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Design and Development Archipelago Architecture Learning Media Using Qr Code Technology

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Abstract

In this digital era, almost all aspects of human life depend on technology, education, business, government, and even daily life. Along with the increasing advances in computer technology used for human interest, the science that supports it also develops, one of which is the field of Human and Computer Interaction often called HCI. Input-related methods are essential to consider in HCI; one example of input is Quick Response Code (QR-Code) technology. QR-Code technology has been widely applied in teaching and learning, such as attendance models and foreign language learning media. In this research, we also use QR-code technology to introduce the culture of the architecture, especially about traditional houses in Indonesia combined with motor training through coloring activities. It is hoped that children will have no problem writing as they get older and help develop creativity. The method used in this research is the Human and Computer Interaction (HCI) test method focused on the design of the user's system so the implementation of the system can be carried out efficiently by taking into user needs. Based on research that has been done, QR-Code technology can be used to support learning media.

Keywords: *Culture of the architecture, QR – Code, Motor, Human and Computer Interaction, Story Telling*.

INTRODUCTION

One of the most technology that is very useful and widely used in various fields is QR (Quick Response) Code. QR-code is the development of a bar code (bar-code) into a matrix / 2 dimensions. QR-code was first introduced in Japan in 1994 and was developed by Denso-Wave, an automotive company in Japan, for the necessary data collection of vehicle spare parts production inventory (Pulungan & Saleh, 2019). QR-codes are considered more effective and efficient because of their smaller size than bar-codes and their ability to store data and information in a high capacity. Furthermore, QR-code can accommodate various data types such as numeric, alphanumeric, symbol, Kanji, and binary (Muharom, 2016). Whereas bar-code delivers information about a product or goods, usually in an item production code, identity number, and expired date. QR-codes are shaped and arranged black modules in a square pattern and use a white background. There are many uses of coloring books to introduce traditional houses, with animation using QR-code technology that does not yet exist. Therefore, this research and experiment will be instrumental in introducing Indonesian culture, especially traditional houses, in a QR-code easily accessible to many people.

QR-code technology is used because it has speed and accuracy in providing information. One of the fields that have implemented QR-code technology is education (GOGOVA, 2014). Many ways have been used to improve teaching and learning activities, such as implementing the Quick Response Code (QR-Code) Based Semester Exam Attendance Model at Jember Muhammadiyah University. This research utilizes QR-code technology and applies it to the attendance model (Muharom, 2016). Besides being applied to the attendance model, QR-code technology is also applied to Foreign Language learning media (Salleh et al., 2018). Those two examples are the application of QR-codes in education, especially in a particular subject. However, other things can be combined with this QR-code technology, which is about culture in Indonesia, especially regarding traditional houses in Indonesia.

According to the ministry of education, Indonesia has 67.273 archipelago heritage (Pane et al., 2017). It proves that Indonesia has many cultures, ranging from regional languages, traditional clothes, traditional houses, and traditional events and dances. It will be a pity if the younger generation is less familiar with the nation's archipelago heritage. Based on these conditions, this research was carried out to help the community, especially the younger generation, recognize the various types of traditional houses in Indonesia, equipped with traditional clothing of each region in the form of animation. It is hoped that culture can be introduced starting from children because culture is often forgotten and displaced due to rapid technological developments and influences from outside cultures. This QR-code technology will help users get to know the culture in Indonesia, especially the diversity of its traditional houses, through activities that we summarize in a coloring book. In Indonesia, culture is a philosophy and way of life materialized in socio-economic values, architecture, health. This QR-code technology will be help facilitate access to a variety of information by displaying various types of files (video, color 3D images, 2D images) to introduce traditional houses owned by Indonesia from each region.

The utilization of QR-Code as an output media cannot be separated from the Human-Computer Interaction (HCI) scientific clump. Human and Computer Interaction is a science that examines how interactions occur between users and the system used. The users referred to in this HCI focus on individuals and everyone who uses technology to complete their tasks. HCI has three essential components, such as humans, computers, and interrelated interactions. In HCI, the user will interact with the computer through an intermediary called an interface (Dalle et al., 2019). Interaction in HCI is divided into two types, namely direct interaction and indirect interaction. Direct interaction defines the action-reaction process between the user and the computer. This process is known as two-way interaction. At the same time, indirect interaction involves processing sensors or codes to achieve a particular goal, for example, in the application of QR-codes.

