Active preparatory work with images

for microscopy teaching

Manual for content developers

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covid-project

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Assigning active learning formats to the course content

When looking for an appropriate format the learning content, it can be useful to determine at which cognitive level this content should be mastered. Bloom's taxonomy provides concrete guidance for such a determination. Table 1 shows an example how the contents of the course ‚Clinical Pathology' of the cLovid-project course was categorised according to the different levels of Bloom's taxonomy.

Structure of the Knowledge Dimension of Bloom's Taxonomy	
A. Factual Knowledge – The basic elements that students must know to be acquainted with a discipline or solve problems in it.	
Aa. Knowledge of terminology	Lymph node lobule, subcapsular sinus, hilus, afferent and efferent vessels, primary and secondary follicles, germinal centre, centrocytes, centroblasts, mantle zone, paracortex, tingle body macrophages, hyperplasia, inflammation, neoplasia
Ab. Knowledge of specific details and elements	Lymphatic fluid and vessels, lymphatic organs, status of follicles and paracortex in relation to immunological status, Location B and T lymphocytes in lymphnode, Cellular processes during antigen exposure
B. Conceptual Knowledge – The interrelationships among the basic elements within a larger structure that enable them to function together.	
Ba. Knowledge of classifications and categories	Histologic appearance of normal, reactive and pathologic lymph node. Overall and cellular structure in each category Disease mechanisms that lead to observable signs and symptoms in patients: tumor in the neck.
Bb. Knowledge of principles and generalizations	Lymph circulation, Role of lymphatic system in defending body against infections, Neoplastic diseases of lymph node, Metastastic disease of lymph node
Bc. Knowledge of theories, models, and structures	N.a.
C. Procedural Knowledge – How to do something; methods of inquiry, and criteria for using skills, algorithms, techniques, and methods.	
Ca. Knowledge of subject-specific skills and algorithms	Identifying the primary tumor (cell morphology, location of metastatic lymph node, detecting tissue-specific antigens) Making a differential diagnosis: probabilities of disease mechanisms in clinical case 1
Cb. Knowledge of subject-specific techniques and methods	Methods of tissue sampling, types of material obtained by each sampling method and their diagnostic opportunities. Methods of histopathological tissue processing.

	Methods of immunohistochemical detection.
Cc. Knowledge of criteria for determining when to use appropriate procedures	Benefits and risks of tissue sampling methods Application of pathologic laboratory findings for diagnostic decisions: findings in cytology report, findings in histopathological report (PAD), findings of immunohistochemical analysis. Using pathologic laboratory findings for treatment decisions
D. Metacognitive Knowledge – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.	
Da. Strategic knowledge	N.a.
Db. Knowledge about cognitive tasks, including appropriate contextual and conditional knowledge.	N.a.
Dc. Self-knowledge	N.a.

Table 1

Based on the Cognitive Process Dimensions of Bloom's Taxonomy (Remember, Understand, Apply, Analyze, Evaluate and Create) appropriote active learning formats were thought out (see table 2).

Structure of the Cognitive Process Dimension of Bloom's Taxonomy	
Process dimension	Active learning formats
1.0 Remember Retrieving relevant knowledge from long-term memory.	
1.1 Recognizing	– Text and images with retrieval practice (MC questions)
1.2 Recalling	– Video tutorials with explanations of structures, processes and mechanisms (Virtual Slide Tours) – Retrieval practice with Free text questions
2.0 Understand Determining the meaning of instructional messages, including oral, written, and graphic communication.	
2.1 Interpreting	– Images with retrieval practice (MCQ, Ranking, Free text) – Interpreting histopathological reports (PADs) with worked-out examples in VQuest (Whole Slide Images with Marker, Longmenu, Free text and MC questions) – Interpreting in small group discussions with Learning Dashboard (online Seminar)
2.2 Exemplifying	
2.3 Classifying	– Categorizing normal and pathological lymph nodes with Compare & Contrast rounds
2.4 Summarizing	
2.5 Inferring	– Inferring in small group discussions with Learning Dashboard (online Seminar)
2.6 Comparing	– Comparing with Compare & Contrast rounds
2.7 Explaining	– Explaining in small group discussions with Learning Dashboard (online Seminar)
3.0 Apply Carrying out or using a procedure in a given situation.	
3.1 Executing	– Applying procedure in VQuest (Whole Slide Images with Marker, Longmenu, Free text and MC questions) – Applying in small group discussions with Learning Dashboard (online Seminar)
3.2 Implementing	

4.0 Analyze Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.	
4.1 Differentiating	
4.2 Organizing	
4.3 Attributing	
5.0 Evaluate – Making judgments based on criteria and standards.	
5.1 Checking	Dialogue in small group discussions with Learning Dashboard (online Seminar)
5.2 Critiquing	Dialogue in small group discussions with Learning Dashboard (online Seminar)
6.0 Create – Putting elements together to form a novel, coherent whole or make an original product.	
6.1 Generating	
6.2 Planning	
6.3 Producing	

Table 2

In accordance with the previous categorisation and the active learning formats assigned to it, the content can be created (see figure 1)

