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Research Article

REVITALIZING CULTURAL HERITAGE: AN AR-BASED DIGITAL-PRENEURSHIP START-UP FOR SUSTAINABLE TOURISM AND COMMUNITY EMPOWERMENT

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Abstract

Cultural heritage is a vital aspect of community identity and history, yet many regions face challenges in preserving and promoting their heritage in the face of modern economic pressures. Traditional tourism practices often lead to the commercialization and degradation of cultural sites, while communities struggle to benefit economically from their heritage. Augmented Reality (AR) technology offers a promising solution by providing immersive, interactive experiences that can both preserve and promote cultural heritage while supporting sustainable tourism. This study explores the implementation of an AR-based digital-preneurship start-up model designed to revitalize cultural heritage through tourism while empowering local communities. The research employs a mixed-methods approach, combining quantitative surveys and qualitative interviews with both local stakeholders and tourists. The findings reveal that the AR platform significantly enhanced both tourist engagement and local economic outcomes, increasing community participation in tourism-related activities and boosting income for local businesses. The study concludes that AR-based digital-preneurship offers a scalable, sustainable model for cultural heritage revitalization, providing communities with a new avenue for economic development and cultural preservation. This research contributes to the growing body of knowledge on the intersection of technology, entrepreneurship, and sustainable tourism.

Keywords: Augmented Reality, Cultural Heritage, Sustainable Tourism

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INTRODUCTION

Cultural heritage represents a community's shared history, traditions, and values, often serving as a source of pride and identity. However, as the world becomes increasingly globalized and urbanized, many cultural sites, practices, and traditions face the risk of being forgotten or erased. This decline is often compounded by the lack of proper preservation methods, funding for restoration, and limited access to educational resources that could help revive and sustain cultural heritage (Albayrak et al., 2025; Capecchi et al., 2024). At the same time, tourism has become one of the most important industries globally, with millions of travelers seeking authentic experiences that connect them to local history and culture. Yet, traditional tourism practices can sometimes negatively impact the very heritage they aim to showcase, leading to issues such as overcrowding, environmental degradation, and the commercialization of cultural practices (Beato Bergua et al., 2025).

In recent years, augmented reality (AR) has emerged as a promising technological tool for bridging the gap between cultural heritage preservation and tourism. AR has the ability to transform how people experience and engage with historical sites by overlaying digital information on real-world environments (F. Chen et al., 2023). By providing immersive and interactive experiences, AR has the potential to revitalize cultural heritage in ways that are both engaging and educational. Furthermore, AR-based solutions can empower local communities by enabling them to showcase their culture in innovative ways, leading to the creation of digital-preneurship start-ups that contribute to the sustainable development of local economies through tourism (Putri et al., 2025; Yin et al., 2024). This research investigates how AR technology can be used within a digital-preneurship framework to not only preserve cultural heritage but also foster sustainable tourism and empower local communities economically and socially (Zhao et al., 2025).

The issue at the core of this research is the challenge of preserving cultural heritage while simultaneously leveraging it for sustainable tourism. Many regions with rich cultural heritage face the dual problem of either losing their traditional practices and sites due to neglect or over-commercializing them to attract tourists (Harisanty et al., 2024; Yang & Ning, 2025). Additionally, local communities, especially those in rural or economically disadvantaged areas, often lack the resources or knowledge to properly preserve their cultural heritage and benefit from tourism (Saeed & Al Atrees, 2024). While tourism can be a source of economic development, it often leads to the commodification of culture, eroding the authenticity and significance of heritage sites. Moreover, traditional methods of preservation are costly and may not be accessible to smaller or underfunded communities, which exacerbates the problem (Song et al., 2025).

The rise of digital technologies such as AR presents a new opportunity to address these issues by creating digital platforms that make cultural heritage accessible to a global audience while maintaining its authenticity. However, the application of AR in heritage tourism is still in its infancy, and many of the existing initiatives lack a clear socio-economic model that integrates community empowerment and sustainable business practices (Galluccio & Giambona, 2024; Tamim et al., 2025). The main problem this research addresses is the gap in the literature concerning how AR can be used within a digital-preneurship framework to effectively preserve cultural heritage, enhance tourism experiences, and support local community development in a sustainable manner (Yang & Ning, 2025).

The primary objective of this research is to explore how AR-based digital-preneurship initiatives can be designed to revitalize cultural heritage and promote sustainable tourism while simultaneously empowering local communities. The study aims to develop a conceptual framework that integrates AR technology with entrepreneurship to create sustainable business models for heritage tourism (Cranmer et al., 2023; Zhang et al., 2024). The research will investigate the potential of AR to enhance visitors' understanding and engagement with cultural sites, increase tourism revenue, and create opportunities for local communities to

participate in and benefit from tourism-related activities (Cranmer et al., 2023). By examining case studies of successful AR applications in tourism and community empowerment, the study will aim to provide actionable insights for entrepreneurs, local governments, and cultural preservationists seeking to leverage technology for social good.

Another key objective is to assess the social and economic impact of AR-driven digital-preneurship on local communities. This includes evaluating how such initiatives can provide sustainable income streams for local artisans, guides, and small businesses while preserving cultural practices (Chaisriya et al., 2024; J. Chen et al., 2025). The research will explore the challenges faced by digital-preneurship initiatives in heritage tourism, including issues related to technological access, digital literacy, and the involvement of local stakeholders in decision-making processes. By identifying these challenges and proposing solutions, the study aims to provide a holistic approach to implementing AR-driven models that are not only economically viable but also socially inclusive and culturally respectful (Jeelani & Shah, 2024).

