Digital Heritage in VR: 360° Media, Theological Insights and Interactive Artifact Exploration – The Case of Tel Lachish

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Abstract: The usage of Virtual Reality (VR) in higher education opens up new possibilities to enhance teaching to be more interactive and immersive. The following study examines the development of a use-case for theology built on the MyScore open-source VR framework rooted in engineering hydrology, a VR application extending to construction informatics by enabling digital twins for historical site reconstruction and sustainable analysis, reducing carbon footprints from physical excursions. The application enables multi-user, location- and time-independent interaction in VR with the historical site of Tel Lachish. It combines 360° media with a digital learning space that provides in-depth historical content, as well as an interactive environment featuring a puzzle-based reconstruction of a museum relief, allowing for exploratory engagement with ancient artifacts. The use of mixed-method approaches, combining curated questionnaires and in-situ observations, shows how the VR environment supports understanding of historical and theological contexts and explores the associated challenges. The findings show that the immersive combination of virtual environments and interactive learning elements not only increases interest in the subject matter, but also enables new forms of knowledge acquisition. The possibility to learn in a self-paced and mentor-guided manner was perceived as flexible and effective by the users. However, technical issues, especially in terms of device usage and stable internet connectivity, were noted. This study highlights the potential of using VR to enhance traditional teaching methods by creating location-independent, collaborative and interactive learning environments, which are tailored as a support for higher education, where physical access to historical sites is limited.

Keywords: Virtual Reality, Theology, Unity, Immersive Learning, Higher Education

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1 Introduction

1.1 Problem Statement

In theological education, historical sites such as Tel Lachish often remain abstract, since they are usually conveyed through texts or two-dimensional media [1]. Historical-critical biblical science requires contextualization of ancient texts, typically deepened through real-world excursions a method hindered by costs, access restrictions and logistical challenges [2]. VR provides innovative ways to make historical contexts accessible and immersive by integrating archaeological findings with textual narratives [3]. Using the example of the Assyrian conquest of Lachish (701 BC), a key archaeological site for understanding biblical narratives, this study examines how VR-supported learning environments promote theological education by deepening historical understanding and commitment, as well as enabling historical building preservation and sustainable site analysis. The application was developed within the open-source VR framework MyScore [4], targeting theology students. The framework, initially tailored, for civil engineering scenarios like flood protection and virtual site modeling, bridges theological heritage with informatics tools for building preservation and digital sustainability [4].

1.2 Objective and Research Question

The goal of this study is to examine the didactic potential of VR and the provided learning environment for historical-theological content. The main focus is to analyze how VR enhances motivation, historical empathy and comprehension through the implementation of traditional media (text, images, videos) in an immersive environment, as well as using constructivist principles [5] for an interactive teaching environment. Research questions:

1. How does VR foster motivation, empathy and contextual comprehension in historical-theological learning?
2. What learning effects arise from combining classical media with immersive spatial experiences?
3. What potential and limits does VR have as an excursion alternative?

The use-case was designed primarily for theology undergraduates to contextualize biblical sites, whereas MyScore's VR framework makes it adaptable for construction-related domains like hydrology engineering education (e.g., virtual flood simulations) and digital heritage preservation in building informatics [4]. This study emphasizes VR in education with sustainability via MyScore's alignment to SDG 4. While VR has been widely applied in engineering, medicine and language learning [6], [7], applications in theological or religious-historical contexts remain underrepresented. Recent systematic reviews [6], [7] list few or no examples that combine archaeological reconstruction, theological interpretation and interactive artifact engagement, marking this as a niche with distinct didactic potential.

2 Theoretical Framework

2.1 Historical-Critical Bible Science and Digital Contextualization

The historical-critical exegesis examines biblical texts as literary testimonies in their historical and cultural context [8]. VR enhances textual work with the addition of visual and spatial components,

enabling historical empathy and illustrating the difference between text and reconstructed history [6], [9], [10]. VR visualizes archaeological textual discoveries, enabling learning with multi-perspectives and building a bridge to abstract text analysis with historical contexts [6].

2.2 Virtual Reality in the Educational Context

VR offers high potential in didactics with the use of immersion, presence and interactivity [11]. Immersion enables diving deep into the virtual environment, presence creates a feeling of attendance with avatars and interactivity promotes active exploration [12], [13]. Incorporation of 360° media enables a change of perspective, while playful elements such as puzzles increase motivation and cognitive activation [14]. Multi-user functions support social interactions and communication in collaborative learning environments [12], [13]. Immersive media creates emotional approaches to promote historical empathy [6]. In theological education, real-world excursions are a core component of methodological competence and VR offers a scalable, accessible alternative to physical visits (e.g. Lachish or Jerusalem) [15]. Gamified methods increase participation through playful, problem-solving-oriented tasks that are coordinated with learning objectives [5], [7].

