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RESEARCH ARTICLE

Pluriquest "*Soerabaja Tempoe Doeloe*" based on Minecraft Education Edition in improving the pluricultural competence of BIPA learners

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ABSTRACT
This study evaluates the development and empirical effectiveness of pluriQuest "Soerabaja Tempoe Doeloe", an interactive 3D virtual learning environment engineered inside Minecraft Education Edition (M:EE) to enhance the pluricultural competence and target language writing performance of advanced learners of Indonesian Language for Foreign Speakers (*Bahasa Indonesia bagi Penutur Asing or BIPA*). Utilizing an ADDIE-based Research and Development (R&D) design coupled with a non-equivalent control group pretest-posttest quasi-experimental framework, the research involved an expert validation panel (n = 4) and 26 advanced BIPA learners divided into an experimental group (n = 13) and a control group (n = 13). Expert validation sheets were scored on a 1–4 rating scale to compute Aiken's V content validity coefficient, whereas student needs assessment and post-game reaction questionnaires utilized a 5-point Likert scale (1–5) to evaluate field practicality. Post-revision content validity reached $V = 0.867$ for instructional media and $V = 0.900$ for learning materials. Inferential statistics revealed that the experimental group achieved a mean pre-test score of 57.08 ($SD = 4.31$) and a post-test score of 87.08 ($SD = 3.77$), yielding a mean gain of 30.00 ($SD = 2.00$) and a High Normalized Gain ($g = 0.7034$). Conversely, the control group yielded a pre-test score of 56.92 ($SD = 3.09$) and a post-test score of 64.92 ($SD = 3.04$), representing a Low Normalized Gain ($g = 0.1863$). A paired sample t-test confirmed a statistically significant learning gain in the experimental group ($t = 54.0833$, $p < 0.001$), while an independent sample t-test demonstrated a significant difference between groups ($t = 36.0804$, $p < 0.001$). These findings demonstrate that integrating 3D virtual sandboxes with local historical heritage accelerates intercultural mediation skills and target language acquisition, directly supporting Sustainable Development Goals 4 and 11.

Keywords: BIPA; Minecraft Education Edition; Pluricultural Competence; pluriquest; Sustainable Development Goals (SDGs).

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INTRODUCTION

In contemporary foreign language pedagogy, foreign language instruction has shifted away from isolated grammatical drills toward the active development of plurilingual and pluricultural competence. Modern language learners are no longer treated as passive acquirers of vocabulary, but as active social agents capable of mediating cultural differences, reflecting upon diverse civilizational perspectives, and navigating dynamic intercultural encounters. Within Indonesian Language for Foreign Speakers (Bahasa Indonesia bagi Penutur Asing or BIPA), this educational transformation carries immense strategic value, as BIPA instruction serves as a primary conduit for cultural diplomacy, soft power projection, and sustainable heritage preservation on the global stage. In Indonesia, official BIPA instructional standards are regulated by the Ministry of Education and Culture through Regulation No. 27 of 2017 (*Peraturan Menteri Pendidikan dan Kebudayaan Nomor 27 Tahun 2017*). This policy establishes five core competency elements: reading (*membaca*), writing (*menulis*), listening (*menyimak*), speaking (*berbicara*), and Indonesian socio-cultural insight (*wawasan Indonesia / wawasan Nusantara*). Despite these policy directives, conventional BIPA classrooms frequently struggle to deliver authentic wawasan Indonesia and deep historical insights to international students. Standard instructional practices still rely heavily on static printed textbooks and two-dimensional slide presentations, which lack the spatial, sensory, and interactive affordances needed to represent the complex historical heritage of the archipelago. Consequently, international students often memorize isolated historical facts without developing deep cross-cultural empathy or spatial awareness of Indonesian identity.

To address these instructional limitations, applied linguistics and educational technology have turned toward Digital Game-Based Learning (DGBL) and 3D virtual sandbox environments. Immersive digital environments offer a dynamic mechanism to place target language structures directly within authentic, three-dimensional spatial contexts. By enabling foreign learners to navigate, explore, and interact with reconstructed historical landscapes, virtual media convert abstract textbook readings into engaging, experiential learning journeys. Among existing sandbox platforms, Minecraft represents a globally recognized 3D virtual environment with vast potential for educational application. Global telemetry data illustrates Minecraft's massive user base and sustained expansion across digital native cohorts worldwide.

