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Interactive Geography Learning Integrated with Game-Based Learning using Augmented Reality for Generation Zilenial at Tourist Destinations in the City of Makassar

Muhammad Fauzi[1]*, Dean Gery Pasamba[2], Nabil Habib Makalalag[1]

1 Department of Urban Regional Planning, Faculty of Engineering, Universitas Hasanuddin, South Sulawesi Province, Indonesia
2 Department of Informatics, Faculty of Engineering, Universitas Hasanuddin, South Sulawesi Province, Indonesia

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*Correspondence: Muhammad Fauzi
Email: muhammadfauzi5502@gmail.com

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Abstract: A significant challenge in contemporary education is the low level of geographical literacy among Generation Z, which is often exacerbated by conventional teaching methods. This study aims to develop and evaluate a digital geography learning framework that integrates Augmented Reality (AR) with Game-Based Learning, specifically tailored for Generation Z in tourist destinations in Makassar City. The primary objective is to assess the viability of this approach for enhancing engagement in learning. A mixed-methods approach was employed, incorporating quantitative data from a questionnaire survey of 46 respondents and qualitative data from a literature review. The findings reveal that 93.6% of participants expressed a strong interest in implementing AR-based Game-Based Learning at local attractions such as Losari Beach. In conclusion, the integration of AR with Game-Based Learning significantly enhances the interactivity and appeal of geography education for the Generation Zilenial demographic.

Keywords: Augmented Reality, Travel Destinations, Game-Based Learning, Generation Z, Digital Geography Learning

Introduction

The development of digital technology in the current era has brought significant transformations in various fields, including geography. Various technologies to support geographic activities have developed, including geospatial technology, digital mapping, and virtual geographic visualization. However, digital development has also led to a decline in public literacy, especially among Generation Z, born between 1995 and 2010, who are the future leaders of the nation (Parhan et al., 2022). Millennials are more adept at producing information and reacting to the flow of information around them. In Indonesia, public interest in reading remains very low. According to UNESCO research, the percentage is only 0.001% of the total population. Data released by the Indonesian Survey Institute (LSI) also show that literacy rates are quite low, with only 20% of Indonesians having read a book in the past year. This is inseparable from the influence of factors in the development of digital technology.

Geographical history can be an interesting educational topic to be raised in interactive Game-Based Learning. Various tourist destinations can be used as thematic elements in the context of geographical history. Makassar is a popular tourist destination in Indonesia. The city of Makassar has many tourist destinations, such as Fort Rotterdam, Fort Somba Opu, Balla Lompoa Museum, Losari Beach, Paotere Harbor, and Samalona Island. Using Augmented Reality and spatial technologies, such as GPS, an interesting Game-Based Learning system can be created. Augmented Reality can present various educational information through attractive visual displays about the tourist attractions that are passed. Meanwhile, the GPS can provide an exploration experience for users while playing the game. In addition, adding an audio talk feature in game development can support an inclusive approach for people with disabilities and increase the interactive elements for users who have little interest in reading. To support this research, we conducted a literature review on theories related to the following topics: Digital Geography Learning, Game-Based Learning, Augmented Reality, Generation Z, Tourist Destinations, and SDGs.

Augmented Reality (AR) is a type of Virtual Environment (VE), often referred to as virtual reality. VE technology completely transports users into a synthetic world. Once inside a VE, users cannot see the real world. In contrast, Augmented Reality allows users to see the real world by overlaying or combining virtual objects onto it. Therefore, AR complements reality, rather than completely replacing it. Ideally, virtual objects and reality will coexist in the same space, similar to the effect achieved in a movie titled "Who Framed Roger Rabbit?" **Figure 1** shows an example of what this looks like.

