

Development of a Trilingual Augmented Reality-Based Picture Storybook to Support Reading Comprehension Among Beginner-Level Adolescent BIPA Learners

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Abstract

Indonesian for Foreign Speakers (BIPA) learning for beginner adolescent learners faces challenges related to limited vocabulary, difficulties in understanding reading materials, and the availability of reading materials that are not fully suited to learners' age and language proficiency. This study aims to develop a trilingual Augmented Reality-based picture storybook appropriate for beginner-level adolescent BIPA learners and to examine its validity, practicality, and potential to support reading comprehension. The study employed a research and development method using the ADDIE model, which consists of the stages of Analyze, Design, Development, Implementation and Evaluation. The research subjects consisted of four experts, five teachers, and 20 beginner-level adolescent BIPA learners in grades VII-IX at Sekolah Dyana. Data were collected through observation, interviews, questionnaires, expert assessments, and pretest and posttest, and were then analyzed using Aiken's V, paired-sample t-test, and effect size. The results showed that the product was valid based on assessments by content experts (mean Aiken's V = 0,906) and media experts (mean Aiken's V = 0,761), and highly practical based on teacher assessments (mean score = 53,80) and learner assessments (mean score = 54,25). The paired-sample t-test results showed a significant difference between reading comprehension scores before and after the use of the product ($t = 5,687$; $df = 19$; $p < 0,001$), with the mean score increasing by 10,35 points and an effect size of 1,27. The picture storybook combines Indonesian, English, and Balinese with illustrations, three-dimensional objects, audio, animations, and interactive quizzes to provide visual, verbal, and interactive support in understanding reading materials. These findings provide preliminary evidence of the potential of a trilingual Augmented Reality-based picture storybook as BIPA reading material appropriate to the linguistic needs, age characteristics, and cultural environment of beginner-level adolescent learners.

Keywords: Augmented Reality; Adolescent Learners; BIPA; Picture Storybook; Reading Comprehension

Abstrak

Pembelajaran BIPA bagi pemelajar remaja tingkat pemula menghadapi kendala keterbatasan kosakata, kesulitan memahami bacaan, serta ketersediaan bahan bacaan yang belum sepenuhnya sesuai dengan karakteristik usia dan kemampuan bahasa. Penelitian ini bertujuan mengembangkan buku cerita bergambar tribahasa berbasis Augmented Reality yang sesuai untuk pemelajar remaja BIPA tingkat pemula serta menguji validitas, kepraktisan, dan potensinya dalam mendukung pemahaman membaca. Penelitian menggunakan metode research and development dengan model ADDIE yang meliputi tahap Analyze, Design, Development, Implementation, dan Evaluation. Subjek penelitian terdiri atas empat ahli, lima guru, dan 20 pemelajar remaja BIPA tingkat pemula kelas VII-IX di Sekolah Dyana. Data dikumpulkan melalui observasi, wawancara, angket, penilaian ahli, serta pretest dan posttest, yang kemudian dianalisis

menggunakan Aiken's V, paired-sample t-test, dan effect size. Hasil penelitian menunjukkan bahwa produk dinyatakan valid berdasarkan penilaian ahli materi (rata-rata Aiken's V = 0,906) dan ahli media (rata-rata Aiken's V = 0,761), serta sangat praktis berdasarkan penilaian guru (rata-rata skor = 53,80) dan pemelajar (rata-rata skor = 54,25). Hasil paired-sample t-test menunjukkan adanya perbedaan yang signifikan antara skor pemahaman membaca sebelum dan sesudah penggunaan produk ($t = 5,687$; $df = 19$; $p < 0,001$), dengan rata-rata skor meningkat sebesar 10,35 poin dan effect size sebesar 1,27. Buku cerita memadukan bahasa Indonesia, Inggris dan Bali dengan ilustrasi, objek tiga dimensi, audio, animasi, dan kuis interaktif untuk memberikan dukungan visual, verbal, dan interaktif dalam memahami bacaan. Temuan tersebut memberikan bukti awal mengenai potensi buku cerita bergambar tribahasa berbasis Augmented Reality sebagai bahan bacaan BIPA yang sesuai dengan kebutuhan linguistik, karakteristik usia, serta lingkungan budaya pemelajar remaja tingkat pemula.

Kata Kunci: *Augmented Reality; BIPA; Buku Cerita Bergambar; Kemampuan Membaca; Pemelajar Remaja*

Introduction

Indonesian for Foreign Speakers (BIPA) is an Indonesian language learning program intended for speakers who use Indonesian not as their first language. BIPA learning has developed alongside the increasing need to use Indonesian for academic purposes, employment, tourism and the introduction to Indonesian culture. Melinda and Muzaki (2023) explain that BIPA learners are foreign speakers who study Indonesian as a foreign language because the language is not their first language in their social and cultural lives. The development of BIPA programs can be seen from the increasing number of institutions providing Indonesian language learning in various countries.