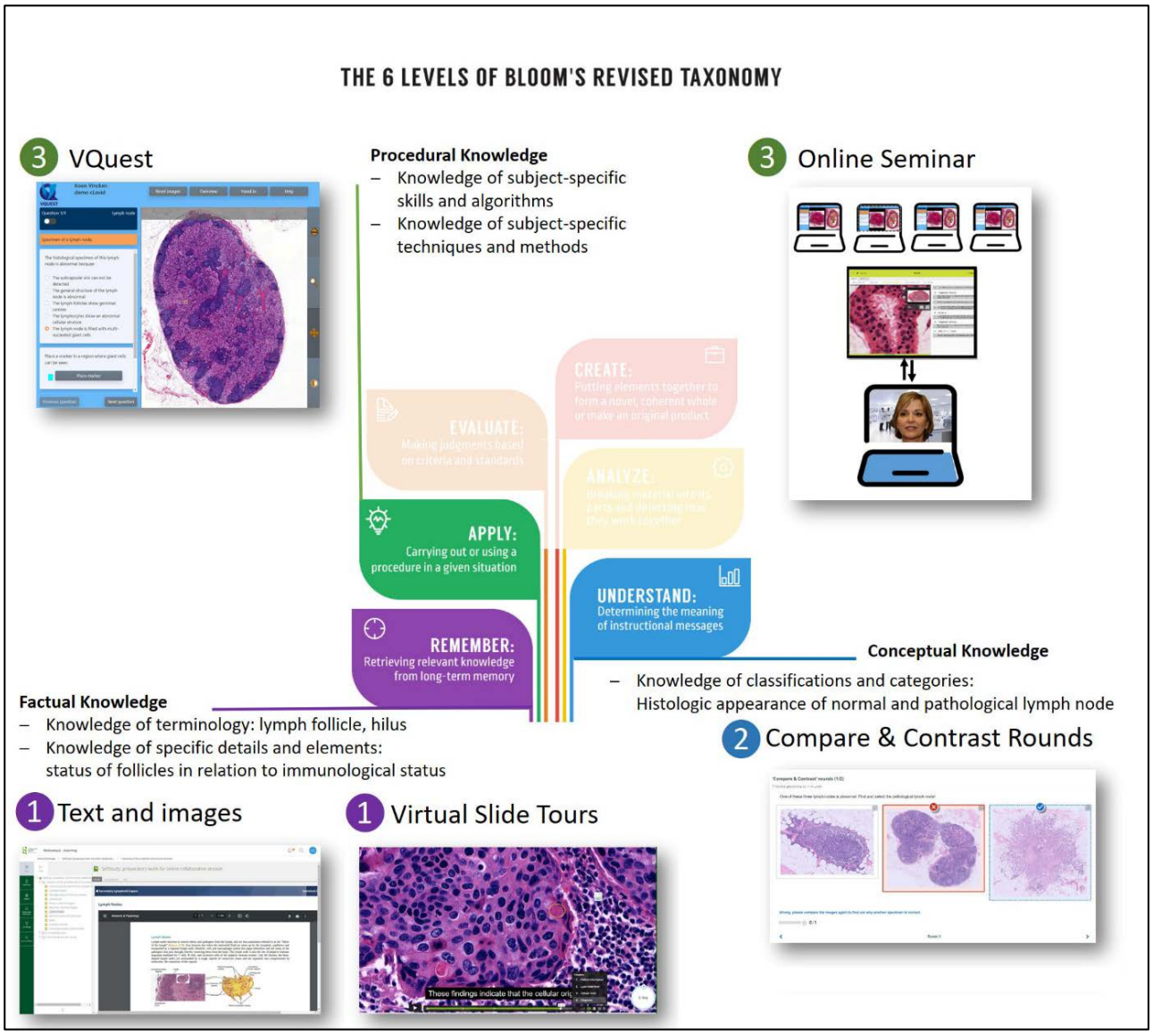


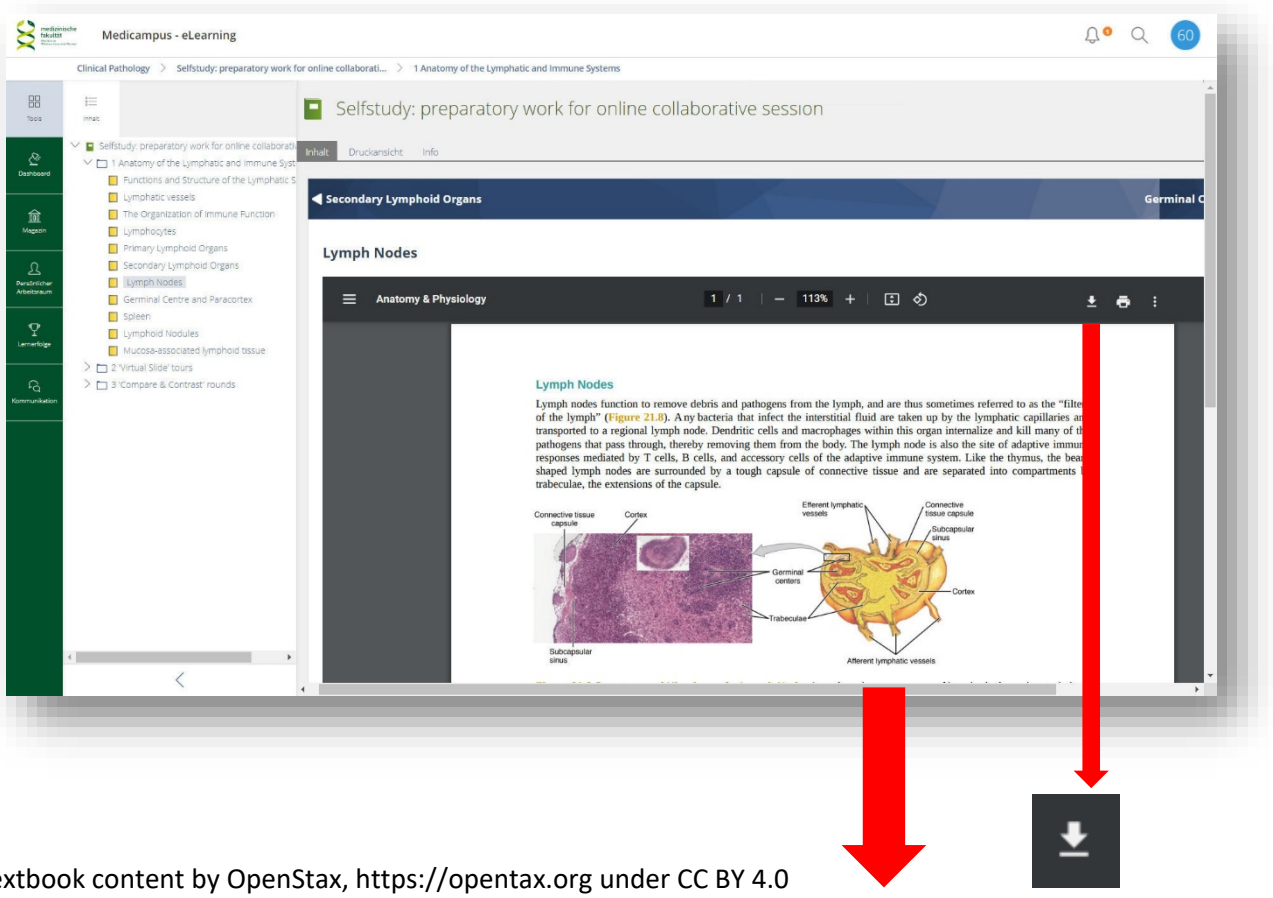
Figure 1 Active learning format for content

Creating course content

Text and images

Instead of writing texts yourself, it is worth searching for existing sources of texts and pictures and to incorporate these existing elements with possibly own additions into the learning management system (LMS) used. In the case of publications from commercial publishers, the university will obviously have to pay licence fees, but if a high quality and authoritative product is available in a good e-learning format, this may be a sensible option. Of course, a critical review of the suitability of the content for the intended target group and an indication of which parts of the material are relevant for this target group, is important.

Another option is to look at open educational resources, which are free of charge, but where one has to comply with the licensing conditions (see figure Creative Commens licenses).