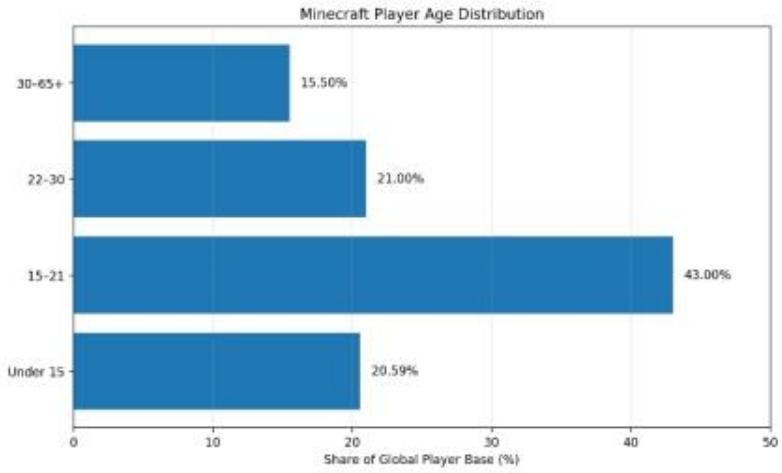


Figure 1. Age Demographics of Minecraft's global player

This broad demographic reach indicates that Minecraft provides a highly familiar digital environment capable of supporting international learners across secondary, university, and adult education contexts. To effectively utilize Minecraft in formal education, instructors must understand the distinct structural differences between its main commercial software editions (Java Edition and Bedrock Edition) and its dedicated educational platform, Minecraft Education Edition (M:EE). Table 1 compares these three software ecosystems across technical and instructional criteria.

Feature & Technical Criteria	Minecraft Java Edition	Minecraft Bedrock Edition	Minecraft Education Edition (M:EE)
Core Architecture & Platform	Java-based (PC, Mac, Linux)[9]	C++ engine (Cross-platform: Mobile, Console, PC)	Built on Bedrock engine with custom classroom tools.
Global Sales / Distribution	~80 Million units sold	>220 Million units sold	Deployed in school systems across 100+ countries.
Target User Base	Modders, custom server builders	General casual players across devices	Teachers, students, and academic researchers.
Teacher Control Tools	None (Requires third-party plugins)	Basic host options	Native Classroom Management (*Border Blocks*, *Allow/Deny Blocks*).
In-Game Instruction Features	Static signs or custom coding	Basic NPC dialogs	Advanced JSON-scripted NPCs with hyperlinked resources[5].
Stealth Assessment Tools	None (External screenshots only)	Screenshot gallery	Native *Camera* & *Portfolio* tools with PDF export.
Safety & World Integrity	High risk of griefing/world damage	Moderate risk of structural loss	Complete protection of historical architecture via Border blocks.

Table 1. *Comparative Analysis of Minecraft Software Ecosystems for Educational Use*

As detailed in Table 1, while commercial Java and Bedrock editions prioritize unguided open-world play, Minecraft Education Edition incorporates essential classroom management features such as Border Blocks and Allow/Deny Blocks. These administrative boundaries prevent structural damage and griefing, allowing educators to guide foreign students along focused instructional trajectories without risking structural loss to virtual heritage sites.

Crucially, implementing complex socio-historical content within a 3D virtual environment requires defining the exact target language proficiency level to avoid cognitive overload. Beginners (BIPA 1–2 / CEFR A1–A2) lack the grammatical and lexical capacity to process complex socio-historical narratives, which would lead to cognitive fatigue. Therefore, this research explicitly targets Advanced BIPA Learners (BIPA Level 5, 6, and 7 / CEFR Level B2–C2). At this advanced stage, foreign learners possess mature sociolinguistic repertoires and cognitive thresholds capable of analyzing historical symbolism, digesting Javanese ethnopedagogy, and comprehending multi-layered urban history. Furthermore, while the virtual map adopts the archaic spelling brand "*Soerabaja Tempoe Doeloe*" to evoke an authentic historical atmosphere and cultural nostalgia, the target language used across Non-Player Character (NPC) quests and JSON dialogue scripts is Standard Modern Indonesian (Bahasa Indonesia Standar) augmented with authentic local Suroboyoan dialect and regional expressions (e.g., local greetings, urban expressions, and Javanese cultural terms). This intentional linguistic design directly operationalizes the *Wawasan Nusantara / Wawasan Indonesia* competency element, exposing advanced learners to real-world sociolinguistic register variations and regional cultural identity.

To operationalize national policy standards for advanced learners, this study introduces pluriQuest "*Soerabaja Tempoe Doeloe*", an interactive virtual learning environment engineered inside Minecraft Education Edition. The virtual map reconstructs two historical architectural eras defining Surabaya, East Java: the indigenous Majapahit Kingdom heritage, featuring red-brick split gateways (*Candi Bentar*) and traditional spatial philosophies, and Dutch Colonial urbanism, featuring European administrative edifices and commercial arcades. The pluriQuest framework directly operationalizes the five core competencies mandated by Permendikbud No. 27 Year 2017 through structured, gamified quest design. Table 2 details how each national policy standard is integrated into the M:EE virtual world.

Permendikbud No. 27/2017 Core Element	Operational Integration in pluriQuest M:EE Virtual Environment	Specific Pedagogical Mechanism & Task Output
1. Wawasan Indonesia (Cultural Insight)	Experiential spatial exploration of restored Majapahit and Dutch Colonial architecture[5].	Comparative analysis of indigenous Javanese vs. European architectural aesthetics[5].
2. Membaca (Reading)	Interactive reading of graded target language texts embedded in Non-Player Characters (NPCs)[5].	Reading JSON dialogue scripts, historical briefing notes, and contextual quest clues[5].
3. Menulis (Writing)	Completing structured e-assignments assigned by specific quest-giver NPCs[5].	Writing reflective entries in the in-game *Portfolio* tool and exporting PDF reports[5].
4. Menyimak (Listening)	Listening to audio narration and teacher briefings during guided virtual tours[7].	Comprehending spoken instructions provided during cooperative multiplayer quests[5].
5. Berbicara (Speaking)	Oral debriefing, peer collaboration, and cross-cultural discussion tasks[7].	Discussing architectural observations and presenting portfolio findings to classmates[5].

