QUALITY CRITERIA FOR TEACHERS TO CHOOSE VIDEO TUTORIALS FOR DIFFERENT LEARNING SITUATIONS

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Abstract

With the development of digital technology tools, the availability of educational videos is also increasing rapidly. As a result, the use of these videos is becoming popular among teachers and students. In this paper, we present a set of quality criteria that can be used to develop or to choose a good video tutorial that can be integrated into the teaching and learning process. Currently, these criteria are tested with a group of teachers. An exemplary evaluation of a video using these criteria is presented.

Keywords: Video tutorials, quality criteria, learning goals.

1 INTRODUCTION

“Our goal is to provide students across the world with the highest-quality self-paced learning experience possible”, Stephan Bayer, CEO & FOUNDER of the Berlin online tutoring platform sofatutor (www.sofatutor.com) promotes the commercially available learning videos for many subjects and for all grades. The great success of the platform, which only emerged from a start-up in 2009, is one example among many that shows the strong demand and importance learning videos have gained in recent years to support individual learning processes.

Learners are accessing learning videos more and more frequently and predominantly independently. Gradually, however, teachers at schools and universities are also incorporating learning videos into teaching in a targeted manner (Ljubojevic, Vaskovic, Stankovic & Vaskovic, 2014; Feldt-Caesar & Bruder, 2018). Videos are freely available and have easy access through platforms like YouTube. The supply of learning videos is also increasing in line with the growing demand. With the help of smartphones and corresponding applications, the production of videos is becoming easier and faster, so that the number of videos made available seems to be growing at a high rate. The quality of the videos varies greatly, both with regard to the type of content presented and its didactic preparation, as well as with regard to the technical implementation and user-friendliness with a high degree of heterogeneity of the users. It is difficult for teachers and learners to keep track of what is currently on offer and to select videos with high learning potential. High user numbers, for example on YouTube, are not a criterion for accuracy and high educational quality as well as learning effectiveness of videos.

The project CAKE conducted by a group of researchers from four departments namely mathematics didactics, sports science, media didactics and multimedia communication at the Technical University of Darmstadt has developed quality criteria for digital learning environments (Bruder, Grell, Konert, Rensing & Wiemeyer, 2015; Feldt-Caesar & Bruder, 2018). Following this, the current project focuses on developing quality criteria for mathematics video tutorials. Research proves that the use of video tutorials has potential to support students’ learning (e.g., Jones & Cuthrell, 2011). In designing quality criteria to choose a good video tutorial that can be embedded in a mathematics lesson, we considered the available literature based on the research done by other educators elsewhere and our own experience in research on teaching mathematics with digital technology. These criteria can be categorized from three aspects: teaching and learning goals; mathematical content and learning situations.

First, we identified different goals connected with using video tutorials in different perspectives. For instance, the video creator has goals and ideas for using the video. Teachers have own goals of teaching a lesson and integrating a video tutorial and there are different learning goals for the students. In particular, students may have different goals for choosing a video which depends on the learning situations such as additional learning; following teacher’s guidance; collecting information for an assignment or for homework and the curiosity of knowing more about a lesson they learnt at school. All these goals need to be considered when choosing a video tutorial and should match each other.
Second, the mathematical content in the video must be accurate, relevant for the curriculum and appropriate for the target group of students. The last but not the least, the video need to contribute to a special didactical focus on learning situations such as introduction, motivation, exercise, reflection, summary or feedback.

In this study, we are focusing on choosing a good video tutorial in the teacher’s perspective and suggested quality criteria to choose such a video are discussed in section 3.

The following section explains the cornerstones of the previous concept for quality assessment of learning videos. In the third section, the concept is concretized with exemplary implementation for the analysis of a learning video with mathematical content. This is followed by questions for necessary research for the further foundation of quality criteria for learning videos.

Currently, the present criteria are being tested by the first author together with mathematics teachers within the framework of a teacher training course on bilingual mathematics teaching with the use of technology.

2 QUALITY CRITERIA FOR LEARNING VIDEOS AND THEIR BACKGROUND

The CAKE project was able to build on the results of quality assessments of digital teaching and learning offerings (e.g., Bruder, Brücher & Sonnberger, 2006), which have been used for some time, particularly as web-based trainings (WBT) in initial and continuing vocational training in companies and also in the field of university teaching, (e.g., Bruder, Deneke & Sonnberger, 2007; Sonnberger & Bruder, 2009). The quality categories and criteria used here describe such requirements for a learning scenario that, according to the current state of knowledge of the disciplines involved, capture important prerequisites for sustainable learning in the digital environment. In a holistic assessment approach, a distinction was made between

- User-related criteria in order to enable a learning offer tailored to the target group
- Criteria related to the learning object (professionalism)
- Criteria related to the quality of teaching (didactics) and
- Technical criteria.