Figure 1. Augmented Reality display
Source: Ardhianto et al., 2012

Figure 1 shows a real phone on a real table. In the same room, there are also two virtual chairs and a virtual lamp. Note that these objects are combined in three dimensions, so that

the virtual lamp can cover the real table, and the real table covers part of the two virtual chairs. AR can be an alternative solution between VE (fully synthetic) and telepresence (fully real). Some researchers define AR in a way that requires a Head-Mounted Display (HMD). To avoid limiting AR to specific technologies, this survey defines AR as a system with three characteristics: combining the real and virtual worlds, being interactive in real time, and being registered in 3-D. Essentially, Augmented Reality involves combining two- or three-dimensional objects and displaying or projecting them into reality in real time.

Generation Z, commonly abbreviated as Gen Z, is a generation with a strong tendency to use technology in their daily activities. Also known as the iGeneration, net generation, or internet generation, Generation Z refers to people born between 1995 and 2010, according to research conducted by the McCrindle Research Center in Australia. During this period, the use of digital technology has advanced significantly. This has shaped the behavior of Generation Z, which is synonymous with digital technology, because they have been exposed to it since childhood. Generation Z generally has characteristics such as being tech-savvy, active on social media, expressive, multitasking, and easily switching between tasks or thoughts.

The Sustainable Development Goals (SDGs) are a global development agreement document to implement sustainable development in three main components, namely social, environmental, and economic. The principles of the SDGs are universal, integrated, and inclusive. One of the 17 main goals of the SDGs is quality education, which aims to make education accessible and encourage inclusivity across all levels of society. Education with a geographical context is still unfamiliar to most people. This is one reason for the general lack of public understanding of geography. To determine the level of understanding, there needs to be innovation that can be packaged in an interesting way. Generation Z is a tech-savvy, dominant force in today's digital society. Based on various sources, Generation Z's literacy level is also not very good. Therefore, an innovative system is needed, especially in the current era of technological disruption.

Given existing issues, this study aims to determine the interest and role of Generation Z in digital geography learning, and to implement and test the effectiveness of an integrated Game-Based Learning method based on Augmented Reality in the tourist destination of Makassar City. The expected benefits include: (1) introducing a digital learning method that raises awareness of the importance of geography for Generation Z; (2) broadening knowledge in the world of education, particularly interactive digital geography learning; and (3) providing material for the evaluation and renewal of the existing digital geography learning system.

Methods

This study uses a mixed-methods approach that combines quantitative and qualitative analyses. Data collection was conducted through an online questionnaire with 46 respondents who were students at Hasanuddin University, as well as a literature review on digital geography learning, Game-Based Learning, and Augmented Reality. The data were analyzed using the SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis technique to evaluate the potential and challenges of applying these methods, and descriptive analysis to measure Generation Z's level of understanding and interest in geography learning. The research was conducted over two weeks (January 1–14, 2025), focusing on tourist destinations in Makassar City, such as Losari Beach, Rotterdam Fort, and Fort Somba Opu. The research instruments included Google Forms questionnaires, observations, and literature reviews from journals and other relevant sources.