Table 2. *National policy standard is integrated into the M:EE virtual world*

As outlined in Table 2 the pluriQuest adventure map uses reading (*membaca*) and Indonesian cultural insight (*wawasan Indonesia*) as the primary engines for spatial exploration. Advanced learners navigate through historic city sectors, reading custom JSON-scripted NPC dialogues that explain the cultural background of each architectural site in Standard Indonesian and local Suroboyoan registers. Writing skills (*menulis*) are operationalized through e-assignments issued by specific quest-giver NPCs. Upon meeting key historical NPCs, students receive reflective prompts requiring them to photograph architectural details using the in-game Camera and record analytical journal entries in their virtual Portfolio. Learners then export their completed portfolio as a standardized PDF document for formal evaluation, providing instructors with a reliable tool for assessing target language writing and cultural synthesis.

Theoretically, pluriQuest operationalizes Pluricultural Competence by operationalizing Byram's intercultural communicative competence framework and the CEFR Companion Volume descriptors. Pluricultural competence is not merely passive knowledge of cultural facts (savoirs), but involves intercultural attitudes (savoir-être), interpretation and relational skills (savoir-comprendre), and critical cultural awareness

(savoir-apprendre/faire). In pluriQuest, advanced learners act as active social agents who mediate between their native cultural backgrounds (L1 perspective) and Indonesian socio-historical manifestations (L2 context). By juxtaposing Majapahit's indigenous socio-ecological principles such as spatial harmony and local brick masonry against the administrative urban layouts of Dutch Colonial Surabaya, learners do not merely absorb historical information; they actively compare, contrast, and negotiate cultural meanings. This spatial contrast prompts foreign students to reflect on how past civilizations adapted to local environments, thereby building cross-cultural empathy and intercultural mediation skills.

Establishing the state-of-the-art requires examining three key benchmark studies in game-based learning, heritage education, and BIPA pedagogy. First, Edwards et al. constructed the Bryn Celli Ddu Minecraft experience for archaeological heritage education, demonstrating that 3D virtual reconstructions foster emotional engagement and spatial retention among youth. However, their work was restricted to historical heritage preservation, lacking foreign language acquisition frameworks, L2 task design, and CEFR pluricultural descriptors. Second, Chen and Wang evaluated gamified Minecraft environments in primary education, proving that 3D sandboxes significantly accelerate conceptual understanding and peer collaboration. Nevertheless, their research focused on primary STEM and elementary social studies, neglecting foreign language learning, sociolinguistic register selection, and adult L2 acquisition. Third, Asteria and Afni developed a BIPA instructional prototype based on Javanese culture, confirming that integrating local wisdom enhances pluricultural competence. Yet, their prototype relied on static 2D print materials and linear media, lacking an interactive 3D spatial sandbox where foreign learners can navigate, manipulate, and reflect upon historic spaces in real time.

These comparative studies highlight a clear double research gap. In BIPA pedagogy, existing digital media remain predominantly two-dimensional, linear, or passive, lacking open 3D sandbox environments that foster spatial exploration and real-time reflection. Conversely, in global game-based learning literature, while Minecraft Education Edition is widely studied in EFL, STEM, and coding, empirical research evaluating M:EE for teaching Indonesian as a foreign language specifically regarding pluricultural competence acquisition among advanced learners (BIPA 5–7) through historic architectural restoration and *Suroboyoan* sociolinguistic exposure is virtually absent. To bridge this gap, this study develops and evaluates the pluriQuest "*Soerabaja Tempoe Doeloe*" virtual environment

inside Minecraft Education Edition using an ADDIE-based Research and Development (R&D) framework

The primary objectives of this research are twofold: (1) to design, construct, and validate an interactive 3D virtual learning world titled "Soerabaja Tempoe Doeloe" in Minecraft Education Edition featuring restored Majapahit and Dutch Colonial architecture, custom JSON NPC dialogue scripts, and structured administrative boundaries; and (2) to empirically evaluate the effectiveness of the pluriQuest framework in accelerating the pluricultural competence and target language writing performance of advanced BIPA learners (BIPA 5, 6, and 7). This study tests the null hypothesis (H_0) that there is no statistically significant difference in advanced BIPA learners' pluricultural competence scores before and after participating in the pluriQuest M:EE learning environment, against the alternative hypothesis (H_1) that exposure to the interactive pluriQuest virtual world produces a statistically significant improvement in pluricultural competence and reflective writing output

This research aligns directly with Sustainable Development Goal 4 (SDG 4: Quality Education) by creating inclusive, technology-driven learning resources that democratize access to Indonesian language and culture worldwide. Packaging local history into an accessible (.mcworld) file enables international institutions to engage in rich cultural learning without geographic or financial barriers. Furthermore, the project advances Sustainable Development Goal 11 (SDG 11: Sustainable Cities and Communities) through 3D digital heritage preservation. Digitally restoring Surabaya's historic urban identity preserves collective memory and fosters cross-cultural dialogue among global digital natives. Theoretically, this study expands second language acquisition literature by demonstrating that 3D virtual sandboxes provide effective spaces for pluricultural learning and intercultural mediation. Practically, it delivers a fully validated (.mcworld) media prototype, custom JSON NPC dialogue scripts, and standardized portfolio evaluation rubrics aligned with *Permendikbud No. 27/2017*.