The need for BIPA learning is also related to the presence of foreign nationals in educational environments in Indonesia. Permendikbud Nomor 31 Tahun 2014 Pasal 11 ayat (3) and (4) stipulate that cooperative education units (SPK) must continue to include Indonesian Language, Pancasila Education and religious education in their curricula. This provision indicates that Indonesian language learning continues to have a position within educational environments that use international curricula. The presence of learners from diverse linguistic and cultural backgrounds requires teaching materials that are able to accommodate their language proficiency levels as well as their learner characteristics.

One educational environment that has these characteristics is Sekolah Dyana in Denpasar, Bali Province. The school has learners from various countries with different cultural and linguistic backgrounds. English is more dominantly used in daily interactions, so some international learners have greater exposure to English than to Indonesian. Indonesian Language and Indonesian Studies are still provided to learners, but differences in linguistic backgrounds result in varying levels of Indonesian vocabulary and language comprehension.

The characteristics of beginner BIPA adolescent learners need to be considered in the selection of teaching materials. Learners in the 12-16 age range already have the ability to think abstractly and critically, but their limited Indonesian vocabulary and language structure can become obstacles to understanding reading materials. Beginner learners need to focus on recognizing language forms while also understanding the content of the reading, so overly complex teaching materials can increase the burden during the reading process (Hermansyah and Majid, 2026). Puspita et al., (2021) also emphasize the need for learning materials that are appropriate to the characteristics and needs of learners.

These problems can be seen from the results of initial observations and interviews with 20 beginner-level BIPA learners in grades VII-IX at Sekolah Dyana. The learners' Indonesian vocabulary remains limited, so they frequently ask about the meanings of words, including simple vocabulary. Differences in sentence structures between Indonesian and English also cause learners to recognize certain words but remain unable to understand the meaning of the sentence as a whole. Limited Indonesian reading comprehension is accompanied by low interest in reading Indonesian-language reading materials.

A review of the learning resources available at the school also shows a mismatch between the reading materials and the characteristics of beginner BIPA adolescent learners. The Indonesian-language storybooks available tend to be intended for children, with cartoon-style visuals and characters that are more suitable for early-age readers. Books with adolescent themes, on the other hand, use vocabulary and language structures that are more difficult for beginner learners. This mismatch creates a gap between learners' linguistic abilities and the themes that are appropriate for their age and interests.

Therefore, teaching materials for beginner adolescent BIPA learners need to balance simple language with themes and visual presentation that are appropriate for adolescent learners. Reading comprehension is one of the aspects that needs to be strengthened because BIPA learners need more than simply recognizing vocabulary. Learners also need to understand the information contained in the reading. Nugraha (2023) highlight reading comprehension as an important component of language learning, while Purba et al., (2023) explain that reading is related to the process of understanding information conveyed through writing.

Reading materials for beginner learners need to use simple language, themes that are closely related to learners' lives and visual support that can help learners understand meaning. Picture storybooks can be one alternative teaching material to address these needs. Illustrations in stories help provide context for the vocabulary and events being read, so learners do not rely entirely on verbal explanations (Yahya et al., 2026). The use of everyday life themes can also make the reading content more closely related to learners' experiences.

For beginner BIPA adolescent learners, storybooks need to maintain language simplicity without eliminating visual characteristics and themes that are appropriate for the learners' age. The development of technology provides opportunities to develop more interactive picture storybooks. Augmented Reality (AR) enables digital objects in the form of three-dimensional images, audio, animations and interactive activities to be displayed through printed media. Rachim et al., (2024) explain that AR can combine virtual objects with the real environment, thereby providing a more concrete learning experience.

The use of AR can also support the learning process because the information contained in printed materials can be reinforced through visual and audio representations. The use of AR in language learning has been implemented in several previous studies. Wang and Chen (2018) used AR in English language learning, while Almutairi and Alkhateeb (2020) applied it in Arabic language learning. Lin and Liou (2021) also demonstrated the use of AR technology in language learning. These studies have mostly emphasized aspects of vocabulary, motivation, speaking, or listening and have involved different learner characteristics.

The development of AR-based teaching materials specifically directed at the reading comprehension of beginner-level adolescent BIPA learners remains limited. The development of an AR-based picture storybook in this study uses three languages, namely Indonesian, English and Balinese. Indonesian is positioned as the main language because

it is the target of learning and is aligned with BIPA Level I Learning Outcomes Standards (SKL). English is used as a bridging language to help learners understand the content of the story without hindering the reading process. Balinese is used to a limited extent as cultural enrichment, particularly to introduce terms related to Balinese culture such as *Ogoh-ogoh* and *Nyepi*. In this study, the term trilingual refers to the functional use of three languages with different roles, rather than the equal use or proportion of each language throughout the book.

Indonesian forms the main linguistic content, English provides comprehension support and Balinese contributes to cultural enrichment. The use of these three languages is therefore based on the linguistic and cultural needs of beginner BIPA learners and the learning environment at Sekolah Dyana. The design of the storybook is primarily grounded in the Cognitive Theory of Multimedia Learning and scaffolding. The Cognitive Theory of Multimedia Learning explains that learners process verbal and visual information through separate but related channels, so the use of text, illustrations, audio and AR can provide complementary support during reading.

