A technical guidebook for using 360° videos in higher education

Learning, teaching training materials – manual/handbook/guidance materials/MOOC

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Selecting a 360° camera

When it comes to selecting a 360° camera, you will notice that there are a lot of different options. There are different brands like Insta360, GoPro, KanDao, Ricoh, Vuze… and they often offer different models. This makes it difficult to choose a 360° camera that suits all your purposes. Therefore, the central question – especially in the context of higher education – is: : What do you want to use the 360° camera for? Do you want to focus on 360° photography, 360° videos or both? Is sound of high quality important to you? Will you use the camera often in the same location, or does it need to be mobile?

In the end it mainly depends on the educational scenario you would like to support. The following section gives an overview of the most important aspects to take into consideration when buying 360°-video cameras for your higher education institution.

Price

he first thing you might think of, and what we recommend as one of the first criteria to consider in your search, is the price. We have to be realistic and admit that a camera of €1000 is not necessary, if a camera of €450 can offer what you need for your purpose. But also that there is simply not always a large budget available for the purchase of a 360° camera. Therefore, determine in advance the maximum price that you can or are prepared to spend. To give you an idea of the prices of a 360° camera, we offer an overview of a selected number of 360° cameras in Table 1.

VUZE XR 3D 180 AND 360 VR	INSTA360 ONEX2	GOPRO MAX	RICOH THETA Z1	KANDAO OBSIDIAN GO
€399	€469	€513	€1.099	€1.850

Table 1. Overview of a number of 360° cameras and their prices.
       * These prices were last checked on 02/06/2021.

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In general you can get started with a budget of around €400 - €500. This is the entry level for a robust 360° camera offering all options needed to produce a fully functional 360°-video. There are offerings from all major camera vendors, for example GoPro, Insta360 and Ricoh.

Starting with € 1000 you will enter the more advanced and specialized 360° cameras. For example the KanDao Obsidian Go is a professional 360° camera integrating 6 synced high quality wide angle fisheye lenses. Also, the Ricoh Theta Z1 uses a very large image sensor, which is of advantage for 360°-photography.

The SEPA360 Project Team recommends starting with a camera in the area of € 400 - € 500.

Resolution

The term resolution is often used, but it is not always clear what it exactly means. There is frequently the confusion that resolution is the only thing that determines the quality of your footage, but that is not entirely true. Resolution is the number of pixels in your image. With 360° cameras, it is about light sensors that capture light. Thus, there is ultimately one light sensor per pixel in your final image. This is important to know, because the greater the number of pixels, the more detailed the image can be. For example, if we talk about a resolution of 1920 x 1080 pixels, this means that there are 1920 pixels horizontally next to each other and 1080 pixels vertically above and below each other. In total, there are 2,073,600 pixels in the image in this example.

This may sound abstract, but think of the example of a puzzle. You might have a puzzle with 20 puzzle pieces in width and 10 puzzle pieces in length (20x10). This means that this puzzle consists of 200 puzzle pieces. Now suppose you have the same puzzle, but this puzzle is made with 80 puzzle pieces in width and 40 puzzle pieces in length (80x40). So this puzzle is made of 3200 puzzle pieces, which means that much more detail can be added.

Another example that you can test yourself is working with graph paper. Suppose you have two paper sheets of equal size, but on one sheet there are 10x10 squares and on the other sheet there are 20x20 squares. You will see that if you want to draw a circle on both papers, you can do so in more detail on the sheet with 20x20 squares (see Figure 1). This is the same principle as with the 360° camera. The more pixels you have in your final footage, the more light sensors your final footage has, so the more detailed your image can be. Note that we again say 'can' be , because the quality of your footage depends on more aspects than just the resolution.
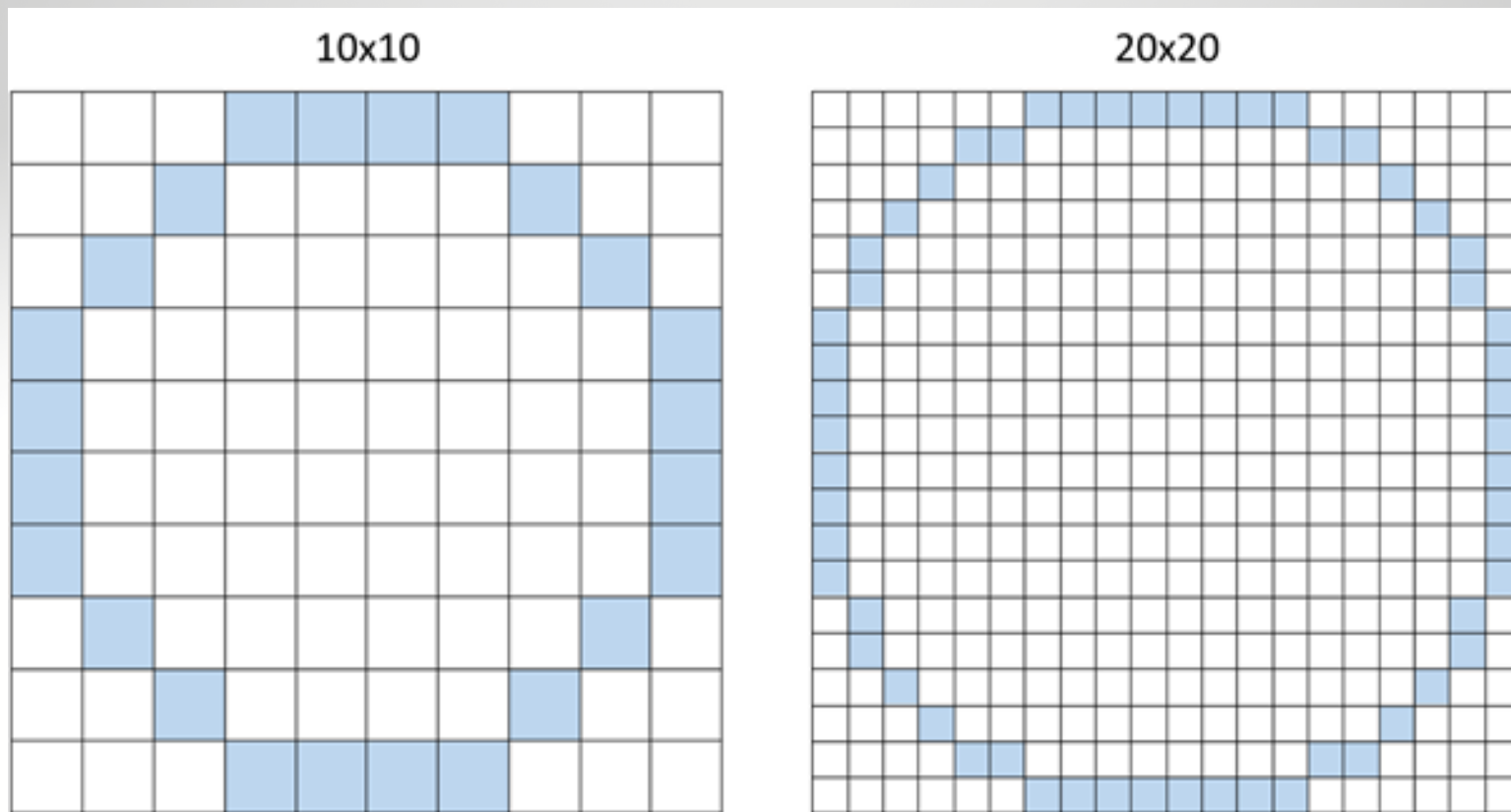
Figure 1. comparison of circles drawn on graph paper with the same
        dimensions but different resolutions.

In practice, resolutions are expressed with a shortened name or a label, simply because it is not convenient to talk about resolutions like 1280 x 720 or 3840 x 2160. The number of pixels in width and length for the same label can sometimes differ, but usually these numbers are used:

- Standard Definition (SD): 720 x 576
- High Definition (HD): 1280 x 720
- Full HD: 1920 x 1080
- 2K Quad HD (QHD): 2560 x 1440
- 4K Ultra HD: 3840 x 2160
- 8K Ultra HD: 7680 x 4320

You may notice that at one point there are references to 2K, 4K and 8K. This is because for the labels higher than Full HD, we refer roughly to the width dimension.

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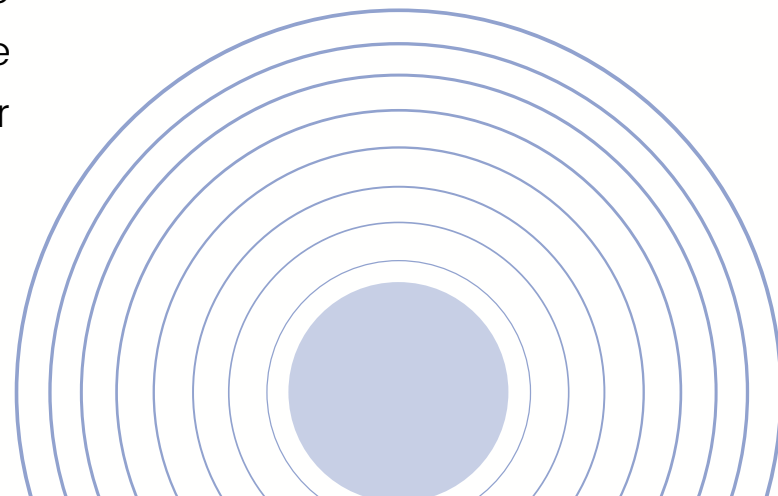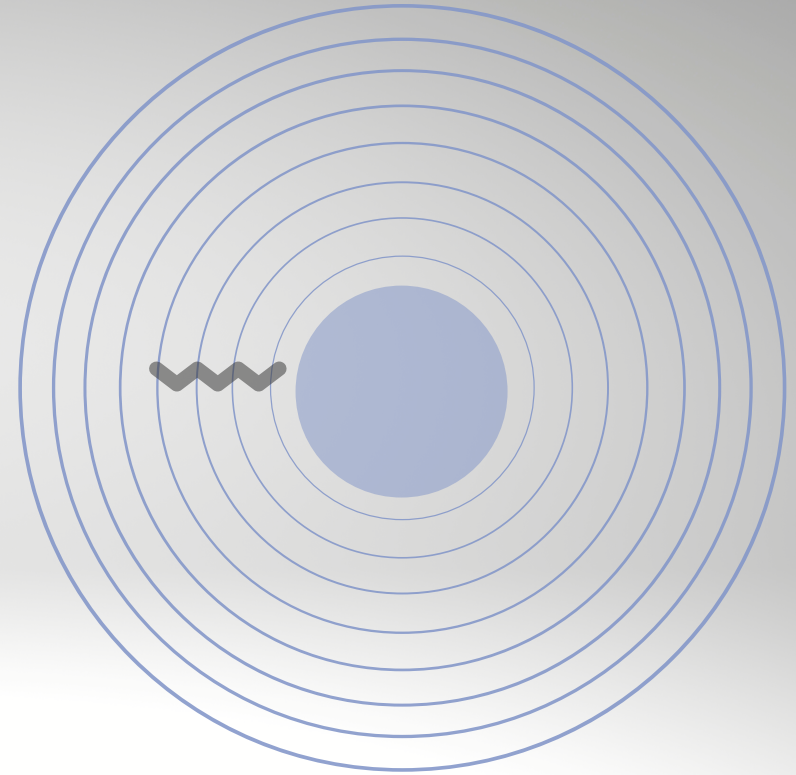
IIn regards to 360°-video one needs to be aware of the actual dimension of such a 360°-video. A 4K recording from a 360° camera will for example result in a video with the dimension of 3840x1920 pixels (Camera reference: Ricoh Theta V). As you can see in comparison to the list above the final resolution may differ slightly.

