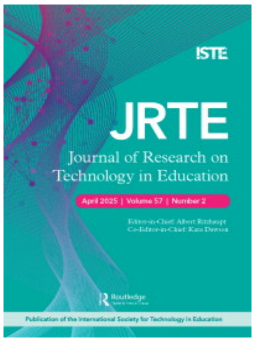

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A heuristic framework for video-based teaching and learning scenarios in higher education

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ABSTRACT

Video has been proven to be an effective tool for enhancing the professional vision of higher education students, which is a crucial situation-specific skill within their professional competence. To ensure the successful integration of video in higher education teaching and learning, several implementation actions and processes need to be considered. This paper proposes a heuristic framework for implementing video-based teaching and learning scenarios across various disciplines in higher education. The framework combines existing research strands on professional vision, video implementation, technological pedagogical content knowledge (TPACK), and interactive, constructive, active, and passive (ICAP) learning activities. To highlight the interdisciplinary nature of the framework, examples from four different higher education disciplines (Catholic moral theology, Communication science, German as a second and foreign language, Medicine) are provided. These examples serve to underscore the framework's applicability across a range of academic fields.

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Video-based teaching and learning; higher education; professional vision; TPACK; ICAP; university students' competence development

Fostering professional vision in higher education through videos representing authentic professional practice

Professional vision is an important situation-specific skill within professional competence (Behling et al., 2019; Blömeke et al., 2015). It is considered a prerequisite for mastering situations in professional fields (Seidel & Stürmer, 2014; Stokking et al., 2003). It was initially introduced by Goodwin (1994) as the profession-specific ability to perceive key elements through proficient use of "a complex of situated practices in a relevant setting" (Goodwin, 1994, p. 626). To meet the demand for competency-based higher education, university teaching and learning settings must offer students opportunities to develop and refine their professional vision within their future professional contexts.

The use of video is particularly effective for fostering students' professional vision which has been predominantly proven for (pre-service) teacher training (Santagata et al., 2021; Santagata

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& Guarino, 2011; Sherin & Van Es, 2009; van Es & Sherin, 2008). Systematic review findings (Noetel et al., 2021) emphasize that video-enriched lectures in higher education reveal better learning outcomes (not necessarily focused on professional vision only) for students. True for any higher education discipline, videos depicting authentic situations from different professional fields offer the possibility to expose students to practice without immediate pressure to act and can therefore help to bridge the gap between higher education and professional practice (Stokking et al., 2003). Authentic field-specific videos can be used to support learners in recognizing, elaborating on, and processing relevant aspects in the noise of the field (Aviation: Ahmadi et al., 2022; Medicine: Feng et al., 2020; Higher education in general: Hodgson et al. 2019; German as a second and foreign language: Janík & Janíková, 2019; Stahl, 2022).

As technical possibilities have advanced rapidly in recent decades, new video options have emerged. 360-degree videos, for example, provide an immersive all-round view (Draghina et al., 2022); appropriate video annotations (e.g. prompts) enable the meaningful didacticization of a video and may support learners' competence development (Sommerhoff et al., 2023). However, it has been demonstrated that the crucial aspect in video use is not the video itself but rather *how* it is used (Blomberg et al., 2013; Seago, 2003). Nevertheless, video use in teaching and learning scenarios is often only described at a general level, even though its effectiveness depends on the details of its implementation (Blomberg et al., 2013). There is still a lack of frameworks that integrate existing empirical and practical knowledge to guide higher education teachers when planning, implementing, evaluating, and disseminating video-based teaching and learning scenarios.[1] Heuristics such as those by Blomberg et al. (2013) are an important step in this direction, but do not cover the complete cyclical process of enacting teaching and learning scenarios and are designed exclusively for pre-service teacher education. To address this gap, this article introduces a heuristic framework aimed at supporting university teachers in the development and implementation of video-based teaching and learning scenarios that may enhance their students' professional vision.

