

Design Thinking for Sustainable Mascot Character Design

Ahmad Faisal Choiril Anam Fathoni^{1*}

¹Animation Program, Visual Communication Design Department, School of Design, Bina Nusantara University, Jakarta, Indonesia 11480

Abstract. In the character licensing industry, we identify one use of a character brand in the shape of a mascot. A good design for a mascot in an institution, community, or specific event will increase the mascot and the institute's sense of belonging. In order for the mascot design to match the community's tastes, the appropriate formulation is required during the process of producing this mascot figure. As a result, it is vital to have a strategy that enables achieving this goal to be more manageable, which can be employed in creating different mascot designs. This research intends to build a formula based on design thinking to capture the target market's tastes, through a poll based on design elements and principles, in a case study of making the "We Love Design" event mascot from Bina Nusantara University. The baby Sumatran tiger was selected as the mascot's form because, in addition to carrying the most frequently selected features in the poll, it also embodies the local content of Indonesia to raise the sense of belonging. The fundamental contribution of this study is the innovation of a system that streamlines the process of developing a brand character, which in this case takes the form of a mascot. Two polls with 724 & 1,018 respondents were employed as the approach. The process used to create this mascot character design is expected to be used in other character designs, including mascots and character licenses to make it sustainable.

1. Introduction

Based on [1], character licensing is a long-term strategy and the license partner functions as a brand ambassador in the market. Licensing contributes significantly to extending the market horizontally. The mascot is a frequent example of a character license usage, often done to promote a brand. Mascots represent various institutions, including companies, sports teams, small businesses, non-profit organizations, and educational institutions. Using mascots, a company can accentuate its distinctive corporate identity [2]. A mascot is also Key for Visual Marketing; cartoon media character branding can enhance product consumption compared to no character branding [3].

Along with the roles mentioned earlier, the mascot itself has the potential to be commercialized through Character licensing, which can generate revenue for the institution. As a result, generating the flow of income can benefit the mascot, allowing it to support itself and develop a sustainable mascot. As an example, consider Kumamon. It is an incredibly successful mascot who supports himself and generates significant cash for those in his immediate vicinity. As one of the most famous Japanese mascots, this Character was created to help promote Kumamoto Prefecture's publicity. In 2019, this bear's product sales surpassed 158 billion. This black bear mascot debuted on March 12, 2011, as the Kyushu Shinkansen opened for the first time [4].

Referring to Kumamon's success, and also since mascots have long been used to promote many businesses

and draw the public's attention, they can also help companies build and nurture their corporate identities on [2]. As a medium that can be used to introduce the We Love Design event organized by the School of Design from Binus University, we create a mascot that can strengthen the sense of belonging to students, alumni, and lecturers to this event. Also, we can generate income to make this mascot usable and commercially sustainable. This mascot will be used as a medium that can be used to introduce the We Love Design event.

1.1 Objectives

This study aims to give designers a helpful reference for creating a good sustainable mascot. Design thinking through a design-based survey was conducted to obtain the essence of customer preferences to achieve this.

2. Literature Review

Character licensing is the highest-earning licensing area; therefore, many designers and businesses are enticed to engage in it. An established figure can profit from licensing and royalties on various products, including apparel, stationery, toys, giftware, games, foodstuffs, and promotions [5]. Character licensing (on products or as standalone items), also defined by a media researcher, [6], can be viewed as paratexts. Paratexts are the peripherals around media and television texts, such as branded items, movie trailers, and movie posters, which must be

* Corresponding author: aanam@binus.edu

recognized as significant components of popular culture that fuel demand for these brands.

Considering a product's qualities and visual identity has become standard procedure due to increased worldwide competitiveness, corporate identities must be established and nurtured by businesses, which can be reinforced through mascots and other visual representations. [2]. Mascots are frequently used by businesses to promote their products or services. [7]. Based on [2] as visual identification markers in sporting competitions such as the Olympics, such images have been frequently employed to attract public attention and develop corporate identity, resulting in increased public awareness and company identity. As [2] also mention that comparing mascot design to communication allows us to see them as 'sign vehicles' in the symbolic world. This vehicle must be created adequately to fulfil the viewer's preferences and perceptions.

