FINAL PROJECT – TI 141501

INCORPORATING KAWAII DESIGN INTO USABILITY EVALUATION SPECIAL FOR CHILDREN PARTICIPANTS (CASE STUDY: MR SIWA)

FACHREZA REYNALDI NUGROHO
NRP 024 1 14 40000 059

Supervisor
Dr. Adithya Sudiarno, S.T., M.T.
NIP. 198310162008011006

Co-Supervisor
Ratna Sari Dewi, S.T., M.T., Ph.D.
NIP. 198001132008122002

DEPARTMENT OF INDUSTRIAL ENGINEERING
Faculty of Industrial Technology
Institut Teknologi Sepuluh Nopember
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TUGAS AKHIR – TI 141501

PENERAPAN KAWAII DESIGN DALAM EVALUASI USABILITAS SPESIAL UNTUK PESERTA ANAK-ANAK (CASE STUDY: MR SIWA)

FACHREZA REYNALDI NUGROHO
NRP 024 1 14 40000 059

Pembimbing
Dr. Adithya Sudiarno, S.T., M.T.
NIP. 198310162008011006

Ko-Pembimbing
Ratna Sari Dewi, S.T., M.T., Ph.D.
NIP. 198001132008122002

DEPARTEMEN TEKNIK INDUSTRI
Fakultas Teknologi Industri
Institut Teknologi Sepuluh Nopember
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Surabaya

Author:

FACHREZA REYNALDI NUGROHO

NRP 02411440000059

Approved by:

Final Project Supervisor

Dr. Adithya Sudiarno, S.T., M.T.

NIP. 198310162008011006

Final Project Co Supervisor

Ratna Sari Dewi, S.T., M.T., Ph.D.

NIP. 198001132008122002

SURABAYA, JANUARY 2018

THE DEVELOPMENT OF CHILDREN USABILITY QUESTIONNAIRE BY INCORPORATING *KAWAII* DESIGN CONCEPT (CASE STUDY: MR SIWA)

Nama Mahasiswa	: Fachreza Reynaldi Nugroho
NRP	: 02411440000059
Pembimbing	: Dr. Adhitya Sudiarno, S.T., M.T.
Ko Pembimbing	: Ratna Sari Dewi, S.T., M.T., Ph.D.

ABSTRAK

Masalah gigi dan mulut di Indonesia seringkali diremehkan. Ditemukan bahwa 90% anak di Jakarta sedang memiliki masalah yang terkait dengan kesehatan mulut dan gigi, dengan rata-rata tingkat kebersihan mulut dan gigi pada kategori sedang. Kondisi tersebut sangat dipengaruhi dengan tingkat pendidikan, dan dapat diperbaiki dengan melakukan tindak pencegahan primer. Salah satu contoh dari tindak pencegahan primer adalah dengan melakukan edukasi terkait dengan kesehatan mulut dan gigi. Edukasi dapat dilakukan melalui dua metode, yakni konvensional dan non-konvensional. Metode konvensional masih dapat digunakan untuk meningkatkan kesehatan mulut dan gigi, namun tidak dapat memberikan dampak yang berkelanjutan untuk menjaga kesehatan mulut dan gigi pada anak-anak. Metode non-konvensional menjadi pilihan untuk mengatasi masalah tersebut. Sebuah riset di Malaysia membuktikan bahwa metode non-konvensional memberikan hasil yang lebih baik dalam hal kesadaran dan keberlanjutan anak-anak untuk menjaga kesehatan gigi.

Hasil penelitian yang dilakukan di SDIT Luqman Al-Hakim dan SD Yapita menunjukkan bahwa kuesioner KUE (*Kawaii Usability Evaluation*) *valid* dan *reliable*, yang ditunjukkan dengan angka *Pearson Correlation* serta *Cronbach's Alpha* yang bernilai signifikan untuk semua butir pertanyaan. Selain itu, ditemukan bahwa kuesioner KUE telah didesain tanpa menunjukkan indikasi kecondongan pada jenis kelamin tertentu, sehingga dapat digunakan secara *universal*.

Hasil observasi menunjukkan bahwa MR SIWA mampu memberikan kontribusi terhadap penambahan ilmu mulut dan gigi pada anak-anak dengan nilai rata-rata nilai kuesioner sebesar 4,072 yang didukung oleh hasil *pretest* dan *posttest* yang menunjukkan perbedaan nilai secara signifikan pada *confidence level* 95%. MR SIWA juga telah didesain tanpa kecenderungan terhadap gender tertentu dilihat dari hasil kuesioner pada sampel perempuan dan laki-laki yang tidak memiliki perbedaan signifikan.

Selain itu, ditemukan bahwa MR SIWA hanya memerlukan *minor improvements* dilihat dari nilai terendah pada butir pertanyaan 1 dan 2 dengan nilai masing-masing sebesar 3,778 dan 3,789.

Kata kunci: anak-anak, usabilitas, *kawaii*, mulut, gigi, kuesioner, MR SIWA

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THE DEVELOPMENT OF CHILDREN USABILITY QUESTIONNAIRE BY INCORPORATING *KAWAII* DESIGN CONCEPT (CASE STUDY: MR SIWA)

Name : Fachreza Reynaldi Nugroho
Student ID : 02411440000059
Supervisor : Dr. Adhitya Sudiarno, ST., M.T.
Co Supervisor : Ratna Sari Dewi, S.T., M.T., Ph.D.

ABSTRACT

Oral and dental health problem in Indonesia is often underestimated. In Jakarta, 90% of children are facing health problems related to mouth and teeth, with the average oral and dental hygiene classified as medium category. Such condition is majorly affected by the education level, and could be improved by conducting primary preventive action. One of the primary preventive action is by educating people on oral and dental health. Education on oral and dental health could be done in two ways, using conventional and non-conventional method. Conventional method actually is still relevant, and could be used in improving oral health, but it fails to maintain sustainability of mouth and teeth health among children. To solve such problem, non-conventional method is used. A research conducted in Malaysia proves that non-conventional method gives a better result in terms of awareness and sustainability.

Research results in *SDIT Luqman Al-Hakim* and *SD Yapita* shows that the KUE (Kawaii Usability Evaluation) questionnaire is valid and reliable, proven by the value of Pearson Correlation and Cronbach's Alpha that is significant for all question items. Moreover, it is found that KUE questionnaire is designed without any inclination towards specific gender, which means that KUE questionnaire is gender universal.

Observation result shows that MR SIWA could give a significant contribution in increasing children's knowledge regarding mouth and teeth with average questionnaire score of 4,072 that is supported by the pretest and posttest score that has significant difference on confidence level of 95%. MR SIWA is also designed without any inclination towards specific gender, proven by the questionnaire result of both male and female samples that has no significant difference.

It is also found that MR SIWA only needs minor improvements that is taken from the lowest average questionnaire score from question item 1 and 2 with the score of 3.778 and 3.789 respectively.

Key words: children, usability, *kawaii*, oral, dental, questionnaire, MR SIWA

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PREFACE

First of all, the writer wants to express gratitude to Allah SWT, because of his bless and grace that the writer could finish this report on time. The writer could finish this report with the help and contribution from various parties, who gives continuous support for the writer. Therefore, in this opportunity the writer wants to express the gratitude towards,

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The Author realizes that this report is far from excellent, therefore comments and advices are accepted for future improvements. The author also apologizes if there is any mistake that exists in this report.

Surabaya, 24th of October 2017

Fachreza Reynaldi Nugroho

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CHAPTER 1
INTRODUCTION

In this chapter, there will be explained about the research background, problem formulation, research objective, research benefit, problem limitation, assumption, and research report systematic.

1.1 Background

Mouth and teeth are two human body parts that should be kept healthy. They are vital since they process foods and other nutrients to provide energy for performing daily activities. Various researches have been done to find evidences about effects of periodontal diseases (gum diseases) to other kind of diseases. According to a research done by evaluating 256 cardiac patients in Finland, people with poor oral health diagnosis is a strong predictor of heart disease. Other researches also advised that poor oral health causing periodontal disease has some kind of connection with various diseases, such as cardiovascular disease, stroke, diabetes, and chronic pulmonary disease (Brown, 2013).

In Indonesia, mouth and teeth problems are often underestimated. A research by Hastuti & Andriyani (2010) found that 89% children under 12 years old are suffering from illness related with mouth and teeth. In Jakarta, 90% of children are facing health problems related with tooth cavity, and 80% are suffering from gum diseases. Another research in Jakarta states that the average oral and dental hygiene of 4^{th} until 6^{th} grade elementary school students is classified in the medium category, which is 53.8% from all of the examined student (Alhamda, 2011).

Various factors have impacts on the oral and dental hygiene of a person (Basuni, 2014). Among all of those factors, educational level becomes one of the most significant factor. Education level has a major influence towards knowledge, attitude, and behavior of a healthy lifestyle. A person with high educational level could have better knowledge about mouth and teeth, which may also affect person's attitude and behavior on a healthy lifestyle, such as the utilization on healthcare services. Existing gap between education levels may cause an effect on how people

use healthcare service, in relation to knowledge variation towards dental health knowledge. People with less knowledge on dental health and its consequences may cause people to neglect the option of using available healthcare service. In the end, low utilization on healthcare service will also provide significant contribution towards poor dental health (Basuni, 2014).

There are various actions that could be done to improve the level of oral and dental health for children. One of the alternatives is by doing primary preventive actions. This actions cover various methods that are conducted before clinical problems emerge. In other words, primary preventive actions are performed before the disease affects the children's health condition. One example of the primary preventive actions is by educating the people on oral and dental health. The health education (Angela, 2005) includes mouth hygiene, sugar diet, and periodical doctor visit. Information transfer also should be done continuously to the mothers and children. In giving health information, economic condition, social status, culture, and education level of mothers should be taken into consideration so that the information could be received well by the children. On the other hand, age, intelligence level, and physical capabilities becomes the main consideration in information transfer to children. Given information should cause positive impacts in motivation and responsibility level in maintaining the oral and dental health. Local clinic, hospital, and dentist workplace could be the alternatives in performing the oral and dental health education.

Information transfer in oral and dental education could be done using various methods, which are generally divided into conventional and non-conventional method. A research done in Malaysia (Sinor, 2011) compares conventional (using health education by dental nurses) and non-conventional method (using cartoon animation). The result shows that conventional method such as the education given by dental nurses was still effective in delivering oral health education. However, the conventional method was fail to maintain the sustainability of mouth and teeth healthcare among children. Meanwhile, the measurement using knowledge, attitude, and practice (KAP) scores between two groups who received different treatment in education method (conventional and non-conventional) shows that

children group who was given non-conventional method actually shows more effective result compared to children group who was given conventional method.

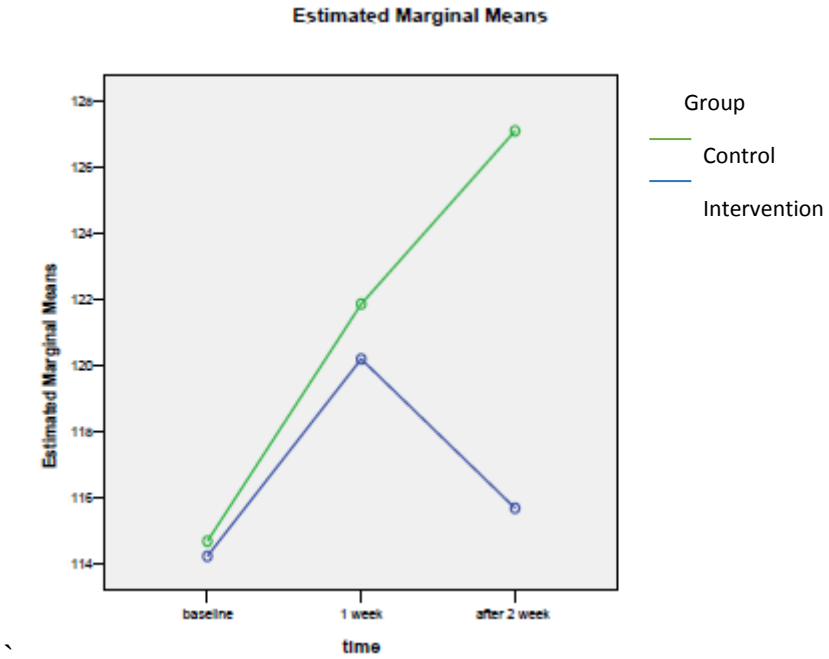

Figure 1.1 Graph of KAP Score vs Time (Sinor, 2011)

Based on results shown on figure 1.1, the level of KAP scores between two groups of control (conventional) and intervention (non-conventional) in baseline period has no significant difference. After one week receiving the education, the gap starts to become wider, and it becomes clear in second week that the conventional education method has lost its sustainability. Non-conventional method proves to provide better effectiveness in terms of sustainability, as most of children's ability in absorbing information is hugely influenced by the used media. Cartoon animation method will provide an alternative to integrate the messages into video, audio, graphic, text, and animation, which will make the children give more attention as it becomes more attractive.

One example of non-conventional method is by using mixed reality. Mixed reality is the result of blending the physical world with the digital world that uses the developed technologies in computer vision, graphical processing power, display technology, and input systems. Mixed reality is a form offering interactive technology that gives opportunities in designing highly immersive story-worlds, becoming one possible alternative in conducting oral and dental health education

(Microsoft, 2017). Nowadays, mixed reality becomes one popular method for various uses, such as training and educational purpose. This is supported by the evidence that shows the increase in number of articles containing keywords "virtual reality" or "augmented reality", "mixed reality", and "training" in Scopus, web of knowledge, and IEEExplore from 1990 to 2013 (Borsci, et al., 2015).

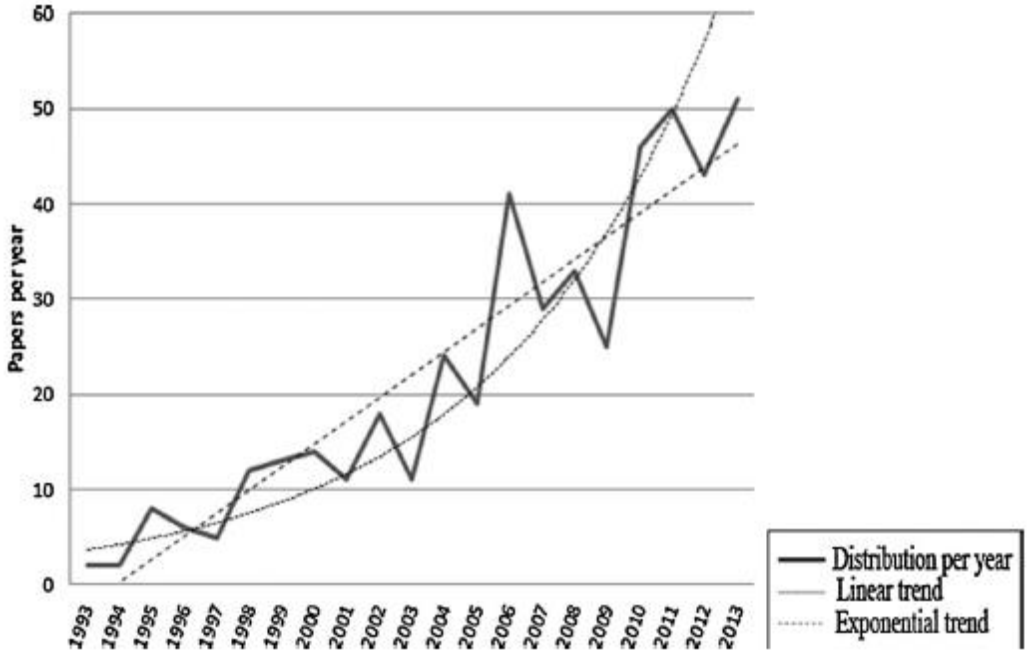

Figure 1.2 Positive Trend in Article about AR, VR, MR, and Training (Borsci, et al., 2015)

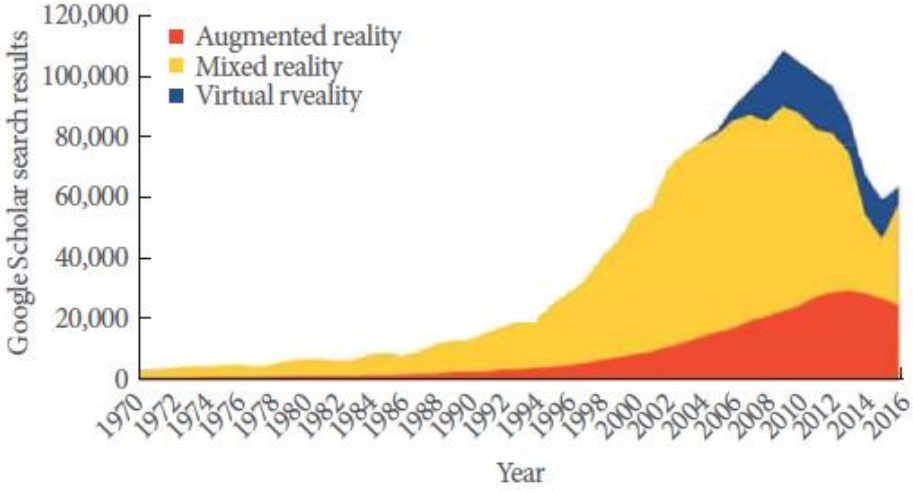

Figure 1.3 Keyword Occurrences for Specific Topics in Google Scholar (Hamacher, et al., 2016)

Figure 1.2 shows that a significant increase in number of article exists over the span of 1993 until 2013, supported with the facts shown in figure 1.3 where the number of keyword occurrences for augmented reality, mixed reality, and virtual reality are increasing, showing that most people have a high interest in this topic. It could be said that most of the people starts to recognize the benefit of mixed reality, where it starts to be explored deeper for various practical implementation in many sectors. In health sector, mixed reality has been utilized for multiple cases, ranging from assistive system, medical simulation, and health education system.

