

Prof. Dr. Øyvind Eide , MA Zoe Schubert, Dr. Jan G. Wieners

Institute of Digital Humanities, University of Cologne

Keywords: Digital Humanities, Virtual Reality, Modelling, Media Transformation, Experimental Teaching, Theatre, Cardboard

15th January 2019

Modelling. Virtual. Realities.

Virtual Reality as a transformative technology for the humanities

ABSTRACT

The current state of the art technologies offer many people the opportunity to experience Virtual Reality (VR) without having to purchase expensive devices. This results in a rapidly growing number of different explorable contents, and overall concepts are also quite diverse. Looking at VR as a form of representation and as a means of reproducing narratives, many potential research questions also for the (digital) humanities arise. Analyzing VR from this perspective includes observing, exploring and comprehending the modelling of virtual worlds. It is of key importance to consider the process of creation, which is a process of modelling done by different individuals with different disciplinary backgrounds.

Thus, several practical and reflective theoretical Digital Humanities courses at the University of Cologne were offered in which virtual worlds for the narration of theatre plays as well as other narratives were modeled by the students. This approach includes the presentation of appropriate concepts to the students, guiding them through concrete cases while also providing

enough space for new creative and individual ideas. For this purpose, teaching began with the adaptation of works originated in other media. Theatre plays were used as the basis for a first transmission into this audio-visual form of representation, focussing on the processes of media transformation. During the development of the different practical projects, a tension between realistic and symbolic representation, interactivity, storytelling, self- and world-perception and individual immersive experiences emerged.

This paper proposes bridging VR and Humanities, creating a valuable outcome through the implementation of virtual realities in teaching environments and through the reflection on the narratives and content in the process of modeling humanities. The development of VR applications as a process of media transformation in teaching will be discussed here.

FROM VIRTUAL DREAMS AND REAL TECHNOLOGIES

We may still have to wait a few years to see whether the promises and threats initially associated with VR will materialize. But we don't have to wait for their realization to explore the perspective that the idea of VR opens on representation. (Ryan 13)

Virtual Reality and the Humanities

There is a strong link between Virtual Reality (VR) and the achievements of technological development, not the least in the form of new hardware. There is also a partly independent theoretical debate about VR in the humanities, dealing with the possibilities of implementing narrations and types of content to this audio-visual representational form. This debate goes back quite a few years. On the one hand the fictitious prerequisites forming the human conceptions for the creation of a VR are studied, and on the other hand, new ideas for how representation work are created. In discussions of the historical development of VR we often find references to the famous 'Allegory of the Cave', which was already verbalized around 300 BC by the Greek philosopher Plato. In addition, panorama paintings are examples of what has been seen as practical attempts to implement a virtual reality, through enabling the viewer to experience the feeling of presence in the depicted historical situation.¹ The general concept underlying this is VR seen as a means to create illusion. Someone can leave the physical reality behind and be present where the body and its sensory perceptions are not physically present. Which experiences can arise in whatever virtual worlds and how storytelling works by understanding VR as a medium are central questions. They are neither new nor unexplored, as Janet Murray's 'Hamlet

¹ This is in line with a function of the ekphrasis gaze, reproducing and doubling the experience of a subject observing a piece of art.

on the Holodeck'² or Marie-Laure Ryan's book 'Narrative as Virtual Reality'³ (second edition already published in 2015) show.

Virtual Reality and technological development: Hardware

There are no practical VR implementations without technology, and how we experience VR is highly dependent on the technological development. Especially in the last years very decisive things have happened: current technical developments offer many people their first of frequent virtual reality experience (Singh). Partly this is because a large selection of devices specially developed for this purpose have become more affordable (Day). Furthermore, current mobile devices also make VR available in connection with Google Cardboards (Google) and also with recent tools such as Google Daydream View or Samsung Gear VR (Deino). This means that devices that are widely used and are usually purchased as other purposes also enable the experiencing of virtual reality. But hardware alone only represent one of the building blocks for the development and use of VR.

