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Grandwisata Educulture Virtual Reality Model for Cultural Awareness and Sustainability Learning in Early Childhood Education

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ABSTRAK. *Transformasi digital telah mendorong integrasi teknologi imersif dalam pendidikan anak usia dini. Namun, implementasi Virtual Reality masih didominasi untuk meningkatkan aspek kognitif dan literasi digital, sementara pengembangan kesadaran budaya dan pembelajaran berkelanjutan belum banyak menjadi perhatian. Penelitian ini bertujuan mengembangkan desain teknologi pendidikan berbasis Grandwisata Educulture Virtual Reality untuk menumbuhkan cultural awareness dan sustainability learning pada anak usia dini. Penelitian menggunakan pendekatan Design and Development Research yang meliputi tiga tahap, yaitu analisis, desain dan pengembangan, serta validasi. Hasil penelitian menghasilkan desain teknologi pendidikan GE-VR yang terdiri atas komponen Input–Process–Output, lima sintaks pembelajaran (Orientation, Exploration, Interaction, Reflection, dan Action), serta empat dimensi cultural awareness, yaitu cultural recognition, cultural appreciation, cultural engagement, dan cultural respect. Model ini mengintegrasikan wisata edukatif virtual, budaya lokal, dan pembelajaran berkelanjutan dalam pengalaman belajar yang imersif, kontekstual, dan berpusat pada anak. Secara teoretis, GE-VR memperluas kajian teknologi pendidikan dengan menempatkan VR sebagai bagian dari desain pembelajaran yang sistematis, sedangkan secara praktis model ini memberikan kerangka inovatif bagi guru PAUD dalam mengintegrasikan teknologi imersif yang berorientasi pada pelestarian budaya dan pembangunan berkelanjutan.*

Kata Kunci : *Teknologi Pendidikan; Virtual Reality; Grandwisata Educulture*

ABSTRACT. *Digital transformation has driven the integration of immersive technologies into early childhood education. However, Virtual Reality (VR) implementation has primarily focused on enhancing cognitive aspects and digital literacy, while the development of cultural awareness and sustainability learning has received limited attention. This study aims to develop an educational technology design termed "Grandwisata Educulture Virtual Reality" (GE-VR) to foster cultural awareness and sustainability learning among young children. The study employs a Design and Development Research approach comprising three stages: analysis, design and development, and validation. The research resulted in the GE-VR educational technology design, which incorporates Input–Process–Output components, five instructional stages (Orientation, Exploration, Interaction, Reflection, and Action), and four dimensions of cultural awareness: cultural recognition, cultural appreciation, cultural engagement, and cultural respect. This model integrates virtual educational tourism, local culture, and sustainability learning into a learning experience that is immersive, contextual, and child-centered. Theoretically, GE-VR expands the field of educational technology by positioning VR as an integral part of systematic instructional design; practically, it provides an innovative framework for early childhood educators to integrate immersive technology focused on cultural preservation and sustainable development.*

Keyword : *Educational Technology; Virtual Reality; Grandwisata Educulture*

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INTRODUCTION

The accelerating pace of digital transformation has fundamentally reshaped educational systems worldwide, creating unprecedented opportunities to redesign teaching and learning processes across all educational levels (Gandana, 2023). The emergence of advanced technologies, including artificial intelligence, extended reality (XR), learning analytics, and immersive virtual environments, has shifted educational paradigms from teacher-centered instruction toward learner-centered approaches that emphasize interaction, collaboration, problem-solving, and authentic learning experiences. Consequently, educational technology is no longer conceptualized merely as the application of digital tools but as a systematic discipline concerned with designing learning environments that integrate technological affordances, pedagogical principles, learner characteristics, and contextual factors to improve educational quality and learning outcomes [1],[2],[3].

