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# "MAKING-OF" – SUCCESSFULLY PLANNING AND IMPLEMENTING PEER-TO-PEER LECTURE FILMS

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## Abstract

*Recently films have been implemented in higher education as additional audio and visual stimulus. Students like to work with lecture films which cover different learning methodologies. If videos are analogous to the desired learning outcomes of the lecture they are considered a reinforcement, rather than a replacement for lectures. However, filming a lecture and providing this as a video lecture is not meant by a lecture video that covers science on short sequences. To interest students` and become a seriously accepted learning material lecture films need to be of a certain standard. Videos on material science are successfully embedded in "inverted classroom" teaching scenarios for mechanical and automotive engineering students at HTW Berlin in their first year. Initially encouraged by students a set of lecture videos is produced during a one term semester project each semester by 3rd year students (peer-to-peer approach). The "making-of" is attended carefully by lecturers and film experts. But, the peer-to-peer approach is very important only then students` needs, learning approach and individual perspective on teaching material is first hand included in the videos. Because we find lecturers very interested in our approach and at the same time certain aspects have to be taken into account to successfully prepare peer-to-*

*peer lecture films we practically contribute to the most important aspects to start and succeed in the "making-of" of lecture videos.*

**Keywords**
Lecture Video, Video, Film, Peer to Peer, Material Science, Inverted Classroom

## 1. Introduction

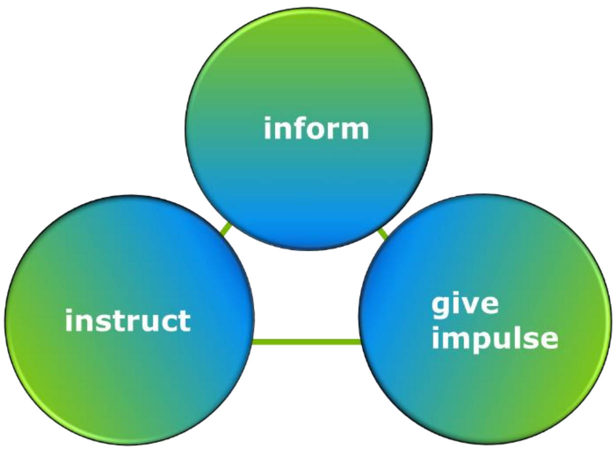
The design led approach has been chosen for nearly a decade to teach material science to first year mechanical engineering students at HTW Berlin via the "design-led" teaching approach: Ashby, Shercliff and Cebon, 2013; Pfennig, 2016). Lecture videos that are embedded into "inverted classroom" teaching scenarios using the blended learning setting (Berret, 2012; Pfennig, 2016; Pfennig, 2017-1/2) positively contributed to self-efficacy beliefs and intrinsic motivation of students (Thai, De Wever and Valcke, 2017). Generally, lecture videos are valued as easy to use and effective learning tools (Kay and Kletskin, 2012) and consider the use of videos significant in learning progress (Gulley and Jackson, 2016; Kon, Botelho, Bridges, Chiu Man Leung, 2015). Videos supply an additional audio and visual stimulus and in general also cover different learning methodologies. If the video included is analogous to the desired learning outcomes of the lecture (Al-Jandan, Farooq and Khan, 2015) lecture videos are definitely a reinforcement, rather than a replacement for lectures (Havergal, 2015). Rose at al., 2014 stated that students prefer online videos accompanied by interpolated questions which at the same time may increase the learner's engagement with the material (Rose et al., 2016) and help to improve actual performance (Szpunar, Jing and Schachter, 2014).

Audio or video recordings of lectures comprise at least five different techniques (Crooka and Shofield, 2017) are completely different from short lecture videos of relevant course material (Pfennig, 2016). Our approach of the "making-of" deals with the latter only and has been introduced at HEAd`18 (Pfennig and Rothe, 2018) and we will know give insight in more details.