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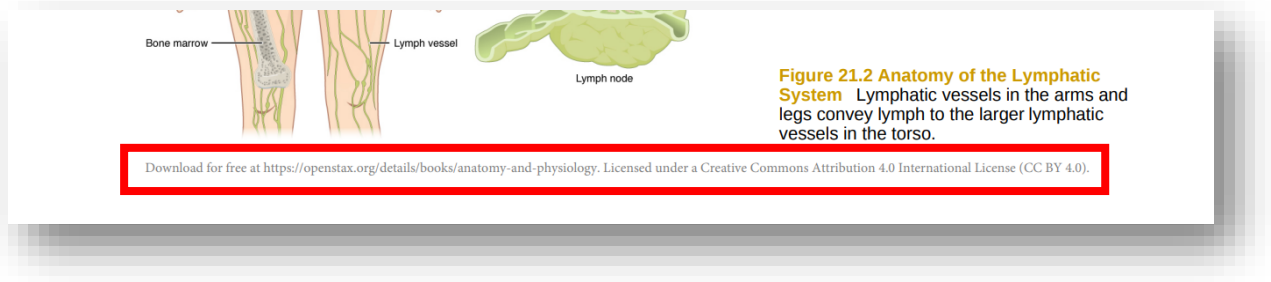

Figure 2 Opensource textbook in ILIAS course

This license lets others distribute, remix, adapt, and build upon this textbook, as long as they credit OpenStax for the original creation.

For the course ‚Clinical Pathology' of the cLovid-project, we made selections of texts from the opensource textbook ‚Anatomy and Physiology' published by OpenStay, added some texts and homemade images and licensed our work under CC BY-NC-SA (Figure 3). In addition we took care that the content could easily be shared with others: a PDF file format and button to download the pages (Figure 2).

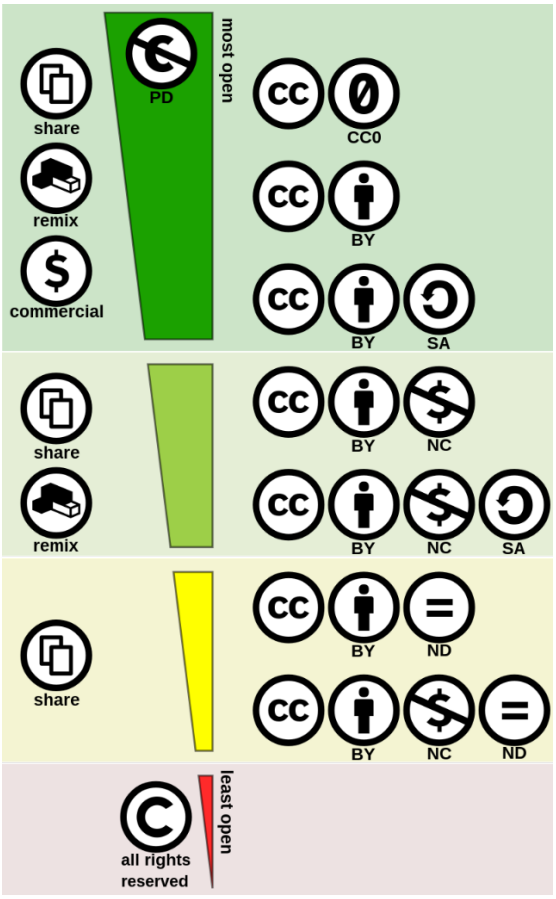

Figure 3 Creative Commens licenses

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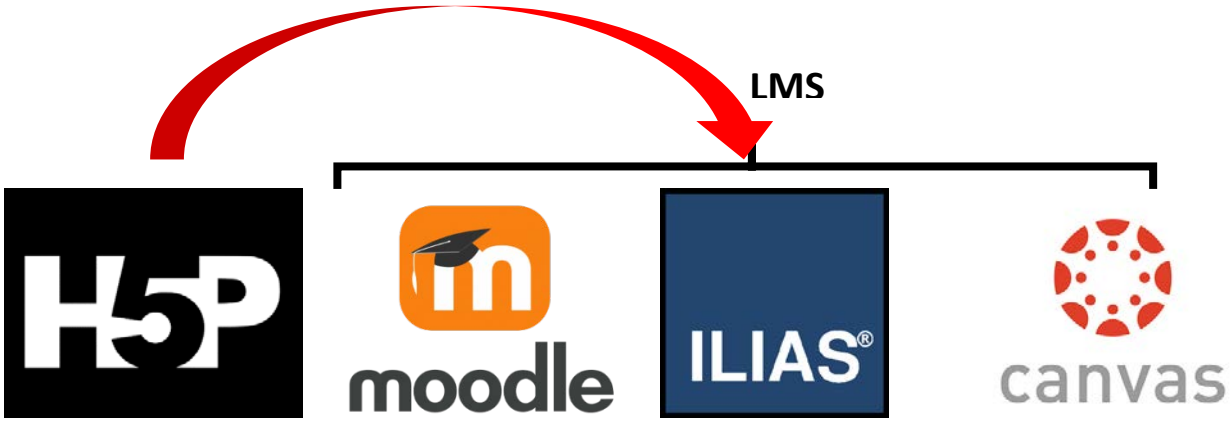
H5P interactive content

H5P is a free and open-source content collaboration framework, licensed with the MIT license. Demos/downloads, tutorials and documentation are all available for users who want to join the community. The aim of H5P is to make it easy for everyone to create, share and reuse interactive HTML5 content. The H5P content can be included in many Learning Management Systems, like: Moodle, Drupal, ILIAS, Canvas and Blackboard.



For sharing interactive HTML5-content a Learning Management System needs a H5P- plugin or a LTI-support functionality.

All that is needed to view or edit H5P content is a web browser. H5P content can be created on any H5P enabled web site like H5P.com or your own Drupal or WordPress site with the H5P plugin installed.

Examples of H5P-content like: Interactive Videos, Presentations, Games, Quizzes Preview can be seen and downloaded at: https://h5p.org/content-types-and-applications

In the cLovid-project we developed a new interactive content-type for comparing of images. This new H5P ‚image Choice Rounds with Feedback and Zooming' content-type provides a template for comparing and contrasting images in a sort of ‚One -Armed Bandit' game. Contentdevelopers can use this template to create their own ‚One-Armed Bandit' games by adding images, texts and by changing the settings so that the game fulfils their goals (Figure 4).

The templates for the content types can be found on our example page: https://clovid.uni-muenster.de/docs/examples/h5p/. There is also a link to the GitHub repository of the developed content type (https://github.com/hpawe01/h5p-image-choice-rounds, this link will likely change in the near future). To use the provided template files the administrator of the LMS where the template is imported needs to allow the uploading of "own" content types (or libraries). After that the new content type will be installed automatically when uploading the file and can be used to create new content.

When a template is filled with content (images, texts), the whole interactive content can be shared between different Learning Management Systems. Figure 5 and 6 shows an example in which the H5P game ‚find the pathological nodes' is exported from ILIAS (LMS University of Münster) and imported in Moodle (LMS University of Turku).