The mixed reality technology founds itself a critical role in developing the existing system, increasing the efficiency and effectivity. Mixed reality (Stantchev, 2009) could become the bridge that connects specific patient requests that needs a high amount of resource on the medical institution, with the process flow that supports the information systems. On other case, mixed reality has also been used for neuroscience/psychotherapy. Using mixed reality, there are various therapies and rehabilitations that could be conducted, such as curing phobias including agoraphobia, acrophobia, eating disorder and fear of flying (Hamacher, et al., 2016).

Other example of non-conventional education method is by using pop-up book. The term pop-up book was first used by a New York company called as Blue Ribbon Press, during the economic depression in 1932 (Rubin, 2005). The company also produced pop-up books that are sold for children, with cartoon characters and funny stories. The examples of published creations are Popeye, Dick Tracy, and Little Orphan Annie

Based on the facts shown above, there is a high potential that mixed reality could be used as an interactive media in increasing health awareness on children. Utilizing such opportunity, MR SIWA is created as an interactive education media. MR SIWA comes from the name "Mixed Reality – *Sinau Waja*". "*Sinau Waja"* is a Javanese term, which means "*Belajar Gigi*" in Indonesian. MR SIWA is an interactive educational media that implements mixed reality technology, which is combined with pop-up book as the tangible object. Along with the fact that the ability to absorb information in children below 12 years old are highly influenced in the used education media, MR SIWA could be used to improve the learning

process for children's oral and dental health. In designing an interactive media, there is one concepts that is popular for producing positive feelings, which is mainly called as *kawaii*. *Kawaii* (Buckley, 2016) comes from Japanese terminology, which is similar to cute. *Kawaii* (Nittono, et al., 2012) is found to affect individual's focus and attention improved after viewing cute images, which could be used in designing an interactive education media that attracts children's attention.

Even so, the usability of education media needs to be measured. Moreover, children (Druin, 1999) has its own environment that researchers would need to understand. Interactive for adults may differ from children perception of interactive. To measure the interactivity of education media, general usability evaluation method for adults cannot be used directly, since it could affect the accuracy of evaluation result. Therefore, it is necessary to design an evaluation tools that could be used towards children participants, on the other words; children usability testing.

To cope with the problems stated above, this research will be aimed to measure the effectiveness of oral and dental educational media using mixed reality into a pop-up book towards children, in terms of children usability and *kawaii* design. The usability measurement will be measured using a new questionnaire, which would be named as KUE Questionnaire (Kawaii Usability Evaluation Questionnaire). Then, using the result on the testing, improvements could be given to enhance the benefit that could be gained by using the education media.

1.2 Problem Formulation

Based on the background explained in previous subchapter, this research will focus to evaluate the usability MR SIWA as an oral and dental health education media by using KUE questionnaire that is considering the concepts of children usability and *kawaii* design.

1.3 Research Objective

The objectives that could be achieved by conducting this research are:

1. Ensuring that using MR SIWA provide better result for the children to understand about mouth and teeth health rather than traditional method

2. Identifying the evaluation parameters for usability testing towards children participant, using the concepts of children usability testing and *kawaii* design.
3. Designing a measurement tool in children usability testing.
4. Checking validity and reliability of KUE questionnaire.
5. Evaluating the usability of MR SIWA as an education media for children in terms of design
6. Proposing an improvement for MR SIWA to increase its effectiveness as oral and dental education media when the result shows improvement is necessary.

1.4 Research Benefit

Benefits that could be gained from conducting this research are:

1. Reducing the number of oral and dental problems in Indonesian children population.
2. Increasing children awareness on oral and dental health.
3. Providing children with the knowledge on how to keep oral and dental health.
4. Proving the validity and reliability of KUE questionnaire for the usage of usability testing towards children participants.

1.5 Research Limitation

This research is done with some considerations on the limitations for increasing the insight on the results. The limitations for this research are:

1. The usability testing is conducted in *Sekolah Dasar Islam Terintegrasi* Luqman Al-Hakim and *Sekolah Dasar* Yapita Surabaya.
2. The samples taken for this research are limited to the students of 4^{th} and 5^{th} grade.

1.6 Research Assumption

This research is done with some considerations on the limitations for increasing the insight on the results. The limitations for this research are:

1. There is no change in knowledge regarding mouth and teeth health among the students beside intended changes occurred in this research during research period.

2. All of the students have never been formally taught about mouth and teeth health prior to this research.

1.7 Report Writing Systematic

The research report consisted of several systematical chapters that are used to record the process of research. The chapters used in this report are explained below.

CHAPTER 1 INTRODUCTION

This chapter consists of introduction towards the research process, including the research background that supports this research, problem formulation to identify the problems that is about to be solved, research objective, research benefit, research limitation, and report writing systematic.

CHAPTER 2 LITERATURE REVIEW

This chapter is comprised of explanation from the theories that is used to support the research process. Theories that are used comes from various references, such as books and journals. The theories used for this research mainly comes from dental health and cognitive ergonomic study field. Specifically, the theories used in this research are mouth and teeth, education media, kansei engineering, and usability testing.

CHAPTER 3 RESEARCH METHODOLOGY

This chapter consists of methods that will be used in the research. The research methodology will be used as the basic reference in conducting the research process so that it could run systematically. The research methodology will include the research phases and necessary steps that needs to be done in a research.

CHAPTER 4 DATA COLLECTION AND PROCESSING

This chapter consists of the data collection and processing that will be used in this research. The collected data includes primary and secondary data. The data will be collected and then processed using suitable method.

CHAPTER 5 DATA INTERPRETATION AND ANALYSIS

This chapter consists of data interpretation and analysis related to the processed data in previous chapter. The analysis would discuss about the usability testing on oral health educational media.

CHAPTER 6 CONCLUSION AND SUGGESTION

This chapter consists of drawing conclusions based on research objective that has been formulated in previous chapter, while also giving suggestions for future researches.

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CHAPTER 2
LITERATURE REVIEW

This chapter explains about the theories that are related and used in supporting this research. The theories included are about mouth & teeth, educational media, kansei engineering, and media testing.

2.1 Education Media

Education can be done in many ways and methods, formally and informally. When it is related with technology applied to the media, there are two general classification, which are traditional methodology and modern methodology (Boumová, 2008). Traditional methodology is a conventional way on knowledge transfer using methods such as formal education, which focuses on the examinations and results rather than understanding of concepts (Nazzal, 2014). Ideally (Kumar, et al., 2015), education should result in a motivation and inspiration that emerges in the participant's mind, as it will become the trigger in changing wrong habit regarding oral and dental health. As traditional method mostly just fills the participants with knowledge, it is found to be problematic in terms of sustainability (Sinor, 2011). Traditional method focuses on giving knowledge via various methods to the participants, such as lectures, assignments and articles, then testing the participants with a set of questions that will challenge the participants on how well the knowledge has been understood.

Moreover, as children tends to get bored easily, an education method using traditional method is less recommended. Therefore, a modern method using technology to design an interactive education media is needed to motivate children in learning various knowledge that would be necessary for the future.

2.1.1 Pop-up Book

Pop-up books are books containing mechanical properties inside it, making it possible to create moving contents, enhancing the reality of information to be obtained by the reader. Pop-up books (Townsend, 2011) are initially called as

“movables”, and it was created only for limited population, excluding children as its target. It is only in 19th century where the pop-up book starts to be produced for children. Pop-up books exist even before most of printed books exist. The overall history of pop-up book development could be seen in table 2.1 below

Table 2.1 History of Pop-up books

Time	Event
1100s	Invention of Liber Floridus, an encyclopedia that has a gatefold opening to show the Globus Terre. This encyclopedia was created by Lambert of St. Omer
1200s	Matthew Paris, an artist, historian, and Benedictine monk from Britain, uses gatefolds to map pilgrimage routes from England to Holy Land and Jerusalem. He is recognized as the first paper engineer to be ever born
1300s	Ramon Llull, mystic from Majorca, used volvelles to organize a collate of human knowledge into a book
1450	Johannes Gutenberg creates a movable type of the Bible
1540	Petrus Apianus (Peter Bienewitz) created Astronomicum Caesareum (The Emperor's Astronomy) for Charles V in Ingolstadt, Germany. The book uses volvelles to depict the movement of heavenly bodies (sun, planets, and moon)
1765	Robert Sayer invented the first movable for children that is generally called as Harlequinade, featuring popular character in that era
1800s	The beginning of first golden age of pop-up books, started with the creation of paper dolls (The History of Little Fanny, S.J. Fuller-1810), then movable paper becomes popular and is frequently used for books especially in England and Germany
1847-1925	Lothar Meggendorfer, recognized as the genius in paper engineering, invented rivets that could perform multiple actions using one tab
1914-1918	The moment World War I (WW I) occurs, production of movable books decreased significantly because of hand labor, paper, and printing media scarcity
1929	S. Louis Giraud, starts to create a true pop-up books, that emerges by flipping the pages
1932	The term "pop-up book" is first used by Blue Ribbon Press, while also creating a series of books featuring various cultural icons, such as Mickey Mouse, Flash Gordon, and Dick Tracy
1950s	Vojtěch Kubašta begins creating pop-up books and ephemera in Czechoslovakia
1965	The beginning of second golden age of pop-up books, where Waldo Hunt forms Graphics International, which later uses pop-ups for advertising. Graphics International is then bought by

Time	Event
	Hallmark Cards, producing an original series of pop-up books for children. Waldo Hunt then forms Intervisual, that later becomes the biggest pop-up book packager in US
1994	Ann Montanaro forms Movable Book Society for collectors, artists, librarians, and packagers of pop-up books

2.1.2 Mixed Reality

Mixed reality (Bowman, 2008) is a technology that combines both virtual and real objects into the real world, implementing both holographic and immersive experience into one interface. Mixed reality (Milgram & Kishino, 1994) is one of the most versatile technology compared to another visual technology, which is able to be perceived anywhere between the spectrum of virtuality continuum.

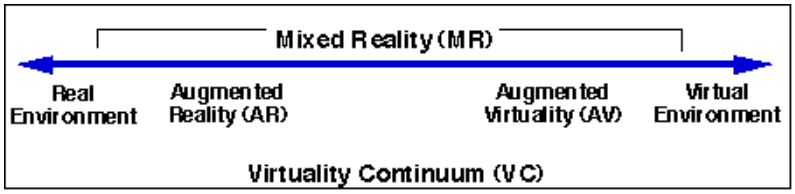

Figure 2.1Virtual Continuum (Milgram & Kishino, 1994)

Mixed reality (Gijevski, 2016) combines both holographic and immersive information in the real world, which means it could as well located anywhere between real and virtual environment. Meanwhile, Virtual Reality (VR) is a completely immersive world, which is located nearer to the right spectrum of virtuality continuum. On the other hand, Augmented Reality (AR) is a technology that overlays digital objects into the real world, which is located nearer to the right spectrum of the virtuality continuum.

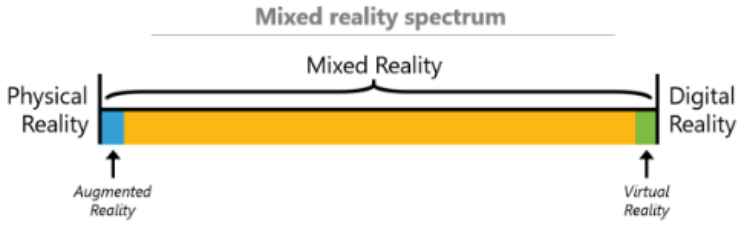

Figure 2.2 Difference between AR, MR, and VR in Virtuality Continuum (Microsoft, 2017)

2.2 Kansei Engineering

Kansei Engineering (Nagamachi, 1995) is a method in product design and development that tries to interpret consumer's feeling (kansei) for a product into attributes that will be used in designing a product. The term "kansei" comes from Japanese language (Nagamachi, 2001), which comes from individual feeling and impression towards a certain object, graphical projection, or another input that could be captured by human senses of touch, sight, auditory, smell, and taste.

The term kansei itself does not have direct translation, as it roots from Japanese culture. Kansei consisted of two kanji characters of "kan" and "sei", meaning sensitivity or sensibility when it is combined.

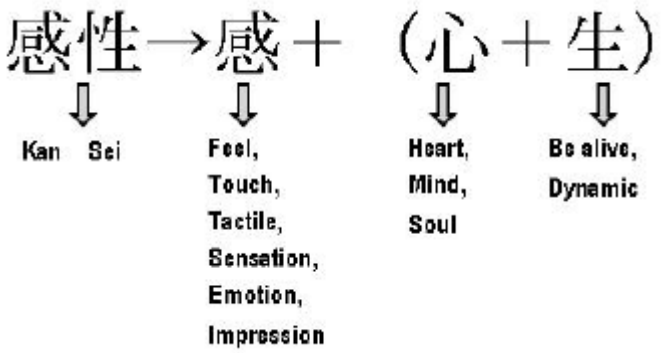

Figure 2.3 Etymology of Kansei (Lee, et al., 2002)

As kansei is termed as sensitivity, it would be logical that every individual possess different kansei. There will be people with rich kansei (Anitawati & Lokman, 2010), is an individual rich in mental feelings, such as sentiments and emotion. To measure it, a direct method could not be used since kansei is an implicit concept. To measure kansei as a parameter in product development, observer does not directly observe the kansei, but is approached by the causal factors and the consequences resulting from the kansei itself (Lévy, et al., 2007). Measuring kansei could be done from the sense activities, psycho-physiological, internal factors, and behavioral responses. Physiological and behavioral response could be seen from measurements, such as electromyography, heart rate, electroencephalography, or participant's expression.

2.2.1 Kawaii Design

Kawaii is one of a Japanese term that is closely related to emotional feeling (Yanagi, et al., 2014). *Kawaii* (Sugano, et al., 2013)is one of Kansei categories that is translated into psychological response similar to cute, lovable, and charming. The perception of *kawaii* is stimulated by the existence of *kawaii* objects or *kawaii* interfaces, which could result in measureable physiological response, such as heart beat change. Various studies have found that *kawaii* design is affected by several characteristics such as shapes, colors, materials, and combination of those characteristics.

Kawaii design (Laohakangvalvit, et al., 2017) has been implemented into various success product, such as Hello Kitty and Pokémon. Nowadays, kawaii becomes one of the kansei values that is critical in Japanese manufacturing companies. *Kawaii* first emerged in Japanese culture during the Heian Period, ranging from 794-1185 AD. Originally, *kawaii* was termed as *kawayushi* during these period, with literal meaning of "pity". *Kawayushi* is first used in *Konjakumonogatarishu* (Tales of times now past), one of the biggest Buddhism literature in Japan created at the end of Heian Period. Kawayushi is also used during Taisho Period until the end of 1945, where it then changes into shorter term which is known as "*kawayui*". Then it changes once again, now into the word that is more familiar to youngster's ear, *kawaii*.

2.2.2 Kawaii Factors

A book under the title "Art and Technology of Entertainment Computing and Communication" states that "cuteness includes the feelings and emotions that are caused by experiencing something that is lovable, charming, cheerful, happy, funny, or something that is very sweet, innocent, or pure. It can stimulate a feeling of adoration, sympathy, or stimulating the care response." (Cheok, 2010). Kawaii has various interpretation, but it is difficult to determine which one is the most accurate interpretation. For example, kawaii may actually translated as loveable, but love is not the emotion of cuteness, in a similar way which happiness is not the same as awe. In this book, there are several research result in factors that affects perception level of *kawaii* products (Cheok, 2010), including:

1. Color

The respondents consisting of both children and adult group are given choice of 16 color hues between color spectrum, with preferences focusing between primary hues of red, blue, purple, with few respondents choosing green and yellow. The result shows that children tend to choose bright colors when presented with color samples from limited color spectrum. Children also tend to choose pure end of the spectrum when presented with color hues, meaning that children show a significant preference for primary hues, specifically the greenish blue and reddish shades.

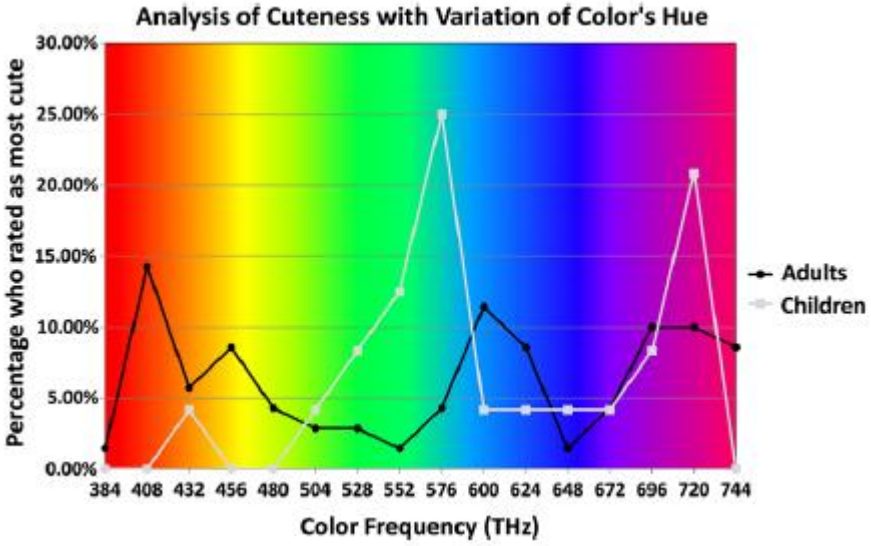

Figure 2.4 Color Spectrum in *Kawaii* Design Analysis (Cheok, 2010)

The preference for choosing a color are affected by various factors coming from personal differences, also symbols and analogies that are natural, instinctually defined, and culturally conditioned. For example, in natural perspective red, orange, and yellow are seen as the color symbol for youth and vitality. In cultural perspective, bright colors are often used for babies and children to show innocence and purity.