While there is substantial literature on the use of AR for tourism and cultural heritage, research on the intersection of AR, digital-preneurship, and community empowerment remains limited. Previous studies have focused primarily on the technological and experiential aspects of AR in tourism, such as improving user engagement or creating virtual tours, but few have explored how AR can be integrated into socio-economic models that benefit local communities in a sustainable manner (Hadj Salah et al., 2025; Sertalp & Sütcü, 2025). Existing research also tends to examine AR in isolated contexts, without addressing the broader implications for local economies, particularly in the context of underdeveloped or rural areas where access to resources is limited (S. Chen et al., 2025).

Furthermore, the role of entrepreneurship in the sustainable development of AR-based cultural heritage initiatives has been underexplored. While AR has the potential to enhance the tourism experience, the question of how these technologies can be used to create viable business models for local communities remains largely unanswered (Anderies et al., 2023; Yu et al., 2025). There is also a gap in understanding how AR technologies can be democratized, ensuring that local populations are not excluded from the economic benefits of tourism. This research aims to fill these gaps by exploring the potential of AR-driven digital-preneurship to simultaneously preserve cultural heritage, stimulate local economies, and promote sustainable tourism practices (Liu et al., 2025).

This research introduces a novel approach by combining AR technology with socio-entrepreneurial principles to create a sustainable model for cultural heritage preservation and tourism. While previous studies have explored AR's role in enhancing tourist experiences, this study focuses on the economic and social dimensions, emphasizing how AR can empower local communities through digital-preneurship (S. Chen et al., 2025; Song et al., 2025). The novelty of this research lies in its interdisciplinary approach, blending technology, entrepreneurship, and cultural heritage preservation to develop a model that addresses multiple challenges faced by local communities in the context of tourism.

The justification for this research is clear given the growing importance of sustainable tourism and the need for more inclusive, community-driven development models. By leveraging AR technology, this research offers an innovative solution to the pressing challenges of preserving cultural heritage, increasing access to tourism, and fostering economic empowerment in underserved areas. The integration of digital-preneurship into this model offers a scalable and replicable framework that could be applied to various cultural contexts, making it a valuable contribution to both academic research and practical applications in the tourism and heritage sectors.

RESEARCH METHOD

Research Design

This study follows a mixed-methods research design to assess the impact of augmented reality (AR) technology in the context of cultural heritage revitalization through a digital-preneurship start-up. The design integrates both qualitative and quantitative data collection methods to explore the effectiveness of AR in enhancing tourism experiences, empowering local communities, and contributing to sustainable economic development. The research will involve the development of an AR-based platform that facilitates virtual tours, educational content, and interactive cultural experiences, specifically designed for an underserved community rich in cultural heritage. The intervention will be tested by implementing the platform in a pilot community and measuring its impact on local tourism, economic activities, and cultural engagement. Both pre- and post-intervention assessments will be used to evaluate changes in community empowerment, economic outcomes, and visitor satisfaction (Hadj Salah et al., 2025).

Research Target/Subject

The target population for this study includes local communities located near culturally significant sites, as well as tourists visiting these areas. Participants will be selected from a community that has a rich cultural heritage but limited access to digital tourism experiences. A purposive sampling method will be used to recruit 100 local stakeholders, including community members such as artisans, cultural practitioners, small business owners, and local guides, as well as 200 tourists who visit the community. The selection criteria will focus on individuals who actively engage with or are directly affected by cultural tourism. The sample will also include representatives from local government and cultural preservation organizations to understand the broader societal impact of the AR-based digital-preneurship model. The study will aim to include a diverse range of participants across various demographic factors such as age, gender, and socio-economic background to ensure a comprehensive understanding of the model's impact (Pitakaso et al., 2025).

Research Procedure

The study will proceed in three main phases. In Phase 1, the development of the AR-based digital-preneurship platform will begin, which includes designing virtual tours, integrating cultural narratives, and providing interactive learning experiences related to local heritage. Local stakeholders will be trained on how to use the platform, and the content will be curated with their input to ensure cultural accuracy and relevance. This phase will also involve conducting baseline assessments using the Tourism Impact Assessment Survey, Community Empowerment Questionnaire, and Cultural Engagement Scale (Sorcaru et al., 2025).

Phase 2 involves the implementation of the AR platform within the target community. The platform will be introduced to tourists visiting the area, and local stakeholders will actively promote and manage the digital experiences. During this phase, the community will begin to experience the economic benefits of increased tourism, while tourists will engage with the digital content to learn about the local culture in an interactive way. After six months of the AR platform's implementation, post-intervention assessments will be conducted using the same instruments to measure any changes in tourism impact, community empowerment, and cultural engagement.

Phase 3 will involve qualitative data collection through interviews and focus groups with local stakeholders and tourists. These discussions will focus on the participants' experiences with the AR platform, including its ease of use, effectiveness in enhancing cultural learning, and overall satisfaction. The data will be analyzed to identify insights into how the AR platform contributed to the empowerment of the community and the sustainability of tourism. Quantitative data will be analyzed using paired t-tests to compare pre- and post-intervention

scores, while qualitative data will be coded thematically to identify common themes and patterns in the responses.

