Open Universiteit | Universiteit van Amsterdam | University of Oslo | Universität Bonn

3D and Virtual Reality in Archaeology

New Applications and Good Practice in Teaching and Research

Bonn, 27th to 29th of May 2026

Römerstraße 164, 53117 Bonn

Programme

Wednesday, 27th of May

16:30	Registration
17:00	Welcome
17:15	Keynote Lecture: Beyond the Illusion: Decimation, Digital Shadows, and the Epistemology of VR in Teaching Archaeology – Matthias Lang
18:15	Ice Breaker Event – drinks and finger food

Thursday, 28th of May

09:00 – 9:30	Introduction – Stefan Feuser
09:30 – 10:00	Virtual Reality in Academia – Insights of Developing a VR-Application – Philippe Pathé & Matthias Lang
10:00 – 10:30	Students' Voices for the Design of Virtual Worlds and Seamless Learning Scenarios in Archaeology, Ancient and Art History – Francis Brouns, Ellen Rusman, Olga Firssova, Jitte Waagen, Stefan Feuser, Hanna Jacobs, Philippe Pathé, Aron Schüßler, Espen Uleberg & Sjoerd van Riel
10:30 – 11:00	coffee break
11:00 – 11:30	Students' Perspectives on and Experiences with Seamless Learning Scenarios for Virtual Worlds in Archaeology and Arts History – Francis Brouns, Ellen Rusman, Olga Firssova, Jitte Waagen, Stefan Feuser, Hanna Jacobs, Philippe Pathé, Aron Schüßler, Adriana Günzel, Espen Uleberg & Sjoerd van Riel
11:30 – 12:00	When Worlds Collide: Creating a Design Framework for Learning Mechanics in Archaeological XR Applications – Hugo Huurdeman & Jitte Waagen
12:00 – 12:30	Affordances and Limitations Using 3D Models in Teaching Archaeology in a Rural Area – Ingvild Solberg Andreassen
12:30 – 13:30	lunch break
13:30 – 14:00	Finding Common Ground in Using 3D to Teach at UiO – Alexis Pantos & Frederik Haugen Pedersen
14:00 – 14:30	360 Cameras and Student Partnership. Student-active Learning and Practical Experience in a Work-Related Context – Heidrun Stebergløkken & Lene Vestrum Kirkhus
14:30 – 15:00	Augmented Reality as a Tool for Teaching Archaeology – The Project ARC3D – Sascha Schmitz
15:00 – 15:30	coffee break
15:30 – 17:30	Workshops
18:30	dinner

Friday, 29th of May

09:00 – 9:30	How May 3D & XR Further Learning in Archeological Documentation & Dissemination – Gunnar Liestøl & Espen Uleberg
09:30 – 10:00	Viewing and 'Feeling' the Past Through Virtual Teaching. A Case Study of the Digital Reconstruction of the Lykosura Group in Arcadia – Sotiria Dimopoulou
10:00 – 10:30	Facilitating Teaching with Digital 3D Models of Archaeological Artefacts - Sjoerd van Riel, Søren Handberg, Inger Marie Berg-Hansen, Hege Damlien, Alexis Pantos & Justin Kimball
10:30 – 11:00	coffee break
11:00 – 13:00	Workshops
13:00 – 14:00	coffee break with fingerfood

Workshops:

Implementing 3D-Models and VR in Teaching. Case studies from Art History and Greek Archaeology – Stefan Feuser, Hanna Jacobs & Philippe Pathé

How Can You Design Seamless Learning Scenarios Using Virtual Worlds for Archaeology? – Ellen Rusman & Francis Brouns

Conference registration until 25th of May: aguenzel@uni-bonn.de

The conference will also be streamed online via Zoom: https://uni-bonn.zoom-x.de/j/62215079001?pwd=aivroc8O34bDj7BBSeREtFi49fKCSx.1

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Virtual Worlds in Teaching Archaeology

Abstracts

Virtual Reality in Academia – Insights of Developing a VR-Application

Philippe Pathé; Dr. Matthias Lang

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This contribution presents practical insights from developing a virtual reality application in Unreal Engine that was specifically designed for university teaching. Unlike many VR prototypes built for open-ended exploration, classroom use introduces strict constraints: limited time, heterogeneous user experience, and the need for reliable participation by all students. These conditions shape core design decisions, starting with how the application is used and presented in the classroom.

