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Development of Augmented Reality Media using Gender-Based Tri Hita Karana to Facilitate Students' Liability towards Local Culture

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Abstract: This study aims to develop Augmented Reality (AR) media using Gender-based Tri Hita Karana to facilitate students' liability towards local culture. This study utilized the Research and Development (R&D) approach with 48 fifth-grade students at SD Negeri 11 Denpasar as subjects. The instruments used in this research were expert validation questionnaires and student questionnaires, while the data analysis techniques include Aiken's V index for expert validation and descriptive analysis of student responses. With an average score of 0.992, the expert validation results using Aiken's V index demonstrate that this augmented reality media was quite legitimate. Furthermore, the study of the student questionnaire reveals a favorable reaction towards the enjoyment of local culture, as indicated by an average score of 3.137. This study determined that combining augmented reality (AR) technology with cultural knowledge-based learning could be a novel approach in contemporary education.

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Introduction

The archipelago of Indonesia, spanning from Sabang to Merauke, boasts an unmatched array of cultural and natural variety. The distinctiveness of Indonesian culture is well demonstrated by the multitude of customs, languages, arts, and beliefs that flourish in every region, therefore mirroring the unique character of every ethnic group (Ediyono et al., 2019). These include the Ngaben traditional ritual in Bali, Reog Ponorogo in East Java, and Batik, which has been officially acknowledged by UNESCO as a global cultural legacy (Alfianti et al., 2023). Furthermore, Indonesia's natural resources are similarly fascinating, encompassing a wide range of varied landscapes such as exquisite tropical beaches, active volcanoes, and rainforests that harbor a multitude of native plant and animal species. The fusion of abundant natural resources and rich cultural heritage is what distinguishes Indonesia as one of the most uniquely exceptional nations globally (Riyanti et al., 2019; Syafitri et al., 2023).

Local wisdom-based learning is an educational methodology that prioritizes the use of local values, knowledge, and traditions as educational assets. Its objective is to fortify cultural identity and augment the pedagogical significance for students (Marwantika, 2022). Across many parts of Indonesia, indigenous knowledge embodies a lifestyle that is in symbiosis with the natural world, social contexts, and spiritual principles down through successive generations (Yuendita & Dina, 2024). Local wisdom-based learning is an educational methodology that prioritizes the use of local values, knowledge, and traditions as educational

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assets (Sudirman et al., 2020). Its objective is to fortify cultural identity and augment the pedagogical significance for students. Across many parts of Indonesia, indigenous knowledge embodies a lifestyle that is in symbiosis with the natural world, social contexts, and spiritual principles down through successive generations (Yuendita & Dina, 2024).

The educational method known as Tri Hita Karana incorporates the indigenous knowledge of the Balinese people, emphasizing three primary harmonies: the connection between humans and God (Parahyangan), the connection between humans and each other (Pawongan), and the connection between humans and nature. Palemahan(Alwi et al., 2024). At the educational level, the principles of Tri Hita Karana are imparted to students as a fundamental basis for developing their character and a mentality that appreciates the equilibrium of spiritual, social, and ecological aspects (Ketut Jayawarsa et al., 2020). This strategy not only prioritizes academic disciplines but also fosters the development of a generation that is environmentally conscious, socially cohesive, and possesses a robust moral obligation (Suciati et al., 2021). By incorporating indigenous values like Tri Hita Karana into the educational program, the process of learning becomes more contextual and applicable for pupils, therefore promoting the conservation of culture and imparting the virtues passed down from forebears (Divayana et al., 2019).