2. Texture

To determine the best texture that is recognized as *kawaii*, the participants are presented with multiple objects with various texture, where the participants are required to fell the texture without looking at it. The participants then select the *kawaii* rating for every texture with choices associated to likert scale,

such as “very cute”, “somewhat cute”, “neutral”, “somewhat not cute”, and “not cute at all”.

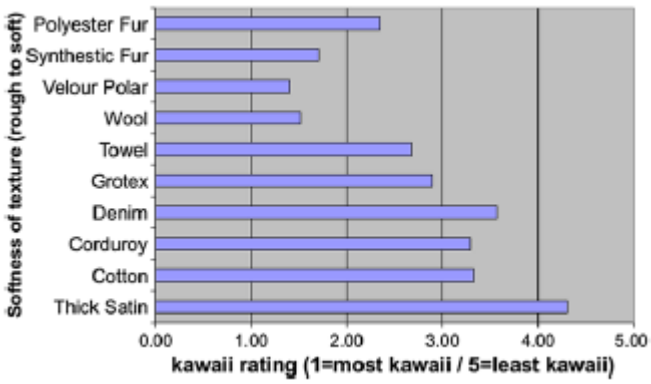

Figure 2.5 Results on *Kawaii* Level of Each Texture (Cheok, 2010)

The results show that thick satin is the texture type with the highest *kawaii* level recognized by the participants. This is caused by the instinctual perception with examples seen in nature. For example, participants may perceive the texture of thick satin as the furs of kitten and puppy. The perception and analogy to participant’s experience could affect the participant’s decision on *kawaii* level of a texture.

3. Motion

To measure kawaii level on motion factor, participants were shown brief animations of black circle that moves around in the screen. The participants will need to give “cute” rating for each motion clip that shows one kind of a movement. Beside ratings, the participants are able to give open feedback on each motion clip. The result shows that the cutest motion is the horizontal movement (left to right) with small hopping motions. The open feedback also gives similar result, where the participants prefers movement that depicts animal movement with small steps.

4. Sound

The participants were given several audio clips that comes from same melody but with different range of notes (pitch). After listening to the audio clip, participants were asked to give impressions by selecting “cute” rating. The participants show preference in melody with high pitch.

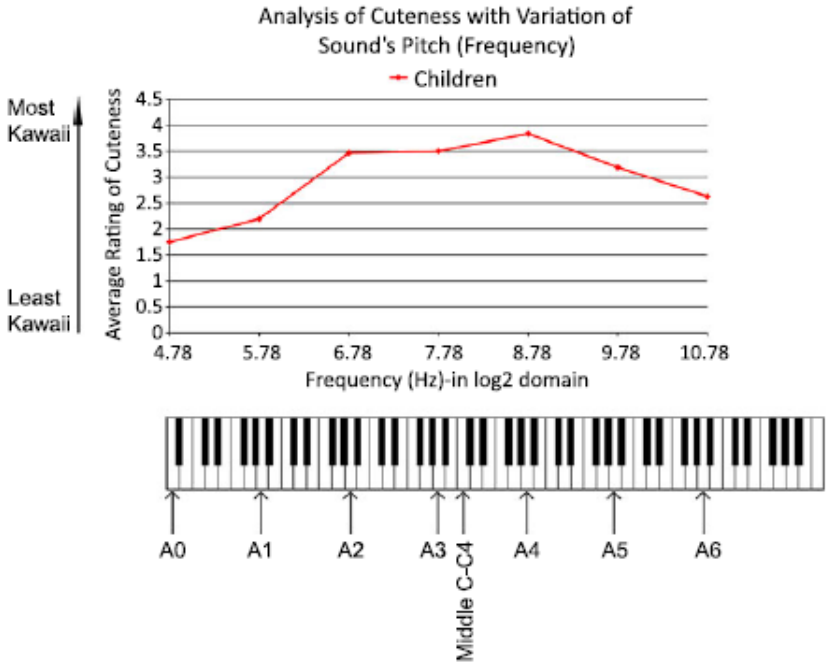

Figure 2.6 Result Chart of Sound Measurement in Terms of *Kawaii* (Cheok, 2010)

Beside pitch, there are several factors affecting the sound's cuteness level, such as tempo, rhythm, instrument or voice, sound envelope, echo, and timbre. Sound, in terms of cuteness, are also perceived through participant's experience with sounds occurring in nature. Most of sound-emitting objects in the nature gives a high sound frequency when is affected with positive feelings, such as happy and cuteness. But it does not mean that higher pitch means higher cuteness, but there are some limitations to the sound pitch, as shown in figure 2.6.

5. Size and Proportion

In the test for size and proportion, the participants are given 2 kinds of test to measure participant's preference towards size, head-body proportion, and relation with "cuteness". The first part of the test is started when the participants were presented with three different scenes with several objects. The participants will need to choose which object with specific size that is perceived as most "cute". The test is done several times with several other objects. The result of the test shows that objects with smaller size compared to other objects are preferred by the participants.

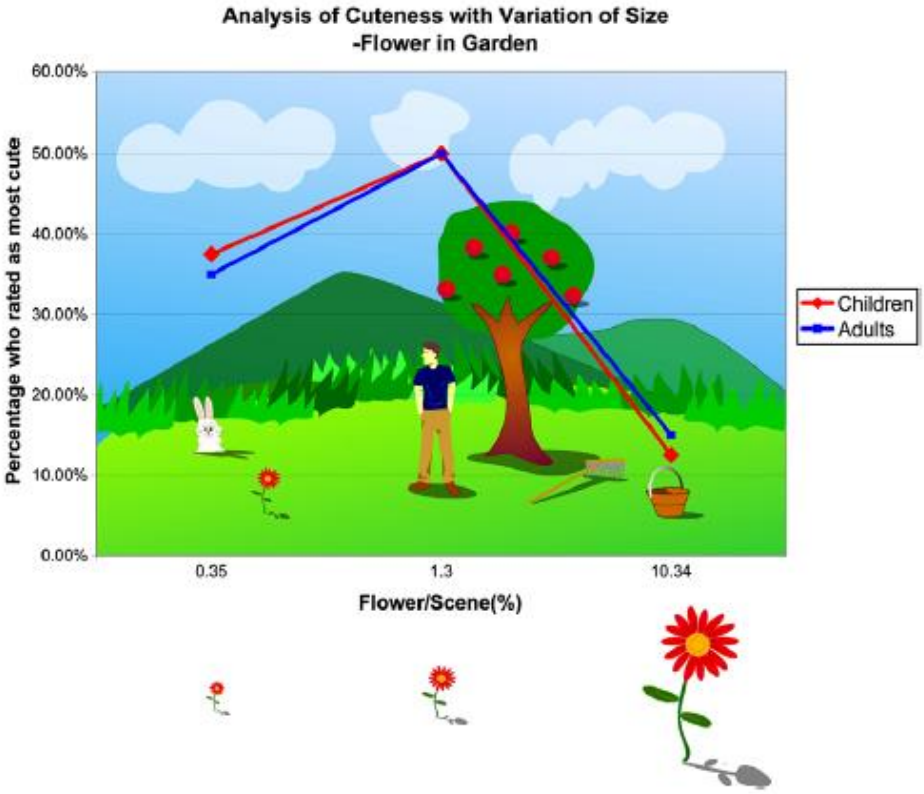

Figure 2.7 Participant's Preference on each Flower Size (Cheok, 2010)

The second part of the test covers the participant's preference towards object's proportion. The test covers many kinds of objects with various proportions. The tested objects are human, cow-like animal, and mushroom, with 4 kinds of proportion. Between all variations, the participants were asked to choose picture that is most "cute".

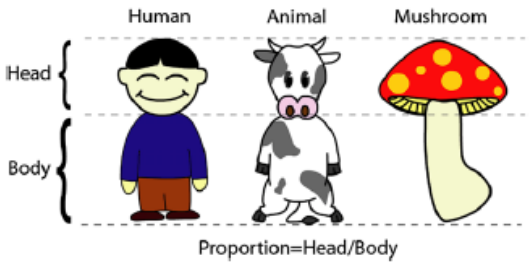

Figure 2.8 Body and Head Section for Each Object (Cheok, 2010)

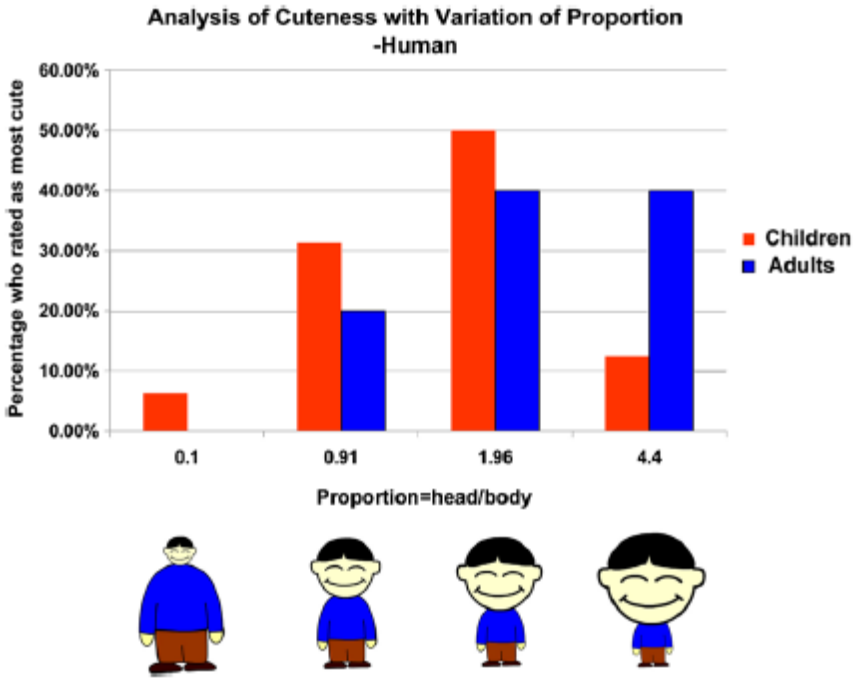

Figure 2.9 Human Proportion Result for Children and Adult Respondents (Cheok, 2010)

First, the respondents are presented with 4 proportion variation on human character design. Proportion is defined as the comparison between head size and body size, thus larger proportion value means larger head, otherwise smaller body. The result shows that most respondent prefers head-body proportion of 1.96, where the head is more or less two times bigger than the body.

But, there is a little difference occurred between adult and children respondent. Compared to adult respondents that choose designs with bigger head, children respondents prefer designs with a more "normal" head-body proportion. Half of children respondents choose head-body proportion of 1.96, while about 30% of children respondents choose proportion of 0.91.

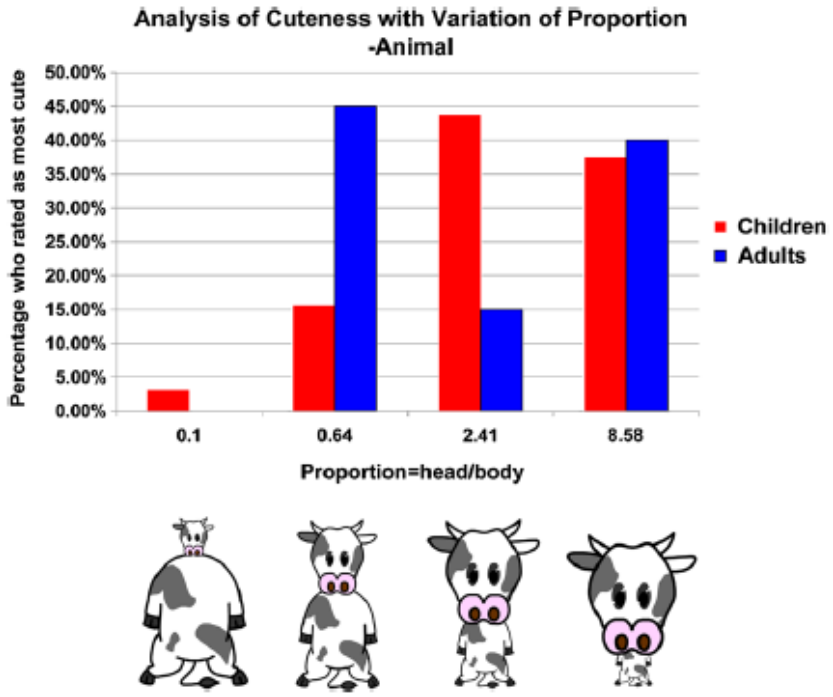

Figure 2.10 Animal Proportion Result for Children and Adult Respondents (Cheok, 2010)

Then, the respondents are presented with 4 proportion variations of animal character, which is shown in figure 2.10. Similar with the human object, the respondents tend to choose animal characters with larger head, except that there are adult respondents who prefer characters with small head which is 0.64.

Then, the last test uses mushroom character as the subject. The respondents are also presented with 4 types of head-body proportion from mushroom character, and the result shows no significant difference with previous two tests, where the respondents prefers bigger head, but with a certain limit. In this test, the respondents mostly choose the design with head-body proportion of 4.48.

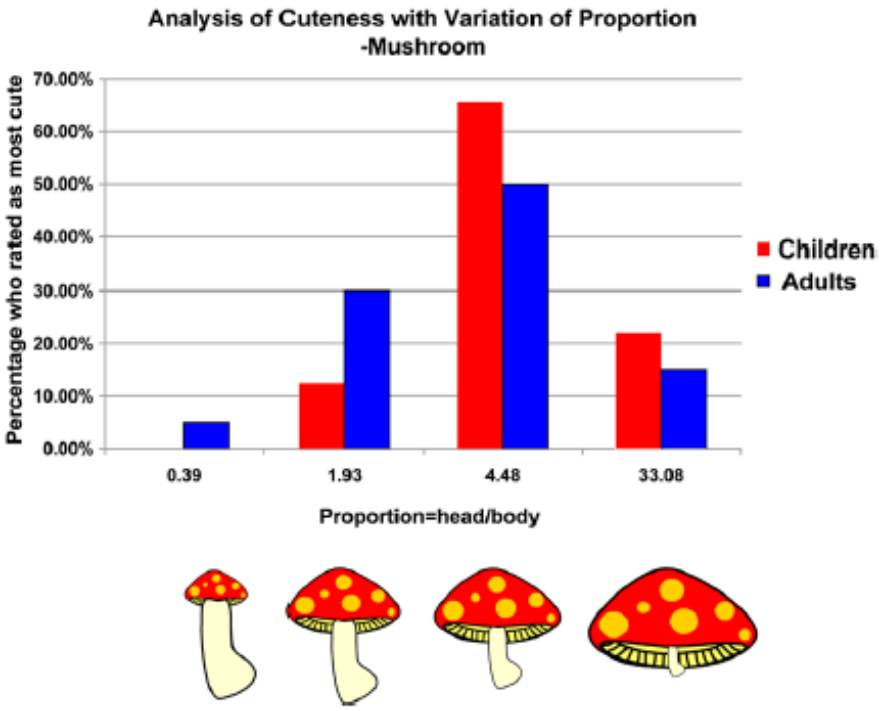

Figure 2.11 Mushroom Proportion Result for Children and Adult Respondents (Cheok, 2010)

The result shows that there are several differences for children and adults. Children respondent shows similar tendency in choosing proportion type, while adult respondents show tendencies into selecting objects with larger head, except for animal object.

Generally, most of the respondent chooses designs with larger head, which is usually related to several natural analogies, such as proportions of a baby. Usually, babies have a bigger head-body proportion compared to other age groups, and most of the people thinks that babies are cute.

6. Shapes and Form

The measurement for shapes and forms are done by instructing the participants to choose between shapes with different roundness in the corners and edges. The result for cuteness level on corner's roundness shows consistent result, where the respondent tends to choose rounder objects. As for cuteness level test on edge's roundness, there is one result that shows interesting fact. It is shown on the children's response towards edge roundness. Even though that the highest cuteness level is on an object with round edge, but there are several respondents who are

choosing objects with sharper edges, maybe because of its association with star-shaped object.

