

On the Design of Explanatory Videos that enable Intuitive Knowledge Acquisition.

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Erklärung zur Verfassung der Arbeit

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Raffaela Pichler

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Kurzfassung

Lernvideos sind in der heutigen Zeit nicht mehr wegzudenken. Vor allem da diese durch die COVID-19-Pandemie schnell an Bedeutung gewonnen haben, sollten ihre Wirksamkeit und ihr Entstehungsprozess nun genauer untersucht werden. Das Ziel dieser Arbeit ist es, das Lernen mit solchen Videos zu verbessern und herauszufinden, welche Art von Videos auf der einen Seite Studenten anspricht, aber auch über einen längeren Zeitraum gute Ergebnisse liefert. Es wird geforscht wie Erklärvideos optimiert werden können für Studenten der technischen Universität Wiens und welcher Videostil am Besten geeignet ist, um längerfristig Lernerfolge zu erzielen. Schlussendlich befasst sich diese Arbeit auch damit, wie sich dieser Video Stil auf Videos außerhalb der TU anwenden lässt und welche Punkte essentiell für ein gutes Video sind.

Um die Forschung durchzuführen wurden drei Umfragen mit sowohl qualitativen als auch quantitativen Fragen zu jeweils drei verschiedenen Videos gestaltet. Teilnehmende Studenten der TU Wien wurden in Gruppen aufgeteilt und mussten eine Umfrage vorab beantworten, bevor sie jeweils ein Video zugeteilt bekamen. Direkt nach dem Video und zwei Wochen später nahmen die Studenten erneut an einer Umfrage teil, welche den Wissensstand überprüfte. Bei den Videos handelt es sich um ein animiertes Video, ein Video mit Folien und dem Lehrveranstaltungsführenden Professor der dazu spricht und einem Video, wo zuerst der Vortragende spricht und anschließend nur mehr die Folien gezeigt werden.

Die Auswertung der Studie zeigt, dass das Animationsvideo sowie das Folien Video ohne Professor am Besten abschneiden. Dabei wurden sowohl die Ergebnisse bezüglich des Wissensstands, als auch das Feedback der Studenten in Betracht gezogen. Im Animationsvideo wurden linguistische Anker verwendet, die den Studenten längerfristig halfen. Jedoch ist die Herangehensweise des dritten Video weiterzuempfehlen, da diese zeit- und kosteneffizient ist.

Weitere Studien, basierend auf dieser Arbeit, mit anderen Gruppen von Studenten, sowie weiterführende Forschungen zu anderen Videostilen würden zusätzliche Erkenntnisse zu diesem Thema bringen.

Abstract

Learning videos have become a fundamental tool of knowledge acquisition in today's world. Due to their quick rise of importance especially in consequence of the COVID-19 pandemic, their effectivity and creation process should now be investigated in greater detail. The aim of this thesis is to improve learning with such videos and to find out which kind of videos are appealing to students but also deliver good results. Furthermore, research is conducted on how to optimize explainer videos for students of the Vienna University of Technology and which video style is best suited to target longer-term learning outcomes. Finally, this work also deals with how this video style can be applied to videos outside the TU and which points are essential for a good video.

To conduct the research, three surveys with both qualitative and quantitative questions were designed for three different videos each. Participating TU Vienna students were divided into three groups and had to answer a survey in advance before they were each assigned a video. Immediately after the video and two weeks later, the students again took part in a survey that checked their level of knowledge.

The three videos are an animated video, a video with slides and the teaching professor speaking to them and a video where after the beginning only the slides are shown.

The evaluation of the study shows that the animation video as well as the slides-only video achieved better results than the video with the slides and the professor being shown. Both the findings regarding the knowledge level and the student's feedback were taken into consideration. Comparing the findings, it was noticed that more explanation for abstract topics is important otherwise redundant content should be avoided. In the animation video, linguistic anchors were used, which were of great advantage. The animation as well as the slides-only video used graphics to highlight the content. However, the approach of the slides-only video, created with a presentation software is our recommended style as it is time and cost efficient. Moreover the subjective rating of the students was in favor of this style. Other video design principles, which we collected from different related work, were also applied in the explainer videos and therefore resulted in the videos all achieving great success in learning outcomes.

Of course, we noticed that the participants have different interests, as well as different strengths in learning. Further foraging into other video styles and groups of participants would be interesting for new insights.

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Introduction

In this this, we create learning videos with in different audiovisual styles and compare their influence on learning outcome with students at TU Wien. The videos are about the same technical contents but differ in length and video style. Using several surveys and knowledge tests, we want to differentiate which video style is best for these students. This thesis will start with the introduction which deals with the aim of the work as well as the motivation for this subject. Furthermore, a short introduction to the field of explainer videos is given and the existing literature is addressed. Afterwards, the methodology for the research question is stated and findings will be discussed, leading to the final results and possible further work.

1.1 Motivation

In 2019, research showed that already 69% of 13- to 18-year-olds watch online videos every day [21] and 27% of all people spend more than 10 hours on online videos according to statista [5]. Regarding this large numbers spent on watching videos it is obvious that video content became a big role in our world. Moreover, nearly every student has watched online videos before, in order to learn new things. *"Video training is no longer a novel idea. It's the new normal [33]."* The potential of video content in education has not been taken advantage of sufficiently yet, which was already stated 2017 [18], and due to upcoming methods for quick and easy creation of videos, for example existing software for beginners or professionals to hire, the creation of videos is becoming easier for people without technical knowledge.

Moreover, the importance of this topic is given since video content is not only the main information-delivery mechanism in many online courses but also integrated as part of traditional courses [4]. Furthermore it has been proven that videos are a highly effective educational tool and can enhance learning [25]. Which is why I have chosen to explore the field of educational video content in detail for my diploma thesis.

These so called "explainer videos" are nowadays a frequently used method for teaching, learning as well as inspiring in areas such as B2B, B2C and C2C. An explainer video is a format that conveys complicated facts and topics to a target audience in a simple way and in a short manner of time. Furthermore, these videos usually have similar structures. They can be used as a process overview or as a problem and solution statement [2]. Explainer videos were already covered in some courses there but moreover we students come in contact with video content even more frequently since the COVID-19 pandemic started. Even before that, students have been searching for explainer videos on the internet to get a better understanding of different topics. But the interesting part is about how to make a video ideal in order to explain a specific content in the right way, and so that others can really understand it.

1.2 Aim of this Work

The focus of this thesis is going to be based on the question, how explainer videos, used at TU Wien, can be enhanced for better learning. It has been researched, that videos in general enhance the learning outcome if they address auditory and visual channels and moreover appeal to the viewers [4].

Building on existing literature, a study specifically designed for the students of the course "Denkweisen der Informatik" will help determine which video style is best for the topics of the course. "Denkweisen der Informatik" is a course held in German, deals with topics of computer science and looks at them in a critical way, for example like policy thinking or surveillance capitalism, which will be discussed in our videos. Among other things, the student's preference but also the knowledge retained afterwards will count. Therefore, the students have to participate, before and after watching one out of three videos with the same topic, in a survey. To furthermore determine whether the videos help the students to remember the content in the longer term, another survey is done with the same questions 2 weeks after the video. Based on the results of the survey a video style is declared that is adequate for computer science students at TU Wien and helps them to better process and remember learning content.

1.2.1 Research Question

This master thesis is going to be influenced by the following questions which are based on the aim of the work. It is important for us to find the ideal video content to represent learning material of subjects from the technical university. Moreover with a focus on choosing the right video style, in order to enhance the learning outcome of the students.

- How can an animated explainer video be designed to enable intuitive acquisition of knowledge?
- What special requirements do TU Wien students have in regards to explainer videos?

- How does a specific style influence the long-term memorization of video content?
- What characteristics does the optimal video style have and how can it be applied to studies away from TU Wien?

1.3 Goal of the Thesis

The main focus will be on the results of the content-related questions. Therefore we want to determine which video style is most suitable for the students. Finally, based on the knowledge question but also on other features like the subjective evaluation of the videos, a style will be highlighted that can be used for videos at the technical university in future. Furthermore, important features will be emphasized to help create better explainer videos. Therefore design patterns and recommendations from the study will be derived, enabling more knowledge about which design elements benefit online videos designed for students at TU Wien.

With the help of the study, another aim of this thesis is to find out what kind of video style helps students the most to remember the content of a video lesson and to get further interested in certain topics. In order to prove the interest of the students, the surveys include checking whether the participants have engaged with the topic outside of class to see if interest has been sparked because of the video.

As researched before doing the study and mentioned in section 2 many papers focus on principles and guidelines in order to maximize student learning. Especially the aim of this thesis is to further explore animated explainer content and their way to improve knowledge transfer. Based on much work already done in this area, one goal will also be to summarize different animated video styles and what their strengths compared to other animation styles are. However the main aim of this thesis is to compare these different kinds of explainer videos in regards to the course "Denkweisen der Informatik" and explore their strengths and weaknesses.

The research will show, which video style is most suitable in terms of learning outcome and students favor. The research, as already mentioned, will specifically focus on students of the technical university which have taken the course "Denkweisen der Informatik". Learning content from this course will be used for further analysis, with the aim of finding the best style for online explainer videos in technical context. The findings will be interesting for teachers of the technical university and can be used to enhance online courses. Furthermore in a modified version of the findings can also be used for other universities, as the thesis is also intended to provide general information, independent from the content.

Which leads to the larger goal beyond video enhancement at the TU Wien. With this work, we would like to give an impulse to not only create videos for the own lessons, but furthermore to put value on a learning progress as well as on the progress of the students in general. We want to discover on how students learn through videos and to adapt the learning videos as good as possible, so that students can remember the content ideally.

Altogether, with this thesis we research on animated explainer videos for further usage in a teaching environment. This should give others a possible way and guideline, based on scientific methods, to achieve better results with videos as an information-delivery mechanism.

CHAPTER 2

Literature Review

It is important for us to have a general knowledge of learning videos in order to create good examples before comparing them. As mentioned, videos do have a great impact on education which is further investigated in this chapter. Furthermore several criteria for good video content were described, as they are used for the videos at a later time. They are divided in visual and linguistic criteria. We also took a look on different animation styles and especially at the style of "Kurzgesagt", which is described in detail in the subsection 2.4.1, since it is commonly used and known by many people. We wanted to find out the specifications of the video and what factors make them as good as they are.

2.1 A brief Overview of E-learning

For several years now, the education landscape has been undergoing a silent revolution and the growth statistics of the E-learning industry are soaring. The term e-learning refers to teaching and learning with the help of various electronic media. According to Rey, other terms such as computer-based training, computer-supported learning, online learning or multimedia learning are also used and have the same background, that learning or teaching is performed with the help of a technical device [29]. It is expected that this industry will continue to grow strongly which is supported by multiple interesting facts. For example the percentage of graduate students in the U.S. taking one or more online classes has risen from 16.5 % in 2008 to 45.6 % in 2016 [32]. Furthermore it is important to keep in mind that E-learning can increase student retention rates by 25 % to 60 %, which is a huge amount when considering how many more people can be educated as a result [32]. E-learning might also be the solution to more education for those who do not have access to universities and subjects such as science or technology [11]. However, it is important to keep in mind that massive open online courses, also known as MOOCs, are often abandoned, because of the free enrollment. In some courses, 85 % to 97 % of the students were lurkers and did not participate in the discussions or did not show up.

Common reasons for a high percentage of lurking students are the lack of motivation and the lack of understanding during a course without external help from teaching staff [12]. According to the study by Mathias Winde et al. in 2020 the demand for digital materials is expected to increase although students generally do not necessarily approve of distance learning technologies, as already mentioned. Among other things, digital instruction will continue to gain acceptance in various educational institutions and the number of online courses are expected to increase [36].

2.2 Significance of Video Content

For E-learning, video content plays a huge role and according to recent research it is proven that the demand for video content is still rapidly growing. Furthermore studies that have been made verified that video content has a positive impact on listeners regarding their learning outcome. Moreover especially short videos which do not exceed 10 minutes are useful for a better understanding [34]. In 1997, a meta-analysis was already conducted by Mayer, who showed one group of participants multiple representations, in verbal and visual form, and another group that received only verbal explanations. In the following test, on average over 75 % performed better after receiving more than just verbal content [22].

