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Assessing Mobile AR Prototype Usability in Teaching Bicolano Mythical Creatures

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This study evaluates the usability and user experience of a mobile augmented reality (AR) prototype designed to teach Bicolano mythical creatures to grade 5 students. The prototype, BIMY AR Application, was developed to enhance the educational delivery of Bicol myths and folklore, promoting cultural engagement through immersive learning experiences. Acceptance testing involved students and teachers using a Likert scale to assess various aspects of the application, including visual quality, content richness, functionality, and overall satisfaction. Performance metrics such as application load times, AR camera responsiveness, and character loading efficiency were systematically recorded, revealing robust application performance with minimal delays, thus supporting a seamless learning experience. User feedback highlighted the application's intuitive user interface, engaging content, and educational value, with average scores predominantly indicating agreement on the application's effectiveness in meeting educational needs. Users recommended improvements such as enhancing the light sensitivity in AR marker detection, making it markerless to reduce the cost, and increasing the content variety to cover a broader range of Bicolano myths. The study confirms that the AR prototype successfully enhances student engagement and satisfaction, suggesting that augmented reality could be a powerful tool in modern educational practices, particularly in cultural education. By integrating user recommendations, future developments can further improve the application's educational impact, supporting its potential to enrich learning environments and fostering a deeper connection to cultural heritage.

Keywords: Cultural Heritage, Education, Local Myth, Mobile Augmented Reality, Mythical Creatures, Prototype

1. Introduction

A. Augmented Reality Technology

Augmented Reality (AR) is a technology that overlays virtual elements such as text, graphics, and other objects onto real-world images, enhancing the user's perception and interaction with their environment [1] [2]. AR combines the actual environment with computer-generated visuals, allowing users to explore both virtual and physical worlds simultaneously [3]. AR origins can be traced back in the 1960s when Ivan Sutherland, a computer scientist and professor, developed the first head-mounted display system, "The Sword of Damocles," which displayed simple wireframe drawings [4]. The term "Augmented Reality" was coined in the early 1990s by Tom Caudell to describe a digital display system used in aircraft assembly at Boeing [5]. During this decade, significant developments included Louis Rosenberg's Virtual Fixtures system, which enhanced manual tasks with stereoscopic graphics [5]. The late 1990s saw the creation of ARQuake, one of the first mobile AR games, illustrating the technology's potential in entertainment [6].

The 2000s brought AR to mobile devices with applications like Wikitude's AR travel guide and the release of ARToolkit, which facilitated AR development [7]. The 2010s marked the commercialization of AR with products like Google Glass and the massive success of Pokémon GO, bringing AR to mainstream consumer use. Microsoft's HoloLens further demonstrated AR's applications in both consumer and enterprise settings[8]. Today, advancements in AI, 5G, and edge computing are driving AR's integration across various sectors, with major companies investing heavily in AR's future, particularly in relation to the development of the Metaverse and new computing platforms[9].

In the early days, augmented reality was primarily used in specialized applications such as aircraft maintenance and surgical procedures, but the advent of smartphones and mobile devices has propelled it into the mainstream, captivating users with immersive experiences. The integration of high-quality cameras, GPS, and processing power in these ubiquitous devices has made augmented reality accessible to the masses, allowing them to superimpose digital content onto the physical world in real time. This technological revolution has had a profound impact on various industries, from entertainment and retail to education and healthcare [10].

AR has found applications across various fields, including marketing, where it has transformed consumer engagement and brand experiences [11], and education, where it enhances learning through interactive digital content [12]. In the tourism sector, AR enriches visitor experiences by integrating virtual content with real-world settings, such as cultural heritage sites and smart tourism initiatives [13].

