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DEVELOPING A CONCEPTUAL FRAMEWORK FOR ENHANCING CULTURAL HERITAGE LEARNING USING VIRTUAL REALITY TECHNOLOGY

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Abstract: This study explores the outcomes of digital cultural learning, with a focus on the limitations observed in informal cultural heritage learning settings despite extensive scholarly investigation. Recognizing that cultural heritage learning encompasses more than cognitive knowledge transfer, including emotions, attitudes, behavior, engagement, enjoyment, and interaction, this research underscores the growing relevance of virtual reality technology as a learning medium, particularly accelerated by the COVID-19 pandemic. The research objectives are: (1) to identify an appropriate learning approach for cultural heritage learning through virtual technology, and (2) to propose a conceptual framework for cultural heritage learning using VR technology. The methodology involves a comprehensive literature review on cultural heritage learning and validation of proposed learning concepts by five experts, incorporating experiential learning, discovery learning strategy, and motivational learning theory. Findings reveal that cultural heritage learning emphasizes interactivity, enjoyment, integrating assessment and self-directed learning features in virtual applications to enhance user participation and effectiveness in cultural heritage learning. Expert reviews affirm the relevance and compatibility of the proposed features, suggesting they enhance the effectiveness of cultural heritage learning. This positive feedback supports the validity and potential impact of the conceptual framework,

confirming its suitability for virtual environment applications in cultural heritage learning. This research contributes to making cultural heritage content more accessible, enjoyable, and educationally valuable through innovative VR applications.

Keywords: Cultural heritage learning, Digital learning, Effective learning, and Virtual reality technology

1. INTRODUCTION

Since 2020, scholars have extensively explored the outcomes of digital cultural learning, particularly through cognitive components and technological mediums designed for classroom settings. However, some studies, such as Chen et al. (2022), have found no significant outcomes for informal cultural heritage learning. The research underscores that cultural heritage learning goes beyond mere knowledge transfer, encompassing emotions, attitudes, behaviors, engagement, enjoyment, and interaction. The shift toward digital learning was accelerated by the COVID-19 pandemic, which necessitated innovative learning approaches and highlighted the growing relevance of virtual reality (VR) technology as a medium. This study aims to (1) identify an effective learning approach for cultural heritage education using virtual technology and (2) propose a conceptual framework for cultural heritage learning via VR technology. To achieve these objectives, the research integrates learning theories such as experiential, discovery, and motivational learning, which align with the interactive and immersive nature of cultural heritage education. These theories emphasize hands-on experiences, participation in cultural activities, and emotional engagement, which enhance appreciation and understanding (Caroline Dike et al., 2023). Furthermore, Bachiller (2023) argues that such theories foster user engagement, self-directed learning, and exploratory knowledge development while promoting learning motivation.

The methodology involves a comprehensive literature review on cultural heritage learning and validation of the proposed framework by five field experts. Each learning theory is systematically analyzed for its attributes and role in shaping virtual environment features tailored to cultural heritage education. These theoretical insights inform the design of VR applications, ensuring they effectively support engaging and meaningful cultural heritage learning experiences.

2. LITERATURE REVIEW

2.1 *Experiential Learning Theory (ELT)*

Experiential Learning Theory (ELT) is a significant theory that underscores the value of learning through direct experience (Rajendra, 2020), particularly relevant when applied to Cultural Heritage Learning (CHL) concept. This review seeks to establish a connection between ELT and CHL by highlighting its pivotal role in realizing a concept of CHL. Additionally, this review examines main previous studies in CHL and correlates this learning concept to offer a comprehensive understanding of cultural learning approaches.