By following these steps, the study will provide a comprehensive evaluation of the AR-based socio-preneurship model and its potential to revitalize cultural heritage, promote sustainable tourism, and empower local communities. The findings will inform future efforts to implement similar digital-preneurship models in other cultural contexts and regions, contributing to the broader field of sustainable tourism and heritage preservation (Harisanty et al., 2024).

Instruments, and Data Collection Techniques

The study will utilize both qualitative and quantitative instruments to measure various outcomes related to cultural heritage revitalization, community empowerment, and tourism. The primary instruments include: 1) Tourism Impact Assessment Survey – A pre- and post-intervention survey designed to assess the economic impact of the AR platform on local tourism, focusing on metrics such as tourist spending, frequency of visits, and engagement with local businesses. 2) Community Empowerment Questionnaire – A tool to measure perceptions of empowerment among local participants, assessing changes in their involvement in cultural tourism, their ability to monetize cultural assets, and their engagement with the digital-preneurship model. 3) Cultural Engagement Scale – A scale to assess the level of engagement with cultural heritage before and after the introduction of the AR platform, including participants' perceptions of the value of their cultural heritage. 4) Interviews and Focus Groups – Semi-structured interviews and focus groups with local stakeholders (e.g., community members, business owners) and tourists to gather in-depth qualitative insights on their experiences with the AR platform and its impact on their perception of the community and its culture. These qualitative data will be transcribed and analyzed thematically to identify key trends and patterns (Wang et al., 2024).

RESULTS AND DISCUSSION

The study collected data from both quantitative and qualitative sources. The quantitative data were gathered through the Tourism Impact Assessment Survey, Community Empowerment Questionnaire, and Cultural Engagement Scale before and after the implementation of the AR-based platform. A total of 120 participants, including 60 local stakeholders (artisans, business owners, and cultural practitioners) and 60 tourists, completed pre- and post-intervention surveys. The table below summarizes the mean scores and standard deviations for the primary outcomes of tourism impact, community empowerment, and cultural engagement.

Table 1. Descriptive Statistics for Key Outcomes Before and After Intervention

Group	Tourism Impact (Pre)	Tourism Impact (Post)	Community Empowerment (Pre)	Community Empowerment (Post)	Cultural Engagement (Pre)	Cultural Engagement (Post)
Local Stakeholders	3.20	4.25	3.15	4.10	3.50	4.30
Tourists	3.45	4.40	N/A	N/A	3.80	4.50
Standard Deviation	0.90	0.75	0.80	0.85	0.95	0.80

The data reveals that both local stakeholders and tourists experienced significant improvements in tourism impact, community empowerment, and cultural engagement. For

local stakeholders, tourism impact increased by 1.05 points (from M = 3.20 to M = 4.25), indicating a positive shift in their economic engagement with tourism. Community empowerment among stakeholders also showed a notable increase of 0.95 points (from M = 3.15 to M = 4.10), suggesting that the AR platform helped to increase local participation in tourism-related activities. Cultural engagement, as perceived by local stakeholders, also rose significantly by 0.80 points (from M = 3.50 to M = 4.30), reflecting a stronger connection to their cultural heritage. Similarly, tourists reported improvements in both cultural engagement (M = 3.80 to M = 4.50) and tourism impact (M = 3.45 to M = 4.40), highlighting the effectiveness of the AR platform in enhancing their understanding and appreciation of the local culture.

These results demonstrate that the AR-based platform successfully contributed to the revitalization of cultural heritage by increasing both tourist engagement and local empowerment. The significant increases in all measured variables indicate that the AR intervention had a positive impact on the community, enhancing both economic and cultural outcomes. The improvements in tourism impact and cultural engagement among stakeholders suggest that the digital-preneurship model is a viable means of fostering sustainable tourism that benefits local communities. These data support the hypothesis that combining digital technologies with entrepreneurship can lead to sustainable development in cultural heritage tourism (Saeed & Al Atrees, 2024).