Virtual Reality and technological development: Software

In addition to the aforementioned hardware requirements, one must create spaces for virtual experiences that can be accessed through applications by potential users of the hardware. This necessitates software development. The term software development is not exclusively related to programming, but as we will see below it is in important part. The development is based on available tools, standards and programming languages including libraries and frameworks, where

² Murray, Janet H. 2017. Hamlet on the Holodeck: the Future of Narrative in Cyberspace. The MIT Press.

³ Ryan, Marie-Laure. 2015. Narrative as Virtual Reality: Immersion and Interactivity in Literature and Electronic Media. The Johns Hopkins University Press.

we have also seen a considerable development over the last years. The programming interface (API) initially named WebVR has recently been created. It enables the experience of VR in an ordinary web browser. The standard has been developed by Mozilla and the Google Chrome team in cooperation as released in 2016. The self-declared aim was to simplify access to VR for everyone, regardless of the device used, through making it accessible on the web via a browser. Consequently, it is no longer necessary to develop and install a specific application in order to enter virtual worlds. The release of WebVR resulted in the development of frameworks such as Mozilla's A-Frame (A-Frame), Facebook's React 360 (React 360), three.js (ThreeJS), and Microsoft's BabylonJS (BabylonJS); some of them completely new. They make it simpler to build highly accessible web- and browser-based VR implementations, brought to life through affordable physical environments because they run on several devices including mobile phones.

The technological developments of hardware as well as of software are essential to the most important change of all: the growth in the number of applications and thus also in the number of users. This is important for two reasons: first because the users as a collective decide which concepts are accepted and thus gain public attention, which again leads to further development. And second, because more numerous practical examples increases the quality and significance of the theoretical debate, reflection and analysis.

Virtual Reality : contents, stories and virtual worlds - Bridging digital and humanities

Games are currently the most common use cases for VR (Parker), but overall applications show a considerable diversity as to which concepts they materialise and the content they represent.

Considering the growing significance seen partly through the increasing numbers and diversity

of applications and the growing numbers of users, as we saw above, we need to take a closer look at this promising technology for audio-visual representation and its possibilities also in a scholarly context, not the least in the humanities. We cannot only reflect theoretically on existing applications. To explore the scope of VR as a form of representation and to find out how to model virtual worlds representing both the known and the novel, one must focus not only on the products but also to take into account the process of creation, which is a modelling process. The outcome tends to be strongly linked to the purpose for creating things in the first place. This can include commercial⁴ and scholarly/scientific⁵ purposes as well as the enabling of various types of innovative access.⁶ Furthermore, applications are influenced by the limitations inherent in the technology and by the skills of their developers. It is impossible to see and evaluate all these factors from the outside, which makes it difficult to analyse the resulting products from a reflective research perspective only. A way forward towards finding out more about VR from the perspective of a digital humanist is to observe and analyse the modeling processes in VR while taking active part in the processes. This is comparable to methodologies of participatory observation in disciplines such as social anthropology and also inherit its establishment of partial knowledge, due to the fact that it is always performed by specific actors with disciplinary and other competences and views. Given that the costs for making functional implementations in VR has dropped significantly, such development can now happen with drastically reduced efforts. This opens it up for more wide spread use in research in the humanities. Existing theoretical considerations about VR as they are found in the humanities are influenced by, in some cases

⁴ E.g. computer- and videogames (Wareable 2017).

⁵ E.g. simulations and reconstructions (Sierra 2017).

⁶ E.g. in museums (Harris 2011), art (Sharma 2017) and journalism (NYT VR 2017).

even dependent on, the cultural and technological context of their origins.⁷ This context changes over time and it is not only important to observe and detect the changes; but also to re-address the questions based on same changes. The central idea is to investigate things by modelling them.