A VR-only approach might exclude students who cannot comfortably use a headset, for instance, due to motion sickness. Therefore, the application was developed as a hybrid system that supports both VR and a conventional 2D mode, ensuring accessibility. We discuss how the scope of features influences teaching: while additional functions may increase flexibility, they also increase complexity and risk of disruption during live sessions. Therefore, the design emphasizes a limited set of crucial functions. Based on classroom deployments at our university, we argue against moving text-heavy tasks, long instructions, or detailed assessments into the VR application. Virtual Reality can easily be used for tasks that do not leverage its strengths unless activities are designed accordingly. Preparation, background reading, and assessment should take place outside VR, where students can work efficiently with familiar tools. VR sessions should be brief, goal-oriented, and built around spatial experience: understanding scale, moving through and around structures, comparing viewpoints, and exploring relationships that are difficult to grasp from images alone.

Accordingly, the application is positioned as a complement to established teaching media, such as texts, images, and plans/maps, rather than a replacement. We also address expectation management and user diversity, including differences often linked to prior gaming experience rather than age alone, and evaluate when multiplayer functionality meaningfully supports learning outcomes in an academic setting. Finally, we emphasize that usability and robustness are most important: having fewer essential features and clear interaction rules makes the application workable under real teaching conditions.

Students' Voices for the Design of Virtual Worlds and Seamless Learning Scenarios in Archaeology, Ancient and Art History

Francis Brouns[1]; Ellen Rusman[1;] Olga Firssova[1]; Jitte Waagen[2]; Stefan Feuser[3], Hanna Jacobs[4], Philippe [5], Aron Schüßler[4]; Espen Uleberg[6]; Sjoerd van Riel[6]

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Virtual Worlds in Teaching Archaeology

The domains of archaeology, ancient history and art history are all about context: students need to learn how to understand and interpret perspectives on the past, making use of various types of artefacts and environments, to e.g. understand the use of objects or the significance of historical events. Obtaining knowledge and skills is not limited to the classroom but develops through interaction with resources in various spaces and across time. While they can rely to some extent on material remains, written and pictorial resources, quite a lot of knowledge remains tacit and has to be inferred or deduced. In this sense the concept of 'context' is very important, but context is distinguished and deduced at various levels, e.g. from the material and surface of single historical objects or from complete archaeological sites. The development of this contextual awareness and analysis skills can pose some difficulties for students, as it requires the combination and application of multidisciplinary and interdisciplinary knowledge and skills to assess, interpret and construct various perspectives of the past and present. Other complicating factors are constraints in time and resources. It is not always possible or feasible to travel to archaeological sites, artefacts are not always available or accessible, interpretation of written representations of historical events and resources is difficult, because it no longer fits our current views and visions, or there are not sufficient lab facilities for students to engage in practical hands-on inquiry activities. Existing educational research suggests some benefits for teaching and learning from virtual reality (VR) and 3D models. The current advances in technology also make this affordable. However, the use of technology in itself does not necessarily make it an effective educational technology to enhance learning. Literature on educational theories indicate that the technology should have a pedagogical purpose and be aligned with envisioned learning objectives, activities, outcomes and assessment, thus supporting effective learning processes (Dron, 2023; Januszewski & Molenda, 2008; Mayer, 2008; Mayer, 2017; Morel & Spector, 2023). Current trends in education show the advantages of educational models that activate learners and stimulate individual and collaborative knowledge construction (Laurillard, 2009). This together with the importance of context in archaeology and related domains, makes the seamless learning design paradigm a feasible approach for the design of virtual world learning scenarios. Seamless Learning Designs (SLD) facilitate (cross-)contextual and cross-boundary learning through technology-supported learning scenario's using mobile and wearable devices and online technology, looking at the potential learning affordances of each environment and opportunities to facilitate learners in making meaningful connections ('binding') between them (Rusman et al., 2024). Context as understood within the Seamless learning design (SLD) paradigm refers to mental models learners create through interaction within an environment, which are partly influenced by the emotional state of the learner. Context is not 'automatically' there, but is actively created by learners through their (inter)action within an environment and related mental "meaning making" processes.