Brand mascots are also referred to as advertising ambassadors, brand icons, or spokes characters in the marketing world [3]. When it comes to increasing brand awareness and creating customer interaction, the employment of mascots has emerged as an essential marketing technique [8]. Brand mascots can capture the attention of otherwise uninterested consumers [2]. Instead of relying on a human spokesperson, commercial campaigns that include cartoon characters as brand ambassadors are more likely to affect customer perceptions of the ad and the brand as a whole [9]. The goal of mascots is not limited to boosting a brand's identification; they also serve as a medium for anthropomorphic translation, reflecting human attributes to the consumer [10]

Japan is one of the world's major mascot-producing countries with best practices in mascot design, which has a massive number of anthropomorphic characters and produces significant revenue from it. In Japan, there is a category of mascot characters known as *yuru-chara* (loose/wobbly characters, which translates as "wobbly characters" in Japanese) (Debra J. Occhi, 2017). *Yuru-chara* is a regional mascot used to promote a region or a particular brand. Through the *Yuru-Chara* Grand Prix, these *yuru-chara* characters were brought to the attention of the public, and as a result, some of the characters have garnered fame on a global scale and have acquired celebrity status in Japan. Few studies have investigated the relationship between the popularity of a given *yuru-chara* and its characteristics Hotogi conducted an investigation into *yuru-charas* that ranked in either the top or the bottom 100 in terms of popularity. During this study, features such as the shape of the eyes and the length of the arms were extracted as a means of determining possible common characteristics among popular (or unpopular) *yuru-charas*. For example, on the basis of Hotogi it has been reported that popular *yuru-charas* commonly have a limb and round black eyes. However, this approach is not suitable for analysis using a large amount of images, since such features should be manually extracted [12]. When it comes to establishing the identity of an institution or group, the greater the number of places or communities that create mascots, the greater the necessity for distinct variances in the design of each of

these institutions. The reason for this is that it is intended that each brand will have a distinct identity and will be easy to recognize from one another. In order to accomplish this, we require a system that makes it easy for designers to produce a variety of designs.

The research from [13] shows that designers of animated characters for children's media and interactive apps do not need to follow these age-specific design trends. However, the results would likely vary in civilizations that commonly employ distinct artistic genres, such as Japanese manga and anime. In addition, it would be intriguing to explore whether children's exposure to specific television programs, movies, and computer games influences the results of individuals within a single society. According to [14] research, Japanese university students prefer flawed personalities that are not only cute. Male pupils like an "interesting" character with an appearance that contradicts its personality/behavior, whilst ladies prefer a relaxed and doodling character with a body shape that comforts them. Regarding character design in Indonesia, additional research is required. In this instance, we chose to employ design thinking. When it comes to characters in Indonesia, more in-depth studies should be conducted before character designs are created. In this particular instance, we chose to utilize design thinking for this mascot character design.

Many industries, including design, business, health, education, and social innovation, incorporate design thinking into their operations [15], because in recent years, design thinking has been recognized as a valuable strategy for dealing with unclear circumstances and uncovering previously unforeseen problems relatively early in the development process [16]. Instead of presuming that possibilities already exist in the surroundings, design thinking focuses on developing new ideas and possibilities by intentional actions in a given circumstance (Nielsen & Stovang, 2015). The design thinking approach was applied to the creation of this mascot to determine which solution was the most effective. This mascot was created using design thinking through a design-based survey that contains questions focused on design elements such as color, form, and texture and design principles such as proportion and composition that aid in the character creation process. As design thinking has spread from the design community to many other sectors throughout the years, numerous design thinking models have emerged [18]. Design thinking used in this paper follows [19], which defines *design thinking* as a series of three stages detailed in this paper: inspiration, ideation, and implementation.