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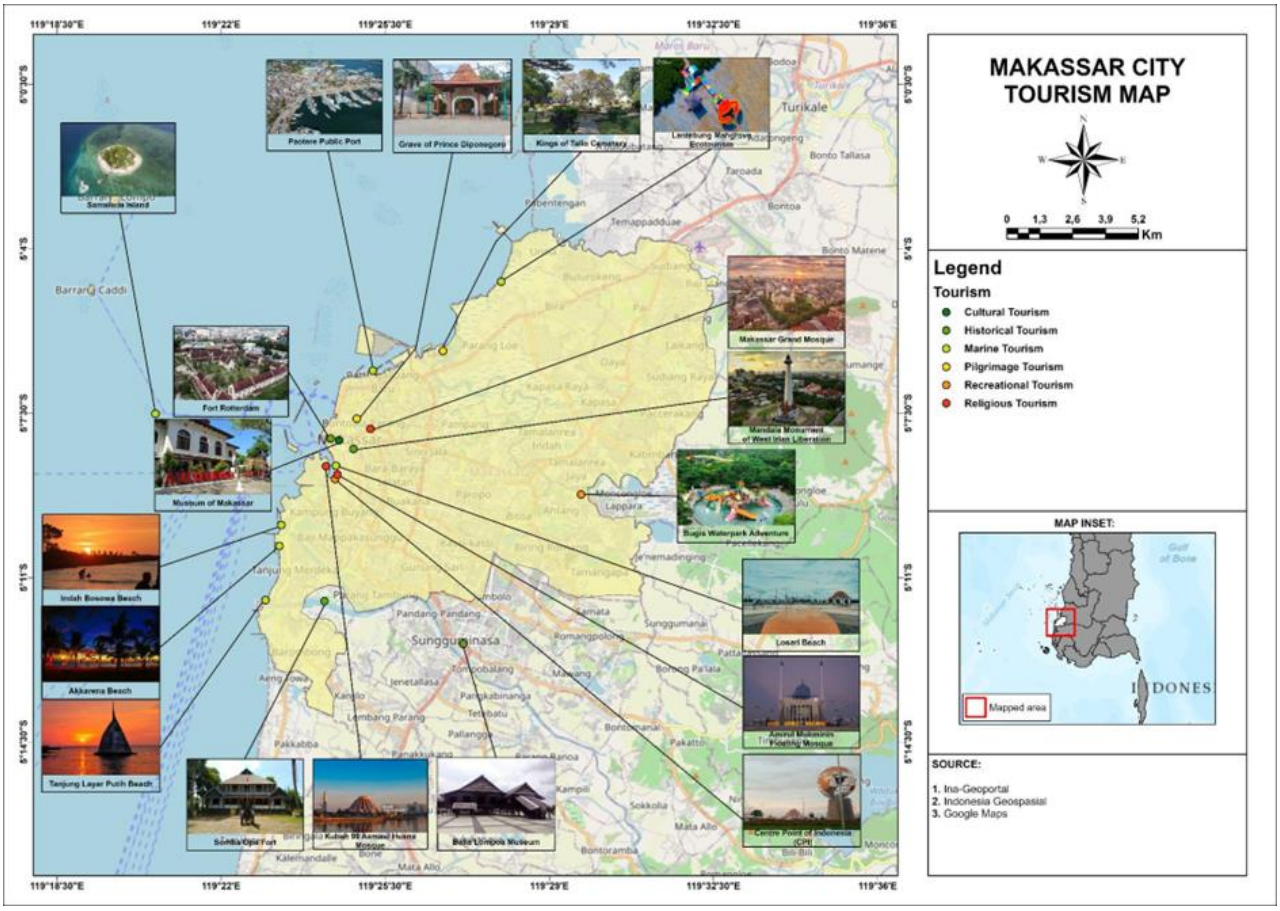

Figure 2. Map of Research Locations and Distribution of Tourist Areas in Makassar City
Source: Author, 2025

Results and Discussion

A. Result

In this study, we used a classification analysis to identify the main findings of the research conducted. We grouped the data into several sentiments (sections) to analyze the interest of Generation Z in Augmented Reality-based Game-Based Learning media for geography learning. We collected data through a user-satisfaction survey on tourist attractions in Makassar. We had 46 respondents. The first sentiment was users' opinions about tourist attractions in Makassar City. The data showed that 93.6% had visited Losari Beach, 48.9% had visited Fort Somba Opu, 63.8% had visited Fort Rotterdam, 36.2% had visited the Balla Lompoa Museum, 46.8% had visited Paotere Harbor, and 14.9% had visited Samalona Island.

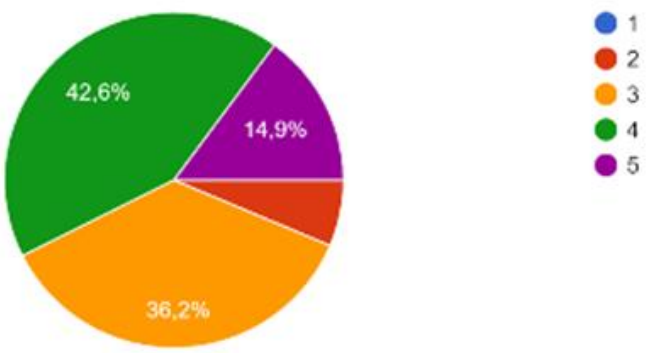

Figure 3. Image of User Experience Survey on Tourist Attractions
Source: Author, 2025