This transformation has become increasingly important following the rapid digitalization of education over the past decade. Educational institutions are expected not only to integrate digital technologies into classrooms but also to ensure that these technologies facilitate meaningful learning rather than simply digitizing conventional instructional practices [4]. Recent systematic reviews indicate that technology-enhanced learning environments improve student engagement, motivation, collaboration, and knowledge acquisition only when instructional activities are intentionally designed to support cognitive processing and meaningful interaction. Therefore, the effectiveness of educational technology depends more on evidence-based instructional design than on technological sophistication itself [1],[5],[6].

Within this context, early childhood education (ECE) represents one of the most critical educational sectors requiring innovative technology integration. Early childhood constitutes a sensitive developmental period during which cognitive, social-emotional, language, and behavioral foundations are established through direct interaction with physical and social environments [7]. According to constructivist perspectives, young children actively construct knowledge by exploring, manipulating, and interpreting experiences rather than passively receiving information [8],[9]. Similarly, experiential learning theory emphasizes that meaningful learning emerges from concrete experiences followed by reflection, conceptualization, and active experimentation [10]. Consequently, digital learning environments for young children should prioritize authentic experiences, active participation, and play-based exploration instead of passive content consumption.

Despite significant technological advancement, many digital learning resources currently implemented in early childhood classrooms remain limited to two-dimensional multimedia, instructional videos, electronic books, or gamified applications that primarily support information delivery rather than experiential learning [11]. Although these technologies improve accessibility and visual presentation, they frequently provide limited opportunities for children to interact with learning environments in ways that promote curiosity, inquiry, creativity, and contextual understanding. As a result, learning experiences often remain disconnected from

children's everyday realities, reducing opportunities to develop higher-order thinking, cultural appreciation, and environmental awareness through meaningful exploration [12],[5],[13].

The challenge becomes increasingly complex in the era of globalization, where children are continuously exposed to digital content originating from diverse global cultures while opportunities to experience their own local cultural heritage continue to decline. Digital media have substantially expanded children's access to information; however, they have simultaneously increased the dominance of globally standardized educational content that frequently overlooks indigenous knowledge, local traditions, and community-based cultural practices. Consequently, educational systems face the dual challenge of preparing children for participation in a technologically advanced society while simultaneously preserving cultural identity and promoting appreciation of local wisdom. This challenge aligns closely with UNESCO's vision of Education for Sustainable Development (ESD), which emphasizes that sustainability education should cultivate environmental responsibility, cultural diversity, social participation, and global citizenship beginning in early childhood [14].

Educational technology therefore should not merely enhance cognitive achievement but should also facilitate holistic child development encompassing cultural identity, environmental responsibility, creativity, collaboration, and sustainable thinking [15]. This perspective is increasingly reflected in contemporary educational technology research, which argues that digital innovation should support learners' cognitive, affective, and behavioral development simultaneously. Accordingly, technology-enhanced learning environments are expected to connect academic knowledge with authentic real-world experiences while fostering children's capacity to understand cultural diversity, appreciate local heritage, and develop sustainable behaviors. Such expectations require instructional designs capable of integrating technological innovation with pedagogical theory and contextual learning experiences rather than relying solely on sophisticated digital visualization [3],[6],[5].

Among the emerging technologies that have attracted considerable attention in educational research, immersive Virtual Reality (VR) has been recognized as one of the most promising innovations for creating authentic, interactive, and experiential learning environments. Unlike conventional multimedia or two-dimensional instructional media, immersive VR enables learners to experience a virtual environment through a strong sense of presence, interact with digital objects, and actively explore contexts that are otherwise inaccessible because of geographical, financial, or safety constraints. These affordances position VR as a technology capable of supporting experiential learning rather than merely enhancing visual presentation. Recent evidence consistently demonstrates that immersive VR improves learner engagement, motivation, conceptual understanding, and long-term knowledge retention when learning activities are carefully aligned with pedagogical objectives rather than relying solely on technological immersion [6],[16].

The growing effectiveness of immersive VR has shifted scholarly attention from evaluating whether VR works toward understanding how and why it facilitates learning.