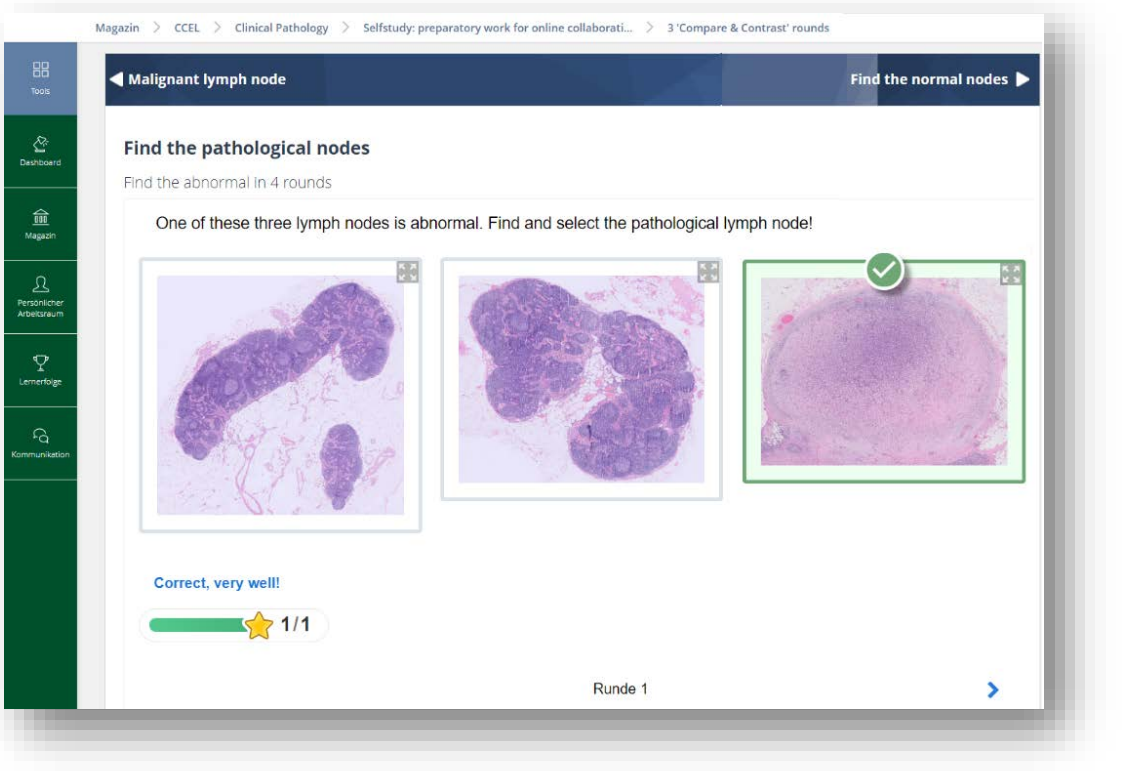


Figure 4 H5P ‚One-Armed Bandit' game with images and texts in ILIAS (LMS University of Münster)

