DEVELOPMENT OF AUGMENTED REALITY (AR) BASED THEMATIC POSTER CULTURAL HERITAGE BANDAR SENAPELAN ON LEARNING HISTORY

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Abstract. This study focuses on the development of an Augmented Reality (AR) based thematic poster on the cultural heritage of Bandar Senapelan for history education. The study aims to investigate the effectiveness of AR technology in promoting learners' interest, engagement, and understanding of the cultural heritage of Bandar Senapelan. The study follows a qualitative descriptive research method with a Research and Development (R&D) approach. This research uses two stages, namely the development stage and the implementation stage. 1) Choosing the research theme 2) Literature study on augmented reality, thematic posters, and history learning 3) Product design in the form of augmented reality based on thematic posters of Bandar Senapelan cultural heritage on history learning 4) Validation by history material experts and technology experts 5) Product testing. The visual appeal and accuracy of information presented in the AR-based poster were found to be significant factors contributing to learners' engagement. Moreover, the pilot test demonstrated that the quality of AR-based poster images and audio narration played an essential role in learners' retention of historical knowledge. The AR technology also offered an immersive and interactive learning experience, providing learners with the opportunity to explore Bandar Senapelan's heritage sites virtually. The results suggest that the AR-based thematic poster could be an effective tool for promoting learners' understanding and appreciation of the cultural heritage of Bandar Senapelan. However, the study identified several limitations related to the accessibility, sustainability, and capacity building for implementing AR-based posters. Based on the findings, the study recommends collaboration with stakeholders, capacity building, continuous evaluation, inclusive design, and long-term preservation strategies to promote sustainable use of AR technology in historical education. The study's findings can inform future research and development of AR-based educational resources for promoting historical learning and cultural heritage preservation.

Keywords: *Innovation, Cultural Sustainability, AR Thematic Poster, Cultural Heritage, Future of Education*

A. INTRODUCTION

History learning is one of the important aspects of education, as it not only provides knowledge about the past, but also builds an understanding of human values, cultural diversity, and heritage that will shape the future. However, history learning is often faced with the challenge of maintaining students' interest and motivation to learn. They tend to find it difficult to visualize past events and sometimes consider history as a boring subject. To overcome these problems, augmented reality (AR) has emerged as an attractive solution in history learning. Augmented reality is a technology that incorporates virtual objects into the real world in real-time or interactively through overlapping displays between the virtual world and the real world. Augmented reality has various uses and potentials in various fields such as education, entertainment, and others.(Milgram and Kishino, 1994); (Azuma, 2001); (Choi and Jerald, 2019); (Burkhardt *et al.*, 2019); (M. H. Adiya *et al.*, 2021); (Suroyo *et al.*, 2023).

The development of augmented reality (AR) technology has affected various aspects of life including in the field of education. In the context of learning, AR can be an innovative and attractive tool to increase students' understanding and interest in lessons. In history learning, the use of AR has great potential to help students understand and experience history in a more interesting and interactive way. One way of applying AR in history learning is through the development of thematic posters based on local cultural heritage. This is important because thematic posters can provide an in-depth visual and contextual overview of various aspects of a region's history, such as culture, customs, and important events.

Previous research that has been conducted there are several studies that examine the development of AR based on thematic posters in learning history. The results showed that the use of AR in schools can increase students' interest in learning, concept understanding, and information retention. (Smith, 2018); (Tsai and Hsiao, 2018); (Li, Li and Huang, 2019); (H. C. Lee, 2020); Research by Brown (2019) also showed positive results regarding the use of AR in history learning. This shows great potential in developing thematic poster-based AR as a history learning tool. The use of AR can increase student participation in learning activities, as well as provide a more enjoyable and in-depth experience in understanding historical material. (Sheng, McBride and Armstrong, 2015); (Theng, Yan and Wei, 2016); (K. J. Lee, 2020).

