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Design and Implementation of Immersive 360° Videography in Teacher Training

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Abstract

Immersive 360° videography promises great potential for applications in teacher training. Beyond the use of professionally produced 360° videos showcasing exemplary teaching sequences, this technology allows students to reflect on their own lessons as part of their practical training. However, immersive 360° video has yet to see widespread use among students and mentor teachers owing to both pedagogical and technological challenges that need to be addressed. Using a design-based research approach, this study examines an exemplary implementation of immersive 360° video in practical training at the Zurich University of Teacher Education, and explores the relevant questions and challenges. It aims to gain insights that would help in effectively integrating the technology in teacher training, with consideration for pedagogical, technological, and organizational factors. The project findings indicate that incorporating immersive 360° videography into practical training is both pedagogically valuable and technically viable, provided that clear guidelines and sufficient support are available.

Keywords 360° Video, Virtual Reality, Teacher Training, Design-Based Research

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Design and Implementation of Immersive 360° Videography in Teacher Training

Martin Berger, Tobias M. Schifferle

1.0 Introduction

In teacher-training, teaching videos are considered an established method for reflecting on teaching activities and, in the course, developing new teaching skills (Brouwer, 2014; Gaudin & Chaliès, 2015; Krammer & Reusser, 2005). However, "traditional" videos have a disadvantage in capturing the full potential of the lesson, as they can only document a section of the classroom activities (Ibrahim-Didi, 2015). 360° videos overcome these limitations by enabling individualized spatial appropriation and positioning (Billingsley et al., 2019; Cooper et al., 2019; Ferdig, Kosko, & Gandolfi, 2023; Hebbel-Seeger, 2018; Rosendahl & Wagner, 2024; Yildirim et al., 2020). Such videos can be viewed in two ways: on a regular flat screen or in a more immersive manner with VR glasses. Studies indicate that the latter enhances users' perception of actually being in the 360° environment (Kosko, Ferdig, & Zolfaghari, 2019, 2021; Shu et al., 2019; Wilkinson, Brantley, & Feng 2021). Such an immersion, experts agree, can lead to an increase in both the learning effect as well as the motivation to learn (Atal, Admiraal, & Saab, 2023; Rupp et al., 2019). It is for this reason that 360° videos, viewed with VR glasses – hereinafter referred to as immersive 360° videos – are considered effective technological media for the teacher-training process (Kunz, 2024; Kunz & Zinn, 2022). Studies indicate, among other things, that the technology offers potential for improvement in both self-reflection and external reflection in the context of practical training (Balzaretti et al., 2019; Feurstein, 2019; Tarantini, 2021; Walshe & Driver, 2019). It is, therefore, surprising that immersive 360° videos are rarely used for imparting practical training to teachers.

Using immersive 360° videos in teacher education predominantly involves reflecting on exemplary teaching vignettes created with sophisticated recording equipment. This is because it is challenging for non-experts, such as students and mentor teachers, to handle the numerous pedagogical and technological issues that arise when using 360° videography. These include dealing with the limitations of the technology (limited recording time, quality of the image and sound) as well as handling large amounts of data and the associated challenges in creating and providing immersive 360° videos (Feurstein, 2019).

2.0 Goal and Focus

Our project aims to simplify the use of 360° videos in teacher training. For this reason, a prototype for an immersive 360° videography task is being developed for internships at the Zurich University of Teacher Education (Department Secondary Level II/Vocational Education) using a design-oriented approach. The project builds on an existing task conducted with traditional videography[1], which is adapted for immersive 360° videography in close collaboration with mentor teachers and students. This iterative prototype serves as the foundation for implementing immersive 360° videography beyond the project. Furthermore, the project aims to gain insights for implementing the technology in the practical training of teachers, keeping in mind the following two perspectives:

1. Pedagogical: The central question is how to ensure that the independent use of 360° videography effectively harnesses the technology's subject-specific didactic potential. Additionally, we aim to explore the perspectives of mentor teachers and students regarding the fundamental pedagogical value of immersive 360° videos.