A second point to consider is the perceived image quality of 360°-video recordings. Depending on the scenarios you would like to support at your higher education institution a lower resolution (e.g.: Full HD or 2K) or a higher resolution (e.g.: 4K and above) is needed. For example if you need to be able to identify gestures and facial expressions in a video (e.g.: for purposes of teacher education) then we highly recommend going with a 360° camera supporting a 4K resolution or higher.

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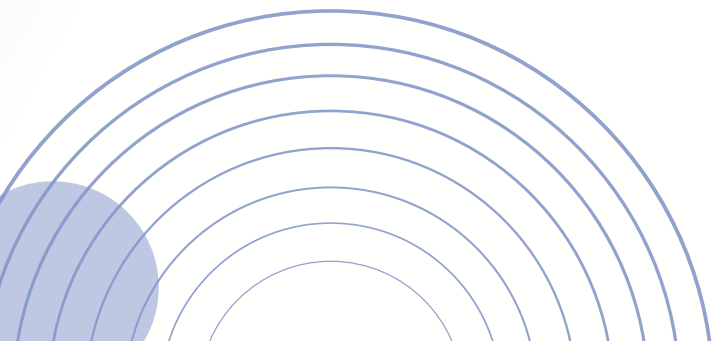
Frames per second (FPS)

As just described, resolution is not the only thing that will determine the quality of your image. There are several aspects responsible for this, and FPS is one of them. FPS stands for frames per second. This refers to the number of images your 360° camera takes every second, and then stitches them together. Because it is by pasting all these images together that you get a video. The higher your FPS, the smoother your image will be. When it comes to recording in 360°, we recommend going for a camera that can capture images of at least 30 FPS.

The figure below serves as an illustration, to compare for example 12 FPS with 6 FPS. You can see that at 6 FPS, the car will be shown very choppy in a video, whereas at 12 FPS it will be slightly smoother.
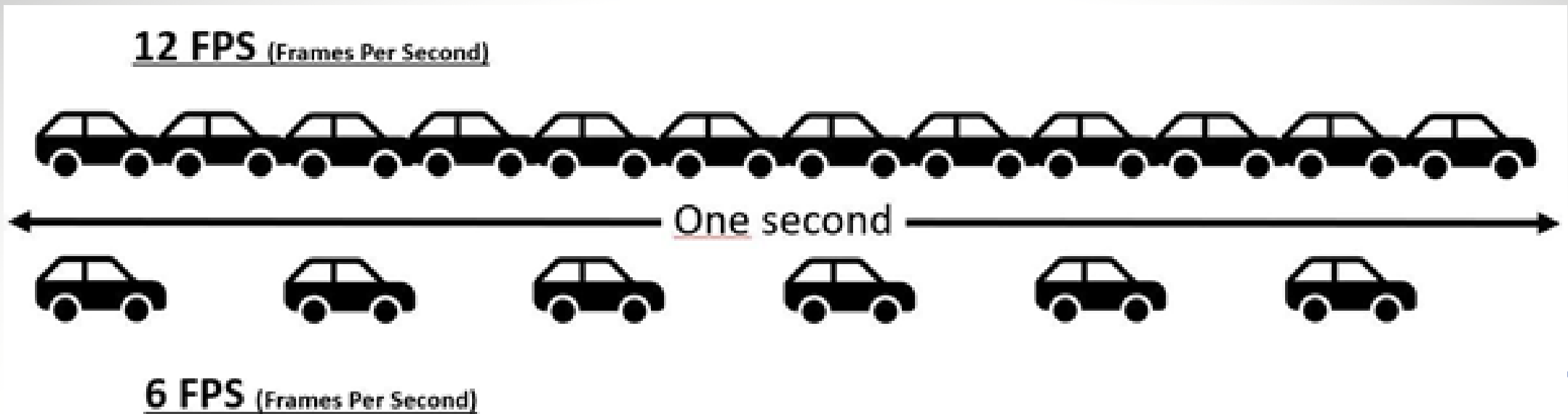
Figure 2. Comparison of Frames Per Second
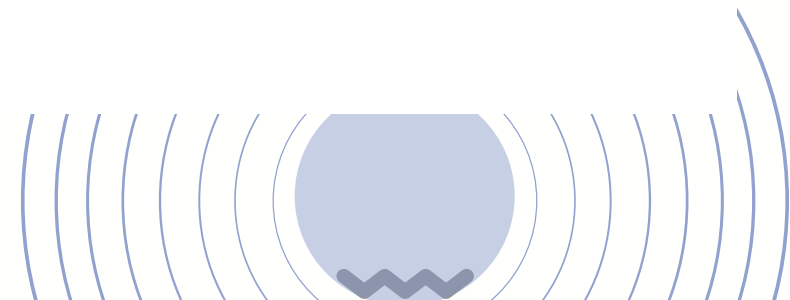
Memory capacity

The amount of memory available to the 360° video camera determines how much footage can be stored. A 360° video camera can have a certain amount of memory in two ways: through a fixed amount of internal memory (e.g.: flash storage) or through an external memory card (e.g.: SD card) placed in the camera. The advantage of a fixed amount of internal memory is that you no longer need to buy an additional memory card. On the other hand, this has the disadvantage that it is not possible to expand the fixed amount of memory. When the maximum memory capacity is reached, one can therefore no longer record footage until memory capacity is freed up.

The use of an external memory card, which is most common, offers the possibility to choose the amount of memory capacity yourself. Even when the maximum memory capacity is reached, one can simply replace it with another memory card. This allows the recording of the footage to continue, without the obligation to continuously free up memory capacity.

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When purchasing a memory card, there are a number of things to take into account. First of all, check which type of memory card is suitable for your 360° video camera. In most cases, this will be the common micro SD. Then also look at the number of memory cards required for the 360° camera, as this can vary from device to device. For example, the Samsung Gear360 camera only needs one memory card, while the KanDao Obsidian Go needs a separate memory card for each lens. Since this camera has six lenses, it requires six memory cards, as shown in Figure 2.

3 more lenses and micro SD memory cards on the backside

Figure 3. KanDao Obsidian Go

Now that it is clear which type and how many memory cards the 360° video camera needs, there is still a choice to be made in the wide range of memory cards. Here it is advisable to look at the maximum memory capacity of the 360° camera, the writing speed of the memory card and finally the reading speed of the memory card.

Before looking at the writing and reading speed of the memory card, it is advisable to check what the maximum memory capacity of the camera is. The Samsung Gear360 for example, has a maximum memory capacity of 200 GB. So, if one would use a memory card with a capacity of 256 GB, this could cause problems with saving your footage. So always choose a memory card smaller than or equal to the maximum memory capacity of the 360° video camera.
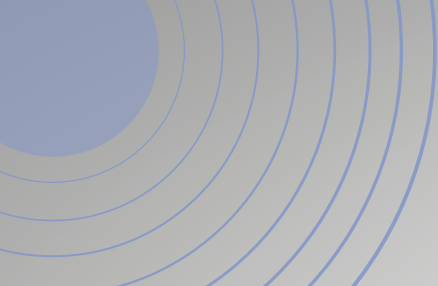
Then one can look at the writing and reading speed of the memory card. The writing speed refers to the speed at which the footage is transferred to the memory card. The reading speed provides information about the speed at which the material is viewed on the camera itself or how fast the camera can transfer the material to, for example, a computer. However, there is no unambiguous answer to the question of which speeds are the best. It is generally recommended to use a high performance high speed class SD card such as an UHS-I V30 speed class or UHS-II Class 10.

The most important aspect with a memory card, remains the memory capacity. As a reference, Table 1 illustrates the size differences between a FullHD and a 4K 360°-video recording from a Ricoh Theta V. Aiming for memory capacities of more than 20 GB is highly recommended.

Resolution	Length	Size
FullHD	24:02	3,47 GB
4K	24:02	10,98 GB

Table 1: Comparing Video Data Size (Camera: Ricoh Theta V)
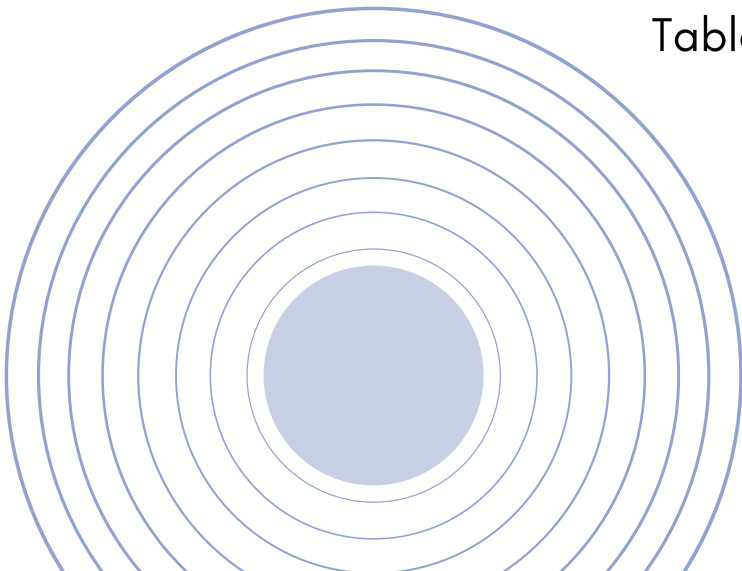
Battery capacity

A battery is used to power the 360º video camera. Depending on the camera one buys, there will be a fixed built-in battery or replaceable battery. Which variant to choose depends mainly on the purpose of use. Choosing a camera with a replaceable battery, offers the possibility to provide yourself with extra batteries. When the battery is not charged or when it is empty after filming footage, it is possible to replace it with a spare battery.

