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The challenges and opportunities of using 360-degree video technology in online lecturing: A case study in higher education business studies

Mikko Hyttinen

Department of Business Economics
Karelia University of Applied Sciences
Email: mikko.hyttinen@karelia.fi

Olli Hatakka

Department of Business Economics
Karelia University of Applied Sciences
Email: olli.hatakka@karelia.fi

Abstract

Novel technologies can offer many benefits for learning and teaching and employ different learning theories and pedagogical methods. 360-degree video technology allows the students to monitor the whole learning environment and using online video streaming students can follow teaching remotely. When 360-degree video technology is used in teaching it may also pose a didactical and pedagogical challenges and lead to the rejection of otherwise usable technologies. In this case study, we explore the challenges and opportunities that are associated with using 360-degree video technology in online lecturing. 360-degree video technology was tested with business students in higher education settings and student's opinions about the technology was inquired. In addition, the teacher's experiences were used in analysis. The findings seem to indicate that comparing 360-degree video to the normal video stream the sense of presence was felt more comprehensive. This help students to focus more on instructions and it may lead to a better learning experience and outcomes. The most didactical and pedagogical challenges were the teacher's cognitive overload and problems with technology such as

connection failure during lecturing.

Keywords: 360 video technology, pedagogy, didactics, educational technology, computer supported learning

Introduction

Educational technology is playing an increasingly important role in higher education. Particularly interesting right now is to use the novel technologies in learning to achieve better learning outcomes and experiences. 360-degree video technology is one cutting-edge technology that can have an impact on teaching and learning (Reyna, 2018).

360-degree video technology provides a better and richer approach compared to a traditional static camera stream. 360-degree video provides a wider perspective to the learning environment and the possibility to active learning by observing others increases. This technology offers a possibility to focus on students engaged in lecture or to focus on teacher activity (Roche & Gal-Petitfaux, 2017). Because of the situational aspect of this technology the student's cognitive growth (Bandura, 2002) may enhance. 360-degree video is evaluated higher in terms of presence, enjoyment and credibility among viewers. There have not been any negative effects on recognition and understanding (Vettehen et al., 2019). Recorded 360 videos has been a good way to improve students' presentation skills. 360 videos give the possibility to study interactions between the presenter and audio, and to view audience reactions (Yamashita et al., 2016). Viewer can explore all the different aspects of the situation and have the feeling to get totally immersed in the situation, but 360-degree video is not explicit enough to give an understanding of the whole teaching situation and 360 video should be used with wide angle or POV (Point Of View) to understand the depth of the situation (Roche & Gal-Petitfaux, 2017).

Technology enhanced learning environment can facilitate meaningful learning by creating a genuine understanding of the learning phenomena. Different technological solutions can help students promote and reflect their own learning. The learning motivation can increase if diverse learning opportunities are offered. 360-degree video technology can provide an opportunity to implement pedagogical solutions in which the negotiation of meanings and epistemic cognitive conflicts will be central (Kolb, 1974; Piaget, 1970) and the conditions for exploratory learning in various contexts (Hakkarainen, Lonka and Lipponen, 2004) might be improved.

Learning environment that is enhanced with 360-degree videos is supposed to employ learner's critical reasoning skills development as well as to engage the learner with an influential and context-oriented situation (Vygotsky, 1978; Dewey, 1910; Piaget, 1980). The learners have to take more active self-responsibility of their own learning process (Bonk &

Graham, 2004). To help learning we can provide scaffolded and situated environment with learning tools that promote discovery and problem solving with other students. This provokes the student to be an active learner (Brown & Palincsar, 1980; Bruner, 1947; Scardamalia & Bereiter, 2006).

Technological challenges are related to the reliability of the technology or the lack of user interfaces required by the teaching situations, such as bandwidth, synchronous and asynchronous experience (Chakraborty & Victor, 2004; Stewart et al., 2011). When using 360-degree videos for online lecturing or creating 360 educational videos, technical challenges such as video quality, positioning the camera, directing the viewer's attention and the lack of editing options for 360 videos may arise (Kavanagh et al., 2016). According to Feurstein (2018) adequate technical integration is needed in order to expand the use of 360-degree videos in education. Feustein (2018) has identified three main challenges related to using the 360 cameras. These challenges are related to control, position and stitching two 360 videos into one format. The learning scenarios that the 360-degree video is suitable for are video analysis, group work and mobile lecture recording (Feurstein, 2018).