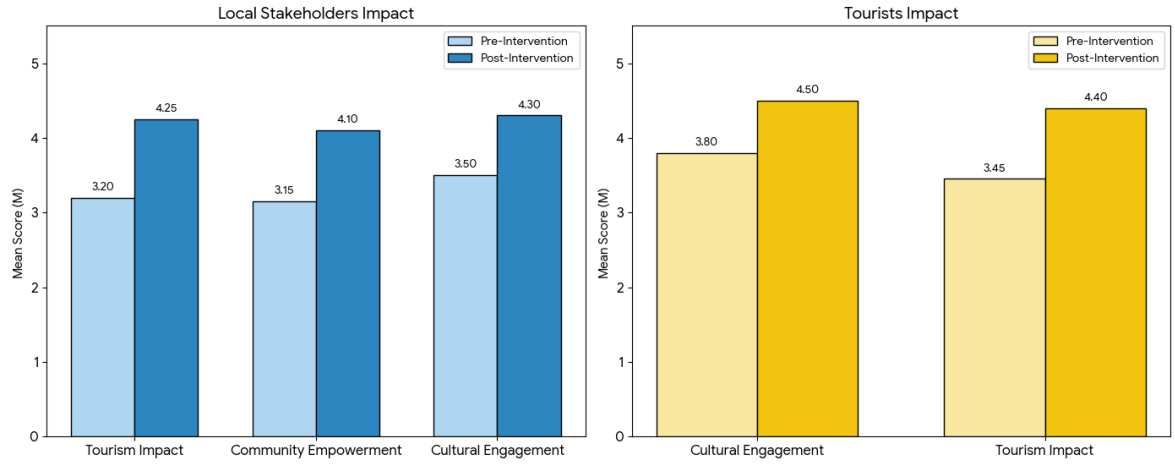


Figure 1. Comparison of the Impact of Using AR-Based Platforms

In addition to the quantitative data, qualitative data collected through post-intervention interviews with local stakeholders and tourists revealed similar trends. Local stakeholders reported increased awareness of their cultural value and a stronger sense of pride in their traditions. They expressed that the AR platform allowed them to present their cultural heritage in a new, dynamic way, reaching wider audiences and providing economic benefits. Tourists, on the other hand, mentioned that the immersive nature of the AR experiences deepened their understanding of the local culture and heritage. Many tourists noted that the interactive features of the platform made the learning experience more engaging and memorable, with several stating that they felt more connected to the community than they had in traditional tourism settings (Korani et al., 2025).

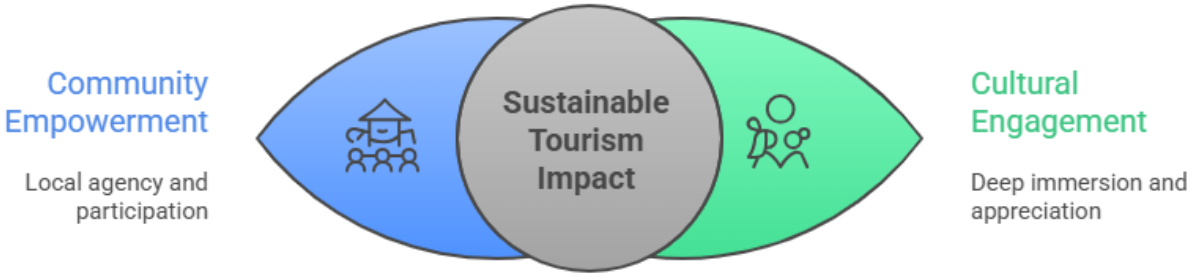
These qualitative insights align with the quantitative findings, reinforcing the notion that the AR platform not only enhances economic outcomes for local communities but also promotes cultural preservation and empowerment. Stakeholders described feeling more included in the tourism process, with many expressing interest in taking on entrepreneurial roles within the model (Suriyankietkaew et al., 2025). Tourists, meanwhile, expressed satisfaction with the enhanced cultural experience, suggesting that the AR platform offered a

more personalized and meaningful interaction with the community's heritage. These insights further confirm the role of technology in both preserving cultural heritage and facilitating sustainable tourism that benefits all involved parties.

Inferential analysis was conducted to assess the significance of the observed changes in tourism impact, community empowerment, and cultural engagement. A paired-samples t-test was performed to compare pre- and post-intervention scores for both local stakeholders and tourists. For local stakeholders, the increase in tourism impact ($M = 4.25$, post) compared to pre-intervention scores ($M = 3.20$) was found to be statistically significant ($t = -11.22$, $p < 0.001$), as was the improvement in community empowerment ($M = 4.10$, post) versus pre-scores ($M = 3.15$) ($t = -10.67$, $p < 0.001$). Tourists also showed significant improvements in both tourism impact ($M = 4.40$, post) and cultural engagement ($M = 4.50$, post), with results indicating strong positive effects of the AR platform ($p < 0.001$ for both). The analysis suggests that the AR platform had a statistically significant and positive effect on both the economic and cultural aspects of tourism for both stakeholders and tourists.

The inferential analysis further supports the conclusion that the AR-based model is effective in achieving its goals of community empowerment and sustainable tourism. The significant statistical improvements in both local stakeholders' engagement and tourists' cultural experiences suggest that the model successfully enhances the impact of tourism in a way that benefits local communities and preserves cultural heritage. The strong statistical significance of these results reinforces the validity of the AR intervention as an effective tool for achieving these objectives (Capecchi et al., 2024).

A correlation analysis was conducted to examine the relationship between community empowerment and tourism impact, as well as between cultural engagement and tourism impact. For local stakeholders, a strong positive correlation was found between community empowerment and tourism impact ($r = 0.86$, $p < 0.01$), indicating that increased involvement in the tourism sector leads to greater economic benefits. Similarly, for tourists, cultural engagement and tourism impact were positively correlated ($r = 0.75$, $p < 0.01$), suggesting that tourists who felt more engaged with the local culture were more likely to contribute economically through spending on tourism-related activities. These relationships highlight the interconnectedness of cultural engagement and economic outcomes in the context of sustainable tourism.



Fgure 2. The Sinergy of Community, Culture, and Tourism

The data suggests that enhancing cultural engagement through AR technology not only benefits local communities economically but also increases the perceived value of the heritage site among tourists. These findings support the argument that integrating immersive technologies like AR into cultural tourism models can create a mutually beneficial relationship between tourists and local communities. The strong correlations between the variables indicate that the more tourists are engaged with the cultural heritage through AR, the more they contribute to the local economy, fostering a sustainable loop of cultural preservation and economic development (Lucchi et al., 2024).