METHOD

This study adopts a Research and Development (R&D) design coupled with a non-equivalent control group pretest-posttest quasi-experimental evaluation model. The media design process follows the five-stage ADDIE framework encompassing Analysis, Design,

Development, Implementation, and Evaluation which provides a systematic structure for engineering digital language learning environments Participants and Research Setting

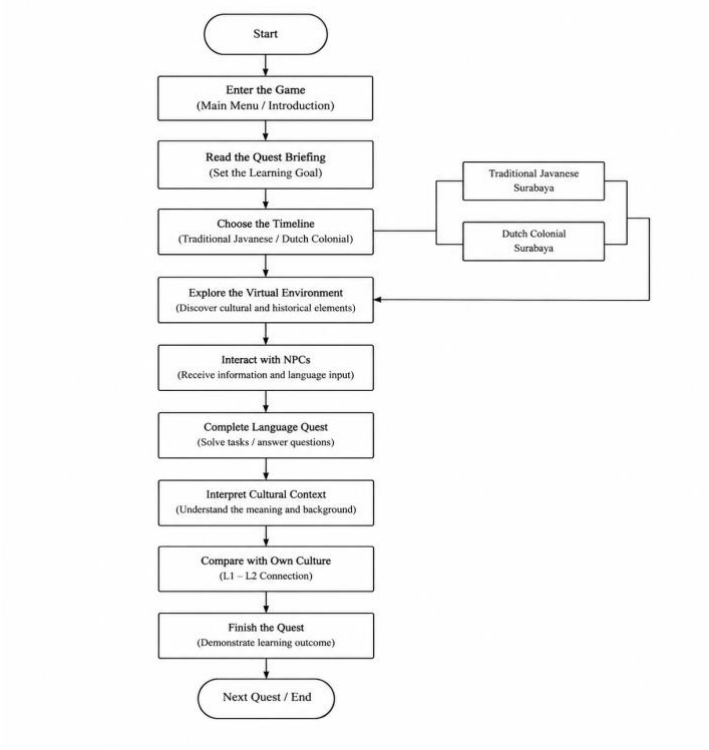


Figure 2. Flowchart based on the ADDIE Framework

The quasi-experimental quantitative design was selected to measure empirical gains in learners' pluricultural competence and target language writing performance in a natural classroom setting. In the Analysis phase, a needs assessment was conducted alongside a socio-historical inventory mapping Traditional Javanese Heritage and Dutch Colonial architecture in Surabaya against national BIPA standards. In the Design phase, spatial layouts were drafted in Minecraft Education Edition, featuring custom Non-Player Character (NPC) dialogue scripts in Standard Modern Indonesian blended with authentic Suroboyoan dialect expressions. During the Development phase, the three-dimensional (.mcworld) virtual map was assembled and evaluated by an expert validation panel before undergoing iterative revisions. In the Implementation phase, the validated prototype was deployed during controlled quest sessions, where learners completed baseline pre-tests, explored the map, and produced in-game portfolio assignments. Finally, the Evaluation phase involved descriptive calculations of validity and practicality alongside inferential statistical analyses of learning gain.

The research was conducted at the Faculty of Languages and Arts, Universitas Negeri Surabaya (UNESA). Virtual environment drafting, 3D block building, and JSON code scripting

were carried out via Work From Home (WFH), whereas expert consultations, product validation, and experimental trial sessions were executed on-site in Buildings T4 and T14 at FBS UNESA. The study involved two distinct participant groups: an expert validation panel comprising four specialists (n = 4) including two senior BIPA language and pluricultural experts and two instructional media design experts and a student sample consisting of 26 advanced BIPA learners from the 2024 cohort (N = 26) selected through purposive sampling. Student inclusion criteria required enrollment in formal BIPA instruction at UNESA, advanced Indonesian proficiency corresponding to BIPA Levels 5, 6, or 7 (CEFR Levels B2–C2), and basic digital device literacy. For the quasi-experimental evaluation, the 26 learners were divided into an experimental group (n = 13) exposed to the *pluriQuest* M:EE platform and a control group (n = 13) instructed using conventional BIPA textbooks and lecture modules.

Primary map construction, 3D spatial rendering, and command block logic configuration were performed on a host laptop equipped with an Acer Aspire 3 architecture and 8 GB RAM. Portable cross-platform user interface (UI) adaptability and touch-screen responsiveness were tested using a Xiaomi Redmi Note 10S smartphone. The software environment relied on Minecraft Education Edition, leveraging classroom management controls specifically Border Blocks and Allow/Deny Blocks to protect historical structures from player damage, alongside built-in Camera and Portfolio tools for evaluation.