Research also shows the relevance of involving all stakeholders in education, both in the design of the course as well as in learning activities. Co-design and participatory design approaches involve all stakeholders to capture their perspectives, leading to new design insights. For example, students involve stakeholders as part of course activities to stimulate understanding, for example in landscape

architecture, campus archaeology or archaeology community projects (Jeffra et al., 2020; Kempenaar, 2021; Kroot & Panich, 2020; Shakour et al., 2019). In education the value of involving teachers as designers of learning material and scenarios has been acknowledged and stimulated (Garcia, 2014; Garcia et al., 2018; Muller-Schoof et al., 2023; Persico et al., 2018). Students of the 'High Tech High Graduate School of Education' even published a guide for teachers on how to involve students in course design and class activities to improve their learning experiences and performance (Bhakta & Meza-Ehlert, 2022).

Therefore, we organised two Spring Schools as part of the Virtual Worlds project with 20 students. Each Spring School lasted five days. Students received literature and documentation to study beforehand. These documents were then discussed in a world café format, introducing students to relevant concepts. Teachers then gave lectures and workshops about virtual reality environments, 3D documentation and models, seamless learning design and course design methodology. Next, students worked in groups on the assignment for two days. On the last day they presented their findings. In the first spring school, students were asked to design learning scenarios for the use of virtual worlds in teaching archaeology. Teachers provided the learning problem and the design constraints, such as educational level, target group and learning objectives. Students received handouts and templates related to course design, but were given the freedom to design the learning scenario completely from their perspectives. In the second spring school, students learned about methods to scan and document 3D objects, applied these in various environments (e.g. a church, an excavation) and made these available in a virtual environment. At the last afternoon, students submitted an online questionnaire about their expectations and experiences of the Spring School.

Students were quite positive about both Spring Schools. They valued the discussion with teachers and students, experiencing other cultures and international settings. The majority found the information they received in advance sufficient as preparation for the activity, although some participants would have welcomed information on learning design beforehand as well. They would also have welcomed more practical experiences with VR to assist them in designing the learning scenario.

When asked what they liked most about the Spring School, respondents indicated the international and cultural aspects, discussion with teachers, discussing and working with fellow students and the group work; learning about VR as an educational application, and experiences with VR environments. They were satisfied with (practicing) the creation of 3D models and making these available in VR environments and learning activities. The Spring School was found successful as one of the participants remarked in the online questionnaire: "*in making the students feel secure enough to brainstorm with complete strangers*".

As take-home outcomes, participants mentioned the value of designing learning scenarios, the knowledge and application of VR in general and its application in education; the knowledge and application of VR to archaeology; the interdisciplinary approach and possibilities for their future studies and research; and the concept of seamless learning.

Even within the short period of time, students were able to design valuable learning scenarios according to the seamless learning paradigm. They proposed a variety of learning activities, combining individual and group work both in-class and out-of-class, using VR to elaborate on and apply theoretical knowledge. Central in their designs were the didactical approaches that promoted learning processes and stimulated active learning, such as inquiry-based and collaborative learning. They ensured that prompts were used in their learning scenarios to direct the learning process.