If the use of explainer videos in the educational environment, specifically at school, is looked at more closely, one can see that according to a study called "Youth/YouTube/Cultural Education" nearly half of all participants between 12 and 19 rated explainer videos as important for their academic success. Based on this study, students mainly use these videos, namely 73%, to repeat content that was not understood. 70% use videos to help themselves with homework and over half use it to consolidate knowledge [14].

2.2.1 Educational Videos in Computer Science

Based on the previously mentioned studies, it can be said that videos are an important tool in many areas, whether in educational or advertising terms. However, animations are particularly useful for conveying knowledge in abstract subject areas as for example computer science. Through the simplified representation of complex topics, connections can be ideally presented to the learners. Through the alternative representation, a generalization is often possible and easier to realize. The mentioned representation helps the viewers to focus on certain aspects that are essential for understanding the topic. Time and size relationships also play an important role here, as they can be presented differently in animations. Thus it is possible to explain things differently and in a simpler way and make them more understandable to a large public [13]. Animations were not only born from science but are very closely related to it. Studies and experiments conducted by scientists such as Eadweard Muybridge and Étienne-Jules Marey served the purpose of visualizing and recording phenomena that would not have been visible to the naked eye. For example did Muybridge study a horse in motion as seen in figure 2.1, which made them able to understand the movement of the body. This was, among other things,

the beginning of the development of the Vitagraphen and then the cinema, but also the beginning of animation for the simplified presentation of scientific topics [1].

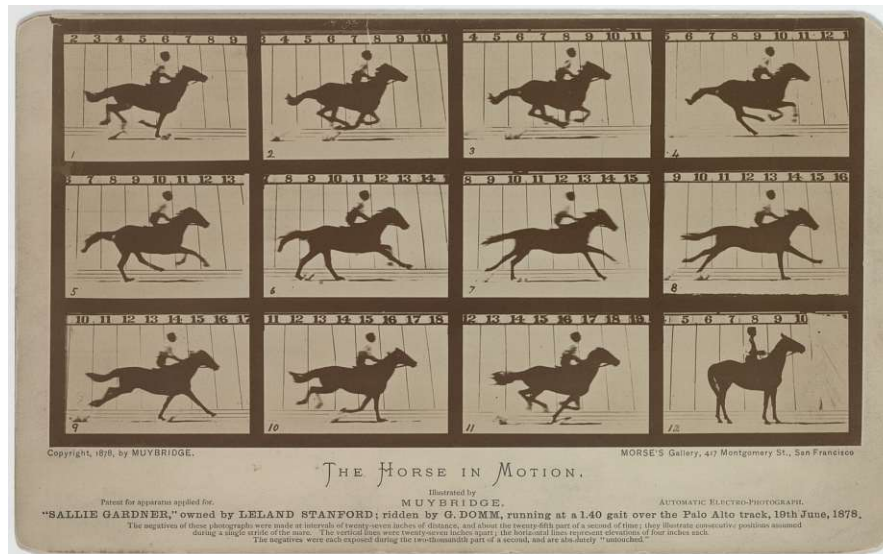


Figure 2.1: The Horse in Motion by Eadweard Muybridge [3].

2.3 Criteria for successful Explainer Videos

According to Karsten D. Wolf, in order to be successful with an explanatory video, it is important to understand that people can remember "dual coded" content more quickly and easily. This effect was invented in the 70s when the psychologist Paivio made the assumption that there is a processing system as well as a memory system in our memory, which processes recorded information. Content is thus encoded both linguistically and visually [37]. Several visual as well as linguistic criteria will be listed down below and discussed in more detail for better understanding of video creation.

2.3.1 Visual Criteria

Preliminary it is important to mention that visualizations are not meant to replace spoken text, they usually serve as a supplement to the information conveyed auditorily.

Briefly summarized by Karsten D. Wolf et al., a visual representation in an animation can have five different functions [37]. Wolf defined five different functions a visual representation in animation can have, which we will now summarize briefly:

- Decoration function: these images have no relation to the text and are considered less complex and essential.

- Representational function: it is used when images match the content of the text and provide a representation of it.
- Organisational function: images with this function describe a complex scenario, for example represented with a flow chart, a diagram or a mind map.
- Interpretation function: like a graphic or a analogue image. This refers primarily to illustrations that are intended to create a connection and do not realistically reproduce the exact word. The mentioned functions from two to four are actually the most common ones used in videos.
- Transformation function: which refers to mnemonic aids. An example mentioned by Wolf is the following mnemonic, originating in ancient Greece, in which abstract concepts are placed in known locations along a path, such as the commute to work. This should help people to remember this concepts exactly at the location placed when rethinking the path in their brain. However this function of pictures is rarely used in videos.

Not only do images have different functions, they are also used for a specific purpose, which can be classified in four different types. An image can have the purpose to inform. Liv Shawn named the example of a police officer in front of a building can tell the viewer of the image that the building is a police station [20]. Same goes for young children in front of a building, this might be a school then. Another purpose interesting for E-learning is an image that educates. Images in history books do often have this purpose. Both of these two mentioned types are also important for explainer videos. The last two types are images that persuade, which means that they want the viewer to believe and in marketing often buy something, and images that entertain, for example pictures of hilarious situations.

Principles of Multimedia

In order to create effective multimedia learning experiences, the educational psychologist and Professor of Psychology Richard E. Mayer developed an evidence-based theory of 12 Principles of Multimedia Learning, which are listed in more detail below. They will be later used in the creation of the three different videos for this study and attention will be paid to learning outcome in correlation with the principle used in the videos.

- A criteria for the presentation of certain passages in videos is the "multimedia principle". It turned out that more abstract images often produce a greater learning effect than concrete-representative images. Moreover the "multimedia principle" says that as mentioned before, humans learn best from words and pictures than just words alone. This is why videos with a typography style are not as successful as other styles regarding the learning outcome [22].

- Furthermore the "image principle" builds onto this. Informative images are often a better representation and help viewers to learn faster than from a talking head video, which are very common and often used in MOOCs. Since not a lot of research has been found on this principle, it will be also interesting in further testing this in the study.
- Mayer also pointed out that visuals combined with spoken words do work better for the best learning outcome than a combination of visuals and printed words, which is described in the "modality principle".
- The "personalization principle" points out, as the name already indicates, that personal aspects are better received in videos. For example, a personal voice can sound better to viewers than a computer-generated voice. Researching on the usage of these principles it has been found out that long and complex words should be avoided as they are not used in normal conversations [7].
- Similar to the previous principle, the "voice principle" is about the fact that people learn less well from computer generated voices than from actual human voiced content.
- Another important principle is the so-called "spatial contiguity principle" which refers to the proximity between written text and the images shown.
- Not only should illustrations and written text have a connection, but they should also coincide in time, which is described by the "temporal contiguity principle".
- Finally, the "coherence principle" is also of great importance. Unnecessary information that has no significant effect on the viewer should not be displayed. Applying this principle to animations it can easily happen that there is too much dynamic and the eye cannot follow the shown images. Not applying this principle causes a distraction of the viewers which might leads them to memorize unnecessary information. However, in contrast to static images, animations can better show changes. Certain effects can also control the visual attention and direct certain areas or points in the video [22].
- Very similar is the "redundancy principle". In practice, it is suggested to choose either text or graphics and to avoid the redundant information [7].
- According to Mayer, the "segmenting principle" describes that humans learn best, if they have control on their learning tempo. Especially nowadays platforms like YouTube allow the viewers to adjust the pace of the video. Moreover content creators are able to create chapters in the videos, were the viewers can immediately jump to a certain topic in the video.
- The "pre-training principle" states that when people already have a basic knowledge of a subject, they are better able to remember things. In principle, this is self-evident, but it can be taken into account in learning videos. For example, a certain

target group can be considered before creating the video and technical terms can be explained accordingly in the video.

- Furthermore, one should be aware that learning strategies that can be applied to printed or PDF material, such as underlining certain statements or commenting on them, are not possible for viewers. However, words or emphasis can also be shown in the video to take advantage of this technique [37]. This is further described in the "signaling principle", which means that it should be shown exactly what to pay attention to, to enhance the learning outcome. As an example, a part of a description written on the video screen can be highlighted [7].

2.3.2 Linguistic Criteria

As far as purely the hearing of the viewers is concerned, an explanatory video can be understood on three different levels. We speak of the auditory, the visual verbal and the non-verbal auditory level which are described in more detail below. Achieving the best possible result is only possible through the interaction of all three levels as a whole, which increases and optimizes the comprehensibility of an explainer video. Therefore, if no consideration is given to the visual material in a video, then the most important content carrier of a video is the spoken part. Value should be placed on voice, intonation, speech tempo and expression. Furthermore, emotions are transported via the spoken text as well as the factual information, though this, it is possible to convey personality, which on the other hand would not be possible by purely written text.

If we refer to the auditory level, there are certain points, as mentioned before, that should be taken into account. According to Dietz, the speaker should communicate clearly and expressively, i.e. it should be unequivocal which emotions are to be conveyed [8]. The pronunciation must also be clear and the speaker needs to pay attention of speaking neither too fast nor too slow.

The second level is the visual verbal level which is associated with written content in videos. In many cases, however, this is not considered relevant and regarded as a high load on the cognitive system for reading incoherent text, which overall reduces the learning effect. However, it can be widely used to assist viewers in listening with short sentences or just words that highlight important content. According to Dietz, it serves as a "sprachlicher Ankerpunkt", which means linguistic anchor, i.e. a reference word to the spoken sentences.

The non-verbal auditory level should be used sparingly as it does not convey any content. Elements used at this level are sound effects or noises for example. They work in addition to the content conveyed on different channels and are thus intended to strengthen the emotional level. Sound effects can furthermore direct the attention of the viewer and listener to certain aspects in the video. Through background music and certain effects it is also possible to create a mood in the video or to strengthen already existing emotions [8].

2.4 The different Styles of Animations

At the moment, many different animation styles do exist and some research on the various video designs has already been done [19, 35, 6]. For example, white board drawing, motion graphic, typography, live animated style, infographic video, stopmotion, 3D animation and rotoscoping are suitable styles for animations and short videos. In 2018, Krämer and Böhr conducted a highly relevant study on an already existing explanation video, which was compared to four different videos. Images of the video styles are depicted in figure 2.2 and the study was focusing on acceptance and learning outcome in the United States and Germany. In general, this study showed a high acceptance of explainer videos among participating users. The best learning outcome was conducted with the so called "Classic Format" whereas the worst results came with the "Color Format"[15]. The first format was also preferred because of the ratio between in- and output. This means the time spent on watching the video and improving the knowledge level.

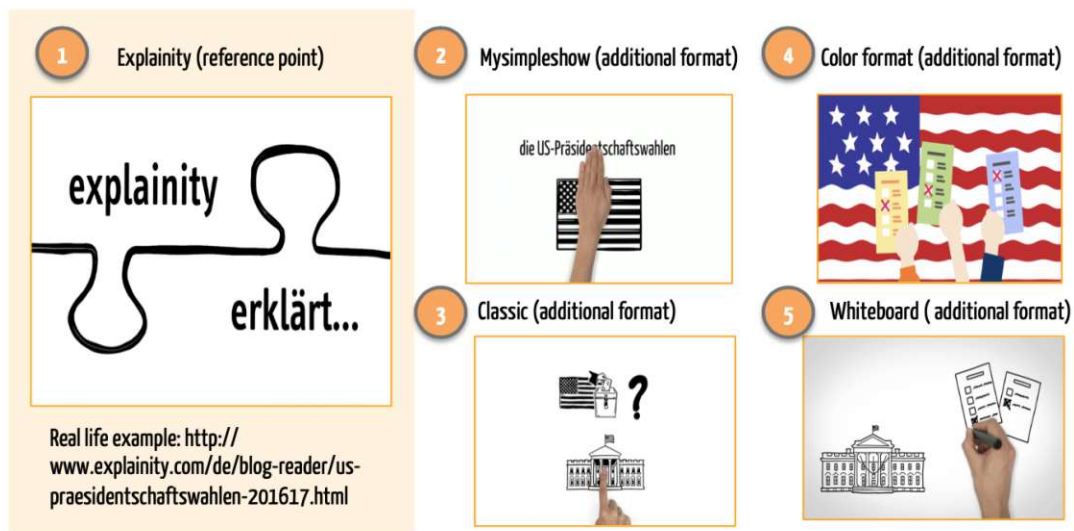


Figure 2.2: Five different video styles [15].

