International Conference of Innovation in Media & Visual Design

IMDES Conference Proceedings
Universitas Multimedia Nusantara
11th-12th November 2020

Designing an Informative Pop-Up Book about Microplastic Particles for 8-13 Years Old Children

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DOI: https://doi.org/10.31937/imdes.v1i1.1127

Abstract: It is undeniable that the use of plastic, especially disposable plastic has become a part of an everyday life of a human. In Indonesia, the waste management is still at its minimum point and unbalanced to the amount of plastic consumptions. Government stated that schools around Indonesia still need education regarding waste. The importance of providing education about plastic and waste from an early age can help educate the children in order to raise their awareness about the use of plastic wisely. Based on the research that has been done, the target readers ranging from 8-13 years old doesn't know yet the harmful effect of what plastic can cause. Pop-up book is the chosen media in order to facilitate the distribution of information, the book is packed with interactive pages, making it easier for children to remember what they see when they are directly involved on a media.

Keywords: plastic; microplastic; waste; pop-up; illustration book; children

1. Introduction

The word plastic is not an unfamiliar term anymore in our daily life, human uses significant amount of plastic every day. In her article, Yolanda stated that the Maritime Coordination Ministry is planning to add waste education primarily about plastic to the curriculum starting from kindergarten to high school because of the lack of knowledge on plastic waste (Yolanda, 2018). Reported by nationalgeographic.co.id, Syarifah stated that scientists have found that one single-used plastic mineral bottle contains 2-44 micro plastic particles per litre. This will cause poisoning in our system, damaging the body's tissue system or even on worse scenarios, deaths. Microplastic was not only found in the sea, but were also found in the air we breathe, and in land animals such as chicken. On one serving of processed chicken, scientists found about 10 microplastic particles inside the chicken's meat (Syarifah, 2018).

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Widyaningrum revealed that even human fesses and intestines were already contaminated with micro plastics. This was sampled by an Austrian scientist who collected human fesses samples across the world from countries such as Japan, Italy, Poland, Netherlands, UK, Russia, Finland and Austria (Widyaningrum, 2018). Problems that arise from plastics have concerned from previous research (Selamet & Simpson, 2019) that designed a mobile application to address plastic pollution.

However, up until now, there are no books about microplastic for students available to read. Therefore, the author purpose a media information in the forms of pop-up book as a solution to educate the reader especially students within the range of 8-13 years old children to gain awareness and insights regarding the use of plastic, especially single-used plastic so the readers could understand more about plastic's cycle and life-span through an interesting way of learning.

2. Literature Reviews

2.1 Pop-Up & Paper Engineering

According to Ives, paper engineering is a process of cutting and creating shapes with a paper or with a card. With paper engineering, various pop-up, moving cards, elegant sophisticated 3-D sculptures or a fully working machines can be made using only paper for the mechanisms (Ives, 2009, p.7).

In order create a basic pop-up mechanism, every pop-up engineer must know several basic folds according to Finch (2013), here are the folds:

1. V-Folds
   V-folds are mainly used as the key pop-up fold. It is very effective creating a dynamic pop-up and very easy to use, it consists of a one folded piece of cards that is being glued or slotted into the page across the centre fold or gutter in the main spread. There are two angles to be considered: the angle that the pop-up is attached to the spread and the angle along the base of the pop-up itself.
2. Parallel Folds
   Parallel folds got its name because of the direction of the folds used to create the pop-up. The folds are all parallel to each other to the main fold down the centre of the spread. Parallel folds are great to create layers of support in a more complex pop-up mechanism.
3. Pull-Tabs; a pull tab is a paper tab with a sleeve that can be pulled.
4. Pivots
   Pivots consists of three techniques combined all together: a pivot, an arm and a pull-tab. When a pivot is assembled it can create a more dynamic movement to the spread.
5. Wheels

Wheels are the terms of the paper technique that can be turned, has a round shape like a wheel and it is form based with a pivot underneath.

6. Dissolving Windows
   Dissolving windows can create a seamless changing animation looks by simply pulling the tab of the windows, it is best used in using changes in a card.