Also keep in mind that battery life differs, just like with all traditional digital cameras. It is therefore advisable to always look at the suggested battery life, which is usually placed among the specifications of the 360º video camera. Here, information will be offered about the time the camera can record, with a fully charged battery.

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However, it is important to take this time with a grain of salt, as it represents ideal conditions. In practice, you will soon be filming for a number of minutes, because you might want to test whether your 360° camera is in the right position, whether there is enough light, or whether there are any disruptive elements present. For example, the Insta360 ONE X's specifications state that it can record for 60 minutes in 5.7K at 30 FPS or 4K at 50 FPS, whereas in reality it will be less than 60 minutes (see figure 3).
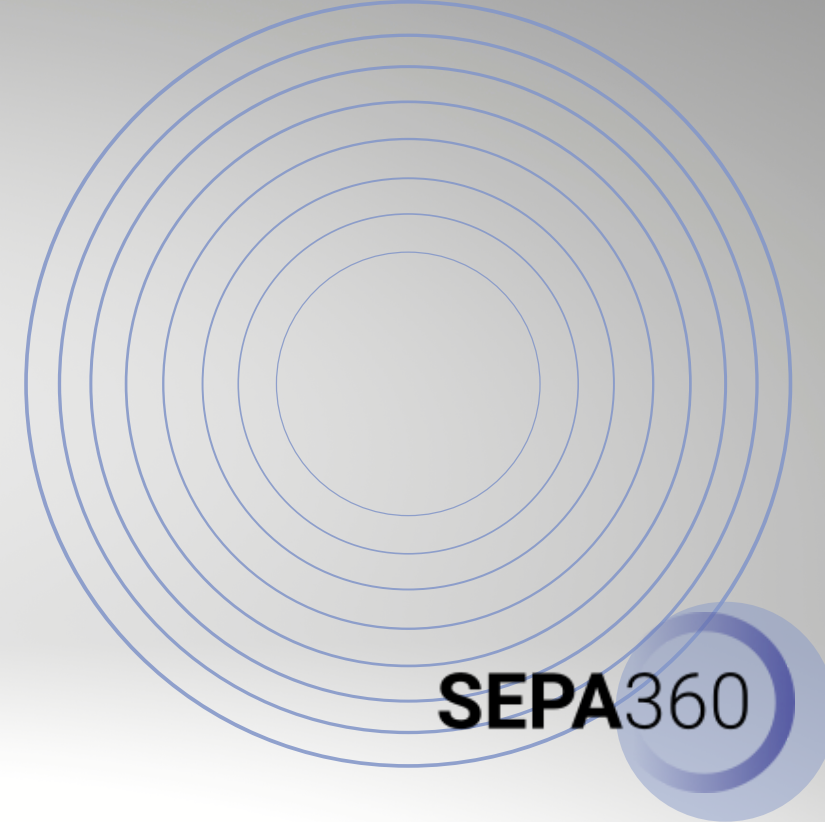
Figure 4. Battery specifications Insta360 ONE X

Battery	Battery Capacity: 1050mAh (5V2A)
	Charging Method: Micro-USB
	Charging Time: 100 mins with a 5V2A charger or 60 mins with our Dual Battery Charging Dock
	Run Time: ONE X lasts roughly 60 mins while shooting 5.7K @30FPS or 4K@50FPS video when it is used independently
	Use Environment: Standard Battery suitable for 32° F to 104° F (0° C to 40° C); Cold-Weather

Maximum Time Per Recording

A regular 360°-video recording may last a few minutes when testing out the camera or playing around with its features. However, bear in mind that there are limitations in terms of how LONG you can record into one dedicated video data file. Therefore, check beforehand what the maximum time per recording is for your preferred camera (if this applies to you). You might be thinking to yourself: maximum recording time? Surely that is just until the battery runs out or until your memory is full?

Well, yes and no. The reason for this is that in order to maintain file size compatibility some camera vendors have applied recording time limitations. This is mainly due to the fact that 360° videos can become very large. Depending on the file system you are using there are certain limitations. A file system formatted in FAT32 will have a maximum file size limit of 4GB. This, however, can be alleviated by using an SD Card formatted in FAT64 (exFAT or FAT64); the file size limitation is 16EB (Exabyte). The Insta360 One X will allow you to record continuously, however it will save the resulting files in segments of 30 – 90 minutes depending on your setting (see detailed table here). The Ricoh Theta V also applies a recording length limitation of 5 – 25 minutes (one can change between these settings via the smartphone app). So, in this case, if you as an institution will design learning scenarios where there will be 30 minute recordings, the camera will stop after 25 minutes. For the remaining 5 minutes, you will have to activate it again. Again, this depends on the camera vendor (in this example it was a Ricoh Theta V) and your specifics about the learning scenarios being produced at your institutions.

Features

Perhaps the most important question one should ask oneself is 'What can the 360° video camera do and what not, so I know it offers the features I need for my goal(s)?' Here we give an overview of the possibilities a 360° video camera may offer. Please note that this is not an exhaustive overview. New developments happen every day, making it impossible to list all the possibilities. That is why we have chosen to display the most common ones. Which possibilities the 360° video camera should have, depends on personal use.

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- 360°-photos: most 360° cameras offer the possibility to take 360°-photos. Note that the image resolution of the 360° photograph will mostly be even higher than the video resolution. As an example the Insta360 ONE X will shoot still images with a resolution of 6080 x 3040 pixels (6K) and will shoot video with a maximum resolution of 5760 x 2880@30fps
- 360°-photo loops: The ability to set the 360° video camera to automatically take a 360° photo every desired number of seconds;
- 360°-videos: the ability to record 360° videos;
- Time lapse: the ability to record fewer images per unit of time, which ultimately results in an accelerated movie. For example, one can put the camera in front of a flower that is still closed and leave the camera until the flower is open. This allows you to play the opening of the flower in a video of, for example 3 minutes, instead of the full time the flower needed to open;
- Timer: the recording of the footage only starts after the set time. This has the advantage that you yourself for example, still have 10 seconds to disappear from the shot, if you do not want to be on the footage;

- Built-in microphone: there is already a microphone in the 360 º video camera, which records the sound. Look at the way the microphone is incorporated in the 360º camera. It may be built in on one side, but the Insta360 ONE X2 for example, has a microphone on each side. This ensures that the sound is recorded with the same quality from each side and prevents the sound from not being equally clear from each side. In practice, this is usually not a real problem because you are usually standing close to the 360º camera. If you are further away from the camera, it is recommended to work with a microphone;

- Streaming: there are options available to tap into streaming services, which allow you to start a live stream that can also be shown live on Facebook or YouTube for example;
- Waterproof: some cameras offer waterproof housing, so it is not damaged internally by water;
- Stabilization: most cameras have a built-in feature, which stabilizes the footage. This ensures that there is no or limited vibration in the image, for example when wind hits the camera. When there is too much vibration, this will still be noticeable in the recording, but for example slight movements due to a little wind will be corrected;
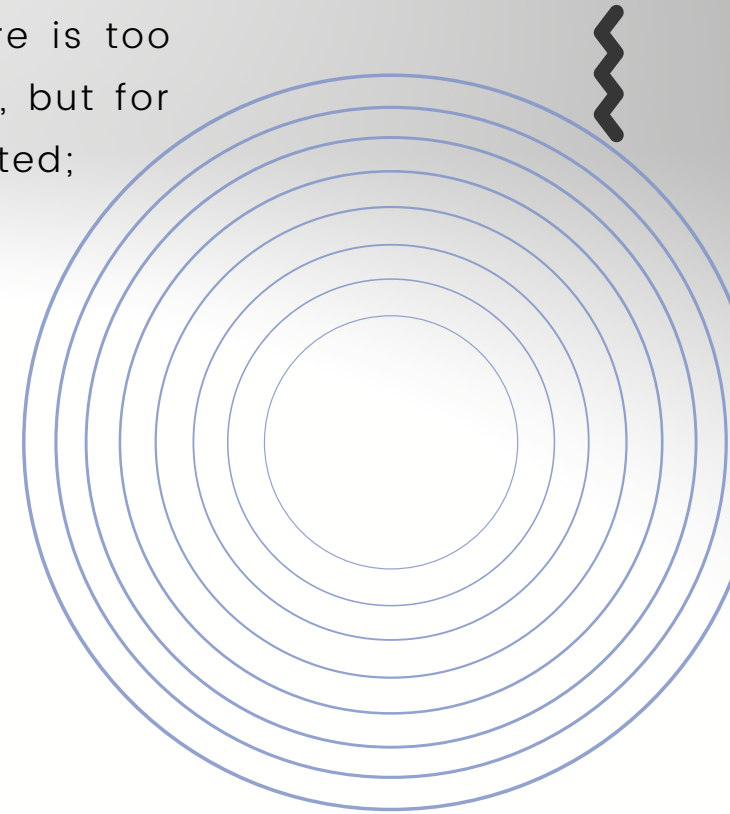
- No 'stitching' required: the ability to immediately get a 360°-video that has already been stitched by the camera itself or through the application. Note however that this might possibly have a negative impact on the quality of the footage;

- Platform Compatibility: not all 360° video cameras are compatible with MacOS, Windows, Android and iOS. Always check this, to prevent the camera from not being compatible with the operating system of your computer or smartphone.