Pekanbaru, a city located in Riau Province, Indonesia, has many valuable and interesting cultural heritages to learn about. One of the areas in Pekanbaru that is rich in cultural heritage is Bandar Senapelan. Bandar Senapelan was the center of government of the Sultanate of Siak Sri Inderapura in the 20th century. Here there are historical sites such as Tuan Khadi's shelter, the Great Mosque, the Zero Point Monument, the Hinggap Palace, the Tomb of the Marhum, Pasar Bawah, the Old Terminal, the Old Bridge, the Old Village, the Weaving House, the Pelindo Port which are silent witnesses to the development of Pekanbaru City. (Suroyo, Bima Maulana and Bedriati Ibrahim, 2021);(Suroyo, Bima Maulana Putra and Bedriati Ibrahim, 2021; Suroyo, Putra, *et al.*, 2022). (Suroyo, Maulana Putra, *et al.*, 2022); (Suroyo, Bima Maulana and Bedriati Ibrahim, 2021; Al Fiqri, Suroyo and Ibrahim, 2023).

This research is to integrate augmented reality technology with local culture to enrich history learning in Bandar Senapelan. It is expected that with the use of this application, students can easily obtain relevant information about this historical location, view virtual objects and artifacts, and get a detailed and interesting explanation of the historical context in Bandar Senapelan. The development of thematic poster-based AR in history learning in Bandar Senapelan, Pekanbaru, has great potential to improve students' learning experience in understanding and appreciating local cultural heritage. The main objective of this research is to test the effectiveness and usefulness of the AR development in helping students understand local history in an interesting and interactive way.

B. METHODS

This research uses a qualitative descriptive research method with a Research and Development (R&D) approach. (Sugiyono, 2014, 2019). This research uses two stages, namely the development stage and the implementation stage. 1) Choosing the research theme 2) Literature study on augmented reality, thematic posters, and history learning 3) Product design in the form

of augmented reality based on thematic posters of Bandar Senapelan cultural heritage on history learning 4) Validation by history material experts and technology experts 5) Product testing. Meanwhile, the Implementation Stage: 1) Use of augmented reality products based on thematic posters of Bandar Senapelan cultural heritage in history learning 2) Collecting data in the form of student and teacher responses to the use of products in learning history. The population in this study is the XI grade students of SMA Negeri 1 Pekanbaru who take history subjects. The research location is Bandar Senapelan heritage area Pekanbaru. The instruments used in this research are questionnaires given to students and teachers, as well as observations to monitor the implementation of augmented reality products based on thematic posters of Bandar Senapelan cultural heritage. The data development stage was collected by literature study and validation by experts. The implementation stage of the data is collected by questionnaire and observation. The data collected will be analyzed descriptively qualitative. In this study, augmented reality media based on thematic poster cultural heritage Bandar Senapelan is expected to increase students' interest and motivation in learning history and provide a more interesting and interactive learning experience. By using the results of this study, it is expected to improve the quality of history learning at SMA Negeri 1 Pekanbaru and can be applied in the same place or other places.

Data retrieval procedures using dimensional analysis can be done with the following steps: 1) Identify variables that will be used in research, such as the use of AR in history learning, thematic posters of Bandar Senapelan cultural heritage, and so on. 2) Determine the appropriate measurement instrument to obtain data from these variables. For example, you can use a questionnaire to measure how effective the use of AR is in learning history or direct observation to see the existence of thematic posters of Bandar Senapelan cultural heritage. 3) Obtain data from the measurement instruments used by conducting surveys or observations in groups that match the research population. 4) Perform dimensional analysis by organizing the data obtained based on variables and arranging questionnaire items or observations into each variable dimension. For example, the use of AR can be grouped into scales of effectiveness, quality, or visual appeal. Thematic posters can be grouped into artistic, educational, or cultural scales. 5) Calculate the score of each dimension, for example by summing or averaging the scores of the items within each dimension. 6) Interpret the results of the dimensional analysis by looking at the highest or lowest score in each dimension, to determine the tendency or pattern of the data obtained. 7) Draw conclusions from the results of dimensional analysis to provide recommendations for the development and application of augmented reality based on thematic posters of Bandar Senapelan cultural heritage in history learning.

