

How to create Educational Videos:

From watching passively to learning actively

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Abstract

This paper describes the design principles that have to be in mind, if videos for educational purposes are produced. Additionally, didactical interactions are presented that allow every teacher in school and higher education the transformation of existing videos into educational videos. The theoretical basis for the design principles are Mayer's Cognitive Theory of Multimedia Learning (CTML) and research on Massive Open Online Courses (MOOC's). Didactical interactions, like students' control, guiding questions, action-oriented tasks and the possibility of social exchange are based on the principle of active learning and can be put into practice with the user-friendly and open source web tool H5P. Video in education should always be part of a well thought didactical concept and/or used in the context of media and method diversity.

So gelingen Lernvideos:

Vom passiven Konsumieren zum aktiven Lernen

Zusammenfassung

Dieser Beitrag beschreibt die Designprinzipien, die zu beachten sind, wenn Videos für Bildungszwecke produziert werden. Zusätzlich werden didaktische Interaktionen vorgestellt, die es jedem Lehrer in Schule und Hochschule ermöglichen, bestehende Videos in Lehrvideos umzuwandeln. Die theoretischen Grundlagen für die Gestaltungsprinzipien sind Mayers Kognitive Theorie des Multimedialen Lernens (CTML) und die Forschung zu Offenen Massen-Online-Kursen (MOOCs). Didaktische Interaktionen, wie Schülerkontrolle, Leitfragen, handlungsorientierte Aufgaben und die Möglichkeit zum sozialen Austausch basieren auf dem Prinzip des aktiven Lernens und können mit dem benutzerfreundlichen und Open-Source-Web-Tool H5P umgesetzt werden. Video in der Bildung sollte immer Teil eines durchdachten didaktischen Konzepts sein und/oder im Rahmen der Medien- und Methodenvielfalt eingesetzt werden.

Keywords:

Educational Video
Educational Technology
Didactical Interactions

Schlüsselwörter:

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1 Introduction

The use of video as a learning medium has a long tradition in education, but its availability has radically changed during the last years. Videocassettes or DVDs are relics of the past. Today, documentaries, film scenes, and explanatory videos can be found on online platforms like YouTube, Vimeo and many others. Also the style of the videos has been dramatically modified, because of new technological possibilities that allow you to record your screen and voice while working with software or to use 3D figures and models to tell a story. What sounds like a lot of effort at first, is nowadays feasible for every educator with the appropriate software. Online, the videos are accessible all the time and on every mobile device, which makes learning with videos possible outside the classroom. Recent media studies show that access to the Internet is growing continuously and that mobile

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devices are playing an increasingly important role to enter the world-wide-web (European Union, 2017). For students, YouTube is the most important platform on the web. Beside the consumption of the offered entertainment clips (e.g. Music, Comedy, Gaming Tutorials,...), YouTube is also used as a tutoring platform (Medienpädagogischer Forschungsverbund Südwest (mpfs), 2017). Especially for mathematical homework problems, kids and teenagers have reported that they look for tutorials to be able to continue with the tasks. The reported development allows teachers in school and higher education to implement new forms of teaching and learning with videos. A concept that currently attracts a lot of attention is the Flipped or Inverted Classroom Model (Bergmann & Sams, 2012; Handke, 2014; Lage, Platt, & Treglia, 2000). In this didactical approach, technology is used to prepare the students at home. Most implementations use videos for this phase (de los Arcos, 2014; O'Flaherty & Phillips, 2015). In the classroom the educators then answer open questions and offer cooperative and problem-oriented tasks. In this concept the teachers act like "guides on the side" instead of "sages on the stage" (King, 1993). Reported benefits of the Flipped or Inverted Classroom are more time for interactive in-class activities, which was also rated positively by students, and the availability to the instructional materials regardless of place and time (Bishop & Verleger, 2013).