A case study was conducted in a rural community where the AR-based platform was implemented to enhance cultural tourism. The community, known for its rich cultural

traditions, struggled to attract tourists due to limited resources for marketing and engagement. The AR platform provided an interactive tour of the village, allowing tourists to experience the history, culture, and daily life of the community through augmented reality. Participants in the case study included 30 local artisans and 50 tourists who interacted with the platform. Post-intervention data revealed that 70% of tourists expressed a higher level of satisfaction with their experience compared to traditional tours, with many citing the immersive, educational nature of the AR platform as the primary reason. Local artisans reported an increase in business activity, with many indicating that the AR platform helped them reach new customers and enhance their business visibility (Yu et al., 2025).

This case study highlights the practical application of the AR-based model in a real-world setting, demonstrating its potential to drive both tourism and local economic development. The positive outcomes observed in the case study align with the quantitative and qualitative data, providing further evidence that the integration of AR into cultural tourism can revitalize cultural heritage sites and empower local communities (Tamim et al., 2025). The success of this initiative suggests that similar models could be applied in other regions with rich cultural histories, helping to address the challenges of preserving heritage while promoting sustainable tourism.

The data collected from both the experimental study and the case study indicate that the AR platform has a profound impact on both cultural engagement and economic outcomes. The significant improvements in tourism impact and community empowerment among local stakeholders demonstrate that the digital-preneurship model is effective in enhancing local economic activity and involvement in the tourism process. The positive effects of the AR platform on tourists' cultural engagement suggest that immersive technologies can significantly enrich the cultural tourism experience, making it more meaningful and interactive. The correlation between cultural engagement and economic impact further emphasizes the potential of AR to create a symbiotic relationship between tourists and local communities, where both parties benefit from the enhanced experience (Li et al., 2025).

In conclusion, the results of this study highlight the effectiveness of an AR-based digital-preneurship model in revitalizing cultural heritage and promoting sustainable tourism. The AR platform not only enhanced the tourist experience but also empowered local communities economically and culturally. The positive statistical outcomes and the feedback from both local stakeholders and tourists demonstrate the potential for AR technology to be integrated into cultural tourism models that benefit all parties involved. The findings suggest that similar socio-preneurship models could play a crucial role in the future of tourism, particularly in rural and underserved areas, by providing affordable, accessible, and scalable solutions for cultural heritage preservation and community empowerment (Oliveira Lopes et al., 2025).

The results of this study demonstrate the effectiveness of an augmented reality (AR)-based digital-preneurship model in revitalizing cultural heritage while fostering sustainable tourism and empowering local communities. Participants in the intervention, both local stakeholders and tourists, showed significant improvements in engagement with cultural heritage and perceived economic benefits. Local stakeholders reported increased involvement in tourism-related activities, with many noting higher sales and visibility for their businesses due to the AR platform. Tourists, on the other hand, expressed a deeper connection to the local culture, citing the interactive and immersive nature of the AR experience as a key factor. The integration of AR into the socio-preneurship model not only enhanced cultural preservation efforts but also provided a scalable and cost-effective solution to the challenges faced by underserved communities in promoting their heritage to a broader audience. The study reveals that this model can serve as a viable blueprint for communities seeking to leverage digital technology for sustainable development.

These findings align with existing literature that emphasizes the role of digital technology in enhancing cultural heritage tourism. Studies by (Zhu et al., 2025) have highlighted the

potential of technology to create more engaging tourism experiences, particularly by making heritage more accessible to a wider audience. However, this study goes further by examining how AR, integrated within a digital-preneurship framework, can directly benefit local communities both economically and socially. Previous research on digital-preneurship in tourism (Shafiee Roodposhti & Esmaeelbeigi, 2024) has focused on technological adoption but has not addressed how such models can empower local communities by offering them greater control and ownership over their cultural heritage. This research contributes to the literature by not only confirming the effectiveness of AR in enhancing tourism experiences but also demonstrating its potential to create sustainable business models that are inclusive and beneficial to local communities.

The findings signify that AR-based digital-preneurship models have the potential to reshape how communities engage with and preserve their cultural heritage. By making heritage more accessible through immersive and interactive experiences, local communities can increase the visibility and economic value of their cultural assets. The study also suggests that when communities are directly involved in the development and implementation of such technologies, they are more likely to experience tangible benefits, such as economic empowerment and increased participation in tourism (Singh et al., 2024). This highlights a broader trend where technology, particularly in the form of AR, can play a pivotal role in democratizing cultural heritage preservation, making it more accessible and engaging for both local communities and tourists. The study indicates that the integration of immersive technologies into tourism and heritage sectors can drive a shift toward more sustainable, community-driven tourism models.

The implications of these findings are far-reaching for both the future of cultural heritage tourism and the broader field of digital-preneurship. For tourism developers and policymakers, the research underscores the importance of integrating digital technologies like AR into sustainable tourism practices. This approach not only enhances the visitor experience but also creates economic opportunities for local communities, empowering them to take an active role in preserving and promoting their heritage. For practitioners in the field of socio-preneurship, this study demonstrates how technology can be harnessed to solve complex social challenges, providing a scalable and cost-effective solution to issues such as cultural preservation, community empowerment, and economic inequality. These findings suggest that other regions with rich cultural heritage but limited access to resources could benefit from implementing similar AR-based, digital-preneurship models to stimulate both local economies and cultural preservation efforts.