The breadth of traditional Balinese art, namely in the realm of gamelan, is a cultural legacy abundant in artistic, spiritual, and social significance(Mulcki et al., 2023). The Balinese gamelan encompasses a diverse range of traditional music groups that employ percussion instruments, including gongs, kendangs, ceng-ceng, and gender specific instruments (Setiadi et al., 2023). Each variant of gamelan possesses distinct attributes and serves a variety of purposes, encompassing religious rituals as well as artistic presentations. The lively and expressive Gamelan Gong Kebyar is commonly employed in dancing performances, whilst the more subdued Gamelan Semar Pegulingan typically complements religious ceremonies. The many variations of Balinese gamelan not only showcase the ingenuity of the Balinese people in the field of arts but also demonstrate their profound connection to spiritual principles and customs. Balinese Gamelan is a significant component of communal life, serving as a medium for cultural exchange, safeguarding of customs, and manifestation of peaceful coexistence between humans and their environment and spirituality.(Permana et al., 2019).

The gamelan gender is a traditional instrumental instrument of Bali that holds significant importance in a multitude of religious rituals and cultural presentations. The gong consists of a sequence of metallic plates that are pounded with a proprietary instrument to provide a unique sound, characterized by a gentle yet profound tone, therefore establishing a contemplative and revered ambiance. Typically, this musical instrument is performed in small groups, particularly in the gender wayang gamelan, which is frequently employed to accompany Balinese shadow puppet shows and religious ceremonies like the Pitra Yadnya tradition. The gamelan gender possesses distinct characteristics in terms of tonal structure and playing techniques, necessitating expertise and a profound comprehension of traditional Balinese music composition. The music generated by the gender not only amuses but also functions as a spiritual conduit that establishes a connection between humans and supernatural forces within the framework of Balinese traditions.(Setiadi et al., 2023).

The results of Alwi's research., (2024) The gamelan gender is a traditional instrumental instrument of Bali that holds significant importance in a multitude of religious rituals and cultural presentations. The gong consists of a sequence of metallic plates that are pounded with a proprietary instrument to provide a unique sound, characterized by a gentle

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yet profound tone, therefore establishing a contemplative and revered ambiance (Kamińska et al., 2023). Typically, this musical instrument is performed in small groups, particularly in the gender wayang gamelan, which is frequently employed to accompany Balinese shadow puppet shows and religious ceremonies like the Pitra Yadnya tradition. The gamelan gender possesses distinct characteristics in terms of tonal structure and playing techniques, necessitating expertise and a profound comprehension of traditional Balinese music composition. The music generated by the gender not only amuses but also functions as a spiritual conduit that establishes a connection between humans and supernatural forces within the framework of Balinese traditions.

The results of the Tegeh research (2019) evidence indicate that the use of instructional resources combined with technology frequently encounters obstacles that may impede the maximization of educational achievements. While technology in education has undoubtedly provided numerous advantages, such as expedited information retrieval and enhanced interactive learning tools, certain elements can impede the attainment of ideal outcomes(Suryani et al., 2021). An important obstacle is the insufficient proficiency of teachers in the assimilation of technology with efficient instructional approaches, together with the restricted availability of technical equipment in certain regions (Made Tegeh et al., 2019). Evidence indicates that the use of instructional resources combined with technology frequently encounters obstacles that may impede the maximization of educational achievements (Gudoniene & Rutkauskiene, 2019). While technology in education has undoubtedly provided numerous advantages, such as expedited information retrieval and enhanced interactive learning tools, certain elements can impede the attainment of ideal outcomes. An important obstacle is the insufficient proficiency of teachers in the assimilation of technology with efficient instructional approaches, together with the restricted availability of technical equipment in certain regions(Alwi et al., 2024).

To fulfill the requirements of education in the 21st century, the implementation of digital learning has become essential for improving the capacity of students to acquire knowledge and develop skills (Bau & Rahardi, 2023). A technology that is becoming increasingly popular in the field of education is Augmented Reality (AR), which offers an interactive learning experience by integrating the physical environment with digital components (Yuendita & Dina, 2024). Augmented reality (AR) media enables students to visually represent intangible knowledge more concretely, therefore improving their comprehension and involvement in the educational process. Furthermore, this technology has demonstrated its efficacy in facilitating profound learning, since students are able to directly engage with educational materials, therefore augmenting their critical thinking and problem-solving capabilities. Within the framework of 21st-century education, which prioritizes technological proficiency and creative thinking abilities, augmented reality (AR) has emerged as a pioneering approach to provide a more captivating and efficient learning atmosphere (Syukur et al., 2024).