Didactics search for an answer to the question of what is good teaching. In didactics, the object of the study is not the actual teaching process or learning but teaching in general and it is defined as a theory of teaching (Hellström, 2008; Hirsjärvi, 1982). Pedagogy is "the study of the methods and activities of teaching" (Cambridge Dictionary, 2019) and can be seen as the art of teaching (Marriam Webster Dictionary, 2019). Pedagogy is about how knowledge and skills are transferred in different learning environments (Hellström, 2008). In this study, the didactical challenges are related to the teacher's skills and knowledge of how to use the technologies effectively and pedagogical challenges are related to problems on how to arrange teaching that desired meanings are conveyed to students.

Pedagogical and didactical challenges such as the instructor's cognitive load can be due to the specialization required by the technological environment and the division of learning situations in remote and near-methods (Online, F2F) and their effective integration into the same learning environment (Bower et al., 2015). Learning with new technologies can also affect the student's cognitive load. On the other hand, cognitive load is part of the student's learning process and eventually leads to student's deeper understanding, construction of meanings and fosters the problem-solving skills (Vygotsky, 1978; Sweller, 1988).

Methodology

The methodology used was a case study approach (Hirsjärvi, Remes, Sajavaara, 2010; Yin, 2009). The objective of this study was to test 360-degree video technology for online video

lecturing in business studies to address the didactical and pedagogical challenges and opportunities related. After the test the purpose was to find out the students' opinions about the use of the 360-video technology in teaching. The research question is the following: What are the challenges and opportunities students and teachers experience when using 360-degree video in online lecturing in higher education and how remote students experience the sense of presence?

This study consists of two cases in different courses. The courses were selected randomly without any previous expectations. Common to both courses was that the students were business students in higher education. The cases were implemented in spring 2018. The research material was collected through a structured questionnaire sent to the students. In addition, the interpretation of results was enriched with teachers' reflections about the opportunities and challenges related to the implementations of 360 video lectures. In the results and analysis of the research it must be therefore taken into consideration that the researchers have also been involved in the case studies and acted as lecturers during the courses.

The qualitative data from the surveyed questionnaires is analyzed by grouping the students' opinions under challenges and opportunities. The data from both queries are combined and analyzed as one. This is because we are seeking the opportunities and challenges associated with the use of this technology and it is not necessary to specify the answers between the different groups. Altogether there were 17 answers.

We will discuss the research setting, the main results and provide a suggestion of how to meet the challenges and how to take advantage of the opportunities. We will also give a detailed description of the case process that can help other teachers to set up their own 360 video learning environment.

Case-study: The implementation of online 360-degree video lecture

Typically, our lectures have taken place only in the classroom or the lectures have been broadcasted though traditional online video stream or shared as recordings to the learners. The didactical problems are related to the use of the online video conferencing tools. Teachers' skills to use the video conferencing tools vary according to their own interest. In turn, the lack in technological skills has an effect on how diversely pedagogical models and techniques are used in lecturing. The broadcasted and recorded video lectures have met the problem that the sense of presence in the learning situation is not so genuine compared to physical classroom. In the recordings the problem is also how to activate the students.

The case was to broadcast the lecture to online students through YouTube with 360-degree video live stream. Students were let to decide whether to participate online or participate in the classroom. The first group of students were Finnish second year business administration students (n=62) and the second group was second year international business students (n=40) studying in Karelia University of Applied Sciences. The studying course for the business administration students was eBusiness (4 credits) and the subject of the lecture was digital marketing communication and social media marketing. The course for the international business students was Leadership Skills (5 credits) and the subject was leadership communication and delegation. From first group 13 students participated online and from second group 21 participated online. Both lectures included teaching and during lecture small group assignments. (Figure 1.)

Figure 1. Lecture in the classroom (business administration students, eBusiness course).

For 360 video we used Samsung Gear 360 camera (Figure 2). This camera enables 4K video quality, which is delivered with 360 degrees. It is also possible to use Full HD (1080p) video quality. For transmission of the video, we used mobile phone with 5G network enabled. The transmission to YouTube was possible with mobile phones running Operating Systems (OS) IOS and Android. Both were tested and for this experiment, we decided to use Samsung Galaxy A5 with Android.

Figure 2. The camera used in the experiments (Samsung Gear 360).

