JUDIKATIF JOURNAL
LPPM Universitas Putra Indonesia YPTK Padang
Lubuk Begalung Main Street, Padang, Zip Code: 25221, Sumatera Barat, Indonesia
Volume: 7, Issue: 2, Page: 75 - 83, December/30/2025, e-ISSN: 2745-9454
Available online at website: https://judikatif-upiyptk.org/ojs/index.php/judikatif

Designing a LKPD DigiLitNum Smartbook for Augmented Reality-Based Literacy and Numeracy Learning for Third Grade Elementary School Students

Debio Pararta Wiguna[1]✉, Armeria Wijaya[2], Aris Kurnia Wicaksono[3], Mochamad Athiful Qolbi Affani[4]
[1,3,4] Department of Visual Communication Design, [2]Department of English Language Education, Faculty of Teacher Training and Education, Muhammadiyah University Surabaya, Zip Code. 60113, Indonesia
✉correspond_author_email: debio.parata.wiguna@um-surabaya.ac.id

Abstract

Augmented Reality (AR) books have increasingly been acknowledged as promising tools to enhance early literacy and numeracy, particularly in elementary school contexts where learning engagement is often limited. AR allows students to interact with digital information embedded in real-world environments, enabling flexible, multimodal learning experiences. This study reports the design of the DigiLitNum Smartbook, an interactive learning resource that integrates Indonesian Language, Natural Sciences, and Mathematics content with AR-based 3D animated objects accessed through QR codes. The design process employed the SWOT method to identify user needs, formulate creative concepts, and develop a functional prototype that aligns with pedagogical goals for young learners. The smartbook features a combination of illustrated storytelling, contextual questions, and AR visualizations intended to simplify abstract concepts and support learner comprehension. The results of the design process indicate that the AR-enabled smartbook provides an engaging and accessible medium that can promote interactive, student-centered learning. This work contributes to the growing field of AR-based educational media by demonstrating how visual communication design, illustration styles, and AR workflows can be integrated into a cohesive learning tool. The DigiLitNum Smartbook has the potential to serve as an innovative alternative for developing literacy and numeracy competencies in alignment with contemporary curriculum demands.

Keywords: augmented reality book, digital literacy, elementary education, numeracy learning, smartbook design.

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1. Introduction

Based on the PISA (Program for International Student Assessment) report published in December 2023, Indonesia ranks 70th out of 80 countries in reading, science, and mathematics [1]. This phenomenon poses a challenge for academics who are directly involved in the design and development of teaching materials that can make it easier for people to digest knowledge. Elementary schools play a role as the initial foundation for the formation of student knowledge, so it is important to convey knowledge to students in a way that can be understood and comprehended. The rapid development of technology in this era has also had an impact on elementary school education. Easy access to technology has led to the adaptation of learning and teaching processes to utilize technology. Currently, the use of digital instructional media is beginning to be implemented in the world of education [2].

One technology that has changed the world of education and is widely known is Augmented Reality (AR). The integration of multimedia into the real world through electronic devices has enabled students to obtain information flexibly, both in terms of time and place. Thus, this has the potential to present learning materials to students through a more varied approach [3]. Augmented Reality (AR) is one of many technologies that has significant pedagogical potential and has gained recognition from researchers in the field of education [4].

In traditional classroom learning, the availability of resources is still limited, so teaching systems that encourage student activity in the classroom are also less than optimal. Augmented Reality technology can be implemented through various types of media such as desktops, smartphones, or mobile devices. This technology is portable, so it can be easily utilized in various situations or conditions. Augmented Reality can be used to enrich the learning process of traditional classroom materials. In addition, it can also provide additional instructions in special classes and present real-world content outside the classroom. Augmented Reality can also be combined with other technologies to expand its application [5]. Augmented Reality-based

learning methods have proven to be more engaging and interactive compared to slide presentations, as students tend to be more interested in learning experiences that involve animations, audio, video, and direct interaction with three-dimensional objects presented in the real world [6].

Various studies on the application of Augmented Reality in education have been developed, one of which is in mathematics, focusing on the topics of solid figures, flat figures, and arithmetic [7]. In this application, the learning material is designed by combining images and text, and is equipped with three-dimensional animations that display solid and flat figures. Another study utilizing Augmented Reality technology was conducted on the topic of the solar system, where the application used only three-dimensional objects without animations depicting the rotational and revolutionary movements of planets in the solar system system [8].