The integration of Augmented Reality (AR) technology with indigenous knowledge in scientific curriculum holds significant promise for enhancing the learning process (Permana et al., 2019). Augmented reality (AR) enables students to both auditory and visual perception and engage with gamelan instruments and the cultural environment in a virtual manner, therefore enhancing the learning experience (Rustiyanti et al., 2020). Integrating local knowledge such as gamelan into augmented reality technology allows students to acquire scientific knowledge interactively and contextually, therefore enriching their comprehension of this cultural legacy (Yuendita & Dina, 2024). Furthermore, augmented reality (AR) offers

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students the chance to actively participate in the learning process, therefore increasing their motivation and making their cognitive and physical abilities more robust. Through the use of globally accessible technology, science education can be enhanced to cater to the needs of the younger generation, ensuring the preservation of local culture and satisfying educational requirements (Ramadiyan & Wijayanti, 2014). The considerable benefits of Augmented Reality (AR) as an educational instrument reside in its capacity to cultivate novel viewpoints for students, enabling them to perceive the surrounding world in unprecedented manners. Furthermore, augmented reality (AR) allows learners to actively participate in real-life situations that are immediately applicable to their everyday experiences. (Yuendita & Dina, 2024).

This research introduces the novel integration of Augmented Reality (AR) technology with the Tri Hita Karana philosophy, enhancing student engagement with local culture through an immersive, interactive learning experience that fosters cultural appreciation, like the gamelan gender, into science education helps deepen students' understanding and admiration for their community's culture by directly linking the study content with the established customs that are still practiced in their everyday lives (Syafitri et al., 2023). Through the study of the gender gamelan, students acquire knowledge not only in the technical aspects of playing the musical instrument but also in the cultural backdrop, spiritual principles, and philosophies embedded within it, including its role in religious processes and social engagements within Balinese society (Alwi et al., 2024). This methodology enables students to develop a deeper understanding and sense of connection to their cultural legacy, therefore enhancing their cultural identity and fostering a robust sense of pride in indigenous knowledge. Therefore, a viable approach to address this issue is the use of Augmented Reality (AR) that showcases the indigenous knowledge of the gender gamelan, rooted in Tri Hita Karana, to foster students' appreciation for the local culture (Ketut Jayawarsa et al., 2020). Based on the background that has been outlined, the purpose of this research is to analyze students' love for local culture through the implementation of Augmented Reality (AR) in science education, infused with local wisdom of the gender gamelan based on Tri Hita Karana for fifth-grade students on the topic of sound.

Research Method

This method of research was Research and Development (R&D). Research and development methods can be defined as a scientific approach to researching, designing, producing, and testing the validity of the products that have been created (Sugiyono, 2017). The R&D research development method is a type of research that creates or develops new products using specific steps (Mulyana, 2020). Augmented Reality (AR) with local wisdom of gamelan based on Tri Hita Karana from this development research was tested at SD Negeri 11 Denpasar, located at Jalan Batas Dukuh Sari No.11, South Denpasar. The subjects of this study were 48 fifth-grade students from SD Negeri 11 Denpasar for implementation.

