The Development of 3D Animation-Based Multimedia for Promoting Rail Tourism : A Case Study of the Pink Line Monorail

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Abstract

This research is a Research and Development (R&D) study that aims to develop and evaluate the effectiveness of 3D animation-based multimedia for promoting rail tourism, with a case study of the Pink Line Monorail. The research methodology is structured according to the ADDIE Model—a systematic instructional design framework comprising five phases: Analysis, Design, Development, Implementation, and Evaluation. Each phase guided the multimedia development process, ensuring structured content design and effective delivery. Additionally, the research references the 3P Production approach (Pre-Production, Production, and Post-Production) to ensure high-quality animation production for effective promotional media.

The population of the study includes tourists and general commuters who use or are likely to use the Pink Line Monorail. The sample consists of experts in 3D animation and rail transport, as well as 100 tourists and general passengers, also selected through purposive sampling, who evaluated the multimedia. The research instruments include expert assessments of media effectiveness and satisfaction questionnaires. The findings indicate that the effectiveness of the developed 3D animation-based multimedia was rated as high by experts in terms of content and presentation ($\bar{X}$ =4.00, SD=0.47) and graphic design and technical execution ($\bar{X}$ =4.06, SD=0.62). Meanwhile, the overall satisfaction of the sample group was rated highest ($\bar{X}$ =4.26, SD=0.65), particularly regarding the value of the media in promoting rail tourism effectively.

The research suggests incorporating interactive elements, enhancing compatibility with Augmented Reality (AR) and Virtual Reality (VR) technologies, adding multilingual narration, and expanding digital distribution channels to cater to diverse tourist demographics. This study provides essential guidelines for developing 3D animation-based promotional media applicable to other public transportation projects in the future.

Keywords: Multimedia, 3D Animation, Tourism Promotion, Rail Tourism, Pink Line Monorail

Introduction

Tourism plays a significant role in the global economy and continues to grow steadily (UNWTO, 2023). In Thailand, the development of public transportation, particularly urban rail systems, is a crucial strategy for sustainable tourism promotion (Ministry of Tourism and Sports, 2022). One of the recently developed public transport projects is the Pink Line Monorail, a monorail system that connects suburban areas to downtown Bangkok, presenting a high potential for promoting tourism (Office of Transport and Traffic Policy and Planning, 2023).

In the digital era, multimedia and 3D animation have proven to be effective tools for tourism promotion and enhancing public understanding of tourist destinations (Liu, 2022). Specifically, interactive multimedia enhances the pre-travel experience for tourists, making information more engaging (Kim & Hall, 2021). 3D animation technology allows for the realistic simulation of travel environments and tourist sites, making content more accessible and captivating (Chang & Wang, 2020). Several studies have demonstrated that 3D animation can enhance destination branding awareness (Xiao et al., 2023) and improve the appeal of promotional destinations (Huang et al., 2021). Additionally, animation simplifies complex information and fosters audience engagement (Moreno & Mayer, 2019).

However, despite the increasing use of digital media in tourism, limited research has focused on the application of 3D animation-based multimedia specifically for promoting rail tourism in the context of urban monorails in Thailand. Most existing studies center on traditional tourism destinations, without addressing how advanced digital media can be used to promote public transportation systems as tourism experiences in themselves. Moreover, a structured development model for such media, integrating both instructional design (like the ADDIE Model) and animation production frameworks, remains underexplored.

This research aims to fill this gap by developing 3D animation-based multimedia for promoting rail tourism via the Pink Line Monorail.The significance of this study lies in its ability to provide an innovative, replicable framework for creating effective tourism media, especially for public transportation. The findings will contribute to effective multimedia applications for rail tourism promotion and their potential adaptation for other public transport systems.

Research Objectives

1.To develop 3D animation-based multimedia for promoting rail tourism via the Pink Line Monorail.

2.To evaluate the effectiveness of the developed 3D animation-based multimedia for tourism promotion.

3.To assess the satisfaction of the target audience with the developed multimedia.

Literature Review

The development of 3D animation-based multimedia for rail tourism promotion is grounded in both theoretical and applied studies. This section begins with foundational concepts in communication, multimedia design, and technology acceptance before narrowing to tourism-specific research and the instructional design framework employed in this study.