One prominent model within experiential learning is Kolb's Learning Model (KLM), developed by David Kolb. This model posits that learning unfolds through a cycle of four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Morris, 2020). According to Kolb's model, individuals exhibit preferred learning styles influenced by their cognitive and affective traits, as well as the learning context's demands. The model delineates four learning styles:

i. Diverging (feeling and watching): Learners who prefer learning through concrete experiences and reflective observation, often imaginative and adept at generating new ideas.
ii. Assimilating (watching and thinking): Learners are inclined towards abstract conceptualization and reflective observation, characterized by logical analysis and adeptness in constructing theoretical models.
iii. Converging (doing and thinking): Learners who favor abstract conceptualization and active experimentation, emphasizing practicality and application of theories to solve problems.
iv. Accommodating (doing and feeling): Learners who thrive in concrete experiences and active experimentation, intuitive and adaptable in dynamic situations, and effective in collaborative settings.

Kolb's model asserts that understanding one's preferred learning style, shaped by personal traits and learning contexts, can optimize learning experiences and outcomes. This learning theory encompasses key components such as active participation, reflection, feedback, and application. The theory finds application across diverse educational settings, including formal education, workplace training, and personal development. It enhances engagement, critical thinking, and problem-solving skills, and fosters lifelong learning (Kolb, 1984).

Drawing from this learning theory, several key attributes can enhance the effectiveness of cultural heritage learning through virtual reality technology. This includes designing interactive exhibits for hands-on exploration, providing opportunities for critical reflection through interactive prompts, offering instant feedback and personalized guidance, facilitating practical knowledge application via virtual tours, and customizing experiences based on individual interests. These elements collectively create a more engaging and immersive learning environment that fosters deeper engagement with cultural heritage. By integrating these ELT attributes into virtual reality application design, a more engaging and personalized learning environment can be created, aligning with cultural heritage learning principles as shown in Figure 1. This approach promotes interactive, self-directed learning experiences that enhance user engagement, knowledge retention, and enjoyment, fostering a deeper appreciation and learning of cultural heritage.

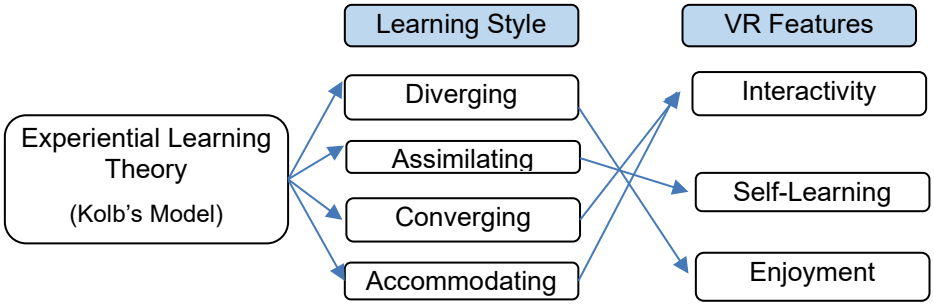


Figure 1. Derived Product Characteristics from ELT

Virtual reality applications can enhance the effectiveness of cultural heritage learning by catering to different learning styles through tailored features. For learners with a diverging style, immersive VR environments offer visually captivating experiences that stimulate their imagination and enhance enjoyment while exploring cultural heritage. Those inclined towards assimilating information benefit from VR applications that provide detailed, interactive learning materials and simulations, facilitating self-directed exploration and deep understanding. Users with a converging learning style engage effectively with VR applications featuring hands-on activities and interactive challenges, promoting practical application of knowledge and problem-solving skills. Accommodating learners benefit from interactive VR environments that encourage active experimentation and real-time decision-making, enhancing personal engagement and enjoyment. By aligning these learning styles with features such as interactivity, self-directed learning opportunities, and enjoyable experiences, VR applications can effectively support diverse learning preferences and maximize the educational impact of cultural heritage learning experiences.