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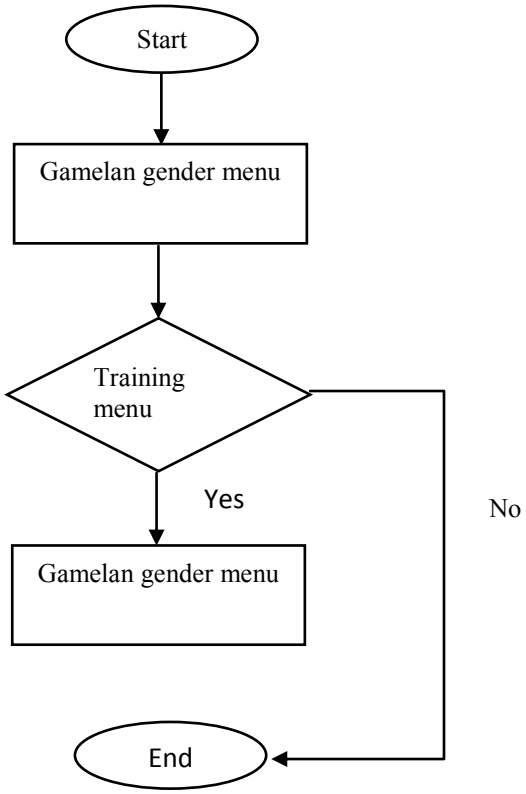

Figure 1. Flowchart of the Gamelan Gender Menu

Figure 1 depicts the Gamelan Gender starting with the Start stage, during which the user actively engages with the augmented reality (AR) program. The following phase is the Initialization of the Augmented Reality (AR) Application, during which the Gamelan Gender instruments are presented in a digital format once the application identifies the user's physical surroundings using the camera. Subsequently, the user proceeds to the Mode Selection stage, where they are presented with the option to select between Learning Mode or Performance Mode.(Noviana et al., 2023). The Learning Mode of the application presents instructional videos and methodologies for playing the Gamelan, but the Performance Mode allows users to play the instruments independently without any external direct instruction. The subsequent phase is AR Interaction, in which users engage with instruments by manipulating them through movement or touch, to which the program provides visual and aural responses. Following that, the user assesses if the Training Session has been completed. Would you prefer to proceed with the session or terminate it? Upon completion, the Save and Evaluate stage offers a numeric score or performance assessment and the ability to save the outcomes. Finally, the narrative reaches its conclusion at the End stage, signifying the conclusion of the interaction session with the AR Gamelan Gender interface.

The validation data utilized in this study comprises expert validation questionnaires on content, instructional materials, and practicality questionnaires for Augmented Reality (AR) technologies that integrate local knowledge, particularly the Gender Gamelan AR rooted in the Tri Hita Karana concept. Furthermore, data about students' affinity for local culture was also acquired via a questionnaire explicitly tailored to evaluate that particular facet. This study investigates the development of Augmented Reality (AR) media using the Tri Hita Karana philosophy, focusing on fostering students' appreciation for local culture, particularly Balinese traditions, through interactive technology-based learning tools.

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Employed for data collection in this study is a questionnaire specifically constructed to assess the credibility and applicability of the instructional materials and the created augmented reality (AR) application(Noviana et al., 2023). Expert evaluation is carried out to assess the viability of instructional materials in facilitating interactive and technology-driven learning. The researchers' objective throughout the data analysis phase of the expert test is to ascertain if the training materials and the created augmented reality (AR) application satisfy the established criteria or need enhancements (Noviana et al., 2023). Should the experts express a divergence of opinion or propose enhancements, the researcher will implement modifications in accordance with that input. Data analysis techniques typically involve organizing, interpreting, and presenting data to draw meaningful conclusions. In research, these techniques can include statistical analysis, content analysis, and validation methods such as expert validation or questionnaire analysis, which assess the reliability and relevance of the collected data carried out comprehensively, including specialists that possess knowledge pertinent to the research instruments, such as material specialists, instruction material specialists, and augmented reality technology specialists. Finally, the specialists will determine if the AR Gamelan Gender application can be deployed as is or if it still needs enhancements to more closely match the educational goals rooted in the indigenous knowledge of Tri Hita Karana.