The category of criteria related to the learning object inquires the relevance of the selected contents to the achievement of the learning objectives. The contents are examined from a qualitative and quantitative point of view and checked for the correctness in form and content. This also includes the investigation of whether the previous knowledge of the learners is dealt with and how individual learning paths are taken into account (dealing with heterogeneity). The criteria of quality of teaching are used to assess the didactic concept used (e.g. inductive, example-based or deductive access to new learning content) and the didactic quality of tasks and exercises. Technical criteria are the executability of the programmes and the availability of necessary (technical) prerequisites to the users.

To validate the assessment from a technical point of view and from the point of view of the actual learning effects it seemed necessary to obtain the required specialist expertise separately and to establish a direct connection to the learner with a user study. Experience with such a procedure with a catalogue of criteria adapted to the WBT's stated objectives is already available from the quality assessment of digital teaching-learning arrangements in university teaching (e.g., Sonnberger & Bruder, 2009).

Based on this preliminary work and previous experience in quality assessment of digital learning environments (WBT), relevant requirements for the assessment of learning videos and video-based learning environments were compiled into an adaptive catalogue of criteria. Here we distinguish between explanatory videos (video tutorials), in which the focus is usually on examples and patterns, and more explorative learning environments, in which independent knowledge acquisition is also to be supported more strongly. In the following, we will concentrate on video tutorials.

With the conception of a catalogue of criteria for the quality assessment of video tutorials, a double objective was pursued: on one hand, the catalogue should be used as a guideline to produce high-quality learning videos (see also Feldt-Caesar & Bruder, 2018). And on the other hand, it should provide orientation when selecting suitable learning videos from the wide range of existing videos. In the latter case, the catalogue of requirements allows the strengths and weaknesses of a digital learning video to be identified, which can then be compiled in an expert opinion (see also section 3).
The adaptively designed catalogue divides the quality criteria considered relevant from the user's point of view into the following categories: accuracy, target transparency, technical implementation, content preparation, subjective perception, individualisation options and, if necessary, embedding in a learning environment. The adaptation of the categories for the quality criteria resulted from the approach to focus more on the learning process. For this reason, target transparency and individualisation options were explicitly identified as categories. The accuracy of the content was also deliberately recorded against the background of the experiences with mathematics videos and, together with the important technical aspect of "executability" (in a more comprehensive sense), should even be regarded as a k.o.-criterion. Distinctive errors, for example, cannot be compensated by the creativeness of the learning video. Table 1 shows examples of some criteria in the above categories.

A current version of the evaluation catalogue was implemented as a digital evaluation tool as part of a scientific term paper (Schwarzer, 2015), which is available at https://wwwdid.mathematik.tu-darmstadt.de/videotutorials/ (in German). In the beginning, the rating tool requests for some general information about the video, such as the type of video ("Classic Explanatory Video" or "Explorative Video"). In the course of the assessment, the user of the tool must additionally indicate whether the learning video is a hyper-video and whether the learning video is embedded in a learning environment or context or whether it stands alone, as is currently the case with most YouTube learning videos. Since these two characteristics result in very different objectives or video types, the following criteria compiled differently depending on the input: The category individualisation options is supplemented with additional criteria for hyper videos, the category embedding in a learning environment is added for videos with learning environment or context. Depending on the information provided, between 44 and 60 criteria are given below. Each of these criteria requires an assessment of whether it is relevant to the video being evaluated. For example, the spelling aspect can be excluded from the rating of a video without text elements. If the question about relevance is answered with 'yes', the question about the existence of the characteristic follows. Only if this question is also answered with 'yes' the user will be asked to evaluate the quality of the characteristic. As a rule, a five-level Likert scale (very good - good - satisfying - bad - very bad) is offered for this. For each of the criteria, a help button is available to explain the aspect to be evaluated in more detail.

<table>
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<tr>
<th>Table 1: Categories and examples of quality criteria of the catalogue.</th>
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<tr>
<td><strong>Category</strong></td>
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<td>1. Accuracy of the content (no errors)</td>
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<td>2. Target Transparency</td>
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<td>3. Technical implementation</td>
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Different levels of knowledge (Bruner)
Highlighting for content support (including the use of colours)
Correct spelling
Speed of image change
Duration of the video (appropriate with regard to content)

4.3 Dealing with complexity and abundance of material
Appropriate exemplification
Didactic reduction
Appropriate small steps
Adequate speed of explanation
An appropriate relationship between technical and everyday language
Summary of the result

4.4 Dealing with heterogeneity
Different requirement levels
Different approaches/solutions

5. Subjective perception
Entertainment - Attention connection
Aesthetics appropriate to the target group
Quality of pronunciation
Speech speed
Clear typeface

6. Individualization possibilities
Navigation options*
Selection of different requirement levels
Help options selectable
Selection of different accesses
* Only if "Hypervideo" is selected

7. Embedding in a learning environment
Usability/Operability
Support
Demonstration of prior knowledge/assurance of the initial level
Choices
Support of communication and cooperation **
Help
Sample solutions
Learning growth control
** only if "learning environment available" is selected

After evaluating all the criteria, the user is given an overview in which an overall score is determined for each of the evaluation categories mentioned, but which, according to our experience to date, is of little significance. However, the presented results provide a broad overview of the quality of a learning video and allow to identify the strengths and weaknesses of a video.