In this study, these elements are used to help beginner BIPA learners understand vocabulary, story events and cultural information. Scaffolding provides the basis for the functional use of English as a bridging language. When learners encounter Indonesian vocabulary or expressions that are difficult to understand, English provides temporary support while Indonesian remains the main language of learning. This theoretical framework positions multimedia and multilingual support as aids to reading comprehension rather than as replacements for the main reading material.

Azzahro and Sukasih (2026) support the use of visual, verbal and interactive elements in learning materials to facilitate learners' understanding. Several studies have also demonstrated the potential of using visual media, multimedia and interactive technology in language learning. Amiroh et al., (2022); and Maritasari et al., (2025) developed AR-based picture books, while Tamba et al., (2020); and Umyati et al., (2021) developed trilingual story media that utilize visual interaction. Mahfud et al., (2021); and Nugroho and Zulfikasari (2025) showed that the use of visuals and audio can support learning, while Saraswati et al., (2021); Wibowo and Supriatna (2020); and Sa'adah et al., (2024) emphasized the importance of contextual stories and cultural elements in BIPA learning.

However, these studies have generally addressed the use of AR, trilingual media, visual support or cultural content separately. The present study brings these elements together in a reading material designed specifically for beginner-level adolescent BIPA learners. The need for teaching materials that are appropriate to the language proficiency and characteristics of adolescent learners indicates an area for further development in BIPA learning. The novelty of this study lies in the integration of reading materials graded to the language level of beginner BIPA learners, multilingual scaffolding through the functional use of Indonesian, English and Balinese, Balinese cultural content, and Augmented Reality technology in a picture storybook designed for adolescents.

Indonesian provides the main reading material at the beginner level, while English supports comprehension and Balinese provides cultural enrichment. AR further supports the reading experience through visual, audio and interactive elements. This integration is directed at addressing the linguistic needs of beginner BIPA learners while maintaining themes and cultural content appropriate for adolescent learners. Based on these problems and needs, this study aims to develop a trilingual Augmented Reality-based picture storybook for beginner-level adolescent BIPA learners at Sekolah Dyana. The developed product was subsequently tested in terms of validity, practicality, and its potential to support reading comprehension among beginner-level adolescent BIPA learners.

Method

This study is a research and development study using the ADDIE model, which consists of five stages, namely analyze, design, development, implementation, and evaluation. The study was conducted at Sekolah Dyana Denpasar from September 2025 to May 2026. The research data sources consisted of the results of the needs analysis, expert assessments, teacher and learner responses, observation and interview results, and test results. The research subjects consisted of four experts who assessed product validity, five teachers who assessed product practicality, and 20 beginner-level BIPA learners in grades VII-IX who used the product and participated in the effectiveness test.

The four experts consisted of two content experts and two media experts. The subjects were selected purposively based on their involvement in BIPA learning and their suitability with the target characteristics of the developed product. The 20 BIPA learners were adolescents aged 12-16 years and came from Australia, Russia, South Korea, Japan, the United States, the United Kingdom, and Germany. The learners had different first-language backgrounds, with English being the main language used for daily communication at school, while Indonesian was learned as a foreign language. Their classification as beginner-level BIPA learners was based on their placement in the school's BIPA 1 level, which corresponds to the beginner level (A1) in the BIPA learning level framework.

The research instruments included observation and interview guidelines, expert validation sheets, practicality questionnaires for teachers and learners, and multiple-choice questions to measure reading comprehension before and after the use of the trilingual Augmented Reality-based picture storybook. Data were collected through observation, interviews, questionnaires, expert assessment, and the administration of a pretest and posttest. The effectiveness test used a one-group pretest-posttest design involving 20 beginner-level BIPA learners who completed a pretest, participated in reading-for-pleasure activities using the product, and then completed a posttest. Data analysis was conducted using descriptive quantitative and qualitative methods.

Product validity was analyzed using the Aiken's V index, while practicality was analyzed based on the average response scores of teachers and learners. Changes in reading comprehension were analyzed using a paired-sample t-test and effect size. Before conducting the paired-sample t-test, the normality of the difference scores (Posttest - Pretest) was examined using the Shapiro-Wilk test. Since the sample consisted of 20 learners, the Shapiro-Wilk test was used as the reference for assessing normality. Qualitative data obtained from observations, interviews, and expert comments and suggestions were analyzed descriptively to identify aspects requiring product refinement.

Results and Discussion

1. Analyze Stage

The Analyze stage was conducted to identify the needs for developing a trilingual Augmented Reality-based picture storybook for beginner-level adolescent BIPA learners at Sekolah Dyana. The analysis covered needs, learner characteristics, learning resources, as well as the environment and devices that support product use. The results of the analysis were used to determine the characteristics of the content, presentation format, theme, and technology appropriate to the learners' conditions and learning environment. Needs Analysis.