This shift is reflected in the Cognitive Affective Model of Immersive Learning (CAMIL) proposed by Makransky and Petersen, which provides one of the most comprehensive theoretical frameworks explaining learning processes in immersive environments [3]. CAMIL argues that learning outcomes emerge through interactions among technological affordances, instructional methods, learner characteristics, and cognitive-affective processes. Specifically, the model identifies presence (the psychological experience of "being there") and agency (the perception of controlling one's actions) as the two principal affordances that distinguish immersive VR from conventional multimedia. These affordances influence learners' interest, motivation, self-efficacy, embodiment, cognitive load, and self-regulation, which collectively determine cognitive, affective, and behavioral learning outcomes.

Building upon CAMIL, the Immersion Principle in Multimedia Learning further explains that immersive technology alone does not automatically produce superior educational outcomes. Rather, immersive environments become effective only when instructional activities are deliberately designed according to evidence-based multimedia learning principles that facilitate learners' cognitive processes of selecting, organizing, and integrating information. Accordingly, instructional strategies such as pre-training, segmentation, signaling, personalization, and generative learning activities remain essential within immersive environments. This perspective fundamentally challenges the common assumption that greater technological immersion inevitably leads to better learning and instead emphasizes the central role of instructional design in maximizing the educational potential of immersive technologies.

Recent systematic reviews reinforce these theoretical perspectives by demonstrating that immersive technologies consistently generate positive effects when pedagogically embedded within structured learning experiences. Across preschool, primary, secondary, and higher education settings, immersive VR has been associated with improvements in conceptual understanding, learner engagement, intrinsic motivation, spatial reasoning, collaborative learning, and authentic problem-solving. However, these reviews also conclude that positive outcomes depend heavily on curriculum alignment, instructional scaffolding, and developmentally appropriate implementation rather than the novelty of the technology itself. In early childhood settings, evidence similarly indicates that immersive technologies can enhance motivation and conceptual learning, although empirical studies remain comparatively limited and concentrated within STEM-related domains.

These findings are particularly relevant for early childhood education, where learning is inherently experiential, play-based, and socially situated. Constructivist theory suggests that young children construct knowledge through active engagement with meaningful environments, whereas experiential learning theory emphasizes concrete experience as the foundation for conceptual development. Immersive VR provides opportunities to operationalize these theories by allowing children to observe, manipulate, and experience phenomena that cannot easily be presented through conventional classroom instruction. Consequently, immersive learning environments have the potential to bridge the gap between abstract knowledge and authentic

experiences while fostering children's curiosity, exploration, and reflective thinking. Nevertheless, translating these theoretical advantages into educational practice requires instructional designs that are explicitly grounded in child development principles rather than technology-centered innovation.

Although immersive Virtual Reality has demonstrated considerable educational potential, the current body of literature reveals several unresolved theoretical and practical limitations that warrant further investigation. First, most empirical studies conceptualize VR primarily as an instructional medium intended to improve learners' cognitive achievement, motivation, engagement, or procedural performance. Consequently, the educational value of VR is frequently evaluated through technological effectiveness rather than through its capacity to support comprehensive instructional design. This technology-oriented perspective has contributed substantially to understanding the effectiveness of immersive environments but provides limited theoretical guidance regarding how immersive technologies should be systematically integrated into pedagogically meaningful learning experiences across diverse educational contexts [3],[6].

Second, existing immersive learning research remains disproportionately concentrated within science, technology, engineering, mathematics (STEM), medical education, and higher education. These contexts primarily emphasize conceptual understanding, technical competence, and professional skill acquisition. In contrast, comparatively little attention has been devoted to early childhood education, where developmental objectives extend beyond cognitive achievement to include identity formation, socio-emotional competence, values education, and character development. This imbalance suggests that current educational technology research has yet to fully address the distinctive pedagogical characteristics and developmental needs of young children, despite increasing recognition that early childhood represents the most critical stage for establishing lifelong learning dispositions and values [5],[13].