B. AR in Education

AR is increasingly relevant in modern education, significantly enhancing the learning experience by transforming traditional methods into more engaging, interactive, and effective forms [14][15]. AR integrates digital information into the real world, enabling students to visualize and interact with complex concepts in an intuitive and immersive manner [16][17]. This technology is beneficial at all educational levels—from preschool to higher education and lifelong learning—by facilitating a better understanding and retention of material [18]. The technology's ability to superimpose 3D models and animations over real-world surroundings helps students visualize complex concepts, thereby improving understanding and retention[19][20].

Integrating AR into education can substantially improve learning outcomes by increasing student engagement and interactivity. It fosters essential skills such as problem-solving, collaboration, and creativity, which are crucial for future readiness [21][22][23]. AR supports experiential learning by allowing students to experience and manipulate 3D models and scenarios, effect0069vely bridging the gap between theoretical knowledge and practical application [24].

Furthermore, AR caters to diverse learning styles, enhancing both hedonic (enjoyment and engagement) and utilitarian (practical and functional) gratifications. This dual enhancement boosts overall learning satisfaction and student engagement [25][26]. AR applications offer flexibility and dynamism in teaching, allowing educators to customize and pre-plan content to meet individual learning needs effectively [10]. Empirical research has also highlighted the positive impact of AR on learning satisfaction and student engagement, with different learning styles benefiting from the immersive and personalized nature of AR. This interactive medium is especially beneficial in elementary education, where it can make learning more engaging and help maintain student interest [27], [28]

C. Importance and educational value of Bicolano mythical creatures

The mythical creatures of Bicol, much like those in various cultures, hold significant cultural and symbolic meanings that reflect the values, fears, and beliefs of the community. These creatures encapsulate a wealth of cultural heritage and educational potential, fostering a deeper connection to traditional values and enhancing the learning experience through storytelling and cultural representation.

Bicolano folklore is a rich tapestry of captivating tales that reveal the deep-rooted cultural heritage of the region [29]. Within this vibrant tapestry, the mythical creatures of Bicol hold a special place, offering a window into the beliefs, values, and traditions of local communities. These enchanting beings, such as the aswang, the kapre, and the tikbalang, not only captivate the imagination but also carry profound educational and cultural significance [30]. The aswang, a shape-shifting creature that feeds on human flesh, serves as a cautionary tale, warning against the dangers of greed, deceit, and the misuse of power. The kapre, a giant tobacco-smoking tree

dweller, embodies reverence for nature and the importance of respecting the natural world. The tikbalang, a horse-like being with human-like features, symbolizes the duality of human nature, highlighting the balance between the physical and the spiritual [30]. Beyond their mythical representations, these creatures serve as vessels for the transmission of traditional knowledge, moral lessons, and cultural identity[31].

For example, the aswang is not merely a terrifying monster but a reflection of the community's concerns about the consequences of unrestrained desires and the importance of maintaining social harmony. Similarly, the kapre's connection to the natural world reminds us of the delicate balance between humanity and the environment, urging us to be responsible stewards of the land[29], [32].

The educational value of learning about mythical creatures spans various disciplines. In early childhood education, myths help children reflect on their inner selves and confront modern value systems, fostering growth and integration within humans, as suggested by Jung [33]. Mythical creatures also serve as engaging tools to teach complex scientific concepts. For instance, using fantastical beings in biology classes can illustrate key principles such as classification and adaptation, stimulating creativity and critical thinking among students [34], [35]. From a humanities perspective, mythology provides a channel to explore diverse cultural, religious, and historical contexts, helping students connect past and present experiences and understand sociocultural influences [32]. Furthermore, mythical narratives can be instrumental in education for sustainable development, promoting values and competencies aligned with environmental harmony [36]. Folklore, including myths, plays a crucial role in preserving cultural identity and values, which is particularly important in the face of digital media's impact on children's cultural perceptions [37]. The mythological approach in literary analysis also helps students comprehend archetypes and universal themes, enriching their understanding of literature and its cultural significance[38]. The developed storytelling program for science learning using local myths has shown an increase in interest and inventive problem-solving abilities of students, which was an unexpected outcome of integrating narrative thinking into science education [39].