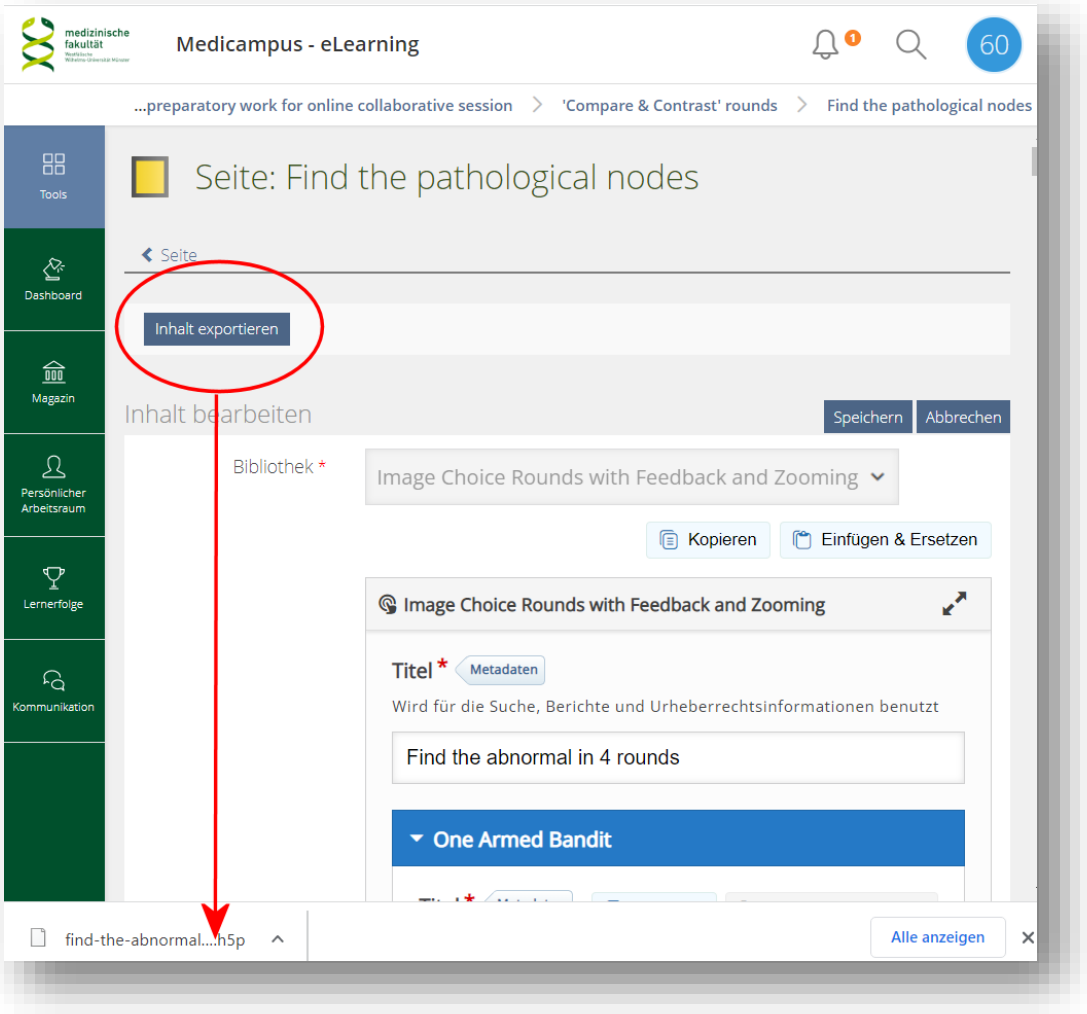


Figure 5 Editing mode in ILIAS: exporting H5P Content

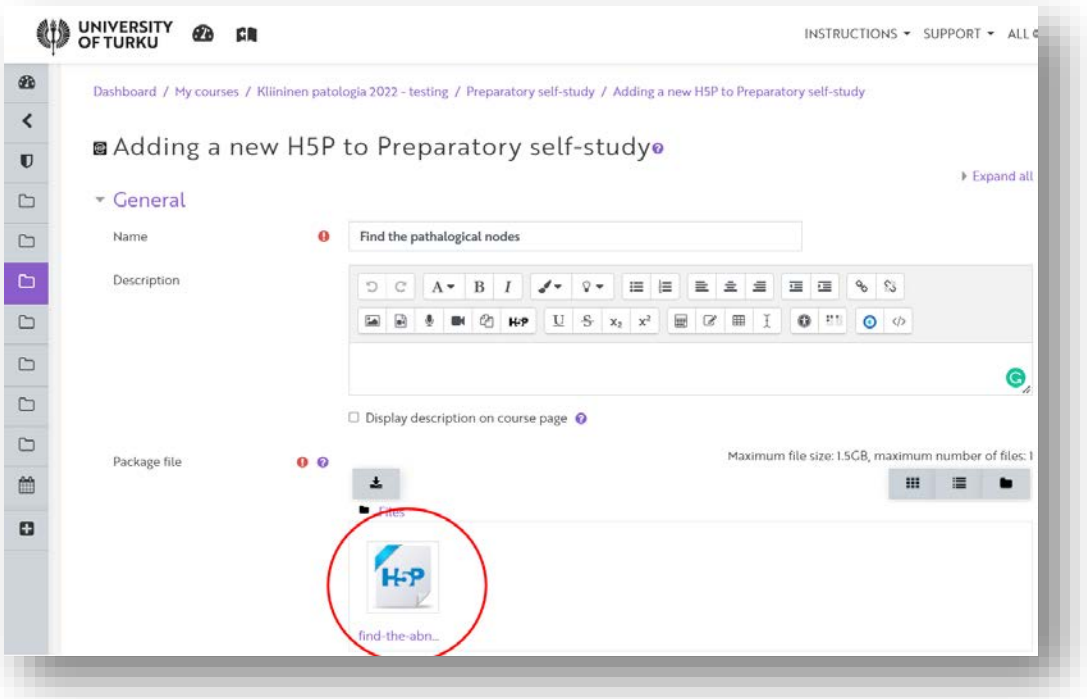


Figure 6 Editing mode in Moodle: importing H5P content

Video tours

In order to transfer expert knowledge in a user-friendly and efficient manner, we have created video tours. The student looks over the shoulder of the pathologist, who leads him or her through the virtual slides and explains what can be seen. To create such teaching materials online remotely with an expert without the need for the expert to do everything themselves, we used various tools to create a sort of storyboard and script that could be shared so that audio-visual production tasks could be delegated to others. We will describe below this production process and the role of the various instruments in it.

Annotating a Whole Slide Image (WSI)

In order to determine together with the content expert what was interesting to tell about a microscopic specimen, we annotated the structures and elements of interest in a WSI with the help of the ‚PathPresenter' platform (Figure 7). You can register for free at https://pathpresenter.net/home and use the platform under the Creative Commons Attribution-Noncommercial-Share Alike for a limited data volume. The WSI in ‚PathPresenter' was shared with the content expert via Video conference software and the locations of interest were annotated by an assistant on instruction by the expert. Because clicking on an annotation automatically navigates the user to the related location, the list of annotations was the stepping stone for an outsider to find these interesting locations in the WSI for later audio-visual productions.

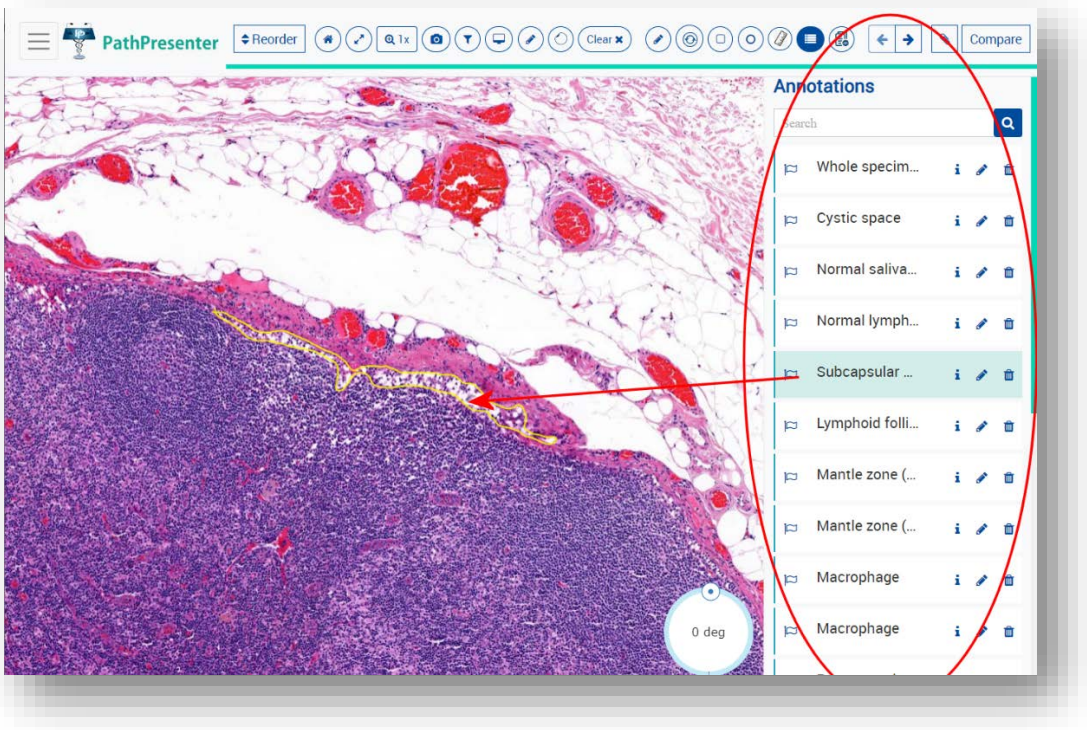


Figure 7 PathPresenter with list of annoted structures and elements

Recording the narrative for a WSI

Then the content expert was asked to tell the interesting facts about the specimen while navigating through the WSI, using the previously created list of annotations. This ‚guided tour' was recorded in a screencast. ‚PathPresenter' itself has a function for making such video recordings, but of course any other screencast programme can be used for this. Because these recordings were solely used as scripts for later voice-over productions, the fluency and pronunciation of the stories were unimportant. Only the message had to be conveyed to enable others the make the final voice-overs.

Creating the final video

Depending on the quality and usability of the ‚script' screencast, the video was either edited directly or re-recorded. For this purpose we used the screen recorder and video editor software ‚Camtasia'. Also here any other suitable software programme can be used. When the shared ‚script' video could be used directly, we first separated its audio and video tracks (Figure 8). The original audio track was than replaced by a newly produced voice-over.