The needs analysis was conducted through observation and interviews to identify learners' difficulties in BIPA learning and their needs for reading materials. The results of the analysis showed that the Indonesian-language reading materials available were still relatively difficult for beginner-level BIPA learners to understand. Reading materials that

used simpler language were also not yet fully appropriate for adolescent characteristics, particularly in terms of themes and visual appearance. Learners showed greater interest in digital learning media, but still needed reading materials that could help them understand unfamiliar vocabulary and information. These findings served as the basis for developing a storybook that uses simple language, themes appropriate to adolescent age, and visual and AR support. Learner Characteristics Analysis. The learner characteristics analysis was conducted to identify the developmental level, language ability, communication habits, and preferences of learners in grades VII-IX.

The learners were in the adolescent age range and came from diverse linguistic and cultural backgrounds. English was more dominantly used in daily communication within the school environment, while the learners' Indonesian language ability remained at the beginner level. These conditions indicate the need for reading materials that continue to use Indonesian as the main language while providing language support that can help learners understand the story content. Age characteristics were also considered in selecting illustrations and themes so that the book would not use an overly childish appearance.

Learning Resources Analysis. The learning resources analysis was conducted by reviewing the reading materials and Indonesian language learning resources available at the school. The results of the analysis showed that some Indonesian-language storybooks were more appropriate for children because they used cartoon illustrations and characters that did not yet reflect adolescent characteristics. Books with themes more appropriate for adolescents tended to use vocabulary and language structures that were more difficult for beginner-level BIPA learners. These findings served as the basis for designing reading materials that combine beginner-level language proficiency with themes, illustrations, and presentation appropriate for adolescents.

Environment and Device Analysis. The environment and device analysis was conducted to determine the readiness for using AR technology in learning. The analysis included the availability of smartphones, device support for AR applications, internet access, and school policies regarding the use of digital devices. The results of the analysis showed that the learning environment allowed the use of digital devices to support learning. The availability of these devices served as the basis for developing AR that can be accessed through smartphones so that its use can be combined with a printed book.

2. Design Stage

The design stage was conducted based on the results of the needs analysis and learner characteristics obtained in the analyze stage. The design of the trilingual Augmented Reality-based picture storybook included determining the topic and theme of the story, developing the storyline, preparing usage instructions, translating the text into English and Balinese, designing illustrations and three-dimensional (3D) objects, creating animations, developing evaluation tests, and designing instruments to assess the validity, practicality, and effectiveness of the product.

The design was consulted with the academic supervisor to obtain feedback before being developed into the product. The initial book design was created using Canva with dimensions of 19 × 19 cm and consisted of 13 pages, from the cover to the final page. The book structure included instructions for using Augmented Reality, a picture story, a Balinese language glossary, and a quiz. Indonesian was positioned as the main language in the story, English was used as a bridging language (scaffolding) to support comprehension, while Balinese was used as cultural enrichment. The sentences and conversations were written simply according to the learners' proficiency level and then supplemented with English equivalents. Balinese terms appearing in the story were

explained through a glossary in Indonesian and English. The illustrations were designed according to the story content and the characteristics of adolescent learners. Each page was designed to support comprehension of the story content while maintaining text readability. The Augmented Reality design included 3D objects, animations, and supporting elements linked to the story pages. This design served as the basis for developing the book prototype and AR features in the development stage.

3. Development Stage

a. Initial Design

The initial design involved developing the Augmented Reality features and integrating them with the book pages. The AR application was developed using Unity and Vuforia, with selected images or markers on the book pages serving as triggers for three-dimensional objects, Indonesian-language audio, and animations related to the story content. The application also included story, quiz and exit menus. The quiz consisted of multiple-choice questions accompanied by a score and completion time, allowing learners to check their comprehension after reading.

The integration of these features was intended to maintain the book's function as reading material while providing supporting visual, audio and interactive elements through Augmented Reality. Learners could read the story in the book and access additional information related to the story through the AR features. An overview of the developed product is presented in the following figures.

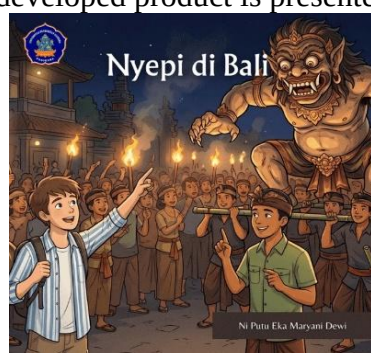


Figure 1. Front Cover



Figure 2. Information on AR Usage



Figure 3. Storybook Content

Bahasa Bali (tulih)	Bahasa Indonesia	Bahasa Inggris
Meneng	Diam / hening	Quiet / to be silent
Ngembak Geri	Hari setelah Nyepi yang bermakna "menyalakan api kembali", ditandai dengan tradisi bersaturajuh, saling bermaafan, dan memulai lembaran baru.	The day after Nyepi meaning "rekindling the fire", celebrated through visits to family and friends asking for forgiveness, and fresh beginnings.
Nyepi	Hari suci perayaan Tahun Baru Caka Bali yang dirayakan dengan keheningan total (Catur Brata Panyepian) untuk penyucian jiwa dan alam semesta.	The Balinese Day of Silence marking the Saka New Year, observed through total stillness and self-reflection to purify the soul and nature.