Communication Theory: Effective tourism promotion requires a clear communication process. The Shannon & Weaver model outlines key elements Sender, Message, Channel, Receiver, and Feedback (Shannon & Weaver, 1949). Schramm's Interactive Model emphasizes the Encoding-Decoding process to align message interpretation between sender and receiver (Schramm, 1954).

Multimedia Learning Theory: Mayer (2021) highlights that animation combined with audio enhances learning efficiency and reduces cognitive load. Key principles include Multimedia Principle: Visuals and audio improve comprehension more than text alone, Coherence Principle: Unnecessary elements should be avoided to reduce distractions, Modality Principle: Information presented in both visual and auditory forms enhances retention.

Technology Acceptance Model (TAM): Davis (1989) asserts that technology adoption depends on perceived usefulness and ease of use. If 3D animation-based media is engaging and user-friendly, viewers are more likely to retain information and have a positive perception (Kim & Hall, 2021).

Instructional Design Framework – ADDIE Model: The ADDIE Model—Analysis, Design, Development, Implementation, and Evaluation—is a widely used instructional systems design (ISD) model. Molenda (2003) highlights the historical development of ADDIE, noting that while it originated in the U.S. military in the 1970s, it has since evolved into a flexible framework applicable to educational and training contexts. Peterson (2003) stresses the model's practicality by illustrating real-world applications where each phase—from needs assessment to evaluation—contributes to effective instructional products. To extend this, Clark (2005) focuses on its role in technical training and how each phase can be tailored to digital content development. Moreover, Branch (2009) provides a comprehensive guide to applying the ADDIE model systematically in instructional design, emphasizing its iterative nature and adaptability across various learning environments.

3D Animation Design and Production: The production of 3D animation involves: 3D Modeling: Creating three-dimensional models, Texturing & Lighting: Adding textures and realistic lighting, Rigging & Animation: Enabling model movements, Rendering & Compositing: Finalizing the animation for high-quality output (Williams, 2020).

Tourism Marketing and Rail Tourism: Kotler et al. (2017) emphasize the 4Ps + 3Ps framework in tourism marketing. Promotion, in particular, is vital in raising destination awareness. Xiao et al. (2023) highlight that immersive 3D content significantly enhances destination marketing. Rail Tourism and the Pink Line Monorail, Rail tourism offers convenient and eco-friendly travel options (Hall, 2019).

The Pink Line Monorail aims to ease urban congestion and encourage rail travel (Office of Transport and Traffic Policy and Planning, 2023). Digital media plays a crucial role in increasing public awareness and promoting rail tourism.

Although previous studies have validated the benefits of animation and multimedia in tourism (Chang & Wang, 2020; Liu, 2022), they largely focus on traditional destinations or general marketing strategies. This study differs by applying a structured instructional design model (ADDIE) to the development of multimedia for promoting an urban monorail system—a unique aspect not yet widely addressed in academic literature. By integrating the ADDIE and 3P frameworks, this research bridges theory and practice, offering a replicable model for future tourism-related multimedia development.

Part 1: Research Methodology

This study adopts a Research and Development (R&D) approach to design, develop, and evaluate 3D animation-based multimedia for promoting rail tourism, using the Pink Line Monorail as a case study. The methodology covers the population and sampling, research instruments, validation and reliability testing, data collection, and data analysis procedures.

Population and Sampling

The population includes individuals relevant to the Pink Line Monorail: 1) experts in 3D animation and rail transport systems, and 2) general users and tourists who currently use or are likely to use the Pink Line Monorail.

• Expert Group: Two experts were selected using purposive sampling. One expert specializes in 3D animation with at least five years of experience in digital media production, while the other has experience in rail system operations or transportation management. Their insights were essential for evaluating the content and technical quality of the multimedia.

• Audience Group: A total of 100 participants were selected using purposive sampling from among tourists and general passengers using the Pink Line Monorail. The sample size was chosen based on recommendations for usability studies and public opinion surveys, ensuring statistical relevance and practical feasibility for evaluating media satisfaction.