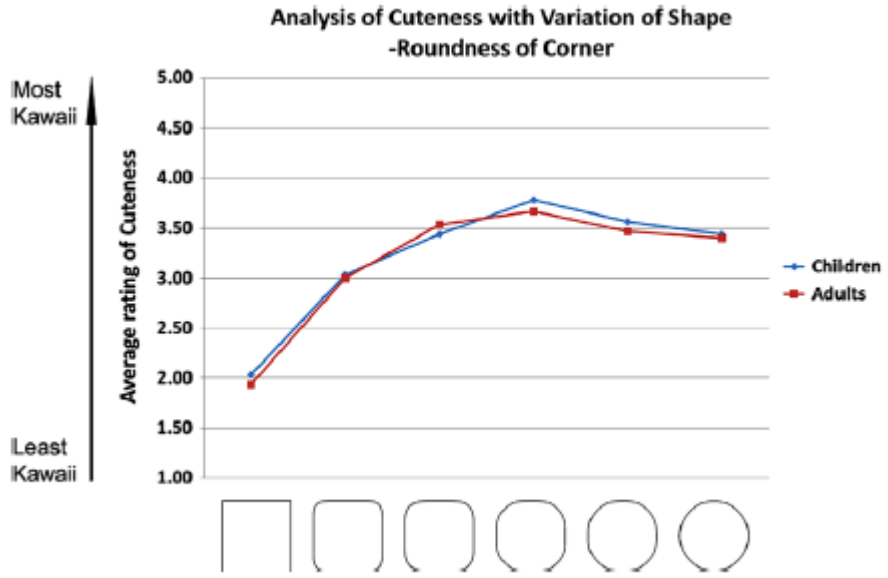

Figure 2.12 Test Result on Effect of Corner's Roundness on Cuteness (Cheok, 2010)

Figure 2.12 show that most of the respondents prefer rounder edges, with the average cuteness rating of 3.5

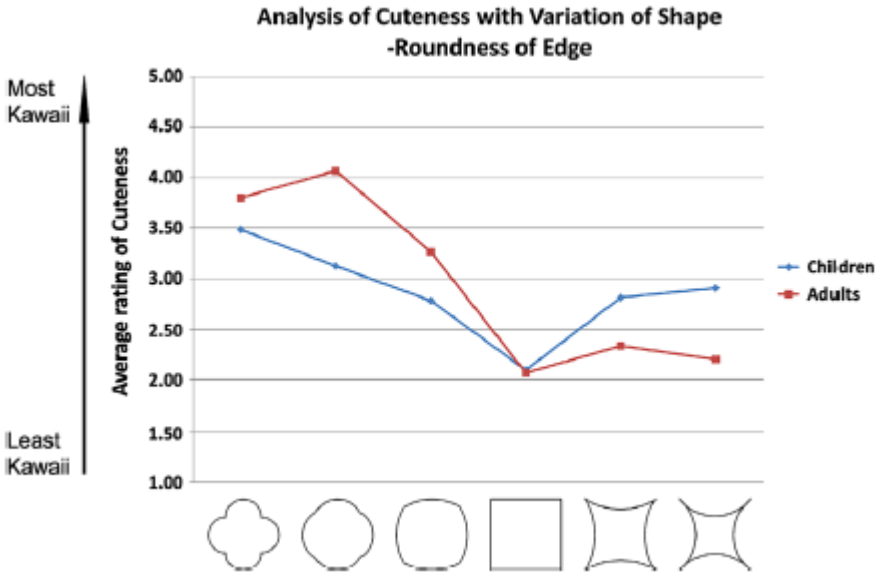

Figure 2.13 Test Result on Effect of Edge's Roundness on Cuteness (Cheok, 2010)

7. Smell and Taste

There are no research results available that specifically measures the cuteness level on smell and taste as of date, but it has been made evident that smell could affect the information absorption, where stimulus could be stored in the brain for a longer period if it is obtained along with smell stimulus. Those facts could be affected by the anatomy of smell senses. Olfactory (smell) and gustatory (taste) sense are connected with each other, and both of the senses have short & simple connection to the brain.

2.3 Usability Evaluation

Usability evaluation (Usability Professionals Association, 2010) is an attempt to measure the usability of the product, identifying the problems and flaws on an interface, which could possibly hinder the user in completely understanding the information available in it. Usability evaluation is generally done to improve the design of a product, or to measure the achievement on usability objectives of that product. Usability, according to ISO 9241:11 (1998) is comprised of several factors that affects the measurement system, which are:

1. Learnability – which is a measure on how fast the user will be able to comprehend the system, and also the easiness in performing the available functions in order to achieve an objective.
2. Efficiency – which is a measure on how much resources used to achieve available objectives
3. Memorability – which is a measure on how long the user will be able to memorize on the system's functions and how to use it
4. Errors – which is a measure on how many misses made by the user and how the misses are done, to uncover the gap between user's perception and system's interface
5. Satisfaction – which is a measure on user's comfort and subjective impression toward the system

2.4 Children Usability

Along the years, researchers (Read, et al., 2009) shows an increasing interest in exploring the human computer interaction field. Moreover, many of the researchers are interested in generating scientific and methodological knowledge related on how to design an interactive system for children. In recent years, many forums and discussions are actively engaging in discussions related to usability evaluation method for adult users. But, when it comes to children users, few to none literatures could be used as reference.

Only few literatures provide complete and detail guide on how to conduct usability testing for children. One of such literatures are made in 1997, on a document under the title "Guidelines for Usability Testing with Children" (Hanna, et al., 1997). There is a statement in the document saying that children have limited duration to focus on something. Preschoolers will only last on average of 30 minutes, and researchers will need to pay attention preschooler's behavior to see if it is necessary to take a break, such as uncontrollable bounce and wriggle.

Beside limited focus duration, children also has different psychological condition, having its own environment and behavior for the researchers to understand. To cope with the limitations, questionnaires should be designed in a way that it could be done in a short period of time, as well as being interactive to avoid boredom when the children fills the questionnaire.

2.4.1 The Funometer

Originally developed by Risden, Hanna, and Kanerva (1997), the funometer is one of the measuring tool that is frequently used in children usability evaluation. Funometer has a vertical scale that becomes the measurement media, which is actually similar to a thermometer.

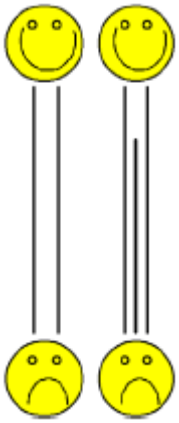

Figure 2.14 The Funometer (Read, et al., 2009)

The Funometer is generally used to measure children's expectation towards an event. Figure 2.14 shows the example of two funometers, with the left side representing expectation before an event, and the right side representing expectation after the event completion.

2.4.2 The Smileyometer

Smileyometer is a measurement tool that is similar to likert scale, which is designed specifically for children. Smileyometer changes the generic likert scale with a graphical representation to increase the attractivity of the measurement tool.

Figure 2.15 The Smileyometer (Read, et al., 2009)

2.4.3 The Fun-Sorter

The fun sorter is a measurement tool that is used by sorting the rank of alternatives or activities to see which one that is most fun and which one is least fun. In general, this tool is a comparative measurement tool, where all of the alternatives are compared with each other in terms of fun. Though repeated use of funometer and smileyometer could also be used to measure comparative fun, fun sorter provides a simpler solution for the comparative measure of fun.

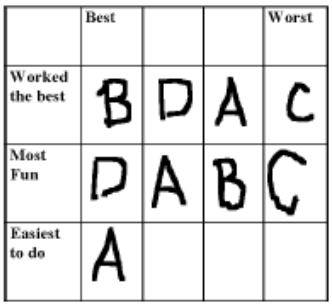

Figure 2.16 The Fun-Sorter (Read, et al., 2009)

Several parameters could be used at the same time to show which alternatives are preferred by the children participants. The children would need to write the activities based on the preference rank. But there is also possible change that could be made to make the tool more interactive, such as using picture cards to fill the spaces.

2.4.4 Again-Again Table

Again-again table is a simple tool which is used to measure the returnance, meaning the desire of the participants to do the activity for the second time. The table lists all of available activities on the left side of the table, with three columns consisting of Yes, Maybe, and No. the children will tick on either yes, maybe, or no for each activity, by considering the question on the desire to retry the activity.

Would you like to do it Again?

	Yes	Maybe	No
Visit U Boat	✓		
Puppet show		✓	

Figure 2.17 One Part of Again-Again Table (Read, et al., 2009)

2.4.5 Expert's Opinion on Children

Compared to adults, children need distinct treatment when it comes to surveys and questionnaires. There are a lot of factors that need extra attention as children's logical and cognitive ability are still on a developing phase. Several points that needs attention (Austin Research, 2014) would be:

1. Keeping Questions as Short as Possible

For children, short questions will be better as long explanations are unlikely to be easily understood. Children in age of 7+ are still developing language and reading skills, but is still feasible for a survey with a level of surveillance on the field of word comprehension (Leeuw, 2011). Children in this age also able to distinguish between different point of views, although it is far from perfect (Borgers, et al., 2000).

2. Avoid Ambiguity

Similar with adults, ambiguity becomes one problem that is faced by children (Leeuw, 2011). Moreover, children are more easy to get confused and caught into ambiguity, since children in this age are still developing language skills.

3. Use Vocabulary that is Relevant to the Age Group

When surveying children, word choices must be considered heavily. The words used by children of 7 years old aren't the same with the words used by a children of 15 years old.

4. Avoid Information, Focus on Feelings

Asking questions that needs the respondent to remember past behavior is commonly avoided when is surveying children. A better approach is to use feelings to illustrate children's opinions, such as using words of "like", "happy", or "frustration".

5. Prioritize Literal Question

Children often interpret language used in questions literally, which is why depersonalized or indirect questions are often avoided since it may lead to miscommunication, resulting in perception difference between what is asked and what the children answered (Borgers, et al., 2000).

6. Avoid Negatively Phrased Statements

Question statements that is formulated in negative form is also considered inappropriate for questionnaires and surveys towards children. In a cognitive perspective, disagreeing with negatively phrased statement is a difficult task.

7. Use Images, Video, and Audio to Make the Survey Engaging for Kids

   Children will be more likely to hold more interest when the survey is more fun, utilizing various media such as images, audio, and video. A motivated children will be more enthusiastic in answering questions, while uninterested children will be more likely to skip over questions or just answer randomly (Borgers, et al., 2000).

2.5 Mouth & Teeth

Mouth and teeth is one of the organs that belongs in human's body. Mouth (TeensHealth, 2017) is covered by mucous membranes in every part of the mouth. Upper part of the mouth; the roof, is called the palate. The front part of mouth is a portion where bone becomes the dominant component, and is called hard palate. Conversely, the rear part of mouth is mostly consisted flesh, which is called soft palate. Hard palate divided the mouth and nasal passage above on the mouth's roof. Soft palate divides the mouth and throat, forming curtain between both. Uvula, which is the hanging flesh located at the back of the mouth, is also included in soft plate. Tonsils are located on the left and right side of the uvula, and looks like two pillars holding up the opening to pharynx (throat). On the surface of tongue, there are several tiny bumps called papillae. Those papillae contain tiny pores which is usually used as taste buds, which senses sweet, salty, sour, and bitter tastes. There are also three pairs of salivary glands that produces saliva, which contains a digestive enzyme called amylase that helps in breaking down carbohydrates so that it could be further processed by stomach. Lips are also covered with mucous membranes on the inside of the mouth, and skin on the outside of the mouth. Lips are mostly covered of one type of muscle which is *orbicularis oris* that allows the lips to move in a more flexible way. As the lips goes inside the mouth, in the end it will be connected to the gums.

Teeth is used as a media in processing the food that goes inside the mouth. It breaks down the food into smooth substances for further digestive processes inside the body. A healthy teeth (Hastuti & Andriyani, 2010) is a neat, clean, shiny, teeth that is supported by the fresh pink-colored gum. In a normal condition, the mouth will not produce any kinds of smells, but it is only possible with a good treatment.

2.5.1 Types of Teeth

Number of teeth present in a mouth are mostly similar for any person. In a normal adult mouth (Hoffman, 2015), there will be about 32 teeth in general.

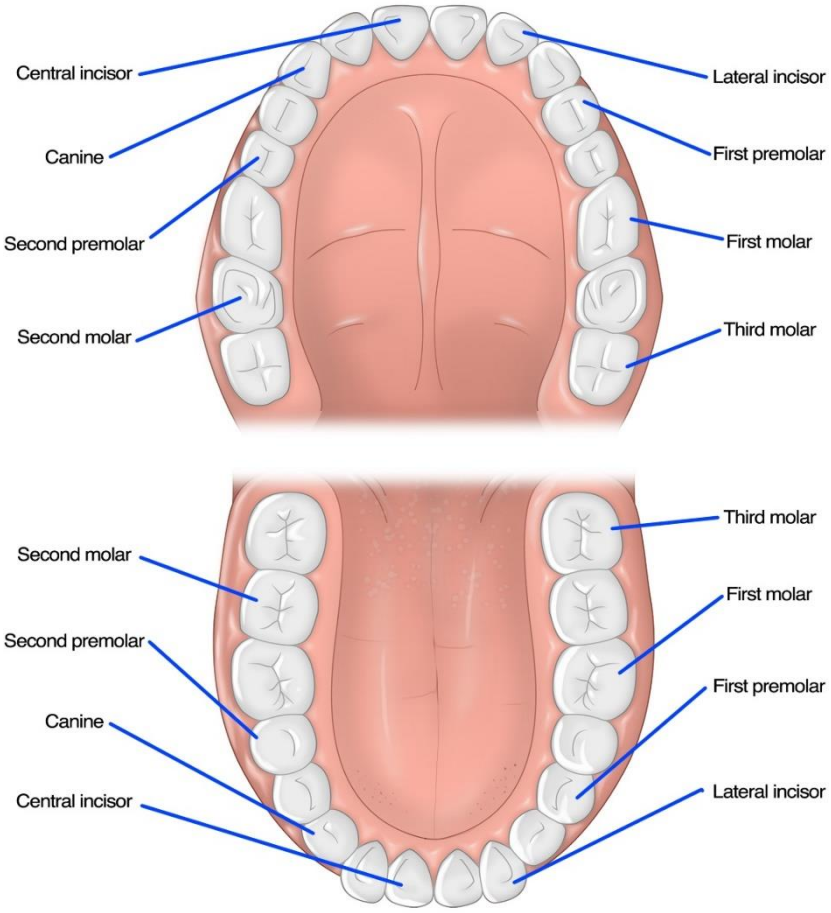

Figure 2.18 Teeth Anatomy of Adult Human (Hoffman, 2015)

Most of teeth started to develop from the age of 13 years old (with the exception of wisdom teeth). Based on its shape and function, the teeth are divided into 5 main types, which are incisors, canines, premolars, molars, and wisdom teeth. The details for each teeth type is explained below (Hoffman, 2015).

1. Incisors

   Incisors are the teeth located at the middlemost of upper and lower jaws, amounting to 8 teethes in total, with 4 teeth on each jaw. Incisors has a horizontal-shaped crown and one root, with the function (Hadi, 2015) to cut the food into pieces, supported with its crown shape, which could cut the food straight into smaller pieces.

2. Canines

   Canines are the teeth located just at the outer part of incisors on lower and upper jaws. There are 4 canines in total, surrounding all of the incisors in both jaws. Canines has one root and a pointed shape, which is functioned to tore and rip the food.

3. Premolars

   Premolars are teeth located between canines and molars, with 4 teeth located in each jaw. Premolars has two roots with low crown, and has several bulges on it. Premolars are used to roll and flatten the food.

4. Molars

   Molars are the teeth located at the rear of the mouth, and is best used for grinding food. Molars has 2 to 3 roots that is functioned as the last food processing in the mouth. There are 8 molars in total, with 4 molars on each jaw.

5. Wisdom Teeth

   Wisdom teeth or third molars are teeth that starts to emerge at around the age of 18, but is often removed to prevent displacement of other teeth.

2.5.2 Oral and Dental Health

Without a proper habit and healthy lifestyle, mouth and teeth could easily develop bacteria that could cause various diseases. Oral and dental disease (United Healthcare, 2014) comes from the bacteria that sticks on the plaque, becoming larger as time passes, covering the teeth. That collection of bacteria will then cause infections that will further become diseases in a human's oral and dental system

There are several diseases that could affect a human's mouth, infecting various parts in the mouth such as teeth and gum. Those diseases (Hoffman, 2015) are explained in detail below.

1. Cavities

   Cavities are caused by bacteria that are able to avoid mouth cleansing process by teeth brushing and saliva, thus causing several damages to the teeth's crown and possibly other parts of the teeth.

2. Plaque

   Plaque is a collection of bacteria that converges in one place, creating a sticky film along with the substances it secreted. Plaque has a quick growth especially after consumption of foods that contains a high level of sugar, but is still easy to be cleaned. For example, teeth brushing could be done to remove plaque from growing.

3. Tartar

   Tartar is the hardened version of plaque, which occurs when plaque is not immediately removed from the mouth. Plaque will keep growing and hardening, creating tartar after some time. Unlike plaque, tartar is difficult to remove, and needs professional doctor to perform the cleaning.

4. Gingivitis

   Gingivitis happens when bacteria causes inflammation on the surface of gum surrounding the teeth. The inflammation is mainly caused by plaque and tartar, and when it becomes worse, gingivitis could lead to periodontitis.

5. Periodontitis

   Periodontitis is the disease that infected the deeper parts of gum, causing inflammation of gum located around teeth, such as the periodontal ligament, jawbone, and cementum). Periodontitis (National Institute of Dental and Craniofacial Research, 2013) causes small spaces between the teeth and gums, causing plaque to grow towards the deeper parts of the mouth. To remove the intrusive bacteria, human's body will respond by breaking the structures that held the teeth on place. On a chronic level, the teeth will be loose and needs removal.

   There are several factors that could cause a periodontitis. Smoking is one of the factor that accelerates the growth of periodontal disease, while at the same time decreasing the chances of successful oral and dental treatment. Other factors are also present, such as

hormonal changes in women, diabetes, other diseases (such as AIDS and cancer), side effects of medicines, and genetic susceptibility.

Several medicines have been developed in curing the periodontitis. The example of those medicines are shown in the table 2.2 below.