3. Methods

We utilize design thinking as our strategy-making process from the design world as this system can unlock creativity and enables everyone to develop an innovative new solution regularly. Stanford and IDEO both use this method as a series of iterative processes that guide what should be prioritized at any given time and are iterated through as needed, as explained by [20]. According to

[19] who is considered one of the pioneers of Design Thinking, this process consists of three steps: **Inspiration, Ideation, and Implementation**. The first step is **Inspiration**, and It is referred to as "inspiration" because of the conditions (which may be a problem, an opportunity, or both) that stimulate the search for answers. This stage emphasizes observing people in their natural environment to elicit ideas using the word "empathy." The goal of the first phase is to conduct interviews to ascertain what people genuinely care about. This step also defines the problem that allows the designer to dilute the research into usable frameworks. By examining the interviews, we may now discern the actual requirements people are attempting to meet. The second step is **Ideation**, for generating, developing, and testing solutions-oriented ideas based on previously established frameworks and models of success. Only the problem and its answers are addressed here. The goal is to develop as many ideas as possible, not the best. At this step, we also create a working prototype to validate our final solution, where we reflect on what we have learned from our group's diverse perspectives. The last step is **Implementation**. To chart a path to market, numerous iterations of projects will pass through these spaces—mainly the first two—as concepts are developed, and new approaches are pursued.

4. Data Collection

As part of the **Inspiration** process, we utilized a preliminary poll in this study. This survey represents the quantitative approach employed in this study, and it included questions ranging from design elements and principles to respondent preferences from other previous mascots. The first survey had 724 respondents addressed as college students, lecturers, employees, alumni, high school or vocational students and design practitioners.

Table 1. Preliminary Survey Respondent Status

Status	Respondent	Percentage
College Students	461	63.7 %
Alumni	161	22.2 %
Lecturer/Employees	88	12.2 %
SMA/SMK Students	10	1.4 %
Industry Practitioners	4	0.6 %

The first poll includes numerous questions concerning preferences frequently used to guide when developing mascots. For example, in addition to questions on the respondent's favorite animal, the author consists of questions about the animal's most preferred characteristics, behavior, or personality to be more impartial in finding the elements that influence respondents' attraction to various animals. Additionally, the author solicited readers' opinions on which personality would be best suited to portray the mascot's character. In terms of design aspects, the author poses questions about the author's favorite shading technique, the most visually appealing lines, favorite basic shapes, eye shapes, mouth shapes, proportions, textures, and colors. To ascertain the

trends and preferences of respondents regarding their favored mascot, the author creates questions centered on the most well-known mascot, the Olympic mascot. Today, the writer attempts to provide responders with a choice depending on the Olympic mascot with the most significant design difference to observe the trend. The author includes questions about the character's motivations to elicit information about the respondent's choice. Along with studying current trends, the author inquiries about the character or characters whose design appeals to respondents and their selection, based on their physical appearance (facial characteristics, body, accessories, armor, etc.) or personality. In conclusion to this first poll, the authors ask respondents for recommendations for a suitable mascot name and why they choose that name.

Table 2. Second Survey Respondent Status

Status	Respondent	Percentage
College Students	674	66.2 %
Alumni	192	18.9 %
SMA/SMK Students	76	7.5 %
Lecturer/Employees	64	6.3 %
Industry Practitioners	12	1.2 %

We developed various alternate design choices based on the preliminary poll replies. We then selected the best three to make it easier for voters in the subsequent survey to choose the pre-final mascots. The second poll, which garnered 1,018 responses, asks voters to select one of the three figures as the pre-final mascot. The second survey's prototype is then refined into a finished mascot design ready to be deployed and commercialized.

5. Results and Discussion

5.1. Inspiration

Inspiration is the first stage in design thinking, and it is one of the processes toward comprehending design difficulties. The issue is the necessity for a mascot that can symbolize the School of Design people as the place where the We Love Design event is held and foster a strong sense of belonging among the institution's students and staff members while also generating cash to sustain the mascot's character. We began this initial phase by conducting a preliminary poll, which we dubbed the preliminary survey. The preliminary survey had 724 respondents addressed as college students, lecturers, employees, alumni, high school or vocational students and design practitioners. Based on the data received from respondents, the initial poll revealed the following findings: most favorite animal, most appealing attribute and personality of this animal, and the personality that is most suited to represent their mascot. We use a personality classification method based on (Kagan et al., 2018), in which individuals are classified as choleric, sanguine, phlegmatic, or sanguine. The sanguine

personality is friendly, enthusiastic, and self-sufficient. Still, it is less responsible, whereas the phlegmatic personality is more stable, peaceful, often indecisive, and Melancholic, focusing on details, logical reasoning, thorough planning, and overthinking.