Various animation styles offer a different level of detail, a whiteboard animation for example is not offering as much details as an illustrated style. Therefore each animation style has its advantages and disadvantages, however a lot does also depend on the personal opinion of the viewers as well as on the context of the videos. Deciding on an animations style is also contingent on what viewers are used to and popularity in order to follow the norms of the industry [31]. Which means that we want to investigate on a popular video style and find out how good the learning outcome on a long term perspective is. Furthermore with the help of the survey do we want to find out if the outcome of the popular style differs a lot from other styles.

2.4.1 The Animationstyle of "Kurzgesagt"

"Kurzgesagt – In a Nutshell" is a YouTube channel and started as a German freelance project, started by Philipp Dettmer in 2013. Nowadays it is not only a big design agency but also the biggest YouTube channel in Germany with more than 19 million subscribers [17] making educational videos. In general their videos are between four and 14 minutes and topics vary between the fields of science, space, technology, biology, history, politicians and philosophy. Image excerpts from their videos can be seen in figure 2.3. The fame of Kurzgesagt is among others due to the fact that they have an unique animation style and explain complex topics in a few minutes as well as very understandable. Videos from Kurzgesagt get a lot of positive feedback which also helped them for a cooperation with Funk, a German content-network of ARD and ZDF. However it is necessary to say that some have also pointed out that Kurzgesagt has a neoliberal bias in their interpretations of statistical data [24][26]. Since courses at the university always reflect a certain opinion of the professor and something like this is hardly avoidable, the advantages and positive feedback outweigh the disadvantages here, which is why Kurzgesagt Videos are well suited as a template for an animation style. For this, it is important to take a closer look at the videos and how they were created. Not only that, but also the subject matter, color scheme and details are essential for a good video for the surveys at the TU Vienna.

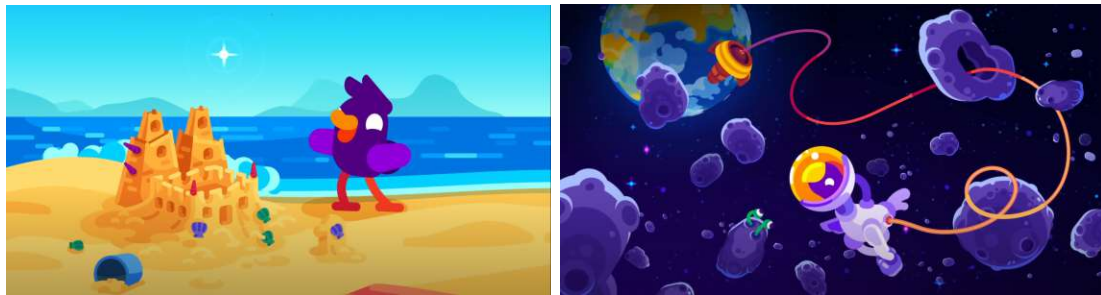


Figure 2.3: Image excerpts of Kurzgesagt [16]

In the next sections, videos of Kurzgesagt have been analysed in more detail and the video creation process has been researched. The results found were divided into different categories such as data collection, visual representation and auditory assistance and will now be explained in more detail.

Data Collection

Before jumping into designing a whole explainer video, a lot of research is necessary. CEO Philipp Dettmer said in an interview, "Everything complicated is only complicated because someone is bad at explaining it [28]". The Kurzgesagt agency invested in a complete team dedicated exclusively to the analysis and research of certain topics, collecting facts and preparing content. They try to bring very complex and controversial issues in an accessible way to the viewers and explain. For this purpose, a script is first written



Figure 2.4: Flat design of a bicycle [9].



Figure 2.5: Rich design of a bicycle [27].

which can take weeks but also years, depending on the complexity of the topic and possible complications in the research. To truly ensure the highest level of accuracy for the production of the videos, the script is sent to various experts and reviewed several times before final completion [23].

Visual Representation

Graphic design is able to change the mood of a person by using colors, images and design principles [30]. Kurzgesagt decided on a colour palette with lots of neon colors, mostly purple and orange tones. This is because in color theory, purple colors are said to evoke negative and sad feelings while orange-red tones are often used to emphasize positive pictures. But not only the colors are of decision but also the design of the images and animations. For this, Kurzgesagt uses a style called "Flat Design". The term is used for numerous graphics or applications that share the same stylistic characteristics. Flat Design describes a minimalistic design as well as the concise use of visual means of expression. "Rich design" is the so-called opposite of flat design. It includes multidimensional and highly realistic graphics, however flat design is reflected in the two-dimensionality. In figure 2.4 a bicycle in a flat design is seen on the left whereas a rich design is seen on the right in figure 2.5.

Flat images as a type of design has been developed more and more in the last few years and is also used for web and mobile interfaces. It is said to improve usability and visual harmony of user interfaces [38]. Thus, the style is also very suitable for explainer videos based on its simplicity. In addition, several principles apply to this design. First of all, little text and a lot of images are being used (image principle). In addition, the flat design uses the redundancy principle, where only the most important information for recognizing the object is displayed.

Auditory Assistance

Furthermore, the music composition and sound design are essential factors for high-quality videos. For this purpose, Kurzgesagt backs the videos with subtle background music

that supports the speaker, depending on the topic. Furthermore, various sounds are played to match the animations in order to support the visuals with acoustic signals and make them even more memorable. As already mentioned, a speaking voice is supported and that voice is also crucial for videos of Kurzgesagt. The voice actor is a professional speaker and trained for this purpose [23].

Summary of this Video Style

To sum up, videos of Kurzgesagt are based on reliable and in-depth research work. It was found that enormous research effort was made before the videos were created. They are short and to the point and have a style running through them, namely flat design as well as a consistent color scheme. Several principles from above were used in the videos. Furthermore, the voice actor is important, supported with background music and various sound effects.

CHAPTER 3

Methodology

For this thesis we decided to choose an exploratory research with the aim to explore the main aspects for designing explainer videos. Therefore we compared three different videos to see which ones are more preferred among students on the one hand, and through which videos they achieved the greatest learning effect on the other hand. Since we are going to test which video style from one to three achieves the best results, the research is going to be deductive.

Especially in research, we humans tend to be biased towards a result more often. This was tried to be avoided as good as possible concerning the results of the students in the surveys. To avoid group work, the survey did not take place in class. Contact was made to the participants by mail and by this we could also exclude the bandwagon effect, because no answers will be taken from others. Furthermore, we have also tried to check the questions and phrase them in a certain manner that does not lead to a specific result. In general, with the help of a survey instead of individual interviews, we had the possibility on the one hand to reach a larger group of people in a shorter time and on the other hand it is possible for us to avoid our own attitude towards the topic and no influence was given.

3.1 Methods used for Data Collection

In order to answer the research questions about designing explainer videos to enable intuitive acquisition of knowledge, the most suitable approach was to collect secondary data. Some of which can also be found in section 2, and further verify it with a study and therefore collect primary data. Mere data collection from already available studies is not sufficient in this case, since most of the studies did not take into account students of TU Wien. They usually have a technical reference and look at things in a different way. A nicely designed animation video will probably find more appeal in an art school and a technical video more with students of the TU Vienna, if considering purely the interests

based on the field of study. Therefore data is not obtained from other studies but is collected by ourselves. Collecting primary data allows us to specifically address students of the Vienna University of Technology and ask questions about their level of knowledge, before they watched the videos, and at different intervals afterwards. Our hypothesis is that depending on the style of the video, the content is remembered differently. Therefore we want to verify this with a study on three different videos. Overall we created a study over two weeks where we had three points in time, where students had to answer questions regarding a specific topic seen in a video. The timescale was set before, so the first questionnaire was planned immediately before watching the given video. After the video students had to answer another survey, in order to test their knowledge gained by the video. Two weeks after watching the video, the final survey was to determine how much stayed in the mind of the students and how much they have learned from their video.

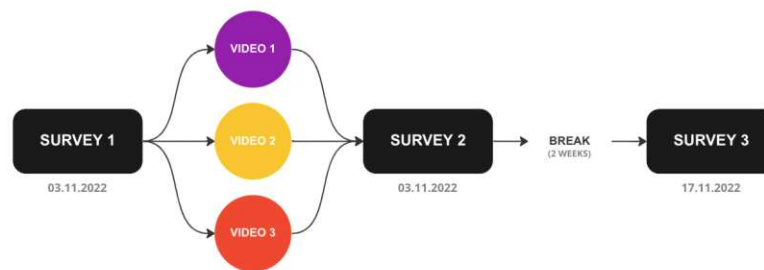


Figure 3.1: Survey timeline

The multiple study approach was essential because a survey alone would not be sufficient to verify how much students remembered the content of the explainer video. Split into a survey immediately after the video, allowed us to determine how much they understood, and a second survey two weeks later, allowed for comparison of these studies. Therefore it is possible to determine which video leads to the best understanding on the one hand, but also with which video students remembered the content the best. This is also crucial in order to answer the second research question, which can be read in section 1.2.1.

As a tool for the surveys, which will be explained in more detail below, in the subsection 3.1.1. We were able to use the university access to Lime Survey and select it for this purpose. It should also be mentioned that the location was irrelevant for data collection, as everything could be viewed and filled out online.

Since most classes at TU Vienna are designed by the professors, we can consider the setting of our survey to be controlled. A constructed setting allowed us to assign a video to each of the participating students and we were able to give everyone the surveys to

complete at the same time interval by E-Mail in order to enable uniform and comparable data collection.

After designing all three surveys, they were also further reviewed by the assistant Prof. Astrid Weiss. She works at the technical university in the research area Human Computer Interaction. Feedback from her was included in the survey to improve better comprehension. Furthermore matters related to the survey, such as the possibility of participants not answering questions were clarified. It was also decided in this case that all questions are mandatory. A question left empty is an uncertain result and does not automatically mean that the concerned student does not know the answer. Otherwise, in some cases, the statistics would not be meaningful if questions were omitted.

Regarding all of the three surveys, qualitative as well as quantitative answers are included. In order to focus on words and meaning and to get more clear of students understandings of specific definitions explained in the video, qualitative questions were asked. Moreover the questionnaire is going to use a liker-scale because of the detailed insights into perceptions unlike binary questions. Therefore for the subjective evaluation of the videos we used questions which allowed us a quantitative data gathering. Furthermore, this survey is also be used to check whether the students themselves have researched on the topic after watching the video, which could provide interesting perspectives.

Overall it has to be said that the collected data is from students at the TU Wien, which makes the type of sampling to an very specific one. However we think that probability sampling is possible, since although they are students at the technical university, they still vary in age, gender and also have a unique personal life, come from different contexts and have different experiences that they base their opinions on. Therefore we are able to use some of the findings, which will be generalized for a broader population. This is also important for the last research question in section 1.2.1, as we want to determine the important points of the best video style and how others can also use this, to enhance their online videos.

3.1.1 The three Surveys

Overall all three surveys were about the topic of "Surveillance Capitalism" and we tried to repeat most of the questions similarly to not only compare the results of the different groups with each other, but also to see how the students' results differed depending on the time of the survey. All of the questions of the first survey, except if they have heard of the topic before, were asked in the next surveys again. Moreover there are three interesting parts we wanted to discover. First the knowledge of the students and the development over time. Therefore we decided for questions regarding the video and were asking them again in all surveys as mentioned. Also important was the subjective rating of the students of the video, they have seen. Therefore we designed a likert scale in the post-video survey. And last, we also wanted to discover if the behaviour of students is changing trough a video shown at the university. Since the video talks about a critical topic, it was possible for us to ask the students how they deal with cookie settings right

before they have seen the video and in the post-video as well as in the long-term survey again. Each survey will be described in more detail down below.

Initial Survey

The survey right before the video allows us to draw references between the surveys and to discover if students had already knowledge regarding the relevant topic, which of course also influences the outcome of the study, if the group of one video has more knowledge than another.

For this study, students of the Computer Science Bachelor at the Vienna University of Technology were asked on November 3rd during the class "Denkweisen der Informatik" if they would like to participate in the study. As an incentive to participate, they were also offered extra credit points in the subject itself, as it reflects the content of the lessons. The participants were divided into 3 groups beforehand and a different link to the initial survey was inserted into the E-Mail for each group. This was due to the purpose that at the end of this survey in each case a different link to a video was inserted and we have thus 3 groups, that see 3 different videos. The mentioned E-Mail with the link to the survey was sent to the voluntary people on the 3rd November. The initial survey as well as the post-video survey, which was possible to attend after seeing the video, were available over the weekend and stopped on Tuesday morning, the eighth of November.