Folklore, particularly legends and myths, holds significant importance in education by enhancing students' reading competency and character development [40], [41]. Folklore serves various functions, such as reflecting collective wishes, legitimizing cultural norms, educating children, and enforcing societal norms, making it a valuable educational tool for elementary school students. By incorporating folklore into literacy teaching materials, students can internalize noble values and character traits, preparing them for future success in academic and economic fields while preserving cultural heritage and fostering civilized behavior. The rich cultural wealth embedded in folklore, including mythical creatures like those found in legends and myths, provides a platform for extracting positive information that reflects local values and wisdom, contributing to character education and the overall development of students.

D. Current challenges in teaching local mythology

Teaching local mythology in the Philippines faces several significant challenges, primarily due to systemic issues within the educational system and the marginalization of regional and Indigenous languages. Despite the country's rich cultural heritage and diverse folk narratives, these elements are often neglected in academic curricula [42]. This neglect is largely due to the lack of integration and resources dedicated to local folklore and mythical creatures, resulting in students missing out on learning about their cultural heritage in a structured manner [43]. Furthermore, the dominance of English and Filipino (Tagalog) in educational materials marginalizes regional and Indigenous languages, complicating the development and use of instructional materials in these languages [44]. This linguistic marginalization hinders the inclusion of local myths and folk narratives in the curriculum, as many of these stories are originally told in local languages.

Another significant challenge is the scarcity of contextualized teaching materials. Teachers often lack the necessary resources and knowledge about local literature and culture, making it difficult to teach folklore and myths effectively. As a result, the teacher must be particularly creative and resourceful in their approach to integrating these topics into their lessons [43].

The structural inadequacies of the Philippine Basic Education system further hinder the effective teaching of local cultural heritage. This issue is compounded by the high dropout rates in the education system, where a significant percentage of students do not reach higher education levels, and where local mythology is more likely to be introduced as a serious subject. For instance, out of 100 Grade 1 pupils, only 14 eventually graduate

from college, meaning only a small fraction of the population has the opportunity to explore Philippine mythology academically.

Cultural heritage and sustainable development are closely linked, and proper education about cultural heritage is essential for raising awareness of its importance in achieving sustainable development goals. However, the current state of the educational system in the Philippines does not adequately support this linkage, further challenging the teaching of local mythology [45]. According to the research and researcher's initial data gathering, some private grade schools in the Philippines incorporate local myths into their History or Social Studies curricula, but these subjects are largely ignored in public schools, especially in the provinces, or it is only tackled occasionally and very briefly [46]. This issue is compounded by the high dropout rates in the education system [47], [48], [49], where a significant percentage of students do not reach higher education levels, where local mythology is more likely to be introduced as a serious subject[46]. This means that only a few students were able to delve deeper into Philippine mythology and gain an academic understanding of its history and cultural implications.

The forces of globalization and commercial entertainment also pose a threat to the preservation of oral traditions, including folktales, legends, and myths. The danger of extinction of these traditions is real if timely action is not taken [50]. These challenges can be addressed by incorporating local myths into educational curricula, educators can provide students with a deeper appreciation for the diversity of human experiences and the nuanced perspectives that exist within different cultural contexts [51], [52]. Additionally, leveraging digital technology to preserve and promote oral traditions can be a vital step in ensuring these cultural narratives endure for future generations [50].

