



Analysis of Visitor Needs for the Development of Educational Applications for the Bandung Geological Museum Collection

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ABSTRACT

The main objective of this research is to improve educational applications at the Museum of Geology. The objective is to identify the need to develop educational applications for visitors to the Museum of Geology in Bandung. This research uses the Design-Based Research (DBR) method. The following steps when conducting DBR research are (1) analysis and exploration, (2) design and construction, and (3) evaluation and reflection. The results showed that UI-UX aspects scored 72.78%, interactive elements scored 86.73%, sensitivity to media interactivity scored 73.31%, and enthusiasm for educational application development scored 84.65%. Based on the research results and data collected from this study, interactive media at the Museum of Geology is in good condition, but visitors have some complaints. Then, visitors anticipated additional content from the design, color, and interactivity categories. Since then, interactive media has become more effective in increasing the capacity to provide information about the collection to users. This can be verified using the scores mentioned earlier in the results and explanation section.

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1. INTRODUCTION

The 21st century is characterized by the rapid development of information technology and the development of automation, where many routine and repetitive jobs are replaced by machine and computer production machines (Aryasatya & Wibawa, 2022). As said earlier, the 21st century has witnessed a tremendous transformation in work. Technological developments also impact humans and the world of education (Wijaya & Nyoto, 2016). Education in the 21st century has transformed from traditional to modern education. So that with the ease of technology, learning can be done when, where, and by anyone.

Januszewski and Molenda (2008) argue that we have assumed learning to be a planned, formal process as usually associated with schooling. However, it is interesting to note that the definition of educational technology and its aim to facilitate learning is more comprehensive than formal processes. The AECT (1977) definition includes a learner as engaged in acquiring new skills, attitudes or knowledge whether by a specific sequence of instructions or a random variety of stimuli. So, learning can be formal or informal, and learning environments can include structured and unstructured settings.

Technological advances have significantly impacted various aspects of life, including education (Miranda et al., 2018). As explained in the previous paragraph, the learning process occurs when, where, and by anyone (Engelbrecht et al., 2020). In education, technology provides new opportunities to improve learning outcomes through more interactive and exciting methods (Friticarani et al., 2023). Some examples of technological advances in learning are the many emerging educational applications, learning software, and interactive media that have enriched the learning process in the classroom and outdoors (Maphosa, 2021; Papadakis et al., 2021).

Ceisar (2011) says that learning is not interpreted as something static. Learning does not only use book learning resources but also other learning resources (Evistasari et al., 2020). Ahmadjonovna and Bakhromovich (2020) state that museums are among the most popular learning resources. Museums have essential implications in improving the quality of education (Daskalaki et al., 2020; Knutson et al., 2020); besides functioning as a learning resource, museums can also function as learning and learning media (Meng et al., 2021).

Speaking of museums, several experts and institutions give their opinions about the definition of museums. One of the definitions of the museum was put forward by the International Council of Museums (ICOM, 2007), which defines a museum as an institution that is non-profit, open to the public, permanently serves the community, and is developed which collects, preserves, researches, communicates, and exhibits the heritage of mankind, both tangible and intangible, and the environment for education, learning, and fun.

According to experts, the definition of a museum, as conveyed by Bai & Nam (2022), is a means of developing human culture and civilization. In other words, museums are engaged in the cultural sector and can move in the economic, political, and social sectors (Ayala et al., 2020). In addition, Butler et al. (2021) said that the museum is a vehicle that has a strategic role in strengthening the community's identity, including the surrounding community.

Museums are no longer places to exhibit artifacts but also educational and research venues that foster unique learning experiences for visitors. With technological advances, museums can foster a fun and engaging learning environment, increasing visitors' knowledge and understanding of history, science, and geography (Marini & Agostino, 2022). Technologies such as Augmented Reality (AR), Virtual Reality (VR), mobile applications, and interactive media have been widely used in modern museum restoration (Fiaji et al., 2021). Using such technologies in museums allows visitors to explore collections in greater depth using

information available in digital form. For one, technological advances have positively impacted the advancement of education and museums (Evelyn & Machdijar, 2019). Through interactive applications and other digital media, museums are becoming more exciting and relevant to the younger generation. This also helps increase public understanding and trust in science fields such as geology as a means to advance the nation.