Although teachers saw the benefits of students' suggested scenarios, they were faced with practical constraints that prevented the full implementation of the proposed scenarios. Nevertheless, the student learning scenarios provided sufficient inspiration to adapt their current learning scenario designs and implementations of (new elements in) virtual worlds.

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Students' Perspectives on and Experiences with Seamless Learning Scenarios for Virtual Worlds in Archaeology and Arts History

Francis Brouns[1]; Ellen Rusman[1]; Olga Firssova[1]; Jitte Waagen[2]; Stefan Feuser[3]; Hanna Jacobs[4]; Philippe Pathé[5]; Aron Schüßler[4]; Adriana Günzel[3]; Espen Uleberg[6]; Sjoerd van Riel[6]

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Re-constructing the past through interpretation of historical and cultural artefacts and material knowledge is inherent to teaching and learning in domains such as archaeology and arts history. Students need to acquire knowledge and skills to deal with past and present contexts, for example develop analysis and excavation skills as well as applying historical and natural science knowledge (Barbara, 2022; Pollalis et al., 2018). Although students gain understanding and insights on artefacts, buildings, sites, and landscapes from paper-based information - text, photographs, images -, the subject matter is inherently three-dimensional (3D) and material. While some of the sites, structures, objects and artefacts are still available, it is not always possible or feasible to view or handle these. In addition, students need to acquire (inter)disciplinary and collaboration skills when dealing with many aspects of the domain, such as materiality of objects, to understand the way people lived and worked in the past (US department of the interior, 2025). In short, these are complex domains in which students – in particular novice students – may face some learning issues.

The advances in technology enable the use of virtual reality and 3D models to potentially counter issues or improve learning. Visualisations of archaeological sites, structures, objects and materials and the use of virtual environments can offer benefits for teaching and learning (DiNatale et al., 2020). In the 'Virtual Worlds in Teaching Archaeology' project we investigated if virtual worlds in which students can reconstruct historical and cultural practices and that facilitate action, interaction and knowledge development of the past, could assist in teaching and stimulate learning. We used the seamless

learning design approach for embedding virtual worlds into teaching and learning about archaeology.

Seamless learning design (Looi et al., 2012; Rusman, 2019; Rusman et al., 2024) is an active learning approach that applies technology to support learning process(ess) in as well as across contexts. As archaeologists through their occupation naturally move through and participate in a range of contexts, for example between a physical excavation site, an (online) library with 3D-models or literature and museum, this learning design approach was deemed particularly feasible in the Virtual Worlds for Learning and Teaching in Archaeology project. Context as understood within the Seamless Learning Design (SLD) paradigm refers to the mental models people create through interaction within an environment and which are partly influenced by the emotional state of the learner. Context is not 'automatically' there, but is actively created by learners through their (inter)action within an environment and related mental "meaning making" processes (Wager & Atlas, 2015; Westera, 2012). This understanding of the word 'context' differs from the connotation in the archeological domain, where if often refers to the circumstances and the characteristics (e.g. natural surroundings, soil etc.) of the place where an artefact is recovered, that may facilitate the interpretation of an object. The SLD design approach aims to activate students and guides them to use affordances offered in each of the environments in an attempt to stimulate and promote the learning process. Affordances are attributes of something, e.g. an object, instrument or environment, that provide an opportunity for executing some action or activity (Gibson, 1979; Rusman et al., 2024; Westera, 2012).