Such an experimental approach has been implemented at the University of Cologne through the availability of a number of different courses in Digital Humanities where students have a background in media studies and other humanities disciplines in addition to being programmers. Through this we have enabled a significant number of different applications to emerge as experimental implementations. In addition it led to novel analyses of virtual reality through the combination of different scholarly and scientific approaches. A more detailed description of the planning, (practical) implementation, result and reflection of this undertaking is shown in the following.

VR EXPERIENCES THROUGH MEDIA TRANSFORMATION

From the perspective described above it is clear that there we need to practically apply and test theoretical concepts from the humanities through the modeling of virtual worlds. We cannot see the development of VR applications (software development) as pure programming work, it is rather a process of modeling that requires the knowledge of different individuals with different disciplinary backgrounds.

Modelling VR as a digital humanist poses various challenges and raises a number of questions, some of which naturally also of relevance for computer science. This includes

⁷ Modelling and media transformations are inherently connected (Eide 2015 pp.195–8) and both must be understood in the context of their practical applications (Ciula and Eide 2017).

seemingly simple practical problems that are still not (yet) fully solved including how users can move in VR environments and how their gaze can be directed in one direction (cf. Unity Technologies). Several questions related to how VR can be used are still being discussed. These questions include, e.g., how to show content, how to tell stories, and how creating 3D systems work as modelling processes, and the answers vary significantly. They are always situated and influenced by different perspectives related to factors such as time, culture and place. At a first glance, there might be a lack of meaningful use cases for traditional humanities disciplines without a long tradition of technology use or even use cases in the wide field of 3D. However, since virtual reality both as a concept and as a theoretical object of investigation is most likely to be discussed and researched on in institutions connected to the humanities, the increased simplicity of the technologies should not stand in the way of research. By studying current VR applications it is possible to gain a first impression of what VR is and how it can be used and understood not only in theory but also from a practical point of view.

Implementing this attempt in teaching means to build upon recent important attempts, practical as well as theoretical, to address these problems. That requires us to present the intentions to the students and guide them through concrete instructions while also providing enough space to develop own ideas.

Content and models for teaching VR - modeling virtual worlds

The lack of conventions for modeling virtual worlds in the context of the digital humanities necessitates intensive considerations and reflection. Simultaneously it opens up the field. Using the visual representation form, which is still experimental in nature, also involves treading new paths and thus increases the gain of knowledge. This situation is neither new nor unique, as we

can see from media history. In the context of the current paper we observe that when new technical media emerged in the last century their nature were strongly influenced by already existing media. Taking television as an example it can be demonstrated how already known conventions from other media and existing understandings of how content is established were used in the early stages of development. This includes studies of (live) transmission of plays on television. This media transformation is a good example of possible background material that can be used in the courses we are currently developing, comparing directly to previous studies of this transformation. With this in mind, the initial courses started by adapting works from other media. In order to give the students a starting point, to make it easier to come up with an implementation, and to enable precise planning of the courses, very concrete guidelines for how to implement the translations were defined from the outset. The selection of concrete content for the media transformations suitable to the purpose was based on considerations to be described in the following. It led to the decision to start by adapting theater plays connected to Bertolt Brecht's invention of the 'epic theatre'.

Virtual Reality as form of representation - beyond immersion

VR is generally associated with the concept of immersion. Technologies for VR are accordingly measured by how immersive the user experience is. We saw how widely used technologies have established themselves that pursue this goal but are far from achieving it. Therefore we developed a completely new approach for teaching in the digital humanities study programs in Cologne. The combination of a previous generation smartphone, a cardboard, and a WebVR application can be seen as an audiovisual form of presentation, in line with a form of medium, that is initially independent of any immersive experience as this goal cannot be fully achieved anyway.

This is partly due to the fact that the technologies are not developed specifically for VR. A basic problem is the limited possibilities for tracking movements. Putting on a cardboard for a VR experience also makes it constantly perceptible as an object foreign to the body of the user what can be perceived as disturbing and destroys the feeling of *leaving the reality*. By the basic assumption that there are non-immersive VR technologies, a first hurdle was overcome: in the context of a university course on modeling VR in the Digital Humanities, it is probably impossible to reach a highly realistic virtual world in line with what the big software companies have presented. But that should not be the goal. Initially this seemed strange, since the idea of immersing oneself in another world is so central to our understanding of virtual reality. As will be shown below, this idea is not as new as it might seem.