The survey results show that 42.6% of respondents found visiting the tourist attraction enjoyable (based on a Likert scale). However, based on the survey results, none of the respondents had a very good understanding of the tourist attractions they had visited; most said they had only a basic understanding. Furthermore, we classified the results of our analysis regarding respondents' opinions on geography learning. Based on the data we collected, approximately 38.3% of respondents felt that geography learning was important, and 29.8% stated that it was very important to them.

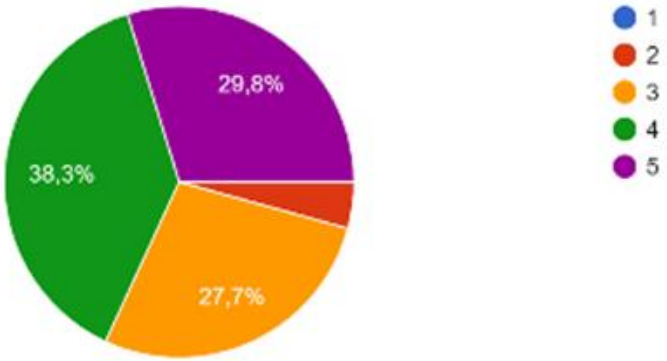

Figure 4. Image of a survey on the importance of geography education
Source: Author, 2025

In addition, we examined respondents' understanding of geography, with results showing that 55.3% had sufficient understanding.

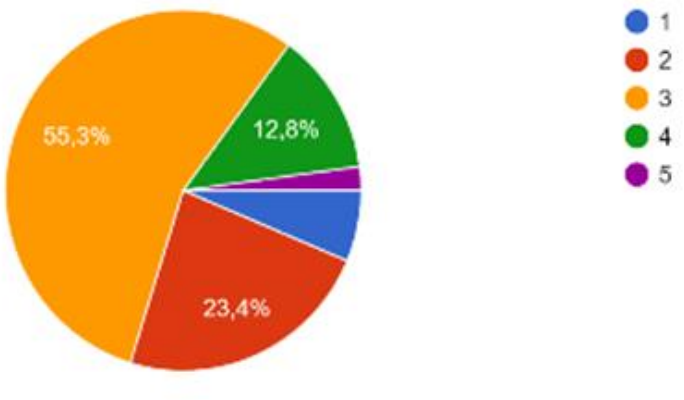

Figure 5. Understanding Geography Learning
Source: Author, 2025

From this data, we conclude that the factors influencing the level of user understanding are the learning media used to study geography. Therefore, in the next sentiment, we surveyed Generation Z about the current use of geography learning media and AR-based Game-Based Learning innovations in geography learning. Most respondents felt that current learning was quite good but still needed further development. Based on the survey, we also found that most respondents showed high enthusiasm for digital geography learning methods.

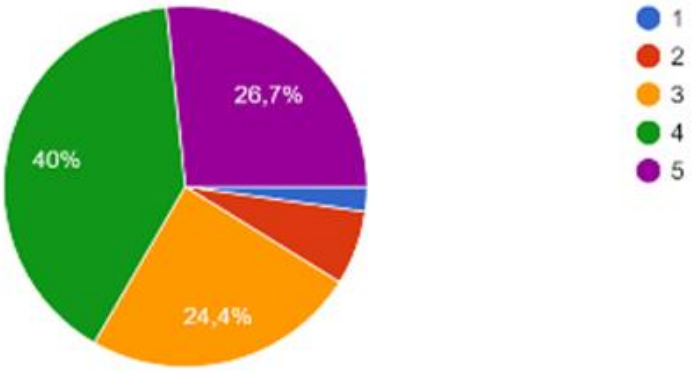

Figure 6. Survey of Digital Geography Learning Platforms
Source: Author, 2025

From these findings, we discovered that most respondents from Generation Z felt that digital platforms were good to use, and quite a few also stated that they were very good. To support our hypothesis, we surveyed user interest in AR-based Game-Based Learning as an implementation of digital platforms. A total of 28.3% were very interested, and 34.8% were interested in using it.