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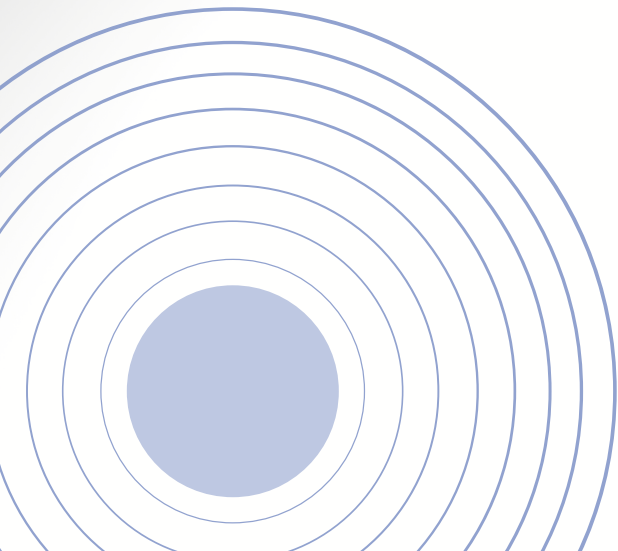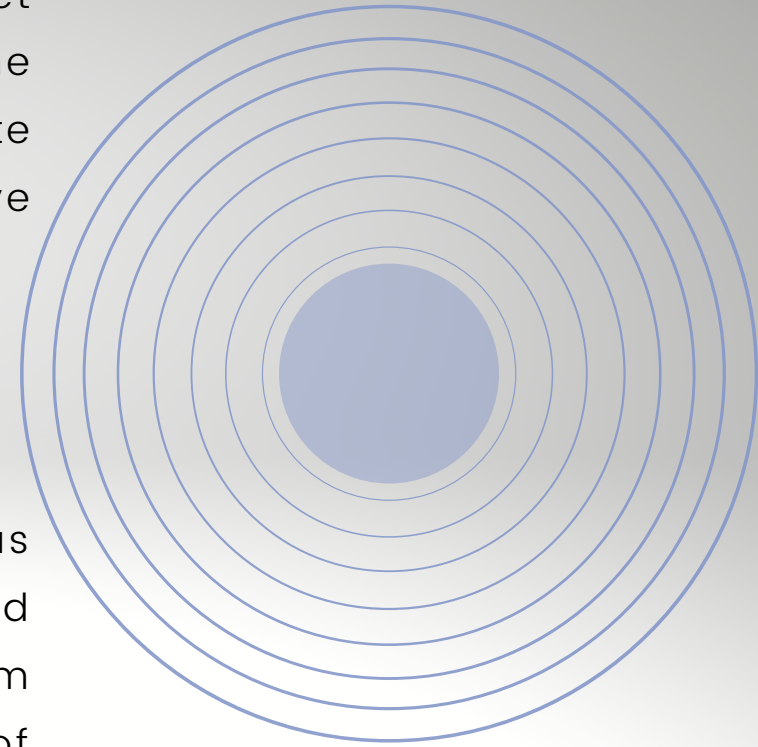
User-friendliness

It is important that the camera is easy to use. That's why a number of aspects are listed here, which can come in handy:

- The size of the 360° camera: you can quickly put the Insta360 ONE X2 for example in your bag, while the Kandao Obsidian Go is too big for this. Also in the use of the camera, a smaller 360° camera often works a little easier, because you can simply hold it with one hand while you place it on a tripod with your other hand. With the larger KanDao for example, this is sometimes a bit of a challenge when you are alone.

- Indication lights or messages: they are often obvious, but not always present. It is always handy to get an indication in one way or another when your battery is low, the memory is full or you simply want to know if the camera is recording or not.

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- Application: because not every 360° camera has a preview screen, you don't always know if your camera is positioned correctly or if the lighting is as you want it to be. Therefore, it is always handy to have a mobile application with which you can follow the footage live. Take a look on YouTube and explore how these apps work in order to get an overview. Each vendor will offer their own dedicated app, which is mostly compatible with Android and iOS. . We can assure you that sometimes a very simple design is used, whereas with some applications you really have to look up how everything works.
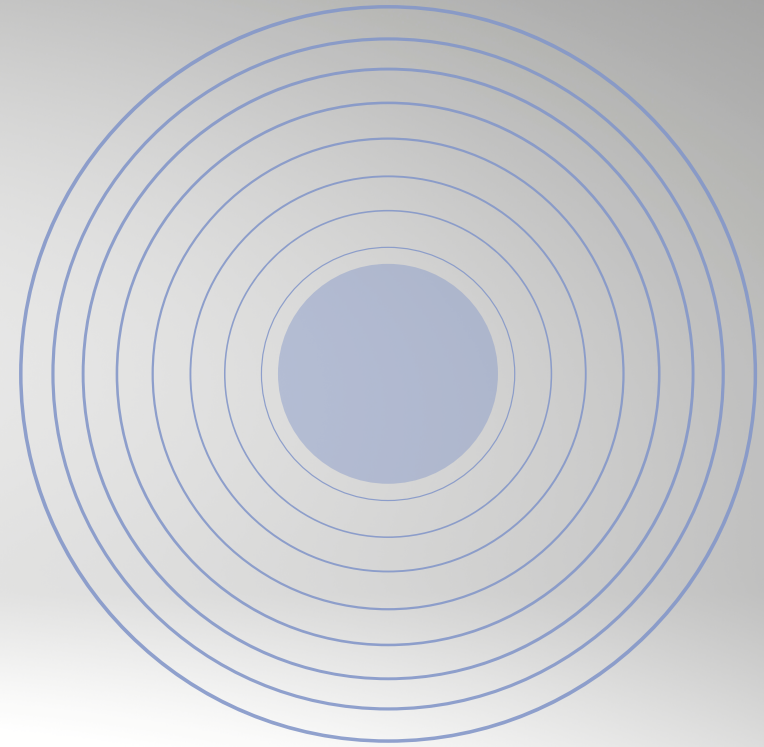
- Digital dashboard or screen: this shows you the live footage, which is really handy. Suppose you can't work with the app because of problems with bluetooth or WiFi, then it's always handy that you can get a live view of your recording on this screen.

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Designing scenarios for 360° videos

Before moving on to filming, it is important to prepare the recording thoroughly. Since every context is different, the need and purpose will also be different. Therefore, we recommend starting with analysing your own context and drawing up a storyboard. In this chapter, we will pay attention to the substantive and preparatory aspects you need to consider and prepare. At the end of this document we also offer a template to help you design your own scenarios.

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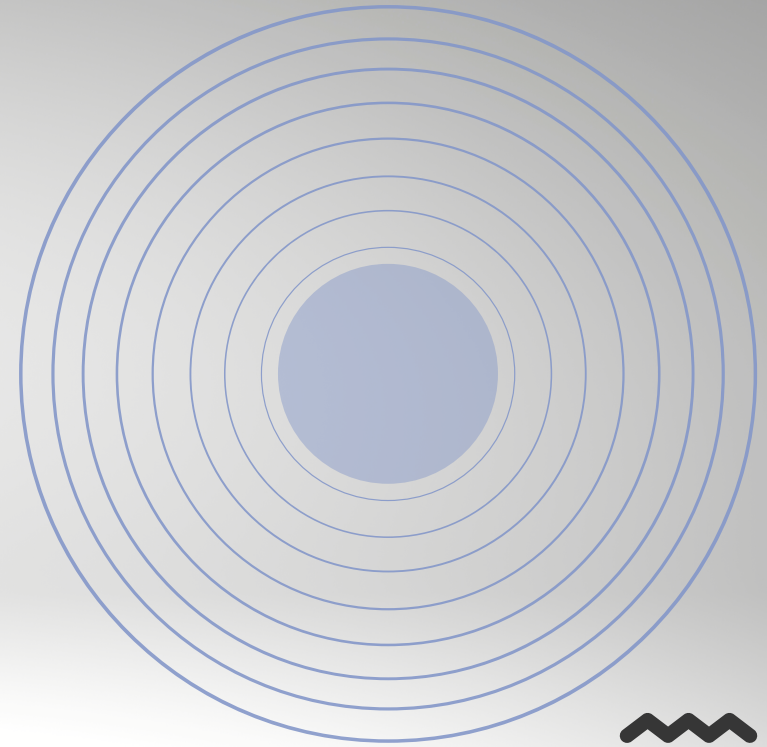
Goals

Start by analysing your goals, i.e. asking yourself the question what you want to achieve? An important reflection to make right away is whether 360° is the right tool for this. For example, some aspects can also be perfectly captured with a regular traditional camera, which means that you do not have to go through all the steps of a 360° video. The added value of the 360° video format must therefore be strongly emphasised. If learning tools are only used because they are attractive, they will quickly lose their added value.

Focusing on your goals will also make it clear what role the 360° video will or can play. For example, you may want to include all of the goals in the 360° video, so that it contains the entire lesson. However, this will not always be possible, so the 360° video could also be a part of your lesson. By focusing on this from the beginning, you will know immediately which specific goals need to be covered in the 360° video.

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Type of video content

Linked to your goals, you can think about the type of 360° video content you need. To help you with this, we advise you to work with the three types of 360° video content which has been defined in the literature:

1. Environment/natural phenomenon: in this case, the content of the 360° video consists of environments and/or natural phenomena such as a volcano or mountains;

2. Situation with spontaneous, human behaviour: In contrast to the first type of 360° video content, there are also people present here who exhibit spontaneous behaviour. They are not the point of interest, but add value to the authenticity of the filmed content. Think of examples such as filming a laboratory to give students a first exploration of this environment, where a number of laboratory staff walk around.
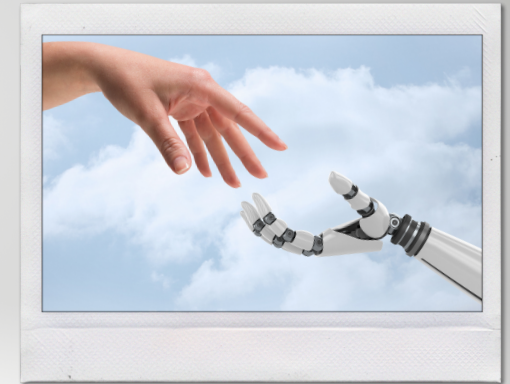
3. Demonstration: Here, the content of the video focuses on specific actions, operations or procedures performed by an expert or machine. The demonstration of this specific process is central to this type of 360° video.

Based on this typology, you can determine what kind of content should be present in your 360° video.

Target group

Now that you have determined what your goals are within the 360° video and what type of content you need, it is time to further tailor this to the target audience. Start by defining them and then describing their characteristics. Think about the following:

- Foreknowledge: The foreknowledge of your target audience will influence the amount of content you have to film. If, for example, your target group has no prior knowledge of your objective, you will have to film and explain a lot more. If your target group already has strong prior knowledge, you can tailor the filming to this and immediately focus on the important content aspects.