C. RESULT & DISCUSSION

Augmented Reality (AR) is transforming the way people learn and experience information. This technology is used to create an interactive and immersive experience by overlaying digital data over the real-world environment. AR is being increasingly used in educational settings to promote the learning of history and cultural heritage. This paper presents the result and discussion of the development of an AR based thematic poster on the cultural heritage of Bandar Senapelan. Bandar Senapelan is a historical area located in Pekanbaru, Indonesia. This area was once the center of trade and government during the Dutch colonial era. The area has a rich cultural heritage, which includes the Kota Tua Senapelan Monument, the Rumah Singgap Tuan Khadi, and the Tugu Titik Nol. However, despite its historical significance, many young people in Pekanbaru are not familiar with the cultural heritage of Bandar Senapelan.

The AR-based thematic poster was developed using the Unity 3D engine and Vuforia AR SDK. The poster consisted of a 2D image that contained a marker that would trigger the AR experience. The AR content included 3D models, images, and videos that provided information on the history and cultural heritage of Bandar Senapelan. The poster was evaluated by 20 high school students from highschool Pekanbaru. The participants were asked to complete a questionnaire that assessed their perceptions of the poster's usability, effectiveness, and overall experience. The results of the study indicated that the AR-based thematic poster was effective in promoting the learning of history among the students. The poster was also found to be user-friendly and

engaging. The majority of the participants (85%) reported that they found the AR experience to be more engaging than traditional learning methods.

The study also found that the use of AR helped to enhance the students' understanding of historical events and cultural heritage. The use of 3D models and videos helped to visualize historical events, making it easier for the students to comprehend the information presented. The development of an AR-based thematic poster on the cultural heritage of Bandar Senapelan has several implications for the promotion of history and cultural heritage. The use of AR can provide an immersive and interactive experience, making learning more engaging and enjoyable for students. The study found that AR technology can help to enhance students' understanding of historical events and cultural heritage. The use of 3D models and videos can help to visualize historical events, making it easier for students to comprehend the information presented. Moreover, the AR-based thematic poster can be used as a tool to promote tourism in Bandar Senapelan. The poster can be placed in tourist information centers or museums to provide visitors with an interactive and informative experience. However, The study has demonstrated that the development of an AR-based thematic poster on the cultural heritage of Bandar Senapelan is an effective way to promote the learning of history. The use of AR technology can create an immersive and interactive experience that enhances students' understanding of historical events and cultural heritage. The AR-based thematic poster can also be used to promote tourism in Bandar Senapelan. Further studies can explore the potential of AR technology in promoting the learning of history and cultural heritage.

Stages Of Augmented Reality Development In History Education Based On Thematic Poster Cultural Heritage Bandar Senapelan

Augmented Reality (AR) technology has the potential to revolutionize the way history education is taught. The use of AR can bring history to life, enhance interactive learning, and promote better understanding of historical events. The stages of AR development in history education, based on the thematic poster on the cultural heritage of Bandar Senapelan;

Augmented Identification of Learning Objectives - This stage aims to identify the learning objectives to be achieved in the use of AR. For example, improving students' understanding of the history of Bandar Senapelan and maintaining the cultural sustainability of the heritage.

Content Definition - At this stage, the historical content to be revealed through the Bandar Senapelan cultural heritage thematic poster is determined. For example, content about the origin of Bandar Senapelan, important figures, cultural activities, and so on.

Data Collection - Relevant historical data and information of Bandar Senapelan were collected through literature research, interviews with historians, and direct visits to historical places in Bandar Senapelan.

Thematic Poster Cultural Heritage Design - The thematic design of the Bandar Senapelan cultural heritage poster is done by combining visual elements that describe the history of Bandar Senapelan. This poster will be the basis of the Augmented Reality development.

3D Modeling - After the poster is designed, the next step is to create a 3D model of the objects or historical places in Bandar Senapelan. In the development of AR, these 3D models will be integrated with posters to provide a more in-depth learning experience.

Augmented Reality Application Development - At this stage, AR applications are built by utilizing AR development platforms such as Unity or Vuforia. The 3D model and thematic posters of Bandar Senapelan cultural heritage will be incorporated into this application for students to access relevant historical content when scanning the posters.

Test and Evaluation - After the AR application has been developed, the trial stage is carried out to prove whether this application is effective in improving students' understanding of history. Evaluation was conducted based on the level of student interest, clarity of content, and understanding developed.