Results and Discussion

The results of this study align with previous research that emphasizes the importance of integrating local wisdom into education to enhance cultural awareness (Alwi et al., 2024; Yuendita & Dina, 2024). Moreover, the use of augmented reality (AR) as an interactive tool has been shown to improve student engagement and understanding in scientific and cultural contexts. The design of this augmented reality show incorporates symbols of Balinese culture, including traditional decorations and backgrounds that vividly depict the distinctive spiritual ambiance of Bali, therefore enabling users to establish a profound connection with local values. The cover utilizes a full-color scheme, with a brownish-yellow foundation for both the front and back covers. This Gamelan gender, rooted in tri hita karana, incorporates many applications of vibrations and waves in technology within the augmented reality of science that encompasses folk wisdom. Augmented reality science incorporates the indigenous knowledge of the gender gamelan, based on tri hita karana, and is designed to address physics principles, particularly sound-related concepts. This augmented reality science elucidates the correlation between the gamelan and a sound generation device capable of producing sound upon striking each of its bars. When the gamelan is hammered, it generates a diverse range of sounds or tones that distinctly differ from the notes "do re mi fa sol la si do". This phenomenon arises from the variation in the dimensions of the materials employed, resulting in corresponding variations in the generated sounds. The magnitude of the sound generated increases proportionally with the size.

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Figure 2. The Initial Display of Augmented Reality (AR) Featuring the Tri Hita Karana-Based Gender Gamelan

Figure 3. Guide to Downloading the Augmented Reality (AR) Application Featuring Tri Hita Karana-Based Gamelan Gender

The comprehensive instructions for downloading the Augmented Reality (AR) application showcasing the Gamelan Gender based on Tri Hita Karana are shown in Image 4. This article provides a comprehensive explanation of the sequential procedures involved in discovering programs on official download platforms, such as the Google Play Store or App Store, and subsequently installing them on the user's device. Graphical representations accompany each stage, providing visual guidance to the user. These images include application icons, information about file size, and details about device compatibility. Furthermore, this guidance emphasizes the need to guarantee that devices are compatible with augmented reality (AR) technology to enable applications to operate at their own best. This tutorial facilitates users in straightforwardly accessing the program and initiating an interactive learning experience of Gamelan Gender, which is seamlessly interwoven with the philosophy of Tri Hita Karana. The musical instrument belonging to the Gamelan genre generates sound waves when being struck. As the stroke becomes less forceful, the number of vibrations generated decreases, leading to a lower pitch. In contrast, a more forceful impact results in more intense vibrations, which in turn causes a higher pitch.

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Figure 4. Guidelines for Using Augmented Reality (AR) Featuring the Tri Hita Karana-Based Gender Gamelan

The user guide for Augmented Reality (AR) showcasing the Tri Hita Karana-based Gamelan Gender, intended to enhance user engagement with the application, is depicted in Figure 4. This manual contains practical instructions covering processes such as accessing the application, scanning things, and digitally playing the Gamelan Gender instruments. Every step is accompanied by diagrams and written instructions elucidating how users can make use of important functionalities, such as choosing a learning mode, modifying audio settings, and comprehending the connection between the Tri Hita Karana principles and Balinese culture.

Figure 5. The display within the Augmented Reality (AR) application featuring the Tri Hita Karana-based Gender Gamelan

The UI of an Augmented Reality (AR) application showcasing the Gamelan Gender based on Tri Hita Karana is depicted in Figure 5. The application effectively combines visual and interactive components seamlessly. The application's interface presents the Gamelan Gender instruments in a digital version that can be viewed virtually via augmented reality (AR) devices, accompanied by intricate traditional Balinese artwork. Within the program, users can delve into a range of functionalities including instructional guides on playing the Gamelan, details on the philosophy of Tri Hita Karana, and choices for interactive learning modalities. The straightforward buttons and clear visual clues in the user-friendly design facilitate effortless navigation and enhance the virtual Gamelan playing experience.