Third, although cultural education and Education for Sustainable Development (ESD) have independently received growing scholarly attention, these domains have rarely been integrated within immersive learning environments. Studies concerning cultural learning generally emphasize heritage preservation, cultural literacy, or intercultural understanding, whereas sustainability education frequently focuses on environmental awareness, ecological responsibility, and sustainable behaviors. Existing investigations seldom conceptualize these educational dimensions as complementary learning objectives that can be simultaneously fostered through immersive instructional experiences. Consequently, educational technology literature lacks an integrated pedagogical framework capable of connecting immersive technology, cultural identity, and sustainability competencies within a coherent instructional design, particularly for early childhood education.

Another important limitation concerns the theoretical orientation of previous VR studies. Most investigations adopt experimental approaches that compare VR with conventional instructional media to determine differences in learning outcomes. While such studies provide valuable empirical evidence regarding technological effectiveness,

they contribute relatively little toward developing transferable instructional design models that educators can adapt across different learning contexts. In other words, previous research has predominantly answered the question of whether immersive VR improves learning, whereas comparatively fewer studies have examined how immersive learning environments should be systematically designed to maximize educational quality. This distinction is particularly important because educational technology, as a scientific discipline, extends beyond evaluating technological tools toward designing instructional systems that integrate pedagogy, technology, learning activities, assessment, and contextual factors into coherent educational experiences.

Furthermore, recent theoretical developments, particularly the Cognitive Affective Model of Immersive Learning (CAMIL), emphasize that educational outcomes emerge through interactions among technological affordances, instructional strategies, learner characteristics, and contextual variables rather than technological immersion alone [3]. Nevertheless, most empirical studies applying CAMIL have focused on explaining psychological mechanisms underlying immersive learning instead of translating these mechanisms into comprehensive instructional models for curriculum implementation. As a result, a substantial gap remains between immersive learning theory and practical educational technology design. Bridging this gap requires instructional frameworks that operationalize theoretical principles into structured learning sequences that educators can implement within authentic classroom settings.

Accordingly, the novelty of this study lies in the development of an Educational Technology Design that extends current immersive learning research in three important ways. First, it shifts the focus of VR research from technological effectiveness toward evidence-informed instructional design. Second, it integrates five complementary theoretical perspectives constructivism, experiential learning, ethnopedagogy, immersive learning theory (CAMIL), and Education for Sustainable Development—within a single pedagogical framework specifically designed for early childhood education. Third, it simultaneously targets cultural awareness and sustainability learning as interconnected educational outcomes, thereby expanding the scope of immersive educational technology beyond cognitive achievement alone.

From a theoretical perspective, this study contributes to the field of educational technology by demonstrating how immersive learning theories can be operationalized into a structured instructional design that accommodates the developmental characteristics of young children while addressing contemporary educational priorities related to culture and sustainability. Practically, the proposed model provides educators, curriculum developers, instructional designers, and policymakers with a theoretically grounded framework for integrating immersive technologies into early childhood classrooms without sacrificing pedagogical integrity or cultural relevance. Consequently, the GE-VR model contributes not only to the advancement of immersive learning research but also to the broader discourse concerning culturally responsive, sustainability-oriented, and developmentally appropriate educational technology.

Therefore, the objective of this study is to develop and conceptualize an Educational Technology Design based on the Grandwisata Educulture Virtual Reality (GE-VR) model to promote cultural awareness and sustainability learning among young children. By integrating immersive technology with pedagogical theory, local cultural wisdom, and sustainability principles, the proposed model is expected to provide both a theoretical contribution to educational technology research and a practical instructional framework that supports meaningful, culturally responsive, and sustainable learning experiences in early childhood education.

METHOD

This study employed a Design and Development Research (DDR) approach to develop an Educational Technology Design based on the Grandwisata Educulture Virtual Reality (GE-VR) model for promoting cultural awareness and sustainability learning in early childhood education. DDR was selected because the primary objective of this study was not to examine the effectiveness of an existing instructional intervention but to systematically design, develop, and validate an innovative educational technology model grounded in educational theories and empirical evidence. The study adopted the Design and Development Research framework proposed by Richey and Klein (2007), which emphasizes the systematic development and validation of instructional models and educational products [17].