Research Instruments

1. Instruments for Development and Data Collection
   1) 3D animation-based multimedia for promoting rail tourism.
   2) Expert evaluation form to assess media effectiveness.
   3) Audience satisfaction questionnaire to measure user engagement.
2. Instrument Validation
   1) Content Validity was assessed using the Index of Item-Objective Congruence (IOC), reviewed by three experts.
   2) Reliability Testing was conducted using Cronbach's Alpha, ensuring a reliability score ≥ 0.7.

Data Collection and Analysis

Data Collection

The sample group viewed the 3D animation-based multimedia via digital devices (smartphones, computers, or tablets). After viewing, participants completed an online satisfaction survey (Google Forms) using a five-point Likert scale (Likert, 1932). The response scale is as follows:

5 meaning Strongly Satisfied

4 meaning Satisfied

3 meaning Neutral

2 meaning Dissatisfied

1 meaning Strongly Dissatisfied

The collected data was analyzed using SPSS statistical software.

Data Analysis

1.Quantitative Analysis

1) Mean ($\bar{X}$) and Standard Deviation (SD) were calculated to summarize audience satisfaction levels.

2) Reliability testing of the questionnaire was performed using Cronbach's Alpha (≥ 0.7).

2.Qualitative Analysis

1) Expert feedback on the quality and effectiveness of the 3D animation-based multimedia was analyzed.

2) Audience comments on content clarity and animation quality were evaluated using Theme Analysis or Content Analysis.

Part 2: Research Process (Based on the ADDIE Model)

Development of 3D Animation-Based Multimedia Using the ADDIE Model

1) Analysis Phase: Conduct research on rail tourism and the Pink Line Monorail. Analyze audience behavior and needs for tailored multimedia content. Examine appropriate 3D animation techniques for effective tourism promotion.

Figure 1: On-Site Field Study for Data Collection on the Pink Line Monorail

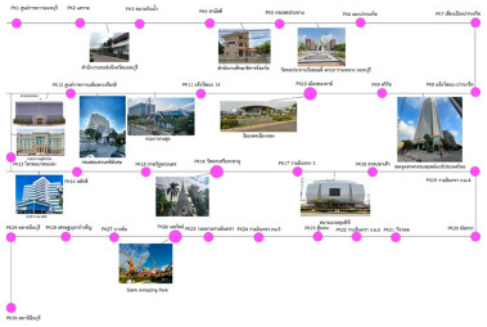

Figure 2: Route Map of the Pink Line Monorail

2) Design Phase: Develop storyboards, scripts, and visual style guides (color schemes, mood, and tone).

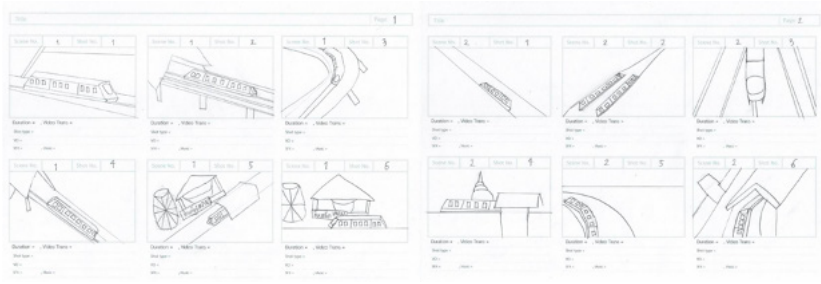

Figure 3: Sample Storyboard

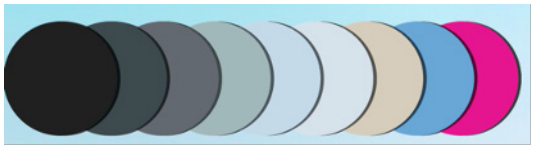

Figure 4: Visual Style (Color Script/Mood and Tone)

3) Development Phase: The 3P Production approach (Williams, 2020) was followed, comprising three key stages: Pre-Production, Production, and Post-Production.

3.1 Pre-Production (Aligned with ADDIE Analysis & Design Phases)

1.Researching 3D animation design principles tailored for tourism communication (Mayer, 2021).