## 2. The Peer-to-Peer Approach

When students are integrated into teaching activities (e.g. here: preparation of lecture videos) their critical thinking is engaged (Colorado State University, 2015; Lord, 2012) and deeper learning outcomes are reached (Goto and Schneider, 2010). "Peer-to-peer" (Ware, 2015) literally means "from students for students" and is applied for planning and completing lecture videos at HTW Berlin according to the 3I-model (OLP Online Lehre Plus /Online Teaching Plus, 2016) (Figure 1). 2-6 students worked on a full concept, implementation and integration of one lecture film per student, each two to eight minutes long.

***Inform, Instruct, Give Impulse.***




**Information**

Short video inputs replacing the traditional frontal type of teaching science in inverted classroom scenarios: Ashby (2013)

**Instruction**

"How-to videos" qualify students for lab work, e.g. work with machines/setups or theoretical models prior to quantitative or qualitative research tasks.

**Impulse**

Short documentary videos for advanced students serve as an additional motivation and affirmation. These videos encourage the individual to critically examine his or her own views and promote cross-border collaboration.

**Figure 1:** *Overview of the 3I Model at HTW Berlin*

## 3. Getting Started

First we would like to recommend the subjects we find worth framing into a lecture film in terms of workload and learning outcome. Due to the high workload producing lecture films is only profitable if their content does not change over a certain time span. Ideal is basic science that has been established and taught for a long time.

The authors emphasize that no professional skills are necessary to produce good lecture videos or professional technical equipment but rather include the aim of the lecture video matches the learning outcome of the course and prepare the content well and clearly. Therefore we would like to introduce our workflow and explain our experience.

At HTW Berlin materials science videos are content of a compulsory semester project work during the 5th semester of mechanical engineering (5 ECTS = 180 hours of workload). Students sign up voluntarily and are therefore greatly motivated. Generally they have no experience in film making. Some have done their own home videos with easy to use software (such as Microsoft mediaplayer). Student groups can vary from one to 10 students depending on the coverage of the theme chosen (some more complex themes need to be broken into different topics). The required average outcome is approximately 5 minutes video of high quality per student. This might seem to be little outcome, but as measured by the sum of work packages this is a very good output.

In general the following work packages have to be fulfilled:

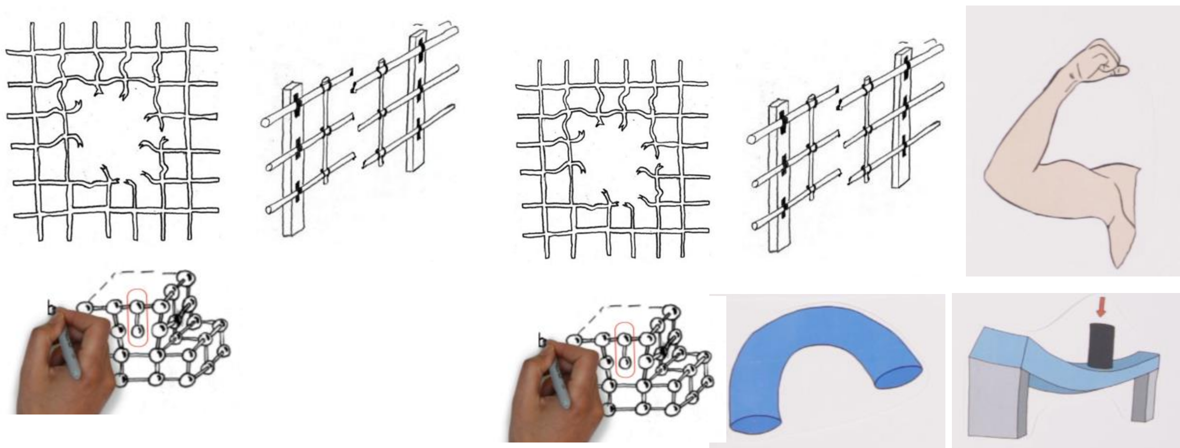
- Script writing
- (Screencast)
- Prearrangement of assets e.g. illustrations
- Text / Recording of voice-over
- Setup of camera and actual shoot
- Post-production and editing
- Final finish and delivery

These are done by the students supervised by the lecturer with the help of a director of documentary film. Only in one film project we had a professional illustrator (fiber reinforced polymers) and in another we had financial aid for a professional speaker (defects in crystals). In most student groups there is one student who has illustrating skills, another whose voice is suitable for the text and film technique and cutting skills are usually learnt throughout the project.