A second approach is blended learning, which combines face-to-face lectures with online learning. Especially in higher education this concept is not just a trend, but an effective and low-risk strategy to handle forthcoming challenges like organizing studies, digital transformation and more competitors in the field of education. The main benefits of blended learning scenarios can be the facilitation of creativity as well as critical and complex thinking (Garrison & Kanuka, 2004). This approach can be realized with various forms of multimedia, but video also plays an ever-increasing role. Evidence for this can be found in the literature about Massive Open Online Courses (MOOC's). This "online only" courses are offered by universities around the globe and use instructional videos to deliver content for a mass audience (Hansch, Hillers, McConachie, Newman, & Schmidt, 2015). The most important MOOC platform is edX, where Harvard University, MIT, Berkeley and lots of others share their produced materials with students all over the world. The courses are open source and also the videos are shared on YouTube. So as an educator you can use these videos for your blended learning scenario or for a Flipped Classroom. The same goes for the Austrian MOOC designer iMooX and the German platform OnCampus, which both provide their materials free and under a CC-BY license on YouTube. In addition to the presented didactical approaches, videos can of course be used in a traditional classroom. Instead of just watching the videos sitting down, the video content can be offered through QR-codes or Augmented Reality markers. The students then walk around in the classroom and use their smartphones to reveal the videos behind the printed pictures and codes (Buchner & Zumbach, 2018).

A lot of videos are already online and wait for their implementation in the classroom. But not all online videos are educational videos and sometimes no video for a specific subject can be found. I suggest two solutions for teachers in school and higher education how to handle this issue: First, produce your own educational videos based on the design principles presented in the next section. Second, to transform existing videos into educational videos with didactical interactions. How this can be done and which tools can be used will be described in section three. Section four summarizes the findings and discusses further research.

2 Design Principles for Educational Videos

As for every educational material, the aim has to be defined to begin with. For example, a history teacher would like to teach their pupils how a picture from the past can be analyzed. In the video the teacher will speak about the criteria for historical source analysis and show every step of it providing an example. Another objective could be to challenge the students with a particular situation (e.g. a conflict); afterwards they suggest solutions for the observed situation. Next step is the preparation phase, in which a storyboard has to be written. The more detailed and accurate the storyboard, the shorter the production time will be. The third step is the production with the following design principles in mind:

2.1 Combine visualizations with spoken text

To maximize student learning from video, Cognitive Load Theory and Cognitive Theory of Multimedia Learning must be taken into consideration (Brame, 2016). Cognitive Load Theory (CLT) differentiates between intrinsic, germane and extraneous cognitive load. Educational material should not increase the extraneous cognitive load, because this could lead to a cognitive overload and hinder the learning effect (Paas & Sweller, 2014; Zumbach, 2010). To prevent a cognitive overload and optimize germane cognitive load, the findings of the Cognitive Theory

of Multimedia Learning (CTML) can help (Mayer, 2002, 2014a). The most important result for teaching and learning with video is that learning with a combination of text and picture is more effective than learning with just a text (Butcher, 2014) and that picture with spoken text is better than picture, written and spoken text as well as just picture and text (Ayres & Sweller, 2014; Low & Sweller, 2014). So for the production of educational videos, pictures in combination with spoken language but without too much text should be used.

2.2 Use highlighting elements

To keep the attention during watching, the use of signaling (or cueing) is recommended (Brame, 2015). This principle can be realized with arrows that point on a specific place on the screen or with colors, which highlight for example that part of the picture that is being explained. In spoken text, signaling can also be achieved through intonation or subtitles (van Gog, 2014).