2.Analyzing tourism promotion strategies and target audience behavior (Liu, 2022).

3.Designing storyboards and scripts for an effective narrative structure.

4.Developing a prototype (Animatic) to test concepts before full production (Chang & Wang, 2020).

3.2 Production

1.Creating 3D models of scenes and characters, ensuring realism and aesthetic appeal (Huang et al., 2021).

2.Enhancing textures, rigging, and animation for dynamic movement.

3.Adjusting lighting and composition for high-quality visual output (Kim & Hall, 2021).

4.Recording voice-over narration and designing sound effects for an immersive experience (Moreno & Mayer, 2019).

3.3 Post-Production

1.Refining rendering and compositing for final animation quality (Xiao et al., 2023).

2.Incorporating visual effects (VFX) and motion graphics to enhance engagement (Liu, 2022).

3.Conducting technical and content evaluations by experts, ensuring a minimum 80% approval rating before release (Chang & Wang, 2020).

4.Finalizing rendering adjustments before dissemination.

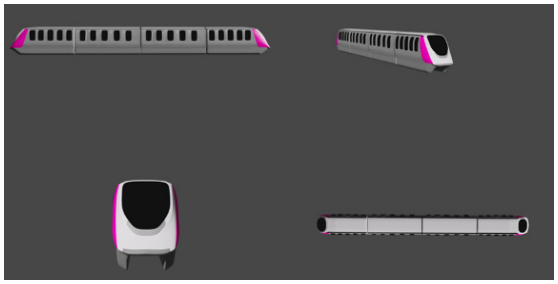

Figure 5: 3D Model of the Pink Line Monorail Created Using Blender

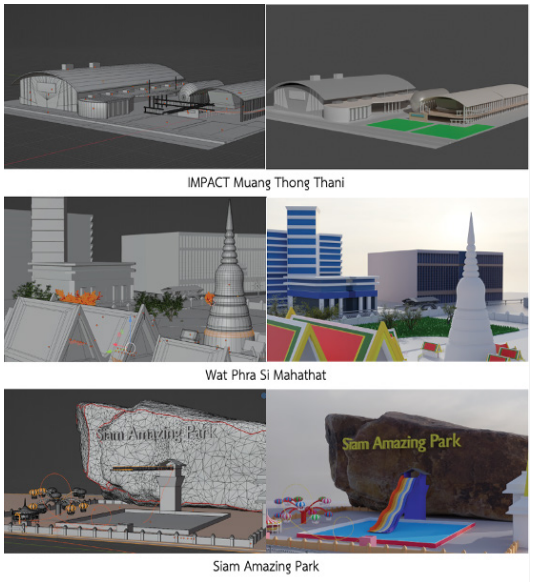

Figure 6: 3D Scenes and Locations Created Using Blender

Figure 7: 3D Animation Media Created Using Adobe Premiere Pro and Adobe After Effects

4) Implementation: The 3D animation-based multimedia was disseminated to the sample group, consisting of tourists and the general public who use the Pink Line Monorail, for evaluation and feedback.

5) Evaluation: A total of 100 participants were surveyed to assess satisfaction levels after viewing the 3D animation-based multimedia. The collected data was then analyzed to measure the effectiveness and impact of the developed content.

Research Findings

The development of 3D animation-based multimedia for promoting rail tourism, using the Pink Line Monorail as a case study, has resulted in the following key findings

Development of 3D Animation-Based Multimedia for Rail Tourism Promotion

The production of 3D animation-based multimedia was conducted following the ADDIE Model (Analysis, Design, Development, Implementation, Evaluation) to ensure the quality and effectiveness of the promotional content.

• Analysis Phase

This phase confirmed a clear gap in the availability of immersive and visually appealing content for the Pink Line Monorail. A needs assessment of the target audience (tourists and general users) revealed preferences for interactive, narrative-rich content that enhances understanding of transportation routes and nearby attractions.

• Design Phase

The narrative structure highlighted landmarks along the Pink Line route and emphasized convenience and tourism appeal. The design was informed by multimedia learning principles such as the use of dual channels (audio and visual), minimizing cognitive load, and maintaining visual coherence. These principles helped ensure that the content was engaging and easy to comprehend.