2. Related Works

A. Theoretical Frameworks

1) Mobile Learning

Mobile learning theoretical frameworks provide structured guidelines for designing and implementing educational content on mobile devices, ensuring that learning is effective, engaging, and accessible. These frameworks often incorporate elements from traditional learning theories, such as cognitive and constructivist approaches, to create a cohesive learning experience that leverages the unique capabilities of mobile technology. For instance, the integration of AR into mobile learning environments has been shown to enhance user engagement and understanding by combining real and virtual worlds, offering real-time 3D interactions and visualizations that can make abstract concepts more tangible and easier to grasp [53], [54]. The integration of AR in mobile learning environments offers unique opportunities for rich, technology-enhanced presentations and interactions, as noted by Yen et al., who emphasize the potential of VR/AR to enhance students' creativity and competencies [55]. The application of these frameworks to MAR involves integrating real and virtual worlds to provide interactive and immersive learning experiences. For example, a conceptual framework for designing MAR applications for mathematics education has been shown to be effective in improving students' understanding of complex topics like squares and square roots, as evidenced by significant improvements in pre-and post-test scores [56]. These frameworks and applications illustrate the potential of mobile learning and AR to create immersive, interactive, and effective educational experiences across various domains.

2)Milgram's Reality-Virtuality Continuum

Introduced by Paul Milgram and Fumio Kishino in 1994, is a conceptual framework that describes a spectrum of environments ranging from the completely real to the completely virtual, with various forms of mixed reality (MR) in between [57], [58]. This continuum is pivotal in understanding and developing technologies that blend real and virtual elements, such as Augmented Reality (AR) and Virtual Reality (VR) [59]. The continuum is not just a linear progression but encompasses a range of experiences where real and virtual elements can coexist and interact in various proportions [60].

a) Key Components of the Continuum

(1) Reality: The physical, real-world environment.

(2) Augmented Reality (AR): The real-world environment is enhanced with virtual elements. AR adds digital content to the real world, such as images, sounds, or other data, while allowing the user to interact with both real and virtual elements.

(3) Mixed Reality (MR): A blend of real and virtual worlds where physical and digital objects co-exist and interact in real time. This term often encompasses both AR and augmented virtuality.

(4) Augmented Virtuality (AV): A virtual environment with some real-world elements incorporated into it. This is less common but involves placing physical objects within a primarily virtual space.

(5) Virtual Reality (VR): A completely virtual environment that is fully immersive, often experienced through VR headsets, where the user is entirely surrounded by and interacts within a digital world.

Milgram's Reality-Virtuality Continuum provides a useful framework for understanding the integration of real and virtual elements in the AR application. By identifying where the study would fall in Milgram's Continuum, the researcher is able to define its scope clearly. The researcher will use the Augmented Reality marker-based technology for this study. Its location in Milgram's Continuum can be seen in Figure 1 below.

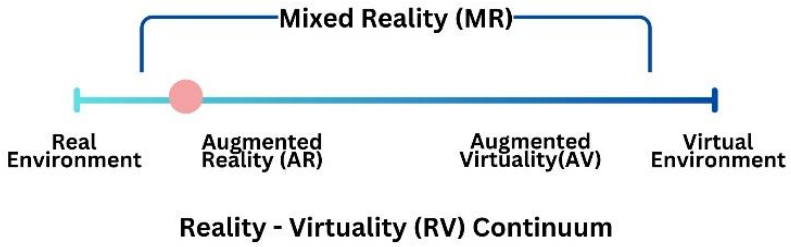

Figure 1. Milgram's Reality-Virtuality Continuum

3. Methodology

Research Objectives

1) To identify the pedagogical benefits and challenges of integrating AR technology into teaching local myths and folklore.

2) To evaluate the usability of a mobile AR prototype in the context of teaching Bicolano mythical creatures.

Research Design

The research design adopted for this study is the Concurrent Triangulation Design. This design is characterized by the simultaneous collection and analysis of both qualitative and quantitative data, followed by the integration of the findings during the interpretation phase. The primary objective of this design is to cross-validate and corroborate the results from both qualitative and quantitative perspectives, providing a comprehensive understanding of the research problem.