Table 2.2 Possible Medications to Cure Periodontitis (National Institute of Dental and Craniofacial Research, 2013)

Medications	What is it?	Why is it used?	How is it used?
Prescription antimicrobial mouthrinse	A prescription mouthrinse containing an antimicrobial called chlorhexidine	To control bacteria when treating gingivitis and after gum surgery	It's used like a regular mouthwash.
Antiseptic chip	A tiny piece of gelatin filled with the medicine chlorhexidine	To control bacteria and reduce the size of periodontal pockets	After root planing, it's placed in the pockets where the medicine is slowly released over time.
Antibiotic gel	A gel that contains the antibiotic doxycycline	To control bacteria and reduce the size of periodontal pockets	The periodontist puts it in the pockets after scaling and root planing. The antibiotic is released slowly over a period of about seven days.
Antibiotic microspheres	Tiny, round particles that contain the antibiotic minocycline	To control bacteria and reduce the size of periodontal pockets	The periodontist puts the microspheres into the pockets after scaling and root planing. The particles release minocycline slowly over time.
Enzyme suppressant	A low dose of the medication doxycycline that keeps destructive enzymes in check	To hold back the body's enzyme response — If not controlled, certain enzymes can break down gum tissue	This medication is in tablet form. It is used in combination with scaling and root planing.
Oral antibiotics	Antibiotic tablets or capsules	For the short term treatment of an acute or locally persistent periodontal infection	These come as tablets or capsules and are taken by mouth.

6. Teeth Grinding (bruxism)

   Teeth grinding is a disease that mostly caused by psychological problems, such as stress, anxiety, or sleep disorders. In a chronic case, teeth grinding could cause tooth fracturing, loosening, and detaching.

7. Sensitive Teeth

   Sensitive teeth will increase the sense on the substance's temperature that enters the mouth and contacts directly with the teeth. Sensitive teeth could imply that dentin is exposed.

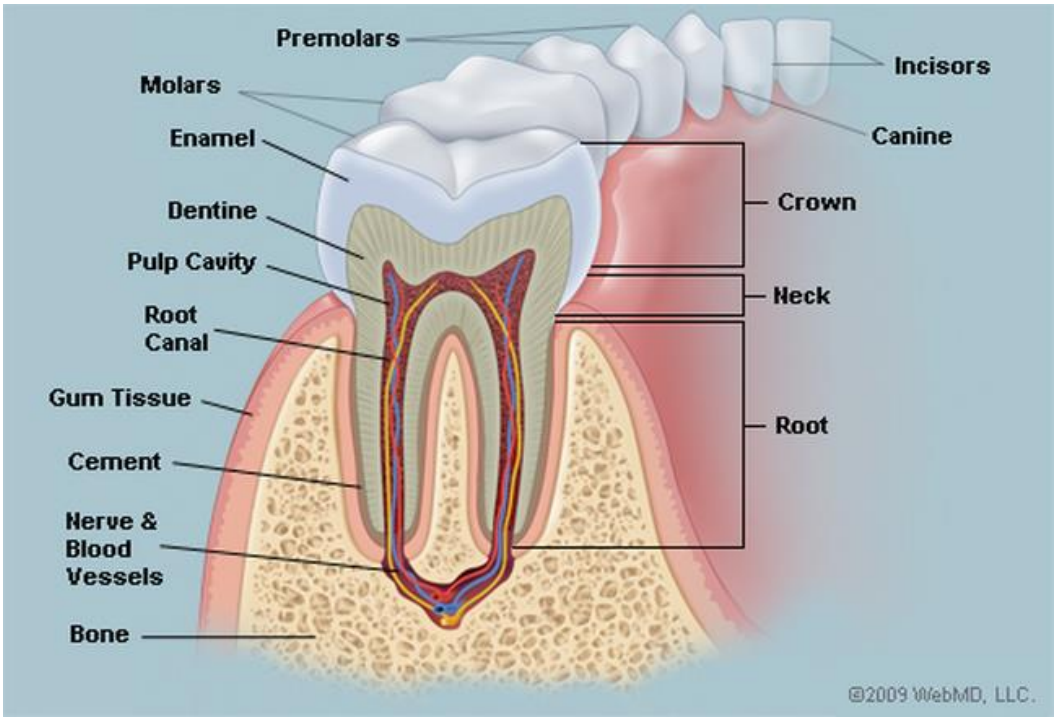

Figure 2.19Dentine Position in Teeth Anatomy (Hoffman, 2015)

2.5.3 Primary Preventive Actions

To keep the oral and dental health of a children, there are various ways that could be implemented. One of the method is by doing the primary preventive action. Primary preventive action (Angela, 2005) is a preventive actions that is conducted prior to the occurrence of clinical indications of a disease. The primary preventive method includes:

1. Children habit modification

   Children habit modification has an objective to change any wrong habits that children have related to oral and dental health, so that the children's oral and dental hygiene could be improved, by increasing the children's knowledge on the right way in keeping the oral and dental health.

2. Oral & dental health education

   Oral and dental health education are aimed to teach the children on a healthy lifestyle, such as in how to maintain sugar diet, and periodical visit to dentists. The information should be given individually to the children and mother. The information should also

be given continuously by considering various factors that could affect the information transfer such as economic, social, culture, and education level of both mother and children. The information should give motivations and adequate knowledges for the participants to be able to maintain the oral and dental health towards a better lifestyle.

3. Mouth hygiene treatment

   Mouth hygiene treatment could be given to teach the children the practical issues regarding how to keep oral and dental health. There are various alternatives that could be taught to the children, such as teeth brushing, flossing, and professional *propilaksis*. However, teeth brushing becomes one of the most critical knowledge to be taught to children, as teeth brushing is one of the fundamentals in keeping a healthy mouth and teeth. For an example of 5 years old children, if the children cannot brush the teeth independently, the parents should assume the role in making sure that the children's teeth are properly brushed everyday until the children could do it without the help of others. It is also advised that children brush teeth for at least three times a day. By doing that, the acids causing teeth plaque could be neutralized by bases contained in toothpaste. Evidence has been found that brushing teeth could normalize mouth's pH from pH 5 to pH normal (6-7), preventing caries from occurring.

4. Sugar diet control

   As most of oral and dental health problems stems from excessive sugar diet, it is necessary to control it. Controlling sugar diet could be done by eating foods with high fiber and water contents to increase the saliva secretion, and also foods with protein and phosphate to increase the pH of saliva. Another way in controlling sugar diet could also be done by using sugar substitutes, such as xylitol and sorbitol. Unlike sugar, xylitol and sorbitol cannot be affected by bacteria, thus preventing acid production that could cause oral and dental diseases.

5. Teeth protection

Teeth protection is an artificial way in preventing oral and dental disease. Teeth protection could be done in three ways, which are sealant, fluor, and chlorhexidine. Sealants (National Institute of Dental and Craniofacial Research, 2016) are thin coatings that is used to strengthen the teeth by applying it on the crown surfaces of rear teeth (usually found in premolars and molars). Sealants protects the teeth from bacteria and food remains that is left in mouth.

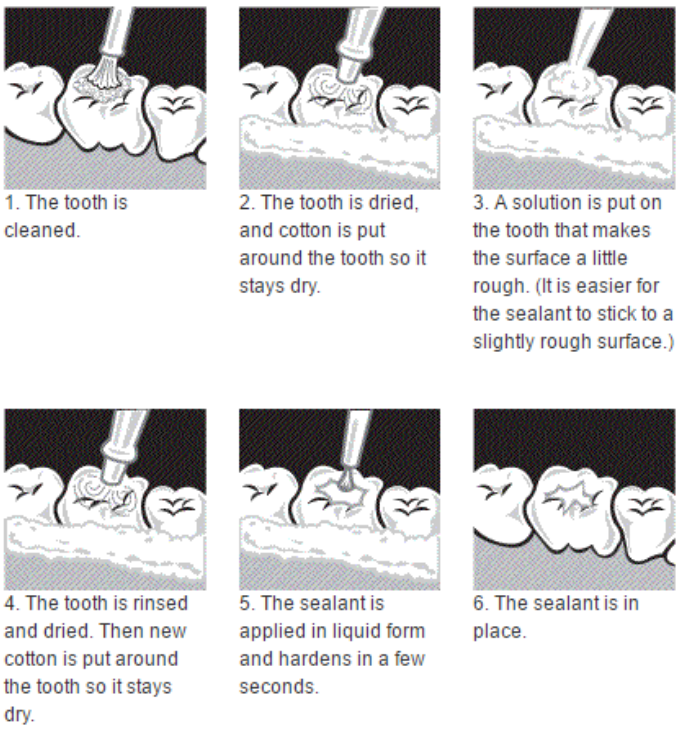

Figure 2.20 Steps in Applying Sealant on Teeth (National Institute of Dental and Craniofacial Research, 2016)

The second method is by using fluor to prevent oral and dental diseases. Fluor could be used in various ways, including water fluoridization, toothpaste, fluor tablet, and fluor mouthwash. The third method using chlorhexidine as anti-bacterial substance is usually found in mouthwash, toothpaste, bubblegum, and gel. Chlorhexidine could also be used to complement sealants, providing better protection from bacteria.

2.6 Previous Researches

This research is made by combining various principles and knowledges that has been explored deeply in many research that are done prior to this one. In general, the topics that becomes the focus in this research are oral and dental health field and researches that utilizes mixed reality technology.

Table 2.3 Previous Researches

Researcher	Title	Year
Michiko Ohkura, Tsuyoshi Komatsu, Somchanok Tivatansakul, Saromporn Charoenpit, Sittapong Settapat	Comparison of Evaluation of Kawaii Ribbons between Genders and Generation of Japanese	2012
Ignatius Hendy Sulistya	*Desain Alas Kaki dan* Mixed Reality Head Mount *sebagai Penunjang Kegiatan Pelatihan Ilmu Bela Diri Taekwondo* (Footwear and Mixed Reality Head Mount Design as Supporting Tool in Martial Arts Taekwondo Training)	2013
Febri Saputra	*Perancangan Media Edukasi Kesehatan Gigi dan Mulut dengan Penerapan Teknologi* Augmented Reality *pada Sistem Berbasis* Android (Mouth and Teeth Education Media Design by Implementing Augmented Reality Technology in an Android-Based System)	2017

The first research is titled as "Comparison of Evaluation of Kawaii Ribbons between Genders and Generation of Japanese" by Ohkura, et al. (2012). This research is aimed to prove the effect of pattern and color towards kawaii level of a ribbon across the generations on Japanese population. The respondents are consisted of men and women which age are about 20s and 40s. The research is done by using a web-based questionnaire that are accessible using web browsers such as internet explorer and google chrome.

The second research is titled as "*Desain Alas Kaki dan* Mixed Reality Head Mount *sebagai Penunjang Kegiatan Pelatihan Ilmu Bela Diri Taekwondo*" by Ignatius Hendy Sulistya in 2013. This research is aimed to design a supporting tool

in *Taekwondo*, to increase the effectivity in *Taekwondo* training by providing the user with target and power measurement using the mixed reality implemented in the head mount and foot protector. As for now, the tool is still limited to foot protector, thus the training movement that could be used by this research is still limited to kicking movements.

The third research is titled as "*Perancangan Media Edukasi Kesehatan Gigi dan Mulut dengan Penerapan Teknologi* Augmented Reality *pada Sistem Berbasis* Android" by Febri Saputra in 2017. This research is aimed to design an education media using augmented reality technology. This research used markerless augmented technology to increase the user understanding on 3D design and also enables the user to perform markerless scan using the designed android-based software.

Based on review from previous researches that becomes the reference for this research, this research tries to evaluate education media using pop-up book with mixed reality technology for oral and dental health, in terms of design and usability. To conduct the evaluation process, the available tools will be combined with each other, both from general and children usability concept. The tool that is going to be used in media evaluation process is questionnaire that is designed based on general usability tools, combined with children usability tool to increase the attractiveness of the questionnaire. The question items will be also derived from both general and children usability concepts, ranging from general usability attributes until potential parameter for children usability. The designed tool will then be used in evaluation process to measure the performance of education media, in terms of usability and design.

CHAPTER 3
RESEARCH METHODOLOGY

A scientific research needs to follow a framework as the fundamental part in conducting a systematic and structured research process. In this chapter, the methodology for conducting the research will be explained.

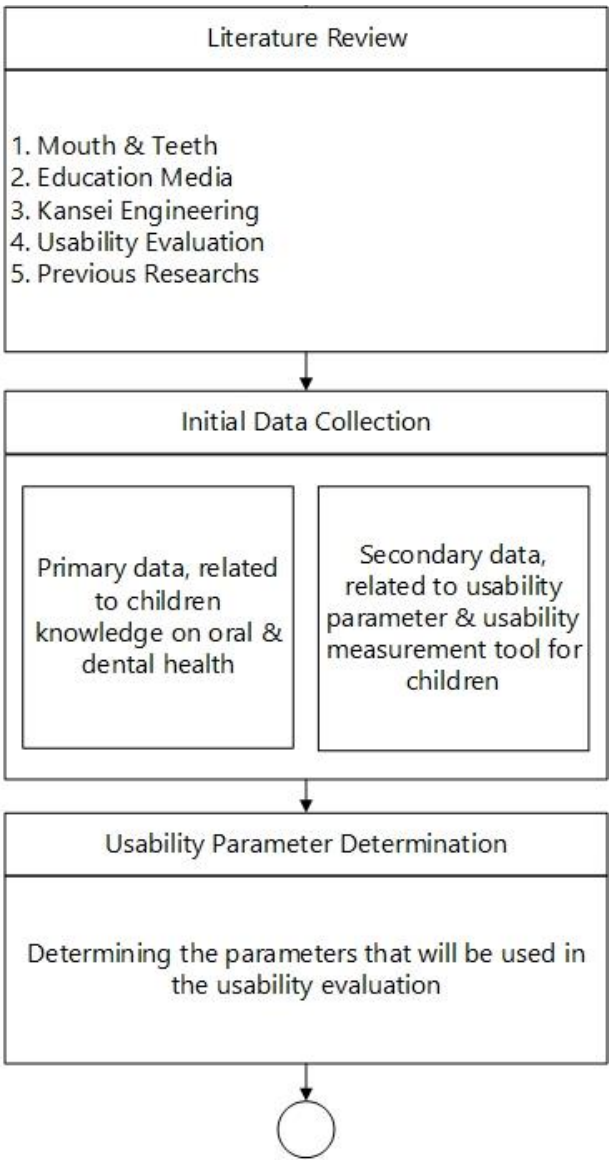

Figure 3.1 Research Methodology

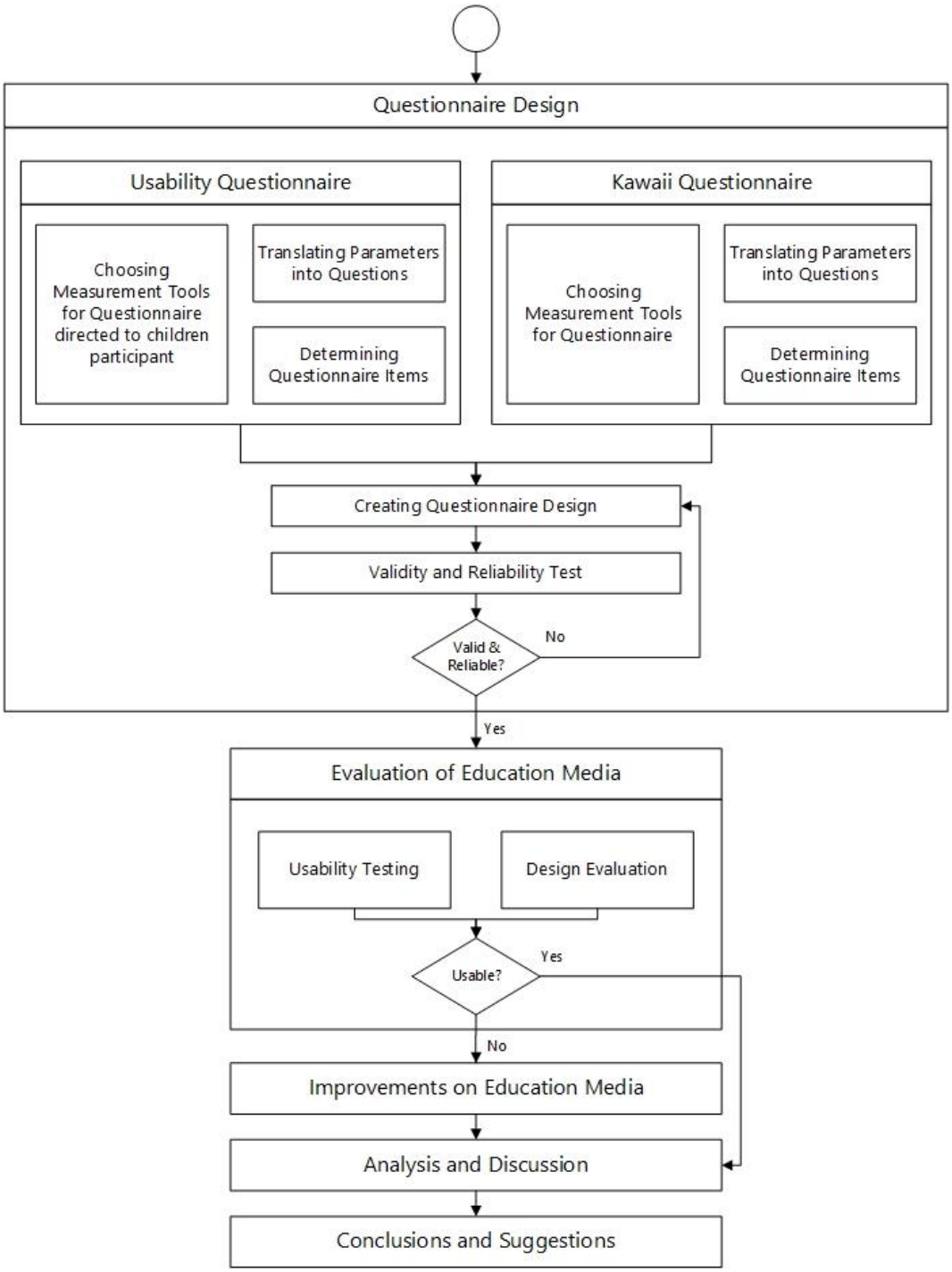

Figure 3.1 Research Methodology (Continuation)

3.1 Literature Review

Literature review is necessary in any research, as the fundamental part that will support the research process. Literature review consisted of base knowledge that are related to the research topic. In this research, the literature review is done

on several topics such as mouth and teeth, education media, kansei engineering, and usability evaluation. In this phase, the previous researches related to mixed reality and oral & dental health education are also explained.