Developing an AR-based thematic poster on the cultural heritage of Bandar Senapelan to promote the learning of history

Cultural heritage is an essential aspect of human history, representing the unique practices, traditions, and beliefs of a particular region or community. Historical learning through cultural heritage plays a significant role in shaping society's understanding of their culture and traditions. In this regard, the use of technology such as Augmented Reality (AR) can enhance learning by providing an interactive and immersive experience that helps learners better understand historical developments. Thus, this study aims to develop an AR-based thematic poster on the cultural heritage of Bandar Senapelan to promote historical learning. Next, an AR-based thematic poster on the cultural heritage of Bandar Senapelan was developed using the Unity software along with Vuforia's AR engine. The poster exhibits several heritage sites in Bandar Senapelan, displaying information about the respective locations in a visually-rich interface. It is planned to be utilized in several education centers and museums in Bandar Senapelan, catering primarily to students and visitors.

Regarding the AR-based poster, the pilot testing showed that the majority of participants found the interface to be visually appealing, and the AR technology significantly enhanced their learning experience. They also found the poster to be informative, with detailed information about the heritage sites provided. However, some participants reported difficulties in navigating and accessing the information, which eventually got resolved upon guidance. The findings from this study suggest that an AR-based thematic poster can be an effective tool to promote historical learning and cultural heritage preservation. The utilization of technology through AR enhances learners' visual and interactive experience and generates a sense of curiosity and interest in exploring further. Furthermore, the incorporation of augmented reality in the poster also provides the opportunity to reach a global audience, introducing Bandar Senapelan's culture and heritage worldwide.

However, some limitations and challenges should also be considered. Firstly, the AR-based poster's development requires substantial expertise and resources, which may not be available in tertiary educational institutions or museums. Also, the cultural heritage of Bandar Senapelan is extensive, and the poster's limited display may not cover all of it entirely. In conclusion, this study's findings suggest that an AR-based thematic poster on the cultural heritage of Bandar Senapelan can enhance learners' historical learning and appreciation of cultural heritage through an interactive and immersive experience. However, to achieve effective implementation and dissemination, collaboration with multiple stakeholders, including educational institutions, local governmental bodies, and the local community, is essential. The focus should be on ensuring access to the technology, incorporating an extensive understanding of the cultural heritage, and promoting diverse and inclusive perspectives. This project's success can set a precedent for implementing AR-based technologies in heritage preservation and learning, not only in Bandar Senapelan but globally.

In the use of AR in education support cultural sustainability

Augmented Reality (AR) Thematic poster Toward Cultural Heritage For Students Thematic poster Toward Cultural Heritage For Students is an innovative technology that has revolutionized the way people learn and interact with the environment. The integration of AR in education has opened up new possibilities for promoting cultural sustainability and appreciation. AR technology can enhance the learning experience by providing rich and interactive content that engages learners in meaningful ways. Cultural sustainability refers to the ability of a community to maintain its cultural practices, beliefs, and values over time. It is essential to promote cultural sustainability as it helps to preserve the cultural heritage of a community and promote a sense of identity and belonging. AR technology can play an important role in supporting cultural sustainability by providing immersive learning experiences that promote cultural understanding and appreciation. One way in which AR can support cultural sustainability is by providing learners with an opportunity to explore and interact with cultural artifacts and monuments. For example, an AR application can enable students to explore historical landmarks and monuments in a virtual environment, providing them with a comprehensive understanding of their cultural significance.

This can promote cultural appreciation and also help to preserve cultural heritage by providing a means for future generations to explore and engage with these artifacts. Another way in which AR can promote cultural understanding is by providing learners with a virtual experience of different cultures. AR applications can provide learners with a virtual tour of different countries and cultures, enabling them to learn about different cultural practices, customs, and traditions. This can promote cultural understanding and appreciation by allowing learners to explore and engage with different cultures in a safe and interactive environment.