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- Level of experience with 360° videos and Virtual Reality (VR): To what extent does the target group have experience with 360° videos and VR? This will determine to what extent you will have to prepare and introduce this. If users have no prior knowledge or experience, we recommend making a short demo 360° video in which you explain how it works. This will give them time to get used to the virtual environment, allowing them to focus on the content you will present later in your video.

- Size of the target group: It is essential to know how many participants your target group consists of. Especially if you want to work with VR headsets, we recommend you to start with a limited number of people and gradually expand. This will give you time to gain experience, before you drown in the multitude of questions you are bound to get.

Implementation

Depending on the above mentioned aspects, you can think about the way you are going to implement the 360° video lessons. You mainly have choices regarding the way you want to show the 360° video lessons and the way you want to set this up.

If we first look at the way you can view the 360° video lesson, there are two main possibilities, each with a number of variations:

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1. Viewing the 360° video lesson on the laptop or computer screen.

a.   Each student has his/her own laptop/desktop and thus his/her own screen;

b. Only the teacher has a laptop/desktop on which the 360° video lesson is played, but this is connected via the beamer, for example, to the large board at the front of the classroom;

2. Viewing the 360° video lesson using a PC VR headset.

a. Each student has his/her own laptop/desktop and PC VR headset;

b. Only the teacher has a laptop/ desktop and a PC VR headset which is also connected to the big board at the front of the classroom. For example, one student can go through the 360° video lesson with the VR headset, while the rest of the class follows along on the large screen. This is possible because the perspective that the person with the VR headset is looking at is shown live on the computer screen.

On the other hand, there are also various possibilities in the way you want to set up the 360° video lessons:
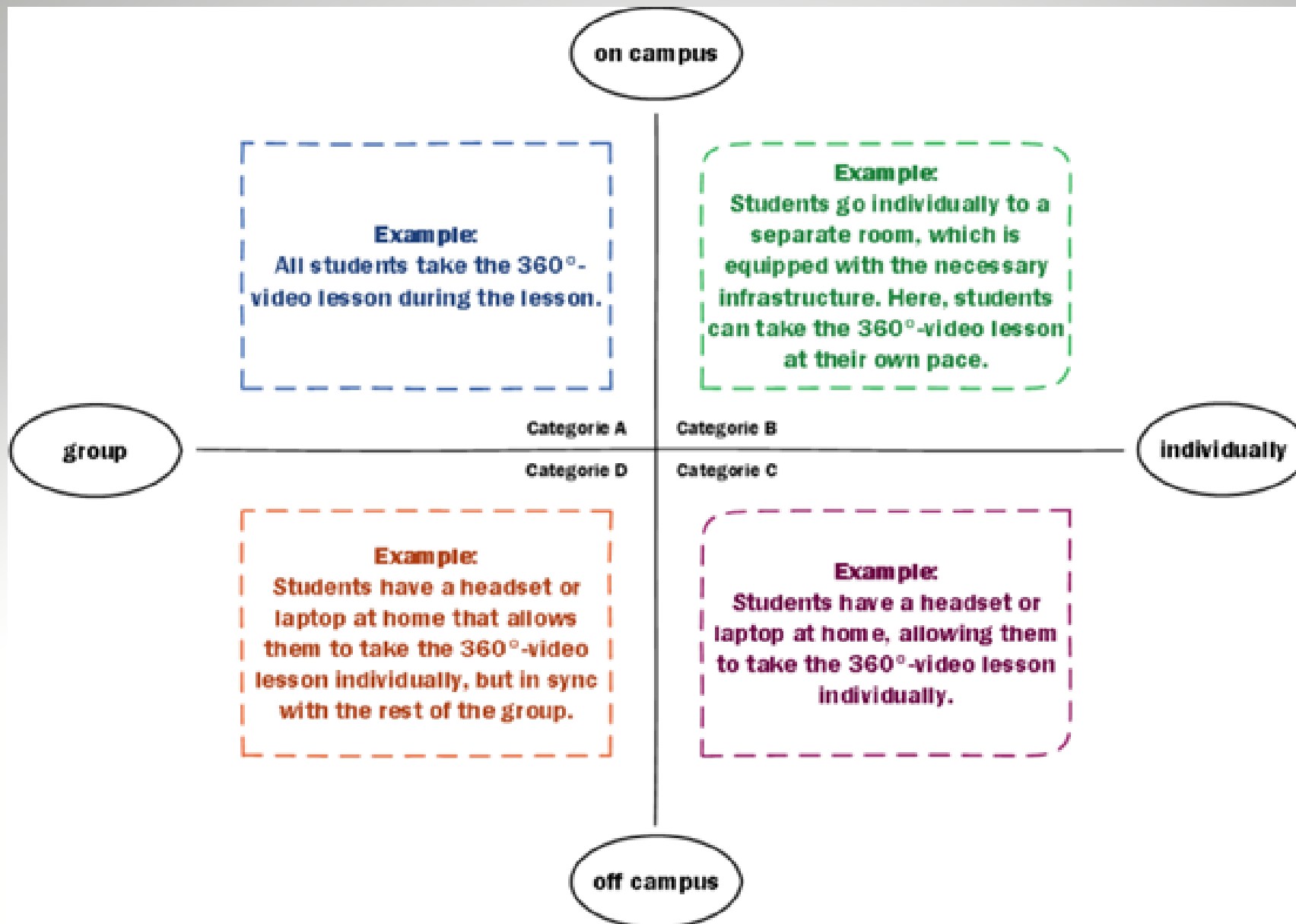

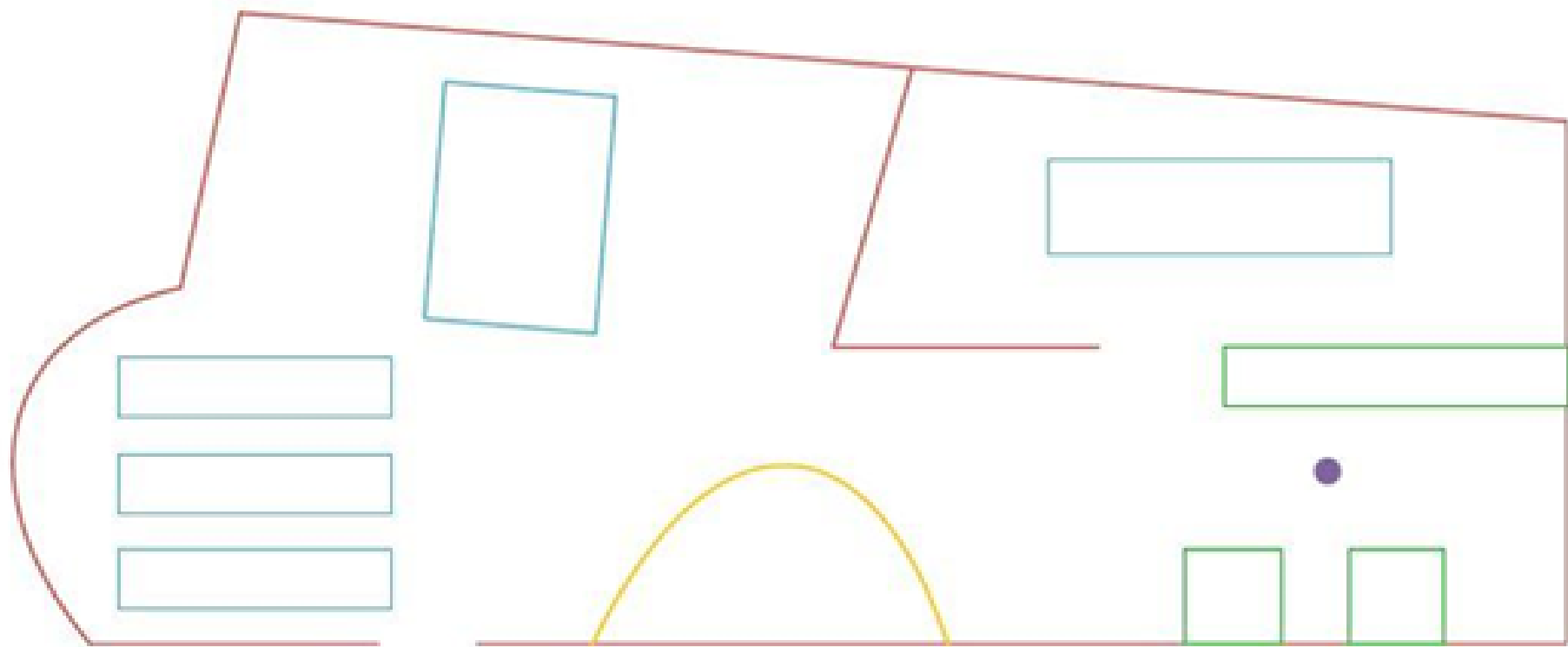Figure 5. Possibilities for implementing a 360° video lesson

Storyboarding

Now that you have finished analysing your context, you can move on to storyboarding or designing your 360° video lesson.

To start with, we recommend you think about the framework of your 360° recording. By framework, we refer to the way in which you will organise the 360° recording. Especially if it is the first time that you are going to make a 360° recording, we recommend that you make a simple sketch of the location where you are going to film. This allows you to think about the location(s) where you will place the 360° camera. An example is shown in Figure 6, where the purple dot represents the location of the 360° camera. Here, the structures in green, being 3D printers, were the subject of the 360° video.

Figure 6. Sketch of recording location

Although we can't give you a one-size-fits-all answer on where to place the 360° camera, as all environments and contexts are different, we recommend not positioning the camera too close to a wall. Especially when you want to watch this 360° video with a VR headset, you might be confused when you suddenly seem to be standing against the wall. If possible, place the 360° camera as centrally as possible in the area where you want to record. Keep in mind that this is only applicable if all points of interest are still in view. If they are too far away from the 360° camera, it is better to place the 360° camera closer.

Now that you have a better idea about how to organise the 360° recording, it is time to think about the content you want to offer within the 360° video in function of your goal. As mentioned earlier, by setting clear goals, you can think about the layout of your recording. So should you provide an introduction, core acquisition, core processing and conclusion within the recording, or only specific parts such as knowledge acquisition?

Once you have this clear, you can think about the actual content to be explained and/ or shown in the 360° recording. Especially the first time, we recommend that you write this down completely or at least in summary form, as this will make you think further on these content aspects. While writing this down, you can also make a note of the enrichment material you need. For example, you may want to add additional photos or videos to the 360° video, but in that case it is also useful to know in advance that you still need to make them.