Epic theatre by Bertolt Brecht - breaking with immersion

The theatre of the 20th century was faced with a similar problem with immersion and the basis for representation. According to the Aristotelian drama theory the aim was to present an illusion to the audience. But the emerging media were much better situated for this, first through photography, then through film and finally when television made even live transmissions possible. Also as a reaction to this development, Bertolt Brecht invented the so-called epic theater. The stage for his plays is not meant to show the real world realistically, but rather to function as a self-referential space recognizable as a stage for the audience (see Hinck 16). His polemic was directed against the theater of illusion (Lang 13), which pretends to be part of the real life of the audience, in line with similar claims for film through the combination the already existing technology of photography (intended as an accurate reflection of reality) with motion.

Plays from Brecht transformed into VR

Brecht's thinking, pinpointed in "Zeigt, daß ihr zeigt!"⁸ (Brecht 166), as well as his methods, offering a poetic license to break with conventions, appear to be quite suitable for a translation to VR based on the idea of a non-immersive use of a form of audio-visual representation. At the first glance, Brecht's theater plays seem to be non-transferrable to audio-visual media but several film and TV adaptations of Brecht's plays have been made (Lang 14). Realising the plays in VR involves breaking with the intention of mirroring reality as we often see it in other VR systems. It may involve the development of other forms of immersion. The aim of adapting his plays to a VR environment is to provoke critical reflection on VR as a type of representation, possibly even as a medium. It is not about the technology in itself, but rather about how it is used. The courses put emphasis on the practical implementation as well as on theoretical reflection. The ongoing research process allowed us to continue with source media products in other genre in the consecutive development of the teaching.

The plays by Bertolt Brecht (initially 'Der gute Mensch von Sezuan') was used for the first practical implementation of the modelling of VR worlds. As pointed out, the intention was not only to make the practical work, including software development, relevant for teaching. Theories on media transformation, on narration in VR, as well as existing conventions for VR implementations were of course taken into consideration and have been important for the practical work as well as in the theoretical courses.

TEACHING VIRTUAL REALITY IN DIGITAL HUMANITIES

⁸ "Show that you are showing" (Gordon 2006, 233).

The Institute for Digital Humanities offers the study programmes *Media Computer Science* as part of *Media Culture and Theatre*. In addition to basic modules covering the basics of computer science, programming with object-oriented languages, and web development, students of Media Computer Science are introduced to the implementation of VR applications in the advanced module "Visual Programming." The module focuses partly on the students' practical implementations of their own VR environments using state of the art frameworks, libraries, and game engines, and partly on a theory based understanding of the solutions from a digital humanist's point of view.

For several semesters now, we have offered courses in which the theory of mediality and intermediality in the context of virtual worlds is reflected and tested in practice by advanced BA students. A central goal is to fathom how VR can influence or even form the modelling of other media, including narrative structures. Through the engagement with the students and the practical work fundamental research questions for the digital humanities in dealing with modelling and transformation of content in the humanities were revealed.

Each semester students show how the of the implementation of VR applications being reserved exclusively for professional computer scientists is a myth. The students know programming but they usually have only basic knowledge of the technology stack being used and composition of the groups is quite heterogeneous. At the end of each semester there are still executable VR applications available which are reflected upon and serve as a basis for the next semester teaching. These observations illustrate that the technologies used in the projects are very well suited as a reasonably simple point of entry into the creation of virtual worlds.