3.2 Initial Data Collection

The next step is to do the data collection for the research, which are divided into two types of data, primary and secondary. The primary data are about oral and dental health on children, regarding children comprehension and awareness towards oral and dental health. As for the secondary data, the collected data are about children usability parameter and also usability measurement tool for children.

3.3 Usability Parameter Determination

After collecting all data related to the research, next the parameters that will be used in this research will be determined. There are several parameters that will be taken and used in the evaluation phase, consisting of both media usability and kawaii design parameters.

3.4 Designing Questionnaire

By identifying the usability parameters, the questionnaire could be designed, which then will be used in the evaluation process. The questionnaire is designed by considering two concepts, which is the children usability and kawaii design. Designing phase is started by translating the identified parameters into question items that will be asked in the evaluation process. Then, the question items that has been made from identified parameters are sorted and selected to be shown in the questionnaire, as there is some possibility that several questions have similar meaning, which should be filtered.

After that, the measurement tools that will be used in the questionnaire are determined. The measurement tools that is going to be used is taken from the general usability concepts. Then, after deciding on the measurement tool, the questionnaire could be designed. When the questionnaire has been designed, validity and reliability test will be conducted to see whether the questionnaire could be used for children participants or not. When it is evident that the questionnaire is

valid and reliable, the research could move to the next step, and if it is not validated, the questionnaire will need to be redesigned.

3.5 Evaluation of Education Media

The next step in conducting this research is by evaluating the oral and dental health education media by using the KUE questionnaire prior to this phase. The evaluation is done to elementary school children. The data collection starts by explaining the students about teeth and mouth. Then, the students are given a pretest to see whether students could understand the material that is delivered prior to the test. After conducting the test, students will be given a chance to try MR SIWA by using the software and virtual reality glass. Then, after the students finished in trying MR SIWA, questionnaire and posttest is given to the students. The questionnaire results will be used in deciding whether the education media needs any improvement or not. Posttest will be used to measure whether there are any change in content comprehension or not.

The data collection is conducted in 2 schools, which are *Sekolah Dasar Islam Terintegrasi Luqman Al-Hakim* and *Sekolah Dasar Yapita Surabaya*. The total samples taken are 90 respondents that are spread on two classes for each school, which are class 5A and 5C for *Sekolah Dasar Islam Terintegrasi Luqman Al-Hakim*, and class 4B and 4C for *Sekolah Dasar Yapita Surabaya*.

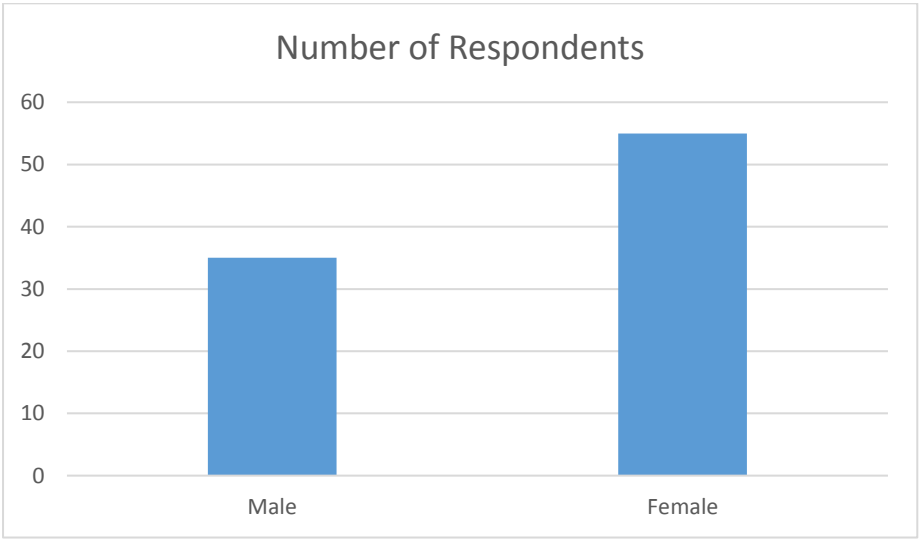

Figure 3.2Number of Male and Female Respondents

The respondents consisted of 55 girls and 35 boys, with the average age of 10.11 years old. There are three kinds of data that are collected, consisting of pretest, posttest, and questionnaire data.

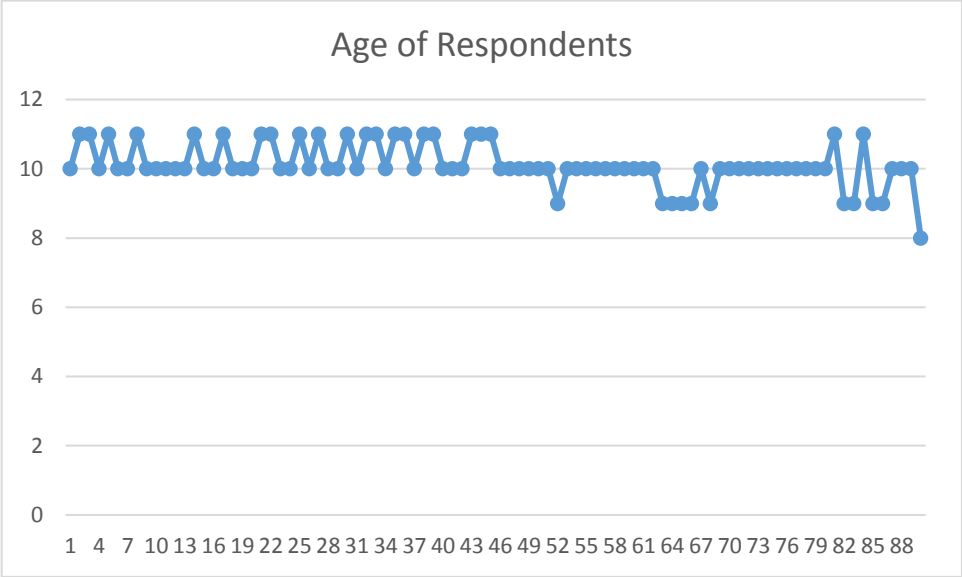

Figure 3.3Age of Respondents

3.6 Improvements on Education Media

After finishing the evaluation phase, the results will be used to determine whether the education media needs several improvements or not. This phase is only done in case when the result of evaluation shows that the education media needs improvement, whether it is in terms of usability or design. The improvement will be done by checking the lowest score for each question item in KUE questionnaire.

3.7 Analysis and Discussion

The result from evaluation will then be used in analyzing the education media's usability and design. The result that comes from usability evaluation will be analyzed by using the comparison between the result prior to the use of education media and after using the education media. The difference in terms of knowledge and awareness will be analyzed to see if there are any improvements in children's comprehension about the mouth and teeth health.

3.8 Conclusion and Suggestion

By finishing the analysis and discussion phase, conclusions and suggestions could be taken. In this phase, the conclusions to answer research objectives are taken, as well as suggestions to improve future researches.

CHAPTER 4
DATA COLLECTION AND PROCESSING

This chapter provides an explanation for each phase on data collection and processing related to the evaluation process of MR SIWA

4.1 About Mixed Reality – Sinau Waja (MR SIWA)

Mixed Reality – Sinau Waja is an education media aimed for children to learrn about mouth and teeth. MR SIWA is divided into 2 sections, with the first section used for waterfall icon, and the other section used for mixed reality marker, pop-up teeth, and hologram system.

The 4 main features which are waterfall icon, pop-up, mixed reality, and hologram included in this education media are explained below.

1. Waterfall Icon

   The waterfall icons are included in the first section of MR SIWA, and is mainly used to explain the characteristic and fuction of each teeth type.

2. Pop-up Teeth Model

   Pop-up teeth model is used in the later section of MR SIWA, between mixed reality and hologram system. The teeth model is used to illustrate the shape of human mouth.

3. Mixed Reality

   Mixed reality markers are placed on the later section of MR SIWA. There are 4 markers at total, with each marker explaining about different topics regarding mouth and teeth.

4. Hologram System

   The hologram system is added in the later section of MR SIWA. It is shown by using the software of MR SIWA on an android phone. The phone is then placed under the designated place while opening the hologram feature in the software.

4.2 Pretest and Posttest Result and Data Processing

The collected pretest data for respondent 1-20 could be seen in the table 4.1 below.

Table 4.1 Summary of Pretest Result

No	Name	Answer per Question									
		1	2	3	4	5	6	7	8	9	10
1	Aghnia	1	0	1	0	1	1	0	1	1	0
2	Aisha	1	0	1	1	1	1	1	0	1	0
3	Anggi	1	0	1	0	1	1	0	1	0	0
4	Confidential Data	Confidential Data									
5											
6											
7											
8											
9											
10											
Description		1 = Correct					0 = Wrong				

Table 4.1 Summary of Pretest Result (Continuation)

No	Name	Answer per Question									
		11	12	13	14	15	16	17	18	19	20
1	Aghnia	0	1	1	1	1	1	1	1	0	0
2	Aisha	0	1	0	1	0	1	1	1	1	1
3	Anggi	0	1	0	1	0	1	1	1	0	0
4	Confidential Data	Confidential Data									
5											
6											
7											
8											
9											
10											
Description		1 = Correct					0 = Wrong				

Then, the data for posttest results could be seen in table 4.2 below.

Table 4.2 Summary of Posttest Result

No	Name	Answer per Question									
		1	2	3	4	5	6	7	8	9	10
1	Aghnia	1	1	1	0	1	1	1	1	1	1
2	Aisha	0	0	0	0	1	1	1	1	0	0
3	Anggi	1	0	1	1	1	1	0	1	1	1
4	Confidential Data	Confidential Data									
5											
6											
7											
8											
9											
10											
Description		1 = Correct					0 = Wrong				

Table 4.2 Summary of Posttest Result (Continuation)

No	Name	Answer per Question									
		11	12	13	14	15	16	17	18	19	20
1	Aghnia	1	1	1	1	1	1	1	1	1	1
2	Aisha	0	0	0	0	0	1	1	1	1	1
3	Anggi	1	1	0	0	0	1	1	1	1	1
4	Confidential Data	Confidential Data									
5											
6											
7											
8											
9											
10											
Description		1 = Correct					0 = Wrong				

During the data collection process, information regarding student comprehension towards the delivered materials are also collected. There are two kinds of comprehension data, which consisted of pretest and posttest score. Pretest is given to the students after participating in oral explanation on teeth and mouth. While posttest is given to the students after trying MR SIWA. Both of test results could be seen in table 4.3 below.

Table 4.3 Data on Pretest and Posttest Score of Each Student

No	Name	Gender	Pretest Score	Posttest Score	Difference
1	Aghnia	Female	65	Confidential Data	
2	Aisha	Female	70		
3	Anggi	Female	50		
4	Aqilah	Female	70		
5	Ayun	Female	65		
6	Confidential Data		Confidential Data		
7					
8					
9					
10					
11					
12					
13					
14					
15					

Table 4.3 shows the difference in posttest and pretest score, which will be used in the analysis.

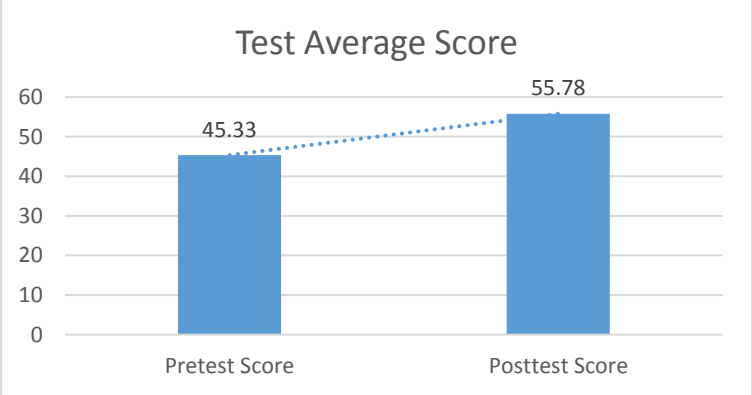

Figure 4.1 Average Score of Pretest and Posttest Results

Figure 4.1 shows that the average score of posttest is increasing compared to the pretest, with the average posttest score of 55.78 and average pretest score of 45.33. But, there are several students who got unfavorable result during posttest, where the score decreases compared to pretest.

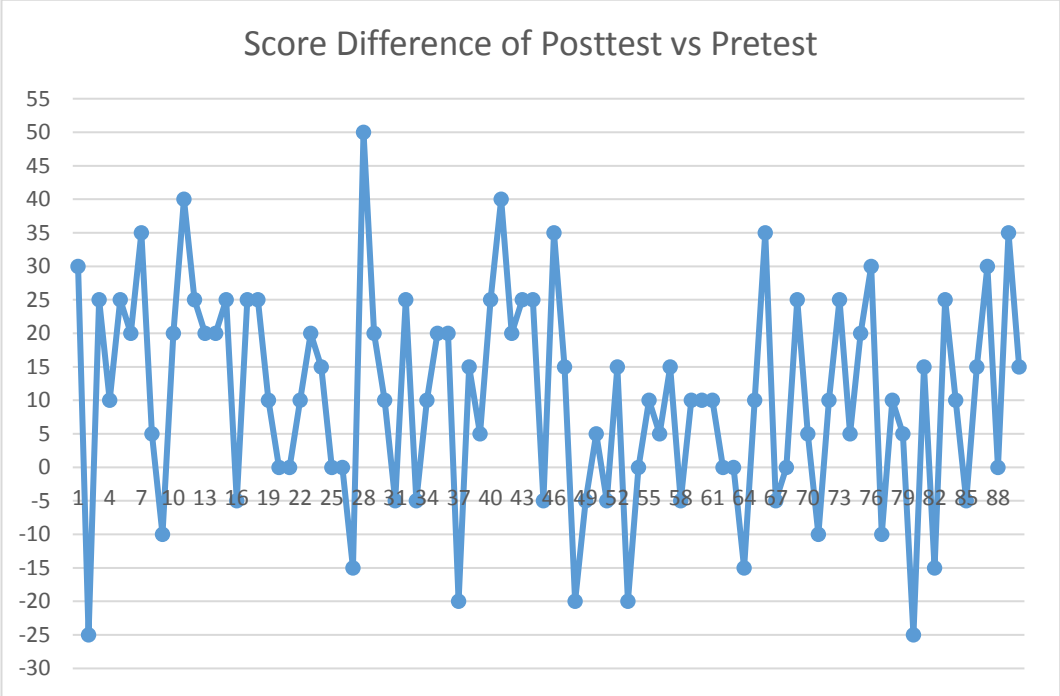

Figure 4.2 Individual Score Difference of Posttest and Pretest

There are 20 students who has lower score in posttest compared to the pretest. The list of students could be seen in table 4.4 below

Table 4.4 Participants with Smaller Posttest Score

No	Name	No	Name
1	Aisha	11	Confidential Data
2	Hanun	12	
3	Naifa	13	
4	Aryo	14	
5	Farel	15	
6	Habibi	16	
7	Nabil	17	
8	Zaidan	18	
9	Alfiah	19	
10	Andiniar	20	

The demographic of students with negative difference between posttest and pretest score could be seen in figure 4.7 until 4.10 below.

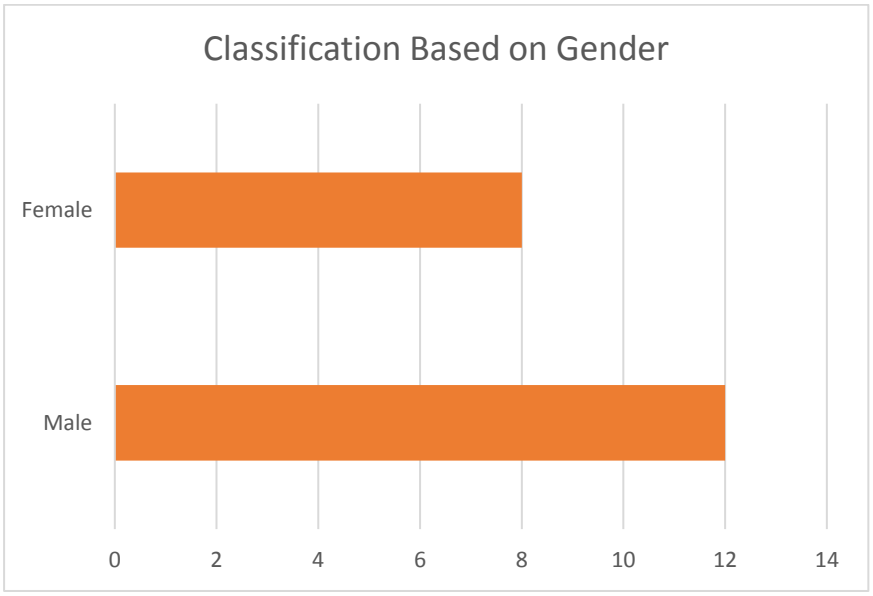

Figure 4.3 Data Classification Based on Gender

Figure 4.3 above shows that the proportion of male and female participants who got smaller posttest score. From 20 participants, there are 8 male and 12 female participants with smaller posttest score.