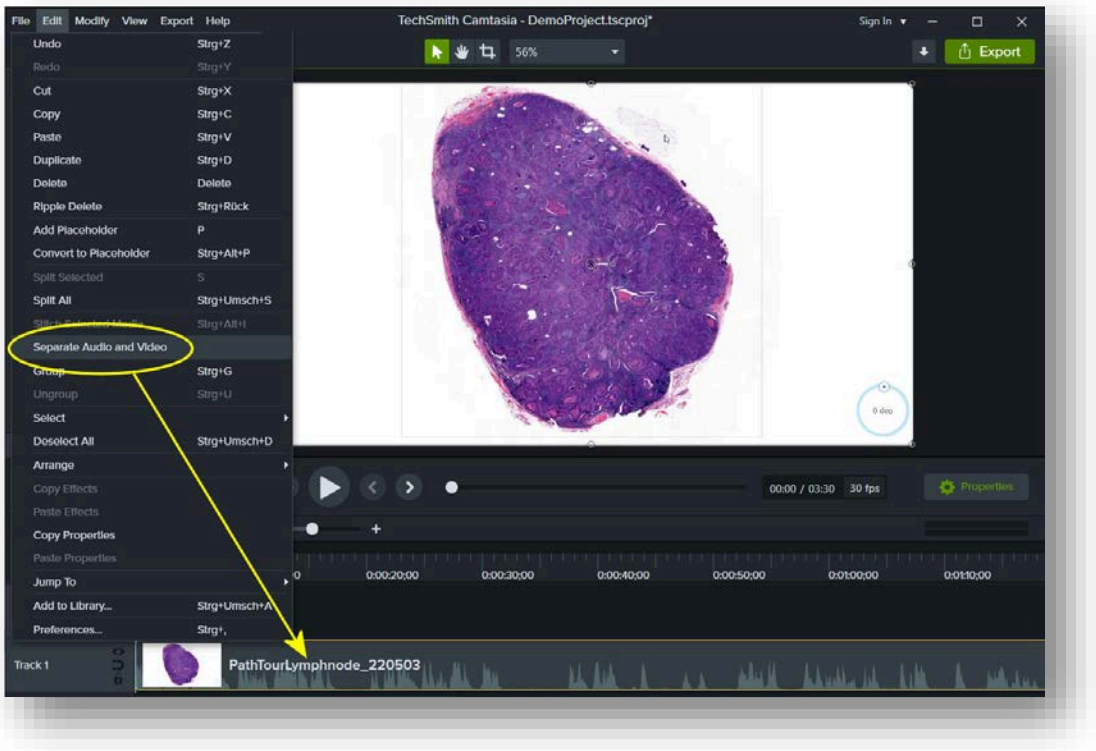


Figure 8 Camtasia: separation of audio and video tracks of the original screencast

Producing a final voice-over and videotutorial

We used the free, open source, cross-platform audio software ‚Audacity' to record the final voice-overs. Because it is difficult to record a long story in one go without slips of the tongue and well-timed with the images, we constructed the entire voice-over from several short sound recordings (Figure 9). This avoided the need to record long recordings in which a small mistake crept in all over again. In addition, fitting separate sound recordings onto an audio track made it much easier to keep them in sync with the image recordings on the video track.

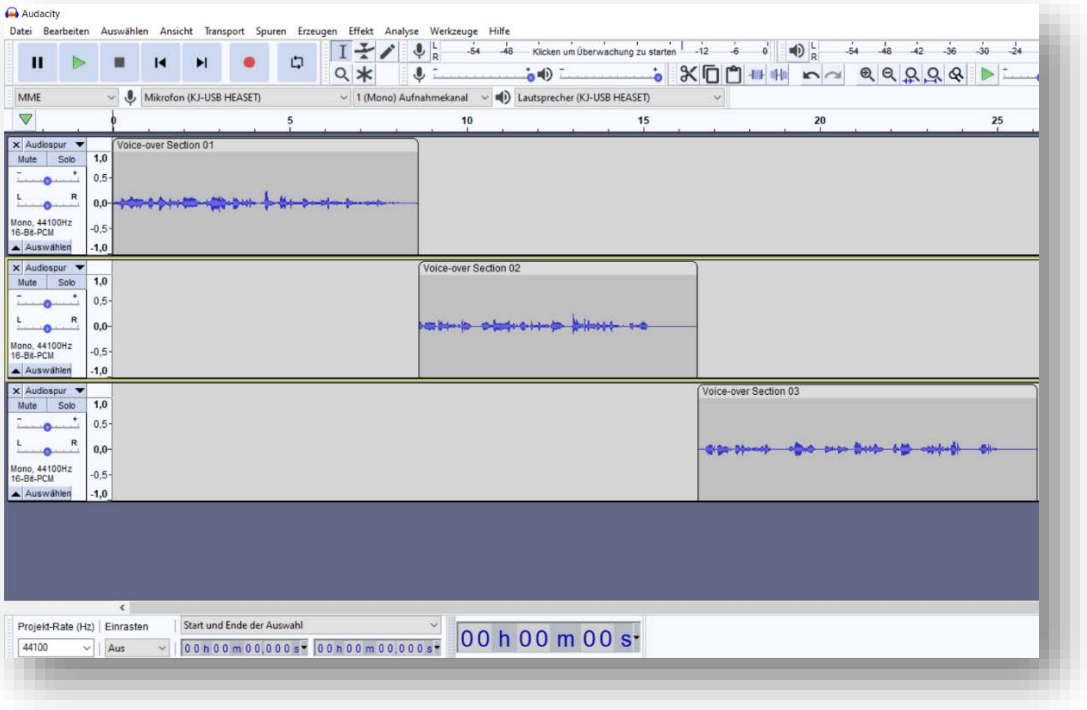


Figure 9 Audacity: several short sound recordings to build up the total voice-over

The voice-over sections in ‚Audacity' were exported as wav-files and imported in the software ‚Camtasia' to join the final video and other media files (e.g. images) to be compiled and edited into the final video tutorial (Figure 10). After the editing, in which for instance timing of the voice-over sections, transitions and annotations were settled, the videotutorial was exported as an mp4-file.