Tripadvisor's reporting website provides information that there are 10 of the best museums in Bandung, with the Museum of Geology in first place. This order is based on tourists' favorite places. Bandung Geological Museum is a museum that has a strategic location located on Jl. Diponegoro, No. 57 Bandung, near the center of the West Java Provincial government. The Geological Museum is also one of the Technical Implementation Units (UPT) within the Geological Agency, Ministry of Energy and Mineral Resources (Hidayatulloh, 2020). The Geological Museum is classified as a special museum, which is a museum that has a collection from one branch of science; in other words, this museum only has one type of collection (Azzahra & Cahyana, 2021).

When conducting a preliminary study at the Geological Museum, researchers interviewed resource persons who manage the education and information section and saw firsthand the conditions in the museum's collection room. During the interview, data was obtained that the display condition, usually displayed on props such as a monitor screen in the museum, needs some fixing. Until now, exciting content is still needed so visitors can present and use it. The required content is also expected to attract visitors' attention and be varied to display.

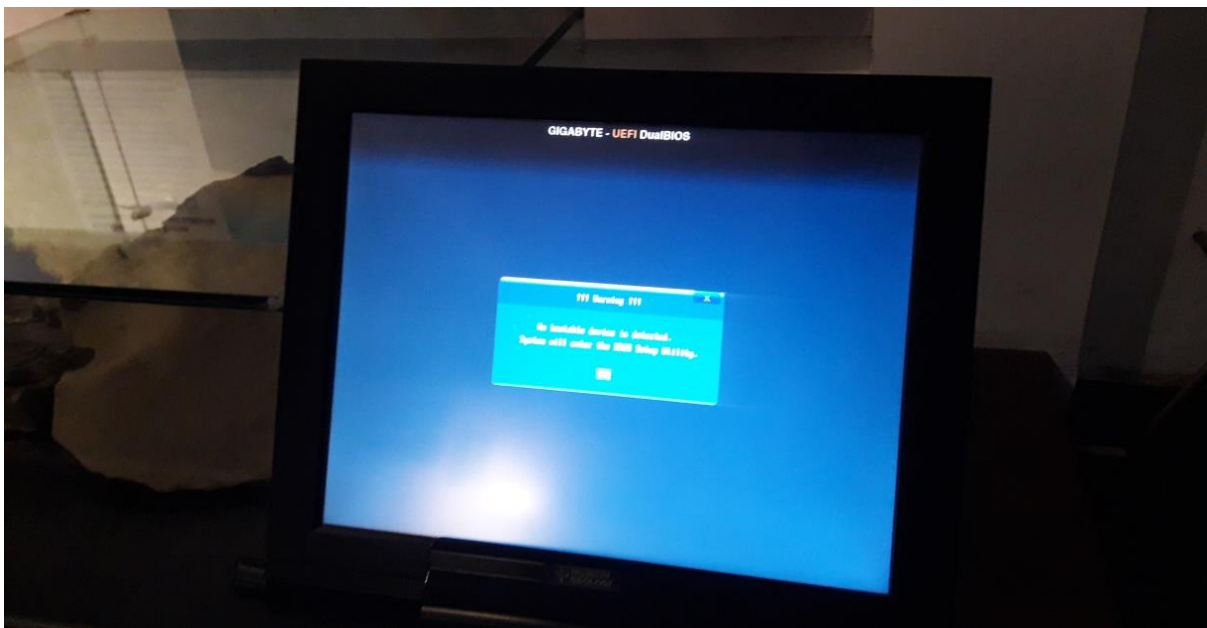


Figure 1. The Interactivity Screen Display is Not Working Well

Not only did the researchers conduct interviews, but they also visited the rooms in the museum to collect data directly. After a direct visit, more than 40 screens needed to be fixed, and some could not be used. One of the rooms that researchers observed more deeply was the monitor in the Indonesian Geology room. In this room, there were 22 monitors with details: 7 screens functioning properly, 6 screens not functioning correctly, 2 "bios" screens, and 7 screens not functioning/not lit.