Based on the literature review that has been conducted, Augmented Reality designers in the field of education need to determine the appropriate media so that the learning process can run effectively. Augmented Reality technology developers must also understand how to design learning experiences that are in line with pedagogical approaches in the classroom, for example by creating technology that can be integrated with the applicable curriculum. In addition, it is also necessary to develop smart applications that are able to connect with existing learning content, such as textbooks [9].

Based on this, this study applied Augmented Reality technology to literacy and numeracy materials at the elementary school level. The selection of this material was motivated by the challenges faced by teachers in determining effective learning media to teach these concepts. These difficulties arose because students experienced obstacles in understanding information, writing, and reading. In addition, they also faced challenges in understanding numbers and mathematical concepts. Therefore, teachers strive to present literacy and numeracy materials that are designed to be simple so that they are easier for students to understand. Previously, a community service project on Augmented Reality applications was conducted at SMA 9 Luwu, introducing the use of Augmented Reality to improve students' literacy and numeracy by using a cell phone camera to display objects without movement or animation [10].

The difference from previous projects is that it displays objects such as humans, objects, fruits, and plants with the addition of animation. Because the Augmented Reality application uses a QR Code scanner, the QR Codes are collected and laid out in a book with supporting illustrations and questions to make it more interactive for school students. The researchers hope that in the future there will be more Augmented Reality books on literacy and numeracy that combine other additional features to make the literacy and numeracy learning process more appealing to elementary school students. Thus, this has a positive impact and improves students' learning assessment results [11].

2. Methods

2.1. Data Collection Methods

In designing this Augmented Reality-based book, the data collection method focused on primary data sources, namely data that was specifically and directly conveyed by informants to researchers. The methods used to collect primary data were as follows: [12]

2.1.1. Observation

Data collection techniques were carried out through direct observation at the research location, which was located at UPT SD Negeri 150 Gresik. The aim was to obtain actual data on the learning process of students in the classroom, their interest in participating in learning, and their activity in completing assignments in their textbooks.

2.1.2. Interviews

Interviews are a method of data collection conducted through direct interaction (face-to-face) and question-and-answer dialogues between the data collector and the informant. Interviews allow researchers to obtain varied data from respondents, regardless of the situation or context [13]. Interviews were conducted with various parties, namely teachers and the principal of UPT SD Negeri 150 Gresik. The purpose of these interviews is to seek the necessary information and data. The information obtained and collected through the interview process will be useful in the design process of this Augmented Reality book**.**

2.1.3. Literature Study

Literature study is a method of data collection by reviewing, studying, and understanding concepts or theories from various literature related to the research. Literature studies are conducted to examine sources related to the topic of this Augmented Reality book design, such as articles, books, journals, and other sources. Through literature studies, researchers are able to identify current trends, best practices, and relevant design concepts to be implemented in this design [13].

2.2. Data Analysis Methods

Data Analysis Method using SWOT Analysis, which is a systematic approach to assessing key elements, namely Strengths, Weaknesses, Opportunities, and Threats. This method provides researchers with the opportunity to identify internal strengths, overcome various weaknesses, take advantage of opportunities arising from external factors, and prepare for potential risks that may occur in the future [14].

2.2.1. Strengths

a. Augmented Reality technology makes learning media about elementary school subjects (Natural Sciences, Indonesian Language, and Mathematics) easy to understand and comprehend, even eliminating boredom in these subjects through the use of 3D designs and animations.

b. The application of Augmented Reality technology in supporting the learning and teaching process, where 3D designs and animations can replace teaching aids, thereby reducing operational costs compared to purchasing real objects and making the learning process more interactive, interesting, and enjoyable.

2.2.2. Weaknesses

a. The creation process requires perseverance, precision, and persistence in developing Augmented Reality-based learning media, as it is the most modern technology.

b. The duration of the creation process requires a considerable amount of time to complete this work in accordance with the specifications and final form of the product to be produced.

2.2.3. Opportunities

a. The presence of Augmented Reality-based learning media creates learning that is interesting, communicative, informative, and effective in increasing interaction in the classroom learning process so that students are more active in learning.

2.2.4. Threats

a. The use of smartphones to access Augmented Reality technology is limited because devices have different specifications, meaning that not all devices can use this technology.

b. Augmented Reality applications have limitations in implementing other features, requiring "premium" access if you want to remove these limitations.

2.2.5. Identify Target Audience

a. The target audience identified in the design of this augmented reality book on literacy and numeracy is third-grade students at SD Negeri 150 Gresik elementary school.