Data collection employed four specialized instruments designed to capture quantitative metrics across the development and implementation stages. Expert validation sheets evaluated architectural accuracy, historical fidelity, JSON script validity, and instructional quality. Student needs assessment and post-game practicality questionnaires measured user interface navigation, gameplay engagement, anxiety reduction, and operational ease. Pre-test and post-test instruments assessed pluricultural competence across indicators of historical cultural awareness, cross-cultural comparative reflection, and socio-cultural empathy. Finally, an analytic portfolio evaluation rubric scored exported PDF reports generated from in-game Camera and Portfolio tasks to evaluate target language writing and cultural synthesis.

A critical methodological requirement of this study involves establishing distinct scoring scales for product validation and field response measurement. To compute the content validity coefficient index from the expert validation panel, a 4-point rating scale

(ranging from 1 to 4) was employed. The resulting expert ratings were analyzed using Aiken's V validity statistic, as formulated in Equation 1:

$$V = \frac{\sum s}{n(c-1)}$$

Where *s = I - l_o,* with *r* representing the expert rating score, *l_o* defined as the lowest possible rating score (1), *n* representing the total number of items or evaluators (*n* = 10 evaluation items), and *c* indicating the maximum category rating (4). The resulting Aiken's V coefficient ranges between 0.00 and 1.00, where values closer to 1.00 signify superior content validity. Calculated coefficients were benchmarked against Aiken's validity criteria, where $V \geq 0.60$ represents acceptable validity and $V \geq 0.80$ indicates high validity.

Conversely, to evaluate user needs, field practicality, and user reaction among BIPA learners, a 5-point Likert scale (ranging from 1 = Strongly Disagree to 5 = Strongly Agree) was utilized. Student response scores were analyzed through percentage agreement calculations (*P*) using Equation 2:

$$P = \frac{\sum X}{\sum Xmax} X\ 100\%$$

Where $\sum X$ represents the sum of empirical scores assigned by student respondents and $\sum Xmax$ denotes the maximum possible achievable score. The calculated percentages were classified into standardized practicality categories: Very Practical/Valid (85.00%–100.00%), Practical/Valid (70.00%–84.99%), Fairly Practical/Valid (55.00%–69.99%), and Impractical/Invalid (<55.00%).

Inferential statistical analysis of pre-test, post-test, and gain scores was performed using SPSS and Python statistical libraries. Score distributions were evaluated for normality using the Shapiro-Wilk test, which is specifically suited for sample sizes under 50 (*n* = 13 per group). A *p*-value exceeding 0.05 ($p > 0.05$) indicates that the data is normally distributed. To test the research hypotheses, a two-tailed Paired Sample t-Test was conducted at a 95% confidence level ($\alpha = 0.05$) to measure within-group gains in the experimental cohort, while an Independent Sample t-Test was executed to evaluate between-group gain differentials. To

quantify the magnitude of learning improvement, Hake's Normalized Gain (g) was calculated using Equation 3:

$$g = \frac{Spost - Spre}{Smax - Spre}$$

Where $Spost$ is the post-test score, $Spre$ is the pre-test score, and $Smax$ is the maximum possible test score (100). Average N-Gain scores ($\bar{g}$) were interpreted as High ($\bar{g} \geq 0.70$), Medium ($0.30 \leq \bar{g} < 0.70$), or Low ($\bar{g} < 0.30$).

RESULTS AND DISCUSSION

The empirical evaluation of *pluriQuest "Soerabaja Tempoe Doeloe"* encompasses four core dimensions: student baseline needs analysis, iterative expert validation using Aiken's V coefficient, field user reaction metrics, and inferential statistical testing of learning efficacy.

Student Needs Assessment Analysis

Prior to media construction, a comprehensive baseline needs assessment was administered to 26 advanced BIPA learners using a 5-point Likert scale. Table 3 details the percentage distribution of student responses across ten key instructional indicators.

No	Needs Assessment Indicator	Score 1	Score 2	Score 3	Score 4	Score 5
1	Interest in learning Indonesian language, culture, and history simultaneously	0.00%	0.00%	15.38%	38.46%	46.15%
2	Difficulty understanding local wisdom via printed textbooks alone	0.00%	7.69%	11.54%	42.31%	38.46%
3	Boredom caused by purely lecture-centered language instruction	0.00%	3.85%	15.38%	50.00%	30.77%
4	Need for visual media and simulation to grasp socio-cultural context	0.00%	0.00%	7.69%	46.15%	46.15%
5	Preference for 3D game-based learning over traditional media	0.00%	0.00%	19.23%	34.62%	46.15%
6	Need for a safe virtual environment to practice conversation without anxiety	0.00%	3.85%	7.69%	38.46%	50.00%
7	Attraction to adventure-based learning models and cultural puzzles	0.00%	0.00%	11.54%	42.31%	46.15%
8	Desire to directly experience virtual social situations in Indonesia	0.00%	3.85%	11.54%	38.46%	46.15%
9	Importance of understanding local etiquette and mindset (pluricultural competence)	0.00%	0.00%	7.69%	38.46%	53.85%
10	Support for utilizing Minecraft as a primary learning medium in BIPA classes	0.00%	0.00%	15.38%	30.77%	53.85%

Table 3. Percentage Distribution of Student Needs Assessment Survey (N = 26)

The needs assessment data (Table 3) highlights a clear demand for 3D game-based learning. A total of 84.61% of respondents agreed or strongly agreed that understanding local etiquette and cultural mindsets is essential for communication (Indicator 9), while 80.77% reported difficulty understanding local wisdom through printed modules alone (Indicator 2). Furthermore, 92.30% indicated a need for visual simulation media (Indicator 4), 88.46% expressed a desire for a safe virtual space to practice conversation without speaking anxiety (Indicator 6), and 84.62% endorsed integrating Minecraft into the BIPA curriculum (Indicator 10).