Both courses were run on Virtual Leaning Environment (VLE) Moodlerooms, which is commonly used for managing the course and the course materials. For the online students the link to the YouTube video stream was shared though Moodlerooms news. Moodlerooms news component sent the messages via email to all students that are enrolled to the course.

The YouTube video was also embedded to the Moodlerooms (Figure 3) and for watching the lecture students only needed to sign into the Moodlerooms or go to YouTube from the link provided with email. If the students were watching the video from Moodlerooms, they were actually viewing the video from YouTube.

From Moodlerooms the students were able to click full screen mode or open the video on YouTube and start chat conversation. Before the online lecture, there were sign up for the student who wanted to follow online. Sign up for online students was implemented using Moodle's selection tool where students just chose if they wanted to participate remotely. To make it easier to find, the 360-degree video from Moodlerooms it was embedded to the same place where the sign up to online lecture was.

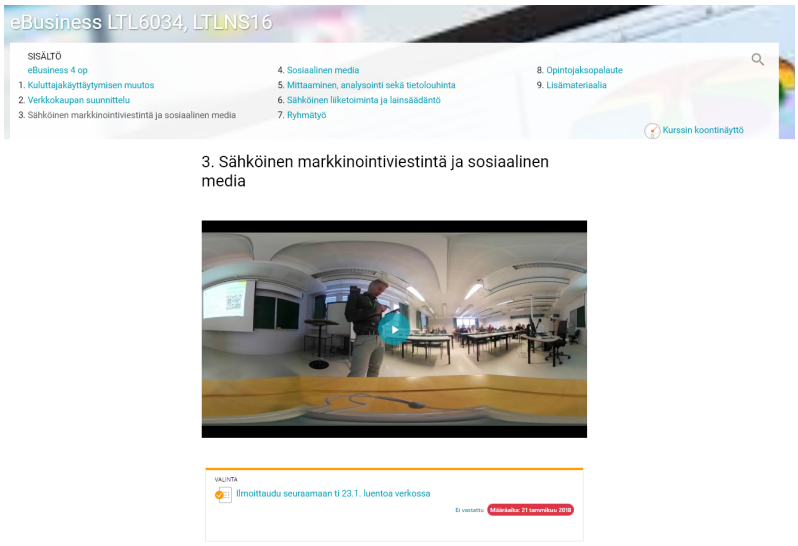

Figure 3. Access to embedded 360-degree video lecture from MoodleRooms.

Students got the opportunity to choose the device for watching the lecture. The lecturing slides were made available for students before the lecture. For later use the 360-degree video was recorded and the permanent link to the recording was shared through Moodlerooms. The broadcasting process is presented in Figure 4.

Figure 4. The broadcasting process.

Using 360-degree video technology in teaching will require some additional preparations from the instructor. The instructor must have a Google account to use the YouTube channel for transmitting the lecture. For conveying the 360-degree video to online requires also a fast internet connection. The arrangements in the classroom contains placing the camera, setting the connection from camera to mobile phone and to YouTube (internet connection) and testing the used technologies needed in the lecture. During the lecture, the instructor can check the connectivity to 360-degree camera from mobile phone (Figure 5).

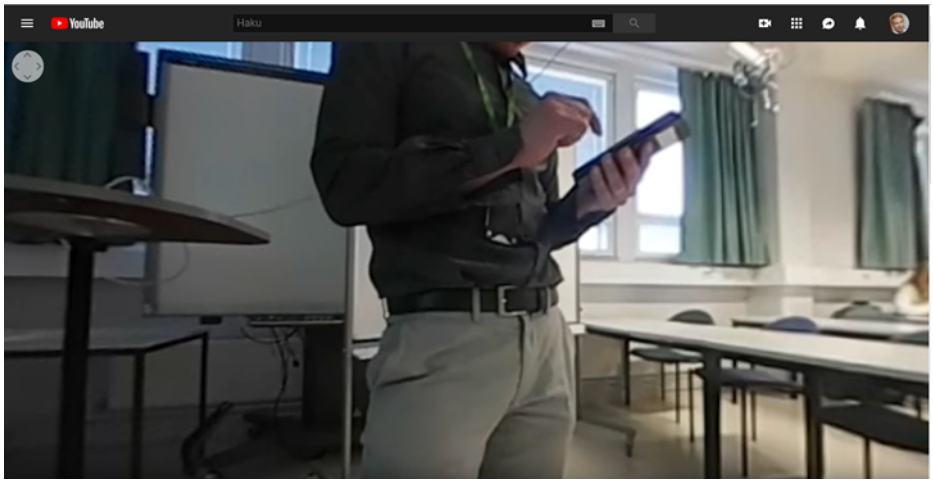

Figure 5. Instructor checking the connection during the lecture.