The universities involved designed several seamless learning scenarios for learning problems identified in existing courses that may improve understanding and learning performance of students. The learning scenarios offered various digital alternatives for handling and experiencing historical objects, extended possibilities to experience and study material closely (e.g. by magnifying and turning them), enhancing 2D written material with 3D models and VR, and participating in (intertwined and designed physical and digital) activities offering alternative perspectives on the past, with the purpose to facilitate individual and collaborative sensemaking processes and thus potentially facilitate more effective, efficient and attractive learning. Learning scenarios were implemented in various archaeology and arts history courses at the University of Amsterdam (Netherlands), the University of Oslo (Norway) and the University of Bonn (Germany). In most cases, learning scenarios were implemented as part of a course, e.g. as specific cases or a dedicated number of activities. In one instance - the course about the double chapel of Bonn-Schwarzrheindorf - the course was designed as a blended learning course with activities involving a 3D-modeled virtual world of the ancient Chapel every week, combined with site visits of the Chapel nowadays. Course assessment was aligned with each universities' assessment model. We explicitly gathered students' perspective on the use of virtual worlds and 3D models through focus group conversations and an online questionnaire that students completed after using the learning scenario at the end of the course.

A first analysis of (part of) the data indicates that students were quite positively evaluating the alternative seamless learning scenario's using virtual worlds or 3D models to facilitate their learning

and the majority would prefer the use of virtual worlds and 3D models in combination with regular teaching and textual resources.

Resources

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When Worlds Collide: Creating a Design Framework for Learning Mechanics in Archaeological XR Applications

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While numerous evaluation studies have been performed on the effectiveness of VR applications for education in the field of engineering and science (see e.g. Luo et al., 2021), the number of empirically-based studies within education in humanities disciplines is still very limited (Waagen et al, 2024). Even though literature on the affordances of 3D environments exists, this research has been criticized as

being "derived essentially from thought experiments" within small team of researchers (Bower & Sturman, 2015). In addition, in their systematic review on design elements of XR applications, Radianti et al. (2020) argue that it is not even possible to formulate best practices, e.g. due to a lack of integration of learning theory and evaluation of learning outcomes. Therefore, actual knowledge on how to design effective XR applications in general, let alone in humanities education, is few and far between.

To help bridging this research gap, we present a starting framework for the analysis and creation of VR applications for education. We take inspiration from two main sources. First, we base ourselves on a large-scale systematic review of empirically-based VR articles in Humanities education (Huurdeman & Waagen, forthcoming). Second, we gain inspiration for the creation of the framework from the research area of serious game design. In this domain, Arnab et al. (2015) devised the *Learning Mechanics – Game Mechanics* model, which directly connects learning mechanics with concrete game mechanics. The model's learning mechanics include for instance tasks, activities and goals derived from existing pedagogical approaches.

Our framework, *Learning Mechanics in XR (LearnMiXR),* connects learning mechanics and design elements for educational VR applications. We contextualize our framework using six archaeology-specific case studies from our prior literature review, demonstrating how the framework can be used to analyze existing learning-focused XR applications. Archaeology is chosen as an initial focal point due to the intrinsically spatial nature of this field. Furthermore, we tentatively highlight how our framework facilitates the design of new XR applications in archaeology, and potentially in a broader humanities setting. Via our paper and presentation, we intend to open up a discussion at the intersection of archaeology, educational sciences and human-computer interaction.

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Affordances and Limitations Using 3D Models in Teaching Archaeology in a Rural Area

Ingvild Solberg Andreassen
University of Oslo, Museum of Cultural History

Archaeological institutions such as museums have a long tradition of digital documentation, increasingly incorporating 3D scanning technologies. Like many others, the Museum of Cultural History at the University of Oslo has made a number of 3D models publicly available online. However, usage statistics show that these resources are used far less outside the professional communities than anticipated by funding bodies and professional communities.

This presentation explores the relationship between digital heritage, archaeology, museums, learning theories and the public. In 2024 we developed a learning scenario for pupils in primary and lower secondary school in a municipality in the southern part of Norway, called Bygland. This municipality harbors only 1200 inhabitants and one class contains children from more than one grade level. We tested out the learning scenario on pupils at all levels from the age of six until fifteen in two different schools.

Bygland is home to several significant findings from the Viking Age, yet the archaeological objects are housed in a museum in Oslo. A five-hour drive from their origin. Few local residents visit the museum, and awareness of these finds is limited locally. This context provides a nice case for examining the potential of digital resources to support learning and mediation, while also revealing their limitations.