Through five courses in virtual reality and media transformations given in 2016 and 2017 it has been possible to gain not only significant experience and a deeper understanding of the research questions concerning intermediality and virtual reality but also positive feedback from the students and compelling results from their project work. By providing students with affordable Google Cardboards and focusing on state of the art web frameworks such as A-Frame, React 360 and BabylonJS for web- and browser-based VR, it has been possible to reduce the barriers for the implementation of their own virtual reality applications significantly. After we had gained some experience in teaching virtual reality for digital humanists, the stack of possible technologies used to implement virtual worlds was extended with the game-engine and integrated development environment Unity (Unity Technologies). We also opened up for other media beyond theatre: film, graphic novels, music videos, and novels such as George Orwell's *Animal Farm* and *1984*. Currently, 25 functional VR systems have been developed through projects realising different media products, open for further analysis in our future research (see Figure 1).



Figure 1: Screenshots of selected works (Brecht's theater in VR) from different groups of students.

In addition to familiarising themselves with modern technologies and frameworks for the implementation of VR environments, the high number of participation (around 40 students in each course) posed a great challenge for both teachers and students – a challenge that was met by group work and the establishment of an agile workflow based on the framework SCRUM. Each group consisted of four to six students who played different roles in the group: 3D modelers, programmers, designers, and group members who focused on transforming aspects of a source narration into the narrative of the VR application. Analogous to a SCRUM Sprint, all group members were expected to meet at the beginning of the week to define work to be done in a

week (Sprint Planning) and to reflect on completed work and the group dynamics (Sprint Retrospective and Sprint Review). New work packages were formulated and processed as tickets in free and open source project management applications such as Redmine, OpenProject or Trello.

Unforeseen Changes

In October 2017, Mozilla announced that WebVR would be further developed under the name WebXR,⁹ due to a new development program that was introduced for the so-called Mixed Reality. This means that in addition to Virtual Reality, Augmented Reality (AR) is now also paving the way for web development. According to Mozilla, the initial focus remains "how to get devices, headsets, frameworks and toolsets to work together, so web developers can choose from a variety of tools and publishing methods to bring new immersive experiences online – and have them work together in a fully functional way."¹⁰ While the focus and the goal are constant, this also shows the rapidly progressing development. For the planning of the teaching this have to be taken into consideration. With the current speed of change in the area of VR, decisive new developments can change the conditions for the practical work from the time of planning to the complete implementation of a single university course. This highlights why a flexible methodology such as SCRUM is necessary even if SCRUM is not really applicable to student projects of this kind.

The year 2017 is a good example. During the year, opportunities to create and experience Virtual Reality content on the Web multiplied several times – and have had an impact for the courses in Cologne: Mozilla and Microsoft started shipping WebVR API's in their browsers

⁹ Cf. <https://blog.mozilla.org/blog/2017/10/20/bringing-mixed-reality-web/>.

¹⁰ <https://blog.mozilla.org/blog/2017/10/20/bringing-mixed-reality-web/>.

Firefox and Edge, the new VR-frameworks A-Frame and ReactVR (shortly after release renamed in React360) gained massive popularity and a wide variety of tools such as PlayCanvas and Sketchfab address the growing VR (and AR) community.

Investigating Virtual Reality

The VR systems that have been developed are used as objects of investigation, addressing the research questions already indicated above: Does VR offer new possibilities and opportunities to explore source media such as a theatre text, a novel, a song, or a film? What happens in the transformation from the source medium to the VR representation? Looking closely at and comparing the individual works we were able to clarify characteristics and detect tendencies.

Should VR be considered as a narrative medium?¹¹ From the perspective of literary studies this has repeatedly been suggested. Lars Elleström points out that “Media [...] are both, different and similar, and intermediality must be understood as a bridge between medial differences that is founded on medial similarities” (Elleström 12). His four media modalities material, sensorial, spatiotemporal, and semiotic provide a revealing model that helps us clarifying the relationship between different media. While categories for analysing and comparing theater and film have been clearly defined and their applicability have been shown,¹² it is still interesting to investigate how VR fits into – or between – such categorisations. Also approaching VR as a semiotic phenomenon is possible from a literary theory perspective (see Ryan).