Results

Students used a variety of technologies, but the result showed that the most used devices were mobile phones and computers. The mobile phones were the most used device. Some of the students also used both computer and smartphone at the same time. (Figure 6)

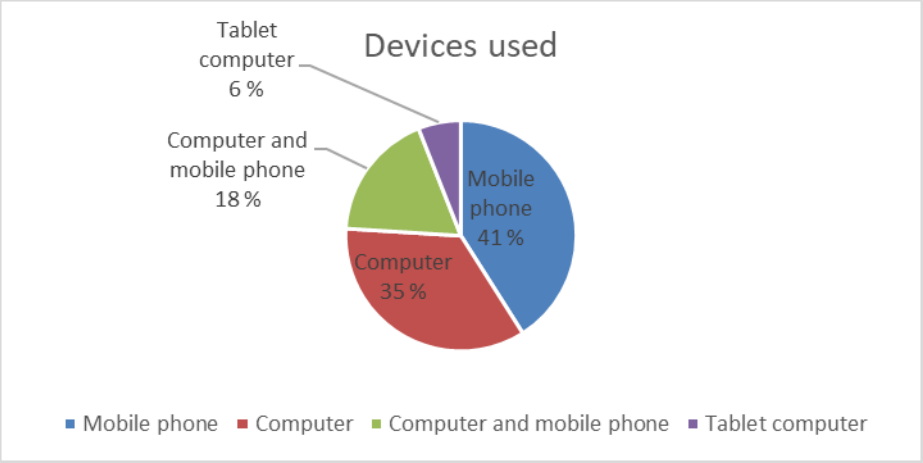

Figure 6. The devices students used to watch lecture.

The following table summarizes the key challenges and opportunities that were identified in this study (Table 1).

Table 1. Challenges and opportunities of using 360-degree video technology.

Opportunities	Challenges
• learning is free from physical limitations • better sense of presence • own peace and privacy • possibility to follow the activities of other people and teacher • use of own familiar devices • pleasant learning environment • better concentration on the issue	• disruption of the transmission and sound • image quality • delay • following the lecture notes same time with the lecture • participation to small group works within lecture • synchronous communication • privacy and information security • instructors cognitive load

Challenges

According to the survey, the main technical challenges were disruption and delay of transmission and the poor video image quality.

> It worked well until the broadcast was interrupted
>
> Sometimes there were technical problems, pauses
>
> Video quality was low, but not really relevant for the lecture.

> the lag and also the low quality of the video due to the slow internet
> Image quality is poor + strain break…
>
> The video crashed half an hour after the beginning. The picture hailed a little, but the voice sounded good, the picture stayed well and the following was easy…
>
> The graininess of the image.

While testing the camera we found that it consumes lot of battery energy and the connection consumes battery energy from mobile phones connected to network. Over one hour lectures the solution is to keep the devices in the continuous power supply to avoid loss of connection or unwanted booting.

A challenge for students was that the lecture slides had to be opened to another screen to follow them at same time with the lecture. If the students were watching the lecturer it took the students' view off the slides. Some of the students resolved this issue by using another computer or screen at the same time. The suggestion is that the presentation slides should be embedded on the same screen (PIP). This way the slides can be seen on the screen with the lecture.

> Following was problematic as the slides were barely visible from the stream
>
> …Following succeeded particularly well if the slides were opened to own computer.
>
> …Slides had to watch from Moodle with another device, as they were unclear in the video.
>
> …Powerpoint should be closer to the shared screen or something like.
>
> …However, it is better to put camera behind the teacher that you can see also the slides

When testing the connection, we found that there is approximately three (3) seconds delay caused by the network buffering. Based on students' answers, the delay was noticed in one comment but it didn't much bother online asynchronous lecturing. Despite the delay, students were able to use the YouTube chat as a communication and feedback channel. If there is need for synchronous interaction then this might cause a problem. The delay problem will be resolved as technology and connections advance in the near future, but there are also other options such as social media tools to use for establishing synchronous communication. Another challenge was that to use YouTube chat students need to register. This might lead to the refusal of using the Chat option. For some students to find and use the chat might be difficult. Participation in small group work during the lecture might also prove difficult if there is not proper communication channel with online students. The synchronous communication is the main issue to be developed in the future.