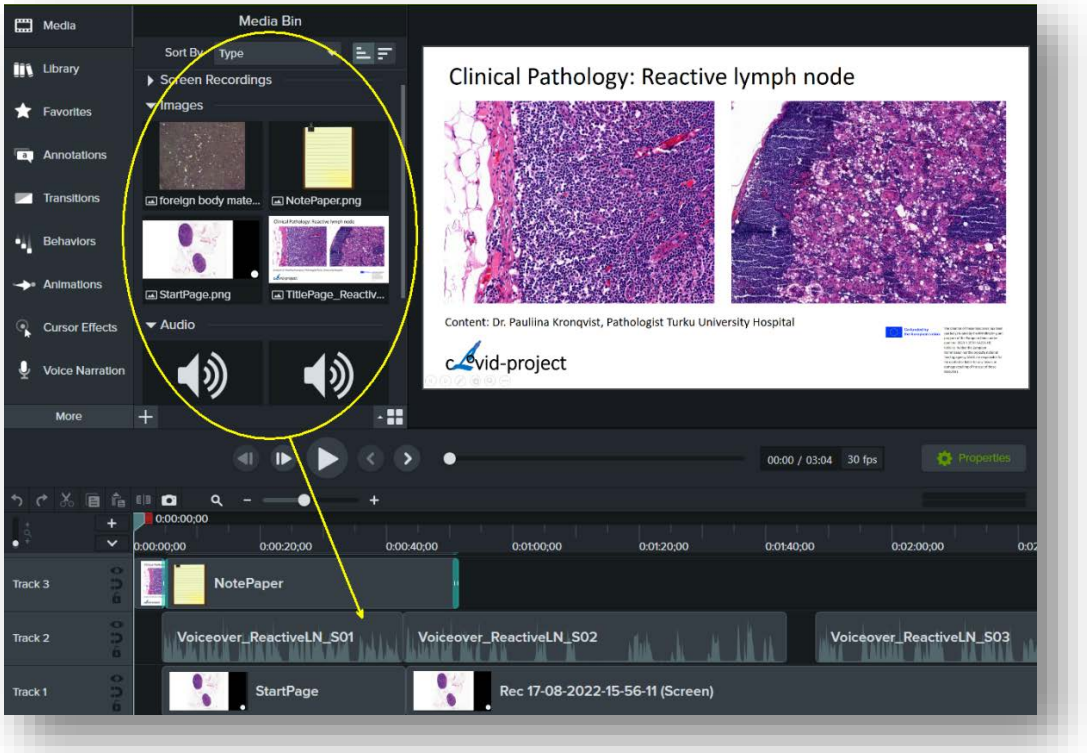


Figure 10 Compiling and editing the video tutorial in Camtasia

Making the videotutorial streaming and adding (multi-lingual) subtitling and chapters

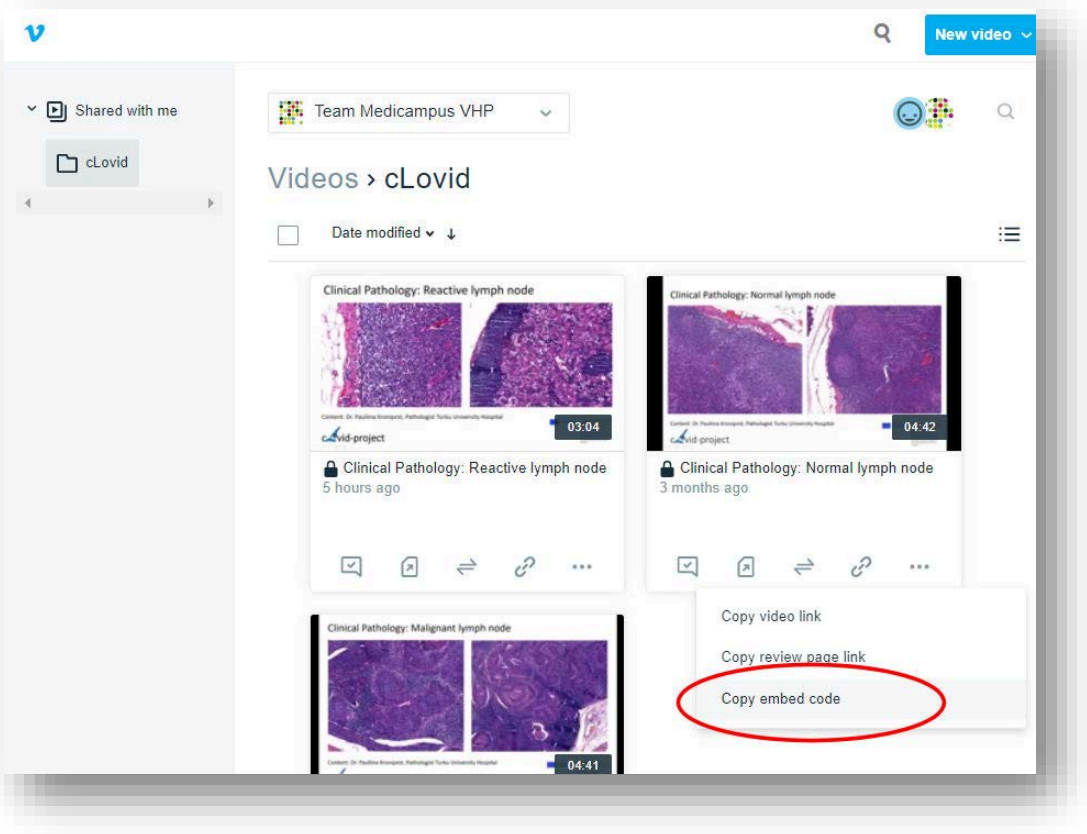


Figure 11 Vimeo-platform with videostreams that can be embedded in online learning materials

The Video-tutorials are uploaded on a streaming-video platform, in our case the ‚Vimeo' platform, so the URLs of the videostreams can be embeded in the learning materials (figure 11) that are hosted in the Learning Management Systems used at a specific university. ‚Vimeo' gives the opportunity to generate ‚subtitles'and ‚chapters' for the videos. ‚Subtitles' provide viewers with a video's dialogue in written form and with ‚chapters' users can navigate to specific parts of a video.

An English voice-over of a video uploaded on the ‚Vimeo' platform will automatically be transfered into ‚subtitles' texts. Because speech recognition is not perfect, further manual refinement of these texts is usually needed. This was done by downloading the texts as a vtt-file and optimizing these texts in ‚Notepad'. The final English ‚subtitle' version was than translated with the online translation programme ‚DeepL' (https://www.deepl.com/) into other necessary languages and finally uploaded as vtt-file again on the ‚Vimeo' platform (Figures 12 and 13).