Iterative Expert Content Validity Evaluation

Product validation was conducted through two iterative evaluation rounds by expert specialists utilizing a 4-point scoring scale (1 = Poor to 4 = Excellent) to establish content validity via Aiken's V coefficient (*V*). Table 4 displays the initial validation scores provided by the instructional media design expert.

No	Evaluation Indicator	Score			
		1	2	3	4
1.	Creative and innovative media manifestation			**V**	
2.	Possesses technical advantages over alternative media				**V**
3.	Visual interface attracts learner interest and motivation			**V**	
4.	Effective and efficient execution in learning delivery			**V**	
5.	Alignment of forms, colors, graphics, and text with materials				**V**
6.	Appropriateness of selected software platform for learning				**V**
7.	Typography (font choice/arrangement) aligned with verbal content			**V**	
8.	Spatial layout of graphics and text clarifies subject matter		**V**		
9.	Graphics and text illustrate material realistically			**V**	
10.	Text clarity without compromising content comprehension			**V**	
	Total Empirical Score			32	

Table 4. Initial Instructional Media Expert Validation Results

In the preliminary media evaluation (Table 4), the expert assigned an empirical total score of 32 across the ten items. Applying Equation 1 yields an Aiken's V coefficient of:

$$V = \frac{32 - 10}{10\ x\ (4 - 1)} = \frac{22}{30} = 0{,}733$$

This initial coefficient represented an 73.3% validity score. Qualitative feedback from the media validator emphasized that the media spatial layout, typography, and visual illustrations required enhancement. Specifically, the validator noted that focusing solely on

segmented descriptions was insufficient; instead, the media needed to be presented as a fully integrated, visual prototype to ensure intuitive user navigation prior to field trials. In response, the research team revised the spatial layout, standardized in-game typography, and enhanced structural rendering within M:EE. Table 5 presents the post-revision media validation scores.

No	Evaluation Indicator	Score			
		1	2	3	4
1.	Creative and innovative media manifestation				**V**
2.	Possesses technical advantages over alternative media				**V**
3.	Visual interface attracts learner interest and motivation			**V**	
4.	Effective and efficient execution in learning delivery			**V**	
5.	Alignment of forms, colors, graphics, and text with materials				**V**
6.	Appropriateness of selected software platform for learning				**V**
7.	Typography (font choice/arrangement) aligned with verbal content			**V**	
8.	Spatial layout of graphics and text clarifies subject matter			**V**	
9.	Graphics and text illustrate material realistically				**V**
10.	Text clarity without compromising content comprehension				**V**
	Total Empirical Score		36		

Table 5. Revised Instructional Media Expert Validation Results

Following these refinements (Table 5), the empirical total score increased to 36 out of 40. Utilizing Equation 1, the recalculated Aiken's V coefficient reached:

$$V = \frac{36 - 10}{30} = \frac{22}{30} = 0{,}867$$

This result corresponds to a 86.7% validity index, placing the *pluriQuest* media interface firmly within the Very Valid category ($V \geq 0.80$) Simultaneously, senior BIPA language and pluricultural experts evaluated the instructional content, historical accuracy, and pedagogical scenario. Table 6 details the initial content validation results.

No	Evaluation Indicator	Score			
		1	2	3	4
1.	Alignment of content with BIPA standards and local socio-culture				**V**
2.	Historical narrative accuracy regarding Surabaya heritage sites		**V**		
3.	Alignment of language quests with pluricultural competence			**V**	
4.	Clarity of vocabulary presentation and grammatical structures		**V**		

5.	Effectiveness of material scenario in facilitating roleplay			**V**	
6.	Capacity of material to minimize cultural distance barriers			**V**	
7.	Contextual vocabulary choice to enhance retention				**V**
8.	Dialogue effectiveness in fostering student collaboration.			**V**	
9.	Balance between L2 language learning and local history				**V**
10.	Depth of active experiential learning vs. rote memorization	**V**			
	Total Empirical Score	30			

Table 6. Initial BIPA Content Expert Validation Results

The initial content validation (Table 6) yielded a total score of 30 out of 40. Equation 1 calculates the baseline Aiken's V coefficient as:

$$V = \frac{30 - 10}{30} = \frac{20}{30} = 0{,}667$$

This value represented a 66.7% validity index. The content validator provided three specific directives for revision: (1) re-verify historical archives regarding Surabaya heritage sites (Indicator 2) to eliminate factual ambiguities; (2) scaffold target language grammar and vocabulary in quest dialogues (Indicator 4) by integrating in-game glossaries and structural hints; and (3) deepen experiential learning (Indicator 10) by replacing passive text reading with problem-based cultural quests. In response, the development team cross-referenced historical records, added JSON-scripted glossaries, and restructured tasks into interactive cultural puzzles. Table 7 illustrates the revised content validation results.