> Sometime the connection when bad and the teaching got delayed for few seconds
>
> There is no chat possibility. It is impossible to tell to teacher about technical problem, if he doesn't answer the phone. There should definitely be some kind of way to get in touch with teacher during class, if needed.

> …Youtube chat is tricky because it can't be used without your own youtube channel.

In the first online lecture session we placed the camera in the middle of the class and from the video recordings we found that the microphone repeats the voice much louder and clearer when it is placed near speaker. The microphone picked up the unnecessary noise and it disturbed the following of the online lecturing. The placement of the camera in the classroom should be considered carefully and the solution is to set the camera on stand near the instructor. This way the focus can be more on the instructor. On the other hand, the students realized that their 'off-topic' conversations were heard online. This lead to students' better concentration to the lecture and the students seemed to be more focused on the relevant issues instead of messing around and talking to the classmates.

> You can see how people focus on the lesson. And thanks to the 360 camera, the students concentrate more to the lecture and do not mess around or talk to a friend as usual.

> I think, that the camera should be placed in front of the desk, so that people who are watching, could have a feeling, that they sit in the classroom and they could see the teacher's face and also to screen. Place of camera in corner is not good, you feel like outsider.

Based on the lecturers' reflections the biggest pedagogical challenge was the lecturer's increased cognitive load. When the second online lecture was started with the different teacher, there was an unexpected system halt. This raised the level of anxiety and distress of the instructor. Fortunately, the technical support was rapidly available and the situation was resolved. Managing the group work activities within the lecture between remote and other students is difficult to conduct and needs more concentration and preparations from the instructors. This causes significant raise of the cognitive load of the instructor and it could be solved if an institution could provide an assistant (Bower et al., 2015; White et al., 2010). Additionally, the meticulous advance planning of actions and technical testing could also reduce the cognitive load of instructor. In the best case, the instructor could only concentrate on the subject matters.

There are also other challenges that instructor might face using the 360-degree video technology in online lecturing, and one important challenge that emerged from teachers' reflections was the various aspects of student's privacy and information security issues, such as the tighter European security legislation (GDPR 2018). 360-degree video technology gives the possibility for students to view closely the whole learning environment and the other students and what they are doing. If the lecture is broadcasted publicly everyone can view the lecture and see the participants. The legislation set the frame for the use of the technology in terms of privacy, which requires for the instructor to sort out the necessary legislation and take necessary actions, such as acquiring privacy contracts or permits before lecture.

The main challenges related to 360 video learning environments is presented in Figure 8.

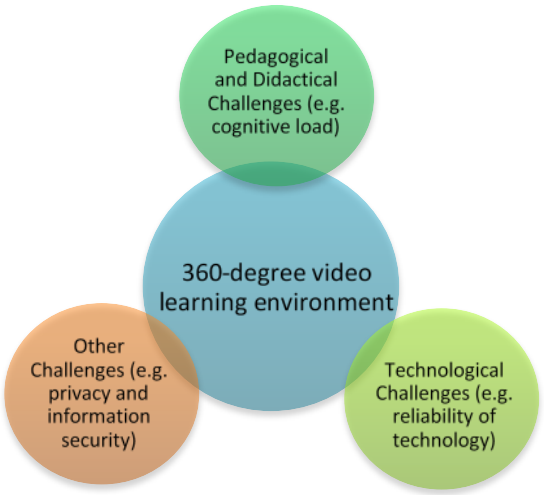

Figure 7. Challenges of 360-degree video learning environment.

Opportunities

Students are able to participate online if they do not have the opportunity to be present at the classroom, for example if students live far from the school or they have suddenly taken ill. There is no need to travel just for a couple of hours and the students can stay on course with the subject in matter. In online lecturing the learning is not tied to a specific place.

> Facilitates long-distance learning.
>
> There is no compulsion to stay behind if you are ill or in a trip when the lecture can follow from where it is at that moment.
>
> It was comfortable and convenient, as it is accessible from any place, hence not tied to any location.
>
> Much better than traditional video, but still quite unclear picture. The face of students are not seen if they sit far away.
>
> I could follow this lecture, that I otherwise would have skipped for practical reasons.