The study consisted of three interconnected phases: analysis, design and development, and validation [17]. During the analysis phase, a comprehensive literature review was conducted to identify theoretical foundations, recent developments, and research gaps related to immersive Virtual Reality, Educational Technology, Constructivism, Experiential Learning, Ethnopedagogy, and Education for Sustainable Development (ESD). Scientific publications indexed in Scopus and Web of Science between 2020 and 2026 were reviewed to establish the conceptual framework of the proposed model. In addition, curriculum documents, educational policies, and previous instructional models for early childhood education were analyzed to ensure that the proposed instructional design addressed current educational needs and was developmentally appropriate.

The design and development phase focused on constructing the conceptual architecture of the GE-VR model by integrating five complementary theoretical perspectives: Constructivism [8],[9], Experiential Learning [10], Ethnopedagogy, the Cognitive Affective Model of Immersive Learning (CAMIL) [3], and Education for Sustainable Development [14]. These theoretical foundations guided the development of the instructional syntax, learning activities, technological components, teacher facilitation strategies, learner engagement mechanisms, and intended learning outcomes. The resulting educational technology design consists of three sequential learning stages: Pre-Immersive Learning, Immersive Learning Experience, and Post-Immersive Reflection, which collectively facilitate children's cultural exploration, authentic interaction, reflective thinking, and sustainability-oriented learning.

The validation phase involved expert judgment to evaluate the conceptual validity, instructional feasibility, technological appropriateness, and pedagogical coherence of the proposed model. The expert panel comprised specialists in educational technology, early childhood education, instructional design, educational psychology, cultural education, and immersive technology. Each expert assessed the model using a structured validation instrument encompassing theoretical relevance, instructional design quality, technological integration, usability, and expected educational impact. The quantitative data were analyzed using Aiken's V coefficient to determine the content validity of each component of the model, whereas qualitative comments and recommendations were analyzed using thematic analysis to refine the model prior to finalization [18].

The final outcome of this study is a validated Educational Technology Design based on the Grandwisata Educulture Virtual Reality (GE-VR) model. The model provides a theoretically grounded instructional framework for integrating immersive Virtual Reality, local cultural heritage, and sustainability education into early childhood learning. It is expected to contribute to the advancement of Educational Technology by offering an innovative instructional design that is culturally responsive, developmentally appropriate, and aligned with the principles of sustainable education.

Gambar 1. Tahapan Pengembangan Produk Adaptasi dari Model ADDIE

RESULTS AND DISCUSSION

Grandwisata Educulture Virtual Reality (GE-VR) Educational Technology Design. The findings of this study resulted in the development of the Grandwisata Educulture Virtual Reality (GE-VR) educational technology design, an innovative instructional model that integrates immersive Virtual Reality (VR), educational tourism, local cultural values, and sustainability-oriented learning into a coherent instructional framework for early childhood education. The design was developed to address the current limitations of VR implementation in early childhood education, which predominantly emphasizes cognitive achievement and digital literacy while providing limited attention to the development of cultural awareness and sustainability learning.

Unlike conventional VR-based instructional models that primarily focus on visualization or cognitive simulation, the GE-VR model positions immersive technology as a pedagogical medium for constructing meaningful cultural experiences. The model is built upon three integrated foundations: Grand Educational Tourism (Grandwisata), Educulture (Education and Culture), and Virtual Reality technology, which collectively facilitate authentic experiential learning within a culturally contextualized environment. These components are intended to produce two primary educational outcomes, namely Cultural Awareness and Sustainability Learning, reflecting the growing demand for holistic competencies in twenty-first century education.

The development of the GE-VR model demonstrates a shift from technology-centered innovation toward pedagogy-centered educational technology design. Contemporary educational technology literature increasingly emphasizes that

technological sophistication alone does not guarantee meaningful learning outcomes. Instead, educational technology should function as a learning ecosystem that integrates instructional objectives, learner characteristics, authentic contexts, and pedagogical strategies [19]. Within this perspective, GE-VR is conceptualized not merely as a VR application but as a comprehensive instructional design that organizes learning experiences before, during, and after immersion.