2.2 How Pop-Up Boost Children Reading Skills

In a journal article by Lestari, it is mentioned that learning by storytelling especially with pop-up involves in a process which the children can be actively programmed on re-telling the stories of what they have seen in the book. Through pop-up, children can have vocabulary growth in their learning process which can affects to their learning vocabulary as well as the ability to analyse words or sentences that will increase the child's cognitive development (Lestari Ika, 2016).

According to a recent article by Minsker, it listed various reasons why pop-up book is great for younger children to read (Minsker, n.d.):

1. Interactive;
   Pop-up book has the ability to turn ordinary illustration into 3-D illustration. Sileo (as cited in Minsker, n.d.) who works both as a children psychologist and author stated that pop-up book is an excellent way to add some incentive and rewards towards reading, because children tend to get bored so quickly. By using pop-up book as an approach, its interactive aspects gave the ability for the children to feel like they're inside the story which makes it all more engaging than ordinary illustration book.
2. Help Build Vocabulary;
   Reading a pop-up book will gives kids a whole new level experience of reading and will make them want to read the book repeatedly. Repeating and rereading is a very important part of memorizing and strengthen children vocabulary skills.
3. Teach the Value of Visualization;
   Pop-up books are important for kids in order to train their imagination to give them insights of what is happening in the story and thus resulting in giving them a richer reading experience.

2.3. Plastic & Microplastic Particles

As stated in the book Crawford and Quinn stated that plastic is a composed of large chain like molecules, that is called macromolecules. The macromolecules are composed by many smaller molecules connected together in a sequence and it is known by the terms "polymer." Polymer itself comes from an Ancient Greek Word for *poly* which means many and *meres* which means parts. The individual unit of this polymer is called a monomer. Monomers are tiny molecules that have an ability to bond together to form long chains. The process of connecting monomer together is called polymerization. All plastics are polymers.

Microplastic is the smaller form of microplastic, it is found on practical every beach on the world and have been detected on every open ocean surfaces, shorelines and sediments of freshwater lakes, mixed with marine sediments and are even incorporated in the polar ice caps. Microplastic is generally any kind of plastic that is smaller than 5 mm to 1 µm in size along its longest dimension. Any piece of plastic that is smaller than 1 µm is called nano plastic. Microplastic comes in various sizes, colours, shapes and appearance. Scientists often have a hard time identifying secondary microplastic since they are more random looking in shape. However, scientists could categorize the microplastic based on the colour since they tend to change colour when they are contaminated with chemical pollutants (Crawford & Quinn, 2014).

3. Design Methods

The methods used in the project was "The Big 6" theories based on O'Grady's book. The Big 6 is an information literacy model or information problem-solving strategy that was originally developed by Dr. Mike Eisenberg and his co-worker Bob Berkowitz in 1990. The methods provide the user learning process where they need to find, understand and apply new information (O'Grady, 2017).

Table 1 The Big 6 Theories

Step 1	Task Definition
Step 2	Information Seeking Strategies
Step 3	Location + Access
Step 4	Use of Information
Step 5	Synthesis
Step 6	Evaluation

- Task Definition
  The first step of the methods is the task definition. This method requires the author to define the information problem in order to identify what information that the target readers of the project may be needed. This involves in finding the urgency and relevancies according to the topic, determining the project's objective, scoping the problem demographically, geographically and psychographically.
- Information Seeking Strategies
  After determining the first step of the big 6 method, the second step of the methods is the information seeking strategies. This step is necessary to define and selects the possible sources and targets for the project, thus selecting the best sources to plan the design strategies. The information seeking strategies was done by seeking various information through literature studies, existing studies, conducting interview with experts, focus group discussion and observation. This step is inseparable with the third step of the method, which is the location + access.