This QR-code will be included in the coloring activity book. This activity is seen as most relevant to childhood, a time when children prefer to play rather than learn. At this time, the child's psychological, motor, and cognitive abilities develop. (Amrulloh & Mulyoto, 2016). Also, at this time, children become more sensitive to the stimulus provided by the environment around them. The stimulus can develop children's creativity and imagination if the stimulus is positive. Therefore, accompaniment from parents is the most crucial aspect of a child's growth and development. In this digitalization era, children grow up with the development of technology around the world. The development of this technology has a significant impact on children's lives. Every child needs to get direction and accompaniment from

parents to use technology wisely and according to their age. The utilization of technology can be applied to education and culture, as done in this research.

This research is aimed at children aged 3-6 years, considering their needs and motor skills. Children's motor skills affect the ability of children as a whole, especially in this technological era. The growth and development of children can be built through games that stimulate the brain. In the learning process, there are simulations related to all abilities possessed by early childhood. The simulation aims for children to be following the stages of self-development and even reach the maximum level. Therefore, the selection of media and the method used is essential. Simulation of children's abilities in the 5.0 technology era is important if accompanied by the formation of a child's character. At 3-6 years old, children's motoric skills can be trained by coloring, such as moving the fingers. This Colouring Activity is called fine motoric training to prepare children not to have difficulties when writing or activities that require finger skills. This fine motor training can be developed after gross motor development. When the child's early age is about one or two years, this gross motor development has developed rapidly. In the third year, children begin to develop fine motor skills, and children have begun to be interested in holding pencils even though they are still stiff and how to hold the pencil is still in the part that is close to the pencil point.

Based on the previous research, the authors use QR-code technology on learning media to introduce archipelago architecture. Reviewing the statement regarding the archipelago diversity of the Indonesian people, the authors focus the research on the following questions: 1) How to design information technology-based learning media? 2) How to design HCI-based learning media that utilizes QR-code technology?.

METHODOLOGY

This research uses the HCI test method, which examines how the interaction occurs between the user and the system used. HCI has an essential role in making a useful and runs effectively, efficiently, and functionally. This HCI focuses on user system design or User-Centered Design (UCD). A system design is fundamental because it is related to user comfort when using the system so that problems in a system can be avoided by applying the HCI concept. The application of the system can be achieved and does not fail. (Dix et al., 2004).

Designing valuable and attractive products requires skill and creativity. Some products innovate from initial ideas through conceptual designs and prototypes. Figure 1 shows the iterative cycle of design and evaluation to help ensure that it meets user needs.

Figure 1 Prototyping steps

The research step starts from designing an information system analysis model and applying the criteria from Jakob Nielsen (Handiwidjojo & Ernawati, 2016), such as :

1. *Learnability*
   Users feel convenience when using the system.
2. *Efficiency*
   Calculation of the user's speed when completing a job.
3. *Memorability*
   The possibility of the user remembering interactions with the system.
4. *Errors*
   Counting how many errors are caused by users and the ease of dealing with them.
5. *Satisfaction*
   How satisfaction, effectiveness, and user's efficiency of the system.

Determine the performance directly through the following requirements (Willey & Sons, 2002).:

1. *Functional*
   We are focusing on the function's direction of the application to be built. There are two types, namely functional and non-functional.
2. *Data*
   Focus on what data are needed to building the product.
3. *Environmental*
   Focusing on the environment, to have to think about pay attention to the reactions of the surrounding environment.
4. *User*
   Focus on what the user has needed.
5. *Usability*
   Focus on the usability of the product for users, including the ease of learning about the product.

Evaluation of the realization results of this QR-code application project uses the heuristic evaluation method. The evaluation process is carried out after the design process and before the implementation process is carried out. This evaluation process is carried out to ensure that if the application encounters a problem or has a deficiency, it can be corrected first in the design process. The heuristic evaluation method evaluates human and computer interactions that examine the usability aspect of an application/program. Nielsen and Molich first proposed heuristic evaluation in 1990. The heuristic evaluation aims to improve application/program design effectively (Savitri & Ispani, 2015).

Heuristic evaluation refers to ten principles, such as 1) Visibility of system status. The system is tasked with informing the user about what processes are being run by the system. 2) The compatibility between the system and the real world. The concepts built on the system must be following the user's language in the real world. 3) User's control and freedom. In this case, users are free to choose what features to use according to their needs. 4) Consistency and standards. 5) Error prevention. 6) Recognition, diagnosis, and problem-solving. 7) Flexibility and efficiency of application usage. 8) Aesthetic and minimalist design. 9) User assistance and problem fixing. 10) Assistance and documentation (Murdiaty et al., 2019).