To overcome this challenge, steps need to be taken to increase the amount and variety of content and develop new methods of delivering information to visitors. Advances in digital technology have made it possible to create more engaging interactions through interactive applications, 3D visualization, and other forms of multimedia. Based on the background of the research above, the general problem formulation of this research has been obtained, namely, "What are the needs in developing SIMUGI applications for visitors to the Bandung Geological Museum?"

2. METHODOLOGY

This research uses the Design-Based Research (DBR) method. The stages in DBR (Design-Based Research) research quote from [McKenny & Thomas \(2013\)](#), namely: (1) analysis and exploration; (2) design and construction; and (3) evaluation and reflection. The application of the DBR method in detail, according to [Ramadhon et al. \(2023\)](#), is depicted in the following figure:

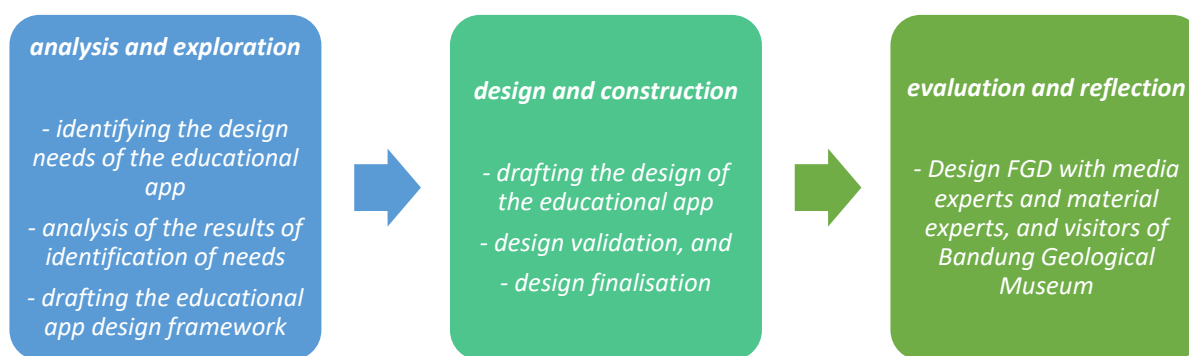


Figure 2. Application of DBR method

3. RESULT AND DISCUSSION

After completing the visitor research and examining the understanding of the importance of UI-UX in the creation of interactive media, this section will discuss the research findings and conclusions regarding user experience (UI-UX) and the phenomenon of visitor boredom with media, as well as visitor enthusiasm and response to media innovation. Through data collection and analysis, researchers can provide helpful information to improve the quality of interactive media and better understand visitors' needs. The results and implications of this research will be detailed in the following paragraphs.

Tabel 1. Assessment Criteria Table

Scale	Achievement Level	Interpretation
5	80% - 100%	Very good
4	60% - 79,99%	Good
3	40% - 59,99%	Moderate
2	20% - 39,99%	Deficient
1	0% - 19,99%	Very Poor