For concerns about design aspects and principles, such as the shading option for the mascot, we choose four of the most common options: gradient shading, flat shading, shading less, and colorless shading. Some of our inquiries are also about popular outline types, such as thick outlines, thin outlines, colored outlines, and without outlines. We utilized the following three fundamental shapes for the character design: square shape, triangle shape, and circle shape. easier for respondents to choose, such as Adventure Time, which uses large shapes on its body and Sonic, who uses small shapes as accents, the use of textures with special effects, which we represent in the form of bubbles, as well as play with motifs such as splattered paint. For color, we utilize a flat color with 15 choices that are the most commonly used in mascot creation; respondents can select more than one of their preferred colors in this section.

When answering concerns about other pre-existing mascots, we used Olympic mascots, which are accessible in various shapes, colors, and styles. We only provide eight mascot alternatives that best represent various sizes, proportions, colors, and styles. In order to have a better insight into respondents' preferences for popular designs, we also asked them to choose 5 of their favorite mainstream character designs from a variety of styles, with the option to fill in the blanks with their own.

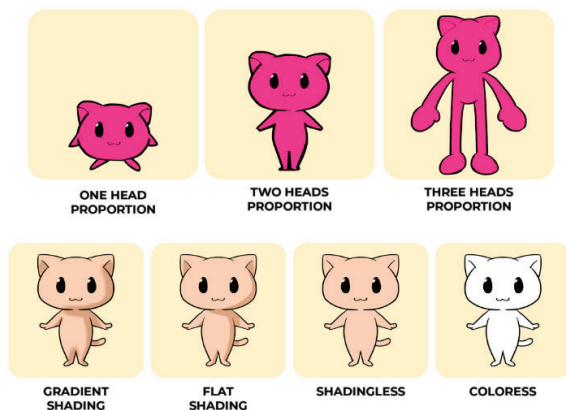


Figure 1. Example of a questionnaire related to design principles and elements

5.1.1 Personality

This research attempted to capture all of the elements and the explanations for each choice to obtain a strong preference from all respondents. In this study, the author emphasized the need to break down design features into sub-parts. Suppose consumer preferences for specific character designs, such as mascots, are not broken down into a few fundamental aspects. They will almost always result in new imitations that are clichéd because they are only copycats of preliminary designs rather than new original designs. When we break down each element into

numerous sections and go deeper into each portion, we can typically capture the essence of the element's selection by starting with the rationale for the element's selection. Then the data can be analyzed again, and use the results to guide our future research efforts.

When asked to identify his or her most favored animal, the respondent may select more than one sort of animal that he or she enjoys. According to the results of this poll, with 218 votes (or 30.11 per cent of 724 respondents), the cat takes the lead as the most popular animal. The cat was followed by the selection of Dogs (167 respondents) and Birds (56 respondents). With the cat family still in mind, the fourth place was taken by the Wildcat category, which includes the likes of lions, leopards, tigers, pumas, lynxes, cheetahs, and jaguars, and was picked by 47 respondents. To capture the spirit of the respondents' preferences, we asked them which characteristics of the respondents' favorite animals they found appealing. The shape was voted the most popular feature by 55% of 724 respondents, or 398 people. Then came the 374 people who voted with their eyes and the 328 people who voted with their feathers. Two hundred ninety-one people voted for color as the fourth most popular option, 234 for paw and 218 for the tail feature.