In the survey, we wanted to determine the knowledge of the students by asking about certain technical terms, like "surveillance capitalism" and "filter bubbles" and if they had heard them before. Furthermore in order to determine whether the behavior of the student changes, due to the gained knowledge, the question "How do you deal with cookie banners?" was also asked. In total, it was eight questions about their knowledge before watching the video and one question about their matriculation number, so that afterwards we still have the possibility to compare the answers in all surveys. Which was very helpful, as you can read in section 6.

At the end of each survey, a link lead them to the specific video. Each video has some differences, which are described in section 3.3 but at the end of each video a sentence was implemented reminding them to read the description of the video, if not already done so, in which the link to the next Survey could be found.

Post-video Survey

In contrast to the first survey, we did not divide it into three different sub-surveys since all participants could complete the same survey. However, in order to be able to distinguish which video they had seen, the participants had to select at the beginning which of the three videos they had watched. The students received the link to the second survey beforehand via the video. It could be found in the video description and also in the video itself was referred to participate in this survey.

At the beginning, participants were asked questions about their subjective opinion of the video they had seen. The questions were asked using a Likert-Scale and students could choose between one to five. Since on mobile devices the points to tick are one below the other, we decided to use 1 for "strongly agree" and 5 for "strongly disagree". An explanation was added beforehand and as a mnemonic it was mentioned that they should answer the questions according to the grading system in school. This evaluation of the videos should help later to see where the students' personal preferences lie and also by asking questions about the length we can recommend an ideal length for explainer videos afterwards.

Subsequently, the students' level of knowledge was checked. Some of the questions from the initial survey were asked again, but new ones regarding the video were also added. Furthermore we asked the students the question "How do you want to deal with cookie banners from now on?" to see whether they now evaluate them differently and also want to act in a different way. In total, 21 questions were asked to the students. The first question was about the seen video and the last question was again about their matriculation numbers. Moreover six evaluation questions were asked and thirteen more to check their knowledge.

Long-term Survey

Before we sent the link for this survey to all participating students, we already examined the results of the previous surveys to see if we should change certain questions. We found that one question in particular was absolutely not understood by the students and has been therefore not taken over into the long-term survey. "What else should be looked at critically besides traditional and partisan advertising on the Internet? (at least 2)" was the question we deleted and the correct answer would have been one of the following: "recommended content, fake news, inflammatory writings and lies". However these words were only mentioned very shortly in the animation video and the connection to exactly this point of the video was not given with the question. Also, some questions in the last surveys were answered with "see previous survey" or "my opinion on this hasn't changed, see first survey", which of course shouldn't happen in the last survey, since it is about testing their knowledge after time had passed. That is why a short sentence was added at the beginning of the questionnaire. The link was sent to the students two weeks later from the last survey on November 17 and in total, 109 people participated in this survey. Again we asked them to check, which video they have seen and added some pictures of each video to the question, so it is easier for them to choose the correct video.

In survey one we checked how they currently deal with cookies and in survey two we asked how they would like to deal with them in the future. However, in order to be able to really determine whether students have actively changed their behavior, this survey checked how students are now using cookies on a daily basis. Overall 15 questions were asked. Again the first question was about which video they have seen and the last about their matriculation number. The survey was closed on November 24, exactly after one week.

In contrast to the second survey, this one also asked whether students had engaged with the topic outside of class. This was intended to be another indicator of whether a video had had more effect. Of course, this also depends on the topic and the participants and gives us little information, but still an interesting question for the design of the lessons.

3.2 Methods used for Data Analysis

In order to ensure a correct analysis of the collected data, we reduced the sample size. Therefore only submissions of all three surveys were considered.

All submissions were imported into a calculation tool and reviewed. Half-completed results were evaluated as inadmissible. Responses were filtered by video type and then questions about the content were scored for correctness. This allowed us to achieve an overview of what percentage had answered correctly for each video. Open-ended questions were also scored as partially correct if some important points were mentioned and as absolutely correct if every important point from the video was mentioned. Not only could the videos be rated against each other, but comparisons could also be made to the surveys before. Results for the survey can be found in chapter 4.

Null and Alternate Hypothesis

Furthermore a null hypothesis was made as well as an alternative hypothesis. In order to make an prediction at the start of the research process, we thought about the possible options of an outcome. Since we are comparing three videos, each video may provide the best learning outcome. Furthermore it may also be the case that two or even all three videos produce the same results.

So as far as the null hypothesis is concerned, there will be no correlation between the videos and the learning outcome. Alternative one of the three videos will have a better outcome than the others. Therefore the alternate hypothesis is, that the animation video will have the best outcome.

3.3 The Three Explainer Videos

For this thesis and the included survey it was decided to compare three videos that vary from each other in various aspects, described later this section in more detail. Overall the animation video differs the most from the other two videos as it is an animated video with a speaker, compared to the others, where a slides presentation is shown, respectively with and without a professor. All of the videos had the same topic but the animation video differs in the text spoken from the other two videos. Comparing these three videos gives the opportunity to answer the first research question, how explainer videos should be designed to enable intuitive acquisition of knowledge, with consideration of the literature already developed. For this purpose, it is important that the videos differ for example in

style and length, in order to determine which aspects are the most crucial for knowledge acquisition. The variation in length can also affect the results, which is why this was taken into account and also considered in more detail.

3.3.1 Topic of the Videos

Since the three videos are to be compared with each other, we decided that all videos should cover the same topic. Alternatively, we could have shown all students three different videos in a row on different topics, but in this case it would be more difficult to determine with which video the learning progress is best, since the prior knowledge can differ significantly. Of course, this is also possible with only one topic in all three videos, but we can still determine whether a group has increased prior knowledge by conducting a survey beforehand. With the help of the course "Denkweisen der Informatik" at the Vienna University of Technology we have the possibility to reach a lot of students and we can therefore divide the participants easily into three groups for each video.

The content of the videos is accordingly also adapted to the aforementioned course "Denkweisen der Informatik" and suitable for one specific topic called "Critical Thinking". At first, the business model of Surveillance Capitalism is explained to the students in the videos. This involves the tracking of data and subsequent sale of the collected data and analysis to companies. Also, the possible insight and the partial prevention of such tracking, with the help of the cookie settings, is mentioned. Another point mentioned in the videos are the algorithmic decisions, whereby people are put into so-called pigeonholes and are only fed with content that fits their pigeonhole. This leads to fewer people debating with each other and less discourse as well as people feeling very affirmed in their own opinions since they hear little from other opinions. In the worst case, this could slowly lead to a massive spread of fake news and a radicalization.

The content mentioned will also be a subject in the surveys and will be used to check if the participants understood it correctly and remembered it. The videos were designed in a way that even non-specialists can watch the videos and answer the questionnaire afterwards. Thus, no prior knowledge is required for the topic covered, but a good technical knowledge is an advantage and certainly leads to faster understanding.

3.3.2 Style and Differences of the Videos

Using the principles and guidelines found in literature, how to enhance educational videos, a decision for three animation styles has been made. In general there are many video styles that appear more commonly. On Youtube styles like whiteboard animation, 2D animation, videos with stock footage, screencast, typography animation and 3D videos are seen very often. However, some reasons speak against some styles. For example, 3D animation is not suitable for this topic and the context of the video. This is due to resources like time and money. Furthermore, this style would probably not be picked up by others in the educational environment. Typographic videos are also not suitable since they are not considered as relevant, as previously mentioned in more detail in the section



Figure 3.2: Color contrast: background / foreground / Figure 3.3: Color contrast: attention focus on the arrow

2.3.2. The cognitive overload of this specific video style can often reduce the learning success.

Animation Video

In order to address the lack of comparison of possible animation styles in literature, it is imperative to conduct an empirical investigation in the context of this research. Therefore we decided to use for our first video a 2D animation which slightly resembles motion graphics. The video was based on those of Kurzgesagt. On the one hand, this has the advantage that this style is known and appealing and on the other hand, there is already some literature about it. Overall the video takes 3:12 minutes and is explained in more detail down below.

Especially the color scheme of this animation video relies on Kurzgesagt. It is deliberately chosen and the style is consistent throughout the video. Most of the time the color purple is present and is used to reflect negative emotions. Highlights in Yellow, Orange and other so called positive colors are a good contrast to direct the gaze on the one hand but represent also in some frames success or whereas other colors mirror failure. For example figure 3.2 shows how the people in bright colors are evaluated from the background visually. Furthermore the picture right next to it shows a green arrow. According to color theory, the green color stands for success and growth and thus represents that again here. In addition, the color is an eye catcher and highlight, because it stands in contrast to the background. This happens due to the fact that green and purple are complimentary colors.

Before the video was animated, the script, i.e. the text, was created. Accordingly, the animations should support the text and symbolize or visualize the spoken information. Most of the time, animation shown in the video were used for a representational or interpretation function in order to provide a representation or a analogue graphic of the text. Figure 3.4 for example represents a person in the United States going to a polling station. However one frame has also an organisational function, as the network diagram of all the companies included in "Martech" is shown in Figure 3.5.

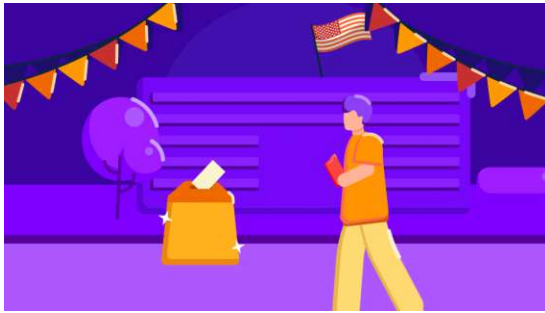


Figure 3.4: Representational Function



Figure 3.5: Organisational Function

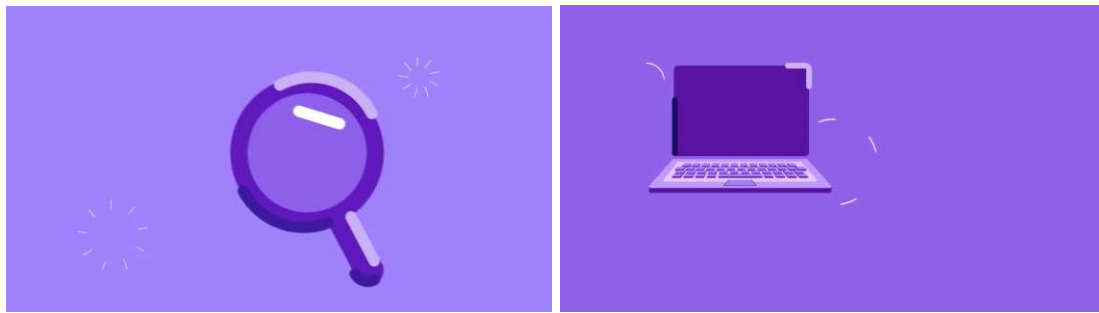
In some frames, text was used to set an linguistic anchor and highlight certain phrases. Since two questions in the survey are exactly about a topic discussed in a sequence with such an anchor, it could be possible to measure if the linguistic anchor is of help. In the first question the participants were asked what the name of the data tracking industry is, which is shown in figure 3.4 and called "MarTech". The second question is about negative examples of the surveillance capitalism. Two immoral categories were once offered to advertise for them on Facebook and are shown in figure 3.6.



Figure 3.6: Linguistic Anchor

In the video we used the decoration function of pictures only on big areas which were empty always regarding the coherence principle. Circles to focus the viewer's attention were animated as seen in figure 3.7.

Overall the video takes exactly 3:12 minutes to watch and is from all three videos the



(a) Two circles with a burst animation.

(b) Two circles with a rotate animation.

Figure 3.7: Decorating elements in the animation video.

shortest. Despite the short length, the same content was transported, however it is more briefly told and with less examples. The text and the content itself all originates from Prof. Purgathofer, as he had already spent several years researching this topic and therefore designed the content to fit the rest of the lessons in the course "Denkweisen der Informatik" at the TU Wien. Rather quickly and soon in the development process the final text, which will be spoken in the animation video, was agreed upon. For the full story, a storyboard seen in figure 3.8 was created, which on the one hand should be the basis for the animation, but also allows changes already at this point and incorporate feedback faster as well as easier. Most of the scenes in the storyboard were exactly like the original scenes and fit very well to the text. However some scenes were slightly adjusted in the animation in order to understand and fit the text spoken in the video. Regarding the storyboard in figure 3.8 the cyan colored font explains the animations to the images and changes in the graphics through movement. For example, another scene was added to better understand the problems caused by negative incidents in Surveillance Capitalism. However some movements or animations were added later. Especially small things, like the movement of the trees in the wind etc. was not labeled extra. In total, this storyboard is three A4 pages with nine images each.