• Development Phase

The 3P Production framework was also applied to enhance the design and technical execution of the animation. The finalized 3D animation-based multimedia is shown in Figure 8.

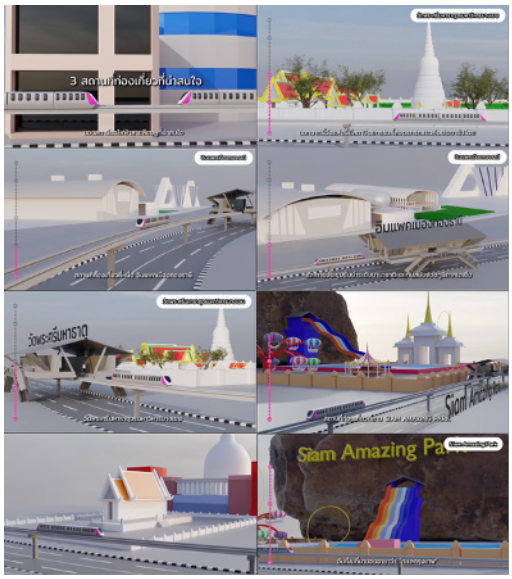

Figure 8: Completed 3D Animation-Based Multimedia Implementation Phase

The finalized animation-based multimedia was distributed digitally to 100 purposively selected users of the Pink Line Monorail. Participants were instructed to view the content on personal devices and subsequently complete an online questionnaire. This ensured flexibility and minimized the need for physical engagement, aligning with modern media consumption patterns.

Evaluation Phase: The Effectiveness of the Developed 3D Animation-Based Multimedia Expert Evaluation (n = 2)

The overall effectiveness of the media in terms of content and presentation was rated as high ($\bar{X}$ =4.00, SD= 0.47). When analyzing specific aspects of content and presentation, the findings are as follows: the alignment of content with objectives was rated as high ($\bar{X}$ =4.00, SD=0.00), the logical sequencing of information received the highest rating ($\bar{X}$ =5.00, SD=0.00), the accuracy and clarity of content were rated as highest ($\bar{X}$ =4.00, SD=1.41), the consistency of content and visuals was rated as high ($\bar{X}$ =3.50, SD=0.71), engagement and narrative flow were also rated as high ($\bar{X}$ =3.50, SD=0.71), and the appropriateness of presentation duration was rated as high ($\bar{X}$ =4.00, SD=0.00).

In terms of graphic design and technical execution, the overall effectiveness was rated highest ($\bar{X}$ =4.06, SD=0.62). Evaluations include character design suitability ($\bar{X}$ =4.50, SD=0.71) rated as highest, scene design and layout rated as high ($\bar{X}$ =4.00, SD=0.00), typography integration rated as high ($\bar{X}$ =3.50, SD=0.71), graphic elements and animations rated as highest ($\bar{X}$ =4.50, SD=0.71), narration quality rated as highest ($\bar{X}$ =4.50, SD=0.71), voice-over suitability rated as high ($\bar{X}$ =3.50, SD=0.71), sound effect quality rated as high ($\bar{X}$ =3.50, SD=0.71), and color selection and consistency rated as highest ($\bar{X}$ =4.50, SD=0.71).

The overall effectiveness of the multimedia in terms of its promotional value was rated as high ($\bar{X}$ =4.00, SD=0.47). Specifically, its effectiveness in promoting rail tourism was rated high ($\bar{X}$ =4.00, SD=0.00), its ability to enhance route understanding was rated highest ($\bar{X}$ =4.00, SD=1.41), and its suitability for promotional use was rated high ($\bar{X}$ =4.00, SD=0.47).Audience Satisfaction (n = 100)

The study assessed the satisfaction of 100 tourists and general passengers using the Pink Line Monorail who were selected through purposive sampling. The overall satisfaction with content quality and presentation was rated high($\bar{X}$ =4.00, SD= 0.69). The detailed findings are as follows: Satisfaction with content alignment to objectives was rated high ($\bar{X}$ =3.75, SD= 0.87). The logical sequencing of content was rated highest ($\bar{X}$ =4.15, SD= 0.59). The accuracy, completeness, and clarity of content received a high rating ($\bar{X}$ =3.94, SD= 0.77). The alignment between content and visuals was rated high ($\bar{X}$ =4.04, SD=0.61).