- Location + Access
  The third step like mentioned before is inseparable with the second step. On this step the author needs to locate the sources needed for the project and find as many information possible with the source. For example, on existing studies the author conducted two interviews involving expertise in their work scope. The first interview was done with Mr. Reza Cordova a lead researcher in marine pollution, specifically marine waste, microplastic and heavy metals to gain insights about microplastic. While the second interview was done with Mr. Joko Wibowo as an editor who works at Elex Media Komputindo, one of the large book publishing company in Indonesia.
- Use of Information
  The fourth step of the method is the use of information, on this step all the information collected through various data collecting methods are being selected to choose only the relevant information for the final output. This step covers the selection of the graphic design aspects and elements of the books such as the colours, typography, illustration as well as the pop-up mechanism that is going to be implemented in the book.
- Synthesis
  The fifth step is the synthesis. In this step the author must organize multiple sources and present the information from the data that is collected and implemented throughout the big 6 theories methods. However, synthesis steps will further be discussed in detail on the design process.
- Evaluation
  After all steps of the methods are done, the last step which is the evaluation step is necessary to test the output effectiveness and efficiency, in this case the final pop-up book. It is important to test the durability of the book and making sure all the mechanism and sizes of the pop-up part are measured well and can function properly as a pop-up thoroughly. A successful pop-up book can be determined by the mechanism when a certain spread is open. How well can the mechanism stand on top of the paper.

4. Design Process

4.1 Synthesis

After collecting all the data needed through interviews, focus group discussion, literature studies, reference studies as well as existing studies, the writer then proceed to the next method of the design which is called synthesis. At this step the writer gathers all keywords related to the project and made a mind map. The mind mapping process help the author to determine and specify the keywords and big idea of the project as a future guideline. See Figure 1 below for the mind mapping process.

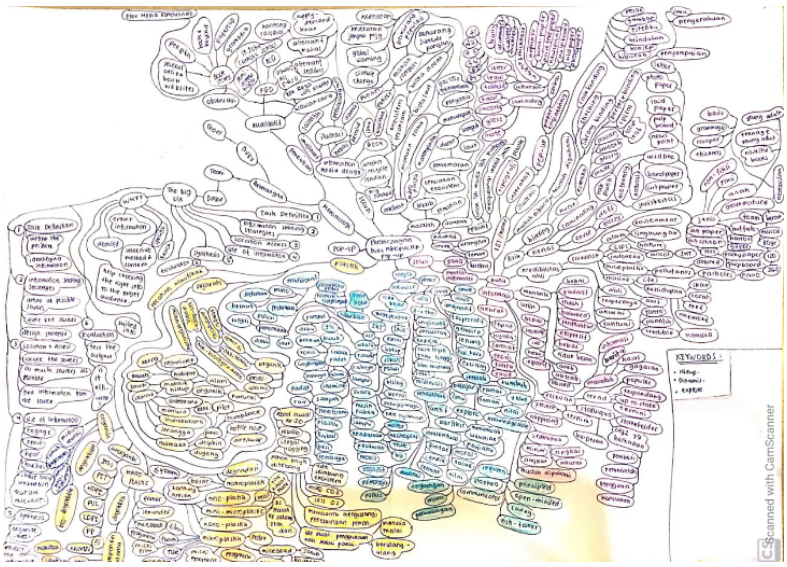

Figure 1 Mind mapping process

The keywords that the author found throughout mind mapping process are journey, explore and dangerous. After that with the help of advisor, the author managed to get the big idea for the pop-up book project which is "a plastic journey that cause potential danger that is needed to be explore more." After all keywords and big idea for the project gathered, then the author moved on to proceed in designing the pop-up book by determining:

1. Book Specification



Figure 2 Dwi & Adhisti: Realita Mengerikan tentang Sampah (Terrifying Reality about Waste) Pop-Up Book Specification

The final book size of the pop-up book is 21 cm x 26 cm the book was determined by careful consideration based on the data collected by doing interview with Joko Wibowo an editor from Elex Media Komputindo, he mentioned that children book mainly ranges

from 21 cm x 21 cm with a special binding technique so each of the spread can be opened at is maximum state in order for the pop-up mechanism to work properly.

The book is designed with a portrait orientation using bluish white 250-gram type of paper. The author chose this paper because of its firm and rigid paper composition making it the perfect paper to support the mechanism used in the book. Bluish white paper also has a matte texture reducing light reflection on the paper thus making the paper comfortable to read for the children.