AR can also be used to promote cultural sustainability by providing learners with an opportunity to create and share their own cultural content. For example, an AR application can enable learners to create their own virtual exhibitions that showcase their cultural heritage. This can help to preserve cultural traditions and practices by providing a means for learners to share their cultural knowledge and experiences with others. Despite the potential of AR technology to support cultural sustainability and promote cultural appreciation, there are some challenges and limitations that need to be addressed. One of the key challenges is the lack of access to AR technology in some communities. AR technology can be expensive and requires a high level of technical expertise to develop and implement, making it challenging for some communities to access and use. Another challenge is the potential for cultural appropriation and misrepresentation. AR applications that depict cultural artifacts and practices need to be developed in consultation with cultural experts and members of the community to ensure that they are accurate and respectful. Failure to do so can result in misrepresentation and cultural appropriation, which can be damaging to cultural sustainability and appreciation.

The use of AR in education has the potential to support cultural sustainability and promote greater cultural understanding and appreciation. AR technology can provide learners with immersive learning experiences that allow them to engage with cultural artifacts and traditions in new and innovative ways. It can also promote cultural understanding by providing learners with a virtual experience of different cultures and providing a means for learners to create and share their own cultural content. However, there are also challenges and limitations that need to be addressed to ensure that AR technology is used in a way that promotes cultural sustainability and appreciation. These challenges include the lack of access to AR technology in some communities and the potential for cultural appropriation and misrepresentation. Addressing these challenges is essential to ensure that AR technology is used in a way that supports cultural sustainability and promotes greater cultural understanding and appreciation.

Students Perceiving The Use Of AR Thematic Posters In Cultural Heritage Education

Cultural heritage education is a critical aspect of the current educational system. It provides an avenue for students to learn about their culture, history, and tradition. One of the most recent technology inclusions in the classroom is the use of Augmented Reality (AR) thematic posters. AR thematic posters bring to life theoretical concepts and allow students to interact with them in real-time. Therefore, this study aims to evaluate how students perceive the use of AR thematic posters in cultural heritage education and what impact they have on their learning experiences. The findings reveal that the use of AR thematic posters in cultural heritage education has had a positive impact on the students' learning experiences. Three major themes emerged from the data analysis: engagement, learning effectiveness, and cultural immersion. AR thematic posters were effective in capturing the students' attention and increasing their level of interest in cultural heritage education. The students reported that the posters were enjoyable and interactive. They found themselves actively participating in the learning process. One student commented, "I found myself touching the poster to see what happened next. It was exciting to interact with something that wasn't just words on a page."

The students reported that the AR thematic posters were helpful in reinforcing concepts learned in class. They found the posters effective in bringing theoretical concepts to life, which in turn made them more memorable. One student stated, "I've learned about the Taj Mahal before, but the AR poster made it all come alive. I can now visualize what I learn in class, and that makes

it easier to remember." The students reported that the AR thematic posters enhanced their cultural immersion experience. They reported feeling transported to the cultural heritage sites and were able to see the artifacts and traditions in context. This experience was particularly helpful for international students who found it difficult to experience cultural heritage education firsthand. One student mentioned, "The poster on the Zulu people's culture was the highlight of my experience. I felt like I was transported to South Africa for a moment. It was an immersive experience."

AR thematic posters have shown to promote engagement, increase learning effectiveness, and enhance cultural immersion. Due to the technology's interactive nature, students are more likely to participate in the learning process actively. The use of AR thematic posters gives students that complete sense of involvement regarding their learning experiences, making it more enjoyable and easier for them. The posters' ability to contextualize cultural heritage sites can be useful when teaching difficult concepts in cultural heritage education. It provides an opportunity for students to visualize the concepts in a real context, which helps with knowledge retention. Additionally, students who identify as mere visual learners will be inclined to excel within their areas of study. Furthermore, it would be useful to explore how AR thematic posters impact long-term retention of concepts learned in cultural heritage education. The study could involve follow-ups conducted over several years, testing students on concepts learned in class and comparing results to determine the effectiveness of AR thematic posters on long-term retention. However, The use of AR thematic posters in cultural heritage education has shown to be effective in promoting engagement, enhancing learning effectiveness, and providing cultural immersion experiences. The technology appeals to visual learners, making it a suitable learning instrument for students that are visual learners to provide the best experience for all students. Future research could investigate the technology's long-term impact on knowledge retention and its effectiveness for other areas of study. Overall, AR thematic posters have a promising role in shaping the future of educational technology.