Satisfaction with engagement and storytelling was rated high ($\bar{X}$ =4.00, SD= 0.66), while the appropriateness of presentation duration received the highest rating ($\bar{X}$ =4.11, SD=0.64).

Regarding graphic design and technical execution, the overall satisfaction rating was highest ($\bar{X}$ =4.03, SD= 0.67). Satisfaction with character design suitability was highest ($\bar{X}$ =4.03, SD= 0.83). The scene design and layout received a highest rating ($\bar{X}$ =4.04, SD= 0.63). Satisfaction with typography suitability was rated highest ($\bar{X}$ =4.01, SD= 0.70). The use of graphic elements was rated highest ($\bar{X}$ =3.99, SD=0.67). Satisfaction with narration quality was rated highest ($\bar{X}$ = 4.11, SD= 0.72), while voice-over effectiveness was highest ($\bar{X}$ =3.97, SD=0.57). Satisfaction with sound effects suitability was rated high ($\bar{X}$ =3.97, SD=0.65). Finally, satisfaction with color selection and consistency was highest($\bar{X}$ =4.11, SD=0.63).

For the overall multimedia value, the satisfaction rating was highest ($\bar{X}$ =4.26, SD= 0.65). Satisfaction with the effectiveness of the multimedia in promoting rail tourism was rated highest ($\bar{X}$ =4.23, SD= 0.66). The effectiveness in enhancing understanding of the Pink Line Monorail route was also highest ($\bar{X}$ =4.23, SD= 0.66). Lastly, the appropriateness of the multimedia for promotional use received the highest rating ($\bar{X}$ =4.34, SD= 0.62).

Summary of Evaluation Results

Expert evaluation indicated that the effectiveness of the animation in terms of content and presentation was high($\bar{X}$ =4.00). The technical execution and graphic design were rated highest ($\bar{X}$ =4.06). The overall value of the multimedia for tourism promotion was also high ($\bar{X}$ =4.00).

Among the 100 participants surveyed, satisfaction with content quality and presentation was rated highest ($\bar{X}$ =4.00). Satisfaction with graphic design and technical execution was highest ($\bar{X}$ =4.03), and satisfaction with the overall value of the multimedia was also highest ($\bar{X}$ =4.26). These findings confirm the effectiveness of 3D animation-based multimedia as a promotional tool for rail tourism.

Discussion of Research Findings

The study findings indicate that the developed 3D animation-based multimedia effectively serves as a promotional tool for rail tourism. This aligns with Mayer's cognitive theory (2021), which suggests that combining motion graphics and audio can reduce cognitive load and enhance information retention. Additionally, the development of 3D animation aids in increasing viewer engagement and comprehension of rail tourism content, consistent with the findings of Wang & Antonenko (2021), who found that 3D animation effectively conveys complex ideas and enhances memory retention.

Regarding multimedia effectiveness, expert evaluations revealed that the content and presentation aspects scored highly ($\overline{X}$ =4.00, SD=0.47), demonstrating that the media successfully communicates travel information and highlights attractions along the Pink Line Monorail route. This supports the study by Xiao et al. (2023), which found that 3D animation enhances tourist awareness of destinations. Furthermore, research by Vijit (2021) confirmed that multimedia animation increases comprehension and encourages public transportation-based tourism.

In terms of design and technical execution, the overall effectiveness received the highest rating ($\overline{X}$ =4.06, SD=0.62), particularly for visual elements and audio integration, which enriched the viewing experience. This aligns with Huang et al. (2021), who emphasized that 3D animation enhances tourism marketing by capturing audience interest. However, there is room for improvement in animation fluidity and realism, as suggested by Chang & Wang (2020: 89). Additionally, research by Pongsak (2022) suggests that well-designed animations with appropriate color schemes and elements can enhance viewer engagement and retention.