360-degree video lecture was found better compared to a traditional video. The students were more aware of the learning environment and they felt they can learn easier. Although it can be more distracting if the students' focus shifts from the lecture.

> Much better than traditional video, but still quite unclear picture. The face of students are not seen if they sit far away.
>
> Well in this one you are at least more aware by the class and learn easier.
>
> Traditional video depends more on the angle of the camera man while 360 video is less likely to tie to that.
>
> More distracting, found myself viewing the other way a few times.

> It was good that there was an opportunity that you can see the whole class…

The voice of the instructor was heard clearly and it was easy to follow the lecture. Many students were pleased that they were able to use their own equipment (computer, tablet, headphones, etc.) in peace and in a pleasant environment. Some students felt that they can concentrate more on lecture at home.

> Your own hardware and peace will help you focus.
>
> You can focus more on teaching at home.
>
> You can look at the materials better and be in a pleasant environment.
>
> You can concentrate more on teaching at home…

One of the findings was that the 360-degree video technology works well for conveying a sense of presence for most of the remote students. One of the reasons described was that the 360-degree video technology allows the whole learning space to be viewed. The students were able to concentrate better to the core substance when following the lecture. They could follow the teacher more precisely, watch the PowerPoint presentation and follow all actions in the classroom. However, for some students the 360-degree video may not give more impressive feeling of presence.

> It was easier to follow what happened in the classroom or in the screen. the feeling of presence was more impressive.
>
> Yes, the lesson was passed sufficiently well and the teacher was even better to listen than usual :)
>
> The 360 camera allows for full space viewing, so well.
>
> Little lacking but still felt involved.
>
> The feeling that you are more 'present'.
>
> It was comfortable and convenient, as it is accessible from any place, hence not tie to any location.
>
> Didn't really feel present.

The students felt that the 360-degree video technology is suitable for lecturing. Mostly for all kinds of lectures, apart from the lecturing that contain small group works or participation in discussions.

> Lectures, when there is not much discussion.
>
> Lecturing.
>
> When there's not enough room in class (seminars for instance).

> Theory teaching, orbservation of theories and practical trainings, those with less direct contact between teachers and students.
>
> Lectures, not lectures including intermittent group work, etc…

For the future insights, the students were hoping that this kind of technology will be used more commonly and they could see its benefits to online lecturing. Although 360-degree video lecturing is not the best way to learn for everybody.

> Hopefully this kind of teaching increases.
>
> Problems are already known, so when they are resolved satisfactory, I will definitely like to follow the next lessons in the same way.
>
> Distance teaching is certainly good for some, and maybe even occasionally for me.
>
> Worth of developing further. In some cases this could be a real help for students, if there would be possibility to participate class also this way.

Discussion

The 360-degree video is a good alternative for traditional video lecturing. It is best used for lecturing. When using group work or synchronous communication during the lecture, the used communication tools should be selected and tested carefully. The technical management of the devices and applications can be difficult for some students and teachers. Using devices and applications that are already familiar to users makes it easier to focus on essential.

Successfully implementing the lectures with 360-degree video technology requires that not only the technological issues are resolved, but also the pedagogical and didactical challenges are considered. Most of the technological challenges such as delay and slow network will be solved as technology evolves. From instructors' point of view, the management of the devices requires advance review of the technology functionalities. The biggest pedagogical challenge can be the increased cognitive load that is a result of learning and managing the new technology. The fear of technology inactivity and lack of expertise if technology problems occur during lecturing can make instructors more nervous. The lack of teacher's skills with 360-degree video technology poses a didactical challenge of how to arrange good teaching. These challenges might cause lecturers not to integrate and take advantage of the 360-degree video in their courses.

Students are willing to participate 360-degree enhanced video lectures in the future and the remote students can have a stronger feeling of presence when using this this

technology. This article has gathered the main challenges and opportunities of using 360-degree video technology in lecturing and proposed solutions about how to handle the challenges. These opportunities and experiences may help the future instructors to meet their challenges and to plan their practices of this technology. For future studies interesting will be the reuse usage of recorded 360-degree videos. It enables the development of new kinds of pedagogical practices for example learning assignments related to the learning environment and participants' observation. Interesting would also be to consider this technology as acquisition of research material as a method.

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