In terms of the personality traits that respondents believe best reflect their mascot, we divide them into four categories: Choleric, who is a leader, results-oriented, and risk-taker, yet tends to think for himself. Sanguine is pleasant, exuberant, and carefree but not responsible. Phlegmatic is a stable person, a peacemaker, but he hesitates quickly, whereas melancholy has attention to detail, logical reasoning, and thorough preparation, but the negative is overthinking. The results obtained from the respondents' opinions show that the first choice is more on the sanguine personality chosen by 39.1% percent of respondents or 283 people, interestingly, followed by the opposite personality in the second position, namely melancholic which is the choice of 258 respondents.

5.1.2 Design Elements

A mascot is a form that is a unity of numerous aspects so that when a respondent is asked what his favorite character is, it is feasible that he likes a work because it contains the elements required. It is vital to break down the aspects of the mascot one by one to understand the reasoning behind each feature of the mascot. According to respondents, the following number of shading possibilities is preferred: According to the results, flat shading, which is more visually appealing, was picked by up to 507 respondents, or 70% of all participants. Meanwhile, 52.2 per cent of respondents (378 participants) chose the Colored Outline. With 461 respondents or 63.7 per cent of voters, the Circle Shape beat out the other two forms (Square & Triangle) for the mascot's fundamental body shape. Another design element, color, was found to be relatively evenly distributed in specific shades, such as Wheat Cream, which was chosen by 206 participants or 28.5 per cent, followed by Mango (27.6 per cent), Banana (20.7 per cent), Turquoise (20 per cent), Light Gray (19.9 per cent),

Dark Gray (18.1 per cent), Black (15.7 per cent), Fuchsia (13.6 per cent), Crimson Red (12.8 per cent), and Denim Blue (11.7 per cent). Up to 296 respondents, or 40.9 per cent of the total participants, chose the rounded form style reminiscent of the character's face in Adventure Time as their favorite texture.

5.1.3 Body Parts

We do not call into question every element of the mascot's anatomy, but only the most recognized features, such as the eyes, lips, and mascot's proportions. In the eye area, the shape of the eyes, as seen in the Detective Conan film, is favored by up to 227 persons (31.4 per cent), while Button Eyes come in second place with 29.7 per cent. While the favored section of the mouth was the one with fangs, which was picked by 267 participants or 36.9 per cent of all respondents, this was followed by the shape of the cat's mouth, which was chosen by 26.8 per cent of all respondents. Meanwhile, the proportion that respondents deemed appealing was the proportion of mascots with a height of two heads, which reached 60.8 per cent (227 persons).

5.1.4 Other Previous Mascot Existed

To better understand the respondents' trends and behaviors, we give them some pre-existing mascots to choose from and analyze their preference trends. We discuss the Olympics, the world's largest sporting event, which uses mascots to represent its numerous events and activities.

As a result, rather than displaying every available Olympic mascot, we chose only eight representing the most significant variations in terms of design principles and design characteristics such as shape, color, proportion, and tone, to assist respondents in making their choices. We tried to choose mascots representing diversity from the inception of the Olympic mascots in Grenoble 1968 through the mascots used at the Tokyo 2020 Olympics.



Figure 2. Eight Olympic mascots to choose from.

According to responses to questions on the Olympic mascot, 387 respondents chose Wind from the 2020 Summer Olympics in Tokyo as their favorite, while 378 respondents chose Soohorang from the 2018 Winter Olympics in PyeongChang as their second favorite.

Table 3. Reason for choosing Olympics mascot.

Mascot Name	1 st Place	2 nd Place	3 rd Place	Total
Cute, Friendly Shape	407	349	328	1084
imaginative	285	298	293	876
Unique / bold / catchy design	322	253	262	837
Merchandisable	272	259	222	753
Simple shape	253	230	229	712
Dynamic Gestures	279	224	205	708
Neat and solid shape	251	222	225	698
Iconic and powerful silhouette	216	185	178	579
Strong cultural element	144	154	166	464
Attractive accessories	146	139	115	400

Alternatively, if the question is only related to the selected Mascot, the result is creating a new character that is a close copy of the previous character in many ways. This is why the author adds a question addressing why the respondent chose the Mascot above to understand better the deeper motivations that may be utilized as the basis for designing a new character that is not simply a copycat of characters that previously existed.