Figure 4. Glossary

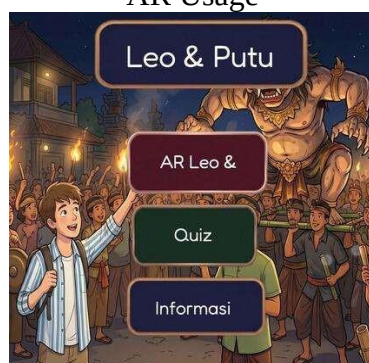


Figure 5. Initial AR Application Menu

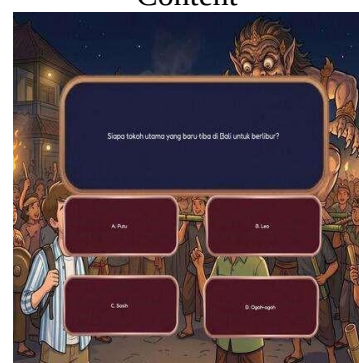


Figure 6. Quiz Display

The product was developed based on the needs identified at the analyze stage, particularly the need for reading materials with an appropriate language level, adolescent-relevant themes and visual and digital support. Indonesian was positioned as the main language to maintain the focus on BIPA learning. English was used as a bridging language to support learners when encountering information that may not yet be understood in

Indonesian. Balinese was used in a limited manner for cultural enrichment, particularly through selected cultural terms and the glossary, so that local cultural elements could be introduced without shifting the primary focus from Indonesian language learning. The product design and development were aligned with the BIPA Level I (A1) Graduate Competency Standards and the principles of grading beginner BIPA books.

Vocabulary, sentence forms, conversations, and reading length were selected to support learners' understanding of basic expressions and short texts related to everyday life. The glossary and English translations provide additional support for recognizing the meanings of cultural terms in the story. The story content supports literal reading comprehension, particularly the identification of characters, setting, plot, and information presented in the text, as well as the recognition of vocabulary related to Balinese culture, as described by (Susanti et al., 2023). Each feature was designed to support a specific aspect of the reading process. The illustrations provide visual cues that help learners relate vocabulary and sentences to the events and objects described in the story.

Indonesian-language audio provides pronunciation support when learners encounter unfamiliar words or expressions, while the three-dimensional objects and animations provide additional visual representations of story content and cultural objects. These features allow learners to connect information presented in the text with corresponding visual and audio information, supporting comprehension without changing the book's primary function as reading material. The quiz further provides an opportunity for learners to check their understanding of information contained in the story through multiple-choice questions.

The integration of visual, verbal, and audio information is consistent with the principles of multimodal learning, in which different forms of representation can support comprehension. The use of Augmented Reality through Unity and Vuforia also corresponds with the studies by Wang and Chen (2018); and Pratama (2024) which indicate that three-dimensional objects and interactive audio can support the presentation of cultural concepts and learner engagement. In the developed product, these features are positioned as supporting elements for understanding the story, vocabulary, and cultural information rather than as replacements for reading the printed text.

b. Expert Appraisal

Expert appraisal was conducted to assess the content and media feasibility of the trilingual Augmented Reality-based picture storybook before its implementation. The assessment involved four validators, consisting of two content experts and two media experts. The content experts assessed the suitability of the material for beginner-level BIPA learners, story clarity, learning objectives, language accuracy, and the presentation of the three languages. The media experts assessed the book design, visual appearance, readability, layout, and ease of use of the Augmented Reality features.

Both assessments used a five-point rating scale, with scores ranging from 1 as the lowest score to 5 as the highest score. The assessment data were analyzed using Aiken's V coefficient based on the formula proposed by (Permadi and Huda, 2020). The validity criteria classified Aiken's V values of 0,41-0,60 as sufficient; 0,61-0,80 as valid; and 0,81-1,00 as highly valid. The content validation instrument consisted of 12 items, with Aiken's V values ranging from 0,750 to 1,000 and a mean value of 0,906. The media validation instrument consisted of 11 items, with Aiken's V values ranging from 0,500 to 0,875 and a mean value of 0,761.

Based on the validity criteria, the content aspect was categorized as highly valid, while the media aspect was categorized as valid. The item-level results show that the content items fell within the valid to highly valid categories, whereas the media items ranged from sufficient to highly valid. The results are presented in Table 1.

Table 1. Results of Expert Appraisal

Aspect	Items	Aiken's V Range	Mean Aiken's V	Category
Content	12	0,750-1,000	0,906	Highly Valid
Media	11	0,500-875	0,761	Valid

Source: Research Data, 2026

The expert appraisal also resulted in several suggestions for product improvement. The content-related suggestions concerned making the book usage instructions more systematic and making minor improvements to language use. The media-related suggestions concerned improving text readability, maintaining consistency in text presentation, providing clearer visual differentiation among the three languages, and adding contextual explanations to the glossary. These suggestions were used as a basis for revising the product before implementation. The expert feedback and the corresponding product revisions are presented in Table 2.