The experiment focuses on the properties of 3D models, the narrative potential of archaeological materials, and how young learners—growing up in a digitally saturated environment—engage with such resources. We present our design process and demonstrate how we attempted to make local archaeological material meaningful to students by using 3D models as a starting point, while simultaneously responding to political directives aimed at reducing screen time in classrooms.

Drawing on a sociocultural perspective on learning, our design sought to promote activity, dialogue, creativity, and the development of historical consciousness. As such the focus in this presentation is mostly on the design process, with the affordances and limitations given in a museum context.

The paper concludes by identifying challenges encountered during design and implementation, reflecting on institutional restrictions and possibilities when combining 3D-documented objects with archaeology and learning theories, in a remote place like the one at hand.

Finding Common Ground in Using 3D to Teach at UiO

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The interdisciplinary project “3D and Virtual Teaching” unites the Natural History Museum, the

Museum of Cultural History, the Faculty of Odontology, the Faculty of Mathematics and Natural Sciences and LINK – the Centre for Learning, Innovation & Academic Development at UiO to investigate how three dimensional (3D) artefacts can be used in education. In addition to these participants the project will also interact with other members of staff at the university including the department of archaeology and conservation (IAKH) and the department of Pharmacy with the expressed aim of supporting the development of a shared learning environment at the university. Two central question guides the work: How can 3D models enable learning outcomes that physical replicas cannot? How can we move students from passive observation to active engagement with 3D resources?

The project builds on the use of 3D in teaching and outreach, especially at MCH and the existing BItFROST system will form an essential element in the work ahead, with the potential for the platform to form part of a shared pedagogical layer across highly diverse curricula. That is to say, we hope to develop an educational environment that encourages pedagogical practice anchored in sociocultural learning theory and evidence based instructional design that are suitable for the post-text book era, rather than simply implementing a new technological system. Key to this aim is the integration of 3D exercises into broader pedagogical contexts, both theoretically and technologically – incorporating it into existing teach educational platforms both Canvas – the university's student learning environment, and viten.no the NHMs outreach education platform targeted toward younger age groups.

The talk will introduce the project aims, and discuss the work undertaken so far. To date this has focused on identifying common ground across the diverse user group and building networks of competence and communication between disciplines. We will discuss some of our future directions for the years ahead and believe developing networks of practice is essential preparation for the arrival of disruptive technologies in the years ahead.

360 Cameras and Student Partnership. Student-active Learning and Practical Experience in a Work-related Context

Heidrun Stebergløkken[1], Lene Vestrum Kirkhus[2]

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In this paper we want to present some examples from a collaboration between management archaeology at NTNU University Museum and the archaeological teaching program at NTNU, Department of Historical Sciences. For the last five years the archaeology teaching program has been involved in different projects, exploring how technology and technological tools such as 360 cameras can contribute to learning in higher education.

An important aspect of these projects for our teaching program has been student involvement. The key pedagogical framework for us has been student partnership, where we have aspired to achieve student involvement on different levels. Student involvement can be understood in four stages (HEA and NUS

2011; Healey et al. 2014). First level would be consultation, the next is involvement, then participation and the last level partnership. This highest level means there is collaboration of institution/faculty/department and students, involving joint ownership and decision-making over both process and outcome (Healy et al. 2014: 16).

We want to show two examples from the current collaboration; the first where students have made 360 tours of a local cultural heritage trail. The student product is now a part of the local museum's public outreach. The other example is how the students have produced 360 tours of their site during the archaeological field course. These tours were made for an audience of fellow students and teachers at the department after the field course, as one of the dissemination tasks. In both cases, the main goals have been student partnership and having the students take part in the decision-making process and in producing outcomes (Callanan and Stebergløkken 2025).