A heuristic framework for higher-order video-based teaching and learning scenarios in higher education

Project context

We developed the framework in collaboration with an interdisciplinary group of researchers from diverse fields including Catholic moral theology, Communication science, German as a second and foreign language, and Medicine. The project, which has received funding (Stiftung Innovation in der Hochschullehre Grant FBM2020-EA-2620-01350), aims to enhance the quality of higher education teaching and learning through the creation and implementation of authentic videos. The first objective of the project is to explore innovative video approaches, such as 360-degree videos, that encourage students' active engagement. The second objective involves integrating four seemingly unrelated disciplines in higher education to develop an interdisciplinary understanding of the nature and development of professional vision in the context of video-based teaching and learning. The third objective is to transfer the knowledge gained from this interdisciplinary collaboration in working with video, culminating in the development of the proposed framework.

Framework development

The framework was developed through an iterative deductive-inductive process in regular interdisciplinary group discussions. Initially, assumptions about relevant stakeholders and processes were derived from the literature (deductive) which formed the core of the framework. Subsequently, the framework was tested in four disciplines and adjusted inductively based on practical field experience. These iterations were repeated until the framework was found to be applicable across all four disciplines.

Aim of the framework

The framework we propose offers several contributions to the existing literature: (1) We have integrated key research strands on professional vision, video implementation, technological pedagogical content knowledge (TPACK), and interactive, constructive, active, and passive (ICAP) learning activities into a cohesive framework. These different research strands have not yet been integrated all together to the best of our knowledge. (2) We provide a practical and accessible heuristic that has been tested in various disciplines within higher education. Our framework serves as a guide for both stakeholders who are new to video-based teaching and those seeking a structured approach for conducting research on video-based teaching and learning.

In the following, we will begin by outlining the framework (Figure 1), followed by practical examples from the four disciplines involved.

Involved stakeholders

Various stakeholders might be involved in video-based teaching and learning in higher education, visualized by the rectangular boxes in the background layer. In the green box, we positioned teachers in higher education, who—in line with supply-usage models (Helmke & Weinert, 1997; Seidel, 2014)—are responsible for supplying high-quality learning activities and processes (Kollar & Fischer, 2019). In the university context, it is common to have additional instructional designers within a central unit, such as a media office. They are most notably concerned with technical and instructional support for higher education teachers by providing individual advice or conducting workshops on pedagogical or technological issues in teaching (Chen & Carliner, 2021). In addition, professional experts can provide authentic insights into the professional field or can support the definition of professional vision in a certain field (e.g. by tracking their gaze and/or asking them to think aloud in a professional situation (cf. for example Gegenfurtner & Seppänen, 2013). Students—as users and co-creators of the teaching and learning scenarios—are represented in the blue box. Students' participation in the conceptualization and implementation

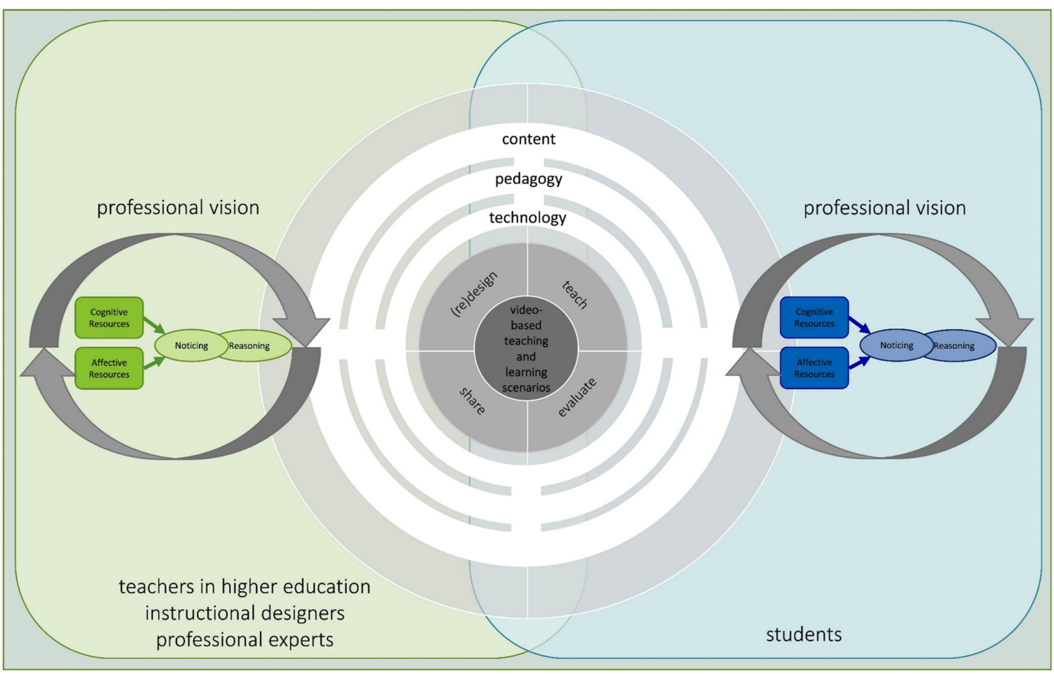

Figure 1. A heuristic framework for higher-order video-based teaching and learning scenarios in higher education.