No	**Evaluation Indicator**	**Score**			
		1	2	3	4
1.	Alignment of content with BIPA standards and local socio-culture				**V**
2.	Historical narrative accuracy regarding Surabaya heritage sites				**V**
3.	Alignment of language quests with pluricultural competence				**V**
4.	Clarity of vocabulary presentation and grammatical structures			**V**	
5.	Effectiveness of material scenario in facilitating roleplay				**V**
6.	Capacity of material to minimize cultural distance barriers			**V**	
7.	Contextual vocabulary choice to enhance retention				**V**
8.	Dialogue effectiveness in fostering student collaboration.			**V**	
9.	Balance between L2 language learning and local history				**V**
10.	Depth of active experiential learning vs. rote memorization				**V**
	Total score	37			

Table 7. Revised BIPA Content Expert Validation Results

As shown in Table 7, the post-revision total content score rose to 37 out of 40. The revised Aiken's V coefficient is computed as:

$$V = \frac{37 - 10}{30} = \frac{27}{30} = 0{,}900$$

This represents a 90.00% validity index, confirming that the instructional material possessed high content validity ($V \geq 0.80$) and was fully optimized for experimental implementation.

User Reaction and Field Practicality

Following map deployment, user reaction and practicality evaluations were gathered from all 26 advanced BIPA learners using a 5-point Likert scale. Table 8 summarizes student feedback across ten evaluation parameters.

No	Student Evaluation Game Indicator	Score 1	Score 2	Score 3	Score 4	Score 5
1	Visual design and map of "Soerabaja Tempoe Doeloe" are attractive and immersive	0.00%	0.00%	7.69%	38.46%	53.85%
2	Minecraft game controls and navigation are easy to operate	0.00%	7.69%	19.23%	46.15%	26.93%
3	Quests provided are highly relevant to local wisdom content	0.00%	0.00%	3.85%	34.62%	61.53%
4	NPC interaction and dialogue features help practice target language	0.00%	3.85%	11.54%	38.46%	46.15%
5	The game prevents boredom and motivates continuous exploration	0.00%	0.00%	15.38%	30.77%	53.85%
6	In-game cultural puzzles stimulate critical thinking skills	0.00%	3.85%	7.69%	42.31%	46.15%
7	Camera & Portfolio tools facilitate reflection documentation	0.00%	0.00%	19.23%	46.15%	34.62%
8	Learning via virtual game environment reduces foreign language anxiety	0.00%	3.85%	15.38%	38.46%	42.31%
9	Playing the game significantly improves pluricultural competence	0.00%	0.00%	7.69%	34.62%	57.69%
10	Overall, highly recommend this media for BIPA instruction	0.00%	0.00%	3.85%	30.77%	65.38%

Table 8. Percentage Distribution of User Reaction and Practicality Evaluation (N = 26)

The field practicality metrics (Table 8) confirm high user satisfaction. A total of 92.31% of learners commended the visual immersion of the map (Indicator 1), 96.15% agreed that the quests were directly aligned with local wisdom (Indicator 3), 92.31% reported significant gains in pluricultural competence (Indicator 9), and 96.15% recommended *pluriQuest* for BIPA classrooms (Indicator 10). Furthermore, 80.77% confirmed that the virtual environment successfully reduced foreign language speaking anxiety (Indicator 8).

Empirical Efficacy and Hypothesis Testing

To measure learning gains empirically, pre-test and post-test scores were gathered from both the experimental group (n = 13) and the control group (n = 13). Table 9 details the raw test scores, gains (D), and deviation parameters for the experimental group exposed to *pluriQuest*.

Table 9 synthesizes the descriptive statistics, mean gains, percentage increases, and Normalized Gain (N-Gain) indexes for both cohorts.

Undergraduated Group	Pre-test ($\bar{X}1$)	Post-test ($\bar{X}2$)	Gain ($\bar{D}$)	Percentase
Control group (Convensional, *n*=13)	56.92	64.92	8.00	14.05%
Experiment (*PluriQuest*, *n*=13)	57.08	87.08	30.00	52.55%

Table 9. Comparative Descriptive Analysis and Normalized Gain (*N-Gain*) Summary

As summarized in Table 9, both cohorts exhibited nearly identical baseline pre-test scores, with the experimental group averaging 57.08 (SD = 4.31) and the control group averaging 56.92 (SD = 3.09). Following the intervention, the experimental group achieved a post-test mean of 87.08 (SD = 3.77), representing a mean gain of 30.00 points (52.55% improvement) and a High Normalized Gain (g = 0.7034, SD = 0.0629). Conversely, the control group reached a post-test mean of 64.92 (SD = 3.04), representing a mean gain of 8.00 points (14.05% improvement) and a Low Normalized Gain (g = 0.1863, SD = 0.0226).

Data normality was tested using the Shapiro-Wilk statistic (n = 13). The experimental group gain distribution yielded W = 0.9172 (p = 0.2299), satisfying the assumption of normality ($p > 0.05$). The control group gain distribution yielded W = 0.8557 (p = 0.0339).