Filming a 360° video

Once the recording has been prepared, this forms the basis for effectively getting started with the 360° video camera. So it is already clear what needs to be present on the footage, but not yet how to ensure that the video is recorded correctly. Since the most efficient and effective way to do this will always differ from situation to situation, we offer an overview of our lessons learned:

- It might sound very obvious, but first of all it is important to get some experience with your 360° video camera. So try to experiment a bit with the 360° video camera beforehand, so it becomes clear how it works and what the results are.

- If you want to enrich your 360° video with the Vivista software, we recommend that you set your camera to record in 4K. Another option is to film in a higher resolution, but when stitching and editing your footage, save it in 4K resolution. We have learned that Vivista works smoothly with footage up to 4K. However, you can always use footage with a higher resolution, but then the footage may stutter or not run as smoothly as it should.

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- We recommend that you always place your 360° camera on a tripod. When watching a 360° video, it is very disturbing if the recording is not stable and moves constantly (especially when recording outdoors or in windy surroundings). This can also cause people to experience 'simulator sickness', which means that people watching the 360° video lesson with a VR headset may become unwell. So always work with a tripod to ensure stable footage. However, take into account the connection piece to place the 360° camera on the tripod. Usually, a standard screw size is used, but this is not the case (e.g. GoPro devices).

- Preferably place the 360° video camera at eye level (±1m70), which will contribute to the authenticity and representativeness of the footage. When viewing the 360° video lesson, this will also feel most natural to the user.

- Just as with a traditional 2D video, it is also important in a 360° video to take the lighting of the environment into account. If there is a lack of light, there is a risk that the colors will be recorded less brightly and/or that haze will be present in the footage. When filming in a building or room, one can often play with the lighting by switching the lights on or off. However, when one chooses to shoot outside, the sun is the only light source. Therefore, it is important to take the weather forecast into account and the time at which the recording will take place. For example, there will be more sunlight around noon than in the evening. A disadvantage of a 360° video camera is that you always film against the sun. Ideally, you can place the 360° camera in a spot where there is a little shade, while the rest of the surroundings are provided with direct sunlight. This will ensure that the surroundings have enough light, but you avoid having direct rays of sunlight in your footage.

- Avoid that the **transition between the different lenses** runs through central objects, otherwise they may become blurred because they are in the stitching line of the footage. Depending on the 360° video camera used, this may or may not be highly visible. This can be prevented by focusing one of the lenses centrally to the most important viewing perspective, so that this is not affected by stitching.

- If you are working with people who are giving explanations or if specific sounds have to be present in the footage, check with a short test that everything is clearly audible. If you cannot position the 360° camera sufficiently close to the source of the sound, you can choose to work with a pricking microphone. You can add the recording made with this to your footage afterwards. The Insta360 ONE X2 for example, has four microphones built into the camera, so that the sound can be recorded qualitatively from all sides. So always check how many microphones your 360° camera has and where they are located. If you have a speaker who stays at a fixed point, it is advisable to position the 360° camera so that the microphone is facing the speaker

Stitching and editing a 360° video

After shooting the 360° footage, you need to stitch it. Since every 360° camera has several lenses, you have several recordings. Stitching is the process of sticking together the images of the corresponding lens images. This way, you end up with one video file, in which all perspectives are combined so that you can see the entire 360° environment. Figure 9 shows what it would look like if you opened a shot without stitching it, while Figure 10 shows what it would look like if you stitched the footage.

Figure 9. 360° recording with two lenses that are not stitched

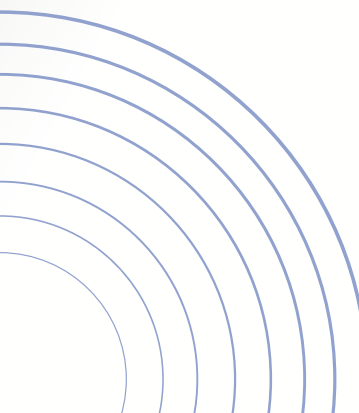Figure 10. 360° recording with two lenses that are stitched.

Before the footage can be stitched and edited, the footage must be present on the laptop/computer. If the 360° camera has a fixed amount of memory, there will be a USB cable to connect the 360° camera to the laptop/computer. This makes it possible to transfer the footage from one device to another. If the 360° camera uses external memory cards (usually a micro SD card), it is possible to use a card reader. In this case, one should insert the memory card into the card reader and then connect it to the laptop/computer.

Once the footage is on the laptop/computer, you can almost start stitching. The only thing you still need is the camera specific software. Every 360° camera has its own software that you can download for free on the website of your camera model or brand. You always need the camera specific software because it recognizes the footage from the corresponding 360° cameras and will therefore automatically start stitching.

Once you have the camera specific software, you can simply select your footage and drop it into the software. The software may need some time depending on the amount and size of the footage, but after that you will be able to view the footage as a 360° file. If you save these files, they are stitched and you can also view them in other software. Think for example about the VLC media player, in which you can also view these stitched 360° recordings in a 360° format. Thus, after stitching, you do not have to use the camera specific software every time again to view the files in 360°. Once stitched, you have one video file that contains the full 360° recording.

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In addition, within the camera-specific software there is usually the possibility to perform a number of edits. However, the editing possibilities here are usually rather limited, such as shortening the video or in some cases the possibility of placing a logo over the tripod (see Figure 11).
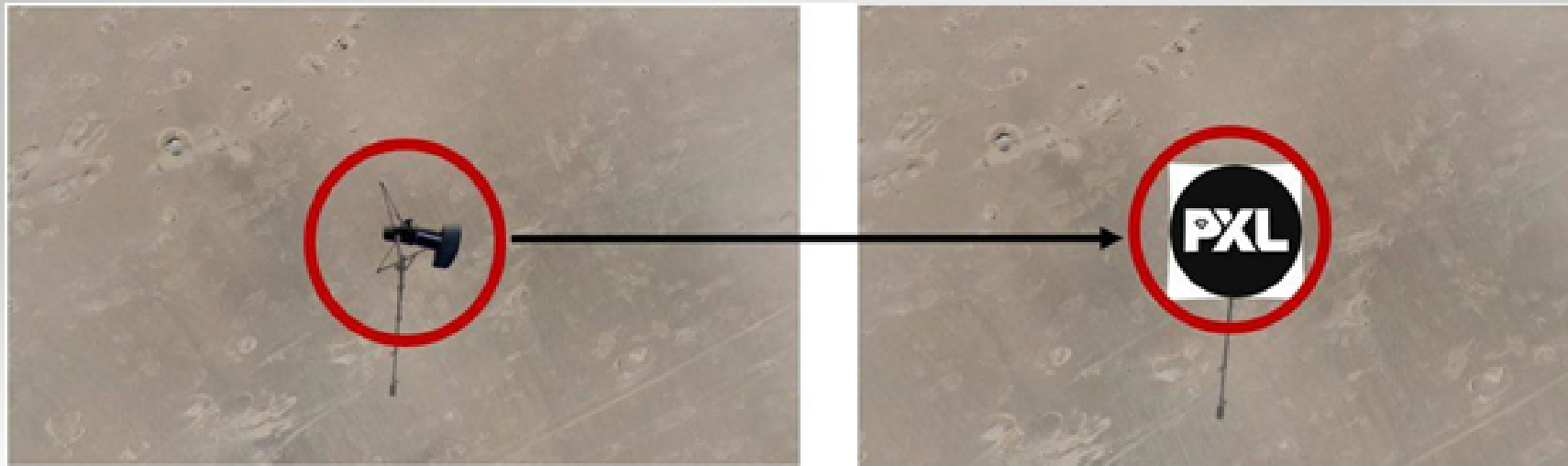

Figure 11. Placing a logo over the tripod with the camera-specific software 'Insta360 Studio'

If you want more options for editing the video, you could consider Adobe Premiere Pro for example. In addition to cutting and trimming, you can also add titles to your video, blur persons or objects, mute the audio of certain parts or just add extra audio to certain time clips...

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Vivista

After stitching and possibly editing your images, you can enrich them with the Vivista software. The Vivista software consists of two parts: the Vivista-Editor and the Vivista-Player. The Editor has the function of enriching stitched 360° videos, while the Player serves to view these enriched 360° videos.
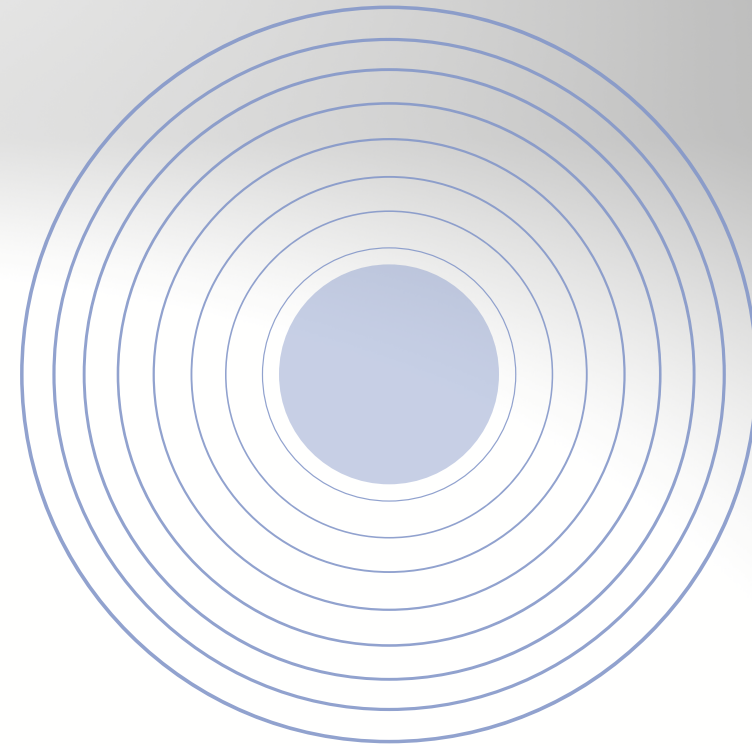
Vivista-Editor: enriching the 360°-video