2. Technological and Organizational: The focus here is on exploring how the independent use of 360° videography must be designed to ensure that it can be efficiently implemented within the context of a teacher education program. This includes evaluating the practical and logistical requirements for using immersive 360° educational videos in teacher training, taking into account the effort involved for all participants.

3.0 Method

The project follows the Design-Based Research (DBR) approach (Brown, 1992; Collins, 1992), which is well-suited to exploring the potential of digital technologies with an aim to achieve desired learning outcomes through newly developed instructional designs (Euler & Wilbers, 2020; Wang & Hannafin, 2005). The process outlined below (see Figure 1) is based on a generic DBR process emphasizing iterative design cycles (Euler, 2014; McKenney & Reeves, 2014). Before the design cycles, an initial analysis phase leads to final implementation. The entire process involves iterative collaboration with student teachers and students to align and integrate practical and theoretical expectations, based on an essential design principle of DBR (Euler, 2024).

In the analysis phase, the baseline for developing Prototype 1 is established by reviewing literature and conducting a focus group interview with mentor teachers. Prototype 1 includes a task for students and their mentor teachers, along with a "360° kit" containing recording devices and VR headsets. The prototype is then evaluated in several iterations through practical application and more focus group interviews, followed by redesigns across two design cycles. The process concludes

[1] The existing videography task, students record a phase of their lesson in order to reflect on it afterwards together with their mentor teachers. The selection of the lesson phase and the focus of the reflection are primarily suggested but can be chosen freely.

with the prototype being transferred to the university's Digital Learning Department, ready to integrate immersive 360° videography into the practical training at the Zurich University of Teacher Education (implementation phase).

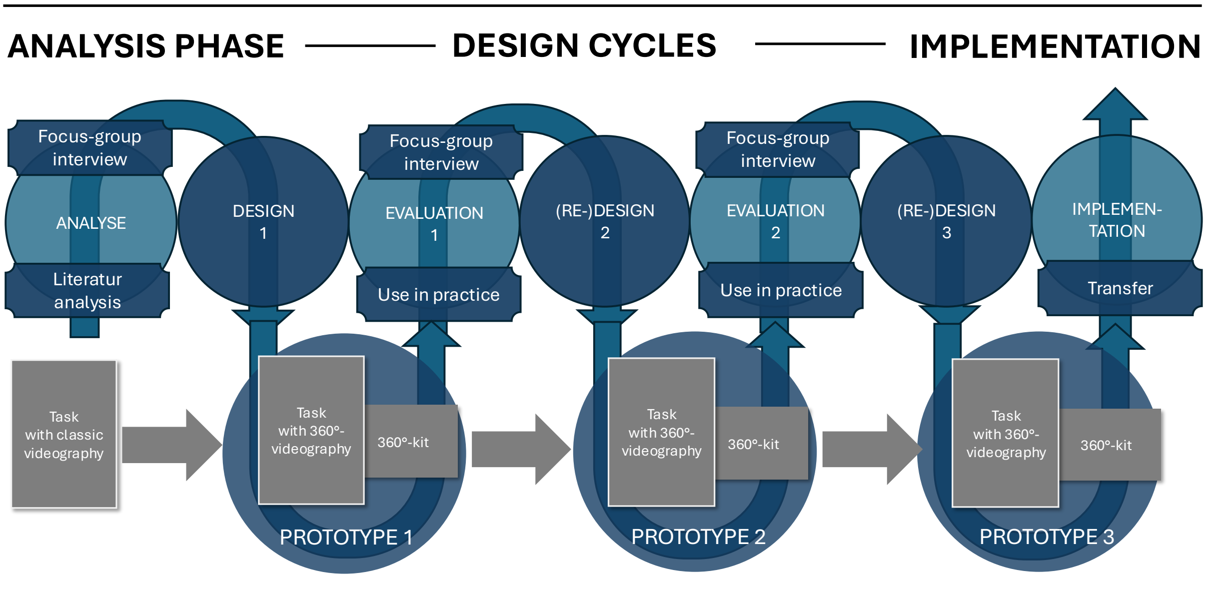

Figure 1: *The process of implementing an immersive 360° videography task in teacher training involves the iterative creation and evaluation of a prototype (task and 360° kit) based on an existing task with classic videography.*