2. Colour

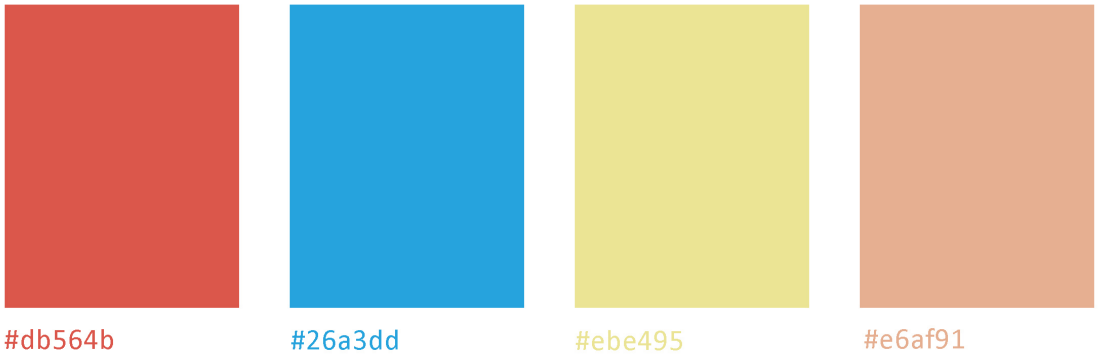

Figure 3 The Main Colours used in the Pop-up Book

In determining the colour that is going to be used in the book the author uses keywords as a guideline. The colours chosen in the book is a representative form of the keywords obtained from the mind mapping process. In her book, Dameria stated that dangerous can be represented by the colour red. The colour red also represents bravery, aggressive, and explosions of emotions. In the pop-up book the author uses the colour red to represents dangerous plastic illustrations (Dameria, 2007, p.44).

Based on Dameria's book, she also stated that the colour blue can also means educative as a positive meaning or toxic as a negative meaning. Furthermore, for the colour yellow she stated in his book that the colour yellow can be used and describe a cautious feeling (Dameria, 2007, p. 30).

3. Typography

In determining the typography for the pop-up book, the author chooses the typeface with sans-serif type with a touch of handwriting looks for the body text throughout the entire text in the book and a slightly "spooky" theme to the headlines of the text. The typeface selection is chosen based on the keywords and big idea that has been determined before. The typeface that the author has chosen looked like a child handwriting that has a fluent characteristic to it but also firm looking. Salisbury in his book stated that the selection of typography that is going to be used in the text must

also pay attention to the arrangement of letters so that the target audience can easily read the content of the book (Salisbury, 2004).

4. Grid & Layout

Modular grid is the chosen grid for the entire artwork, full illustrations are applied to the spreads. On every spread 1,5 cm length is used on the left, right, top and bottom margin with 0,2 gutter value, making the centre margin 3 cm in length. The size page of the paper itself was made based on A3 paper which has the dimension of 29,7 cm in height and 42 in length, but the height is being cut to 26 cm in height in order to match the final book height.

5. Character & Illustration Style

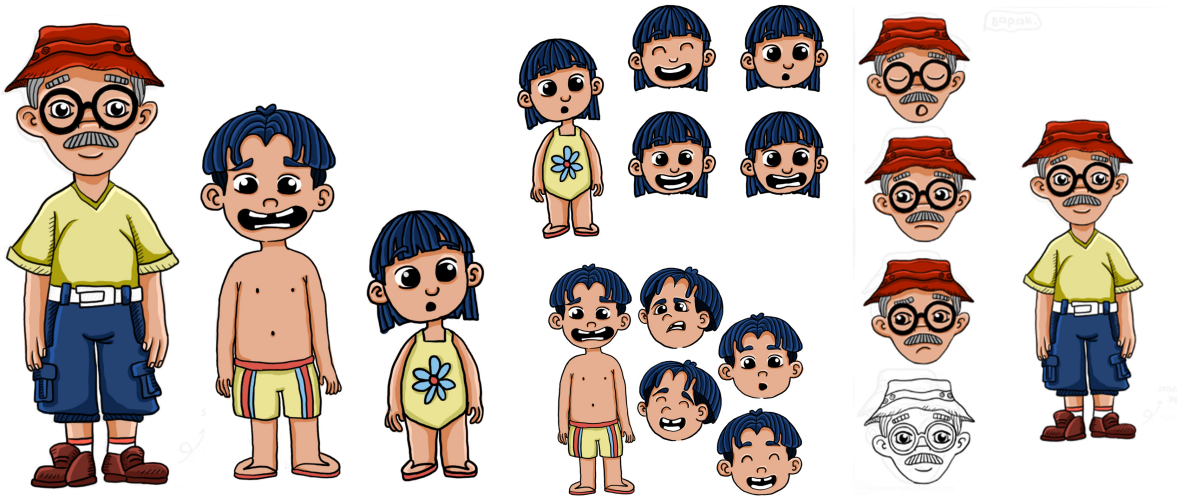

Figure 4 Character in the pop-up book (from left to right): Bapak, Dwi, and Adhisti