3. Results and Discussions

3.1. Results

3.1.1 Design Concept

3.1.1.1 Verbal Concept

The verbal concept refers to information conveyed to the target audience, where words or sentences in context are used to convey information and persuade. In designing DigiLitNum SmartBooks for Augmented Reality-Based Literacy and Numeracy Learning, the learning material will be outlined, focusing on three subjects, namely Natural Sciences, Indonesian Language, and Mathematics, which will be packaged concisely and then supplemented with questions that are more attractive with the addition of illustrations or QR codes to access Augmented Reality with minimalist animations and 3D objects that will serve as explanations to answer the questions.

3.1.1.2 Visual Concept

The DigiLitNum SmartBooks for Augmented Reality-Based Literacy and Numeracy Learning are designed to be minimalist and attractive so that elementary school students do not get bored while reading. The books contain simple illustrations that are easy for students to understand. The illustrations in the book are larger than the text so that they complement the narrative by showing aspects of the story that are difficult or impossible to convey through text alone [15]. The QR codes for accessing Augmented Reality are placed close to the illustrations so that readers can explore objects or 3D animations from various angles, including above, behind, left/right side, and below.

3.1.2. Brainstorming

Brainstorming helps to gather various ideas and formulate creative strategies to identify and solve problems. To maintain consistency and focus in the design, details can be seen in Figure 1.

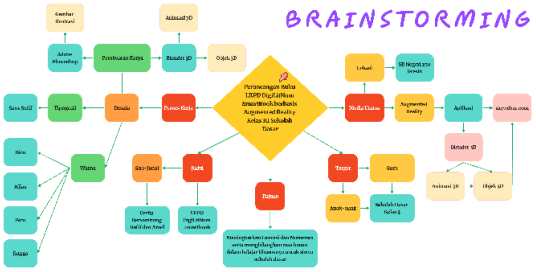


Figure 1. Brainstorming

3.1.3 Verbal Message

3.1.3.1 Headline

The headline used in the design of this book focuses on the intelligence and sophistication of Augmented Reality technology for elementary school children. The main function of this title is to attract the attention of the intended audience. Typographically, the font size of the title is generally larger than the font size for text or other verbal messages. The headline used in this book is "LKPD DigiLitNum SmartBook."

3.1.3.2 Sub-Headline

A sub-headline is defined as a written statement that elaborates and clarifies the main title, supported by relevant explanatory sentences. In this book, the sub-headline used are as follows: "Cerita Bersambung Rafif dan Amel"

3.1.4 Visual Concept

3.1.4.1 Format & Size

This DigiLitNum SmartBook uses an A5 format (14.8 cm x 21 cm) with 180 gsm art paper for the contents and cover, finished with a matte lamination. The book uses a portrait layout. This format and size were chosen to produce an efficient medium that is easy to carry and resistant to damage.

3.1.4.2 Manuscript Writing Style

The writing style in this book uses simple, concise, and informal diction to make it easy to understand, while also matching the visual style and atmosphere presented.

3.1.4.3 Visualization Style

Based on the target audience, the visual style applied to this augmented reality-based book uses a cartoon illustration approach with flat coloring (flat/solid colors). The cartoon style was chosen because it is simple and does not have strict rules in terms of body anatomy. The cartoon style has simple lines and basic shapes, so it is usually targeted at children [17]. The layout is designed with a predominance of illustrations combined with bright colors to convey a cheerful and playful impression.

3.1.4.4 Layout

The book layout that will be implemented in the design of this Augmented Reality-based book is the Column Grid style. The purpose of the Column Grid style is to produce a more dynamic, structured, organized design, with the size and number of columns more flexible in harmonizing the information that will be conveyed. Column Grid is often used in publication layouts by combining illustrations and text. With Column Grid, the reading sequence will be more structured and effective.

3.1.4.5 Typography

A font is a complete set of characters from a particular typographic design or typeface presented in digital format [18]. Fonts are the visual form of a particular typeface or script developed in various styles, such as regular, bold, and italic [19]. The font selection in this design uses only one type, namely "Nunito," but with two variants: 'Regular' for the text content of the book and "Black" for the title/headline.

Figure 2. Nunito Reguler and Black

3.1.4.6 Color

Color plays an important role in communicating information visually, especially for the target audience. The use of color needs to be aligned with the characteristics of the target audience. The colors used in the design of this Augmented Reality-based book are blue, green, red, and orange. These colors were chosen because they have an attractive visual effect and attract attention. This is in line with the preferences of children of this age, who tend to like bright colors [16].