The Concurrent Triangulation Design is utilized in this study to gather comprehensive data on the impact of AR applications. By collecting quantitative data, such as surveys and pre-and post-tests, the study measures the AR application's effectiveness and gathers broad, measurable outcomes. Simultaneously, qualitative data is collected through methods like interviews, focus groups, and direct observations, providing detailed insights into participants' experiences and interactions with the AR application. After the separate analyses of quantitative and qualitative data, the findings are integrated during the interpretation phase. This integration process involves comparing and contrasting the results to identify points of convergence and divergence. By doing so, the study ensures a thorough understanding of the AR application's usability and educational impact, capturing both measurable outcomes and detailed participant experiences. The use of Concurrent Triangulation Design thus enhances the validity and reliability of the research findings, offering a comprehensive evaluation of the AR application.

Methodology

The researcher used Design-Based Research (DBR) as the methodology. is a methodological approach primarily used in educational research to develop and refine theories and practices through iterative cycles of design, implementation, and evaluation within real-world contexts. This approach is characterized by its collaborative nature, involving researchers, practitioners, and participants as co-designers to address practical problems while simultaneously contributing to theoretical knowledge [1] [2]. DBR aims to bridge the gap between theory and practice by creating interventions that are tested and refined in applied settings, allowing for reflexive and iterative adjustments to accommodate changes and improve outcomes [3]. Originating in the 1980s and 1990s as a response to the limitations of traditional research methods in fields like labor economics, DBR has since been adapted to various disciplines, including education, where it is used to study and enhance learning environments systematically [4]. The methodology is particularly effective in complex, situated social practices, such as classroom settings, where it helps develop new theories, artifacts, and practices that can be generalized to other contexts [6].

Participants

The participant sample for this study comprised two distinct groups: 266 Araling Panlipunan (AP) teachers from 47 different elementary schools in Legazpi City and 40 Grade 5 students from an elementary school within the same city. This diverse sample ensured comprehensive feedback from both educators and students, providing valuable insights for the development of the AR tool.

The AP teachers are directly responsible for educating students about Bicolano culture, making their insights crucial for developing an AR tool that is both accurate and pedagogically sound. Their feedback on content accuracy, technical features, and usability directly informs the iterative design process, ensuring the tool meets educational standards and classroom needs.

The Grade 5 students, as the primary users of the AR tool, provide firsthand feedback on their learning experience. Their interactions with the AR application help identify strengths and areas for improvement in terms of engagement, usability, and educational impact. This feedback is essential for refining the tool to ensure it effectively enhances students' understanding and appreciation of Bicolano myths and legends.

In summary, the purposive selection of 266 Araling Panlipunan teachers from 47 elementary schools and 40 Grade 5 students in Legazpi City provided a rich, informed, and diverse sample. This comprehensive feedback from both educators and students was integral to the development and refinement of the AR tool, ensuring it is tailored to meet the educational needs and preferences of its users, thereby enhancing the teaching and learning of Bicolano cultural heritage.

Mobile AR Prototype Development

Character modeling is a critical step in developing the AR app aimed at teaching Bicolano mythical creatures and legends. To ensure high-quality, engaging, and culturally accurate 3D models, the researcher formed an animator team dedicated to this task. Here are the key steps followed by the team:

3) Concept Art and Design

The process begins with the creation of concept art and design. The animator team starts by developing initial sketches based on detailed descriptions and references from Bicolano myths. These sketches serve as the foundation for visualizing the characters and establishing their basic features and proportions. Next, the team creates more detailed drawings to refine the characters' appearances, ensuring they incorporate authentic cultural and historical elements. This phase is crucial for setting a clear artistic direction and ensuring that the mythical creatures are accurately and vividly represented, aligning with the cultural narratives and educational goals of the AR application.