2.3 Avoid distractions

The purpose of an educational video is to support the learning process. For that, no “Hollywood-style” elements are needed. Keep the video as simple as possible. Brame (2016) calls this weeding which is the elimination of information that does not contribute to the learning goal. For example, music, background noise and extra features that can divert attention from the instructional content are elements that should be avoided. Also, unnecessary additional or redundant information should not show up in an educational video or any other educational medium (Kalyuga & Sweller, 2014). Here, also the use of persons or the so-called talking head (=when the speaker is visible in the video with face and shoulders) have to be discussed. Referring to the authors above and the findings of Mayer (2014b), persons or a talking head must not be part of an educational video, except the speaker has a relevant role for the learning process (e.g. an interview with an expert). The use of the talking head, which is a video clip showing the speaker until his or her shoulders, in combination with slides (e.g. PowerPoint) tends to have quite a positive effect on student engagement (Guo, Kim, & Rubin, 2014). Contrary, Hansch et al. (2015) point out that the talking head can be perceived as monotonous, but has the potential to build an emotional connection between the viewer and the lecturer. And as research has shown, emotions are a good way to promote successful learning (De Bruyckere, Kirschner, & Hulshof, 2015, p. 87; Gläser-Zikuda, Fuß, Laukenmann, Metz, & Randler, 2005). More research has to be done in this field to be able to make serious statements. Until then, teachers should decide on their own if they want to be visible in self-made videos or not. My recommendation, based on practical experiences, is to welcome the learners with a picture, provide them with an overview of the upcoming topic and then disappear. Before the end of the video the picture of the speaker shows up again with thanks for watching and ending on a goodbye note.

2.4 Keep it short!

The length of an educational video is an important factor to keep students watching until the end. Guo et al. (2014) analyzed student engagement in four edX MOOC's. They found that the optimal length for videos is six minutes or shorter. The highest engagement was found for videos with a length of three minutes, which coincides with other authors who found that two to five minutes of video length were preferred (Gruber & Buchner, 2017; Thomson, Bridgstock, & Willems, 2014).

2.5 Provide structure

To allow students a successful organization of the presented pictures and words in their working memory, time is needed. Especially when the information is rich and fast presented, short chunks can help to prevent a cognitive overload (Mayer & Moreno, 2003). In various experiments Mayer and Chandler (2001) found that a multimedia presentation, which is broken down into smaller parts is more effective compared to a non-segmented presentation. Important is here that the learners have control over the parts and click forward if they are ready with their understanding. Brame (2016) complements that the principle of segmenting (Mayer & Moreno, 2003) can be realized with regard to the video length explored by Guo et al. (2014) and interactive elements that give learners' control over the content in a video presentation (Ibrahim, Antonenko, Greenwood, & Wheeler, 2012; Zhang, Zhou, Briggs, & Nunamaker, 2006). In practice use numbers, titles or other forms of enumerations.

2.6 Tell and show a story

Inventing a story for content can have a huge impact on the learning process. The Cognition and Technology Group at Vanderbilt (1992) invented a character called “Jasper Woodburry” to motivate students during the process of mathematical problem solving. Learners can identify with such a character and are willing to help him. Computer games use the same principle to keep the player playing (Gee, 2003). A story lives from emotions; so for educational videos, capture attention with the unexpected, create suspense and surprising moments. Use authentic problems and combine them with relevant visualizations (Koumi, 2006; Thomson et al., 2014).

2.7 Speak to YOUR audience

People learn more deeply when social cues are used in a video. Here, language has an important role to activate and engage the viewers. According to the Personalization Principle, a conversational style of language is better than the use of a formal language. To put this into practice, use “you” and “I” rather than the third person and speak directly to the learners, for example “I’m sure you’ve already experienced that” (Mayer, 2014c). Also show the learners that this special video is for them and for their personal development. Enthusiastic speaking can also motivate the learners (Brame, 2016).