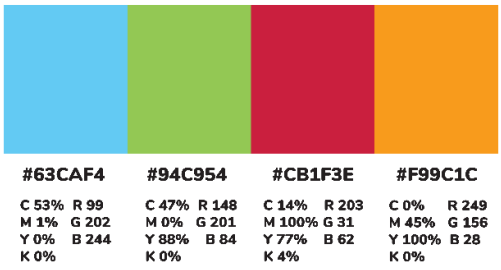


Figure 3. Selected Colors

3.1.5. Design Visualization

3.1.5.1 Illustration

In creating an Augmented Reality-based book, the author used an application called Adobe Photoshop and applied a cartoon illustration style. This cartoon illustration style also uses flat/solid colors so that the illustrations appear simple and easy to understand. Various types of illustrations were created, such as humans, animals, and plants. In addition, there are also several illustrations depicting supporting activities in

accordance with the explanations in the book.

Figure 4. Illustrations for the book's content

3.1.5.2 3D Modelling

In the modeling stage, the application used was Blender 3D software, which supports features such as modeling, animation, simulation, rendering, compositing, motion tracking, and video editing.

The modeling stages were created one by one using Blender, with models using objects that were adapted from the 2D illustrations that had been created previously, aligning with the illustration style.

Figure 5. Modelling Object

After the modeling process, the next step is texturing, which gives objects characteristics such as color, shine, highlights, and light distribution. After texturing, the animation process is carried out, where the objects or models are given movement effects to make them more lifelike and realistic.

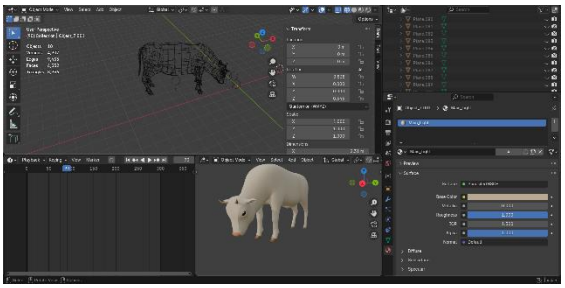


Figure 6. Modelling Animation

3.1.5.6 Augmented Reality Merging Process

After creating a 3D object/model, the next step is to convert it into Augmented Reality. The application used by the author is mywebar.com. This application can convert objects/models that have been created previously and adjust their layout so that they can be displayed in Augmented Reality.

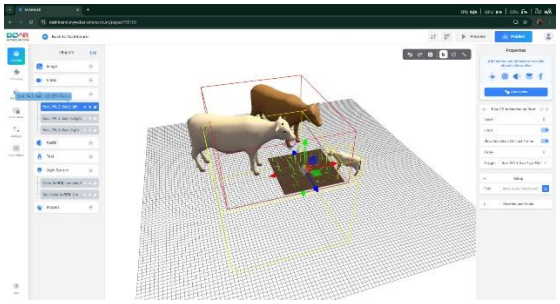


Figure 7. Process of Converting 3D into Augmented Reality

After everything has been converted and adjusted, Augmented Reality can be used by publishing it so that a QR Code display appears that can be used and laid out in the book. As shown in Figure 8.

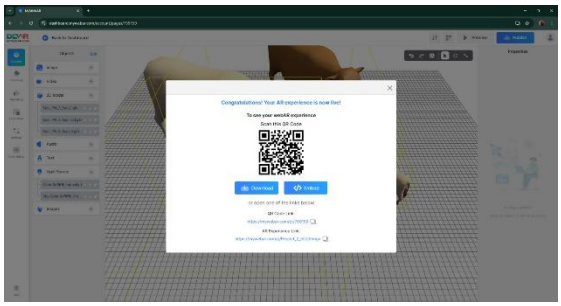


Figure 8. QR Code for book layout

3.1.5.4 Cover Page

The book titled “LKPD DigiLitNum SmartBook – The Continuing Story of Rafif & Amel” features two children named Rafif and Amel studying in a classroom setting with a blackboard and bookshelves decorated with a globe, various books, and number boxes.

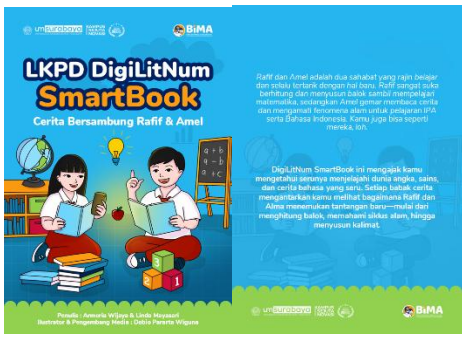


Figure 9. Front and Back Covers

The cover design of this book is visualized in bright colors such as blue and green. Blue is the dominant color because in color psychology, blue gives a feeling of calmness. [20]. The back cover of the book also provides background information about Rafif and Amel in the first paragraph. The second paragraph explains the experiences presented in this book.