Afterwards the text was professionally spoken by Michael Brandt and at the same time all the graphics were created in Adobe Illustrator. In total, there are 15 individual scenes that were created. The objects are vector graphics and therefore have the advantage that they are scalable. the advantage of these scalable graphics is that the whole video can be rendered in different sizes. In total, the scenes took about 25 hours to complete. Due to previous experiences with animating graphics for videos, the amount of time needed would be higher for someone unfamiliar with this task. At this point, it is important that a scene is sorted correctly at the individual levels and has individual names, since this is crucial for the further work process in other programs. Thus, every hand and every joint of the character had to be labeled, which can be seen in graphic 3.9, so that each part of the body respectively even each part of the image, can be animated later.

As soon as the story was recorded and all the scenes were finished, it was possible to start with the animation. The animation was done in Adobe After Effects. For this purpose,



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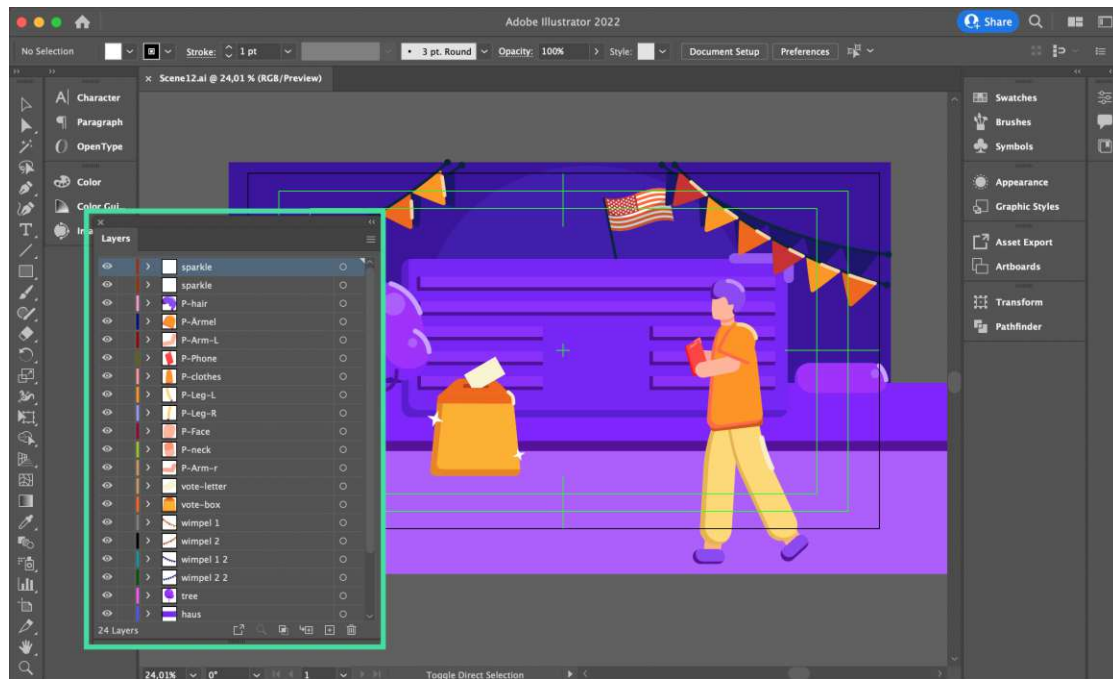
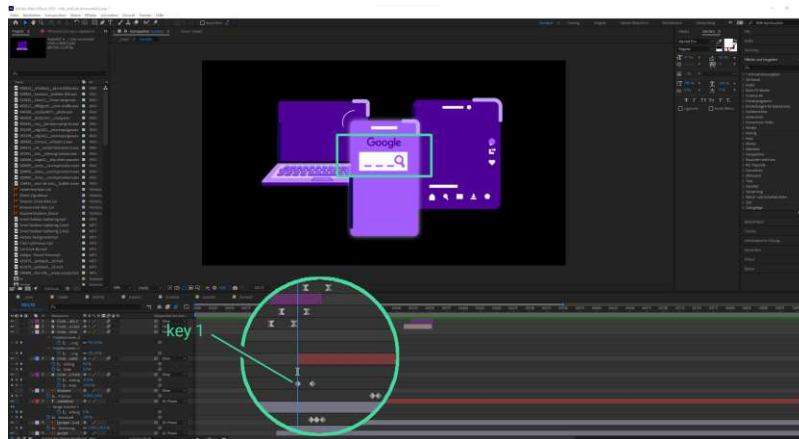


Figure 3.9: Illustrator file with all layers.

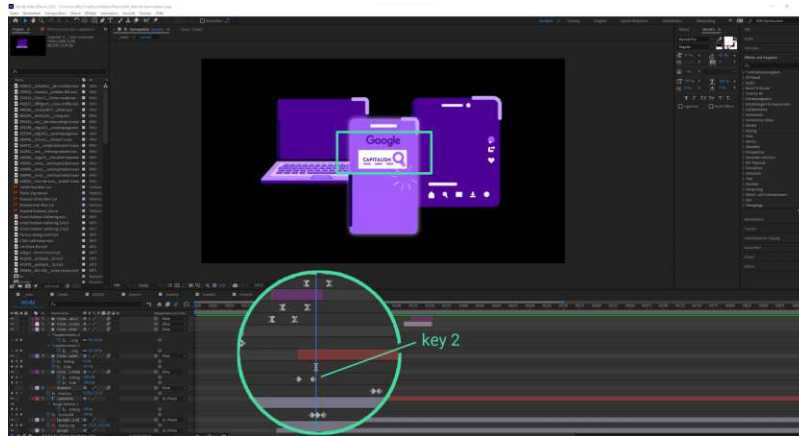
the previously created scenes were imported one by one into the program and motion was added to each scene. For example in the first screen, the title text was animated and the magnifying glass moves over the title. After the first scene was done, a transition to the next scene was created at the same time, the following scene was imported and motion was added again.

Most of the time simple keyframe animation was used, where an object moves, scales or rotates from one point to another over time. Therefore the object is placed on the screen and a so called keyframe, which is kind of an anchor, was set at a specific time. Now the timeline moves forward for a few milliseconds and the object can be moved than again to the end-position. With the help of a computer generated calculation the object can move exactly along the path from the first to the last position in the given time. In figure 3.10 the first image shows the keyframe of the word "capitalism" and the second image shows the next keyframe and the already written word, which is animated in the time between the two keyframes. However also expressions, which remind a bit of programming, were added to give some animated objects a random factor on the one hand or to move objects smoothly over a longer period of time on the other hand. For this purpose, the calculation of the computer is intervened and a previously created movement can be repeated in a loop, for example.

Overall the whole process of animating the video took me about 60 hours. In total, the whole process of creating the video will have taken about 90 to 100 hours. It's also worth mentioning that you need a certain base level of experience with these programs,



(a) First keyframe with empty search field.



(b) Second keyframe with filled search field.

Figure 3.10: Animation happens between keyframe one and two.

otherwise it would take much longer. So this kind of animation is not easy to do without a professional video editor. These are important points that will be discussed more in the chapter 6.

Professor Video

The second video has, as already mentioned, the same topic, however it varies in production, length and style. The whole video is 8:56 minutes long which is mainly due to the fact that the text was freely recorded. The video format is also different as it has a different solution with 2520x1080 pixel. At the beginning of the video, Prof. Purgathofer starts to talk to the viewers fullscreen as seen in figure 3.11a. Afterward the video switches to a set of slides, shown on the left side of the video, the other space is filled with a video of Prof. Purgathofer talking to the audience, seen in figure 3.11b.

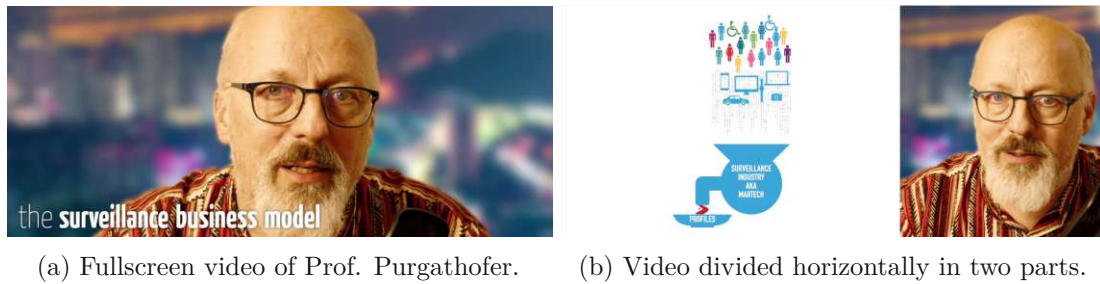


Figure 3.11: The design of the professor video.

Thereby the left part, on which the slides are shown, is larger. This is partly due to the fact that the program with which the slides were created allows this format, but this is also important since more changes are made and graphics are for this reason more visible to the viewers. The audio is supported by the video with the speaker visible at the same time.

Overall the video was produced with the program keynote. For this purpose, the slides were designed normally as you can do for presentations and a video stream was placed as an object on the slides. This makes it possible to include a camera recording as seen in figure 3.12. This video stream was created on all slides and also runs across the slides when presenting.

Furthermore the objects on the slides were animated with Keynote. The tool that was used most often for this is called "magic move" and provided by keynote. For the animation a slide is duplicated and the object that you want to animate is moved. A computer algorithm automatically moves the object from point A on slide 1 to point B on slide 2. This presentation was recorded and saved directly in Keynote itself. For example in graphic 3.13 you can see the first slide on the first image and the added effect called "magic move". While presenting and switching to the next slide the dots move automatically to the position seen in the second subfigure.

This video was not given a storyboard or scripted text. The goal is to make this very similar to commonly used teaching methods. Often in lectures, slides are shown to which a teacher speaks. In this case, this is to be adopted for the online video. The video was thus recorded in one take and the slides were switched to match the content. Important is the good structure of the slides, the little text and the possible animations that were also built in. The slides have also been designed with the aim of providing the audience with useful graphics that perform a representational or interpretation function.

One advantage of the professor video is that its creation is much easier compared to the animation video. Overall, the research took a lot of time, but has to be done for the video independent of the style or animation technique used. As for this video here, the slides for the lecture were already partially available and hardly any effort was needed for that. For adapting the format about an hour, in addition comes an hour of recording and editing, as well as uploading. So in total this video was only an effort of 2-3 hours.