Concerning audience satisfaction and its impact on tourism behavior, findings indicate that satisfaction with content and presentation was at the highest level ($\overline{X}$ =4.00, SD=0.69), aligning with Liu's (2022) study, which found that 3D animation technology increases engagement and tourist interest. However, improvements could be made by incorporating interactive elements and expanding travel-related content to better align with audience needs (Kim & Hall, 2021). Similarly, Somsak (2023) found that adding interactive features in digital tourism media enhances user engagement and encourages the use of public transportation.

Recommendations for future development include integrating Augmented Reality (AR) and Virtual Reality (VR), which would allow users to experience rail travel virtually before their journey (Park & Lim, 2022). Thai-based research by Chutima (2021) suggests that VR tourism applications significantly enhance visitor engagement. Additionally, content should be adapted for diverse audiences by incorporating multilingual narration to cater to international tourists (Davis, 2020). Napaporn (2022) found that multilingual media improves accessibility and expands

the potential tourist base. Lastly, further research could examine the impact of 3D animation-based multimedia on tourism behavior using the Technology Acceptance Model (TAM), as suggested by Davis (1989). Phanupong (2023) found that perceived usefulness and ease of use are key determinants in the adoption of new technologies in the tourism sector.

Overall, this study concludes that 3D animation-based multimedia is an effective tool for promoting rail tourism, with positive evaluations from both experts and target audiences. However, further improvements can be made, particularly in enhancing interactivity and leveraging advanced technologies to improve user experience. The findings offer valuable insights for the future development of multimedia-based tourism marketing and contribute to the sustainable growth of rail tourism in Thailand.

Recommendations

Based on the study on the development of 3D animation-based multimedia for promoting rail tourism in the case of the Pink Line Monorail, the following recommendations are provided for future multimedia development and research:

1. Recommendations for the Development of 3D Animation-Based Multimedia

1.Enhancing Interactivity – It is recommended to incorporate interactive elements, such as enabling viewers to explore additional information or navigate through routes interactively. This would allow users to engage with the content based on their interests and improve their understanding.

2.Integrating Augmented Reality (AR) and Virtual Reality (VR) – The adoption of AR and VR technologies can provide a more immersive experience for users, making the presentation of information more engaging and realistic.

3.Improving Animation and Graphic Quality – Although the developed media received high satisfaction ratings, further improvements in animation quality and scene details can enhance realism and viewer engagement.

4.Incorporating Multilingual Narration – To cater to a diverse audience, adding narration in multiple languages, particularly English and Chinese, would enhance accessibility and inclusivity for international tourists.

5.Expanding Content Coverage – The media should include more comprehensive travel information, such as details on facilities, transportation connections, and related tourist activities, to provide a more holistic view of the rail tourism experience.

2. Recommendations for Implementation and Dissemination

1.Expanding Distribution Channels – The developed media should be disseminated through various platforms, such as tourism agency websites, mobile applications, and social media, to maximize accessibility and engagement with the target audience.

2.Collaborating with Businesses and Local Agencies – Partnerships with tourism-related organizations and local businesses can support wider distribution, for example, by integrating the media into government tourism campaigns or collaborating on promotional events with tourism service providers.

3. Recommendations for Future Research

1.Studying Factors Affecting Technology Acceptance – Future studies should explore the factors influencing the adoption and usage of 3D animation-based multimedia among target audiences, using models such as the Technology Acceptance Model (TAM) as a framework.

2.Developing Media for Specific Target Groups – Further research should focus on adapting digital media to better suit specific demographics, such as international tourists, the elderly, or persons with disabilities, ensuring inclusivity and broader tourism promotion.

Conclusion

The ADDIE-based methodology effectively guided the development of engaging, high-quality 3D animation-based multimedia for rail tourism promotion. Statistical evidence from expert evaluations and audience feedback confirms the strengths of the multimedia product in terms of design coherence, technical quality, and promotional value. These findings support the future use of structured instructional design models like ADDIE in multimedia production for tourism and public communication. However, there remains room for further improvements, particularly in interactivity, distribution strategies, and research on its impact on traveler behavior. These insights can serve as a foundation for developing more effective tourism promotional media in the future, ultimately supporting sustainable rail tourism growth in Thailand.