With 407 votes, respondents who stated that the Mascot was chosen for its "cute, friendly shape" received the most votes. With 322 votes, the reason "Unique / bold/catchy design" was voted into second place, followed by "Imaginative," which received 285 votes, to take third place overall.

Still concerned with trends and behavior, the author raises concerns about the most popular mainstream character, citing the diversity of available characters and the revenue of the character's license. The selection of these characters is based on discussions with a group of academics and students, who make decisions about character shapes and sizes based on current trends and preferences.

Pikachu won the most votes in the top spot, with 240 votes, or 33.1 percent of total responses. Chosen by 154 people, Mickey Mouse is the second most famous character. Darth Vader, on the other hand, receives 104 answers. Winnie the Pooh came in fourth place with 80 replies, followed by Hello Kitty in fifth place with 31 votes.

5. 2. Ideation

After the Inspiration step comes the Ideation step; as a result of the preliminary survey findings described previously, the author team seeks to study the most popular options created by the previous poll to generate multiple possibilities To choose which character to apply as the mascot, the team used the most popular animal as a starting point, a cat, followed by a dog as the second

option. It is just that the cat's character is not immediately used as a mascot; the reason for selecting these animals is a more significant factor in determining which character will be used. The "shape" feature is the most favorite reason, followed by the "eyes" feature in second place, the "furs" feature in third place, the "color" feature in fourth place, the "paw" feature in fifth place, and the "tail" feature in sixth place.

As a result of the above concerns, it has been transformed into a character that contains the power of these features and the power of the locality. Correspondingly, that possesses strengths in the characteristics mentioned before; Tiger is the character that most closely resembles the cat character. We wanted to accentuate the cuteness of the baby Sumatran Tiger by depicting it on a reduced scale and our attempt to select endangered and indigenous animals from this country. The baby Sumatran tiger was chosen as the mascot because, in addition to its strong local content, it possesses all of the characteristics that the survey respondents most favored.

After narrowing the numerous color and texture alternatives to eight, which were then debated internally with the Team, it was agreed to condense the options into the three best options to choose pre-final mascot designs in the final survey, which would make it easier for responders to choose than selecting several possibilities.



Figure 3. Preliminary survey-derived designs.

Along with asking respondents to choose their favorite mascot from the three we had chosen, we asked about a variety of other topics in the final survey, including their favorite merchandise and the team's preferred names, which had been narrowed down based on the names submitted in the preliminary poll, and the most visually appealing survey accessories. Utilized the mascot These accessories are the most exciting items that are ideal for merchandising, as they are derived from products that reflect the creative world and futuristic life, like virtual goggles, tablet stylus, traditional pencil, paper tube bag, backpack, floating skateboard, spokeless bike, flying robot buddy.

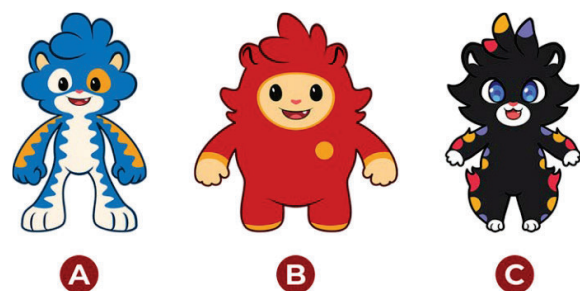


Figure 4. Three options in second survey to choose pre-final mascot designs in final survey.

Table 4. Pre-Final Mascot Choice

Character Personality	Respondent	Percentage
C. Black, Orange, Red, Blue	553	54.3 %
A. Blue, White, Orange	330	32.4 %
B. Red, Cream, Orange	135	13.3 %

According to the final survey results, mascot C was chosen as the most popular of the three mascots, predominantly black with red and blue accents, and was selected by 553 respondents, or 54.3 per cent of 1,018 respondents. Followed by three hundred thirty people voted for mascot A, which features the colors blue, white, and orange, whereas 135 people voted for mascot B, which features the colors red, cream, and orange. As a result of this, mascot C was chosen as the pre-final mascot in the final survey.