The project began in January 2023 and spanned 24 months. Four volunteer mentor-student pairs were part of it; each pair had an experienced mentor teacher (two women and two men with several years of teaching experience in vocational schools) and a student (also two women and two men who had their own classes but lacked professional teaching experience). The university's Department of Digital Learning provided technological support throughout the project.

The analysis phase took place in the spring semester of 2023. As indicated before, in addition to a literature review, a guided focus group interview with the mentor teachers had been conducted while setting the baseline for the prototype. The first part of the interview explored the participants' experiences with the existing task using traditional videography, focusing on its benefits and limitations. The mentor teachers then had the opportunity to independently view various examples of 360° teaching videos – both immersive (using VR headsets) and non-immersive (using tablets). In the second part of the interview, we gathered their immediate impressions as well as their preferences and ideas for the effective use of immersive 360° videography. The focus group interview was then analyzed using Mayring's qualitative content analysis method (2004). The findings from both the focus group interview and the literature review were used to create Prototype 1 in August 2023. Implementation allowed for both options at this point: the immersive variant with VR glasses and the non-immersive variant with a tablet.

In the autumn semester of 2023, Prototype 1 was used for the first time by mentor-student pairs as part of the first design cycle. In this cycle, the project team provided a brief overview and instructions on creating videos even as they handled the transfer of videos to the VR headsets. A guided focus group interview with the mentor teachers was used to evaluate Prototype 1, which was then further developed (Prototype 2).

In the spring semester of 2024, Prototype 2 was used and evaluated in the second design cycle. In this cycle, students independently recorded and transferred the 360° videos to the headsets as much as possible, following instructions that had been provided to them. Prototype 2 was further evaluated through additional focus group interviews conducted separately with mentor teachers and students. Based on these findings, in turn, Prototype 3 was developed.

In the autumn semester of 2024, Prototype 3 was transferred to the university's Digital Learning Department. Since the beginning of the spring semester of 2025, the immersive 360° videography task has been available for use in practical training.

4.0 Results

As mentioned briefly earlier, the project explored the use of immersive 360° videos from two perspectives: a pedagogical focus as well as a technological and organizational focus (see Section 2). Both perspectives are elaborated in the following section.

4.1 Pedagogical Perspective

Analysis: In the focus interview, mentor teachers noted the high intensity and richness of impressions and information provided, which they found valuable for discussing teaching practices. They regarded the increased volume of information as an advantage over traditional videography, though they also expressed some reservations. They highlighted the risk of information overload and suggested that this potential challenge should be considered when using immersive 360° videography.

> It can be a bit overwhelming when you look at it. You somehow have to find a way to deal with this overwhelming amount of data. You really have to look at it in a targeted way, otherwise you'll be completely overwhelmed. (PT_Pos. 28)

Such an assessment was also reflected in the literature review. Hebbel-Seeger (2018) emphasizes the importance of frameworks to fully harness the didactic potential of this abundance of information in such a way that viewers may not experience concentration difficulties. The information overload can certainly lead to the feeling of being overwhelmed, resulting in effects such as fear of missing out (FOMO) (Aitamurto et al., 2021) or reduced focus (Passmore et al., 2016).

Mentor teachers gained additional insights and impressions, particularly regarding learner behavior. In the interview, comments on immersive 360° videos mainly centered on learner behavior (25 mentions), while teacher behavior was mentioned only twice. It was emphasized that what immersive 360° videos make possible – choosing different perspectives and immersing oneself in the topic – enables more detailed and focused reflection on the (lack of) engagement of certain learners.