A. Analysis Need's

Based on the needs analysis of coloring books as a learning media for the recognition of archipelago architecture by utilizing QR-Code technology, it was found the needs as follows:

a. QR- Generator and QR-Code

A QR-code generator also supports the use of QR-codes to generate the QR-codes used in this research. There are several web and mobile-based applications that provide features to create or generate QR-Codes. Unfortunately, with the non-paid feature, there are several deficiencies, such as a limitation on the time of using the QR-code or not adding a logo to the QR-code as needed. This reason makes us consider creating our QR-code generator with a web base that can be used as needed without any time constraints.

b. Content

The output of this research is a coloring book as a form of brain stimulation for children aged 3-9 years, both fine motor skills and children's creativity. This coloring book also aims as a learning medium to introduce Nusantara architecture as one of the nation's archipelago wealth. The technological advances omit not it, so required as content for this purpose are 1) Black and white 2D media to be the center of coloring activities. This page will become content of the first QR-code so that activities can reprint as needed 2) 3D pictures equipped with colors help give children who need particular coloring examples. The QR of example hopefully will help coloring activities become convenient and more fun. 3). Animation is related to the introduction of archipelago architecture. The use of animation is used in addition to being a differentiator with other traditional house coloring books, with animation using the storytelling method to introduce the main components of the culture's architecture in a style that children 3-6 years old can understand.

c. Animation Character

The target of this archipelago architecture coloring book is children from the 3-6 years old range. Then to make storytelling more interesting, characters are needed that will be used to tell information related to archipelago architecture.

d. QR-Code Reader

From the results of the needs analysis that has been done, we decided to create a QR-Code Reader application which we named DC-Scanner. The DC-Scanner application is intended for users of Coloring Books and an introduction to archipelago architecture. This application can be used via a smartphone. Although there are many applications on the application provider platform that can read the QR-Code, this DC-Scanner application is expected to make it easier for users to access information from the QR-Code listed on the book.

B. Design Process

a. QR Generator and QR Code

In developing the QR-Generator as a QR-Code generator, we used an open library based on JavaScript to create the QR-code generator in Figure 2. In the application process, we made it in a web-based form.

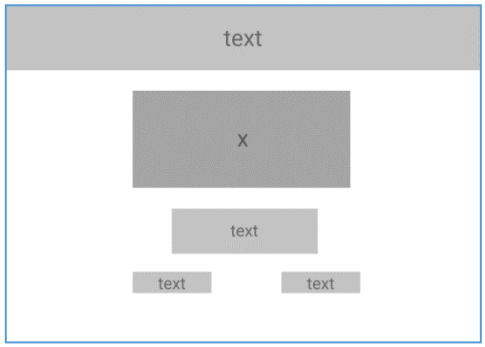

Figure 1 QR-code Generator design view

In Figure 3, a flowchart of how the QR-Generator works to generate a QR-Code, which will contain the files needed by the application.

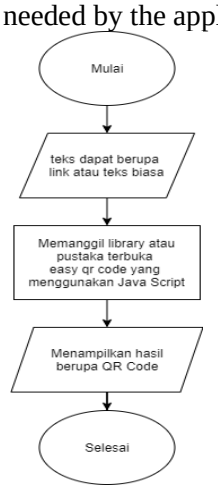

Figure 2 QR-code Generator Works Flowchart

While Figure 4 shows the result QR-Code generated design by QR-Generator. In the middle, we add a logo indicating the maker's institution.

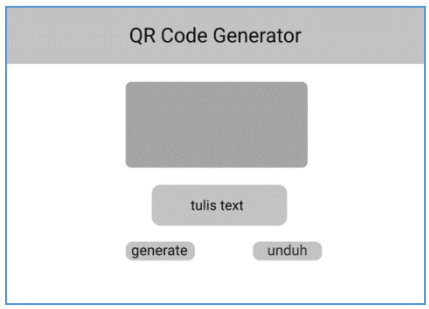

Figure 3 Result Plan from QR-code Generator

b. Content

The design process as coloring book content is: 1) Black and white 2D media that will be the center of coloring activities can be seen in Figure 5 below. 2D images are made similar to the appearance of a real traditional house in an area to emphasize the elements of culture's architecture.