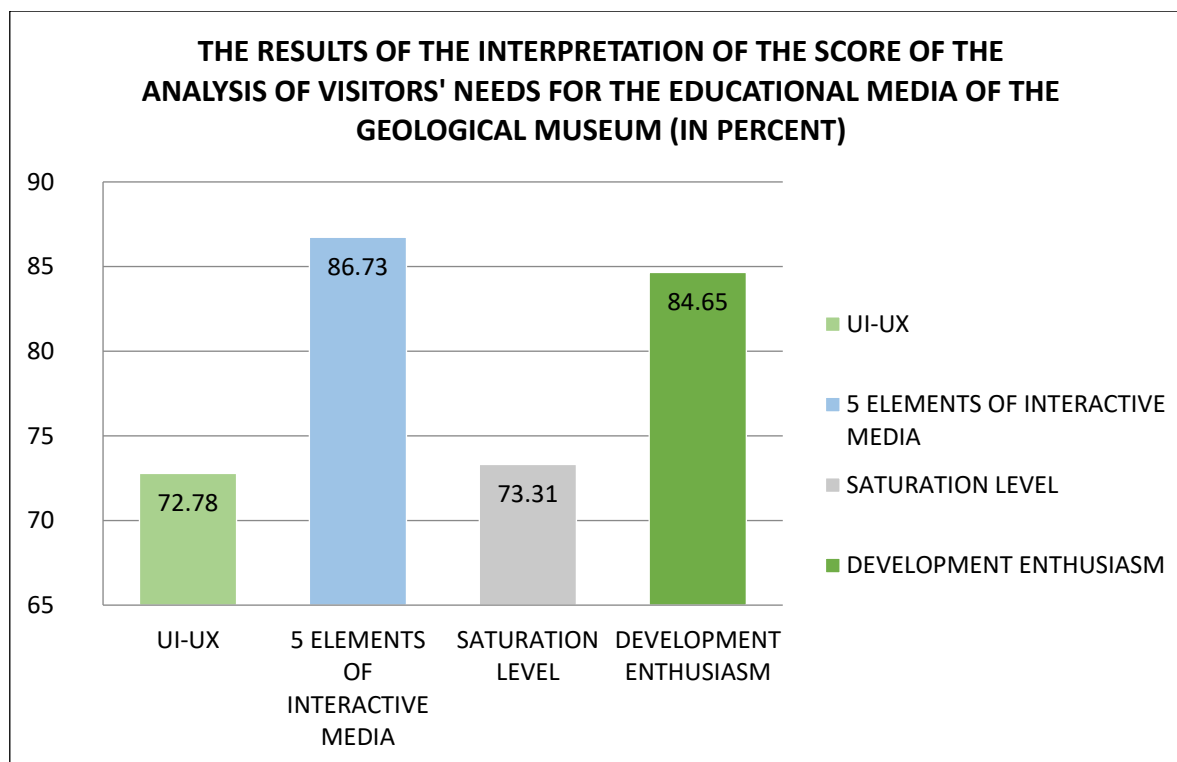


Figure 3. Interpretation of Visitor Needs Analysis

In the UI-UX aspect, it generally received a score of 1085 out of a total score of 2480 with a percentage of 72.78% so that it can be categorized as Good. In the UI-UX aspect, researchers included questions on numbers 1-8, with a maximum score of 310 per question. First, related question number 1, which asks about "how difficult it is to interact with interactive media in the Museum of Geology," received a score of 212 with a percentage of 68.38% of the total, namely 310. Second, related question number 2 states that "the extent to which the UI media display presented by the Geological Museum attracts visitors' attention" received a score of 235 with a percentage of 75.8%. Third, related to question number 3, which asks about "the readability of text and graphics on the media presented," I got a score of 232 with a percentage of 74.83%.

Furthermore, related to question number 4, which asks, "Does media navigation not feel intuitive and difficult to understand?" I got a score of 214 with a percentage of 69.03%. Then, related question number 5, which asks about "the use of color and contrast in the media at the geology museum," received a score of 234 with a percentage of 75.48%. Then, related to question number 6, which asks about "how responsive the media is in providing feedback," got a score of 215 with a percentage of 69.35%. Seventh, related to question number 7, which asks about "the use of animation and visual effects on the media provided," received a score of 245 with a percentage of 79.03%. Furthermore, related to question number 8, which asks, "How consistent is the appearance and UX experience on the media in the geological museum?" received a score of 218 with a percentage of 70, 32%.