3 System Development

3.1 Technological Basics

The VR use-case of Tel Lachish was created with the help of Unity Engine (2022 LTS) and the open-source VR framework MyScore [4]. Additionally, Blender for 3D modelling was incorporated in the development process. The Meta Quest 2 and Meta Quest 3 standalone VR devices were used for the testings. The VR framework enables the integration of 360° media, interactive actions and multi-user functionalities in a modular design. It is optimized for mobile headsets as well as an non-immersive Windows version. The framework ensures scalability and synchronization in multi-user environments.

3.2 Conception of Content: Tel Lachish as a Place of Learning

The VR environment contains four functionally structured areas, each containing elements of immersion, exploration, cognitive activation and cooperative interaction through intuitive interfaces, direct feedback and adaptive media control (Overview: [16]). The rooms are:

- **Meeting Room**: Starting center point with navigation aids, a meeting area for synchronous sessions with up to 20 users and a screen-sharing zone for collaborative parts of web content. The open design offers a clear overview of all modules and makes navigation easier (Figure 1).
- **360° Excursion Room**: Provides 360° media with an interactive map and laser pointer, using ‘Star’ shaped UI elements for user-friendly navigation (Figure 2).
- **Media Room**: Offers classic educational media formats with curated choices, that support the learning content of the environment and provide additional information (Figure 3).
- **Relief Room**: Enables the reconstruction of the Assyrian Tel Lachish Relief (British Museum) with 3D fragments, triggers for contextual videos and an introduction video that supports users through the task, as well as give valuable information after a successful execution (Figure 4).

Figure 1: Meeting area

Figure 2: 360° media area

Figure 3: Media room

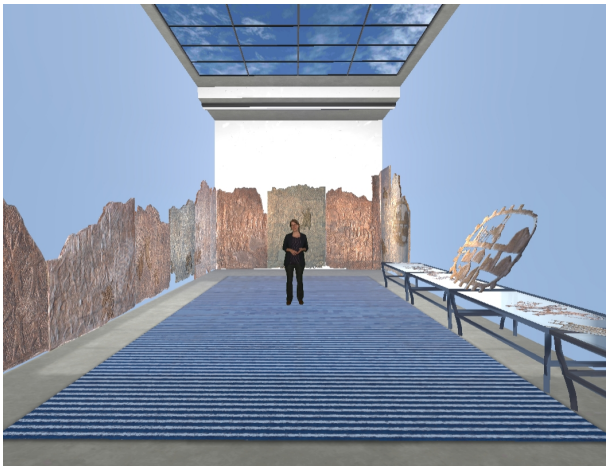

Figure 4: Relief room

3.3 Usability and Technological Challenges

For efficient use of VR devices, a well-structured introduction to the control and navigation system is needed to provide users with different technical backgrounds with the most comfortable experience. Challenges include motion sickness, limited battery life, high graphics processing demands and stable network connectivity. VR hardware and software preparation is essential to minimize technical issues.

To ensure accessibility and comfort, the VR experience was implemented within the MyScore framework with built-in comfort features such as teleport locomotion and vignette mode to reduce peripheral motion during navigation, as well as a snap turn feature. These measures address motion sickness by limiting continuous acceleration and maintaining a stable horizon, in line with VR ergonomics research [11]. While no dedicated measurement of motion sickness was conducted, no participant reported discontinuing the session due to discomfort.

Battery life and device overheating were mitigated through a low-poly visual style, which reduces GPU load and short sessions rather than prolonged exposures. Graphical demands were further reduced through light baking and efficient asset management, minimizing real-time lighting calculations. These

methods are known to improve battery longevity without noticeably impacting immersion [9], [10] and together they supported smoother performance without compromising learning content.

4 Didactic Design

The VR use-case "Tel Lachish" was developed as an immersive, skill-oriented and multimedia learning environment for theological and historical education. The main focus was offering historical contextualization, digital skills and broad learning methods. The design corresponds to the concepts of constructive alignment, aligning objectives, immersive tasks, and assessment opportunities.

4.1 Learning Objectives

The learning environment supports:

- **Understanding historical contexts**: Learners are encouraged to engage with biblical contexts in a spatial and visual way, helping them to better grasp the historical settings and narratives behind the scriptures.
- **Developing methodical skills**: The VR environment supports the development of practical skills in using digital media formats such as 360° media, videos and interactive puzzle pieces to enable learners to navigate and examine content effectively.
- **Gaining digital and communicative skills**: Through collaborative multi-user activities in a shared space, students strengthen their ability to use modern learning technologies and interact meaningfully with others in the virtual environment.