> It's really, really cool how you can actually follow an individual student, like stalk them a little bit. The ones that are not normally in focus. Yes, it's still kind of cool that I can say, I'm going to see what she's doing. (PT_Pos. 8)

> And I immediately went to see what they were all doing. And sometimes I was shocked. One of them is not involved at all. (PT_Pos. 13)

The suitability of this technology for focusing on learner behavior, among other aspects, is indeed supported by literature. For example, Kosko et al. (2021) demonstrated that mentor teachers watching 360° videos observed a greater number of student actions than their counterparts who watched traditional videos. The mentor teachers' recommendation to focus specifically on learner engagement is supported by literature as well, which identifies it as a suitable area for instructional reflection in the context of 360° videography (Fauth & Leuders, 2018; Gold, Pfirrmann, & Holodynski, 2021; Meinert & Tuma, 2022). Learner engagement is seen as an indicator of cognitive activation of learners (Fredricks, Reschly, & Christenson, 2019), which is described as a fundamental dimension of good teaching (Kunter & Trautwein, 2013) and, due to its very nature, it cannot be observed from the outside (Praetorius et al., 2018).

Design 1: Insights from the analysis phase were incorporated into the first prototype. The design primarily addressed the aforementioned issue of being overwhelmed by the information density of immersive 360° videos. Due to limited resources, existing technological focus-support tools – such as the post-production integration of audiovisual cues – were not a viable option. Instead, this challenge was tackled by introducing a predefined focus for reflection. The focus was placed on learner engagement, which had by now been identified as particularly well-suited to the potential of 360° video technology. An appendix from the "Observation Manual for the Lesson Feedback Sheet for Deep Structures" (Beobachtungsmanual zum Unterrichtsfeedbackbogen Tiefenstrukturen) by Fauth, Herbein, & Maier (2021, p. 11) was added to the task, providing positive and negative indicators for learner engagement. The option to freely choose the teaching phase to be observed, as outlined in the existing videography assignment, was retained.

Evaluation 1: After the students and mentor teachers had used the prototype, their experiences and insights were the subject of discussion in another focus group interview with mentor teachers. In this interview, the particular issue of how to manage the information richness of 360° videos – initiated during the analysis phase – was explored in greater depth. While this issue had previously been perceived as problematic and overwhelming – leading to a design decision to restrict user autonomy by prescribing a fixed focus on learner engagement – it was now viewed less critically. This shift reflects a widely discussed point in the relevant literature: despite the potential for cognitive overload, the high information density of 360° videos is also considered a key advantage over traditional videography. It enables the discovery and discussion of unplanned or unnoticed aspects that would otherwise remain hidden in the blind spots of perception. (Rosendahl & Wagner, 2024).

In this second round of focus group interviews the decision to focus on learner engagement was reiterated as valuable and meaningful.

> I definitely think the focus is very good. It's something you can observe very well. (PT_Pos. 12)

The attached sheet listing positive and negative indicators of learner engagement was also found to be helpful.

> So I knew that I should pay attention to the activation. And that helped me a lot, the indicators, so that I had a bit of a clue. I wasn't just relying on intuition to observe learner and cognitive activity. They really helped me maintain focus. (PT_Pos. 8)

However, the interviewees requested that the opportunity to focus on other aspects such as social interaction be built into the task. In general, the mentor teachers not only had a positive attitude towards narrowing the focus but also expressed interest in using new technology to set individualized reflection focuses based on the situation.

The (free) choice to focus on a specific teaching phase was also discussed in this round of interviews. Although one participant suggested focusing on a single phase, the mentor teachers felt it was unnecessary, as they saw opportunities for cognitive activation through all phases of the lesson.