3.1.5.5 Book Contents

This LKPD DigiLitNum SmartBook contains 39 pages. In addition, this book has 3 focused learning materials, namely Natural Sciences, Indonesian Language, and Mathematics. These materials are given different colors and an opening sentence before the learning material so as not to confuse the reader.

Figure 10. Introduction Page

Each lesson material has two different types of pages. The difference lies in the appearance of the book, which shows only illustrations and QR codes along with illustrations. In addition, there is also a white column for students/readers to answer questions prepared by the author so that students/readers can easily learn with Augmented Reality directly and answer quickly in the white column.

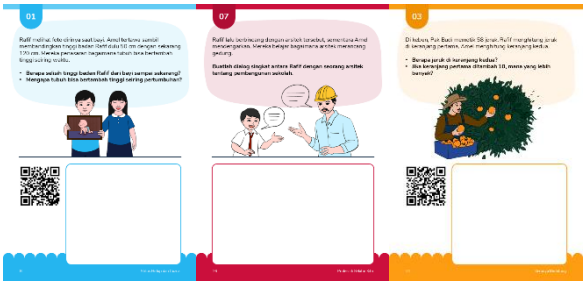
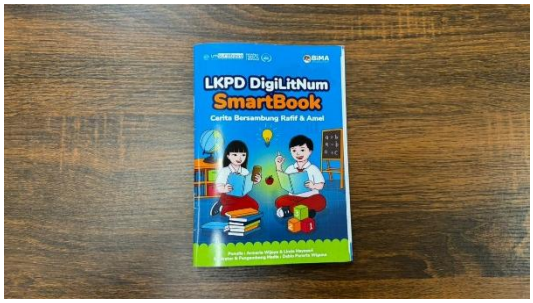


Figure 11. Differences in Material on Each Page

3.2.5.6 Final Augmented Reality

This Augmented Reality-based DigiLitNum SmartBook LKPD book explains learning materials and questions with the addition of Augmented Reality through QR Code scanning on several pages so that a 3D display of the illustrations described on that page will appear with the addition of animations that look lifelike and interactive, along with various examples of Augmented Reality scanning, as shown in Figure 12.



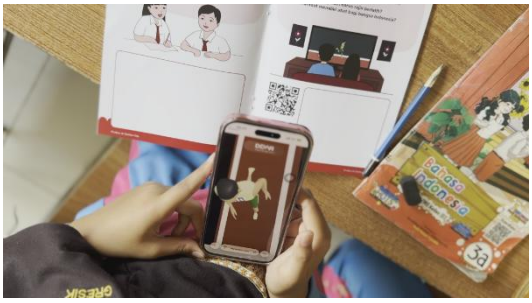


Figure 12. Augmented Reality Scanning

3.2 Discussion

The design of the DigiLitNum Smartbook demonstrates how Augmented Reality (AR) can be systematically integrated into printed learning media to strengthen elementary students' literacy and numeracy learning. This study's findings indicate that AR-based visualizations—such as 3D models, animations, and interactive QR-coded elements—enhance learners' engagement by transforming abstract concepts in Indonesian language, science, and mathematics into concrete, visual, and multisensory experiences. This aligns with Mayer's Cognitive Theory of Multimedia Learning, which suggests that learning is optimized when verbal and visual channels work together to reduce cognitive load and support meaning-making. The smartbook's combination of cartoon illustrations, simplified text, and AR elements exemplifies an instructional design approach that intentionally leverages multimodal representations to facilitate deeper comprehension.

From a visual communication design perspective, the smartbook contributes to the theoretical understanding of how illustration style, color psychology, layout structure, and typography affect young learners' cognitive processing. The choice of a flat, minimalist cartoon style and a bright, child-friendly color palette supports visual clarity and emotional engagement [21]. that memorable children's books rely on simplified forms and vibrant colors to sustain attention. The use of Column Grid layouts, Nunito typography, and balanced text–image composition reflects best practices in educational media design, ensuring readability and visual hierarchy. Importantly, the integration of QR codes near illustrations demonstrates an applied model of *AR-enabled visual communication*, where printed and digital layers coexist seamlessly, offering a new reference model for hybrid print–digital learning media.