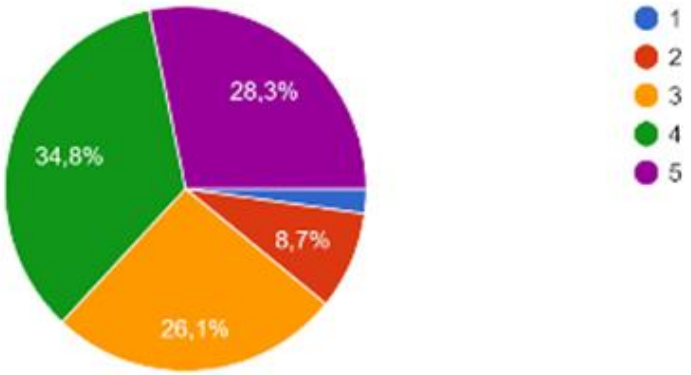

Figure 7. Game-Based Learning AR Media Survey
Source: Author, 2025

We also conducted an equation analysis using machine learning to support our estimates of the effectiveness of AR use in tourist attractions. Testing the data produced an R2 score of 68%. This figure may not be high enough, as it may be influenced by our research objective, which emphasizes descriptive analysis of response variation patterns from our survey. Based on this, the survey focuses more on the behavior patterns and feelings of Generation Z. Below is a graph of the results of the equation analysis we conducted through testing the data.

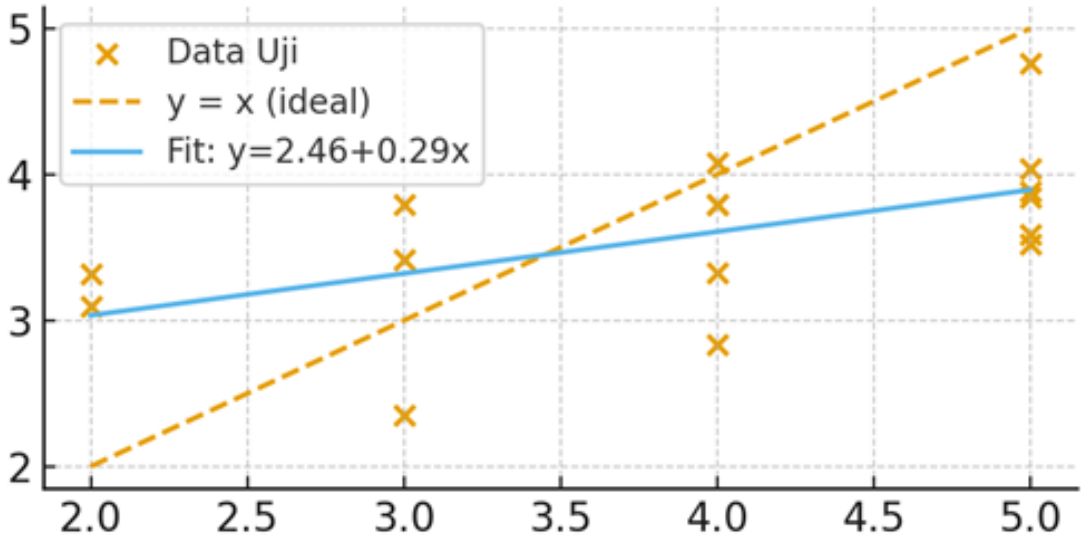

Figure 8. Equation Analysis Graph
Source: Author, 2025

Discussion

The analysis used in this study is the SWOT Analysis (Strengths, Weaknesses, Opportunities, and Threats), an analytical technique that identifies the strengths, limitations, opportunities, and threats of a learning method for Generation Z at tourist destinations in Makassar.