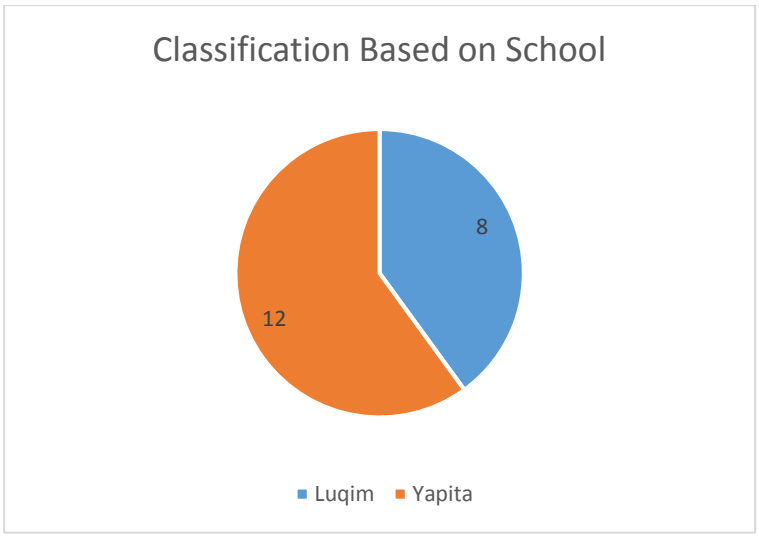

Figure 4.4 Data Classification Based on School

Figure 4.4 shows the classification based on school. From the graph, it could be seen that there are 8 students from Luqman Al-Hakim and 12 students from Yapita who has smaller posttest score.

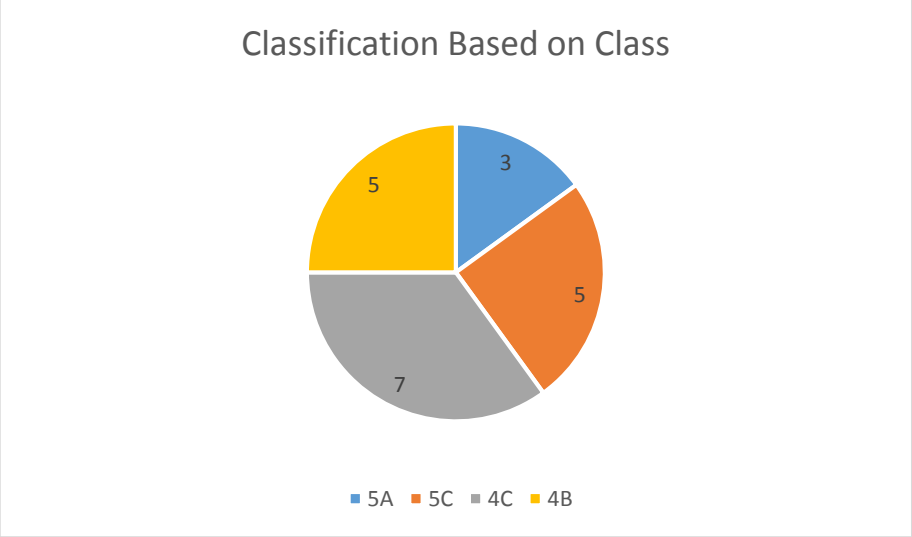

Figure 4.5 Data Classification Based on Class

Figure 4.5 provides the illustration on data classification based on class. There are 3 students from 5A, 5 students from 5C, 7 students from 4C, and 5 students from 4B.

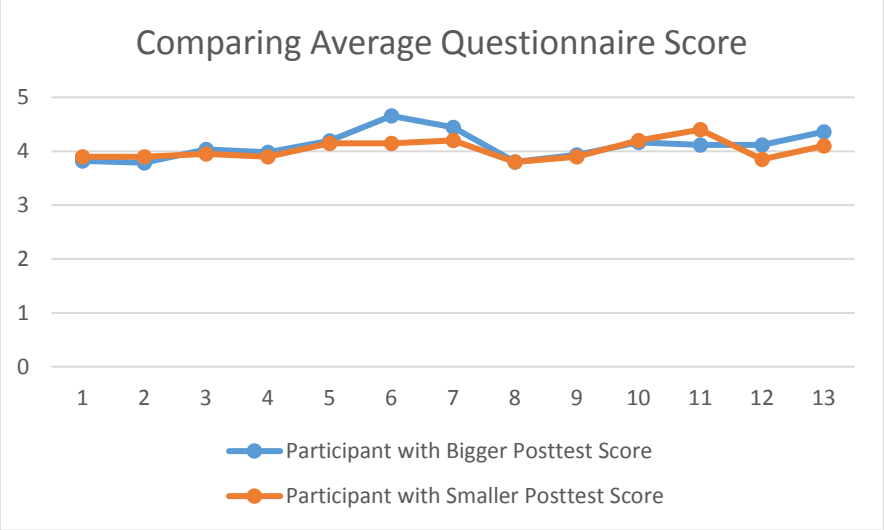

Figure 4.6 Average Questionnaire Score for Participants with Bigger Score and Participants with Smaller Posttest Score

In figure 4.6, it could be seen the average questionnaire score per item for participants with bigger posttest score and participants with smaller posttest score.

It could be seen that the average questionnaire score for both sample types are mostly similar.

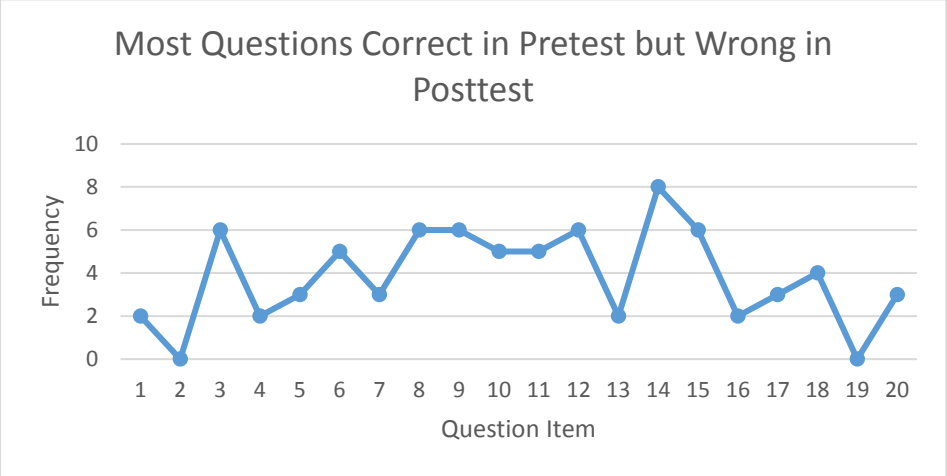

Figure 4.7 Frequency of Participants Who Answered Correctly in Pretest but Wrong in Posttest for Each Question Item

Based on figure 4.7, there are several question items where the participants had correct answer in pretest but wrong in posttest. Such event occurs the most in the question item number 14, where about 8 participants had correct answer in pretest but wrong in posttest.

The collected data in table 4.3 is then processed by using t-paired sample hypothesis testing to see whether the results in posttest has significant difference compared to pretest or not. The hypothesis testing result could be seen in table 4.5

Table 4.5 Paired Sample Hypothesis Testing Results

	Posttest Score	*Pretest Score*
Mean	55.77777778	45.33333333
Variance	315.6803995	259.4382022
Observations	90	90
Pearson Correlation	0.562489446	
Hypothesized Mean Difference	0	
Df	89	
t Stat	6.227297146	
P(T<=t) one-tail	7.65509E-09	
t Critical one-tail	1.662155326	
P(T<=t) two-tail	1.53102E-08	
t Critical two-tail	1.9869787	

The test result shows that actually the posttest result and pretest result yield significant difference, with t stat value (calculated t) more than t critical two tail value (t table). The data is also processed based on the gender and school classification to see whether there is any difference in the score increase between pretest and posttest. The statistical analysis result could be seen in table 4.6

Table 4.6 Paired Sample Hypothesis Testing Results

	Based on School		Based on Gender	
	Luqim	*Yapita*	*Male*	*Female*
Mean	14.36170	6.162791	13	8.818182
Known Variance	258.2794	217.6633	247.3529	254.596
Observations	47	43	35	55
Hypothesized Mean Difference	0		0	
Z	2.523369932		1.222762014	
P(Z<=z) one-tail	0.005811803		0.110709798	
z Critical one-tail	1.644853627		1.644853627	
P(Z<=z) two-tail	0.011623605		0.221419597	
z Critical two-tail	1.959963985		1.959963985	

4.3 Questionnaire Design

This subchapter explains the questionnaire development, which includes the design and parameter that is used for questionnaire

4.3.1 Questionnaire Parameter

This subchapter will explain the parameters that will be used in the KUE questionnaire for MR SIWA evaluation. Prior to the determination process, it is necessary to understand what parameters that could be used in the evaluation process. The parameter for evaluation comes from two concepts, consisting of usability and *kawaii* design. In general theories, usability usually consisted of several parameters, which are learnability, efficiency, memorability, error, and satisfaction.

On the other hand, *kawaii* design are often associated with cute, which is defined as a characteristic of a product, person, thing, or context that makes it appealing, charming, funny, desirable, often endearing, memorable, and/or

(usually) non-threatening (Marcus, et al., 2017). The used factors in KUE questionnaire will be integrated into the usability parameters, and are consisted of color, motion, shape and form, and sound, since other parameters would either be quite difficult to be understood by the children when it is asked directly, or it is irrelevant with the education media.

The explanation for each parameter in usability and *kawaii* design concept is explained below

1. Usability

   The main objective in conducting usability testing is to understand about how the user could easily comprehend the system's mechanism and also getting satisfactory results. In measuring how the media could help the user in achieving the expected objectives, there are 5 primary parameters which are defined as Nielsen's Attributes of Usability (Nielsen, 1993), which are consisted of:

   a. Memorability

      Memorability (Nielsen, 1993) is defined as how easy to remember the system. This measure is used so that casual user could adapt to the system after not using it in some period of time. This parameter will be measured by asking the children on how easy to remember the control system. Control system is about the mechanism to operate MR SIWA, such as how to use the mixed reality and hologram feature. The children will be able to re-use the system easily when it could be remembered in a short time.

   b. Error

      Error (Nielsen, 1993) is defined as the measure on how many flaws occurred during the system operation, either caused by the operator or the system design which misleads the user into an error. Naturally, it is expected that the design contains low error rate. To measure this parameter, the children will be asked on how many errors that occurred while using the media, mainly the errors that are caused by the software, where the mixed reality and hologram is implemented.

   c. Learnability

Learnability (Nielsen, 1993) is defined as how easy the user to learn about the system, which ultimately helps the user in achieving expected results by using it. With higher learnability, the user will be able to perform the intended activity effectively and efficiently. Measuring learnability could be done by asking the children on how easy to use the media, such as how easy it is to use MR SIWA.

d. Efficiency

Efficiency (Nielsen, 1993) is a measure on the level of productivity that could be achieved by the user after fully adapted to the system. It is expected that the user could reach a high level of productivity by using the media. The measure on efficiency could be done on how much the user understands about the included contents of education media, and also the efforts made in achieving such results.

e. Satisfaction

Satisfaction (Nielsen, 1993), is measurement on how pleasant the system for users. If the system is more pleasant, a better satisfaction result could be obtained. The measurement on this parameter could be done by asking subjective opinion of the children on how good the media that was used, and also the desire of the children to use it again.

2. *Kawaii*

Kawaii factors cover various aspects of design that could emotionally affect an individual. The kawaii design evaluation will be integrated into usability parameters, which will then be measured to determine the usability of MR SIWA. In this research, several factors will be used as additional parameter in measuring the usability of MR SIWA. Even so, not all parameters will be used due to several constraints present in various conditions of the research. The detail explanation for each *kawaii* factor will be explained below.

a. Color

Color will be used as one of the measurement factor in this research. The color factor will be integrated into the satisfaction. To measure this factor, the children will be asked how suitable the colors

that are used in MR SIWA. To reduce miscommunication on this question, it will be placed in the last number so that the student further comprehends the meaning of this question better, after answering other questions of kawaii factors that was asked in terms of cuteness. It means, the main objective of this question is to see whether the applied color is suitable for *kawaii* design.

b. Texture

Due to the material constraint of MR SIWA, texture factor will not be included in the research. As MR SIWA uses MR technology, it needs a clear and unobstructed marker so that it could be identified easily. Therefore, there are only limited choices of materials that could be used for MR SIWA.

c. Motion

Motion is used as one measurement factor that measures children satisfaction in usability measurement. The motion parameter is measured by the mascot's movement in the video that is included in MR SIWA. To measure the satisfaction level, children will be asked on how funny the movement in the video. Funny in this context means that it attracts that children's attention, as it could possibly affect the user experience of the children in using MR SIWA

d. Sound

Sound will be used as one of the measurement factor in this research. This parameter will be integrated in satisfaction. The sound measurement will be primarily focused on the audio embedded in the video included in MR SIWA. The measurement will be done by asking the children on how cute the sound is.

e. Size and Proportion

The size and proportion will not be included as the usability measurement factor for this research. It is caused by the shape of MR SIWA's mascot that is similar to human tooth. The design makes it difficult to distinguish between head and body part. Thus, the measurement of size and proportion is not applicable in this case.

f. Shape and Form

The shape and form factor will be used in this research as one of the measurement factor. The shape will be used to measure the *kawaii* level of MR SIWA's mascot. The measurement will be done indirectly by integrating this *kawaii* factor via integration with memorability parameter. Latest research found that actually emotional-involved events may enhance the memory quality when it is retrieved in the future (Bettam-Toronto, 2012). Therefore, the memorability could be used as an approach in measuring the *kawaii* level in terms of emotion included in *kawaii* feeling. But, with time constraint, the children will be asked to estimate whether the mascot is memorable or not.

g. Smell and Taste

Smell and taste is not included in the usability measurement of this research. Even though it could include emotions, but the usability research of MR SIWA mainly focuses on visual and auditory senses, whereas the other senses are irrelevant and cannot be used as parameters.

The factors in *kawaii* design are then integrated into usability parameters so that it could be measured together in KUE questionnaire. The assignment of each *kawaii* factors into usability parameters could be seen in table 4.7 below

Table 4.7 Parameters & Measurements Used in KUE Questionnaire

Parameter	Measurement		Question no	
	Usability	Kawaii	Usability	Kawaii
Memorability	Control System Easy to Remember	Memorable Mascot	1	2
Error	Error Occurrence		3	
Satisfaction	Wants to use it again	Fun Design	6	7
	How good the system is	Cute Sound	13	8
		Fun Motion		12
		Color Scheme		11
Learnability	Easiness in using the media	Design helps in using the media	5	4

Parameter	Measurement		Question no	
	Usability	Kawaii	Usability	Kawaii
Efficiency	Content Comprehension	Funny video & hologram, also helps in understanding the content	9	10

In table 4.7, there is one cell that is shaded yellow. It means that there is no parameter that could be classified into that category to measure the usability of MR SIWA. The effectivitiy evaluation will be based on the measurement factors that has already been determined, where the result score for each measurement factor will be used as the evaluation. Each measurement factor will be used as one question item in the questionnaire, thus the score of one question item will affect the score of a measurement factor. In the end, even if there is a difference in the question item quantity for each parameter, there will be no significant difference on the final result of evaluation.

As kawaii is more related to design, it has more correlation towards user satisfaction, which is why there are 4 kawaii factors in satisfaction. Meanwhile, when kawaii is used to measure error, it could only be done when comparing the result of before and after treatment, whereas this research has a purpose to only evaluate the performance of MR SIWA.

The parameters will be measured using five level of response, which has a score range of 1-5, where 1 is the worst response and 5 is the best response. The result of questionnaire will then be used as the base for improving MR SIWA. When the question item has a score of 1 and 2, major improvement will be needed, where immediate change is necessary to improve MR SIWA. When the score is 3 and 4, minor improvements is suggested to further improve the performance of MR SIWA. A score of 5 means that any improvement will be unnecessary.

Table 4.8 Improvement Level Based on Questionnaire Result

Score	Level of Improvement
1-2	Major Improvement
3-4	Minor Improvement

Score	Level of Improvement
5	No Improvement

4.3.2 Questionnaire Development

Figure 4.8 KUE Questionnaire Design

The figure 4.8 above shows the example of questionnaire question that is given to the children. The changes included in the KUE questionnaire design compared to general questionnaire are explained below.

1. Use of Images and Visual Representations

The use of images and visual representations are intended to increase the attention of children since questionnaires with only texts are usually boring, moreover for childrens. Thus images and visual representations are useful for capturing students' attention in filling the questionnaire questions. There are five images in KUE questionnaire which could be seen in figure 4.9, each representing different value of response. The five responses generally mean very disappointed, disappointed, normal, satisfied, and very satisfied. Though, the response varies for every questions, where the used phrasing could be different.