The book has three main characters which help in the distribution of information to the target readers as seen in Figure 4. The character started out from determining their persona by making 3D character to determine their physiology, sociology and psychological aspects. After making each of the character's persona, the next step was making rough sketch in paper and outlined by drawing pen. After that the character was further discussed with one of the author's specialists advisor and then continued by colouring and finalizing the character on a digital platform.

After finishing the sketch and the prototype of the spreads, the author scans it to proceed in colouring using digital software which is Adobe Photoshop. Keywords from brainstorming process is applied in determining the illustrations style. The use of bold lines with shading and blocking can deliver the "dangerous" message that is implied in the book. Blocking technique on the colorization process is used to emphasize the shadow of the objects in the illustration, it also acts as a transition from dark to bright. With crosshatching and blocking illustration style, the keywords

"dangerous" can be relevant to the message that is wanting to be delivered to the target audience.

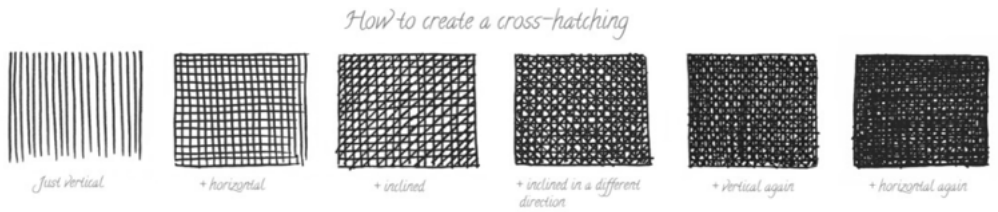

Figure [] Cross Hatching Illustration Style used in the book. Retrieved from https://eugeniahauss.com/2017/05/11/the-basics-of-ink-techniques-hatching-and-cross-hatching/

6. Book Binding Technique



Figure 5 Double Fan Adhesive Binding used in the Pop-Up Book

For the book binding technique, the author decided to use double fan adhesive binding for the book. Double-fan adhesive binding has the best balance of durability and openability, it is mainly used for spreads consisting of single sheets. Double fan binding is used by clamping the entire book together (Cani, 2003). Double fan adhesive binding is suitable for the pop-up mechanism because it gives maximum impact in order for the paper to open and for the mechanism to work fully, this giving it a more pleasant reading for the target readers. Double-fan adhesive binding also proven to have a long-lasting binding because of its high durability.

4.2 Promotional Media Components Identification

After designing the pop-up book, the author designed promotional media components identification to help with the book's promotion in accordance with rules set by the author. The media then is divided into print ads, social media, gimmick and merchandise.