Table 2. Expert Feedback and Product Revision

Aspect	Expert Feedback	Revision Focus
Media	Improve text readability	Improvement of text presentation to support readability
Media	Improve consistency in text writing	Correction and standardization of text presentation
Media	Make the trilingual presentation clearer through visual differentiation	Clearer visual distinction among Indonesian, English, and Balinese
Media	Provide contextual explanations in the glossary	Addition or improvement of contextual explanations for cultural terms
Content	Make the book usage instructions more systematic	Reorganization of the instructions for using the book
Content	Make minor improvements to language use	Correction of minor language-related aspects

Source: Research Data, 2026

The content appraisal indicates that the book materials were generally aligned with the characteristics of beginner-level BIPA learners. The use of simple sentences, short conversations, glossary entries, and English translations was intended to support learners in understanding the story and unfamiliar vocabulary. Indonesian was positioned as the main language of the reading material, English functioned as a bridging language to support comprehension, and Balinese was used in a limited manner to introduce selected cultural terms and their meanings through the glossary.

The content structure was therefore directed toward supporting beginner-level reading comprehension while retaining the cultural elements presented in the story. The media appraisal indicates that the visual and technical components generally supported the use of the book as reading material. Readable text, clear illustrations, systematic layout and accessible Augmented Reality features were incorporated to support learners' interaction with the story. The expert feedback also identified specific aspects that required improvement, particularly text readability, consistency of text presentation, visual differentiation among the three languages, and contextual explanations in the glossary. These revisions were incorporated before the product was implemented.

The design of the product was theoretically grounded in the Cognitive Theory of Multimedia Learning (Mayer) and Dual Coding Theory (Paivio). The integration of text, illustrations, audio, and three-dimensional objects was intended to provide complementary verbal and visual representations that could support learners in

connecting linguistic forms with their meanings. The glossary and English bridging language were also intended to provide additional support when learners encountered unfamiliar vocabulary.

These theories function as a theoretical rationale for the design of the product rather than as evidence that the expert appraisal demonstrates the cognitive mechanisms proposed by the theories (Ridha and Kusasi, 2024). The organization of the material was also informed by Cognitive Load Theory (Sweller) and the concept of scaffolding. Beginner-level BIPA learners may encounter unfamiliar vocabulary and language structures while reading. The glossary, English bridging language, and supporting audio were therefore incorporated to provide assistance when learners encountered information that was difficult to understand.

These elements were positioned as design supports to facilitate access to the reading content, rather than as evidence of reduced cognitive load or the occurrence of scaffolding. The validation results are consistent with the study by Amiroh et al., (2022) on the development of an interactive Augmented Reality-based picture storybook and the study by Tamba et al., (2020) on trilingual picture story media. Both studies support the use of picture stories and the integration of technology or multilingualism as feasible learning media.

The findings of this study are also consistent with Mahfud et al., (2021) who emphasized visual and audio quality in AR-based media and Pratama and Kurnia (2020) who demonstrated the relationship between typographic readability and illustration clarity and learner engagement. The suitability of themes to age characteristics and the use of cultural elements in BIPA teaching materials are also supported by (Saraswati et al., 2021; Wibowo and Supriatna, 2020). Both studies show that stories appropriate to learners' contexts, supported by cultural and visual elements, can help learners understand the target language.

c. Developmental Testing

Developmental testing was conducted to assess the practicality of the trilingual Augmented Reality-based picture storybook in terms of its ease of use and user responses. The assessment involved five teachers of BIPA, Indonesian, and Indonesian Studies and 20 beginner-level BIPA learners at Sekolah Dyana. The practicality questionnaire consisted of 12 items using a five-point Likert scale, ranging from 1 (lowest) to 5 (highest). The minimum possible score was 12 and the maximum score was 60. The practicality category was determined using the ideal mean (Mi) and ideal standard deviation (SDi), with $Mi = 36$ and $SDi = 8$. Based on the criteria applied in this study, a mean score above 48 was categorized as Highly Practical. The results of the practicality assessment are presented in Table 3.

Table 3. Product Practicality Test Results

No	Aspect	Teacher	BIPA Learners
1	Design and Appearance	4,47	4,43
2	Materials, Language, and Writing	4,4	4,39
3	User Friendly	4,56	4,68
	Overall Mean	4,48	4,52
	Overall Score	53,8	54,25
	Category	Highly Practical	Highly Practical

Source: Research Data, 2026

The teacher assessment produced an overall mean score of 4,48, equivalent to a total score of 53,80, while the learner assessment produced an overall mean score of 4,52, equivalent to a total score of 54,25. Both total scores were above the upper category boundary of 48,00 and were therefore classified as Highly Practical. At the aspect level,

the teachers gave the highest mean score to User Friendly (4,56), followed by Design and Appearance (4,47) and Materials, Language, and Writing (4,40). The learners also gave the highest mean score to User Friendly (4,68), followed by Design and Appearance (4,43) and Materials, Language, and Writing (4,39).