The design used to represent the answer alternative for each question item is the same, where it is started with the worst answer represented by the sullen emoticon, until the best answer that is represented with the emoticon with biggest smile. The research from Read, et al. (2009) found that children just wanted variety of mouth articulation in representing the answer choice, rather than an extreme expression of frown and smile. Furthermore, it is found that the face with straight line mouth is percepted by the children as an angry face, thus the face with weak smile is suggested for a neutral answer. Besides, the use of yellow color for the

emoticon is to ease the children in percepting the meaning behind each emotion shown in the answer alternatives, as yellow is also usually used as the general color for any kinds of emoticon.

2. Short Questions

Short questions are used to increase the data accuracy by increasing children's comprehension on what is being asked by the question. As children's cognitive ability is still undergoing development process, long explanations may make the children confused. Therefore, each question used only less than 10 words. Whether the used questions are effective will be tested further in next chapter.

3. Attributes in Answer Alternatives

Usually, answer choices in questionnaire are only consisted of answer types, such as agree or disagree. But sometimes, it is cognitively difficult for the children disagreeing to negatively phrased questions, or phrases with negative meaning. For example, when the question asked if error is rarely occurred, disagreeing to such questions means that the error occurrence is high, but it is cognitively difficult for the children to perceive that. To prevent that, attributes are added to the answers, so that the children could understand the question easier, while at the same time choose the intended answer accordingly.

4. Use of Simple Language

Simple language means that the questions used in the questionnaire uses only words that could be understood easily by the children. The language in questionnaire is adjusted to the vocabularies of elementary school children. by implementing it in the question, it is expected that the student could comprehend the question easily, which potentially could further increase the data accuracy.

The questions sentences for *kawaii* factors in the questionnaire are indicated by the words of "*lucu*" and "*menyenangkan*", that in the end is used to measure the attractivity of MR SIWA in terms of design towards the user. It is also supported by the use of visual image of the smiley where the student will percept that the word of "*lucu*" and "*menyenangkan*" is related to the level of how attracted the students towards MR SIWA, indicated by the emotion shown by the smiley icons.

4.4 Questionnaire Result and Test

This subchapter will explain about the questionnaire result and testing of the designed questionnaire.

4.4.1 Data Collection Result

In this research, there are three kinds of data that are collected, consisting of pretest, posttest, and questionnaire data.Collected questionnaire data for respondent 1-20 could be seen in the table 4.9 below.

Table 4.9 Summary of KUE Questionnaire Result

No	Name	Response for Each Question Item												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Ankaa	2	4	4	4	4	4	4	2	3	4	4	2	4
2	Aryo	4	5	4	4	4	4	4	5	5	5	5	4	5
3	Baghiz	3	4	3	4	5	5	3	1	3	4	3	4	3
4	Confidential Data	Confidential Data												
5														
6														
7														
8														
9														
10														
Description		1 = Very Bad			3 = Neutral			5 = Very Good						
		2 = Bad			4 = Good									

Based on the KUE questionnaire results, the average questionnaire score for all of the respondents is about 4.072, which means as good in qualitative result. similar result is also given when the data are classified based on gender. The average score for male and female respondents are 4.022 and 4.103 respectively.

4.4.2 Validity Testing for Questionnaire

Validity testing is performed to estimate the extent to which variance in the measure reflects the variance in the underlying construct (Westen & Rosenthal, 2003). The measurement for validity testing is done by using bivariate correlation in SPSS, looking at the correlation between each question item with the total result. The result would be called significant when the calculated parameter r is higher

than the critical r, which means that the item has significant effect to the total score. The validity testing result of KUE questionnairefor all participants could be seen in table 4.9, with significant items marked using two apostrophes (‘’) at significance level more than 0.01 (refer to appendix for full r table). A valid questionnaire means that the question items could measure the things that are intended to be measured.

Table 4.10 Validity Testing Results

		Total
Item_1	Pearson Correlation	.692”
	Sig. (2-tailed)	.000
	N	90
Item_2	Pearson Correlation	.695”
	Sig. (2-tailed)	.000
	N	90
Item_3	Pearson Correlation	.426”
	Sig. (2-tailed)	.000
	N	90
Confidential Data		

4.4.3 Reliability Testing for Questionnaire

The reliability testing is conducted to see whether the questionnaire has similar result when it is used on repeated trials (Carmines & Zeller, 1979). The reliability testing is done by using SPSS software. The reliability test result of KUE questionnaire for all participants is then compared to the standard of acceptable alpha, which is commonly around 0.65 to 0.8 at minimum (Goforth, 2015). Reliability testing result could be seen in the table 4.11 below.

Table 4.11 Reliability Testing Results

Reliability Statistics

Cronbach's Alpha	N of Items
.898	13

The test result of KUE questionnaire for all participants using software SPSS shows that the Cronbach's alpha result is 0.898, which means that KUE questionnaire has a good reliability. A reliable questionnaire means that it could be used many times, and still yield similar result for each iteration.

4.4.4 Gender Effect on Questionnaire and Education Media

The effect of gender could be seen from two perspectives. First, the gender effect on the questionnaire that could be measured through validity and reliability of the questionnaire based on gender classification. The results of gender effect on the questionnaire and education media is explained in detail below.

a. Effect of Gender on Questionnaire

The effect of gender on the questionnaire could be seen by using the validity and reliability testing. The results of validity and reliability testing for male and female participants could be seen in table 4.12 until table 4.14 below.

Table 4.12 Validity Testing Result (Male)

		Total
Item_1	Pearson Correlation	.763**
	Sig. (2-tailed)	.000
	N	35
Item_2	Pearson Correlation	.741**
	Sig. (2-tailed)	.000
	N	35
Item_3	Pearson Correlation	.520**
	Sig. (2-tailed)	.001

		Total
	N	35
Confidential Data		

The results above show that the question items are all valid for male participants, where all of the Pearson correlation (r value) has higher value compared to r critical.

Table 4.13 Validity Testing Result (Female)

		Total
Item_1	Pearson Correlation	.639**
	Sig. (2-tailed)	.000
	N	35
Item_2	Pearson Correlation	.655**
	Sig. (2-tailed)	.000
	N	35
Item_3	Pearson Correlation	.319*
	Sig. (2-tailed)	.001
	N	35
Confidential Data		

The results above show that the question items in the questionnaire are all valid for female participants, where all of the Pearson correlation (r value) has higher value compared to r critical.

Table 4.14 Reliability Testing Result of (a) Male (b) Female

Reliability Statistics

Cronbach's Alpha	N of Items
.920	13

(a)

Reliability Statistics

Cronbach's Alpha	N of Items
.881	13

(b)

The reliability testing result that could be seen in table 4.14 shows that actually questionnaire is reliable to be used by both male and female participants.

b. Effect of Gender of Education Media

The effect of gender on education media could be seen by comparing the average score of questionnaire result on both male and female participants. The gender effect is compared by using hypothesis testing two populations with Z parameter. The result could be seen in table 4.15 below.

Table 4.15 Hypothesis Testing on Average Score of Questionnaire

	Female	*Male*
Mean	4,103497	4,021978
Known Variance	0,291742	0,431455
Observations	55	35
Hypothesized Mean Difference	0	
Z	0,613916	
P(Z<=z) one-tail	0,269635	
z Critical one-tail	1,644854	
P(Z<=z) two-tail	0,539271	
z Critical two-tail	1,959964	

Table above shows that the z value (calculated z) is 0.614, which is less than z critical two tail value (z table) of 1.96. Thus, the conclusion is to support null hypothesis where actually there is no difference between male and female participant in regards to the questionnaire result.

4.4.5 Summary of Questionnaire Result and Test

Based on the data collection and processing on previous chapters above, several results could be obtained, starting from the validity testing and reliability testing for all participants, male participants, and female participants, also the average KUE questionnaire score for all participants, male participants, and female participants. The summary of those results could be seen in table 4.16 below

Table 4.16 Summary of KUE Questionnaire Result and Testing

Participants	Testing Conclusion	KUE Questionnaire Score Conclusion
All	Questionnaire valid & reliable for all participants	MR SIWA has a good rating for all participants
Male	Questionnaire valid & reliable for male participants	MR SIWA has a good rating for male participants
Female	Questionnaire valid & reliable for female participants	MR SIWA has a good rating for female participants

CHAPTER 5
DATA INTERPRETATION AND ANALYSIS

This chapter explains about the interpretation and analysis from the collected data in previous chapter. The interpretation and analysis are done on the results of pretest and posttest, as well as the questionnaire and comparing gender factor.

5.1 Analysis on Pretest and Posttest Results

Generally, the test result shows a positive trend with average pretest result of 45.33 and average posttest result of 55.78. The fact is further supported by the result of paired sample hypothesis testing which shows a result of significant difference between posttest and pretest, meaning that MR SIWA gave a significant contribution in increasing children knowledge towards mouth and teeth.

Despite the positive result, it could be seen that there are several students who got worse result in posttest that in the pretest. The data from figure 4.7 in chapter four shows that most of the students with smaller posttest score has wrong answer in number 14, even though the answer in pretest was correct. There are about 8 students who are experiencing such event. Question number 14 asks about the function of incisors. It may be because that there are other questions that asks about the function of another teeth type, which are canines, premolars, and molars. Because of similar questions, the students need to recall the functions of all teeth, where the student's memory could be jumbled up because of it, and then choose the wrong answer.

Based on all of the demographic data, there seems to be no factor that influences the small posttest score, since almost all of the data shows a proportion that approaches 50%. The only hint comes from difference in average questionnaire score between participants with bigger posttest score and participants with smaller posttest score. One question item with highest deviation comes from item number 6, which asks about whether the participant wants to use the media again in the future or not. Most of the respondent with smaller posttest score gives smaller rating

compared to participants with bigger posttest score, even though that the rating is still high enough to be considered as good (4.15 for participants with smaller posttest score).

The processed data from table 4.6 in chapter four also shows a variation in the score increase when it is specified into categories of school. The result of hypothesis testing using z test shows that the score increase between pretest and posttest in SDIT *Luqman Al-Hakim* is significantly different compared to score increase in SD *Yapita*, indicated with the z stat (2.52) that has bigger value compared to critical z (1.96). Meanwhile, the result doesn't reflect any differences when it is classified based on gender, where the z stat (1.22) is smaller than the critical z (1.96). the score increase difference in school-classified data may be caused by the difference in the student's grade, where the students in SDIT Luqman Al-Hakim are from 5^{th} grade, while in the students of SD Yapitaare from 4^{th} grade. On the other hand, the gender-classified data shows no significant difference, which means that both male and female student both comprehends the knowledge provided by MR SIWA on the same level.

5.2 Analysis on Questionnaire Result

The score from respondent's responses also shows a positive result, with the average value of 4.072 (refer to appendix for complete summary of questionnaire result) for all respondents. It means that overall rating of the respondent towards various aspects of MR SIWA is good enough. The questionnaire result is further supported by result of pretest and posttest, where positive trend is shown by posttest that has a different result compared to the pretest. There is a significant increase in posttest score compared to the pretest that shows MR SIWA. When the test score difference is connected to the questionnaire score, it could be said that both results are directly proportional, where MR SIWA has a good design and usability, as well as able to help the students in increasing knowledge regarding mouth and teeth health.

Data processing result shows that KUE questionnaire is valid and reliable, thus it is able to be used for children to evaluate the performance of MR SIWA. The validity and reliability of questionnaire is proven by using Pearson correlation and

Cronbach's alpha. Pearson correlation for the questionnaire testing shows that all of the items has significant effect to the total score on significance level of 0.01. thus, it could be said that the questionnaire is valid to be used for children, especially students of 4th grade and 5th grade. Valid questionnaire means that the question items in the questionnaire could measure things that are intended to be measured.Reliability testing also provided similar results, where the questionnaire is proven to be reliable with Cronbach's alpha value of 0.898. as the value surpasses the minimum standard of 0.65 to 0.8, the questionnaire could be said to be reliable. A reliable questionnaire means that it could be used many times, and yield similar result.

5.3 Analysis of Gender Effect on KUE Questionnaire and MR SIWA

The gender effect on KUE questionnaire is seen from validity and reliability testing shown from table 4.12 until 4.14 in chapter 4, where both male and female shows similar result with all of the question items valid and reliable. Though, there is one question item (item 3) in validity testing of female samples that actually is significant only when the significance level is more than 0.05, whereas other question items are significant when the significance level is more than 0.01.

The second perspective that is gender effect on education media design is analyzed through hypothesis testing using Z parameter, comparing the questionnaire result of both male and female samples. The hypothesis result in table 4.9 indicates that there is no significant difference between male samples and female samples. Based on the result of both gender effect on KUE questionnaire and education media design, it could be said that the design of KUE questionnaire and MR SIWA are gender universal, and could be used by both genders.

5.4 Improvements on MR SIWA

The need for improvement of MR SIWA's design could be seen from the questionnaire score of all respondents. The ratings are proportionally increasing with the increase in score, where 1 is the worst condition and 5 is the best condition.

Table 5.1 Average KUE Questionnaire Score for Each Question Item

Question Item	1	2	3	4	5	6	7
Average Score	3.778	3.789	4.011	3.956	4.156	4.500	4.400

The data on table 5.1 is related to the question item that is listed in table 4.7. Based on the results, it could be said that there are only minor improvement in design that is necessary for MR SIWA. Since the overall score is above 3.5, it means that the overall response for MR SIWA is good enough.

With such condition, the improvement that could be proposed is taken from the question item with lowest score highlighted in table 5.1 above. The question number 1 is related to memorability of control system, and question number 2 is related to the memorability of mascot in MR SIWA. The control system could be improved by adding a tutorial feature into the software so that the children could learn about how to operate the system anytime. While for memorability of mascot, it could be improved by increasing the involvement of the mascot in MR SIWA, since the existing design does not involve the mascot that much in its features, especially in the video and hologram.

CHAPTER 6
CONCLUSION AND SUGGESTION

This chapter explains about the conclusions that could be taken from the research process that has been conducted. Several suggestions will also be given as a reference for improvement of future researches that is related to this research.

6.1 Conclusion

Based on previous chapters of data processing and analysis, there are several conclusions that could be taken, considering the objectives that have been stated in the beginning of this research. Those conclusions are:

1. The result of test shows that MR SIWA provide better result compared to using traditional method, shown by the significant increase in the test score and the result of statistical test. t-test for paired sample means found that the difference between posttest and pretest score is significant with t value of 6.227 that surpasses t critical for two tails of 1.987.
2. Based on the concepts of usability testing and *kawaii* design, there are several parameters that could be used to evaluate the effectivity of MR SIWA as an education media for mouth and teeth health. The used parameters in usability concept consisting of efficiency, memorability, learnability, error, and satisfaction. By determining the parameters in usability concept, *kawaii* factors are then integrated into each parameter.
3. KUE questionnaire is the measurement tool designed for the children usability testing. The consideration comes from the use of images and visual representation, short question sentence, attribute embedded in each answer alternative, and the use of simple language to match the children's vocabulary.
4. Based on the data processing result, it is found that all of the question items in the questionnaire are valid and reliable, both in general result and gender-classified result. Hypothesis testing using z-test also found that the questionnaire result for both male and female participants yield no significant

difference with z value of 0.614, less than z critical for two tails of 1.96, which means that the questionnaire is gender-universal.

5. The evaluation for design of MR SIWA is done by using the KUE questionnaire. It is found that MR SIWA has significant contribution in increasing student's knowledge about mouth and teeth health. Average questionnaire score for all of the participants is 4.072, while for gender-classified result is 4.103 for female and 4.022 for male participants. which means that the overall rating for MR SIWA's design is good.
6. Based on the questionnaire result, it is found that there is no critical improvement needs to be given. But, several opportunities for improvement could be seen through the lowest average score of the questionnaire, which is the question item 1 and 2 that is related to MR SIWA control and memorability of the mascot respectively.

6.2 Suggestion

Suggestions that could be given for future researches related to usability questionnaire for children on MR SIWA are:

1. Further observation to see whether mouth and teeth education using MR SIWA could affect the lifestyle of children in keeping mouth and teeth health
2. Conducting a FGD session after finishing the data collection process to ask the students about improvements that may be necessary for MR SIWA
3. Improving the questionnaire by adding additional feature to increase its attractivity, such as increasing color alternative for each answer alternative, or changing the emoticon shape by matching the context of each question item

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AUTHOR BIOGRAPHY

Fachreza Reynaldi Nugroho was born in Malang, May 17th 1997. Author was the son of three siblings from Nugroho and Luluk Rosida. The author had graduated from formal education in TK Al-Huda Kediri, SDN Banjaran IV Kediri, SMPN 1 Kediri, SMAN 2 Kediri, and is now studying in Industrial Engineering of Institut Teknologi Sepuluh Nopember Surabaya. Author has many organizational experiences, such as the staff & expert staff of Internal Affairs Department in ITS Student Choir, Staff and Head of Welfare Division in Student Welfare Department. The author currently enlisted as the assistant of Ergonomic and Work System Design Laboratory. The author has a professional work experience as the private teacher in LBB Sumber Ilmu, teaching Junior High School and Senior High School Student. Author also has an experience of internship in Pertamina Shipping, North Jakarta. The author could be contacted from several media, which is listed below.

Address : Perum Sukorejo Indah II/25 Kec. Ngasem, Kab. Kediri
Email : rezakdr@gmail.com / rezaray46@yahoo.com