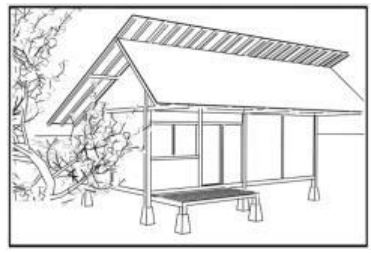

Figure 4 2D Design Process for coloring

2) 3D images equipped with coloring are expected to help cognitive stimulation in children to introduce archipelago architecture. 3D images can be seen in Figure 6.

Figure 5 3D Design Process

3). animation related to the introduction of archipelago architecture. Animated videos performed by animated characters named Kacil and Kelly are not only limited to the appearance of a 3 (three) dimensional traditional house and its name. The information in the animation video also contains information about the philosophy and materials used to build the traditional house. The information conveyed is, of course, aimed at introducing the cultural architecture regarding the diversity of traditional houses, which are the wealth of the Indonesian people.

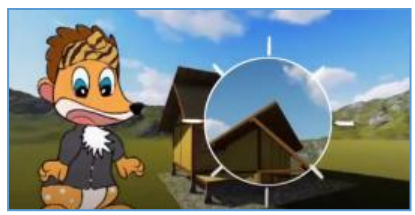

Figure 6 Proses Pembuatan Animasi

c. Animation Character

All the information contained in the video is explained by two cute characters named Kelly and Kacil. These two characters will explain the traditional houses scattered throughout the archipelago. They will be the characters in charge of explaining the meaning of the traditional name house, the basic materials used to build the traditional house, and the philosophy and utility of the traditional house. When conveying information, they also wear

traditional clothes from each region. Figure 8 is a character display of Kelly and Kacil.

Figure 7 Kelly and Kacil as Story Telling Characters Animated

The characters of Kelly and Kacil are designed as attractive as possible so that children do not get bored quickly when listening to the explanations delivered through the video. Furthermore, the placement of these characters so that the video can become more lively, not seem stiff and monotone. The primary purpose of these Kelly and Kacil characters is to trigger children's curiosity to learn and get to know Indonesian culture, especially the archipelago architecture in the form of traditional houses and their clothes.

e. QR-Code Reader

Figure 5 shows the initial view of the DC – Scanner application. The user will be asked to press the available button to scan the QR-code to access further information when running the application.

C. Build Prototype

After going through two stages, specifically the needs analysis and the design process, the next stage is making a prototype. Based on the flowchart in Figure 3, an interface is made to generate an image containing a QR-Code, which we call a QR Code Generator, as shown in Figure 9.

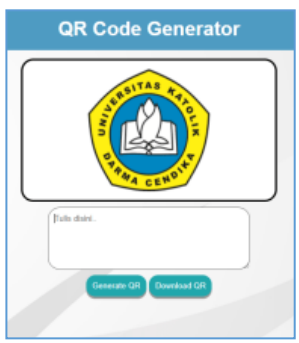

Figure 8 QR Code Generator appearance

Whereas the QR image generated by the QR code generator can be seen in Figure 10.

Figure 9 QR Code appearance

One of the advantages of using QR Code technology is that content can be scanned with any QR Scanner application, some already available on smart devices. However, we created a special scanner named DC-Scanner to make it easier for children to use it. The DC-Scanner display can be seen in Figure 11.

Figure 10 Initial view of DC–Scanner

With this application, users press the scanner button and easily access the data contained in each QR Code.

RESULT AND DISCUSSION

We produced two activities in this research, namely coloring and technology activities with the DC-Scanner application. This QR-Code-based coloring activity book contains an introduction to the architecture of the archipelago. The front view of the coloring activity book can be seen in Figure 12. In the lower-left corner, a QR-Code contains an animation on how to use the book.

Figure 11 Coloring Book Front Cover Display

Meanwhile, the back view of the book is shown in Figure 13.

Figure 12 Coloring Book Back Cover Display

Inside the book, there is a coloring area which is the main activity on each page. The picture of the traditional house is only black and white, where later this object will be used by children to express their imagination and creativity in giving color to the book. The advantage of this coloring book is that it is equipped with three QR-Codes, as shown in Figure 14 and Figure 15.

The first QR Code contains objects in the same 2D form as the developed media used to reproduce a collection. The second QR Code contains colored 3D objects, which are expected to be used as references. While the third QR Code contains an animated video explanation of the traditional houses of the archipelago on the page.