From an educational point of view there are different pedagogical goals to be achieved from this. On the one hand, there is the perspective of work-life relevance. We want to prepare the students by giving them experience of different digital tools that they will meet after they finish their degree. On the other hand, it is also about creating student-active learning events and allowing the students to get hands-on and practical experience that also increases their learning outcomes. Moreover, an additional value has been having the students engaged in current and research-based cases. Together with NTNU University Museum, the students have been brought in as collaborators on an ongoing project funded by The Directorate for Cultural Heritage (*Riksantikvaren)*: namely 'The Conservation program of rock art'.

In this paper we will show some examples of this collaboration, and how we have created some synergies between education, management archaeology and public outreach.

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Augmented Reality as a Tool for Teaching Archaeology – The Project ARC3D

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Archaeological institutes worldwide maintain collections. These are an important tool for teaching students how to describe, identify, and analyze objects. The collections of smaller institutes are often insufficient to fulfill this purpose. However, for ethical, financial, and space reasons, it is difficult to expand them.

The use of digital 3D models offers a solution. However, when viewed on a screen, these cannot match the educational potential of physical objects standing freely in space in their original size. In addition, comparing objects with each another is the fundamental method used in object and image sciences to determine their age, origin, and significance. A tool that enables realistic examination of 3D objects and direct comparison with physical objects is therefore necessary.

As part of the Augmented Reality Collections 3D (ARC3D) project, an augmented reality (AR) viewer in the form of a mobile app was developed to close this dissemination gap. This makes it possible to place archaeological objects in their original size on the floor next to a physically existing object and compare them with each other. Digital 3D objects can thus be used in research and teaching in much the same way as real objects, except that it is not possible to touch them.

A series of 3D scans of plaster casts from the collections of the Universities of Frankfurt and Trier are currently available in the app. It is currently being tested in two courses. One is a typical description exercise on Greek sculpture. The students use the app to examine and describe statues that are not available in the universities plaster collection. They can do so in the collection or at home for example to prepare their presentations, by easily producing their own photos of the details they want to discuss. The second one is an experimental course in digital sculpture reconstruction. The students pose as reconstruction proposals for incomplete statues and are recorded using motion capture. The AR models serve as visual aids for taking the poses. In the future, the aim is to extend the range of features, as well as connect the collections of various institutes so that objects available at a participating location can be used for research and teaching via AR where they would otherwise not be available.

How May 3D & XR Further Learning in Archeological Documentation & Dissemination

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With the recent advances in 3D and XR (Extended Realities = AR, VR, MR) new opportunities emerge in archaeological teaching and learning. In this context it is pertinent to rethink the relationships between documentation and disseminations in cultural heritage and archaeology. Despite the long material tradition in archaeology, as an object–oriented discipline, its – often lost – immaterial context must not be forgotten. This is especially important now that visualization and reconstruction of the immaterial is so close at hand. Here we use UNESCOs basic definition of 'Immaterial Heritage' as a starting point and primarily focus on human action as a key component in the various domains of intangible heritage.

In this presentation the authors will convey ideas and examples regarding how digital reconstructions of the immaterial can be employed in creative and constructive ways to further provide meaningful contexts to learning in archaeological education. The discussion draws on a long collaboration between the disciplines of digitalization and documentation in archaeology on the one hand and media studies and location–based media design on the other.

A Unity–based Indirect AR platform has been in development for over a decade, and we believe it already provides relevant perspectives and practical solutions for both teaching and learning with 3D in these disciplines.

In the Sitsim AR platform we distinguish between two separate but continuous modes of use: 'Experience mode' and 'Information mode'. Experience mode is dynamic and focused on activities and human actions in the reconstructed virtual world, that is everyday human activities in prehistoric environments (or specific events if historical sources are available). Thus, in experience mode it is possible to add the immaterial context of human actions to provide meaningful contexts for individual artefacts, for example how tools are produced and used. Motion capture is an important ingredient in this contextual augmentation. We use motion capture based on sensor suites, and record specific movements, which are then implemented in digital human characters who again populate the digital environments accessed on location.