2.8 Expand the learning space

Video has the power to take your students on a journey to every place of interest. Virtual field trips through video content can bring your students close to lions in the African desert, into the European Parliament to follow a political discussion or even on a trip onto the moon can become reality (Koumi, 2006). Here, it is often criticized that educational technology would like to abolish school trips. If a trip in reality is possible, of course, this is to be preferred. It is important in this discussion to point out that there is not an “either or”, but only a connecting and complementary AND of digital/virtual and analog/real learning experiences (Tampio, 2018). For the learning of psychomotor skills, micro and macro views as well as slow motion scenes can be used. Just think about the football shooting technique of Neymar or the incredible step length of Usain Bolt. History education videos can bring the past to life and support the imagination of the students. The same applies for demonstrations of experiments in physics or chemistry, which would not be possible in everyday school life (Hansch et al., 2015).

The presented design principles can be used for all different styles of educational videos. Choriantopoulos (2018) provide taxonomy of instructional videos with pros and cons to help educators by deciding with type would fit best. For the beginning I recommend the easiest form of video type, which is a classical screencast. Here, the screen of your laptop or tablet is recorded together with the spoken text. Use an existing presentation that follows the guidelines above and record it. It must be noted that also this form of educational video takes time in production. Additionally technology skills are needed, which are still not an integrate part of teacher education or university didactic courses. Universities often install a center for teaching and learning or for content production. Then the production of educational videos is done together with the experts of these centers. In schools, such centers do not exist, so whether a video is produced or not is entirely up to the teacher. The use of materials from the Internet must be considered too. Only non-copyrighted materials may be used in the videos if they are to be published. Another way in school is to have students make the videos. With the didactical approach learning by designing children and teens can train skills in media literacy as well as subject specialized knowledge, soft skills like teamwork, cooperation, communication skills and are allowed to work creatively (Kolodner et al., 2003).

As it turns out, there are obstacles if you want to create meaningful educational videos yourself. In order to counteract this and still allow the use of educational videos, the next section will introduce didactical interactions that can transform any video into an educational video.

3 Didactical Interactions within Videos

The basis for the following recommendations is the widespread concept of active learning. Active learning sums up different learning strategies, which see students’ activities as the center of the learning process. In practice such strategies are experiential learning, learning by doing, participatory learning and forms of student-directed learning (e.g. self-regulated learning experiences) as well as role-playing, laboratory work and the use of case

studies (for an overview see Carr, Palmer, & Hagel, 2015). With active learning in mind it is important that students also must be active during watching a video. Brame (2016) recommends interactions to realize this claim as well as Mayer (2014b). Interactions are activities that try to support the learning process. Classic interactions are navigation options such as pausing, forwarding and rewinding, which are available on almost all video players in the Internet. These interactions can be separated from didactical interactions that are implemented by educators and allow learners to engage in a proactive way with the presented content. Viewers then can modify the video and get feedback related to their actions (Metzger & Schulmeister, 2004). Several studies have shown that interactive video is associated with better learning outcomes, for knowledge as well as task-performance and higher attention while watching (Lawson, Bodle, Houlette, & Haubner, 2006; Lawson, Bodle, & McDonough, 2007; Merkt & Schwan, 2014; Merkt, Weigand, Heier, & Schwan, 2011; Schwan & Riemp, 2004; Szpunar, Khan, & Schacter, 2013). Mayer (2014b) notes that it is important to use behavioristic and cognitive activations.

As mentioned before, with the right software almost every video can be transformed into an educational video. I recommend the free and open source software H5P (<https://h5p.org>) that allows teachers to integrate interactions to already existing YouTube videos. The software is user friendly, based online and with a plugin it can be used within learning management systems (LMS, e.g. Moodle) too. How to use the software from the technical side would go beyond the scope of this article. But I have collected instructions for H5P for you; with the link <https://t1p.de/h5panleitung> you find videos in German, with the link <https://t1p.de/h5pinstruction> in English. All of the following recommendations can be realized with this software.