Design 2: In Prototype 2, learner engagement remained the primary focus for reflection, though it was defined as a recommendation rather than a requirement. This change accommodated the mentor teachers' request for flexibility to explore other areas of reflection. The option to freely choose the teaching phase to be filmed was also retained. The adaptation of the prototype aimed to ensure that, on the one hand, students would continue to receive guidance on how to meaningfully navigate the information overload, while on the other hand, they would not feel restricted in their ability – together with their mentor teachers – to independently explore their own teaching practices.

Evaluation 2: Since the adjustments to the assignment – both in terms of managing the information richness and using the technology in a didactically meaningful way – had been deemed appropriate after the first cycle, the second cycle focused on exploring the added value of immersive 360° videos when compared to non-immersive 360° videos from the participants' perspective (three of the four tandems tested both variants). The aim was to examine whether the didactic potential of immersive recordings, as described in the literature (Shu et al., 2019; Hebbel-Seeger, 2018), was also perceived in the same way by the student-teachers and mentor teachers. To investigate this, focus group interviews were conducted with both mentor teachers and students. Although all participants found non-immersive 360° videos valuable, there was consensus among the interviewed students and teachers that immersive videos offer additional benefits and should be integrated into practical courses from an educational standpoint.

> I think it's clearly worth watching it with glasses, from my point of view. (PT_Pos. 18)

The main reason for favoring immersive videos over non-immersive ones was that the former offered a deeper insight into the lesson.

> Well, you're completely involved. And I don't know whether you perceived it the same way on the laptop. You could really stand behind the students and look over their shoulders, and you were really fully involved. I think it was brilliant. And I think it would be a shame if you couldn't watch it with the glasses. (PT_Pos. 18)

> Yes, I think it makes a difference whether it's 2D or 3D. In terms of the feeling of actually being in the room. When I put the glasses on, I'm part of the room. It's subtle, but I think it's essential in terms of the learning space experience. We get more of the atmosphere. It's not a woodcut-like difference, it's a more subtle story, but it's essential. (Stud_Pos. 15)

> You're really part of the action. I felt like Harry Potter with the invisible cloak (laughs). (PT_Pos. 26)

Furthermore, an increase in attention was observed when watching the instructional videos. This is due to the improved insight into the lesson.

> This doesn't sound negative, but you're also forced to stay focused. And I had the feeling that I was completely absorbed and could really take it in without distraction. That was very much how I felt. (PT_Pos. 33)

Design 3: In line with the mentor teachers' positive feedback to the pedagogical approach, Prototype 3 remained unchanged from Prototype 2 in terms of an educational perspective. First, the focus on learner engagement was retained as a suggestion, while other individual foci were also accepted. Second, the two versions (immersive and non-immersive) were presented, with the advantages of the immersive version (Shu et al., 2019; Hebbel-Seeger, 2018) being particularly emphasized.

Further development focused primarily on technological and organizational modifications, which will be discussed in detail in the following section.

4.2 Technological and Organizational Perspective

Analysis: As part of the development of the prototype, a technological and organizational analysis was carried out to determine whether and how independent recording and use of 360° videos could be made possible for participants with only a viable amount of effort. The prototype therefore had to be designed in such a way as to maximize the image and sound quality of the immersive 360° videos while minimizing the equipment and effort required by the participants. The challenges related to the following steps were examined:

- Step A: Recording the 360° video in the classroom.

- Step B: Conversion and subsequent transfer of 360° videos to the video portal and VR headsets.

- Step C: Joint reflection on immersive 360° videos using VR headsets.

During the analysis phase, we primarily drew on the expertise and experience of the study's authors and the Digital Learning Department at the Zurich University of Education, as there were limited field reports and implementation guidelines available on the technological and organizational aspects of using immersive 360° videos.

Design 1: As mentioned before, for Prototype 1, a "360° kit" was developed in the form of a suitcase. The kit included an Insta 360 X3 360° camera, several microphones to capture room acoustics and individual voices, and various accessories such as a power bank, cables, and a tripod (see Figure 2). This setup was primarily designed to ensure high sound quality, as past experience had shown that audio quality is often a challenge when recording classroom sessions. Meta Quest 2 VR headsets were also provided in a separate case.