These results indicate that the product was generally easy to use and suitable as supplementary reading material for beginner-level BIPA learning. Field observations provided additional information about the usability of the Augmented Reality features. During the first scanning activity, learners showed enthusiasm when three-dimensional objects and Indonesian audio appeared in accordance with the story content. The visualization of Ogoh-ogoh and the atmosphere of Nyepi also attracted learners' attention. Native-speaker pronunciation audio provided additional support for recognizing the pronunciation of Indonesian vocabulary.

However, some learners experienced usability difficulties when scanning the AR markers, particularly when the lighting was insufficient or when the device was held at an inappropriate distance from the marker. These difficulties indicate that the AR scanning process was affected by environmental and device-position conditions and therefore represents a usability limitation of the product. Learners were able to continue scanning after adjusting the lighting, device distance, or scanning position and some learners assisted one another during the process.

The observation findings were used directly to refine the product, particularly by improving the AR usage instructions to provide clearer guidance on lighting conditions, device distance, and scanning position. The revision was intended to reduce difficulties during initial use and make the scanning procedure easier for first-time users to follow. The product combines a printed storybook with digital features while maintaining the book's primary function as reading material. Indonesian is used as the main language of the story, English provides bridging support when learners encounter unfamiliar information, and Balinese is used for selected cultural terms and glossary entries.

Illustrations support the interpretation of vocabulary and story events, while Indonesian audio, three-dimensional objects, animations, and quizzes provide additional representations related to the text. This design is consistent with the Cognitive Theory of Multimedia Learning, in which learners process verbal and visual information through related channels. The AR features therefore function as supporting elements that complement the reading process rather than replacing the printed text. The practicality findings also reflect the suitability of the product for beginner-level BIPA learning. The story uses simple language and familiar reading structures, while the Balinese cultural theme provides a contextual basis for vocabulary and information presented in the text.

The glossary and English support can assist learners when they encounter unfamiliar terms, while the illustrations and AR features provide additional representations of cultural objects and events. These characteristics are in line with the BIPA Level I (A1) Graduate Competency Standards and the characteristics of beginner-level reading materials, particularly the need to support understanding of literal information and vocabulary in short texts. These findings are consistent with Triandini et al., (2021), who explain that the practicality of teaching materials can be seen from user responses, ease of accessing information, ease of understanding the story content and its benefits in learning. The responses of teachers and learners, which indicated a highly practical category, as well as the results of observations during product use, show that this storybook is easy to use and can serve as supplementary reading material in beginner-level BIPA learning.

4. Implementation Stage

a. Prerequisite Test

The Implementation stage was conducted after the product underwent expert assessment, practicality testing and revision. The revised product was then used in reading-for-pleasure activities in the library with beginner-level BIPA learners. This stage aimed to obtain data on product use and examine changes in learners' reading comprehension after using the trilingual Augmented Reality-based picture storybook. The effectiveness test used a One Group Pretest-Posttest Design. The learners first completed the pretest and then used the trilingual Augmented Reality-based picture storybook in reading activities. After completing the activity, the learners took the posttest to identify changes in their reading comprehension scores. The effectiveness analysis used a paired-sample t-test after the data met the required assumption. The results of the prerequisite test are presented in Table 4.

Table 4. Results Of The Normality Test

Test	Method	Data	Statistics	Sig.
Normality Test	Shapiro-Wilk	Difference (Posttest - Pretest)	0.912	0.069

Source: Research Data, 2026

Based on Table 4, the Shapiro-Wilk test for the difference scores (posttest-pretest) produced a significance value of 0,069, which was greater than 0.05. Since the number of learners was 20, the Shapiro-Wilk result was used to assess normality. The result indicates that the difference scores were normally distributed. Therefore, the data met the normality assumption for conducting the paired-sample t-test.

b. Paired-Sample t-Test

The descriptive statistics showed that the mean pretest score was 58,60 (SD = 26,61), while the mean posttest score was 68,95 (SD = 20,14). The mean difference between the two measurements was 10,35 points, with the posttest score higher than the pretest score. The results of the paired-sample t-test are presented in Table 5.

Table 5. Results Of The Paired-Sample t-Test of Reading Comprehension

Comparisons	Mean Difference	t	df	Sig.
Posttest-Pretest	10,35	5,687	19	<0,001

Source: Research Data, 2026

The paired-sample t-test showed a significant difference between the pretest and posttest reading comprehension scores, with $t = 5,687$, $df = 19$, and $p < 0,001$. The mean difference of 10,35 points indicates that the learners' posttest scores were higher than their pretest scores. These findings show an observed increase in reading comprehension scores following the use of the developed product. Because this study used a one-group pretest-posttest design without a comparison group, the observed increase cannot be attributed solely to the developed product.