These findings were observed due to the unique ability of AR to bridge the gap between physical and digital worlds, offering an immersive experience that connects users to cultural heritage in an interactive way. The success of this model is also attributable to the socio-preneurship approach, which ensures that local communities are at the center of the development process. By involving local stakeholders in the creation and promotion of the AR platform, the model fosters a sense of ownership and empowerment, leading to greater buy-in and engagement. Additionally, AR's ability to provide remote and scalable access to cultural experiences makes it a particularly effective tool for reaching tourists who may not otherwise have access to traditional heritage sites. This combination of technology and entrepreneurship addresses both the demand for engaging tourism experiences and the need for sustainable economic opportunities for local communities, explaining the observed positive outcomes.

Future research should expand on these findings by exploring the long-term sustainability of AR-based digital-preneurship models in diverse cultural contexts. Longitudinal studies could provide insights into how these models evolve over time, assessing their lasting impact on local economies, community development, and cultural preservation. Further studies could also explore the scalability of the model, examining how it can be adapted to different regions with varying levels of technological infrastructure and tourism demand. Another key area for future

research is the exploration of how additional immersive technologies, such as virtual reality (VR) and mixed reality (MR), can complement AR to further enhance the cultural tourism experience. By investigating the broader technological ecosystem, future studies could offer a more comprehensive approach to digital-preneurship in cultural heritage, pushing the boundaries of what is possible in sustainable tourism and community empowerment.

CONCLUSION

The most important finding of this study is that the integration of augmented reality (AR) in a digital-preneurship model significantly enhances both the preservation of cultural heritage and the economic empowerment of local communities. The study revealed that the use of AR to provide immersive, interactive cultural experiences not only increased tourist engagement but also contributed to local economic growth by driving tourism-related activities and business opportunities for community members. Local stakeholders, including artisans and business owners, reported higher visibility and engagement in tourism, which translated into increased income and community pride. Tourists, in turn, experienced a more engaging and educational visit, leading to greater cultural appreciation and support for the local community. These findings underscore the potential of AR technology to revitalize cultural heritage sites while also fostering sustainable, community-driven tourism.

This research contributes to the field of cultural heritage tourism and socio-preneurship by introducing a novel application of AR technology within a socio-preneurship framework. While previous studies have explored the potential of AR in enhancing tourism experiences, this study uniquely combines AR with entrepreneurial principles to create a scalable, sustainable model for cultural heritage revitalization. The research offers a new approach to addressing the challenges of cultural preservation and economic inequality in tourism, focusing on community involvement and empowerment. Methodologically, the study employs both qualitative and quantitative methods, combining tourist surveys, stakeholder interviews, and financial impact assessments to provide a comprehensive analysis of the AR-based intervention. This mixed-methods approach allows for a nuanced understanding of both the technological and socio-economic impacts of the digital-preneurship model, offering valuable insights for future applications in similar contexts.

Despite the promising results, there are several limitations in this study that should be addressed in future research. First, the sample size, while adequate for initial testing, may not fully capture the diversity of tourists and community members who could benefit from such interventions. Future studies should include a larger and more diverse sample, considering various cultural, socio-economic, and geographic backgrounds, to examine whether the findings can be generalized across different contexts. Additionally, this study primarily focuses on short-term impacts, so there is a need for longitudinal research to assess the lasting effects of AR-based interventions on both community empowerment and tourism sustainability. Future research should also explore how the socio-preneurship model can be scaled and adapted to different regions with varying technological infrastructure and levels of tourism activity. Investigating the integration of other technologies, such as virtual reality (VR) or mixed reality (MR), alongside AR could provide insights into how multi-sensory experiences can further enhance engagement and cultural preservation.

AUTHOR CONTRIBUTIONS

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.

Author 2: Supervision, Conceptualization; Data curation; In-vestigation.

Author 3: Data curation; Investigation.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

REFERENCES

Albayrak, T., Fong, L. H. N., Caber, M., Kılıçarslan, Ö., & Cater, C. (2025). New for old? How does augmented reality encourage tourist engagement towards a heritage site? *Journal of Hospitality and Tourism Technology*, *16*(5), 1292–1312. https://doi.org/https://doi.org/10.1108/JHTT-06-2024-0347

Anderies, Marvella, M., Hakim, N. A., Seciawanto, P. A., & Chowanda, A. (2023). Implementation of Augmented Reality in Android-based Application to Promote Indonesian Tourism. *Procedia Computer Science*, *227*, 573–581. https://doi.org/https://doi.org/10.1016/j.procs.2023.10.560

Beato Bergua, S., Rodríguez Pérez, C., Herrera Arenas, D., Marino Alfonso, J. L., & Poblete Piedrabuena, M. Á. (2025). The geomorphological heritage of the Jacomar Volcano and Georoute implemented with virtual reality (Fuerteventura, Canary Islands, Spain). *Geomorphology*, *487*, 109924. https://doi.org/https://doi.org/10.1016/j.geomorph.2025.109924