In information mode time is paused, the environment becomes static, and spatially positioned hypertext links and other interface elements are visible for access to detailed underlying information and documentation. For this purpose, 3DHOP has been modified to suit mobile terminals such as smartphones and tablets. We are also continuously experimenting with different versions of HMDs (Magic Leap, Meta Quest, Apple Vision Pro and will eventually continue with emerging forms of eyeware). Experience mode and information mode, dissemination and documentation are thus combined to create location–based 3D environments, which again also serve as interfaces to 3D databases of scanned archaeological artefacts.

The presentation will show several examples from various sites, both in Norway, Europe and elsewhere, including the mesolithic rock carvings at Ekeberg in Oslo, which is one of the most recent cases, and is intended for use in organised educational settings. The examples showcase various challenges and solutions as well as a range of topics and periods.

Viewing and 'Feeling' the Past Through Virtual Teaching. A Case Study of the Digital Reconstruction of the Lykosura Group in Arcadia

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This study aims to demonstrate that 3D digital technology can improve our understanding of, and

access to, the past by providing virtual tours of cultural heritage sites. To what extent can virtual educational programmes offer students and cultural travellers the chance to experience virtual museums and archaeological sites? What impact could such virtual visits have on encouraging schools and universities to promote physical presence and broader knowledge?

The research focuses particularly on students' knowledge and serves two purposes. Firstly, teaching through virtual reality provides access to archaeological sites and museums that are often unknown to the public and difficult to access for various reasons, such as financial difficulties, transportation issues and danger due to conflict. On the other hand, it can encourage further research projects in the broader field of archaeological science and contribute to a multifaceted approach to various subjects through individual perception.

Specifically, the present study focuses on a virtual 3D representation of the Cult Group at the Temple of Despoina in Lykosura, Arcadia. The learning objective is twofold: firstly, to present an important Hellenistic monumental sculpture in its entirety, and secondly, through a digital tour of the dark cella, to facilitate contact with a mysterious form of the cult that is experiential in character. It also provides an innovative approach to experiencing monumental sculpture from the viewpoint of an ancient visitor. The study also sheds light on the lesser-known and difficult-to-access wider area of Lykosura. Ultimately, students are expected to gain an understanding of the ancient perception of this mystery cult and step into the role of the initiate, acquiring broader, more experiential knowledge of similar cults, by 'feeling' the past through the present.

Facilitating Teaching with Digital 3D Models of Archaeological Artefacts

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A fundamental part of teaching archaeology at a university level revolves around the analysis of artefacts. Access to these artefacts for teaching purposes can be limited by practical or safety considerations. For these reasons, but also to enhance the study of artefacts in ways that physical handling cannot facilitate, the use of digital 3D models of artefacts in teaching archaeology at universities has become commonplace.

In our presentation, we will present our experiences using digital 3D models of artefacts for teaching undergraduate students. The cases revolve around the development of two learning scenarios in conjunction with the Erasmus+ project *Virtual Worlds in Teaching Archaeology*. Using the browser based BItFROST platform, the students got access to 3D models of archaeological artefacts. Through integrated functionalities in the platform, the students were given access to several tools for studying digital 3D models, such as measuring- and sectioning tools. Combined with traditional learning material such as handouts and online reference collections, the students used the integrated spots and notes functions to create spatially located notes. This was considered to be a powerful tool, since the ability

of the students to observe characteristic features and describe their spatial relevance, are considered an important learning outcome for the courses. The notes could then be sent to, and opened by, the teachers on their own PC, maintaining the spatial relationship between the written notes and the features in 3D space which they describe.

The presentation will focus on the implications of these learning scenarios on the teaching as well as how they were perceived by the students, through the results of a survey conducted after the scenarios were implemented.