Hypothesis testing was conducted using paired and independent sample t-tests. A paired sample t-test within the experimental group yielded t = 54.0833 ($p = 1.0513 \times 10^{-15} < 0.001$), leading to the definitive rejection of the null hypothesis ($H0$). This result confirms that exposure to *pluriQuest* produced a statistically significant gain in pluricultural competence and target language writing output.

Between-group comparisons were executed via independent sample t-tests. Comparing post-test achievement between the experimental and control groups produced t

= 16.4818 ($p = 1.3722 \times 10^{-14} < 0.001$). Furthermore, comparing learning gain scores ($\bar{D}$) between groups yielded $t = 36.0804$ ($p = 2.0128 \times 10^{-22} < 0.001$). These statistical metrics demonstrate that *pluriQuest* inside Minecraft Education Edition significantly outperformed conventional textbook instruction.

Theoretical, Pedagogical, and Policy Discussion

The empirical findings confirm that 3D virtual sandbox technology effectively addresses structural limitations in foreign language pedagogy. While traditional textbooks present local culture as static facts, *pluriQuest* converts historical heritage into an interactive, spatial experience. Navigating restored Majapahit split gateways (*Candi Bentar*) alongside Dutch Colonial administrative arcades enables foreign students to observe how different historical eras adapted to local environments. This spatial juxtaposition fosters critical cultural awareness (*savoir-apprendre/faire*) and intercultural mediation skills, directly operationalizing Byram's Intercultural Communicative Competence model and the CEFR Companion Volume descriptors.

Furthermore, the game's sociolinguistic design played a key role in student language acquisition. By integrating Standard Modern Indonesian alongside authentic Suroboyoan dialect expressions within JSON-scripted NPC dialogues, advanced BIPA learners (BIPA 5–7) were exposed to natural register variations. This exposure directly operationalized the *Wawasan Nusantara* competency element mandated by Permendikbud No. 27 of 2017. Additionally, M:EE's built-in Camera and Portfolio tools provided an effective mechanism for stealth assessment. Capturing in-game photographs of architectural sites and writing reflective journal entries allowed learners to produce structured target language text, which was exported as PDF reports for formal writing evaluation (*menulis*).

Comparing these results with benchmark studies highlights the study's contribution. While Edwards et al. established that archaeological reconstructions in Minecraft enhance spatial memory, their framework lacked foreign language learning objectives. Similarly, Chen and Wang demonstrated that 3D sandboxes promote peer collaboration in primary STEM classrooms, but did not address adult L2 acquisition or sociolinguistic register selection. Furthermore, while Asteria and Afni validated Javanese cultural content for BIPA instruction, their media remained restricted to two-dimensional printed formats. By bridging 3D spatial sandboxes with advanced L2 pluricultural pedagogy, *pluriQuest* addresses a double research gap in CALL literature.

Finally, the study's outcomes carry practical implications for global educational sustainability. Packaging local history into an accessible (.mcworld) digital file advances Sustainable Development Goal 4 (Quality Education) by democratizing access to authentic Indonesian cultural learning for international institutions. Furthermore, digitally preserving Surabaya's urban heritage advances Sustainable Development Goal 11 (Sustainable Cities and Communities) by safeguarding cultural identity within modern virtual spaces.

CONCLUSION

This research demonstrates that *pluriQuest "Soerabaja Tempoe Doeloe"* inside Minecraft Education Edition significantly improves the pluricultural competence and target language writing performance of advanced BIPA learners. Content validity evaluations established high validity indexes (V = 0.867 for media and V = 0.900 for instructional materials). Quasi-experimental field testing proved that learners using *pluriQuest* achieved a post-test mean of 87.08 (SD = 3.77) and a High Normalized Gain (g = 0.7034), significantly outperforming control group students instructed via conventional textbooks (g = 0.1863). Inferential statistical analyses confirmed the statistical significance of these gains ($t = 54.0833$, $p < 0.001$ for paired testing; $t = 36.0804$, $p < 0.001$ for between-group gain comparisons). These results indicate that 3D virtual sandboxes provide effective spaces for contextualizing local wisdom, reducing foreign language anxiety, and scaffolding target language acquisition.

Theoretically, this study operationalizes Byram's Intercultural Communicative Competence model within an interactive 3D virtual environment, illustrating how spatial exploration fosters intercultural mediation. Practically, the project delivers a validated (.mcworld) learning module, custom JSON dialogue scripts, and portfolio evaluation rubrics aligned with Permendikbud No. 27 of 2017. Furthermore, the intervention supports SDG 4 (Quality Education) and SDG 11 (Sustainable Cities and Communities) by democratizing access to Indonesian language instruction and preserving urban heritage in digital formats. Future research should examine the multi-site deployment of *pluriQuest* across international university hubs and explore its applicability across elementary and intermediate BIPA levels.

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DECLARATIONS

Ethical considerations

Not applicable

Use of artificial intelligence (AI)

The authors declare that Gemini AI was utilized to assist in calculating empirical research data and structuring the data organization workflow. The AI tool was employed exclusively to support data processing efficiency without altering raw data values, manipulating statistical outcomes, or fabricating study findings. Full responsibility for the originality, scientific content, accuracy, and interpretation of the data remains entirely with the authors.

Conflict of Interest

The authors declare no conflicts of interest.

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