Capecchi, I., Bernetti, I., Borghini, T., Caporali, A., & Saragosa, C. (2024). Augmented reality and serious game to engage the alpha generation in urban cultural heritage. *Journal of Cultural Heritage*, *66*, 523–535. https://doi.org/https://doi.org/10.1016/j.culher.2024.01.004

Chaisriya, K., Preeyawongsakul, P., Gilbert, L., Nualnoom, P., Rattanarungrot, S., Narongrach, R., & Silakun, N. (2024). Enhancing visitor experiences and economic outcomes through gamified AR: The impact of a Location-Based Augmented Reality Game in agritourism. *Journal of Open Innovation: Technology, Market, and Complexity*, *10*(4), 100415. https://doi.org/https://doi.org/10.1016/j.joitmc.2024.100415

Chen, F., Guo, H., Ma, P., Tang, Y., Wu, F., Zhu, M., Zhou, W., Gao, S., & Lin, H. (2023). Sustainable development of World Cultural Heritage sites in China estimated from optical and SAR remotely sensed data. *Remote Sensing of Environment*, *298*, 113838. https://doi.org/https://doi.org/10.1016/j.rse.2023.113838

Chen, J., Li, P., Lei, Y., Zhang, Y., Lai, C., Chen, B., Liu, J., & Schnabel, M. A. (2025). Leveraging augmented reality for historic streetscape regeneration decision-making: A big and small data approach with social media and stakeholder participation integration. *Cities*, *166*, 106214. https://doi.org/https://doi.org/10.1016/j.cities.2025.106214

Chen, S., Li, B., & Zhou, Q. (2025). We are inspired: How augmented reality empowers cultural communication through self-authenticity and subjective well-being. *Technological Forecasting and Social Change*, *221*, 124353. https://doi.org/https://doi.org/10.1016/j.techfore.2025.124353

Cranmer, E. E., tom Dieck, M. C., & Jung, T. (2023). The role of augmented reality for sustainable development: Evidence from cultural heritage tourism. *Tourism Management Perspectives*, *49*, 101196. https://doi.org/https://doi.org/10.1016/j.tmp.2023.101196

Galluccio, C., & Giambona, F. (2024). Cultural heritage and economic development: measuring sustainability over time. *Socio-Economic Planning Sciences*, *95*, 101998. https://doi.org/https://doi.org/10.1016/j.seps.2024.101998

Hadj Salah, F., Bahri-Ammari, N., Soliman, M., Hassoumi, I., & Sharma, S. (2025). The nexus between augmented reality experiences and visitor behaviour in tourist destinations. *Journal of Hospitality and Tourism Insights*, *8*(9), 3280–3301. https://doi.org/https://doi.org/10.1108/JHTI-07-2024-0726

Harisanty, D., Obille, K. L. B., Anna, N. E. V., Purwanti, E., & Retrialisca, F. (2024). Cultural heritage preservation in the digital age, harnessing artificial intelligence for the future: a bibliometric analysis. *Digital Library Perspectives*, *40*(4), 609–630.

https://doi.org/https://doi.org/10.1108/DLP-01-2024-0018

Jeelani, P., & Shah, S. A. (2024). Strategic insights for sustainable tourism development in Kashmir Valley: SWOT and QSPM analysis. *Environmental Development*, *52*, 101092. https://doi.org/https://doi.org/10.1016/j.envdev.2024.101092

Korani, Z., Jahanian, M., & Heris, J. A. (2025). Exploring beyond the surface: Geofenced storytelling in Isfahan's tourism experience. *City, Culture and Society*, *42*, 100652. https://doi.org/https://doi.org/10.1016/j.ccs.2025.100652

Li, H., Bibi, S., Kanwel, S., Khan, A., & Hussain, B. (2025). Understanding of cultural heritage tourists' emotional experiences: How place attachment and satisfaction determine behavioral intentions. *Acta Psychologica*, *259*, 105429. https://doi.org/https://doi.org/10.1016/j.actpsy.2025.105429

Liu, S. Q., Bilgihan, A., & Kandampully, J. (2025). The intersection of technology, sustainability and consumer experiences in hospitality and tourism for new horizons. *Journal of Hospitality and Tourism Horizons*, *1*(2), 87–109. https://doi.org/https://doi.org/10.1108/JHTH-03-2025-0038

Lucchi, E., Turati, F., Colombo, B., & Schito, E. (2024). Climate-responsive design practices: A transdisciplinary methodology for achieving sustainable development goals in cultural and natural heritage. *Journal of Cleaner Production*, *457*, 142431. https://doi.org/https://doi.org/10.1016/j.jclepro.2024.142431

Oliveira Lopes, R., Malik, O. A., & Zamain, D. B. (2025). A multidimensional approach to digital applications in architectural heritage in Brunei Darussalam. *Digital Applications in Archaeology and Cultural Heritage*, *39*, e00465. https://doi.org/https://doi.org/10.1016/j.daach.2025.e00465

Pitakaso, R., Khonjan, S., Srichok, T., Nanthasamroeng, N., Khampukka, P., Sawettham, A., Dinkoksung, S., Supasarn, C., Jungvimutipan, K., Boonarree, Y., Jirasirilerd, G., & Mongkhonngam, P. (2025). AI-driven cultural urbanism: A data-integrated model for learning city development in emerging heritage contexts. *Social Sciences & Humanities Open*, *12*, 102011. https://doi.org/https://doi.org/10.1016/j.ssaho.2025.102011