Figure 5. Pre-final mascot designs

5. 3. Implementation

The final phase is refinement by improving the pre-final mascot that has been chosen; during this stage, the author team discusses various aspects of the character, such as when they discover that the selected mascot tends to be a more female character. Meanwhile, this character needs to be more gender-neutral to get more appreciation from users. As a result, minor changes to the mascot's look have increased its masculine presence. We also employ the most selected accessories as the mascot's primary

accessories. Now the mascot has been completed and is ready for use.



Figure 6. Final mascot designs

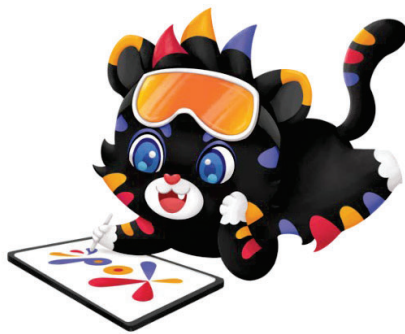


Figure 7. Final mascot in activity

6. Conclusion

To collect and analyze respondents' preferences, we must employ design thinking to create sustainable and appealing mascots. This does not have to be an immediate response. To collect and analyze respondents' preferences, we must employ design thinking to create sustainable and appealing mascots. This does not have to be an immediate response. Creating characters or mascots that copy from existing characters risks creating copycats who continue to replicate themselves without regard for current trends or human behavior, which is a concern. As a result, we added questions in our survey asking respondents to explain why they chose a specific response option. We may discern the essence of the respondent's preferences from their responses to these questions, enabling us to analyze and brainstorm for the more attractive characters to emerge in the final result. The additional study must be performed to ascertain the response and input of members of the institution in issue, in this case, Bina Nusantara University's School of Design.

References

1. S. Hosany, G. Prayag, D. Martin, and W. Y. Lee, *Journal of Marketing Management* **29**, 48 (2013)

2. R. Lin, P. C. Lin, and K. J. Ko, *A Study of Cognitive Human Factors in Mascot Design* (1999)

3. V. I. Kraak and M. Story, *Obesity Reviews* **16**, 107 (2015)

4. The Japan Times (2020)

5. A. Knight, *The Brand Licensing Handbook, Your Essential Guide To The Brand Licensing Industry* (Brand Licensing Europe, London, 2018)

6. J. Gray, *Show Sold Separately: Promos, Spoilers, and Other Media Paratexts* (NYU Press, New York, 2010)

7. A. Patterson, Y. Khogeer, and J. Hodgson, *Journal of Marketing Management* **29**, 69 (2013)

8. G. Malik and A. Guptha, *Journal of Global Marketing* **27**, 128 (2014)

9. R. S. Heiser, J. J. Sierra, and I. M. Torres, *J Advert* **37**, 75 (2008)

10. K. Letheren, B. A. S. Martin, and H. S. Jin, *Tour Manag* **62**, 65 (2017)

11. Debra J. Occhi, *Kumamon Japan's Surprisingly Cheeky Mascot*, 1st ed. (Routledge, 2017)

12. M. Hotogi and M. Hagiwara, *International Journal of Affective Engineering* **14**, 299 (2015)

13. E. J. Carter, M. Mahler, M. Landlord, K. McIntosh, and J. K. Hodgins, *Proceedings of IDC 2016 - The 15th International Conference on Interaction Design and Children* 421 (2016)

14. K. Nosu and M. Tanaka, *IEEJ Transactions on Electrical and Electronic Engineering* **8**, 535 (2013)

15. A. Withell and N. Haigh, *Developing Design Thinking Expertise in Higher Education* (2013)

16. S. K. Fixson and J. Rao, *Learning Emergent Strategies Through Design Thinking.Pdf* (2014)

17. S. L. Nielsen and P. Stovang, *Education and Training* **57**, 977 (2015)

18. K. Dorst, *Des Stud* **32**, 521 (2011)

19. T. Brown, *Design Thinking* (2008)

20. J. H. de Oliveira, 5 (2019)