3.3. The Three Explainer Videos

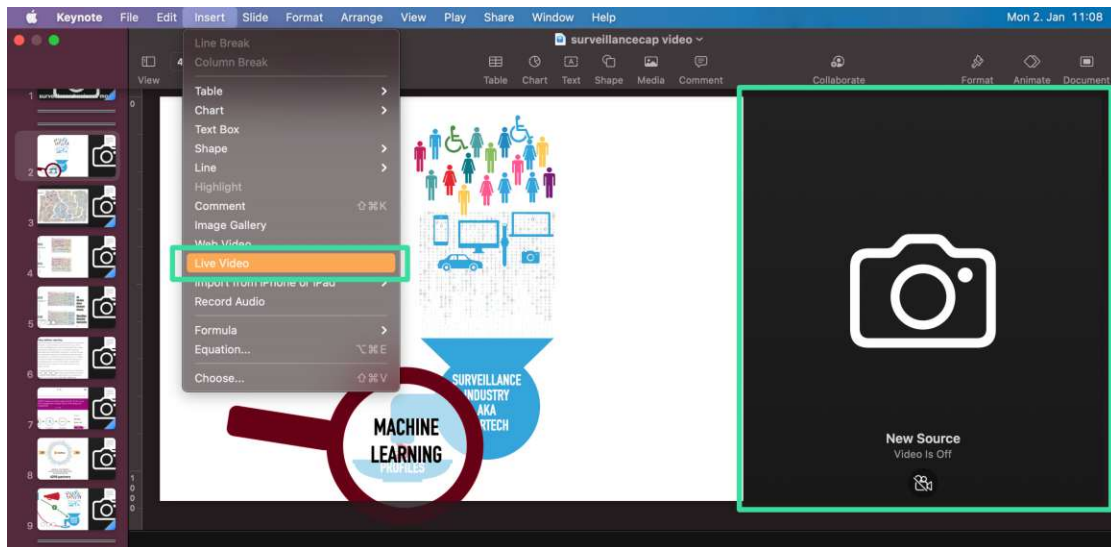
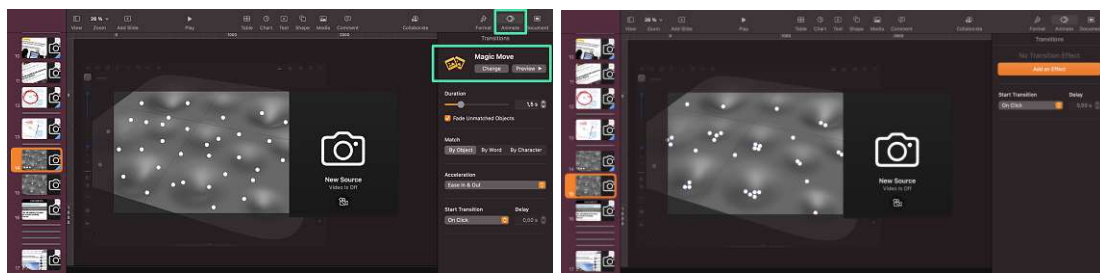


Figure 3.12: How to insert a camera object in keynote.



(a) Slide one with Magic Move animation. (b) Slide two with Magic Move animation.

Figure 3.13: Animation between two slides.

However, a noticeable difference is the large variation in video length between this video and the animation video. Therefore the subjective opinion on the timing of the video will be questioned in the post-video survey. Depending on the survey results, the duration can therefore turn out as an advantage as well as an disadvantage, since it could take too long for the students.

Slides-only Video

The "slides-only video" is very close to the previously discussed "professor video". However, in this video no professor is shown next to the slides as seen in figure 3.14. Therefore "professor video" was recorded first and for this video the side with the teacher was cut away.

The goal of this comparison is to find out if the lack of a person shifts the viewers attention and therefore reduces the learning outcome. Since no person is shown, the video

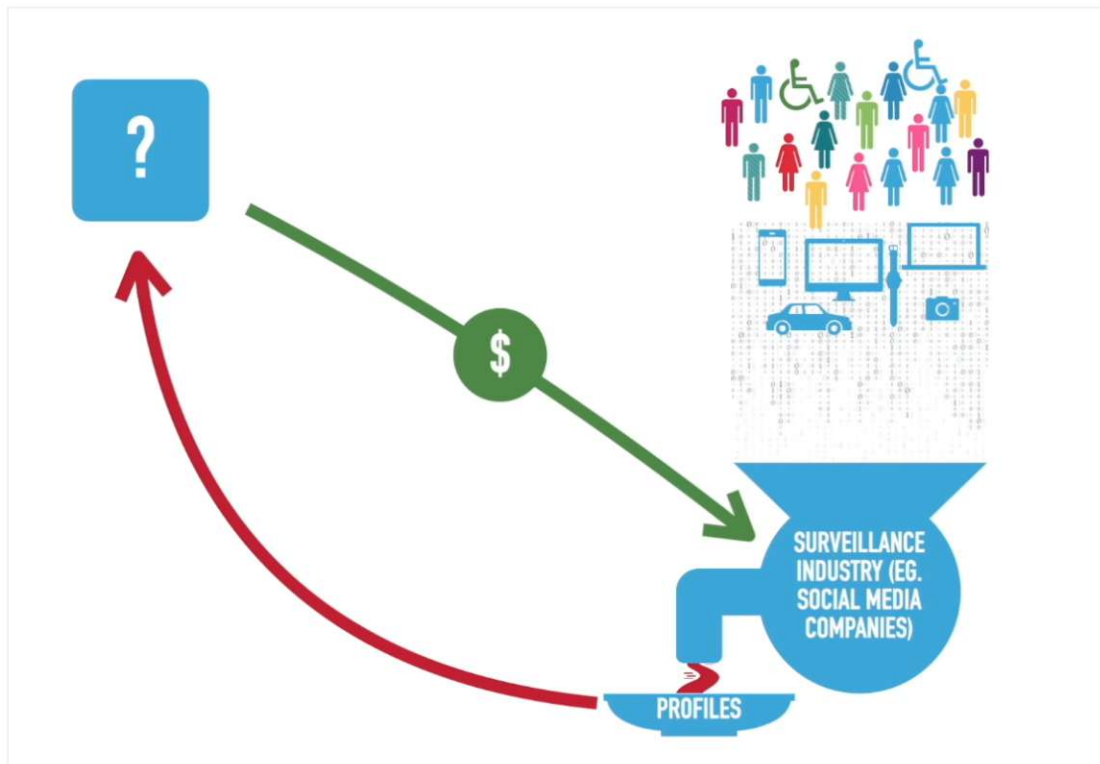


Figure 3.14: Screenshot of a slide in the slides-only video.

can quickly appear as monotonic to viewers and thus also inhibit the learning process. On the other hand, the focus will be only on the slides and not on the teacher speaking. Since a shown speaker does not transport necessary information, we furthermore want to find out if the speaker, as seen in the "professor video" falls into the principle of coherence, i.e. that unnecessary information should not be shown. With the help of this video, we are able to find out which of the possibilities will occur.

This video, just like the previous one, has a duration of 8:56 minutes. This is because the same audio was used, and changes were only made to the visual content. Due to the omission of the second panel, showing professor Purgathofer, the aspect ratio changes to 4:3 in this video.

CHAPTER 4

Results

On the one hand, we tested the students on how well they could remember the content of the videos over a longer period of time. Thus, we will show how this played out. On the other hand, the videos were also compared with each other to show which of the videos performed better. Finally, there are also the results for the evaluation and personal assessment of the students to the videos, as well as the change in behaviour after seeing the video.

Overall the course had 689 participants and a total of 197 people registered for the surveys, of whom all were sent an E-Mail with a link to the survey. Not all of the 197 took part in the survey and further numbers of participants will be mentioned down below at each survey. However we reduced the samples size to 101 submissions, since we only took those who answered all three surveys completely. Moreover the participants were divided between the three different videos and are listed here:

- Animation Video: 29 Participants
- Professor Video: 42 Participants
- Slides-only Video: 30 Participants

The results of the videos are then discussed and separated into initial survey, post video survey and the results of the long-term survey, highlighting the most important findings. Moreover they they will be compared to each other to see how the students' answers have changed over time. More specifically, we look at the long-term knowledge depending on the videos, the students' personal opinion of the videos, and how their behavior has changed as a result of the videos. Furthermore it is important to mention that all questions are written in English in this thesis, however the survey was in German.

4.1 Information regarding each Survey

This section will deal with the three surveys and give an overview about the participants as well as mention specific questions of the surveys. Moreover it is important to mention that it was also noticeable, through the answers of the participants of the animation video, that some students were not fluent in German and therefore some responses were partly inadequately and the content was probably not always understood. This affected especially two participants in the animation video.

4.1.1 Initial Survey

Overall, 130 participants have done the initial survey. 42 students have participated in the survey with the link to the animation video. For the professor video 45 participants have completed the survey. For the slides-only video we had 43 participants.

At the beginning, students were asked if they have heard the term "Surveillance Capitalism" before and most of them did not know it. Specifically because of the "pre-training principle", this was significant and thus largely precludes subsequent surveys from being greatly influenced by it. Overall the group of the animation video performed worst and the group of the professor video performed best which again could lead to the mentioned principle and helps for better results at the long-term survey, however this was not the case.

In general, a large increase in correct answers was observed at all groups between the initial survey and the post video survey. The results of the initial survey for all three videos can be found in table 4.1.

	Animation Video	Professor Video	Slides-only Video
Have you ever heard the term "Surveillance Capitalism"?	10,34%	9,52%	3,33%
What might be meant by "surveillance capitalism"?	58,62%	47,62%	60%
What happens after your data is stored by cookies?	58,62%	50%	66,67%
Give an example of a negative incident in the past of "Surveillance Capitalism":	10,34%	21,43%	6,67%
What do you understand under the term "filter bubble"?	58,62%	80,95%	70%
Are "filter bubbles" good for society?	86,21%	90,48%	93,33%
What problems can arise from so-called "filter bubbles"?	55,17%	78,57%	63,33%

Table 4.1: Percentage of correctly answered questions from the initial survey.

4.1.2 Post-Video Survey

The amount of participants decreased to 122 for the post-video survey which, unlike the first survey, consisted of only one questionnaire for everyone. However most of the students who started the survey also finished it, therefore the survey itself was good in length. In general the number of correct answers increased and best answers were given by the group of the animation video. Again the results of the post-video survey can be found in table 4.2. Furthermore the subjective opinion of the students was asked in this survey and will be further discussed in section 4.2.

	Animation Video	Professor Video	Slides-only Video
What might be meant by "surveillance capitalism"?	79,31%	66,67%	66,67%
Tracking data from technical devices is processed by an industry, what is it called?	100%	92,86%	93,33%
List at least 2 companies that this data tracking industry includes:	100%	100%	100%
Where can I actively refuse to share data?	89,66%	97,62%	96,67%
What happens to the data after it has been saved?	89,66%	73,81%	66,67%
Give an example of a negative incident in the past of "Surveillance Capitalism":	93,10%	76,19%	90%
What is the advantage of online campaigns? (in contrast to television or newspaper advertising)	89,66%	92,86%	90%
What do you understand under the term "filter bubble"?	82,76%	92,86%	90%
Are "filter bubbles" good for society?	96,55%	64,29%	90%
What problems can arise from so-called "filter bubbles"?	89,66%	92,86%	83,33%
What is formed by these filters and profiles? (without terms)	79,31%	73,81%	90%

Table 4.2: Percentage of correctly answered questions from the post-video survey.

4.1.3 Long-term Survey

The long-term survey was submitted by 109 students. 119 students just partly answered the questions. At the beginning we had 197 participants and as expected, these became fewer. The long-term survey was very important to test, whether the results remained the same, have worsened or improved.

Students were furthermore asked if they had dealt with the topic on their self after seeing the video. 31% of the participants who had seen the animation video claimed "yes", followed by 23% of the slides-only video. Only 11,9% of the professor video had further dealt with the topic of surveillance capitalism. To ask students if they dealt with the topic was especially interesting regarding the question about filter bubbles and what they understand by it. 83% of the students who have seen the animation video answered this question correct right after the video and even 93% had it right at the long-term survey two weeks later which is very impressive. Since some students did also further deal with this topic we did look up the numbers and compared the false answers in the post-term survey with the answers in long-term survey. We found out that some of the people who answered the last survey correct did spend some time on this topic, which explains the increase in correct answers.

It is also interesting that the animation video and the slides-only video are both the best in terms of long term knowledge, which will be further discussed in the next section. Furthermore all results of the long-term survey are listed in table 4.3.

	Animation Video	Professor Video	Slides-only Video
What might be meant by "surveillance capitalism"?	68,97%	59,52%	76,67%
Tracking data from technical devices is processed by an industry, what is it called?	96,55%	88,10%	90%
List at least 2 companies that this data tracking industry includes:	100%	100%	100%
Where can I actively refuse to share data?	93,10%	90,48%	93,33%
What happens to the data after it has been saved?	89,66%	69,05%	73,33%
Give an example of a negative incident in the past of "Surveillance Capitalism":	65,52%	59,52%	63,33%
What is the advantage of online campaigns? (in contrast to television or newspaper advertising)	96,55%	92,86%	93,33%
What do you understand under the term "filter bubble"?	93,10%	95,24%	90%
Are "filter bubbles" good for society?	89,66%	90,48%	96,67%
What problems can arise from so-called "filter bubbles"?	89,66%	100%	96,67%
What is formed by these filters and profiles? (without terms)	68,97%	71,43%	83,33%

Table 4.3: Percentage of correctly answered questions from the long-term survey.