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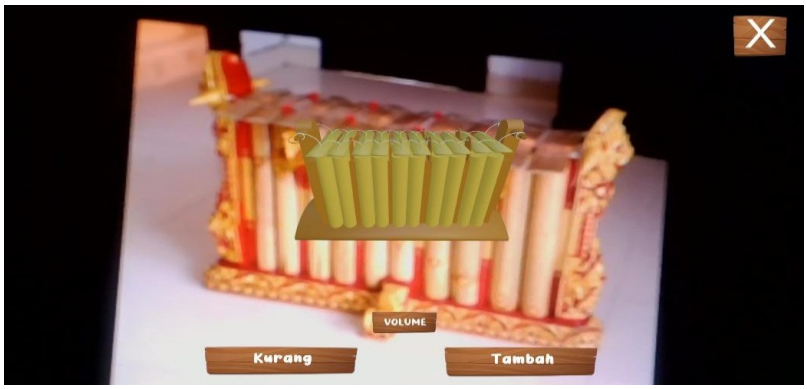

Figure 6. Direct visual display of the Augmented Reality (AR) application featuring the Tri Hita Karana-based Gender Gamelan.

Visual representation 6 showcases a real-time representation of the Gamelan Gender derived from Tri Hita Karana, as seen through the Augmented Reality (AR) application. This feature showcases the ability of users to observe and engage with the Gamelan in real time using their mobile devices. It seamlessly incorporates visual components such as musical instruments and Balinese decorations into the user's physical surroundings. This interactive experience offers both technically oriented instruction on playing the instrument and enhances the comprehension of Balinese cultural philosophy through a contemporary and captivating technological integration.

The viability of incorporating the Gamelan gender into augmented reality (AR) based on Tri Hita Karana is assessed by the evaluation of professional validators. Aiken's V index evaluation among three assessors yielded the augmented reality (AR) representation of the Gamelan gender based on Tri Hita Karana. The Aiken's V index is the formula employed for validation. The Aiken's V formula, developed by Aiken in 1985, computes the content validity coefficient by summing the evaluation results of items by a group of n experts and assessing the degree to which the questions accurately represent the construct being assessed. Expert test data analysis was performed using the Aiken-V formula as described in the equation.

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

Description: V represents the measure of respondents' judgment on the item's validity, s represents the score given by the respondent minus the lowest score (s = r-1), r represents the score of the choice category for the respondent, n represents the number of respondents, c represents the number of choice categories completed by the respondents.

Table 1. Expert Test Validity Criteria

Average Score	Validity Level
$0.8 < V \leq 1.0$	Very Valid
$0.4 < V \leq 0.8$	Valid Enogh
$0 < V \leq 0.4$	Invalid

The table above displays the validity categories of a dataset according to the average score achieved. The scale employed consists of three tiers. At the first level, data falling within the range of 0.8 to 1.0 ($0.8 < V \leq 1.0$) is classified as "Very Valid," indicating a high level of validity and reliability of the data. At the second level, data that falls between the range of 0.4 to 0.8 ($0.4 < V \leq 0.8$) is considered "Valid Enough," meaning that the data is adequately valid for usage, despite any slight deficiencies. At the third level, data falling between the

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range of 0 to 0.4 ($0 < V \leq 0.4$) is categorized as "Invalid," indicating that the data lacks validity and is not appropriate for subsequent analysis or interpretation.

Table 2. Assessment of Media Validators of Augmented Reality (AR) Gamelan Gender Based on Tri Hita Karana

Validator	Aiken's V	Category
Validator 1	0.984	Very Valid
Validator 2	1	Very Valid
Average	0.992	Very Valid

The table above displays the validity categories of a dataset delineated by the mean score achieved. The employed scale consists of three levels. The first level of data is classified as "Very Valid" if its average score falls between 0.8 and 1.0 ($0.8 < V \leq 1.0$), indicating a high level of validity and trustworthiness. At the second level, data scoring between 0.4 and 0.8 ($0.4 < V \leq 0.8$) is considered "Valid Enough," meaning that the data is adequately valid for usage, notwithstanding some minor deficiencies. The third level categorizes data with a score ranging from 0 to 0.4 ($0 < V \leq 0.4$) as "Invalid," indicating that the data is not legitimate and not appropriate for further analysis or interpretation.