2.2 Discovery Learning Strategy (DLS)

Derived from constructivist learning theory, Discovery Learning Strategy (DLS) emphasizes problem-solving situations, enabling learners to construct new knowledge based on prior information and experiences (Ozdem-Yilmaz & Bilican, 2020). Introduced by Bruner in 1961, this approach encourages learners to test hypotheses and discover knowledge independently, moving away from traditional teacher-centered methods (Martaida et al., 2017). DLS, also known as "constructive interaction," provides valuable insights into user thinking processes including perception, responses, interactions, and emotions during learning tasks as illustrated in Figure 2

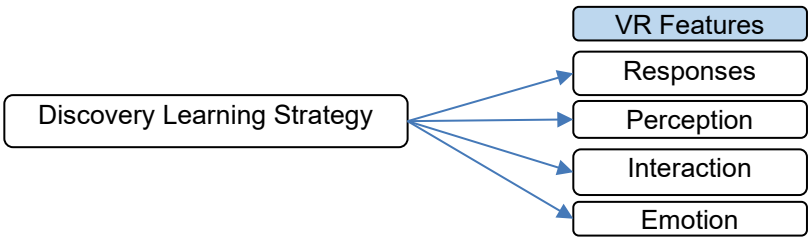


Figure 2. Derived Product Characteristics from DLS

Novantri highlights DLS's role in education, where it fosters active student participation in knowledge development through creating experiments, solving problems, and developing strategies (Novantri et al., 2020). This approach not only engages students actively but also enhances learning outcomes significantly, with studies showing up to a 56% improvement compared to non-DLS methods (Anggraeni et al., 2020). In cultural heritage learning contexts, DLS proves effective in fostering creative knowledge acquisition and intellectual development through independent, problem-based learning (Rashidov, 2023). Therefore, integrating DLS into cultural heritage learning frameworks promotes problem-based learning characteristics and effective learning performance. This learning strategy is aligned with constructivist principles that support self-directed learning, where learners take ownership of their learning processes. Moreover, its emphasis on active, problem-solving learning enhances engagement and enjoyment, contributing to a more fulfilling educational experience.

2.3 *Motivational Learning Theory (MLT)*

The ARCS Model of Motivational Design, developed by John M. Keller (1987), stands as a well-established theoretical framework utilized to enhance motivation within educational contexts. Its application to Cultural Heritage Learning (CHL) provides a structured approach to fostering motivation and engagement, pivotal components in the realm of cultural heritage learning. This literature review examines the implementation of the ARCS Model in CHL, focusing on its impact on motivation and its role in enhancing cultural learning performance. The ARCS Model comprises four essential components: Attention, Relevance, Confidence, and Satisfaction, collectively guiding educators in designing and delivering motivating learning experiences (Chen et al., 2022). Within CHL, capturing learners' attention proves crucial, particularly given the diverse and intricate nature of historical and cultural content. Effective strategies such as immersive storytelling, multimedia presentations, and interactive simulations are employed to ignite curiosity and engage learners with cultural heritage topics (Pisoni et al., 2021).

In multicultural educational settings, cultural heritage learning may initially appear distant or irrelevant to learners. The ARCS Model encourages virtual reality technology to underscore the relevance of cultural heritage by linking it to learners' identities and experiences. Inclusive curricula that emphasize personal and community histories contribute to fostering a sense of belonging and enhancing personal relevance (Van der Hoeven & Brandellero, 2015).

Given the complexity inherent in CHL, including understanding historical contexts, interpretation, and critical analysis, the ARCS Model advocates for scaffolding the learning experience to bolster learners' confidence. This entails providing structured guidance, opportunities for skill development, and clearly defined learning objectives. Gradually increasing task complexity while offering adequate support enables learners to cultivate the self-efficacy needed to engage deeply with cultural heritage content (Thompson et al., 2022).

Ensuring learners' satisfaction with cultural heritage learning involves creating a supportive and encouraging learning environment. Regular feedback, positive reinforcement, and opportunities for personal achievement or recognition play pivotal roles in this process. These elements not only bolster learners' commitment but also enhance overall learning performance and experience (Filgona et al., 2020).