4.2 Subjective Opinion of the Students

In order to get feedback specifically to the videos, we asked the participants seven general questions about the video. Since personal preferences say a lot about how interested a video is viewed, these were compared with each other. This should further help to discover the preferences of the students. A likert-scale was used for the response options and the participants could choose between the following five options: "totally agree", "agree", "neutral", "disagree", "totally disagree". In figure 4.1 the diagram shows all questions and the average for each video regarding each question. In this case five would be "totally agree" whereas one is "totally disagree". The last question in this figure is about the length of the video and originally they were asked to answer from "too long" to "too short". Therefore we have changed the question in the diagram to fit the scale of 1-5.

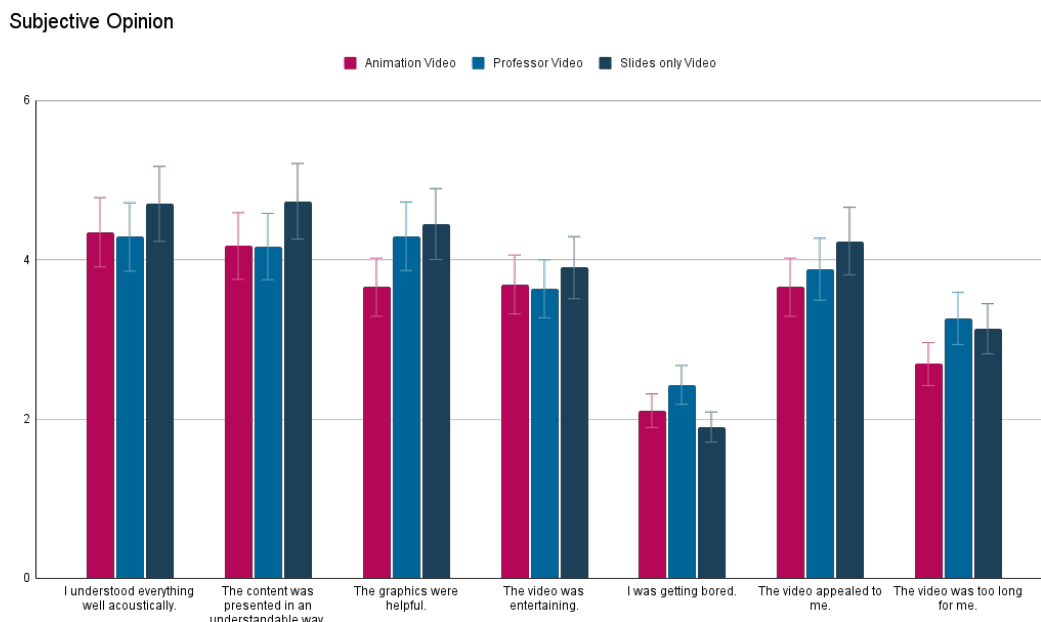


Figure 4.1: Subjective opinion of the students for all three videos.

It is interesting that the professor video and the slides-only video had the same text and the same acoustics, but nevertheless delivered different results. Participants in group three of the slides-only video, scored higher on the acoustics and content preparation question than participants who saw the professor video. On the one hand this could be because of the difference of the groups since the significance regarding the acoustic is not high but on the other hand this could be due to the fact that the head next to the slides was perceived as distracted by the students and less capacity was available for concentrating on content and acoustics. Since especially the second question about the content preparation is rated significantly higher in the slides-only video. The group of

the animation video scored also lower than the slides-only video and this is most likely due to the short and fast narration.

Furthermore the graphics were also similar in the professor video and the slides-only video, only the picture of the teacher changed the view. It is also noticeable that the graphics were rates as more helpful in the slides-only video. This may be due to the coherence principle, since the graphics were perceived better in the slides-only video, as there was no picture of the teacher alongside, which could be perceived as distracting. Moreover another reason for the scoring could be the image principle and that talking head videos do not only score lower regarding the results in knowledge, but do also maybe score lower in subjective rating. The animation video also scored worse here which is significant. This may be due to the fact that graphic elements were used creatively and not purely to explain the content.

Most of the participants did strongly agree that animation video was the most entertaining. We attribute this to the graphics used in a more respect to design. However in total the slides-only video scored best again. This also holds true for the next question, whether participants got bored. The slides-only video also scores best and clearly ahead of the professor video. Perhaps this is because the slides change constantly and the face of the teacher remains the same in the professor video.

The slides-only video scored best in the question if the video appealed to the students and the video of the professor is ahead of the animation video. We attribute this to the fact that both, the professor and the slides-only video, contain a personal component and the students on the one hand recognize the teacher figuratively and on the other hand are also accustomed to the voice from real life and can thus build up a relationship. Another possibility why the slides-only video performs so well is that you have less of a feeling of being watched. There is no face to look at, so there is less commitment and you can concentrate more on listening.

Lastly, the video length was compared. For most of the participants the video length fits, but if you look at it more in detail, the professor and the slides-only video were rated as a bit too long and the animation video as a bit too short. So the ideal video length is most likely right between the videos. The animation video is 3:12 minutes and the others are almost 9 minutes long. For the slides-only video, most participants rated the length as "just right" so an ideal time would be around 6-7 minutes.

In sum, you can see the slides-only video was definitely rated the highest and was the furthest ahead in the preferences of the participants.

4.3 Comparing the Knowledge of the Students

After the subjective evaluations of the videos by the students resulted in a favorite, it is now important to see whether this video also led to the best learning successes. For this purpose, on the one hand we look at which group performed better on which questions directly after the video, but still achieved good results after two weeks. To gain an

general overview we calculated the average percentage of right answers for each survey, which is also shown in figure 4.2. As already mentioned the professor video scored best at the initial survey, however it scored least in the post video and long-term survey. Overall, the slides-only and the animation video both generally achieved very good results. On average, both videos achieved 87% in the long-term survey. This could be due to different principles and reasons mentioned in the following. Also noticeable is, that the animation video had the biggest increase overall. The knowledge of the students who have seen the animation video increased by 35% from the initial to the post-video survey.

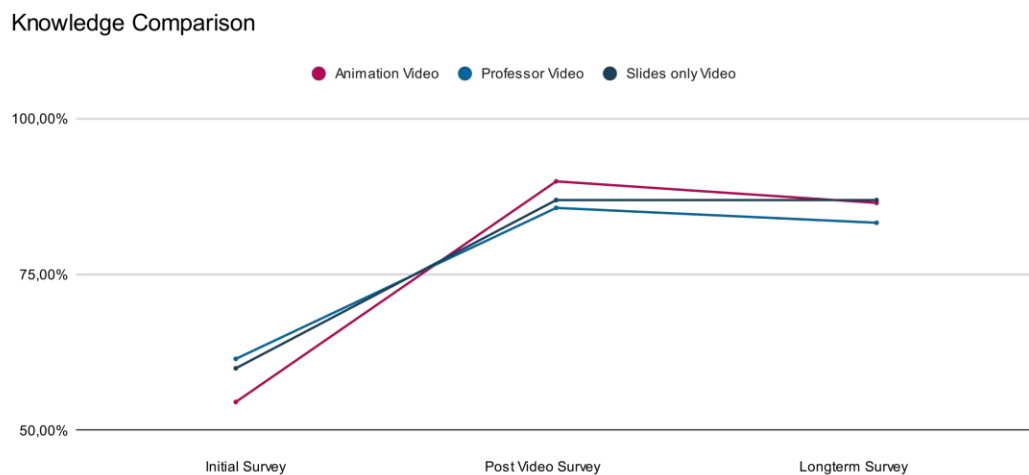


Figure 4.2: Average knowledge of each survey and video.

After looking at the average results of all videos, our goal is to establish a connection between the videos and several principles and to recognize which video performed better in which areas. For this purpose, the results of the respective surveys were compared with each other.

At this point, it should also be mentioned that participants in group one, those who have seen the animation video, have subsequently dealt with the topic the most, according to the results of the long-term survey. There are two theories for this, on the one hand personal interest could have been aroused, on the other hand the video was very short and in order to get more understanding, research was done. But also with this option it shows that students were driven by the first video to read more about the topic of Surveillance Capitalism.

The number of people who have heard of "Surveillance Capitalism" before watching the video is very similar in all three videos. The least have heard of it in the group of the slides-only video. It is exciting to see that the distribution for the question of what is meant by "Surveillance Capitalism" remained about the same across all 3 surveys. Before the video, only a few people knew the answer, after the video a lot of people knew the

answer, and after two weeks the number of respondents decreased a little bit, but it was the same for each video. Whereby the video with only the slides scored best.

Before students had seen the professor video most knew an example of a negative incident in Surveillance Capitalism's past. However, this did not remain the same as the animation video scored better after two weeks. In the animation video, the negative incident concerning the elections in the USA was presented pictorially on the one hand, but another example was also presented with text in the video on the other hand. The categories that could be addressed negatively via Facebook were highlighted with a linguistic anchor. Whereas in both of the other videos the examples were only mentioned in the conversation of the teacher, without any real pictorial background. This may be the reason why more students had remembered the examples of the animation video.

The multiple choice question "Tracking data from technical devices is processed by an industry, what is it called?" was answered best by the group of the animation video. Again, the name "MarTech" was placed as a linguistic anchor in the middle of the picture and led to more students remembering the name. The listing of the two companies included in this industry was answered by 100% of all groups in all surveys. Admittedly, the question was also very simple, since almost every company is included here.

Regarding the knowledge questions about cookies, the professor and the slides-only video achieved the better results in the post-video survey. After two weeks, however, the group of the slides-only video had more correct answers and therefore performed better in terms of long-term knowledge. Moreover the follow-up question about what happens to the data after it is saved was answered best by the group of the animation video.

In the professor video as well as the slides-only video, it has been more talked about Online Campaigns and Advertisement and you can see that in the results right after the video. However, if you take a look at the long-term results, the animation video achieved the better results. This may be because the animation video only addressed the question and so there was more capacity available to remember that answer.

The last topic covered in all three videos was about filter bubbles and opinion pits. The question of what is understood by filter bubbles was answered worst by the group of the animation video. Moreover the second question regarding this topic was also answered better by the group of the slides-only video. We think that this could be due to the reason that the topic is very abstract and mentioning more examples and spending more time on abstract topics leads to better results.

The last question of the post-video and long-term survey was particularly interesting regarding the knowledge gained through each video and was divided into four sub-questions. Two of the sub-questions were purely comprehension questions and two of the sub-questions dealt with terminology. Here it is also important to mention that this was the last question and has a lot to do with the topic of attention span, which is probably the reason of the worse result in general. It can be seen that the slides-only video achieved significantly better results in all sub-questions, although the video length was the same as the professor video. Based on the results of the subjective surveys, we attribute this

to the fact that the slides-only video was perceived less boring and more entertaining, and thus more attention was paid to the video at the end. The animation video came in second after the slides-only video. It is also exciting that the animation video did better than the professor video, even though the professor video covered the topic more intensively. The animation video, however, only dealt with it briefly and thus possibly more attention was paid to the essential and relevant for the test questions.

4.4 Changes in Behaviour of the Students

Especially with the question how students deal with cookie settings we wanted to find out if a change in behaviour is going to happen after the seen video and also in regard to the long-term survey. In fact, it was found that student behavior changed a lot. Thus, the animation video led to the fact that out of 24% of the students who stated in the initial survey that they accept all cookies, only 3% made this choice in the post-video as well as in the long-term survey anymore. The responses of the group that saw the animation video changed the most and the figure 4.3 shows the change between the initial and the long-term survey of this video.

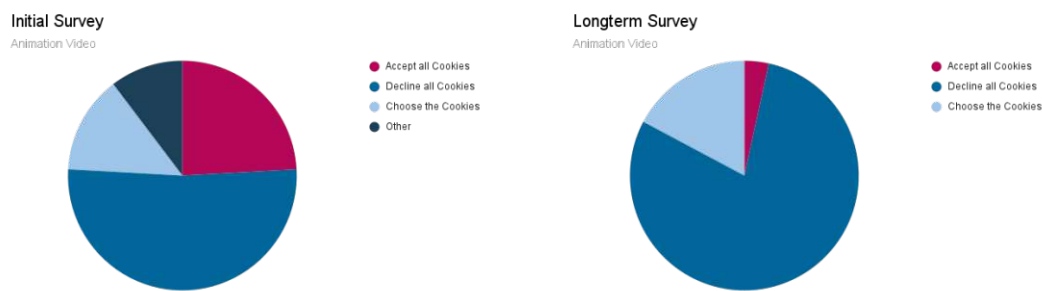


Figure 4.3: Results of the initial and long-term survey regarding the question about cookie settings.