When compared to previous studies, the DigiLitNum Smartbook offers several novel design contributions. Earlier AR implementations often focused on single-domain topics such as geometric shapes [22] or solar system visualization [23], typically presenting static or limited-motion 3D objects. Other AR-based literacy projects [24] introduced AR elements without

integrating them into a coherent narrative or book structure. In contrast, this smartbook combines multidisciplinary content, continuous storytelling ("Rafif & Amel"), interactive questions, curriculum alignment, and animated 3D objects in a single, cohesive learning resource. This integration positions the design as a more holistic AR learning medium that supports not only conceptual understanding but also emotional engagement through narrative and illustration.

The broader implications for literacy and numeracy learning are significant. By embedding AR into printed pages, the smartbook bridges traditional and digital modalities, offering teachers a practical tool to enrich classroom instruction without requiring high-cost hardware or specialized training. The interactive 3D models help students visualize objects such as animals, plants, or mathematical shapes from various angles, supporting spatial reasoning and decoding skills that are essential for early literacy and numeracy. Moreover, the smartbook encourages active learning, exploration, and self-paced understanding—elements that are known to improve motivation and retention in young learners. Its portable A5 format and QR-based accessibility make it adaptable for home learning, allowing parents to participate in their children's literacy and numeracy development.

Overall, the DigiLitNum Smartbook contributes theoretically by demonstrating how AR can operationalize multimodal learning principles in tangible educational media, and contributes practically by offering a replicable design model for future AR-enhanced textbooks and LKPDs. Its integration of visual communication design strategies, pedagogical alignment, and AR technology offers a blueprint for developing engaging, inclusive, and curriculum-relevant learning resources in primary education.

4. Conclusions

Designing a LKPD DigiLitNum Smartbook for Augmented Reality-Based Literacy and Numeracy Learning for Third Grade Elementary School Students aims to improve literacy and numeracy for students, especially those in the third grade of elementary school. This book focuses on three subjects, namely Natural Sciences, Indonesian Language, and Mathematics. This book is designed to be engaging, featuring bright colors, cartoon-style illustrations, and, of course, augmented reality, which brings 3D objects and animated movements to life, making them interactive. In addition to the advantages mentioned above, this book can also be used as a more attractive learning tool between teachers and students or between students and their parents. Therefore, the author has tried to adapt and create a learning book that is no longer boring and is more appealing to the target audience so that this design can be on target and can be developed further in the future.

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Biographies of Authors

Debio Pararta Wiguna

He works at Muhammadiyah University Surabaya as a lecturer and researcher. He was born on June 10, 1997, in Surabaya. He earned his bachelor's degree in Visual Communication Design from Universitas Dinamika Surabaya with an S.Ds. degree and a master's degree in Communication Science from Universitas Dr. Soetomo Surabaya with an M.I.Kom. degree. He can be contacted via email at debio.parata.wiguna@um-surabaya.ac.id. His office is located at Jalan Sutorejo No. 59, Surabaya, East Java, Indonesia, at Muhammadiyah University Surabaya. His area of expertise is visual communication design.

Armeria Wijaya

She works at Muhammadiyah University Surabaya as a lecturer and researcher. was born in Curup, on May 3, 1988. She earned her bachelor's degree in English Studies from STIBA Satya Widya Surabaya and her master's degree in English Education from Universitas Negeri Surabaya. She is currently a lecturer in the English Education Study Program at Universitas Muhammadiyah Surabaya. Her academic interests include English language teaching, literacy development for young learners, and digital innovation in education. She is also an active researcher and community service practitioner, focusing on enhancing English literacy and parental engagement through technology-based learning tools.

Aris Kurnia Wicaksono

He works at Muhammadiyah University Surabaya as a lecturer and researcher. He was born on September 10, 1993, in Surabaya. He earned a bachelor's degree in Arts from Malang State University with an S.Sn. degree and a master's degree in Design from Bandung Institute of Technology with an M.Ds. degree. He can be contacted via email at aris.kurnia.wicaksono@um-surabaya.ac.id. His office is located at Jalan Sutorejo No. 59, Surabaya, East Java, Indonesia, at Muhammadiyah University Surabaya. His areas of expertise are visual communication design and

	logo design.
	Mochamad Athiful Qolbi Affani He is studying at Muhammadiyah University Surabaya. He was born on May 4, 2005, in Surabaya. He is currently pursuing a bachelor's degree in Visual Communication Design at Muhammadiyah University Surabaya.