Figure 2. Sample Concept Art and Design

4) 3D Modeling

Following the concept art phase, the team moves into 3D modeling. Using advanced 3D modeling software such as Blender or Maya, animators create a basic mesh that outlines the character's general shape and structure. This base mesh acts as the framework for further refinement. The detailing process involves adding intricate features such as textures, skin, hair, and clothing, which bring the characters to life. Sculpting tools are utilized to enhance finer details, ensuring the models are realistic and visually appealing. This step is essential for transforming the 2D concept art into a tangible 3D form that can be animated and interacted with in the AR environment.

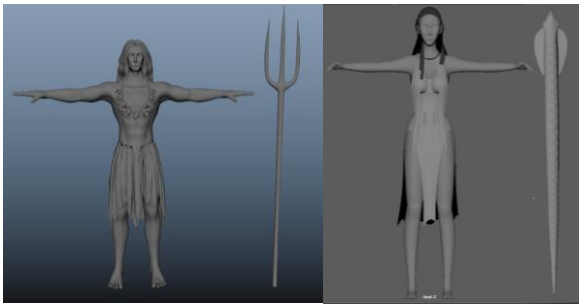

Figure 3. Sample 3D Modeling

5) Texturing

Once the 3D models are sculpted, the team proceeds to the texturing phase. This involves UV mapping, where the 3D model is unwrapped to create a 2D representation. UV mapping is crucial as it allows textures to be applied accurately to the model's surfaces. The animators then paint textures onto this 2D UV map, adding colors, patterns, and intricate details that bring depth and realism to the characters. The texturing process ensures that the characters are visually engaging and that their appearances are consistent with the cultural references, enhancing the immersive experience of the AR application.

Figure 4. Sample Texturing

6) Rigging

Rigging is the next step, where a virtual skeleton is created for each 3D model. This skeleton consists of bones and joints that mimic the character's anatomy, enabling movement and animation. The skinning process involves

attaching the 3D model to this skeleton, ensuring that the mesh moves naturally with the bones. Rigging is a technical yet crucial step that allows characters to be animated in a realistic manner. It sets the foundation for the characters' movements, making sure they can perform actions fluidly and interactively within the AR environment.

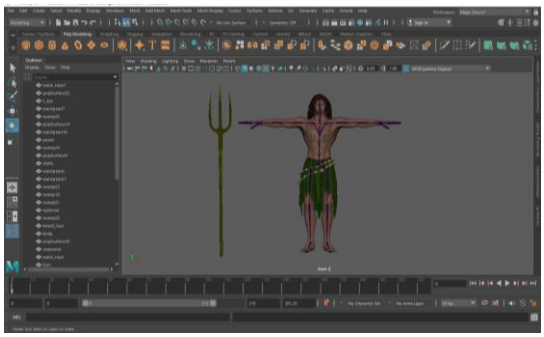

Figure 5. Sample Rigging process

7) Animation

With the models rigged, the animation phase begins. Animators design various poses and movements for the characters, such as walking, running, or performing specific actions relevant to the myths. These animations bring the characters to life, enhancing the interactive aspect of the AR application. The team rigorously tests these animations within the AR environment to ensure they function seamlessly and appear natural. This phase is vital for ensuring that the characters are not only static models but dynamic entities that can engage users and enrich their learning experience.

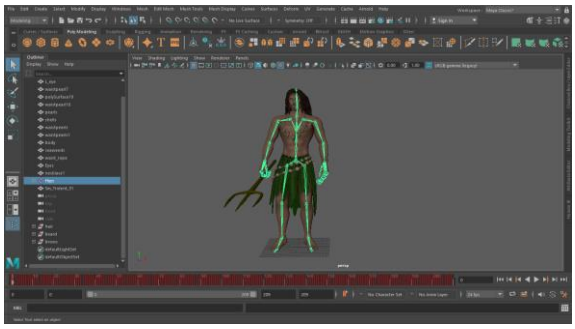

Figure 6. Sample Animation

8) Integration into AR Environment.