The first thing to do is to start working with the Editor, which you can download for free via this link https://github.com/Saticmotion/Vivista/releases. When installing the software, you may get a message in the form of "your PC is being protected". You get this message because Vivista has not yet been downloaded in sufficient quantity to pass the threshold for it to be considered safe. To continue with the installation, you should click on 'more information', after which you will be given the opportunity to install the software.
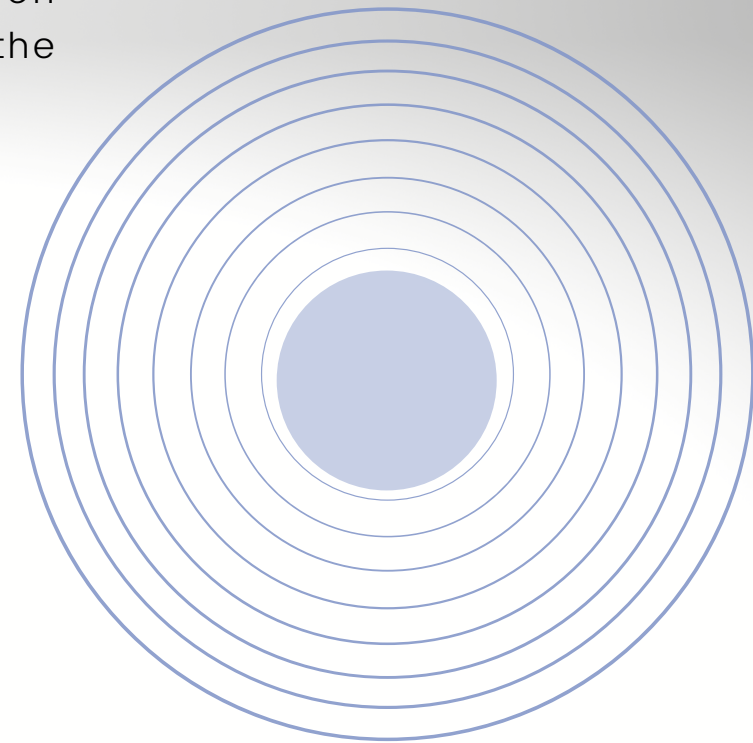
Another important note is that your computer needs certain minimum specifications to work smoothly with the Vivista software. These specifications are listed in Table 1 for your reference.

CPU (processor)	Intel Core i5 9400 $_{OR}$ AMD Ryzen 5 3400G
GPU (1) (graphics card) $_{OR}$	NVidia GeForce GTX 970 4GB $_{OR}$
GPU (2) (graphics card)	AMD Radeon R9 290 4GB
RAM	8GB DDR4 RAM
VIDEO OUTPUT	DisplayPort 1.2
PORTS	1x USB 3.0
OS (operation system)	Windows 10

Table 2. Vivista minimum specifications

Once you have installed the editor and have your stitched 360° video, you can actually start working with it right away. When you open the editor, you will see a screen like Figure 12. Here you can click on 'New' to create a new project and give it a name. When you then click on 'open', you can browse through your documents to select your stitched 360° video and it will automatically open in the editor.
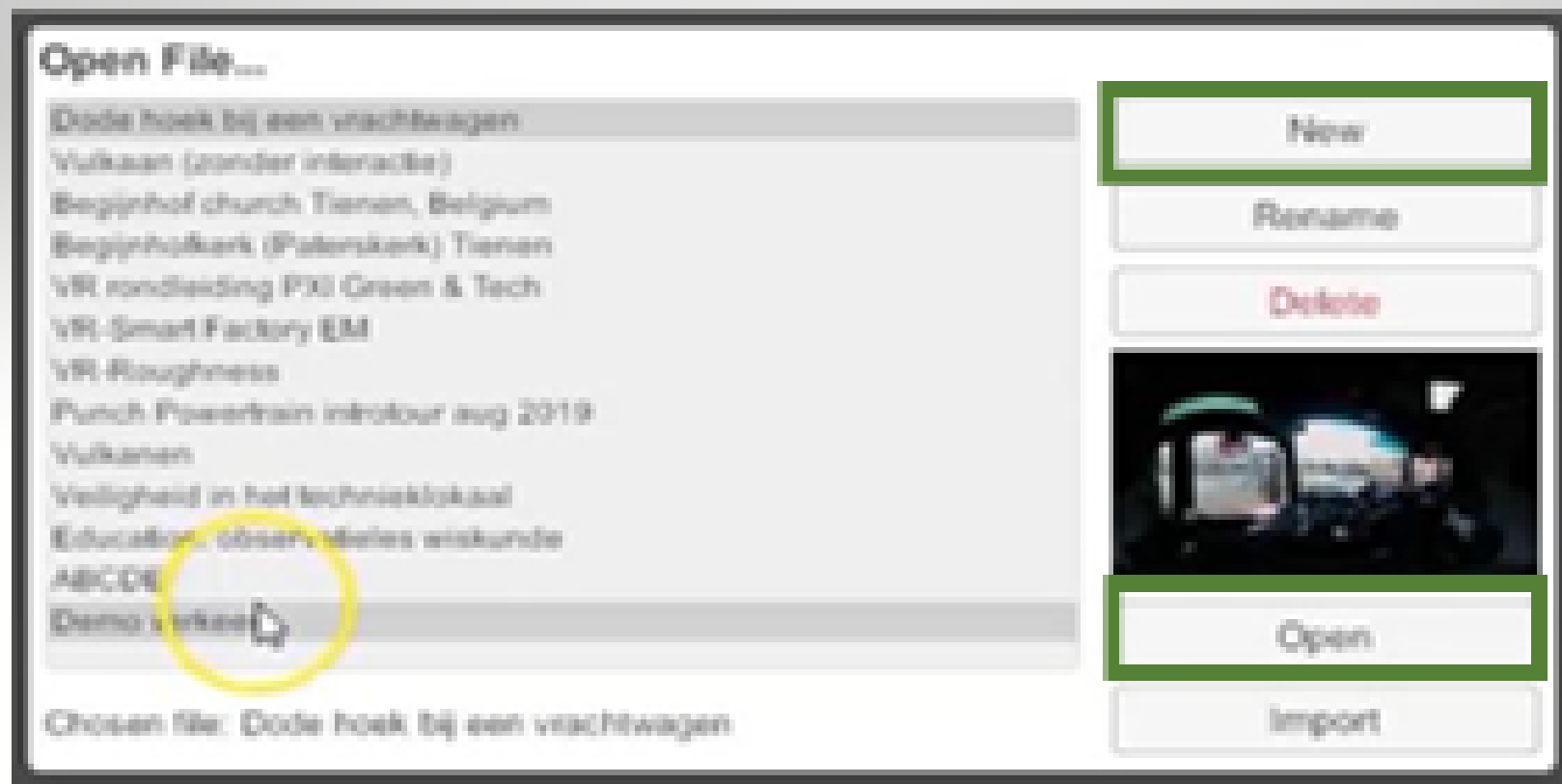
When the 360° video opens in the Vivista Editor, you immediately see a number of elements that are present. Figure 13 describes the functions of these elements.

Here you will find options that are previously associated with the settings:
- Under 'file' you can save the file or open another one.
- By 'Tags' you can create new tags.
- At 'Chapters' you can create new chapters
- By 'help' you can report bugs

This navigation compass shows in which perspective you are currently looking. When interaction points appear, this compass will also indicate where they are in the 360° environment.

Toolbar and timeline that contains the interaction points you add. Here you will be able to move them in time, lengthen or shorten them and edit or delete them.
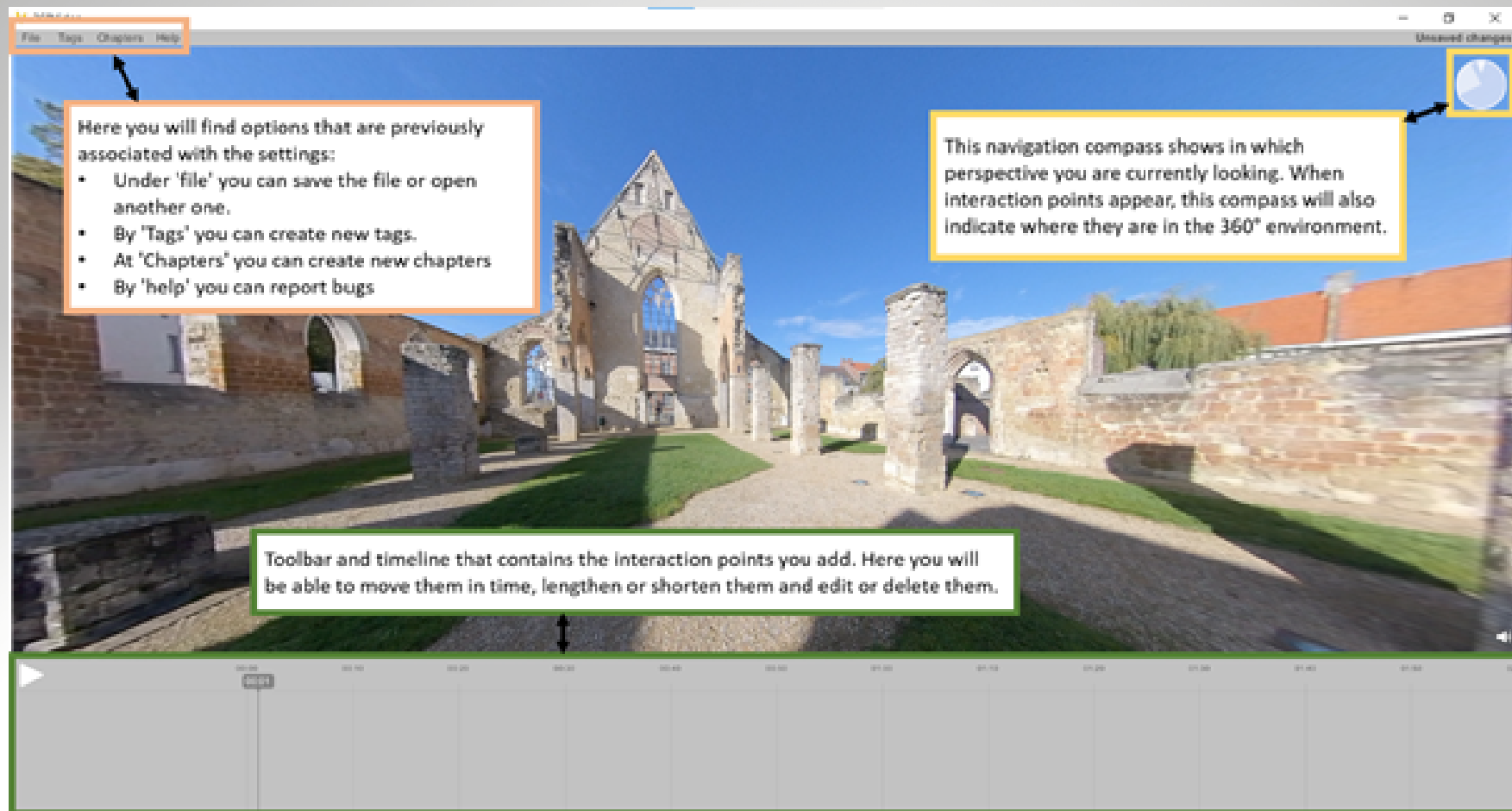
Figure 13 Function of the various elements in the Vivista-Editor.