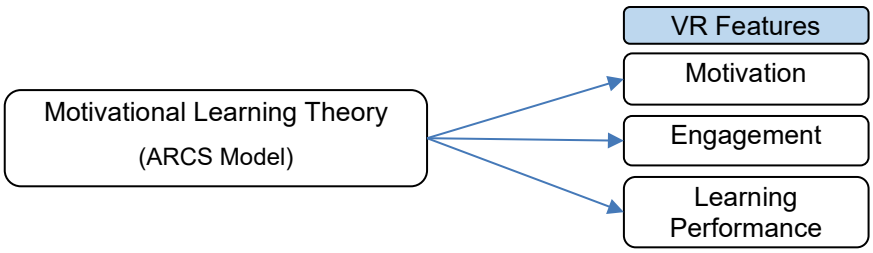


Figure 3. Derived Product Characteristics from MLT

By applying the ARCS Model in CHL, the virtual reality application enhances motivation, engagement and contributes to improved cultural learning performance as illustrated in Figure 3. Addressing the components of Attention, Relevance, Confidence, and Satisfaction makes cultural heritage content more captivating, meaningful, accessible, and rewarding for learners. Integrating these principles into the design of assessment features within virtual environments can further enhance engagement, relevance, and satisfaction, thereby supporting deeper cultural understanding and fostering appreciation among learners.

3. METHODOLOGY

The methodology employed in this research comprises two main phases. The first phase involved a content analysis through a comprehensive literature review. This phase focused specifically on three prominent learning theories: Experiential Learning Theory (ELT), Discovery Learning Strategy (DLS), and Motivational Learning Theory (MLT). These theories were selected based on their alignment with the conceptual characteristics of cultural heritage learning. They were critically examined to propose suitable features for virtual reality applications tailored for cultural heritage learning. This phase was instrumental in achieving the first research objective.

The second phase of the methodology focused on obtaining expert validation for the proposed conceptual framework of virtual reality features aimed at enhancing learning performance in cultural heritage education. Five experts participated in this review: two specialists in Human-Computer Interaction (HCI), one in Multimedia, one in Virtual Reality (VR), and one in Cultural Heritage Learning Education. Using a structured questionnaire incorporating Likert scale ratings and short-answer responses, the experts provided critical insights and suggestions, ensuring a thorough evaluation of the framework (Abubakar et al., 2013). The selection of these five experts, deemed sufficient for theoretical framework validation as suggested by Al-Aidaroos (2017), was based on their diverse areas of expertise. This multidisciplinary approach ensured a holistic review, with their feedback proving instrumental in affirming the framework's potential to enhance learning performance in cultural heritage education.

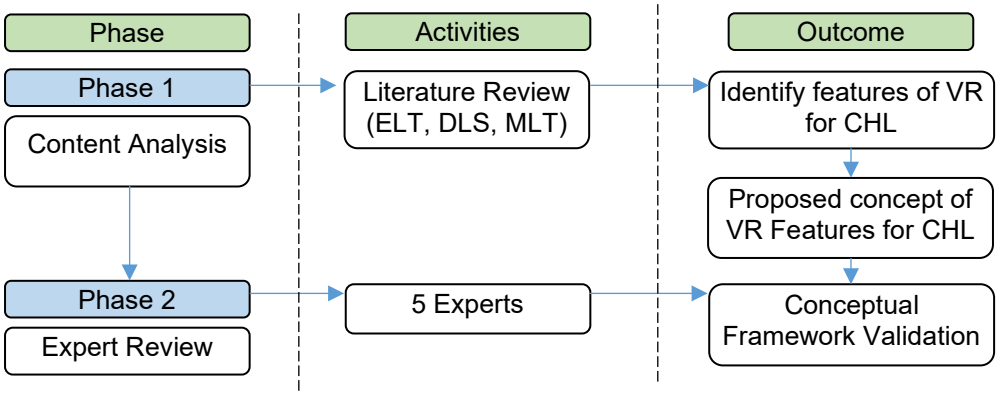


Figure 4. Methodology phases

The flow of these two phases is visually represented in Figure 4, illustrating the sequential process of validating the conceptual framework through literature analysis and expert feedback. This methodological approach ensures both rigor and comprehensiveness, providing a strong theoretical foundation while ensuring the

practical applicability of the proposed virtual reality features for cultural heritage learning.