The final step is integrating the 3D models and animations into the AR environment. The completed models are exported into formats compatible with AR development platforms such us Unity. During implementation, the models are programmed to interact with the real-world environment as designed, incorporating behaviors and interactions that align with the educational goals of the application. This step ensures that the AR tool is not only visually and technically robust but also effective in providing an interactive and immersive educational experience that enhances students' understanding and appreciation of Bicolano cultural heritage.

Figure 7. Sample Integration into AR Environment

Moreover, AR's application in various academic fields, facilitated by tools like Unity and Vuforia, underscores its versatility and potential to revolutionize educational delivery in the coming years [22].

Data Collection Methods

The data collection for this study employs a multi-method approach to comprehensively evaluate the AR application designed for teaching Bicolano mythical creatures and legends. It begins with a pre-study survey to assess students' initial perceptions of cultural diversity and inclusivity. During the AR interaction phase, students engage with the AR application, and data on their engagement and participation is collected. This is followed by post-study surveys and tests to measure changes in students' perceptions, knowledge, and attitudes. Focus groups and interviews with students and teachers provide deeper insights into their experiences and perceptions of the AR tool. Additionally, observational studies are conducted to gather contextual data on student interactions with the AR application in real-time. This comprehensive approach ensures a robust evaluation of the AR tool's educational impact and effectiveness.

4. Results & Discussion:

1) Pre and Post-Survey Results

The "Cultural Inclusivity Pre and Post-Survey" section presents the comparative analysis of students' perceptions of cultural diversity and inclusivity before and after using the Augmented Reality (AR) application. The pre-survey aimed to gauge the initial understanding and attitudes of students towards cultural diversity before any intervention. It included questions designed to measure their awareness and appreciation of Bicolano folklore and myths. After the teaching sessions, the post-survey was administered to evaluate any changes in these perceptions.

Figure __ shows the survey results for "Pre-Test", it reveal several key insights into students' familiarity, interest, and attitudes toward learning about Bicolano myths and legends. While most students are somewhat familiar with these myths, a significant portion lacks familiarity. Yet, there is a high interest in learning more, presenting an opportunity for educational initiatives to bridge this knowledge gap. The varied perceptions of the importance of learning local myths suggest differing attitudes, but the strong link between these myths and understanding cultural identity indicates that cultural education can enhance students' self-awareness and appreciation of their heritage. Furthermore, the infrequent exposure to Bicolano myths and the discomfort in sharing these stories highlight the need to increase cultural content in educational materials and foster a supportive environment for storytelling to build students' confidence and interest.

The post-survey results after using Mobile Augmented Reality (AR) to teach Bicolano mythical creatures reveal significant improvements in several areas. Firstly, there is a marked increase in familiarity with Bicolano myths and stories, with 32 out of 39 students now reporting they are very or extremely familiar, and no students reporting a lack of familiarity. This indicates that the AR method has been highly effective in making the content more accessible and engaging. Furthermore, the interest levels in learning more about Bicolano mythical creatures have also seen a substantial rise, with 36 students expressing very or extremely high interest. This high engagement level suggests that the interactive nature of AR has successfully captivated students' curiosity and sustained their interest.

In terms of the perceived importance of learning local myths and legends, there is a clear shift towards recognizing their significance. Thirty-six students now view it as very or extremely important, reflecting an enhanced appreciation for cultural education fostered by the AR experience. Similarly, students' understanding of their cultural identity through local myths has notably improved, with 36 students feeling that it helps them understand their cultural identity to a great extent. This underscores the impact of AR in connecting students with their cultural heritage on a deeper level. Finally, there has been a significant boost in students' comfort levels in sharing local stories and legends, with 36 students feeling very or extremely comfortable. This suggests that AR not only enhances learning but also promotes a more inclusive and confident environment for cultural storytelling. Overall, the AR method appears to be a powerful tool for enhancing cultural education, fostering engagement, and building students' confidence in sharing and preserving their heritage.