of higher education teaching and learning scenarios is considered to have great motivational and learning potential for students as well as teachers (Koehler et al., 2004). This is indicated by the overlap of the two boxes for the key stakeholders involved. As is true for any higher education teaching activity, various contextual factors such as available technical equipment are also relevant for the successful implementation of videos in teaching (for further contextual factors, see Sailer, Schultz-Pernice, et al., 2021). These contextual factors are visualized by the box in the background.

Development of professional vision

Professional vision is a situation-specific skill that must be learned in each specific professional context and depends on a person's cognitive and affective motivational resources (Blömeke et al., 2015; Goodwin, 1994). Professional vision frameworks commonly differentiate professional vision into noticing and knowledge-based reasoning. Noticing refers to the knowledge-driven identification of key elements (Seidel et al., 2010; Seidel & Stürmer, 2014; Sherin & Van Es, 2009; van Es & Sherin, 2002). Knowledge-based reasoning encompasses the processing of the aspects noticed (Behling et al., 2019; Seidel & Stürmer, 2014).

In line with Gegenfurtner et al. (2022), who recently proposed a framework for visual expertise, we assume that a certain level of professional vision preexists among all stakeholders. Stakeholders can enhance their professional vision within the context of lifelong learning as their level of expertise develops and they advance within a professional field. While students (stakeholder illustrated on the right side) are generally expected to have a novice level of professional vision, the stakeholders on the left side (teachers in higher education, instructional designers, professional experts) require a more advanced level of visual expertise to identify key professional issues that may serve as a foundation for developing teaching and learning scenarios. Implementing and reflecting on the scenarios may contribute to the further development of stakeholders' professional vision ("to teach is to learn twice"). The circular arrows for both stakeholder groups capture these assumed continuous development processes.

Implementation of higher-order video-based teaching and learning scenarios

Implementation actions

When implementing video-based teaching and learning scenarios, we advocate that higher education teachers' actions need to be defined in accordance with the well-established Technological Pedagogical Content Knowledge (TPACK) framework (Koehler et al., 2014; Koehler & Mishra, 2009; Mishra & Koehler, 2006). TPACK provides a well-structured overview of the knowledge facets relevant for technology-enhanced teaching.[2] While the original TPACK framework represents knowledge facets of technology-enhanced learning, more recent TPACK research has expanded its scope to see TPACK as a competence addressing to-be-mastered teacher actions (Willermark, 2018). We follow these more recent approaches and understand TPACK's core components of content, pedagogy, and technology (illustrated in rings) and their interplay (cross-connections between the rings) as teacher actions to be performed when implementing video-based teaching and learning.

Mishra and Koehler (2006) assume that (higher education) teachers need certain core knowledge facets to successfully integrate technology in their teaching: technological knowledge (TK), pedagogical knowledge (PK), and content knowledge (CK). The interactions between these areas, however, are equally important, as they form a very specific type of knowledge. For example, pedagogical content knowledge (PCK) refers to how a particular content can be adapted when teaching a particular audience, e.g. the embedding of a video in a teaching and learning scenario. Technological content knowledge (TCK) captures a person's understanding of the impact of technology on the subject matter and vice versa, e.g. when enriching or annotating a video with further material or technical options. Technological pedagogical knowledge (TPK) describes a person's knowledge of how teaching and learning is affected by using certain technologies, e.g. how the selection of tasks and methods regarding video implementation in lessons affects students' cognitive activation. Technological pedagogical content knowledge (TPACK)—as the interaction of all three core knowledge components—is defined as a deep understanding of the interrelationships among technological, pedagogical, and content knowledge, which comes into play in actions such as the development of prompts and scaffolds. The significance of each knowledge facet and corresponding teacher action is dependent upon the nature of the teaching and learning scenario and the way the scenario is realized across its various phases.