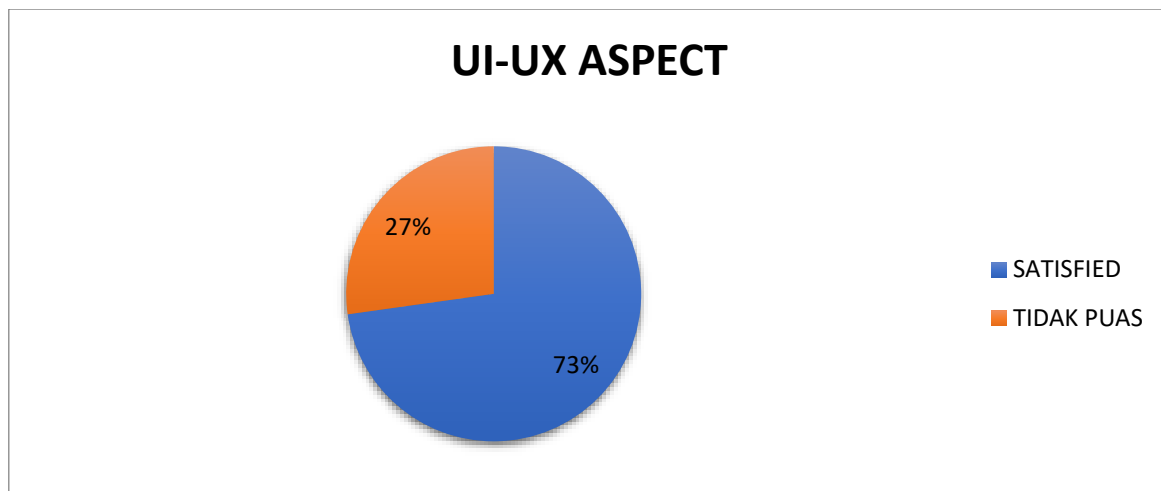


Figure 4. Percentage of UI-UX Aspect Requirement Analysis

Regarding 5 interactive media elements, it generally gets a score of 2151 out of a total score of 2480 with a percentage of 86.73%, so it can be categorized as Very Good. According to Tanzil (2018), there are 5 elements of interactive media: text, sound, video, images and animations, and interactivity. Researchers included questions at numbers 9-16; the total maximum score obtained for this aspect was 310 per question, with 62 respondents. First, related to question number 9, which asks about "the text provided is difficult to understand," it obtained a score of 226 with a percentage of 72.9%. Secondly, related question number 10, which asked about "the effectiveness of using graphics in explaining the material," received a score of 250 with a percentage of 80.64%.

Furthermore, related to question number 11, which asks about "how often visitors expect audio elements or sound effects in interactive media in geological museums," received a score of 266 with a percentage of 85.80%. Fourth, related to question number 12, which asks about "the use of videos can increase understanding of the material presented," received a score of 278 with a percentage of 89.67%. Fifth, related to question number 13, which asks, "How important is it to have interactivity features such as zoom in/zoom out, or interactive questions?" received a score of 282 with a percentage of 90.96%. Furthermore, related to question number 14, which asks, "How important is the zoom-in-out feature on text or graphics in the media presented?" received a score of 280 with a percentage of 90.32%. Then, related to question number 15, which asks, "To what extent do visitors agree that interactive media in geology need to provide language options used?" received a score of 279 with a percentage of 90%. Finally, in this aspect, related to question number 16, which asks, "To what extent do visitors agree that the development of interactive media in the museum should pay attention to visitor suggestions and needs?" received a score of 290 with a percentage of 93.54%.