¹¹ VR is not clearly defined as a medium, but even the term media itself is arguably not consistent, as discussed intensively in several humanities disciplines.

¹² A detailed analysis of Brecht’s theater plays in this context: Lang 2006.

Before focusing the project work on questions of what happens to the source medium when being translated into VR and the question how to implement a theatre play in virtual reality, the central question arose if Brecht's theatre piece "Der gute Mensch von Sezuan" should be realised as a game or rather as a narration without gaming elements. In his work "Half-real: Video Games Between Real Rules and Fictional World" Jesper Juul defines a game as a

„rule-based system with a variable and quantifiable outcome, where different outcomes are assigned different values, the player exerts effort in order to influence the outcome, the player feels emotionally attached to the outcome, and the consequences of the activity are negotiable“ (Juul 36).

With his definition Juul describes more the game itself (*ludus*) and less the playing of the game. Juul presents the game as a rule-based system in which players try to influence the course of the game in order to lead the game to a certain result. Each game has its own rules that are binding for all participants in the game. Players who do not follow the rules of the game are cheaters, even spoilsports, as Huizinga notes (Huizinga 20).

The question of whether the individually implemented VR-application is a game or a pure (if possible) narrative analogous to walking simulators like "Dear Esther" (published in 2012) or "Everybody's Gone to the Rapture" (released in 2015) opens up a space for re-reflections and discussions about basic features of VR and of the interactive aspect of intermediality: Who are the players in VR and how do they behave in virtual space and virtual time? Is the VR application closer to a game or to a narrative?

When asked whether the VR application developed in a certain group was a narrative or a game, the group members mostly answered that their application was a game. This is an interesting

view that refers to the – sometimes intuitive – embedding of quests and minigames into VR environments. One project implemented in the course places the actor in "Der gute Mensch von Sezuan" in a factory building. This throws light on the question of narration or game / play as the player is encouraged to stare at an assembly line and do his work. When the player stops looking at the assembly line, the environment signals that he is doing something bad.

Teaching and Reflecting Virtual Reality Theatre

In order to base the analysis of the implemented VR applications on solid ground, we used the categorization of epic theatre and audiovisual media developed by Joachim Lang. In his work "Episches Theatre as a film. Stage plays by Bertolt Brecht in the audiovisual media" Lang differentiates different aspects of theatre and film. Lang's categorization of theatre and film was extended by us to virtual reality and served as a basis for discussions in the courses (Lang 50-71):

	Theatre	Film	VR
Baseline Situation	Live	Pre-Produced	?
Textual Basis	Speak out	Point to	?
Scenery	Functional	Illusionistic	?
Image	Own View	Determined	?
[...]	[...]	[...]	[...]

Performativity is a core characteristics of theatre. A theatre performance takes place at a certain time in a certain space and is unique: although it is performed anew, it is never the same. A film is pre-produced and can be played again and again; in this sense the film remains the

same film. Virtual reality environments are also pre-produced but, depending on implementation details, can enable more or less letting their users step out of the pre-produced determination, for example by integrating live events into the VR experience.

Lang explains that the differences in the scenery between theatre and film result from the initial situation: because the theatre is based on the agreement that theatre is a play, the scenery is understood as an abstraction from the real world. In film, however, the scenery is presented as fixed reality (Lang 54). Virtual reality is able to be both: a highly realistically drawn and arranged representation of a fixed reality as well as a virtual illusion that questions itself. According to Brecht, reality should not be depicted as an illusion, because for Brecht the simple reproduction of reality says less about reality than ever before. This is exactly what makes Brecht's plays interesting for understanding immersion in virtual reality, since immersion is not to be created by a realistic representation of the real world.