References

Branch, R. M. (2009). Instructional Design: *The ADDIE Approach. Springer*. 1–35.

Chamnarn, T., & Team. (2021). Development of multimedia for promoting rail tourism: A case study of tourist destinations connected to public transport. *Journal of Transport Research*, 12(1), 55-71.

Chang, L., & Wang, X. (2020). The impact of 3D animation on tourism promotion: A case study of digital tourism marketing strategies. *Journal of Travel & Tourism Marketing,* 37(4), 85-99.

Clark, R. C. (2005). *Developing Technical Training: A Structured Approach for Developing Classroom and Computer-Based Instructional Materials.* Pfeiffer. 5–60.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly,* 13(3), 319-340.

Davis, J. (2020). Multilingual accessibility in tourism media: Enhancing communication with digital content. *Tourism Review,* 75(1), 56-72.

Hall, C. M. (2019). *Rail tourism: Sustainable transport perspectives.* Channel View Publications.

Huang, Y., Liu, S., & Wang, J. (2021). The effectiveness of 3D animation in destination marketing: Enhancing visitor engagement through digital media. *Tourism Management,* 82, 214-222.

Kim, S., & Hall, C. M. (2021). Digital transformation in tourism: The role of immersive media and smart technologies. *Journal of Destination Marketing & Management,* 20, 567-589. Kotler, P., Bowen, J. T., & Makens, J. C. (2017). *Marketing for hospitality and tourism* (7th ed.). Pearson Education. 3–38.

Liu, X. (2022). 3D visualization and virtual tourism: An analysis of multimedia engagement in destination branding. *Journal of Tourism Research,* 28(3), 45-59.

Mayer, R. E. (2009). *Multimedia learning* (2nd ed.). Cambridge University Press.

Mayer, R. E. (2021). *Multimedia learning* (3rd ed.). Cambridge University Press.

Ministry of Tourism and Sports. (2022). *Annual tourism report 2022. Office of Tourism Policy and Strategy.*

Molenda, M. (2003). In search of the elusive ADDIE model. Performance Improvement, 42(5), 34–36.Moreno, R., & Mayer, R. E. (2019). Interactive learning through animated multimedia: Cognitive principles and design strategies. *Educational Psychology Review,* 22(2), 87-105.

Office of Transport and Traffic Policy and Planning. (2022). *Guidelines for developing the rail transport system in Bangkok and metropolitan areas.* Bureau of Transport and Traffic Planning.

Office of Transport and Traffic Policy and Planning. (2023). *Report on the development of public transport systems and the Pink Line Monorail Project.* Bureau of Transport and Traffic.

Park, Y., & Lim, S. (2022). The role of animation in public relations campaigns: A case study on transportation communication strategies. *Journal of Public Relations Research*, 34(2), 38-51.

Peterson, C. (2003). Bringing ADDIE to life: Instructional design at its best. *Journal of Educational Multimedia and Hypermedia,* 12(3), 227–241.

Ruangsompong, P. (2015). The use of 2D animation media for disseminating information about the ASEAN Community. *Journal of Communication Studies,* 7(2), 45-61.

Schramm, W. (1954). *How communication works.* In W. Schramm (Ed.), The process and effects of mass communication (pp. 3-26). University of Illinois Press.

Shannon, C. E., & Weaver, W. (1949). *The mathematical theory of communication.* University of Illinois Press. 1–30.

Suksawat, C. (2021). The use of virtual reality (VR) technology in promoting tourism in Thailand. Journal of Tourism and Culture, 15(2), 88-102.

Wang, Y., & Antonenko, P. (2021). Evaluating the impact of 3D animation on cognitive load and knowledge retention in digital tourism guides. *Computers in Human Behavior,* 121, 312-325.

Williams, R. (2020). *3D animation essentials: A step-by-step guide to digital media production.* Wiley.

Xiao, Y., Zhang, P., & Li, H. (2023). Enhancing tourism promotion through immersive 3D content: The future of destination marketing. *International Journal of Tourism Research*, 29(1), 98-112.