnal Ilmiah Pendidikan Guru Madrasah Ibtidaiyah, **9**(1), pp. 27-34, 2019.

[39] Guntur, T., Bandung Institute of Technology, Bandung, personal communication, 2020.
[40] Broekman, F.L., Piotrowski, J.T., Beentjes, H.W.J., & Valkenburg, P.M., *App Features That Fullfill Parents's Needs in Apps for Children*, Mobile Media & Communication, **6**(3), 2018.
[41] Pratama, A.D.Y. *Translation of Children's Picture Book*, Retorika: Jurnal Ilmu Bahasa, **5**(2), pp. 168-176, 2019.
[42] Azis, A., Azah, N, Batmaz, F., Store, R. & Chung, P.W.H., *Selection of Touch Gestures for Children's Applications*, International Journal of Advanced Computer Science and Applications, **5**(4), pp. 97- 102, 2014.
[43] Misky, F. & Putra, R.W., *Virtual Aesthetic of 3D Game 'Dreadeye VR (MDA Framework Approach),* Kartala Visual Studies, **2**(1), 2022.