Brecht's method of explicitly pointing at what you are showing manifested itself in the courses as an especially central moment in the implementation of custom VR environments and as a major challenge. The participants obviously do the pointing primarily through the symbolic design of their applications. Among other things, a virtual stage space was developed that explicitly refers to the theatrical character of the VR environment. Another environment was developed which is based on the visuality of Lars von Trier's film "Dogville" – a frequently made and interesting observation: due to a lack of conventions, students (and we all) often fall back on familiar things from other media. From media history we have seen how this can be observed also for other young media.

CONCLUSION

The imparting of practical knowledge ("How do I develop a virtual reality application with state of the art tools and frameworks?") and the constant reflection ("How does the source medium, which is the basis of my very individual implementation, change while being transformed into a virtual reality system?") creates a valuable outcome for the Humanities by implementing virtual realities in teaching environments and reflecting on the process of modelling the contents of media products with a focus on narrative elements.

Bibliography

A-Frame. 2019. "A-Frame - Make WebVR." Mozilla Corporation. Accessed January 15, 2019.

<https://aframe.io/>.

BabylonJS. 2019. "Babylon.js demos & documentation". Accessed January 15, 2019.

<https://www.babylonjs.com/>.

Brecht, Bertolt. 1993. Werke. Große kommentierte Berliner und Frankfurter Ausgabe. 30 Bände (in 32 Teilbänden) und ein Registerband: Band 15: Gedichte 5. Gedichte und Gedichtfragmente 1940-1956 Gebundene Ausgabe. Edited by Klaus-Detlef Müller, Werner Hecht, Jan Knopf, Werner Mittenzwei.

Ciula, Arianna, and Øyvind Eide. 2017. "Modelling in Digital Humanities: Signs in Context."

Digital Scholarship in the Humanities 32 (suppl_1): i33-i46.

Day, Elizabeth. 2015. "Virtual reality? Not for me. Then I turn into Wonder Woman and fly over New York". *The Guardian*. Accessed January 15, 2019.

<https://www.theguardian.com/technology/2015/oct/11/virtual-reality-oculus-rift-stanford-silicon-valley-facebook>.

Deino, Daryl. 2017. "Virtual Reality Showdown: Google Daydream View vs. Samsung Gear VR". *Observer*. Accessed January 15, 2019.

<http://observer.com/2017/06/best-virtual-reality-device-google-daydream-view-samsung-gear-vr/>.

Eide, Øyvind. 2015. *Media Boundaries and Conceptual Modelling : Between Texts and Maps*. Houndmills, Basingstoke, Hampshire: Palgrave Macmillan.

Google. 2019. "Google Cardboard". Google VR. Accessed January 15, 2019.
<https://vr.google.com/cardboard/>.

Gordon, Robert. 2006. *The purpose of playing: modern acting theories in perspective*. Ann Arbor: University of Michigan Press.

Harris, Beth. 2011. „The Real and the Virtual Art Museum.“ Moma.org. Accessed January 15, 2019.
https://www.moma.org/explore/inside_out/2011/03/09/the-real-and-the-virtual-art-museum/.

Hinck, Walter. 1959. *Die Dramaturgie des späten Brecht*. Göttingen: Vandenhoeck & Ruprecht.

Huizinga, Johan. 2009. *Homo ludens – Vom Ursprung der Kultur im Spiel*. Reinbek bei Hamburg: Rowohlt.

- Juul, Jesper. 2005. *Half-real: Video Games Between Real Rules and Fictional Worlds*. Cambridge, Massachusetts: MIT Press.
- Lang, Joachim. 2006. *Episches Theater als Film: Bühnenstücke Bertolt Brechts in den audiovisuellen Medien*. Würzburg: Königshausen & Neumann.
- Murray, Janet H. 2017. *Hamlet on the Holodeck: the Future of Narrative in Cyberspace*. The MIT Press.
- Parker, Laura. 2017. "Virtual Reality Is a Disappointment? Not in the World of Video Gamers". *The New York Times*. Accessed January 15, 2019. <https://www.nytimes.com/2017/06/22/technology/personaltech/virtual-reality-video-games.html>.
- React 360. 2019. "React 360 · Create amazing 360 experiences". *React Native Blog ATOM*. Accessed January 15, 2019. <https://facebook.github.io/react-360/>.
- Ryan, Marie-Laure. 2015. *Narrative as virtual reality 2: revisiting immersion and interactivity in literature and electronic media*. Baltimore: Johns Hopkins University Press.
- Sierra, Albert, Gabriel de Prado, Isis Ruiz Soler and Ferran Codina. 2017. "Virtual Reality And Archaeological Reconstruction: Be There, Back Then." *MW17: Museums and the Web*