3 EXAMINING A VIDEO USING THE CATALOGUE
This section is intended to provide a concrete implementation of the catalogue for the use by mathematics teachers to select a suitable learning video for a learning situation in school lessons. In any learning situations, it is necessary to identify the learning goal of a video. To be able to explain a single criterion in more detail, we selected a video that shows an introduction of the product rule in differentiation. The video is taken from the homepage of the creators of the video called “Flip the classroom" (https://fliptheclassroom.de/die-produktregel/). They introduce the video with the claim that the rule itself is not that difficult, but rather the decision when to use it. They write that the rule needs to be applied when there are two functions that are connected with a multiplication sign.

In the video, you always see both presenters on the screen talking to the audience or to each other (see Fig. 1). Here they begin with a given function $f(x)$ and differentiate it incorrectly.
Apart from the deliberate error at the beginning of the video, no content error is made. The technical accuracy is also given and the video is always available on YouTube. These two criteria are crucial factors that should always be positive.

Focusing on the targeted transparency, the video is divided into meaningful sections and follows a main focus of the video. The authors use a cognitive conflict to show the necessity of introducing a new derivation rule. By this, they create the potential of a high level of motivation and cognitive activation. However, there is only an implicit formulation of objectives for the learner. Both, a reference or closeness to the everyday life of students, as well as a reference to a contemporary context or other social-political issues are not relevant for this video. Further, there are no indications about the prerequisites or prior knowledge to follow the content in this video. This property is an example of an item in the catalogue that, from our point of view, is relevant to a video about the product rule, but is not mentioned in the video itself. However, the entry into the problem can be rated positive with a smaller deduction for the lack of an explicit formulation of objectives and the missing description of necessary prior knowledge.

The colour of the font could have been selected better in some places. A bright blue and green can be distinguished on a good screen, but it is difficult on some projectors as they are used in schools. The quality of the font, the size or the sound of the video are very good and were rated by us accordingly as ‘very good’.

The examples of tasks that are used in the video at the end should serve to form a pattern orientation on the problem. As can be seen in the video, using the chain rule can lead to confusion among students. Therefore, the appropriateness of an exemplification can only be assessed mediocre.

The closeness to the everyday life of pupils is not relevant here // The authors try to get in contact with the students through everyday language and simple analogies (“Lego kit”) on a communicative level. They do not use any scientific expressions. These should already be used at this age level. // Explanations are less understanding-oriented but aimed for a more algorithmic approach. This is supported by a reasonable level of explanation and an adequate speed of explanation.

On the level of the visualization and design elements, the speed of the image changes and in general, the duration of the entire video was positively noticed. For example, at appropriate points, some activities in the processing of tasks are skipped, which have nothing to do with the product rule itself. Therefore, the speakers count backwards of three in these points of the video to give the listeners the chance to pause the video in the appropriate place, in order to be able to devote themselves to editing first. Clearly expandable is the use of different forms of representations to visualise the problem.

Overall, the didactic reduction of the content can unfortunately only be rated as “not good”. For example, there are no offers for alternative access options or explanations, such as a derivation for the rule.

There are no individualisation options for the students (e.g., no navigation within the video except pausing) or choices of different approaches to the problem.

4 CONCLUSION AND SUGGESTIONS

In view of the enormous distribution of learning videos, it seems reasonable to develop certain standards for their development as well as for the selection of suitable learning videos.
Concepts of technology support for learning processes have a long tradition in pedagogical and didactic contributions. Again, and again, however, they are accompanied by questions about theoretical foundations for teaching concepts and teaching decisions in connection with digital tools. We see the activity concept after Vygotsky and Leont'ev as a far-reaching and viable instrument for analysing and describing learning processes in connection with teaching interventions (Richter & Bruder, 2016).

So far, there are no conclusive studies on the effectiveness of learning videos. A control group design could make various interrelationships between the characteristics of learning videos and the learning effects achieved transparent and be incorporated into the design of the criteria catalogue. However, it should not be overlooked that learning processes that can be observed generally emerge from complex interrelationships and, at best, favourable factors can be identified (Feldt-Caesar & Bruder, 2018).

Due to the multitude of different objectives and the associated diversity that can be observed in the conception of learning videos, it seems sensible to further expand the adaptivity of the criteria catalogue. A query of corresponding metadata at the beginning of the evaluation process would make it possible to take greater account of the objective of the video. Its target group and the intended use scenario by adjusting the quality characteristics to be classified. At the same time, a basis of universal criteria would have to be established, which would represent a common standard for all learning videos and thus guarantee the comparability of their quality, at least to a certain extent. Here, far-reaching negotiation processes are still outstanding, in which not only the didactics and media pedagogy, but also the individual disciplines can and should be involved.

REFERENCES