4. DATA FINDINGS AND ANALYSIS

4.1 Virtual Reality Application Features for Effective Cultural Heritage Learning

The study explores three prominent learning theories (Experiential, Discovery, and Motivational learning) as discussed in the literature review section. The research meticulously examines the attributes associated with each theory to identify essential elements for seamless integration into framework components, particularly within the context of virtual environments for cultural heritage learning. The research establishes a significant link between these learning theories and the features required in virtual applications, as depicted in Figure 5.

Experiential learning emphasizes the importance of interactivity and self-directed learning of virtual reality technology within cultural heritage contexts. Discovery learning similarly prioritizes interactivity and enjoyment as critical features. Motivational learning stresses the incorporation of assessment and interactivity features in virtual applications to foster user participation and enhance the effectiveness of cultural heritage learning. These findings collectively set the foundation for developing prototype features that draw inspiration from the unique features of each learning theory to promote effective cultural heritage learning.

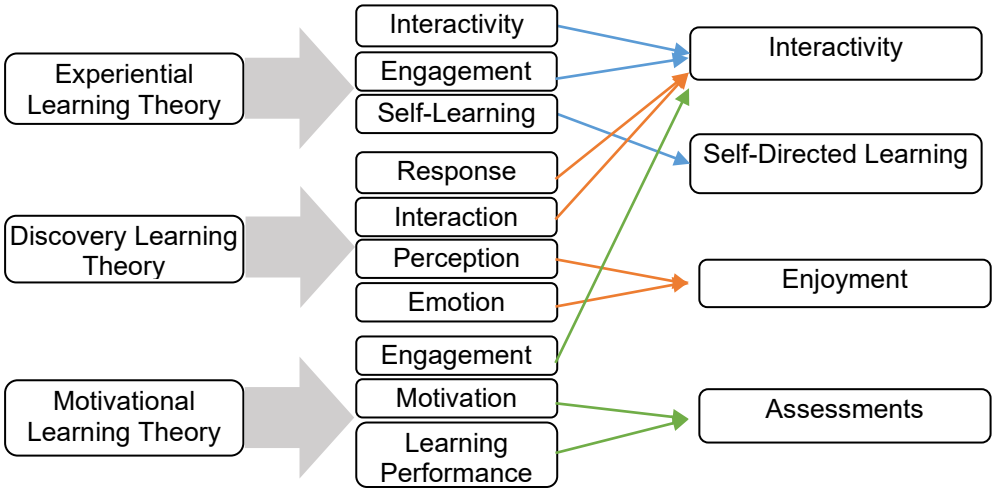


Figure 5. Derived Virtual Application Features from Learning Theories

As a result, these identified virtual reality features have been utilized to propose an effective conceptual framework for virtual environment applications in cultural heritage learning. Figure 6 illustrates this proposed conceptual framework, which aims to achieve the second objective of the research.