2) Pre and Post-Test

This data collection shows the impact of the AR application on students' knowledge of Bicolano mythical creatures and legends. The pre-test establishes a baseline by assessing students' initial understanding and familiarity with the subject matter before using the AR tool. After the interaction phase, the post-test evaluates any changes or improvements in their

The pre-test and post-test results reveal a significant improvement in students' knowledge after using the AR application. The average score increased from 2.24 to 8.18, and the median score rose from 2 to 9, highlighting the substantial positive impact of the AR tool on student learning outcomes. The range of scores also shifted positively, with pre-test scores ranging from 1 to 5 points, indicating limited initial knowledge, to post-test scores ranging from 7 to 10 points, demonstrating a much deeper understanding and effective retention of information. The distribution patterns further illustrate this improvement: the pre-test scores were concentrated at the lower end, with most students scoring between 1 and 3 points, while the post-test scores were skewed towards the higher end, with many students scoring between 9 and 10 points. This dramatic shift in score distribution indicates that the AR application was highly effective in enhancing students' engagement and comprehension of Bicolano mythical creatures and legends. Overall, these results strongly suggest that integrating AR technology into the curriculum can significantly enhance educational outcomes, making learning more interactive and impactful.

3) Usability Test

The researcher used the "Technology Acceptance Tool" to assess the usability of the Mobile Augmented Reality. The following are the results of the evaluation:

Perceived Usefulness (PU)
Mean Scores:
PU_1: 4.6
PU_2: 4.7
PU_3: 4.6
PU_4: 4.6
Students generally find the AR application useful in understanding Bicolano myths and legends, enhancing their interest and overall learning experience.

Perceived Ease of Use (PEOU)
Mean Scores:
PEOU_1: 4.1
PEOU_2: 4.0
PEOU_3: 4.0
PEOU_4: 4.1
The AR application is perceived as user-friendly and easy to learn, although there is slight variability in individual comfort levels with the technology.

Attitude Toward Using (ATU)
Mean Scores:
ATU_1: 4.7
ATU_2: 4.7
ATU_3: 4.7
ATU_4: 4.7
Students have a positive attitude towards using the AR application, finding it enjoyable, a good idea, and engaging.

Behavioral Intention to Use (BI)
Mean Scores:
BI_1: 4.7
BI_2: 4.7
BI_3: 4.7
BI_4: 4.7
There is a strong intention among students to continue using the AR application and to recommend it to others.

Cultural Relevance
Mean Scores:
CR_1: 4.3
CR_2: 4.4
CR_3: 4.3
CR_4: 4.4
Students perceive the AR content as culturally relevant and feel that it accurately represents Bicolano culture, enhancing their appreciation and pride in their cultural background.

Exposure to Technology
Mean Scores:
ET_1: 4.0
ET_2: 4.0
ET_3: 4.0
ET_4: 4.2
Students are generally comfortable with technology and have previous exposure, which supports their use of the AR application.

Content Quality
Mean Scores:
CQ_1: 4.8
CQ_2: 4.6

CQ_3: 4.7
CQ_4: 4.6
The content provided by the AR application is seen as high-quality, accurate, well-organized, and engaging.

Cultural Inclusivity
Mean Scores:
CI_1: 4.6
CI_2: 4.7
CI_3: 4.6
CI_4: 4.6
The AR application is perceived to promote cultural inclusivity, helping students understand and appreciate cultural diversity, and encouraging respect for different cultures.

The data indicates a high level of acceptance and positive response towards the AR application among grade 5 students. The application is perceived as useful, easy to use, and culturally relevant, which aligns with the external factors of the Technology Acceptance Model (TAM).

5. Conclusion

The findings indicate that the AR application is well-received by grade 5 students, effectively enhances their learning experience, and promotes cultural inclusivity. The positive responses across various dimensions of the Technology Acceptance Model (TAM) suggest that the application is both accepted and valued by students, making it a promising tool for integrating cultural education into the classroom.

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