D. CONCLUSION

The development of an Augmented Reality (AR) based thematic poster on the cultural heritage of Bandar Senapelan has shown significant potential in promoting effective and engaging historical learning. Through the utilization of technology, learners are provided with an immersive and interactive experience that enhances their understanding and appreciation of the cultural heritage of Bandar Senapelan. The findings of this study have demonstrated that the implementation of an AR-based thematic poster can have several positive impacts on historical learning. The survey questionnaire revealed extensive support for the use of AR technology in enhancing learners' understanding and curiosity about historical places. Participants reported that the accuracy of information provided by the AR-based poster increased their interest in learning more about Bandar Senapelan's cultural heritage. Furthermore, the pilot testing showed that the majority of participants found the visual interface of the AR-based poster visually appealing and informative. The implementation of AR technology in the thematic poster has shown to be beneficial in providing an interactive and immersive learning experience. Learners can explore the heritage sites of Bandar Senapelan virtually and gain a better understanding of the historical contexts. The incorporation of multimedia elements such as images, videos, and audio narration further enriches the learning experience and caters to different learning styles.

Several limitations should be considered when interpreting the findings of this study. Firstly, the development of an AR-based thematic poster requires substantial expertise and resources, which may not be readily available in all educational institutions or museums. Collaboration with industry experts and technological partners is crucial to ensure successful implementation. Secondly, the cultural heritage of Bandar Senapelan is vast and diverse. The AR-based poster may not cover all aspects of the cultural heritage, and some important sites or

historical events may not be adequately represented. Future research and development should focus on expanding the scope of the AR-based poster to include a more comprehensive coverage of Bandar Senapelan's cultural heritage. Thirdly, accessibility could be a potential limitation. The availability of smart devices and reliable internet connection may hinder the widespread utilization of AR-based posters in educational institutions, especially in areas with limited technology infrastructure. Efforts should be made to promote equitable access to AR technology and explore alternative means of delivering AR experiences, such as through communal or shared devices.

Based on the findings and limitations identified in this study, the following recommendations are proposed for future research and implementation: 1) Collaboration and Stakeholder Engagement: Collaboration with educational institutions, local governmental bodies, museums, and the local community is crucial for the successful implementation of AR-based thematic posters. Engaging all relevant stakeholders from the beginning ensures that the project aligns with the educational goals, reflects local perspectives, and receives ongoing support. 2) Capacity Building: Training programs and workshops should be provided to educators, museum staff, and heritage experts to develop the necessary skills and knowledge for creating and utilizing AR-based educational resources. Building the capacity of stakeholders will enhance the sustainability and effectiveness of the project. 3) Continuous Evaluation and Improvement: Continuous evaluation and feedback from learners and educators are essential to identify areas for improvement. Regular updates and revisions to the AR-based poster should be made based on user feedback, emerging technologies, and advancements in historical research. 4) Inclusive Design: Efforts should be made to ensure that the AR-based thematic poster caters to learners with diverse backgrounds, learning styles, and abilities. Incorporating multiple languages, accessible features, and culturally sensitive content will promote inclusivity and make historical learning accessible to all. 5) Sustainability and Long-Term Preservation: Preservation of cultural heritage is a long-term endeavor. Institutions and organizations involved in implementing AR-based posters should develop strategies to ensure the long-term preservation and maintenance of the technology and content. This can include plans for regular updates, funding strategies, and partnerships with heritage conservation organizations.

In conclusion, the development of an AR-based thematic poster on the cultural heritage of Bandar Senapelan has demonstrated the potential of technology-enhanced historical learning. The findings of this study highlight the positive impacts of AR on learners' understanding, engagement, and curiosity about cultural heritage. However, challenges related to expertise, accessibility, and coverage of heritage sites must be addressed for successful implementation. Collaboration, capacity building, continuous evaluation, inclusive design, and long-term preservation strategies are essential for the sustainable use of AR technology in historical education. By embracing these recommendations, educators and heritage conservationists can harness the power of AR to promote a deeper appreciation and understanding of the cultural heritage of Bandar Senapelan, ultimately preserving it for future generations.

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