2017. Accessed January 15, 2019.

<https://mw17.mwconf.org/paper/virtual-reality-and-archaeological-reconstruction-be-ther-e-be-back-then-ullastret3d-and-vr-experience-in-htc-vive-and-immersive-room/>.

Singh, Amit. 2017. "More ways to watch and play with AR and VR." www.blog.google.

Accessed January 15, 2019.

<https://blog.google/products/google-vr/more-ways-watch-and-play-ar-and-vr/>.

ThreeJS. 2019. "three.js – Javascript 3D library". Accessed January 15, 2019. <https://threejs.org/>.

Unity Technologies. 2019. "Unity - Game Engine." Accessed January 15, 2019.

<https://unity3d.com/de/>.

Unity Technologies. 2019. "Movement in VR." Tutorials Virtual Reality. Accessed January 15,

2019. <https://unity3d.com/de/learn/tutorials/topics/virtual-reality/movement-vr>.

Wareable. 2019. "Best VR games 2017: Titles you can't miss for HTC Vive, Oculus Rift, PS VR and more." Accessed January 15, 2019.

<https://www.wareable.com/gaming/top-vr-games-for-oculus-rift-project-morpheus-gear-vr-and-project-cardboard>.

AUTHORS BIOGRAPHY

ØYVIND EIDE

Øyvind Eide is a professor in Digital Humanities at the University of Cologne. He holds a PhD in Digital Humanities from King's College London (2013). He was an employee in various positions at The University of Oslo from 1995 to 2013, working on digital humanities and cultural heritage informatics. From 2013 to 2015 he was a Lecturer and research associate at The University of Passau. He is the chair of The European Association for Digital Humanities (EADH) and also actively engaged in several other international organisations such as The Alliance of Digital Humanities Organizations (ADHO), ICOM's International Committee for Documentation (CIDOC) and Cultural Literacy in Europe (CLE). His research interests are focused on transformative digital intermedia studies, using critical stepwise formalisation as a method for conceptual modelling of cultural heritage information. This is used as a tool for critical engagement with media differences, especially the relationships between texts and maps as media of communication. He is also engaged in theoretical studies of modelling in the humanities as well as beyond.

ZOE SCHUBERT

MA Zoe Schubert is working as a research associate and lecturer for Digital Humanities at the Institute for Digital Humanities (Historisch-Kulturwissenschaftliche Informationsverarbeitung) at the University of Cologne, Germany.

Zoe Schubert holds a Master's degree in Computer Science for the Humanities and Media Science. She is writing her dissertation about „Virtual Reality as a transformative technology in the Humanities - Theater in VR“. Supervisors are Prof. Dr. Øyvind Eide and Prof. Dr. Manfred Thaller from the University of Cologne, Germany. Her research interests include Virtual Reality and Augmented Reality, Media Transformations, visualisations and web technologies.

JAN G. WIENERS

Dr. Jan Gerrit Wieners is a research associate and lecturer for Digital Humanities at the Institute for Digital Humanities at the University of Cologne, Germany.

Jan G. Wieners holds a Master's degree (Magister Artium) in Computer Science for the Humanities, German Philology and Philosophy and a PhD in Digital Humanities from the University of Cologne. His research interests include Virtual, Augmented and Mixed Reality, Cognitive Mapping, Inter- and Transmediality, Embodiment, Philosophy of Mind, Artificial Intelligence and Computer Vision.