c. Effect Size

The magnitude of the observed difference was further examined using effect size. The effect size was calculated using the t-value and sample size. The calculation is presented as follows:

$$ES = t \sqrt{\frac{1}{N}}$$

$$ES = 5,687 \sqrt{\frac{1}{20}}$$

$$ES = 5,687 \times 0,2236$$

$$ES = 1,271$$

The effect size value of 1,271 falls into the very high category based on the criteria applied in this study. This result indicates that the observed difference between the pretest and posttest reading comprehension scores had a large magnitude. The effect size indicates the magnitude of the observed difference but does not establish that the developed product alone caused the improvement. The observed increase in reading comprehension can be theoretically supported by the Cognitive Theory of Multimedia Learning. This theory explains that verbal and visual information can support each other in the process of understanding information. Beginner-level BIPA learners who have limited vocabulary and knowledge of Indonesian language structures may require additional support when reading story texts (Agustin and Kusuma, 2026). Illustrations and multimedia features in the book provide representations related to the textual content, which can help learners construct meaning from the story (Simanjuntak and Mastiah, 2026). The combination of these elements therefore provides additional support for comprehension without replacing the reading process.

The trilingual format also provides linguistic support for beginner-level learners. Indonesian is used as the main language, English serves as a bridging language when learners encounter difficulties, and Balinese introduces selected terms and local cultural elements in the story. The three-language presentation can assist learners in understanding information that has not yet been fully mastered in Indonesian. The glossary provides explanations of vocabulary related to the story and may reduce the need for learners to interrupt their reading frequently to search for word meanings (Suryani et al., 2026).

Augmented reality provides additional support when learners encounter cultural elements that may be unfamiliar. Terms and concepts such as *Ogoh-ogoh* and the atmosphere of *Nyepi* are represented through three-dimensional objects and animations connected to the story. Pronunciation audio also provides a model for Indonesian word pronunciation. These features provide additional cues for understanding the text and cultural information while maintaining the storybook as the primary reading material. Field observations also showed positive initial learner responses to the AR features during product use. These findings are consistent with Susanti et al., (2023) who emphasized the importance of reading materials that correspond to the language proficiency and needs of BIPA learners. The characteristics of the developed product also reflect the needs identified during the analysis stage. The story uses language appropriate for beginner-level BIPA learners while incorporating themes and cultural elements relevant to adolescent learners in the school environment. The illustrations support the meaning of the story, while the English bridging language and glossary provide assistance when learners encounter unfamiliar Indonesian vocabulary.

The AR features extend the information available in the printed book through audio, animation, and three-dimensional representations. The quiz provides an opportunity for learners to check their understanding after reading. The findings are consistent with previous studies. Khanifah et al., (2026) showed that multilingual and local-culture-based BIPA teaching materials can support learners in understanding linguistic and sociocultural aspects. The use of supporting languages in the present product provides comprehension assistance without shifting Indonesian from its position as the target language.

Amiroh et al., (2022) also reported that AR-based picture storybooks integrating stories, visuals, audio, and interactivity can support learning activities. Tamba et al., (2020) further showed that trilingual formats and interactive visual elements can support vocabulary learning in the target language. The observed increase in reading comprehension should be interpreted as a result associated with the use of the complete product rather than with any individual feature. The study does not allow the contribution

of illustrations, bridging language, glossary, audio, animation, three-dimensional objects, or quizzes to be examined separately. The findings therefore provide evidence of an observed change in reading comprehension following product implementation, rather than evidence of the independent effect of each product feature. The findings also reinforce the position of the storybook as the primary reading material. The text, storyline, vocabulary, and reading activities constitute the core of the reading experience, while AR functions as a complementary support for understanding the content and context of the story. The integration of AR adds visual, audio, and interactive support without shifting the main function of the product as BIPA reading material for beginner-level adolescent learners.

5. Evaluations Stage

The evaluation stage is the final stage of the ADDIE development model, which functions to assess the development results based on findings from each preceding stage. This study used formative evaluation conducted throughout the development process, while summative evaluation was not conducted due to time limitations in the study. Formative evaluation was carried out through feedback and assessment results obtained during the analyze, design, development, and implementation stages to identify parts of the product that still required improvement.

The findings from the evaluation process were used as the basis for revising the trilingual Augmented Reality-based picture storybook. The evaluation covered the suitability of the product to learners' needs, the results of assessments by experts and practitioners, as well as findings during implementation and the effectiveness test. This series of evaluations resulted in a final product that had undergone improvements based on the needs and feedback obtained throughout the development process.

Conclusion

This study produced a trilingual Augmented Reality-based picture storybook for beginner-level adolescent BIPA learners. The product uses Indonesian as the main language, English as a bridging language, and Balinese for cultural enrichment through stories themed around Balinese life and culture. It is equipped with AR features in the form of three-dimensional objects, audio, animations, and interactive quizzes. The product met the validity criteria based on content and media expert assessments and was rated highly practical by teachers and learners for use in BIPA learning. The results showed a statistically significant difference between learners' reading comprehension scores before and after using the product, with a very high effect size. These findings provide initial evidence of an observed change in reading comprehension following product use, although the one-group pretest-posttest design does not allow the change to be attributed solely to the developed product. The book can serve as an alternative BIPA teaching material that combines simple language, illustrations appropriate to adolescent characteristics, bridging language support, cultural enrichment, and AR technology to support a contextual and interactive reading experience.

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