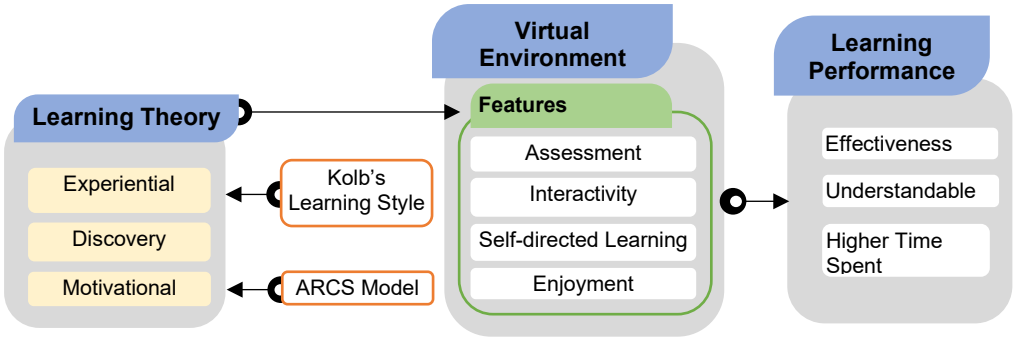
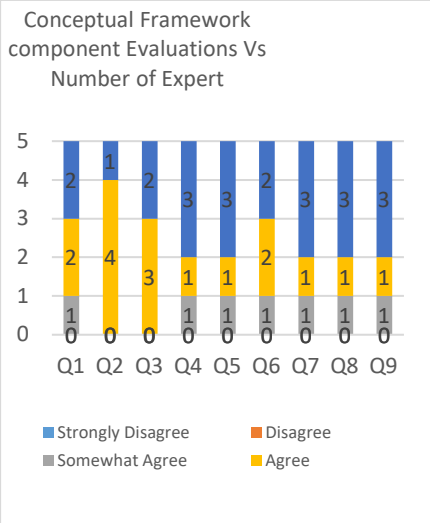


Figure 6. Conceptual Framework of Virtual Environment Application for Effective Cultural Heritage Learning

The prototype development involved several stages, including storyboard design, content collection, and integration. Storyboards served as a guide for design refinement, incorporating feedback throughout the process. The development integrated elements from the proposed framework, such as 3D model artifacts, 360° panoramic images, cultural heritage quizzes, and rich media like images and videos. This approach ensured the creation of a cohesive and immersive virtual museum experience, aligning with content delivery, aesthetics, and user engagement objectives.

4.2 Conceptual Framework Validity

The proposed conceptual framework underwent a comprehensive validation process following its development. Initially informed by an extensive literature review and prior investigations on cultural heritage learning, the framework was refined using an expert review method. This review involved soliciting feedback from specialists in relevant fields. The data obtained from the expert review were systematically organized and presented. The outcomes of the expert evaluation, conducted using a Likert scale, were visually represented through clustered column charts, as shown in Figure 7. This data analysis provided a detailed overview of response frequencies, offering insights into the compatibility and relevance of the proposed framework.



Questionnaire of Expert Review

No	Question
Q1	The learning theories in the proposed conceptual framework is compatible and relevant
Q2	The overall connection and flow of all components and elements are logical, compatible, and relevant
Q3	The overall structure and flow of all components and elements are readable and usable for a virtual museum application development
Q4	The Experiential Learning theory that has been applied in the proposed conceptual framework for cultural heritage learning is compatible and relevant.
Q5	The Discover Learning theory that has been applied in the proposed conceptual framework for cultural heritage learning is compatible and relevant
Q6	The Motivational Learning theory that has been applied in the proposed conceptual framework for cultural heritage learning is compatible and relevant
Q7	The Interactivity element in virtual museum features is compatible and relevant to enhance cultural heritage learning.
Q8	The Self-directed learning element in virtual museum features is compatible and relevant to enhance cultural heritage learning
Q9	The Enjoyment element in virtual museum features is compatible and relevant to enhance cultural heritage learning to enhance cultural heritage learning

Figure 7. Expert Level of Agreement on the Questionnaire Items

The table summarizes the expert review feedback on the proposed conceptual framework for virtual environment applications in cultural heritage learning. The responses to nine questions (Q1 to Q9) are categorized into five levels of agreement: Strongly Disagree, Disagree, Somewhat Agree, Agree, and Strongly Agree. For Q1, most experts (4 out of 5) either agreed or strongly agreed, indicating a general approval of the statement associated with this question. Q2 shows an even stronger consensus, with all experts agreeing or strongly agreeing, reflecting a highly positive reception. Similarly, Q3 received unanimous agreement, with a notable lean towards strong agreement, suggesting robust approval. Q4 and Q5 exhibit similar patterns, with most experts strongly agreeing. This trend continues in Q6, where most responses fell into the agree or strongly agree categories, showing positive feedback. Q7, Q8, and Q9 also reflect this pattern, with most experts strongly agreeing, indicating consistent positive views across these questions.