Implementation process

Based on the literature (Sailer, Murböck, et al., 2021), the implementation process of video-based scenarios can be structured into four phases: (re)design, teach, evaluate, and share. In the framework model, these phases are positioned radially around the teaching and learning scenarios. Skipping phases or transitioning from any one phase to any other phase is possible.

(Re-)design. This phase encompasses all steps necessary for designing and producing a teaching and learning scenario. This includes the production of video material for a new teaching and learning scenario (design) or the selection and adaptation of preexisting video material (re-design) (Blomberg et al., 2013). First, relevant content to train professional vision as well as students' assumed level of professional vision needs to be identified. Second, learning goals (e.g. drawing upon the revised version of Bloom's learning taxonomy by Krathwohl, 2002) need to be defined while considering students' prerequisites, such as their affective-motivational (e.g. attitude toward learning with videos) and cognitive resources (e.g. content knowledge, technological knowledge) (Sailer, Murböck, et al., 2021). Third, a type of video needs to be chosen, e.g. typical vs. best-practice, real vs. scripted (Blomberg et al., 2013), a 360-degree video in a VR environment or a monitor-based video, a video taking the perspective of the agent in the situation or an external perspective. For a scripted video, professional experts may be consulted to highlight typical challenges within their professional field as the foundation for the script. Fourth, when suitable video material is not available yet, the material must be produced by teachers and/or instructional designers. Fifth, the chosen videos need to be embedded in the lesson plan and aligned with other learning materials (Blomberg et al., 2013). This can be achieved through prompts and scaffolds (Sommerhoff et al., 2023) to support noticing and knowledge-based reasoning. During a technical needs analysis, it is essential to determine which technical tools or software are appropriate for this purpose. Suitable software (e.g. H5P) offers a variety of options, such as visual highlights, pop-up windows with supplementary images or info texts, embedded questions, and user selection. Sixth, the teaching and learning scenario may be integrated into a digital learning platform (Fyfield et al., 2019), depending on the intended teaching format (e-learning; blended learning; live session).

Teach. After the video material has been produced, selected, or prompted, the scenario might unfold within an online teaching unit, a seminar, a small-group discussion, or a lecture. Independent of the teaching setting, instruction should evoke learners' deep involvement with the video and the additional or embedded learning material, in accordance with the established ICAP framework (Chi, 2009; Chi et al., 2018; Chi & Wylie, 2014). ICAP suggests that certain overt behaviors by students are more likely associated with certain knowledge change processes and corresponding learning outcomes. ICAP differentiates between four engagement modes:

- *Passive* means that a learner receives information, which should lead to unlinked storing of information. In video-based teaching, there is a risk for passive learning experiences if students are simply asked to watch a video without any further prompts.

- *Active* is defined as the purposeful manipulation of materials to encourage the learner's activation of prior knowledge, linkage, and storage of new information. In video-based teaching, this would be the case when learners can pause, rewind, or fast-forward the video to observe certain scenes in more detail or influence the video's script by choosing various options in a branching scenario. Control over the video might be beneficial since it enables students to self-regulate their cognitive load (e.g., by rewinding, pausing, or fast-forwarding), which makes learning more effective (Noetel et al., 2021). This may also include navigation of a 360-degree video: By moving their head, the user actively determines which parts of the video to view.
- *Constructive* demands that a learner generates new ideas beyond the information and materials presented by inferring from their own prior knowledge. It might be prompted by questions or learning tasks that encourage the learner to explain their observations from the video, take notes in their own words and annotate the video. Prompts can be embedded in the video itself during the design phase or presented when facilitating the scenario in a way that is adapted to students' learning prerequisites.
- *Interactive* is defined as collaborative interaction between at least two partners who engage, contribute constructively, and refer to each other's utterances. The core of this approach is the mutual addition of new ideas, which should lead to a co-generation of new information that a single person would not have thought of by themselves. It can be achieved by having students discuss the video material with a partner, e.g., via (video) chat or a face-to-face conversation. Learners are asked to add new ideas, questions, or elaborate on their peers' observations.