Table 1. SWOT Analysis of AR-based Game-Based Learning for Geography Education

Strengths	**Weaknesses**
• Digital learning methods are highly appealing to Generation Z. • 28.3% of respondents expressed a strong interest, and 34.8% expressed interest in AR-based Game-Based Learning. • Geography learning is considered very important (38.3%) or important (29.8%) by respondents. • AR provides interactive, visual, and engaging content that aligns with Generation Z's preference for images, animations, and videos (Hastini et al., 2020). • AR enhances real-world experiences by combining virtual and real elements.	• Generation Z can show low initiative and inconsistency in learning, requiring more supervision and comprehensive explanations (McConnell, 2018). • This demographic has a short attention span and a preference for instant gratification, which can lead to boredom if learning facilities are inadequate (Hastini et al., 2020). • Implementation requires high technological proficiency from developers. • Access to devices and stable internet connections may be a barrier for users with limited economic resources.
Opportunities	**Threats**
• Generation Z is known for its ease in mastering digital technologies, making them a receptive audience for AR-based learning. • AR-based learning supports highly effective learning activities and can help achieve learning objectives more effectively (Deviantari et al., 2018) • Tourist destinations in Makassar (e.g., Fort Rotterdam, Losari Beach) can be used as stages for interactive learning, providing rich historical and geographical content.	• AR-based learning may lead to social isolation and a reduction in interpersonal interaction if not managed properly. • Dependence on the technology could become a concern. • The lack of initiative among Generation Z (McConnell, 2018) could hinder the effectiveness of the method if the experience is not sufficiently engaging.

Implementation

Strengths: Digital geography learning will certainly attract Generation Z more than direct learning methods or other approaches. However, based on earlier studies, there needs to be a breakthrough to prevent demotivation among Generation Z in learning. Generation Z has a short attention span. They find visual images easier to understand. Therefore, for Generation Z, the most appropriate learning method is one that uses images, animations, or videos (Hastini et al., 2020). Based on this, using Augmented Reality-based Game-Based Learning can be an alternative solution in maintaining Generation Z's motivation to learn.

Weaknesses: Augmented Reality learning methods require a high level of technological proficiency, which poses a challenge for developers. In addition to technical capabilities, limited access to devices in Indonesia and stable internet connections will also pose challenges for Generation Z, who have limited economic resources.

Opportunities, the development and application of Augmented Reality-based learning opportunities can support learning activities that are highly effective in achieving learning objectives (Deviantari et al., 2018). Development of Augmented Reality in Geography Learning, Development and Application of Augmented Reality-Based Learning Tools, based on the scientific references above, Augmented Reality supports highly effective learning activities in achieving learning objectives. The Augmented Reality learning method provides a more interactive and realistic experience at tourist destinations in Makassar. Several locations will be used as stages in the game: Fort Somba Opu, Losari Beach, Rotterdam Fort, Balla Lompoa Museum, Paotere Port, and Samalona Island.

Threats: Augmented Reality-based learning methods can cause individuals to become isolated and less interactive with others, and can also lead to dependence on the technology.

Conclusion

The role of Game-Based Learning using Augmented Reality for Generation Z in geography education, implemented at tourist attractions in Makassar, will undoubtedly serve as a new medium for advancing geography education. As outlined, this innovation will have both advantages and disadvantages; however, it will undoubtedly provide the best solution to Generation Z's lack of interest in traditional, direct learning methods. With the interaction between the virtual and real worlds, geography learning will become more interesting and interactive. Implementation in tourist attractions in the city of Makassar could be one step in overcoming boring learning. Generation Z will find new experiences through exploring tourist attractions packaged in Game-Based Learning using Augmented Reality while learning about the history of these places. This could be one solution to improve understanding and experience in learning geography and become an innovation

for Generation Zilenial in today's digital era. With this innovation and research, as well as cooperation among various parties, including agencies, academics, and the community, it is hoped that it will contribute to the development of more effective and creative learning methods and positively impact tourism in Makassar City and other cities in Indonesia.

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