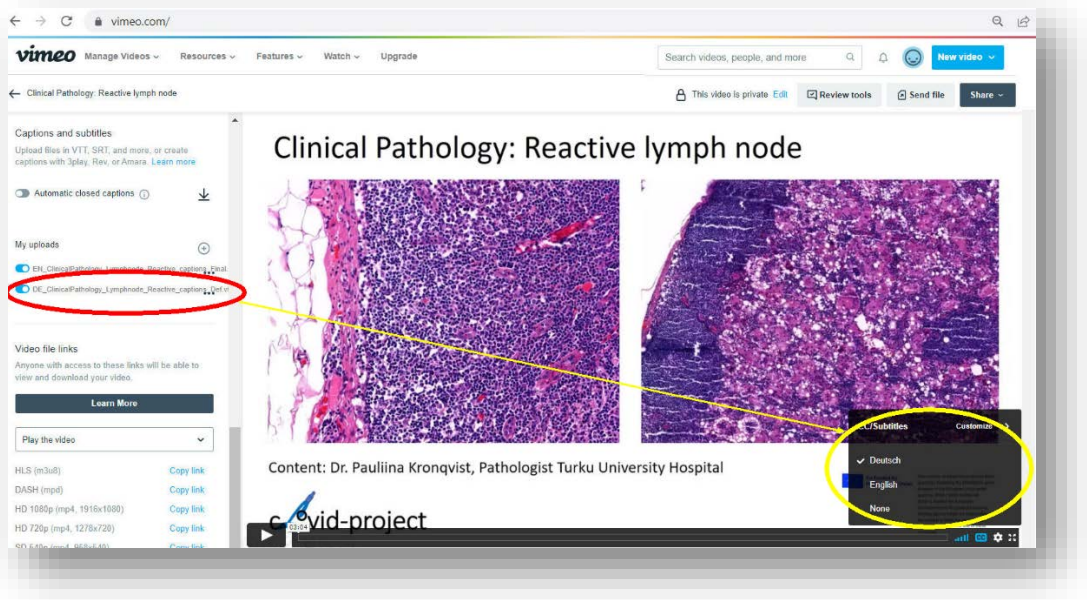


Figure 12 Vvt file with manually added German subtitles

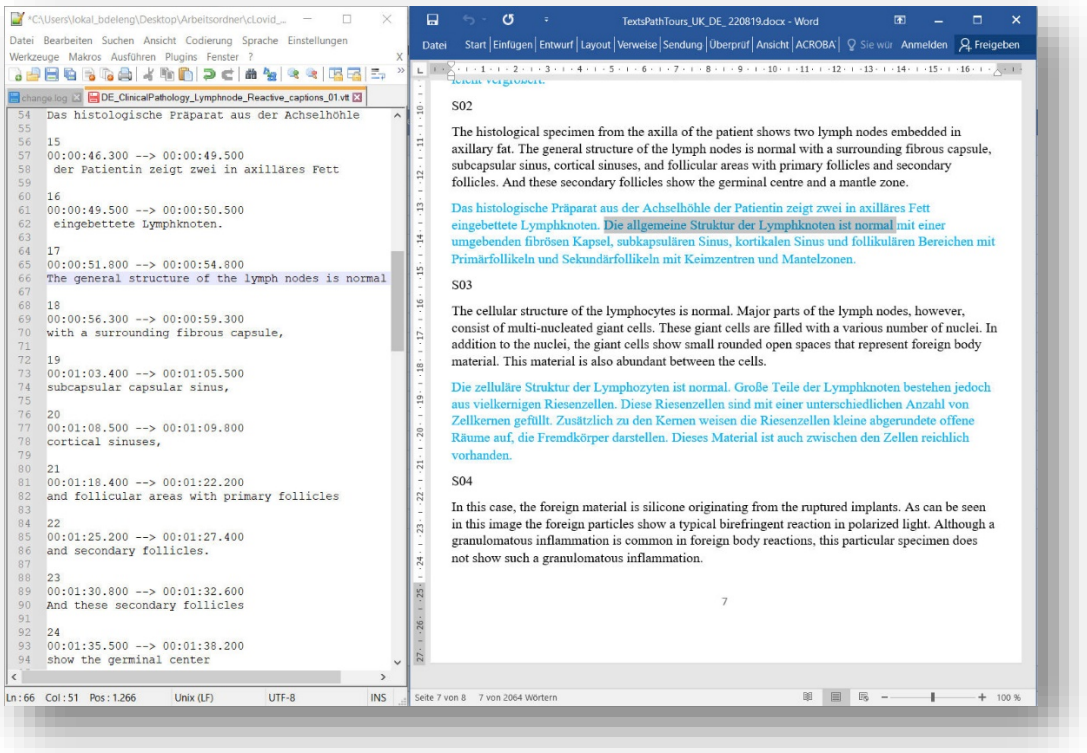


Figure 13 Vvt-file downloaded from the Vimeo platform and opened in Notepad (left). Wordfile with texts translated with DeepL from English to German, that is copied and pasted in a new vvt-file (right)

On the ‚Vimeo' platform, we manually added ‚chapter' headings for a video, which can be used in the videoplayer to jump to specific topics (figure 14).

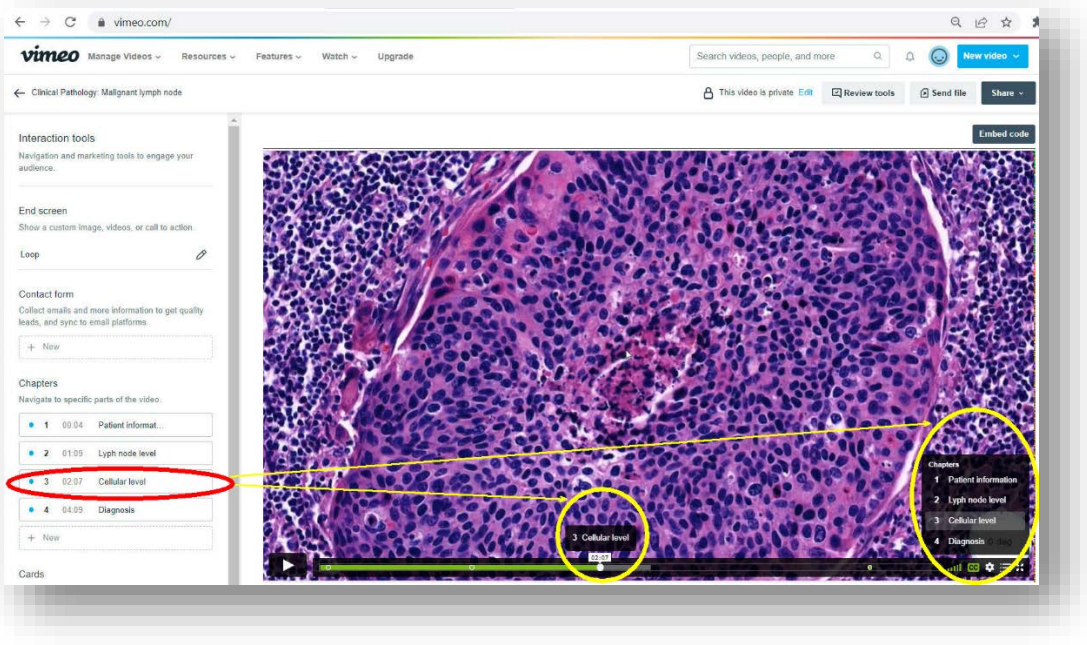


Figure 14 Vimeo platform in which chapters are manually added