4.2 Learning Modes and Learning Experience

A self-directed exploration for autonomous learning and a mentor-based mode with structured guidance were offered. Both showed complementary advantages in autonomous versus contextual support. The learning experience follows flow and constructivist principles, enhancing motivation, emotional engagement and knowledge gain [5], [7]. Flow enables balanced challenges and direct feedback in the virtual environment, while constructivism enables interactive tasks, reflection and collaboration. Additionally, flow improves emotional engagement and historical empathy.

4.3 Integration into the Teaching Context

The application is versatile for digital excursions, seminars or extracurricular activities and offers a low-threshold entry into biblical-historical learning. It enables the combination of experiences with traditional text analysis in workshop formats or as a cost-efficient alternative to physical study trips. The modular design allows teachers to adapt content to specific curricular needs, which increases applicability in different teaching contexts.

4.4 Evaluation Methods

A mixed-method approach combined quantitative Likert-scale questionnaires (motivation, usability, satisfaction) and qualitative in-situ observations (interaction, communication). The quantitative evaluation used a 5-point Likert scale (1 = Strongly agree, 5 = Strongly disagree), chosen for its balance between sensitivity and participant reliability in small-sample studies [5], as well as multiple-choice selections. The full questionnaires and results are available publicly via the project's OSF repository [17]. The questionnaire contained five core items:

- The VR environment improved my understanding of the historical context.
- The interactive elements increased my motivation to learn.
- The navigation was intuitive and easy to use.
- The 360° media enhanced the realism of the experience.
- I would like to use VR for similar learning activities in the future.

Participants: N = 21 (mean age = 28.9 years, SD = 8.1; range = 19–54), 14 female, 6 male, 1 divers. Participants (theology students and scientific staff) volunteered in a seminar context. Qualitative data were gathered from in-situ observation of user interaction, communication and task completion.

Descriptive statistics were used for all items; no regression or correlation analysis was performed due to the exploratory scope and small sample size. A control group was not implemented in this study but is planned for future iterations to compare with traditional methods. Standardized usability instruments such as SUS or UMUX were not applied here, which may limit generalizability, but will be integrated in future studies to enable direct comparability with other systems.

5 Results and Evaluation

The mixed-method analysis with 21 participants showed:

- 66,7% (14/21) had no VR experience, underlining the need for a guided introduction. An introductory environment supported 78,9% (16/19) to understand the VR control.
- The VR application was considered by most users as motivating and helpful, based on the available learning content (e.g., "helps to better understand content," "playful learning"). 47.6% are unsure to use VR in the future, 23.8% plan to use it, 23.8% don’t plan to use it .
- The contribution to deeper understanding of historical context with puzzle-based reconstruction was rated as 30% significant, 40% slight, 20% minimal, 10% confusing.
- 85,7% (18/21) found the 360° media to be "quite" or "very immersive" and 73,7% (14/19) rated the instructional videos as "very" or "quite effective" for additional information.
- 81% (17/21) expressed interest in applying VR experience to other topics or places in a different context (e.g., Jerusalem).
- 75% (15/20) preferred mentor-based teaching units through a lecturer.

6 Discussion

The questionnaire and observations suggest that the VR application was perceived as motivating and helpful for developing historical understanding by the participants, particularly through the use of 360° media and interactive puzzles. It supports both self-directed and guided learning. Despite technical challenges, VR remains a scalable addition to teaching. Comfort depends on smooth interaction

design, while battery limits, space (2.5 m²) and stable networks remain key for multi-user use. Given the small sample size, descriptive statistics were used to identify trends, reserving advanced tests for future controlled studies.

7 Conclusion and Outlook

The presented study explored if VR can enhance student motivation, historical empathy and contextual understanding in historical-theological learning. Immersive 360° media, puzzle-oriented artifact exploration and combination of independent and guided reflection were perceived as engaging and helpful learning strategies. Most participants reported increased motivation and improved comprehension, though these findings remain tentative due to the small sample size and reliance on descriptive measures. Despite limitations related to hardware, network availability and setup requirements, the "Tel Lachish" application illustrates how VR can function as a flexible, location-independent alternative to traditional excursions, enabling collaborative and interactive learning experiences. The combination of archaeological reconstruction, theological interpretation and interactive artifact engagement may offer a perspective less common in current VR learning contexts [9], [15]. Future research approaches should add additional analytic methods as controlled comparisons, correlation and regression tests and standardized usability measures (e.g., SUS, UMUX) to investigate the effects of VR on motivation, learning outcomes and knowledge retention in a more quantified manner. Longitudinal research with larger and more diverse samples could track learning gains and experimental designs with control groups that use traditional teaching methods, as well as enabling stronger claims about the advantages of VR. Additionally, the current VR framework can be adapted for other disciplines to expand its content base. By resolving these research deficits and technical limitations, virtual reality could position itself as a scalable alternative to higher education teaching and digital heritage conservation.

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