To add interaction points yourself, simply left-click on the location where you want to place the interaction point. This will open a window with an overview of the different interaction points. When you have chosen a point, you can add a tag, a title and content. A Tag will ensure that you can structure the interaction points in the 360° video, making it immediately clear to the users what a certain interaction point will expect from them. There are three pre-programmed tags: Instruction (), Information() and test (). But you can also add extra interaction points yourself by clicking on 'Tags' in the top left-hand corner. Once you are done with the interaction point, you can click on 'done', after which it will be added to the 360° video. The process of adding an interaction point is shown in Figure 14.
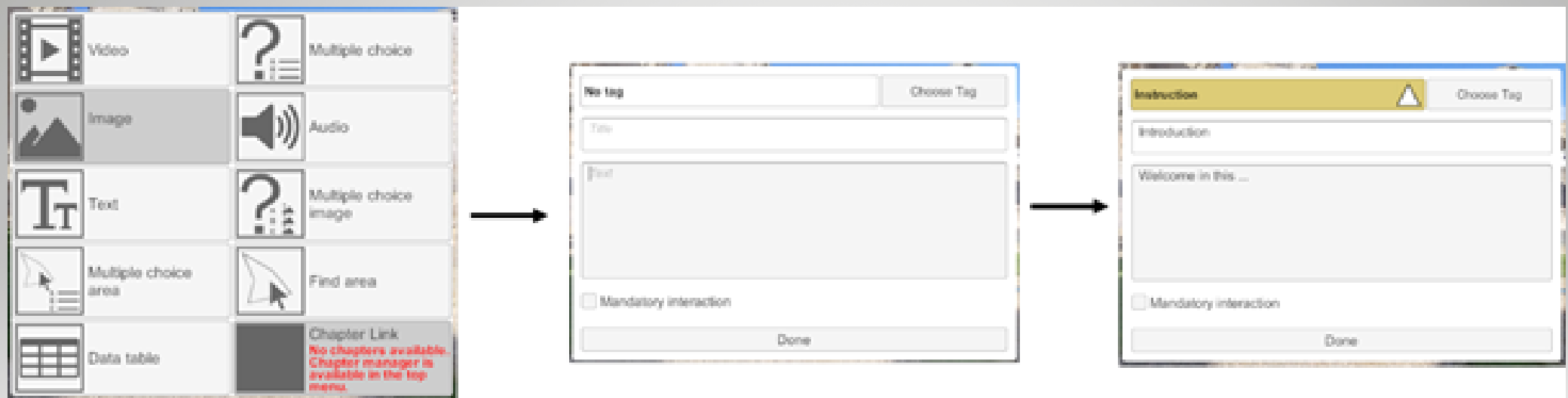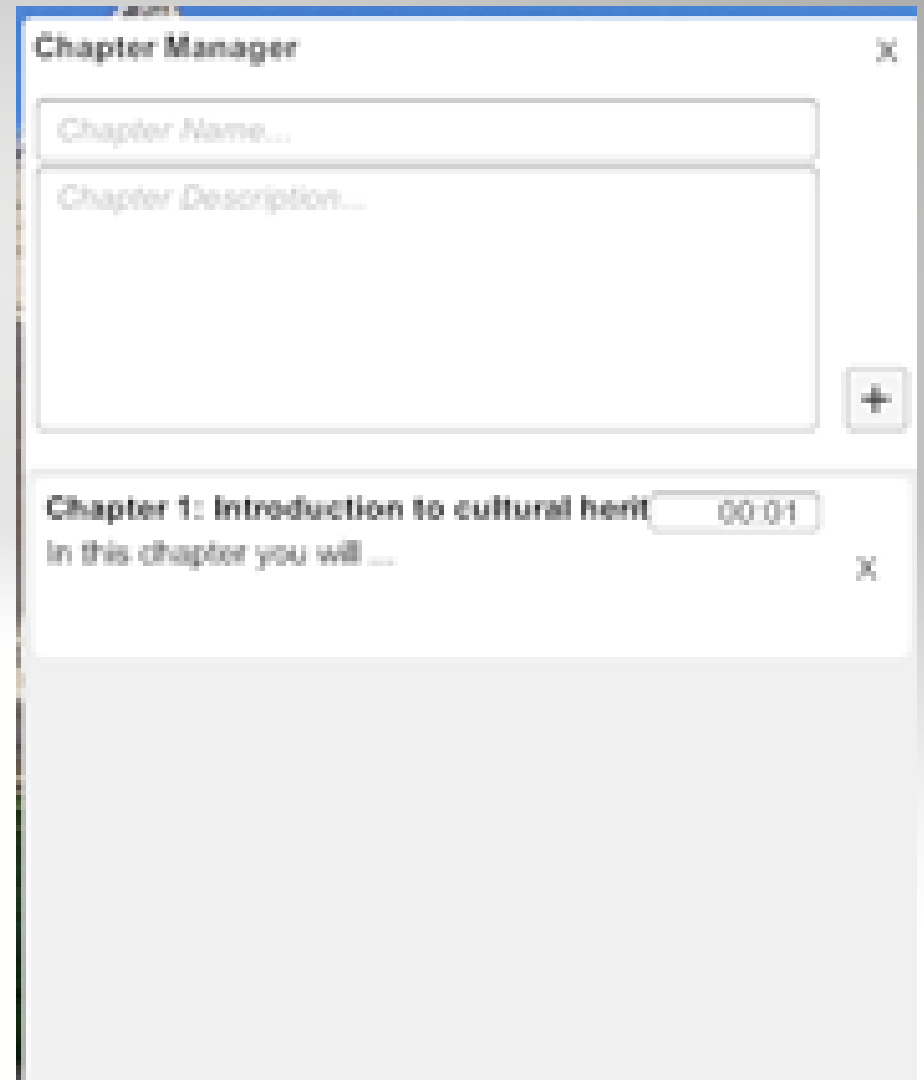

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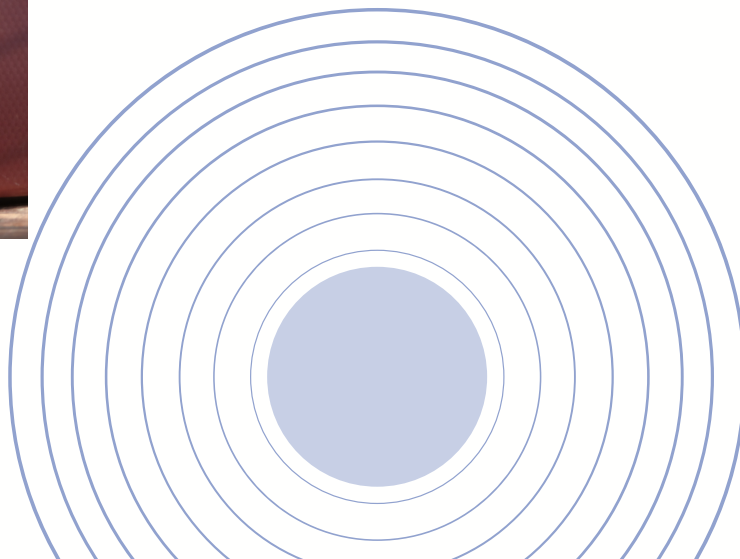
Figure 14. Adding interaction points

As you can also see in Figure 14, the interaction point 'chapter link' has the message: 'No chapters available. Chapter manager is available on the top menu'. All interaction points work in the same way, but chapters is an exception. If you choose to add chapters to the 360° video, you must first create them in the chapter manager. To do this, you need to click on 'chapters' in the top left-hand corner, as you can see in Figure 13. Then you can click on chapter manager and a new screen will appear. Here you can add a title and description for the chapter you want to create. When you click on the plus icon, it will be added and you can indicate to which time fragment it should be linked (see picture 15). After this, the message at the interaction point 'chapter link' will disappear and you will see the chapters you have added in the chapter manager.

When you have finished adding interaction points, just save the project in the top left corner after which you can close it.

Chapter Manager

Chapter Name...

Chapter Description...

Chapter 1: Introduction to cultural herit   00:01
In this chapter you will ...

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Vivista-Player: watching the 360°-video lesson

When you have enriched the stitched 360° video in the Editor, you can view it in the Player. All videos in your Editor are automatically synchronised with the Player. This means that new projects or adjustments to existing projects, are immediately visible and adjusted in the Player.

As mentioned earlier, you can view the enriched 360° video in the Player in two ways: on the screen of your laptop/computer or with a PC VR headset.

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If you choose to view the enriched 360° video on the laptop/computer screen, you can get started right away. All you have to do is open the Vivista player and click on the desired video in the menu. The video will open automatically and you will be able to start learning right away.

If you choose to view the enhanced 360° video with a PC VR headset, there is an additional step, as you need SteamVR for this. This is because SteamVR will be running in the background to connect the headset to the Vivista software. We have documented how to set this up, as well as how to connect a PC VR headset to your computer, in step-by-step plans for specific VR headsets. The links below will take you straight to the step-by-step plans for four different PC VR headsets:

- Oculus Rift: https://manual.vivista.net/wp-content/uploads/2020/11/Connect_Oculus_Rift_to_Vivista.pdf
- Oculus Rift S: https://manual.vivista.net/wp-content/uploads/2020/11/Connect_Oculus_Rift_S_to_Vivista.pdf
- Oculus Quest: https://manual.vivista.net/wp-content/uploads/2020/11/Connect_Oculus_Quest_to_Vivista.pdf
- HTC Vive Cosmos: https://manual.vivista.net/wp-content/uploads/2021/06/Connect_HTC_Vive_cosmos_to_Vivista.pdf