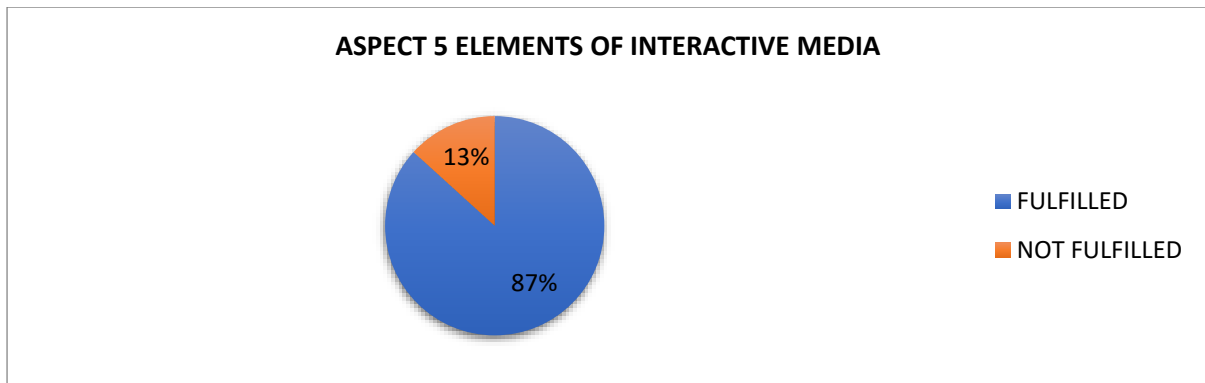


Figure 5. Percentage of Needs Analysis of Interactive Media Element Aspects

Regarding visitor saturation, it generally gets a score of 1591 out of a total score of 2170 with a percentage of 73.31%, so it can be categorized as Saturated. In this aspect, researchers included questions in numbers 17-23, with the maximum score for each question being 310. First, related to question number 17, which asks about "the extent to which visitors feel interested in the media provided," 62 respondents got a score of 244 with a percentage of 78.7%. Furthermore, related to question number 18, which asks about "the media presented feels very boring," out of 62 respondents, a score of 216 was obtained, with a percentage of 69.67%. Third, related to question number 19, which asks about "the extent to which visitors feel involved in using the media presented by the geological museum," out of 62 respondents got a score of 207 with a percentage of 66.77%. Fourth, related to question number 20, which asks about "the visual appearance of the media presented is not interesting," out of 62 respondents got a score of 229 with a percentage of 73.87%.

Furthermore, question number 21 asks, "To what extent do visitors feel the media presented provides an enchanting experience?" out of 62 respondents received a score of 240 with a percentage of 77.41%. Then, related to question number 22, which asks about "how satisfied visitors are using the interactive media presented by the museum as a whole," out of 62 respondents got a score of 231 with a percentage of 74.51%. Finally, related to question number 23, which asks about "the interactive media presented makes visitors confused when using it," out of 62 respondents got a score of 224 with a percentage of 72.25%.

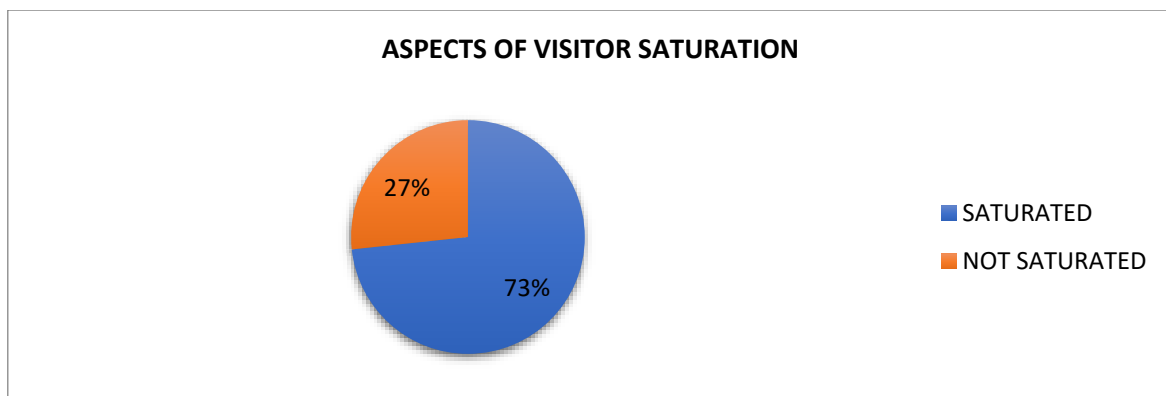


Figure 6. Visitor Saturation Aspect Needs Analysis Percentage

Regarding the level of visitor enthusiasm for developing the SIMUGI application, the score is 1837 out of a total score of 2170 with a percentage of 84.65%, so it can be categorized as Very Enthusiastic. In this aspect, researchers included questions 24-30 with a maximum score of 310. First, related to question number 24, which asks about "the extent to which visitors think that SIMUGI can increase understanding of the collection," 62 respondents got a score of 259 with a percentage of 83.54%. Second, related to question number 25, which asks about "the extent to which visitors are interested in trying SIMUGI to access collection information," out of 62 respondents got a score of 258 with a percentage of 83.22%. Third, related to question number 26, which asks about "the extent to which visitors agree that SIMUGI can make the visitor experience more interesting," out of 62 respondents got a score of 264 with a percentage of 85.16%.