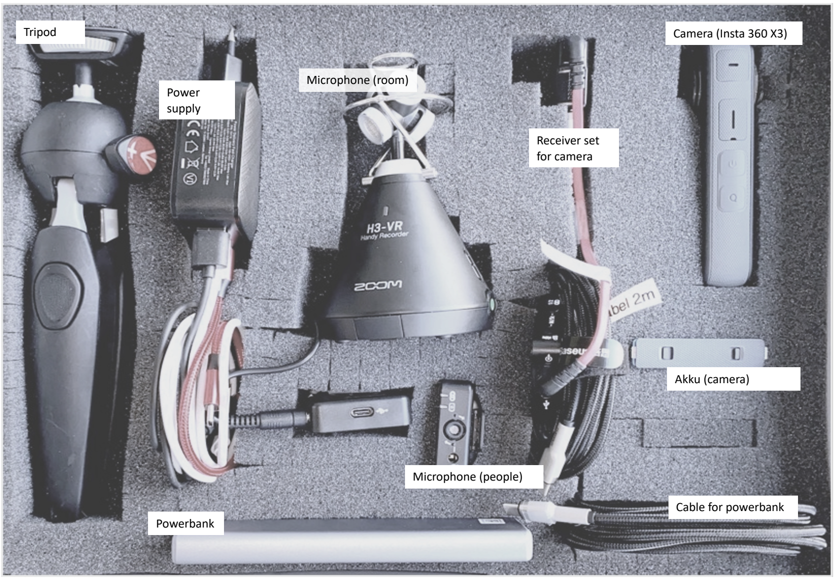

Figure 2: *The 360° kit with extended setup.*

For the 360° video recording in the classroom (Step A), students received training through instructions and a brief orientation session with the project team. The transfer of the 360° videos to the university's media portal and VR headsets (Step B) was handled by the project team in this cycle. After recording, the students returned the 360° cameras with the recorded footage. The project team then converted the recordings and uploaded them to the university's media portal and VR headsets, as direct streaming from the media portal was not feasible. The students and internship teachers were free to decide how they wanted to conduct the joint reflection with the immersive 360° videos (Step C).

Evaluation 1: In the focus group interview, all four mentor teachers rated the usability of the first prototype as good and "straightforward". This positive assessment applied both to the video creation process (Step A) and the joint reflection on immersive 360° videos (Step C). However, the latter was also described as challenging, with a critical discussion about the need for clearer guidelines and instructions for implementing the reflection process effectively.

> I don't know if that's necessary, because everyone found a form that they liked on their own. (TT_Pos. 60)

Various methods for conducting collaborative reflection on the immersive 360° videos were shared in the interview. For instance, in one mentor-student pair, the mentor teacher analyzed the video by viewing it through the VR headset and directly communicated his reflections and insights to the student. It was ultimately agreed that creating a list of suggested approaches for structuring the collaborative reflection phase would be beneficial.

Design 2: In designing Prototype 2, the hardware setup was simplified by removing the individual and room microphones (see Figure 2). This reduced the complexity of the recording process (Step A) but introduced the risk that sound quality might not be sufficient for lesson reflection. Step-by-step instructions were developed for converting the videos and transferring them from the camera to a media portal for viewing on a screen and VR headset. These instructions aimed to enable students to complete this process (Step B) independently and with minimal support. Based on the mentor teachers' recommendations, two ways of conducting the joint reflection on the immersive 360° videos (Step C) were included as non-binding suggestions: The first suggested that the mentor teacher watches the lesson through VR glasses in the presence of the student and shares his or her impressions; alternatively, the mentor teacher can watch the video independently, marking specific timestamps and perspectives to be reviewed and discussed together in the reflection session that followed.