3.1 Give learners control

For a long time the advantage of written learning materials over audio-visual ones was the possibility to turn back to a needed page or to go further to a more interesting chapter. Now, almost all video players on the Internet allow the users exactly this. On YouTube even the playback speed can be set, which is especially for videos without sound, e.g. tutorials or instructions, very helpful. A didactical interaction in sense of control is the organization of a video into chapters. Learners then can click on the appropriate topic and move directly to this part of the video. This control option tends to contribute to higher learning outcomes and greater satisfaction (Zhang et al., 2006). With the tool H5P this can be realized with two interactive elements. First, the set of bookmarks at the beginning of every video is possible. Learners then see in an overview what content await them and if it fits the given learning objectives, they can navigate to a specific chapter. Second, with the element *crossroad* you can allow choices for your students regarding to their interests at a given time. According to the Self-Determination Theory of Motivation choice can foster the feeling of autonomy, which can then promote intrinsic motivation (Deci & Ryan, 2000; Ryan & Deci, 2000). In practice ask at the beginning of the video “What do you want to start with?” and then present three to five topics the learners can choose from. The element *crossroad* and bookmarks allow teachers the usage of videos longer than six minutes too, because the video can be subdivided into shorter units. As mentioned before segmenting is a design criteria for educational videos. Control is an easy way to motivate and activate students while watching videos. Too much control can hinder the learning process and could probably lead to a cognitive overload (Paas & Sweller, 2014), so a balance between self-control and teacher’s task is recommended (Hill, Wiley, Miller Nelson, & Han, 2003; Karich, Burns, & Maki, 2014).

3.2 Use guiding questions and action-oriented tasks

The main problem of video in education is that students experience it as an easy medium. This leads to passive consumption and a lack of commitment (Salomon, 1984). Probably you have experienced this fact yourself when a teacher started a film and the order was to note the most important information. Especially when the content is totally new to learners, this lack of guidance hinders learning. Lawson et al. (2007) compared groups of learners while watching an educational video with four different conditions. The control group just watched the video, the second group took free notes and groups three and four read guiding questions. Additionally group three was not allowed to answer the guiding questions while watching the video, but group four. The group who answered the guiding questions achieved the highest score in a quiz that was offered to the participants immediately after the learning process. Interesting result here is that the score for quiz questions unrelated to the guiding questions is similar for all groups. So the anxiety that guiding questions can lead to limited attention can be discarded, rather they might help to identify key concepts within the video and support an active engagement with the presented content. The action of writing down notes and answers related to the questions

is strongly recommended (Lawson et al., 2006, 2007). So, in practice show a video as part of a flipped classroom or in class and prepare questions or materials that activate your students during the clip. This can be done with traditional materials like a blank map, which needs to be supplemented or like mentioned before with questions that lead like a path through the video content. Another idea is to prepare answers and let your students search for the questions. In addition to these analog possibilities, online tools like H5P allow the integration of different types of tasks directly into videos.

When learners reach the passage with the task the video stops and they can complete it via clicking, dragging or dropping. H5P allows the creation of single choice and multiple choice questions, drag and drop tasks, fill in the blank as well as writing tasks like open questions or essay writing and reflective pauses. Szpunar et al. (2013) found that interpolated exercises like memory tests reduce mind wandering, facilitate learning and can also lead to more note taking. Similar results have been found by Vural (2013), who used educational videos with embedded questions to teach computer literacy to in-service teachers. The author points out that the implementation of action-oriented interactions, for example creating a concept map (Vural & Zellner, 2010), must be in mind when working with video.

Interpolated tasks have a big advantage: They immediately give feedback to the learners who can then decide for themselves if a deeper engagement with the presented content is necessary (Brame, 2015).

3.3 Make it social!

The use of videos in education is usually associated with two extremes: First, all students watch a film together in class and individual learning pace or prior knowledge is ignored. Second, video isolates learners and prevents the exchange with others in order to deepen, discuss and reflect on the learning content. Here are a few tips how you can leave these extremes behind you and make video learning to a social event:

- Allow your students to watch videos together, in pairs or small teams. With H5P you can integrate text boxes in every YouTube video or self-created video to make the cooperative viewing a condition.