Furthermore, related to question number 27, which asks about "the extent to which visitors agree that SIMUGI can increase visitor involvement in getting to know the collection," out of 62 respondents got a score of 267 with a percentage of 86.12%. Then, related to question number 28, which asks about "how effective the use of SIMUGI is in helping visitors to understand complex collections," out of 62 respondents got a score of 256 with a percentage of 82.58%. Furthermore, related to question number 29, which asks about "to what extent visitors agree that SIMUGI can provide a more enjoyable learning experience at the Museum of Geology," out of 62 respondents got a score of 266 with a percentage of 85.8%. Finally, related to question number 30, which asks about "the extent to which visitors agree that the use of SIMUGI can increase visitor involvement in getting to know and understand the collection," 62 respondents got a score of 267 with a percentage of 86.12%.

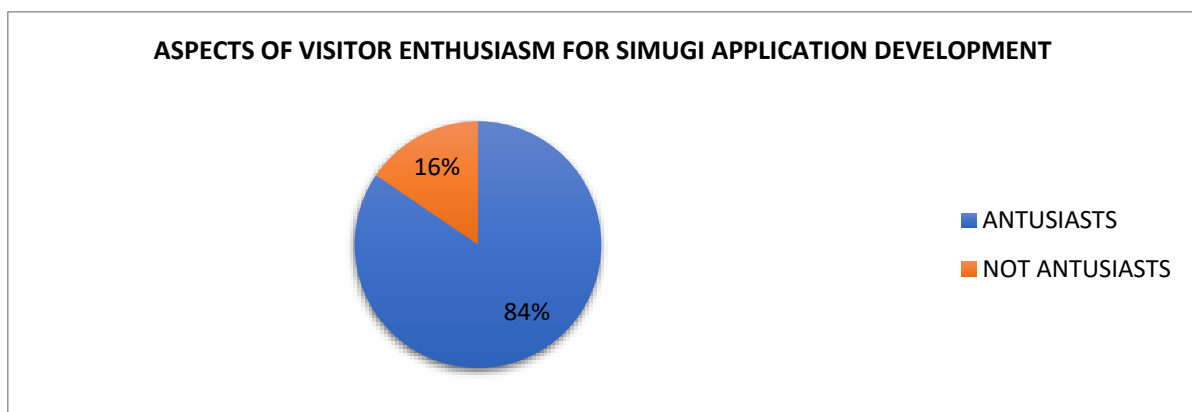


Figure 7. Visitor Enthusiasm Aspect Needs Analysis Percentage

3.1. User Interface (UI)

User Interface, often known as UI, is a visual representation of a product used to communicate between the system and the user (Pitale & Bhungara, 2019). The UI is designed to be as attractive as possible by paying attention to aspects or elements such as color, typography, layout, images, and things that enhance the appearance. Therefore, UI is how a product's packaging is seen by users (Marques Junior & Rodrigues, 2022). User interface design focuses on what the user is likely to do. It ensures that the interface has easy-to-access, understand, and use elements to facilitate those actions. UI defines interaction design, graphic design, and information architecture (Stone, 2005).

Designers should consider specific UI design characteristics, such as considerations for creating an attractive and pleasant user interface. Some of the best UI design characteristics

include being clear and concise, responsive, consistently using standard UI elements, strategic use of colors and text, typography for hierarchy and explanation, and communicating what is happening.

From the research results that have been conducted and aligned with existing theories, the user interface in the interactive media at the Museum of Geology is included in the excellent category.

3.2. User Experience (UX)

User Experience, abbreviated as UX, is the experience users of a product have when using the product (Sauer et al., 2020). The benefits come from ease of use and the ability to maximize all aspects of the product, including features, design, and content that can assist users in achieving their goals when interacting with the product. To create a product as quickly as possible, designers must consider three main factors: product appearance, feeling, and usability (Sutcliffe, 2022). The look of the product is a way of creating a product that has a visual appeal that aligns with the users' values and captures what they expect from the product and what they expect from the product. The benefits of the product should be enjoyable as well as functional. UX designers must create products that meet user needs while providing customizable functions (Smith, 2018; Yang et al., 2018; Zheng et al., 2017). To improve UX, the following factors should be considered during the process:

1. Change is only sometimes good because users are used to other habits and tend to be unwilling to adapt to new changes that are too good.
2. The use of durable, consistent, and responsive designs.
3. Understanding user motivations and needs.
4. Highlighting key points.
5. Provide a challenging journey for yourself.