Table 3. Aiken's V Index on each Aspect

Aspect	Aiken's V	Category
Content	1	Very Valid
Presentation	0.968	Very Valid
Characteristics	1	Very Valid
Average	0.992	Very Valid

According to Table 3, four different factors are assessed: Content, Presentation, Characteristics, and the Average score. With an Aiken's V score of 1, the Content element is deemed very genuine, with no notable deficiencies or flaws. The Presentation component achieved a score of 0.968, thus remaining in the "Very Valid" category. This indicates that the presentation of information is very commendable, albeit with some room for enhancement. The Characteristics facet achieved a perfect score of 1, indicating that the features of the analyzed product or thing closely align with the criteria and are regarded as highly valid. The mean score of these three characteristics is 0.992, indicating that the evaluation as a whole demonstrates a very high level of validity and confirms that all evaluated aspects are regarded as highly valid. The results demonstrate that the instrument or object under testing exhibits robust reliability in all facets of its assessment.

Table 4. Questionnaire Results of Attitudes of Loving Local Culture of Students for Each Indicator

Indicator	Score	Category
Interest	3.452	Very good
Faithfulness	3.052	Good
Concern	3.032	Good
Award	3.012	Good
Average	3.137	Good

The analysis of Table 4 indicates that the student's affinity for local culture, as expressed in the student questionnaire responses, is highly positive towards the developed tri hita karana-based augmented reality (AR) Gamelan gender. Furthermore, the students show a keen interest in engaging in educational activities facilitated by the tri hita karana-based augmented reality (AR) Gamelan gender. Therefore, it can be asserted that the students have successfully developed a deep appreciation for the local culture by engaging with tri hita karana-based augmented reality (AR) Gamelan gender. The interest indicator for the attitude

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of love towards local culture recorded a score of 3.304, placing it in the very good category. This indicates that students acknowledge and appreciate gamelan as a form of indigenous knowledge. Furthermore, students also recognize and value the traditional musical instruments originating from the region as an integral component of the cultural richness of the area, including the Gamelan. Furthermore, students have the opportunity to integrate the indigenous knowledge of Gamelan with their scientific education, particularly in the subject of "Sound." The loyalty metric for the attitude towards local culture had a score of 3.052, placing it in the good category. Therefore, students can uphold and safeguard gamelan as a unique form of indigenous knowledge.

Furthermore, students have the option to give precedence to local regional culture above foreign culture in their everyday existence. Moreover, students gain a profound understanding of the local culture, particularly from the sagacity of the indigenous gamelan. The concern metric for the attitude of affection towards local culture obtained a score of 3.032, placing it in the good category. This indicates that students are concerned about the preservation and advancement of gamelan as a traditional musical instrument. The appreciation indicator for the attitude of love for local culture had a score of 3.137, indicating a good level of appreciation. Students demonstrate an appreciation for the variety of local cultures, comprehend the advantages of gamelan as a manifestation of local knowledge, and incorporate local knowledge into the advancement of gamelan as a traditional musical instrument, particularly in the subject of "Sound." The conceptual implications of this study highlight how integrating AR technology with cultural knowledge enhances students' appreciation of local traditions, promoting cultural conservation while improving interactive, technology-driven educational experiences.

Conclusion

The research results concluded that expert evaluation reveals a very high level of validity, with an average score of 0.992. This indicates that this application is regarded as highly valid in terms of its content, presentation, and features. Furthermore, the student questionnaire revealed a favorable reaction to this augmented reality (AR), as students showed considerable curiosity and admiration for the local culture. Education in this medium not only imparts scientific knowledge to students but also fosters a deep appreciation and consciousness of the need to safeguard Balinese culture. This Tri Hita Karana-based augmented reality gamelan application effectively integrates teaching and cultural conservation, offering a dynamic and significant learning experience.

Recommendation

The research results are highly relevant for both teachers and future researchers. Teachers can utilize this study to integrate augmented reality and local wisdom into their classroom practices, enriching cultural awareness in education. Meanwhile, future researchers can explore further advancements, improve the model, or extend the use of this innovative technology in other educational settings.

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