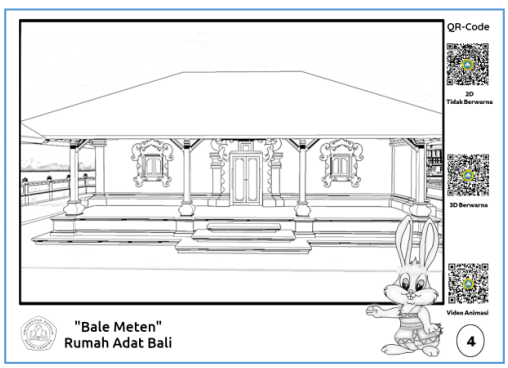

Figure 13 Display on Balinese Traditional House

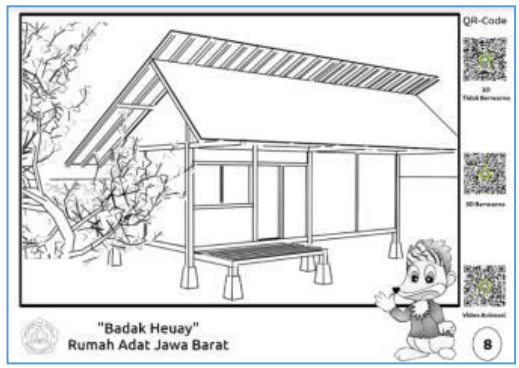

Figure 14 Display on the West Java Traditional House

After pressing the scan button, the user is asked to point the camera at the QR-Code listed on the coloring book; then, the application will process the QR-Code in such away. This animated video is uploaded to Youtube, so users can access the video easily by scanning the QR-Code. Figure 16 shows the processing results from the QR-code, which is an explanation video display about traditional Balinese houses.

Figure 15 Balinese Traditional House Video Scan Display

This animated video consists of 15 traditional houses, namely 1) Rumah Betang-Sulawesi 2) Rumah Hanoi-Papua 3) Rumah Bubungan Tinggi 4) Rumah Bali 5) Rumah Suku Baduy-Banten 6) Rumah Nuwo Sesat-Lampung 7) Rumah Lamin-Kalimantan 8) Rumah Badak Heuay-Jawa Barat 9) Rumah Adat Masaulaki-NTT 10) Rumah Adat Tongkonan-Toraja 11) Rumah Adat Siwaluh Jabu-Batak Karo 12) Rumah Adat Limasan-Jawa 13) Rumah Adat Suku Korowai-Papua 14) Rumah Adat Balla Labbrina-Sulawesi Selatan dan 15) Ruma Adat Bagas Gondang-Suku Mandailing.

The video display is made alternately between Kelly's character and Kacil's character. The clothes they wear are also adapted to the traditional clothes that will be told. The opening and closing

appearances are also always tried to vary according to the area to be discussed. One of the details of the opening display of the animated video can be seen in Figure 17.

Figure 16 Details Opening Animated Video By Kelly

By the IMK theory, the detailed discussion material in animation also pays attention to various delivery methods, namely through voice and writing (as shown in Figure 18). With various delivery methods, it is hoped that the information conveyed can be received better.

Figure 17 Animated Videos Using Voice and Text

Following the objectives that have been described, this coloring activity is carried out as a form of gross motor training for children. In addition, coloring activities are also helpful in developing creativity in children and introducing the nation's culture from an early age so that technological advances do not necessarily negate the nation's cultural wealth.

The evaluation method in this study used the heuristic evaluation method. This heuristic evaluation method refers to the usability aspect of an application. This heuristic evaluation is guided by ten principles, namely visibility of system status, compatibility between the system and the real world, user control and freedom, consistency and standards, error prevention, identification, diagnosis, and handling of user problems, flexibility and efficiency of application use, aesthetic design and minimalism, user assistance and problem fixing, and help and documentation.

Based on the evaluation method carried out on fifteen respondents, this study obtained the following results.