CHAPTER 5

Conclusion

Within this thesis, three different videos were compared with each other. The participating students were divided into several groups and with the help of three surveys at different points, before and after watching the video, the knowledge level of the individual groups could be determined. The best results were achieved by the animation video and the slides-only video. Furthermore the slides-only video scored best at the subjective survey. In order to answer the research question and give a general conclusion, a brief overview of the most important results will now be drawn.

5.1 Answering the Research Questions

The thesis was built on certain research questions formulated at the beginning of this research that provide guidance. We will now discuss these research questions more detailed and provide different ideas that help in designing explainer videos in a more ideal way. This section in particular is intended to help others in designing explainer videos that assist viewers in acquiring knowledge easily and efficiently.

5.1.1 How can an animated explainer video be designed to enable intuitive acquisition of knowledge?

In order to enable intuitive acquisition of knowledge with an explainer video, some ideas and principles have been gathered and are summarized below. A few important points can be highlighted from the last section, such as benefits that resulted from the animation video and impacted the results of the participating group. In general, the animation video is very brief and addresses only the important areas of the overlying theme. Hardly any excerpts are made and the relevant points, which are almost the entire content within a video of short length, were subsequently asked in the surveys. This leads due to the coherence principle, thus surplus omitting, to the fact that less

contents in general was shown and more capacity exists to remember the important parts. Moreover the redundancy principle was also used and most of the time only graphics and voice without any text was shown, with a few exceptions, which then followed a different idea, mentioned next.

The questions that were best answered by the group of the animation video were those that had a linguistic anchor in the video, which is a written text in order to assist spoken content. You can see, for example, that the term "MarTech" was memorised better by the participants. As well as the two examples specifically regarding Facebook for negative incidents of Surveillance Capitalism, which were also reinforced in writing once again in the video. Therefore it helps students during their learning process by highlighting important terms in videos containing written text. This is not only supported by the theory of the linguistic anchor, but also with the signaling principle. This principle was also used in the slides when zooming into the listed amount of companies included in MarTech. Moreover a zoom onto the important part of the screen was used at a certain point in the professor and slides-only video. In general the principles were confirmed to be good guidelines to enhance explainer videos for students and therefore support their intuitive acquisition of knowledge.

The slides-only video was rated the best at being well understandable acoustically, which is an important point to consider for explainer videos. A quality recording of the voice is important for comprehension and a clear voice helps listeners follow the content more easily.

Another thing that caught our attention is the emotional and personal factor which played a huge role in some of our videos. In the professor and slides-only video in particular, an image of the teacher was used on the one hand, but also the known voice of the lecturer on the other hand. According to the personalization principle, if the person is likeable for the participants, this also leads to a better acquisition of knowledge. This is also visible in the feedback from the students, since more people rated the professor and slides-only video more appealing than the animation video.

If a closer look is taken at the subjective surveys and specifically the professor and slides-only video, the latter scored better. We attribute this to the image principle. It states, among other things, that a "talking head" video is less successful than a video that shows graphics. Also, based on the results of the tests, we can see that the slides-only video achieved better results. Hence in this video there was no distraction by the pictorial representation of the speaker and the focus could lie solely on the content material. As mentioned in the results, the reason for the lower rating of the professor video could also be the feeling of being obliged to look, because the course instructor is "watching" you.

The best way therefore is to design explainer videos in a personal way and include the design principles for video creation. Graphics and animation do help the viewers to better comprehend more difficult and complex processes. But even simple concepts can be better remembered through pictorial representations. In the end, the animation video as well as the slides-only video are good examples for explainer videos in order to intuitively

gain knowledge. Intuitive explainer videos bring a lot of advantages since students do not have to research, to prepare or to read papers and can easily improve their knowledge by just watching these video.

5.1.2 How does a specific style influence the long-term memorization of video content?

To answer this research question, we focus on the results of our long-term survey. If the outcome of the three videos is compared, it can be seen that after two weeks the animation video and the slides-only video both performed very well. This is also shown quite accurately in the results of figure 4.2.

Especially the questions about certain terms and their meaning were answered better by the participants of the animation video after two weeks. The questions on the topics of filter bubbles and opinion pits were answered best by the group of the slides-only video. The topic of filter bubbles is more abstract and thus often requires more explanation, which was done better in the slides-only video. Therefore it is shown that abstract topics do need more explanation and examples. Otherwise, if the topic is treated sufficiently and clearly, results also show that an animated video achieves good results even after two weeks. The professor video performed worst in the long-term survey.

Just as in the previous section, we attribute this to the distraction, away from the content and to the speaker. Regarding the video style, we would therefore suggest to use either a slideshow with little animation or a completely animated video for long-term memorization of video content.

5.1.3 What special requirements do TU Wien students have in regards to explainer videos?

Since the subjective opinion of a group of students at the TU Wien was collected, we considered what requirements for videos might specifically affect these people. Therefore, the subjective questions from the post-video survey show, that the participating students preferred the slides-only video.

In this respect, learning videos can be optimized for students of TU Wien by using the voice of the teacher to create a personal reference. Alternative or as an addition, adding a picture of a well-known person can also contribute to the learning effect. However the image should be used wisely, as mentioned before "talking head" videos do not compete as good compared to the other video types. This was also tested with the slides-only video, where the image of the teacher was used in fullscreen at the beginning for just ten seconds as an introduction and was not shown again afterwards.

Furthermore the slides-only video also showed us, that animated slides are a good concept as the graphics were rated as most helpful by our participants. The graphics in the slides-only video were even more helpful and appealing than the ones in the animation

video. Our hypothesis is that students of the TU Vienna put more emphasis on the pure content instead on the visual aesthetics of the video.

5.1.4 What characteristics does the optimal video style have and how can it be applied to studies away from TU Wien?

Already at the beginning the comparison of different ways to design explainer video were discussed with the first research question. The optimal video style should therefore focus on showing only the most relevant things. Abstract topics should be treated more extensively and should be supported with short textual phrases that are shown in the video. In general, there is the possibility to emphasize important things which should also be used as it helps students to focus better. The optimal video style should create a personal connection and also the linguistic criterias should be implemented. Therefore the speaker of a video should speak clearly, understandable and include emotions. We also advise against a computer generated voice for this reason.

5.2 Change in Behaviour

In addition to the answered research questions, it could be seen that in all three videos the students stated that they changed their behaviour for accepting cookies after watching one of the three videos. We were able to check this using the cookie settings implemented in every website. Students were asked about their behavior before the video and how they would like to behave in the future after the video. In the long-term survey two weeks, the participants were asked again how they were currently doing. It was very clear that all three videos led to a change in the students' behavior in this regard.

5.3 Overall Conclusion

Altogether, it turns out that a completely professionally animated video is not needed in order to get good results. Students react better to a more personal video which can include the voice or the view of a teacher. This can be taken into account not just at the TU Wien, but also in other learning areas. Furthermore, it is essential to have a clear recording of the voice, which leads everything being well understood. With the help of software such as Keynote or PowerPoint, simple animations can be created quickly and lead to excellent results. Comparing the effort for creating the videos it is obvious that handcrafted animations requires a magnitude more effort. Attention should also be paid to stylistic features and graphics should therefore be easily understandable in order to help students. It turned out that the same view, such as the picture of a lecturer should be avoided to be shown for an extended period of time. Furthermore slides should not be overcrowded and images should be used helpfully as done in the slides-only video. Linguistic anchors that are used in a minimalist and targeted manner are advantageous, not only for TU Wien but also for other areas of learning.

Discussion and Future Work

It is interesting that so many studies mention how unpopular online learning and digital learning is [10] and yet it is steadily increasing [32]. E-Learning has a lot of potential, however it is essential to make online learning more accessible in order to subsequently gain more popularity. This thesis is intended to contribute to a better preparation of video content. However in general it should be continued to work on making online learning as pleasant and promising as possible.

6.1 Evaluation of the Methodology

Overall the methodology worked well for this research and was very effective. The result was probably not expected by many and shows an exciting outcome. As an additional question, it would have been good to hear from students what they liked and disliked about the videos. It was still possible for us to figure out what worked well for them, which length a short explainer video should ideally have and what leads to a great learning outcome. In order to achieve a truly accurate result, we decided to evaluate only the surveys of the participants who took part in all three questionnaires. This meant that we had fewer participants overall, but it also had the advantage that the same people were checked across 3 questionnaires and we were therefore able to see where the strengths and weaknesses lay.

However, the indication of which video the students had seen was problematic. For about 30% of the participants, the information from the second survey and from the third survey was not identical and additionally did not match what we knew from the initial survey. This resulted in us having to email 34 participants again to find out which video they had actually seen. Asking for the matriculation number therefore had a huge benefit for the accuracy of the study and not just to give students extra points (which served as an incentive for the survey). In the future, we would definitely recommend to include a possibility to contact the participants and a denominator that refers to all 3 surveys.

This way we could change afterwards which video the students have seen and guarantee the correctness of the survey. Furthermore, it would be important to add a picture right at the beginning, so that they can immediately recognize which video the participants have seen. We added the pictures to the long-term survey and used textual designation before and with the pictures. In our case, the first video was called "animation video", the professor video was called "slides with professor" and the slides-only video was called "slides without professor". However, these were not ideal because in the slides-only video the professor was seen at the beginning. And although we added the pictures of each video to the question later, there were some incorrect answers from the students. However, the argument against adding a link is that the students can then watch the video again and thus the results would be falsified. Another possibility, however, would be to make the query which video the students have seen only completely at the end of the surveys and attach a link to the respective videos. Otherwise, you could also add several images to the videos and hope that the students then tick the right one. Overall, this was a hindrance in the polls that can be designed differently in the future.

6.1.1 Design of the Videos and Surveys

Another point we would change in the future is the length either of the professor or the slides-only video. In this study, both videos have the same length, giving us less variation. Another video with a different time frame would allow us to filter even better which video length is ideal, although this has already worked very well with the two existing different lengths. We stated that the ideal time would probably be between 6-7 minutes, therefore it would be very interesting if videos in this time frame perform different regarding the knowledge test but also regarding the subjective rating of the students. If you look at this from another point of view, the opposite would also be interesting for future research. To compare three videos with exactly the same length could have the advantage to exclude the factor time and to focus more on the content of the videos.

Moreover the subjective rating, voice and comprehension was good in the slides-only video. However it would have also been interesting to differentiate between the videos regarding the acoustics and to test the gained knowledge therefore. In our results we write that "a quality recording of the voice is important for comprehension and a clear voice helps listeners to follow the content more easily." Testing this with knowledge tests especially for such explainer videos would be another very interesting possibility.

Furthermore, we exclude the possibility that a computer voice achieves good results based on found resources and principles. This would have been another design option for one of the videos and for testing with the surveys. Future work could also contribute on developing AIs which read written text in the voice of a teacher.

6.1.2 Participants

Since it would have been interesting, which of the three videos would be rated best, it would also be interesting in having another group which would be able to see all three

results. However this would influence the learning outcome completely and therefore only be relevant regarding the subjective rating.

Despite that, we also noticed that our group of participants were only students of the TU Wien. In order to go into more detail about the research question, how the video style differs for TU Wien students, it would be interesting to study not just a group of TU students but also students from other universities. This would allow a comparison group and give even better results.

6.2 Evaluation of the Results

Since the animation video and slides-only video had very similar results it is hard to declare an overall winner. However, this also led us to look more closely at what gave good results in the animation video and what did better in the slides-only video. Also in some points, the results of the professor video were not as good, which on the one hand may be due to the video itself, but on the other hand may also be due to the group of participants. Since the result is somehow dependent on the group of students, it would be interesting to do a part of the research again as a study with other participants and groups and with consideration of the insights obtained.

6.3 Time and Costs

Regarding the time factor, creating a video with the help of a presentation program with subsequent recording is much more efficient than creating an animation video with your own animations. Of course, graphics have to be well chosen and assembled. Also they have to be animated to achieve a good result, but this is less effort than creating these graphics with a vector program and animating frame by frame. This also leads to lower costs since no one has to be hired externally. However, such an animated video also gives the possibility to outsource the capacity if necessary and can still be an option for many online studies or courses, if no internal capacity is available. If this is the case, it would still be important to work together with the chosen company in order to apply the personalization principle, to improve the results regarding the learning outcome of students with the explainer video.

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