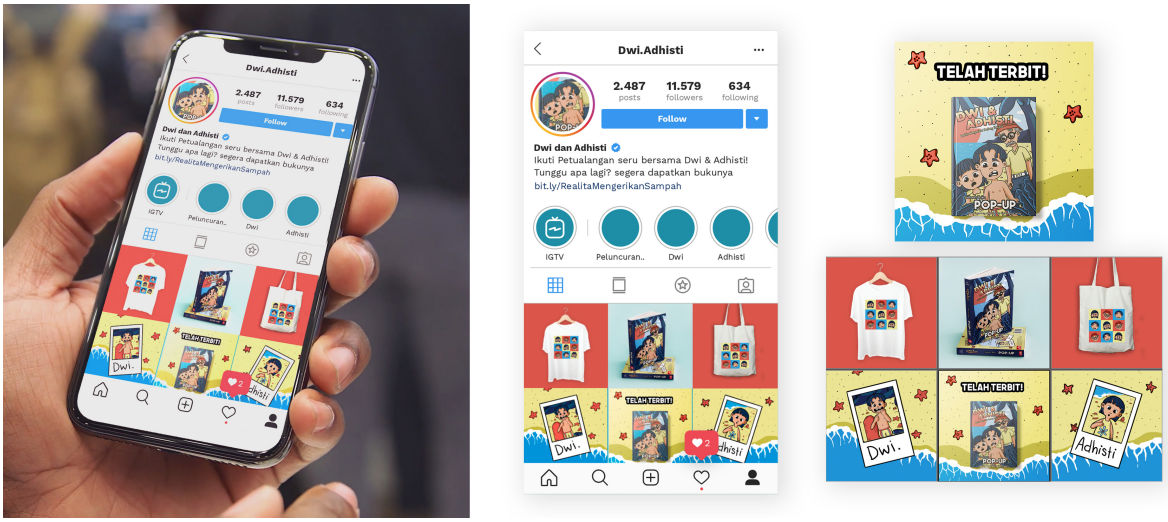

Figure 6 Dwi & Adhisti Pop-Up Book Instagram Promotional Media

To design the promotional media components identification, it is important to use visual hints from the pop-up book, the same colour pallet is also used in designing various promotional media components identification such as Instagram as seen on Figure []. These Instagram posts are planned to be posted shortly after the launching of the book. Besides Instagram, there are x-banner and web banner to help promote the pop-up book. Both x-banner and web banner are going to be placed in various bookstores and websites.



Figure 7 Dwi & Adhisti Pop-Up Book Web Banner Promotional Media

For the secondary identification, gimmick and merchandise are chosen. The merchandise will be tote bag, t-shirts, foldable lunch box and a hard case pencil case, while the gimmick is an aluminium water bottle. Lunch boxes are chosen as the merchandise because they are easy to carry, lightweight and useful for lunch at school during recess time or any kind of school or outdoor activities. Hard case pencil cases are useful to store their school supplies. Had case pencil cases are stronger and more durable compare to the average pencil case. Tote bag are chosen because they are useful in many ways it can also be a substitute of plastic bag when the child goes shopping or in need to carry thing, because it has many spaces to put inside yet light-weighted and strong. The blue tumbler on figure [8] is chosen for the gimmick. The author uses the outlined face of the character inside the pop-up book which is Dwi & Adhisti as the design.



Figure 8 X-Banner, Gimmick and Merchandise

5. Conclusion

This information media book was designed to educate the readers from an early stage about the danger of plastic and microplastic through a pop-up book with the help from the main characters inside the book, which is Bapak, Dwi and Adhisti. The pop-up book itself is designed to educate the readers in understanding the information that wants to be delivered because children need to know from an early age that microplastic can have serious effects on human health as it may leave dangerous chemical and metal substances inside the human body due to its additive chain reaction.

The pop-up techniques that are used for the pop-up book is suitable for the target readers that ranges from 8-13 years old because it can give the readers a whole new experience in gathering information since pop-up book can turn 2D into 3D image, giving the target readers a richer experience in reading. Moreover, the readers can explore interactive information in flaps inside the book. As pop-up books are proven to improves children

learning ability, teaches the value of visualization and are able to extend children vocabulary resulting in making pop-up book an excellent way for the children learning process obtaining knowledge in plastic and microplastic along with the help and guidance from their teacher, parents or guardian in obtaining information from the book.

Through this pop-up book, the author hoped that children from an early age can know the danger and be aware of microplastic resulting in developing a habit in terms of using plastic more wisely and bravely say "no" to single-used plastic. As for the future research plan of the distribution of the paper itself, together of the Ministry of Education the pop-up book will be distributed through schools and various communities focusing on zero-waste lifestyle to support the content of the book itself.

Acknowledgements: This paper and research is a part of Angelina Salvita's final project bachelor thesis and would have not been possible without the endless support from my advisor, Rani Aryani Widjono. Her enthusiasm and guidance have kept my work on track until the final draft of this paper. Reza Cordova, the lead scientists and researcher of microplastic from LIPI (Lembaga Ilmu Pengetahuan Indonesia) as well as families and friends that has given me supports throughout the project.

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