The integration of educational tourism within virtual environments represents a significant conceptual contribution. Educational tourism traditionally allows learners to gain knowledge through direct interaction with authentic cultural environments. However, geographical limitations, financial constraints, safety concerns, and accessibility issues often prevent young children from participating in field-based cultural exploration. Through immersive VR, these limitations are substantially reduced, enabling children to virtually experience cultural heritage sites, traditional communities, indigenous lifestyles, and environmentally sustainable practices while remaining within the classroom. Such authentic simulation supports the development of situated learning experiences that closely resemble real-world interactions [6].

From the perspective of educational technology, this finding reflects the evolution of immersive learning environments from simple visualization tools toward comprehensive instructional ecosystems. Makransky and Petersen argue that immersive technologies become educationally valuable only when cognitive engagement is accompanied by instructional guidance and meaningful learning activities [3]. Similarly, Mayer emphasizes that technological immersion should always be integrated with sound instructional design principles to optimize cognitive processing and minimize unnecessary cognitive load [20].

Another important finding concerns the integration of local wisdom into immersive learning environments. The GE-VR design positions local culture not as supplementary learning content but as the central learning resource. This approach differs considerably from many existing VR applications that emphasize science education, language learning, or historical visualization without incorporating indigenous knowledge systems. The integration of ethnopedagogical principles within immersive technology contributes to preserving cultural identity while simultaneously developing global competencies required in the digital era.

This finding is consistent with UNESCO (, which recommends that digital transformation in education should preserve cultural diversity while promoting inclusive and sustainable learning opportunities [14]. Likewise, Moreno-Vera demonstrated that integrating digital technology with cultural education significantly improves learners' appreciation of cultural heritage by transforming passive observation into interactive exploration [21].

Furthermore, the incorporation of sustainability education into the GE-VR model reflects the increasing global emphasis on Education for Sustainable Development (ESD). Rather than teaching environmental concepts through abstract explanation, the model enables children to experience environmental conservation, waste management, biodiversity, and human–environment relationships through immersive virtual

simulations. These authentic experiences strengthen ecological understanding by allowing children to observe the consequences of environmental actions in realistic contexts.

Recent educational technology research has increasingly recognized immersive technologies as powerful tools for sustainability education. Javaid reported that immersive learning environments significantly improve environmental awareness because learners emotionally engage with ecological problems rather than merely reading textual information [22]. Emotional engagement, empathy, and experiential participation collectively enhance long-term behavioral intentions toward environmental conservation.

The GE-VR model also aligns with the Cognitive Affective Model of Immersive Learning (CAMIL), which explains how immersion influences learning outcomes through cognitive and affective mechanisms. According to CAMIL, immersion enhances learners' sense of presence, intrinsic motivation, emotional engagement, and cognitive processing, ultimately improving conceptual understanding and meaningful learning [3]. Within the GE-VR framework, immersive cultural exploration serves not only as a technological experience but also as an affective catalyst that strengthens children's emotional connection with cultural heritage and environmental stewardship.

Importantly, the findings indicate that the model was intentionally designed to accommodate developmental characteristics of early childhood learners. The educational experiences are structured around play-based learning, multisensory interaction, contextual exploration, short-duration VR sessions, and collaborative social interaction. These characteristics correspond closely with contemporary recommendations regarding developmentally appropriate practices for integrating immersive technologies into early childhood education. Lampropoulos argues that VR implementation for young children should prioritize exploratory play, sensory engagement, and guided interaction rather than prolonged technological exposure [5].

From an instructional design perspective, the GE-VR educational technology model demonstrates that immersive technologies should function as facilitators of experiential knowledge construction rather than replacements for teacher-mediated learning. Teachers continue to play essential roles as facilitators, scaffolding children's exploration before immersion, guiding reflective discussions after virtual experiences, and connecting virtual observations with authentic everyday contexts. This finding supports Vygotsky's sociocultural theory, which emphasizes that meaningful learning occurs through mediated social interaction rather than independent technological engagement [9].