From the results of research that has been conducted and aligned with existing theories, the user experience contained in interactive media at the Museum of Geology is included in the excellent category.

3.3. Interactive Media Elements

Rusli et al. (2021) state that there are five elements of interactive multimedia: text, graphics, audio, video, and animation. In addition, multimedia elements such as facsimiles, holograms, images, interactive videos, and live videos can be seen through the basic types used in multimedia objects (Quattrini et al., 2020). After reviewing the results and existing theory, the aspects of interactive media elements contained in the Museum of Geology have been fulfilled. They are in the very good category, which means that the interactive media at the Museum of Geology already includes the elements and only needs to be slightly touched on the audio element.

3.4. Interactive Media Utilisation

The theoretical concept of multimedia computer-based learning states that media is a source of learning outside the classroom and facilitates the individual and group educational process (Shahid et al., 2019; Usman & Madudili, 2020). This multimedia serves to fulfill the needs of learners who want to learn. According to Khaira (2021), using media in education will make learning more interesting, efficient, and effective. A study conducted in the United States concluded that the use of multimedia in education is very effective, allowing learning to be 30% better, 40% faster, and 30% cheaper (Rahmat, 2015). Computer-based learning

multimedia is a tool that helps in the educational process. With the help of multimedia learning, the educational process provides new nuances that make it more interactive, effective, efficient, and exciting and can increase learning motivation (Allen, 2016; Lonto et al., 2021; Poernamasari et al., 2022). Using multimedia in education can improve learners' understanding because the material is presented systematically and contextually. Through multimedia learning, educators become companions or facilitators for learners in learning. Learning is no longer teacher-centered learning but rather student-centered learning. Learning with the help of multimedia encourages students to be more active and creative during the learning process (Al Hashimi et al., 2019; Kotiash et al., 2022; Susilana et al., 2022).

In line with the theory and research that previous researchers have put forward, the Bandung Geological Museum has implemented digitalization and has used interactive media to convey information and educational material from each collection on display. The research shows that visitors feel that the interactive media at the Geological Museum is already classified as very good and makes visitors interested in exploring more about the collection; there are still some visitor notes to provide suggestions so that the interactive media provided is better in the future.

4. CONCLUSION

User Interface (UI) is a visual representation of a product that communicates between the system and the user. UI focuses on elements such as color, typography, layout, and images to enhance the appearance. UI design includes interaction design, graphic design, and information architecture. Designers should consider characteristics such as being clear and concise, responsive, and using standard UI elements. User Experience (UX) is the experience users have when using the product. This comes from the ease of use and the ability to maximize all aspects of the product. Factors such as understanding the user's motivations and needs, highlighting key points, and providing a challenging journey for the user should be considered to improve UX.

Interactive multimedia comprises text, graphics, audio, video, and animation. Multimedia elements such as facsimiles, holograms, images, interactive videos, and live videos can be seen through the basic types used in multimedia objects. The interactive media elements in the Museum of Geology have been fulfilled and fall into the excellent category. Computer-based learning multimedia is a learning resource outside the classroom and facilitates the educational process. Using multimedia in education makes learning more interesting, efficient, and effective. It can improve learners' understanding and encourage learners to be more active and creative during the learning process. The Bandung Geological Museum has implemented digitization and uses interactive media to convey information and educational material from each collection on display. Visitors feel that the interactive media at the Geological Museum is very good and makes them interested in exploring the existing collections further.

From the data taken during the research, the user interface (UI) and user experience (UX) on interactive media at the Museum of Geology are very good. In addition, the interactive media at the Museum of Geology has been improved, especially audio, which needs more attention. The use of interactive media in education can also increase the efficiency and effectiveness of education.

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