- Implement learning goals and task, which need exchange. For example, use an open question format with the instruction "Ask one (or two, three,...) classmate(s) for his/her opinion and compare it with yours!" The video stops, the learners talk to each other (also when the video is used as homework, then they can communicate with their smartphones or other media) and then they write their answer.

- Realize group-working methods like *Jigsaw*. With the interactive element *Crossroad* you can subdivide every video into chapters. Four students watch four different chapters and afterwards they discuss the content and present their summary to the classmates.

- Use the comment function, e.g. on YouTube or find software that allows your learners to annotate the video. Vohle (2017) invented the *edubreak player* and used it in German Soccer Trainer Education. This program is taught through a blended learning format that includes an online phase with *Social Video Learning*. Within this tool the participants can analyze football videos with regard to tactical and technical patterns by drawing arrows, circles, etc. and writing commentaries directly onto the sequences. The given feedback shows that the learners are satisfied with this form of video learning and that the learning goals can be reached. Advantages of *Social Video Learning* can be spontaneous reflections that belong to relevant situations, drawings and writings of these reflections as well as the coordinated exchange between the students. Additionally to sports trainer education *Social Video Learning* has been successfully used in teacher education and vocational training (Vohle, 2016; Vohle & Reinmann, 2014).

- Probably the most important idea on how to use videos in education is the learning by design approach. Students then are active designers of videos, write a storyboard in a team, look for relevant materials and produce their own video (e.g. with a smartphone). Content knowledge, life skills (e.g. teamwork, speaking to an audience, problem-solving...) as well as media literacy can be developed with this active learning method (Kolodner et al., 2003; Palmgren-Neuvonen & Korkeamäki, 2015; Schuck & Kearny, 2006; Stevenson, Länsitie, Kogler, & Bauer, 2015).

- If a video already exists, interactions can be used for a learner-oriented design process too. Benkada and Moccozet (2017) recommend letting students create interactions for educational videos. The teacher selects a learning-goal relevant video and the students complete it with different tasks. After this process the educational videos can be shared with the class or can be used by other teachers in other classes or learning environments. Design principles are good to know, but didactical interactions have the power to support active learning. Teachers had and still have to think about how to use different media in the classroom. Therefore, it can also be expected to do so for the use of videos. The production of own educational videos cannot always be expected, because it is time-consuming and certain technical competences are needed. But they can implement their

considerations in the form of didactical interactions in already existing videos. These can be implemented easily and quickly with user-friendly and open source online tools (e.g. H5P).

4 Summary

The use of video in education is not new, but the digitalization of it allows educators to invent new ways of learning with it. I follow Brame (2015; 2016) here, who notes that video should always be part of a well thought didactic setting. This can of course be in a classroom, supplemented with active learning tasks or as part of a video-based treasure hunt. Use well-designed educational videos for the preparation phase of a Flipped/Inverted Classroom or for blended learning scenarios. Allow your learners to watch videos together, starting a discussion about the seen afterwards. Keep your videos short, speak to your audience and with enthusiasm. Avoid “Hollywood-style” effects that gain too much attraction and focus on the defined learning goal. Tell a story, create emotions and take your learners on a virtual field trip to nearly everywhere. With the upcoming format of 360-degree videos, these trips will become more and more realistic. To keep the attention while video viewing high, use different behavioristic and cognitive interactions. Implement quizzes, drag and drop as well as writing tasks and give your learners control to have enough time for deep learning experiences. Organize your video into chapters and use elements that support learners feeling of autonomy. At the end of this article it is important to note that the use of video in education should be based on what we know about learning. Learning needs diversity and surprise, and especially repetition and time, to study the content intensively (De Bruyckere et al., 2015). Video is just one medium that can assist you and your students in this process. I recommend the use of educational videos in the context of method and media diversity.

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