Overall, these findings suggest that the GE-VR educational technology design extends current educational technology literature by integrating immersive learning, ethnopedagogy, educational tourism, and sustainability education within a single instructional framework specifically developed for early childhood education. The model therefore represents an innovative pedagogical approach that balances technological advancement with cultural preservation, experiential learning, and sustainable development objectives.

Discussion of the GE-VR Educational Technology Design Framework. One of the principal findings of this study is the formulation of the Grandwisata Educulture Virtual Reality (GE-VR) model through a systematic Input–Process–Output (IPO) framework. Unlike many virtual reality learning models that emphasize technological features, the GE-VR framework positions instructional design as the primary determinant of learning quality. The model integrates three interconnected components: (1) Input, consisting of local cultural values, ecopedagogical principles, and characteristics of early childhood learners; (2) Process, encompassing pre-immersive, immersive, and post-immersive learning experiences; and (3) Output, represented by the development of Cultural Awareness and Sustainability Learning.

The adoption of an IPO framework reflects contemporary perspectives in educational technology that regard learning as a systemic process rather than a simple interaction between learners and technology. Educational technology is fundamentally concerned with designing, developing, utilizing, managing, and evaluating learning resources to improve educational effectiveness (Januszewski & Molenda, 2008). Consequently, the effectiveness of immersive technology depends not merely on the sophistication of VR devices but on how instructional elements are systematically organized to facilitate meaningful learning experiences.

The Input Component: Integrating Local Wisdom, Ecopedagogy, and Child Development. The first component of the GE-VR model consists of three essential instructional foundations: local cultural values, ecopedagogical principles, and developmentally appropriate characteristics of early childhood learners. These components function as the pedagogical basis from which all instructional activities are derived.

The inclusion of local wisdom represents an important departure from conventional technology-enhanced learning models. Rather than using culture as supplementary content, the GE-VR model positions indigenous cultural heritage as the primary learning resource. Children are introduced to traditional houses, local arts, traditional games, folklore, indigenous lifestyles, regional cuisine, and cultural heritage sites through immersive virtual experiences. This approach strengthens children's cultural identity while simultaneously encouraging appreciation of Indonesia's cultural diversity. This finding is strongly supported by ethnopedagogical theory. Similarly, UNESCO emphasizes that digital transformation should reinforce cultural diversity rather than replace local identity with globalized educational content [23].

Another important aspect of the input component is the integration of ecopedagogical principles. Ecopedagogy extends environmental education by emphasizing the interconnected relationship between humans, culture, and nature. Within the GE-VR model, environmental conservation is presented alongside cultural practices, illustrating how indigenous communities maintain sustainable relationships with their natural environments. Instead of memorizing environmental concepts, children experience environmental stewardship through authentic virtual scenarios that illustrate sustainable practices embedded within local cultural traditions. The third input component concerns developmental appropriateness. The GE-VR model

recognizes that early childhood learners possess distinctive developmental characteristics, including curiosity, playfulness, multisensory learning preferences, limited attention spans, and strong dependence on social interaction. Consequently, immersive activities are intentionally designed to be simple, visually engaging, interactive, and relatively brief to ensure children's physical comfort and cognitive readiness. Developmentally appropriate practice (DAP) emphasizes that instructional technologies should complement not replace children's active exploration, social communication, and play-based experiences. Therefore, the GE-VR model demonstrates an important pedagogical principle: immersive technology functions as an instructional facilitator rather than an autonomous teaching system.

The Process Component: From Immersion to Meaning Construction. The second major finding concerns the instructional process, which consists of three sequential learning phases: Pre-Immersive, Immersive Experience, and Post-Immersive Learning. The Pre-Immersive phase focuses on activating prior knowledge, introducing cultural themes, communicating learning objectives, and preparing children for safe VR participation. This stage reflects one of the fundamental principles of cognitive learning theory that prior knowledge substantially influences subsequent learning outcomes.