Each of these modes is assumed to comprise and to be superior to the previous mode, i.e. the engagement mode interactive comprises constructive, active, and passive elements. It is assumed that learners engage more deeply with learning material in the following mode order I > C > A > P. Therefore, the highest learning outcomes are expected for interactive learning opportunities (Chi, 2009; Chi et al., 2018; Chi & Wylie, 2014). Consequently, following ICAP in video-based higher-order teaching and learning scenarios, students should at least show overt motoric behaviors that require "focused attention while manipulating" (Chi & Wylie, 2014, p. 222).

Evaluate. In the evaluation phase, students' cognitive (e.g. knowledge gain) and affective outcomes (e.g. technology acceptance) as well as professional vision development may be assessed. The collected information serves as the basis for the re-design phase. Evaluation can include different formal or informal assessments of the success of the teaching and learning scenarios. Useful tools include standardized questionnaire surveys, feedback rounds, and having an instructional designer prepare an observation protocol and discussing it as a group. Researchers encourage monitoring student output to test the effects of different intended engagement modes based on ICAP (Chi et al., 2018; Chi & Wylie, 2014). This can be achieved by observing student manipulations of the video, analyzing explicit student statements, giving students standardized knowledge tests, or instruments to measure professional vision changes (such as the Observer Tool; Seidel et al, 2010; Seidel & Stürmer, 2014). On a broader level, there is the possibility of developing adapted measurement environments in research projects that can reveal more complex and accurate information about the teaching and learning scenarios' effectiveness, such as examining multiple comparison groups working with the same video but different prompts or applying pre- and post-tests with eye-tracking to detect changes in visual behavior.

Share. This phase includes the structured description, proactive communication, and dissemination of the videos or the entire teaching and learning scenarios with other higher education teachers and higher education institutions. For systematic dissemination, a structured description and indexing of the video's access point, i.e. a video platform, is necessary (Sailer, Murböck, et al., 2021). Sharing can occur by presenting at conferences, publishing the scenarios in academic journals and on open educational resource platforms such as *OER Commons*, *Internet Archives*, or *TED-Ed*, incorporating the scenarios into universities' professional development programmes for higher education teachers, or simply sharing them with colleagues. Sharing depends on data protection configurations, i.e. what video material may be made accessible to which users.

Practical examples

In this section, we describe examples of higher-order video-based teaching and learning scenarios from the four disciplines involved in the project. The scenarios were conceptualized and implemented in accordance with the framework. Although the described scenarios were not experimentally investigated, they may serve as a proof of concept for the suggested framework. Evaluation results for all scenarios are presented.

Catholic theology

A simulation video was created by the Catholic theology department in which a pastoral caregiver engages in a conversation with a terminally ill woman who mentions her desire to die. Over the course of the video, students can decide for themselves how the conversation will continue by choosing from different options from the caregiver's perspective. Thereby students can directly influence the course and outcome of the conversation and interact with the video. During the script creation process, three experts from the fields of clinical pastoral care, supervision, telephone counseling, and hospital pastoral care were invited to simulate an in-person counseling situation. The conversations were recorded and served as the base for the video's script. The video[3] was used in a lecture on moral theology in which students decided which option to pursue as a group, followed by a discussion. Based on concepts outlined in the preceding course session, the teacher prompted students to explain their reasons for choosing a particular option (knowledge-based reasoning). In addition to the first video, students could individually watch a second version of the video including commentary and context to further help them better understand the situation and behavior of the two individuals and thus support their knowledge-based reasoning.

Evaluation results of this application, based on a pre-post-questionnaire, showed that students' acceptance of the video was above the theoretical mean of the evaluation scale. Additionally, students rated their engagement in the teaching and learning scenario as both passive and interactive. According to students' self-report, their professional vision increased from before to after the learning scenario, indicating the potential of the scenario to enhance students' learning outcomes. The video is also applicable in medicine, e.g. in courses addressing ethical topics.

Media and communication science

Professional vision for mediatization—defined as the increased pervasion of our everyday life with media technology—is an important skill for media and communication scholars and practitioners. The video-based teaching and learning scenario therefore addresses the daily use of communication, information, and entertainment media and how it can affect our personal interactions and relations to other people. A 360-degree video was produced that could be watched *via* virtual reality glasses or cardboard boxes. This enabled the students to have different perspectives and build an emotional connection to the characters. The video showed three everyday life scenarios that were weakly, moderately, or strongly mediatized (= pervaded by media technology) from two different points of view: character A and character B. The classes were divided into groups of four, allowing for an interactive engagement between students that had watched perspective A or perspective B.