1. This research was conducted by children aged 3-9 years who were in pre-kindergarten to elementary school.
2. Referring to the usability principle from 1-5, 12.5% of respondents gave 1, 18.8% of respondents gave 4, and 68.8% gave 5 to the ease of application to operate. These respondent's evaluation shows that the application designed has met the value of the ease of use aspect.
3. Based on the eighth principle scale of 1-5, 6.3% of respondents gave a scale of 2, 31.3% of respondents gave 4, and 62.5% of respondents gave 5. Some respondents indicated their satisfaction with the color display on the DC-Scanner application, and the rest provided input regarding the lighting side, color selection, and images to make them more attractive.
4. Based on the seventh principle from a scale of 1-5, 6.3% of respondents gave a scale of 1, 6.3% of respondents gave a scale of 2, 43.8% of respondents gave a scale of 4, and 43.8% of respondents gave a scale of 5 on performance and efficiency assessments application. The respondent's assessment of the speed of application performance is good.
5. Evaluation size of the DC-Scanner application was stated by 6.3% of respondents giving a scale of 2, 37.5% of respondents giving a scale of 4, and 56.3% of respondents giving a scale of 5.
6. Respondents gave 2, 31.3% of respondents gave 4, and 62.5% of respondents gave 5. Some respondents gave their assessment of the menu display on the DC-Scanner application straightforward and easy to understand. Furthermore, the rest provide input to add colorful icons/images to attract children's interest more.
7. Evaluation of the ease of downloading and installing applications on mobile devices stated that 6.3% of respondents gave a scale of 2, 6.3% of respondents gave a scale of 3, 31.3% of respondents gave a scale of 4, and 56.3% of respondents gave a scale of 5.
8. Typographic Evaluation aspect regarding the size and font type of DC-Scanner application from a scale of 1-5, 6.3% respondents gave 2, 31.3% respondents gave 4, and 62.5% respondents gave 5.

9. Based on the second principle, 12.5% of respondents gave a scale of 2, 18.8% of respondents gave a scale of 4, and 68.8% of respondents gave a scale of 5. The level of respondents' satisfaction with the QR-Code conformity with the video content is good, and some respondents advise improving the QR-Code reading process on the application.
10. Referring to the second principle of target users aged 3-9 years, 6.3% of respondents gave a scale of 2, 6.3% of respondents gave a scale of 3, 37.5% of respondents gave a scale of 4, and 50% of respondents gave a scale of 5. Some respondents advise that images in printed books of traditional houses can be simplified because the details of traditional houses in the book are too small, so they are not suitable for children aged 3-9 years. In addition, the manual instruction can be further clarified in children's language so that children can also better understand how to use books and applications.
11. 6.3% percent of respondents gave a scale of 2, 37.5% of respondents gave a scale of 4, and 56.3% of respondents gave a scale of 5 to assess the use of QR-Code technology in this book.

CONCLUSION

In addition to the DC-Scanner application, this research also produced a coloring book entitled "Knowing Archipelago Architecture." This coloring book is aimed at children aged 3-6 years, of course, with parental guidance. Not only contain objects to color, but this book also includes a QR-code as a source of information to find the color reference used and an explanation video about traditional Indonesian houses.

Based on the discussion that has been described previously, the following conclusions can be explained.

1. This research resulted in a QR Code-Reader application called DC-Scanner and a coloring activity book entitled "Archipelago Architecture."
2. DC-Scanner applications are created by using an open library based on JavaScript.
3. The animated video on the QR-Code contains information about the philosophy's value and the materials used to build traditional houses.
4. The design of the DC-Scanner application refers to the five principles of Jakob Nielsen, namely learnability, efficiency, memorability, errors, and satisfaction.
5. The evaluation method used in this study is the heuristic evaluation method.
6. Based on the evaluations that have been conducted, the results obtained that 68.8% of respondents gave a scaled assessment of 5 on the aspect of usability, 62.5% on the satisfaction of color display on the application, 43.8% on the performance and efficiency of the application, 56.3% against the light application size, 62.5% on the design of the menu display that is clear and easy to understand, 56.3% on the ease of downloading and installation of the application, 62.5% on typographic aspects, 68.8% of QR-Code conformity with video content, 50% against the target users of books and applications in children aged 3-9 years, and 56.3% against the assessment of the use of QR-Code technology in the book "Archipelago Architecture."

In addition to producing a QR Code-Reader application, this study also produced an external coloring activity book titled "Archipelago Architecture" aimed at children aged 3-9 years. For further development, it is expected to fix external shortcomings and weaknesses; both contained in the application and coloring books. Shortcomings that need to be improved and developed further are the addition of colorful icons to attract children further, improve the lighting and selection of images and colors contained in animated videos, simplify the details of traditional houses used as a medium of coloring activities for children, and clarify the guidebook of the use of applications and books and adapted to the children's language so the children can better understand how books and applications work which are certainly accompanied by parents.

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