Discussion of the Learning Dimensions and Instructional Syntax of the GE-VR Model. Another important finding emerging from this study is the formulation of four dimensions of cultural awareness and five instructional syntax stages that collectively operationalize the Grandwisata Educulture Virtual Reality (GE-VR) model. These components demonstrate that the developed model is not merely a technological innovation but a pedagogically structured educational technology design that systematically facilitates children's cognitive, affective, and behavioral development through immersive cultural experiences.

Development of Cultural Awareness through Four Progressive Dimensions. The GE-VR model conceptualizes cultural awareness as a multidimensional construct comprising Cultural Recognition, Cultural Appreciation, Cultural Engagement, and Cultural Respect. Rather than viewing cultural awareness as simple knowledge acquisition, the model proposes a developmental progression beginning with recognition and culminating in the internalization of respectful attitudes toward cultural diversity. This conceptualization is consistent with contemporary perspectives in multicultural education, which argue that cultural competence develops gradually through cognitive understanding, emotional appreciation, behavioral participation, and value internalization [24]. Consequently, the four dimensions identified in this study represent successive stages in children's cultural learning rather than isolated learning outcomes.

Cultural Engagement: Active Participation in Learning. The third dimension, Cultural Engagement, emphasizes children's active participation during cultural learning activities. Indicators include exploring virtual environments, asking questions, participating in cultural games, engaging in artistic activities, discussing with peers, and attempting cultural practices directly. Engagement is widely recognized as one of the strongest predictors of meaningful learning. The immersive nature of VR further

enhances engagement by reducing psychological distance between learners and learning content. According to Radianti, immersive technologies promote higher engagement because learners perceive themselves as active participants rather than external observers [25]. This characteristic is particularly valuable for early childhood learners, whose attention and motivation are strongly influenced by interactive sensory experiences.

This design reflects contemporary educational technology theory emphasizing that technology should enhance human interaction rather than replace it [19]. Social interaction functions as an essential mechanism for negotiating meaning, correcting misconceptions, and strengthening conceptual understanding. The Reflection stage enables learners to verbalize their experiences, connect virtual observations with everyday life, and construct deeper conceptual understanding. Through guided reflection, children transform concrete experiences into transferable knowledge. Finally, the Action stage extends learning beyond virtual environments by engaging children in authentic cultural and environmental activities, including drawing cultural objects, performing traditional arts, participating in role-playing, practicing traditional games, and demonstrating environmentally responsible behaviors. This final stage represents one of the most significant pedagogical contributions of the GE-VR model. Rather than terminating learning upon completion of immersive experiences, the model intentionally facilitates knowledge transfer into real-life contexts. Overall, the findings suggest that the instructional syntax and cultural awareness dimensions developed within the GE-VR model provide a coherent pedagogical pathway through which immersive technology supports cognitive development, emotional engagement, cultural identity formation, and sustainable behavioral change among young children.

CONCLUSION

This study successfully developed an Educational Technology Design based on the Grandwisata Educulture Virtual Reality (GE-VR) model as an innovative instructional framework for fostering cultural awareness and sustainability learning in early childhood education. Unlike conventional virtual reality applications that primarily emphasize cognitive achievement and technological immersion, the GE-VR model positions immersive technology as one integrated component within a comprehensive pedagogical system. The model is grounded in the complementary integration of Constructivism, Experiential Learning, Ethnopedagogy, the Cognitive Affective Model of Immersive Learning (CAMIL), and Education for Sustainable Development (ESD), resulting in a theoretically coherent and developmentally appropriate educational technology design. The proposed framework consists of an Input–Process–Output (IPO) structure, three sequential learning phases (Pre-Immersive Learning, Immersive Learning Experience, and Post-Immersive Reflection), five instructional syntax stages (Orientation, Exploration, Interaction, Reflection, and Action), and four progressive dimensions of cultural awareness: Cultural Recognition, Cultural Appreciation, Cultural Engagement, and Cultural Respect. Collectively, these components demonstrate how immersive virtual

educational tourism can transform local cultural heritage into authentic, meaningful, and sustainability-oriented learning experiences for young children.

AWARD

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