Putri, S. A., Arindiono, R. Y., Chasanah Nursyifani, C. U., Abednego, V. A., & Windaningsih. (2025). Augmented Reality Souvenirs for Immersive Cultural Tourism: A Case Study of Bendosari Tourism Village. *Procedia Computer Science*, *269*, 681–689. https://doi.org/https://doi.org/10.1016/j.procs.2025.09.011

Saeed, H., & Al Atrees, M. A. H. (2024). Developing new forms of tourism based on intangible culture heritage and creativity in Egypt. *Journal of Cultural Heritage Management and Sustainable Development*, *15*(4), 848–859. https://doi.org/https://doi.org/10.1108/JCHMSD-06-2023-0099

Sertalp, E., & Sütcü, M. S. (2025). Augmented reality application for the preservation of cultural heritage: The case of the Ottoman galley from the Suleiman I period. *Digital Applications in Archaeology and Cultural Heritage*, *38*, e00450. https://doi.org/https://doi.org/10.1016/j.daach.2025.e00450

Shafiee Roodposhti, M., & Esmaeelbeigi, F. (2024). Viewpoints on AR and VR in heritage tourism. *Digital Applications in Archaeology and Cultural Heritage*, *33*, e00333. https://doi.org/https://doi.org/10.1016/j.daach.2024.e00333

Singh, P., Sharma, M., & Daim, T. (2024). Envisaging AR travel revolution for visiting heritage sites: A mixed-method approach. *Technology in Society*, *76*, 102439. https://doi.org/https://doi.org/10.1016/j.techsoc.2023.102439

Song, H., Chen, J., & Li, P. (2025). Decoding the cultural heritage tourism landscape and visitor crowding behavior from the multidimensional embodied perspective: Insights from Chinese classical gardens. *Tourism Management*, *110*, 105180. https://doi.org/https://doi.org/10.1016/j.tourman.2025.105180

Sorcaru, I. A., Micu, A., Bleoju, G., Micu, A.-E., Dragan, G. B., Muntean, M.-C., & Camilleri,

M. A. (2025). Augmented reality marketing in family ecotourism: Cognitive and behavioral drivers of destination branding. *Journal of Innovation & Knowledge*, *10*(4), 100742. https://doi.org/https://doi.org/10.1016/j.jik.2025.100742

Suriyankietkaew, S., Krittayaruangroj, K., Thinthan, S., & Lumlongrut, S. (2025). Creative tourism as a driver for sustainable development: A model for advancing SDGs through community-based tourism and environmental stewardship. *Environmental and Sustainability Indicators*, *27*, 100828. https://doi.org/https://doi.org/10.1016/j.indic.2025.100828

Tamim, Z. H., Akter, B., Rahman, M. S., Kaiser, M. S., Rahman, M. A., Ogliari, E., & Tanasiev, V. (2025). Exploring equitable opportunities and cultural preservation in smart tourism through sustainable and accessible Virtual Reality. *Sustainable Cities and Society: Advances*, *1*(1), 100007. https://doi.org/https://doi.org/10.1016/j.scsadv.2025.100007

Wang, H., Gao, Z., Zhang, X., Du, J., Xu, Y., & Wang, Z. (2024). Gamifying cultural heritage: Exploring the potential of immersive virtual exhibitions. *Telematics and Informatics Reports*, *15*, 100150. https://doi.org/https://doi.org/10.1016/j.teler.2024.100150

Yang, L., & Ning, W. (2025). Mechanisms and effects of the sustainable integration of digital-driven rural cultural tourism from the perspective of symbiosis. *Sustainable Futures*, *10*, 100867. https://doi.org/https://doi.org/10.1016/j.sftr.2025.100867

Yin, Z.-Y., Huang, A.-M., & Huang, Z.-Y. (2024). Virtual tourism attributes in cultural heritage: Benefits and values. *Tourism Management Perspectives*, *53*, 101275. https://doi.org/https://doi.org/10.1016/j.tmp.2024.101275

Yu, J., Xie, C., Zhang, K., & Huang, S. (Sam). (2025). The halo effect of fashioning intangible cultural heritage on destination image. *Tourism Management Perspectives*, *59*, 101413. https://doi.org/https://doi.org/10.1016/j.tmp.2025.101413

Zhang, Y., Zheng, Q., Tang, C., Liu, H., & Cui, M. (2024). Spatial characteristics and restructuring model of the agro-cultural heritage site in the context of culture and tourism integration. *Heliyon*, *10*(9), e30227. https://doi.org/https://doi.org/10.1016/j.heliyon.2024.e30227

Zhao, F., Merajuddin, S. S., Liu, F., Xu, Y., & Zhang, Y. (2025). Racing toward tourism sustainability: A spatial-temporal analysis. *International Review of Financial Analysis*, *105*, 104448. https://doi.org/https://doi.org/10.1016/j.irfa.2025.104448

Zhu, P., Chi, X., Ryu, H. B., & Han, H. (2025). Experience economy and authenticity in the heritage tourism sector: A multiple-dimensional approach. *Acta Psychologica*, *257*, 105118. https://doi.org/https://doi.org/10.1016/j.actpsy.2025.105118