Evaluation 2: The evaluation of the second design cycle centered on two main questions: (1) whether participants found the sound quality sufficient despite the simplified recording setup (Step A), and (2) whether they were able to independently transfer the videos from the camera to the VR headsets (Step B).

All participants rated the sound quality as adequate. The simplified recording process (Step A), achieved by reducing the hardware setup, was seen as helpful and important. The instructions provided in Prototype 2 for Step B were described as clear and easy to follow. Participants reported no issues with independently converting the videos and transferring them from the camera to the media portal for later viewing on a screen and VR headsets.

Design 3: The simplified recording setup from Prototype 2 was retained for Prototype 3, as it met sound quality requirements while reducing complexity. The space saved in the kit allowed both the video camera and VR headsets to be stored in the same case, streamlining the rental process (see Figure 3).

Figure 3: *360° kit with simple recording setup and VR glasses (Meta Quest 2).*

At the recommendation of the project, the university's Department of Digital Learning enhanced the media portal to enable direct streaming of videos through the VR headset's browser. The videos are password-protected to prevent unauthorized access, eliminating the need to manually load and delete videos on the headsets.

Implementation: Prototype 3 has been handed over to the Department of Digital Learning. Based on this prototype, several kits are currently being created, which will be made available to students through the university's lending system in the medium term. The instructions are also being revised. The immersive 360° videography task is scheduled to be integrated into the regular internship program in 2025. However, this implementation process is outside the scope of the current project.

5.0 Conclusion

The project results suggest that independent use of immersive 360° videography by students and mentor teachers in practical training is pedagogically useful and technologically and organizationally feasible. This is conditional on specific tools, guidelines, and support, as described above, which would need to be made available.

From a pedagogical perspective, it is essential to fully leverage the unique possibilities of immersive 360° videos to maximize their educational value. Focusing on technology-suited observational aspects, such as learner engagement, they can help unlock the full potential of this medium. Additionally, providing guidelines can aid in navigating the potentially overwhelming variety of perspectives and experiences made possible by immersive 360° videos. However, given that a key strength of this technology is its ability to provide diverse impressions and flexible perspectives, it is equally important to preserve a variety of approaches for observation and reflection, rather than restricting them prematurely. This flexibility is essential, as the choice between focused and open-ended analysis, or between predefined and self-selected focal points, should be tailored to the students' backgrounds and the specific teaching context.

The project underscores the importance of didactic guidelines in the use of educational technology, as they are necessary to fully exploit its potential while also addressing its risks. When available technology presents both opportunities and challenges from a pedagogical perspective – as is the case with immersive 360° videos – this dual nature should be explicitly addressed in the guidelines, and the instructions should be formulated accordingly.

From a technological and organizational perspective, it is essential to consider the resources available for students' independent creation and use of immersive 360° videos. Here, the costs of hardware and software are of far less importance. More critical are the required resources in terms of working hours, both for the students and their mentor teachers as well as for technical support staff. These should therefore be prioritized. From a curricular standpoint, questions arise about the extent to which students should be exposed to complex technological processes during their studies. Although the use of technology can be justified as enhancing students' media literacy, pedagogical training must remain the primary focus. Additionally, the university must consider how much it is willing to fund technical staff support that may be needed for using the technology.

It is clear that implementing immersive 360° videography in students' practical training, despite its pedagogical value, can only be successful if the technological and organizational processes are designed to enable students to operate independently, and with minimal support. Technical assistance should ideally be limited to lending equipment and offering occasional help. As demonstrated by the project, this can be made possible by providing the simplest possible equipment (hardware and software), which strikes a balance between video quality (e.g., sound) and ease of use. Furthermore, clear support materials, such as handouts, tutorials, guidelines, and brief introductory sessions, are needed to facilitate independent work with the technology.

In conclusion, project experience indicates that creating these support tools may be time-intensive, but it could be a crucial success factor for ensuring that the technology is used more widely for imparting practical training to teachers.

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