Overall, the responses indicate a strong positive consensus among experts. There were no instances of Strongly Disagree or Disagree, suggesting that the proposed framework did not receive any negative feedback. The data reveals that experts found the proposed features relevant and compatible, likely enhancing the effectiveness of cultural heritage learning. This positive feedback supports the validity and potential impact of the conceptual framework, confirming its appropriateness for virtual environment applications in cultural heritage learning.

5. DISCUSSION

5.1. Enhancing Cultural Heritage Learning through Virtual Reality

This study's exploration of three prominent learning theories (Experiential, Discovery, and Motivational learning) has provided critical insights into the essential features for effective VR applications in cultural heritage learning. The meticulous analysis of the theory's attributes has enabled the identification of key elements that can be integrated into VR environments, ultimately enhancing cultural heritage learning.

Experiential learning emphasizes interactivity and self-directed learning. Within the context of cultural heritage, these features are crucial as they allow learners to actively engage with the content and explore it at their own pace. VR applications that incorporate interactive elements, such as virtual tours and hands-on activities, can immerse learners in cultural heritage sites and artifacts, making the learning experience more dynamic and memorable. Self-directed learning enables learners to take control of their educational journey, fostering a deeper and more personalized understanding of cultural heritage.

Discovery learning highlights the importance of enjoyment and exploration. VR applications that prioritize enjoyable experiences can captivate learners' interest and encourage continuous engagement with cultural heritage content. Elements such as gamified learning, immersive storytelling, and interactive simulations can make the process of discovering cultural heritage both fun and educational. Enjoyment in learning is particularly important for sustaining long-term interest and motivation, which are essential for deepening cultural knowledge.

Motivational learning underscores the necessity of incorporating assessment features within VR applications. These features can provide learners with feedback on their progress and understanding, helping to maintain their engagement and motivation. Assessments, such as quizzes and interactive challenges, can enhance the learning experience by offering measurable goals and rewards. This approach not only keeps learners engaged but also reinforces their knowledge and skills related to cultural heritage.

5.2 Contributions to Effective Cultural Heritage Learning

The findings and expert validation suggest that the proposed conceptual framework significantly contributes to effective cultural heritage learning through VR applications. By integrating essential elements from Experiential, Discovery, and Motivational learning theories, the framework provides a comprehensive approach to designing VR environments that are engaging, interactive, and educationally effective.

The interactive and self-directed learning features, aligned with Experiential and Discovery learning principles, ensure that learners can deeply engage with and explore cultural heritage content. The emphasis on enjoyment and assessment features, as highlighted by Discovery and Motivational learning theories, helps maintain learner motivation and provides valuable feedback on their progress.

This comprehensive approach enhances the learning experience by making cultural heritage content more accessible, enjoyable, and educationally valuable. The proposed framework supports the development of VR applications that not only engage learners but also improve their understanding and appreciation of cultural heritage.

5.3 Future Research Directions

While the proposed framework has received positive feedback and validation from experts, future research should focus on empirical testing and user studies to further refine and optimize the VR application features. Longitudinal studies could provide deeper insights into the long-term effectiveness of these features in enhancing cultural heritage learning. Additionally, exploring the integration of emerging technologies, such as augmented reality (AR) and artificial intelligence (AI), could offer new dimensions to the framework, further enriching the learning experience.

6. CONCLUSION

In conclusion, the proposed conceptual framework, grounded in Experiential, Discovery, and Motivational learning theories, provides a validated and effective approach for developing VR applications in cultural heritage learning. The strong consensus among experts highlights its relevance and potential impact, setting the stage for future advancements in the field and significantly contributing to the preservation and appreciation of cultural heritage through innovative educational technologies.

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