Once again, the evaluation was based on a pre-/post-questionnaire. The results illustrated that students' acceptance of the 360-degree video was around the theoretical mean of the evaluation scale. In terms of the learning activities rated by the students, both passive and constructive learning activities were the most prominently perceived. However, students did not self-report an increased professional vision in the post- questionnaire after participating in the learning scenario. In contrast, preliminary interview results indicate that students were in fact reflecting on interdisciplinary issues of professional vision in the group discussions. The 360-degree video—which can also be watched on a regular 2D monitor—can be accessed and shared freely *via* Youtube.[4]

German as a second and foreign language

The scenario aims to train students' awareness of gender in teaching situations. The video was embedded in a teaching and learning scenario conducted in a remote seminar session. On the students' part, a constructive engagement mode was evoked by tasks such as identifying (noticing), describing, and explaining aspects of gender with the help of prompts presented in info boxes and, if necessary, naming alternative actions (knowledge-based reasoning). Knowledge-based reasoning was supported by examples that gradually introduced the students to their tasks. An interactive learning mode was targeted by encouraging students to engage in comparative discussion of their individual observations.

A pre- and post-questionnaire-based evaluation demonstrated students' acceptance of the video to be above the theoretical mean of the evaluation scale. Aligned with the aim of fostering students' constructive engagement, students rated their engagement as mainly constructive. Students reported an increased professional vision from before to after participating in the teaching and learning scenario. These positive outcomes support the utilization and dissemination of the scenario in its current version. Since the scenario was scripted and acted out by amateur actors, the video and teaching and learning scenario are available as open educational resources. Due to its cross-sectional topic, the scenario might also be used in other teaching-related disciplines.

Medicine

To train medical students' professional vision by taking varying perspectives on an operation setting (removing a mole), a multi-perspective video was produced: students could actively switch between the video of the whole situation, details such as the surgical instruments, and the perspectives of the physician and surgical assistant. The two perspectives were filmed with a mobile eye-tracker they each wore. The video was embedded in an asynchronous online teaching session with questions guiding the observation to prepare students for an interactive skill training on saturation techniques.

To assess students' utilization of the video, they gave feedback on the video after the skills training. Students appreciated the video, but described they would have experienced a greater efficacy of the video in the in-person skill training compared to the previous online session. The video may also be suitable for use in higher semesters of medical studies, aiming to enhance students' awareness of different perspectives held by physicians and surgical assistants regarding the same medical situation. As real patients were filmed, the learning scenario is restricted to sharing within the university context only.

Conclusions

Professional vision is a central skill for future professionals and its development can be facilitated through video-based teaching and learning scenarios across disciplines. In this article, we introduced an interdisciplinary heuristic framework which provides a comprehensive guide for educators to navigate the implementation actions and processes of video-based university teaching. By the integration of TPACK, ICAP, and professional vision, we combined three well researched theories applicable for illustrating the learning-effective implementation of video in higher education across disciplines. One limitation of our work is that, at present, the model only exists as a theoretical construct. However, it has been challenged in the implementation of individual scenarios, as evidenced by the provided examples and available evaluation results. Nevertheless, systematic experimental research on the implementation of specific phases is still pending, as is the exploration of potential discipline-specific adaptations that may be necessary. Therefore, from a research perspective, we recommend conducting further investigations of

1. the assumption that professional vision is both a necessary pre-requisite and outcome in video-based teaching.
2. the impact of new video technologies, e.g., if 360° videos lead to different motivational and cognitive learning outcomes, and
3. the effects of different types of prompts in videos for triggering different ICAP modes.

Notes

1. Hereafter, we refer to video-based teaching and learning scenarios as teaching and learning scenarios.
2. The description of the TPACK framework points out that the term technology does not necessarily refer to new and digital technology but can also refer to analog and older technologies.
3. https://hedgedoc.digillab.uni-augsburg.de/etm5A8MGTz-X2HT XNKWFaQ?view
4. https://www.youtube.com/@uniaugsburg-muk-medienreal5517

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Disclosure statement

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