**3.1 Organizing Student Working Groups**

As soon as students have signed up for the lecture film project, there is a first meeting in covers all the boundary conditions, such as length of films, deadlines, content and type of lecture video, etc.. The composition of the script is carefully introduced and examples of lecture videos and scripts are discussed in the group as well as offered as hand-outs.

To support students understanding the correlation between text and illustration, children books are read and anlalyzed. Three different types are identified: Text only with minor pictures, picture scenes with a good story around it and detailed pictures with a text that explains exactly what the reader is given in the picture. The latter is how students should understand their film project: explain complicated science simply – but not in a trivial manner–and simultaneously visualize details. For example: The strength of an engineering material is improved by lattice defects. The defect itself is only one content. It is much more important to visualize the higher strength in detail (Figure 2).



Display of Defects　　　　　　　　Display of Higher Strength through Defects

**Figure 2:** *Graphical Translation of the Sentence: "Lattice Defects Increase the Strength of an Engineering Material"*

Figure 3 shows a fantastic solution to illustrate electrical and thermal conductivity. And Figure 4 shows the demonstration of good conductivity, high strength and low density.

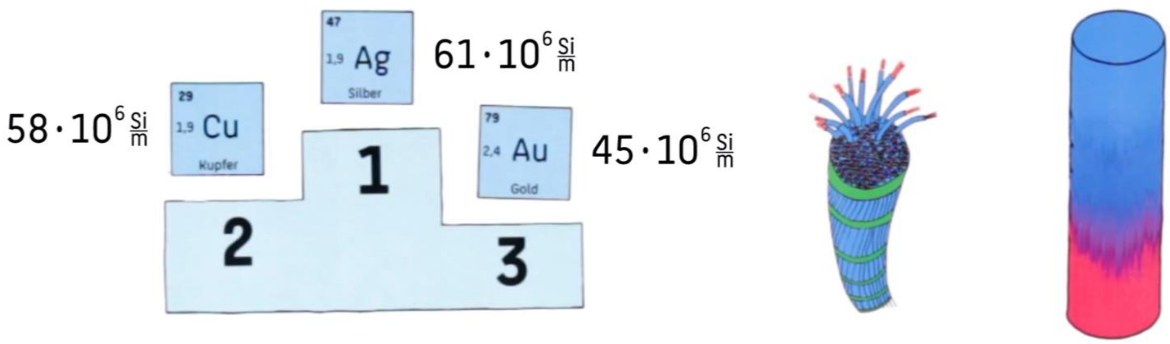



**Figure 3:** *Illustration of Thermal and Electrical Conductivity*

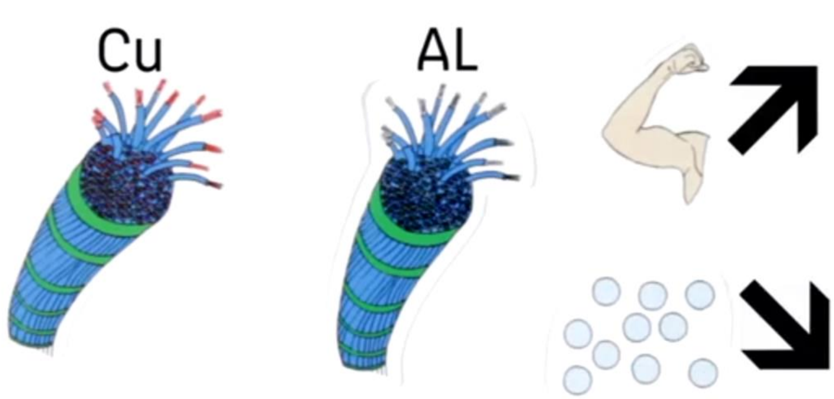



**Figure 4:** *Illustration of High Thermal and Electrical Conductivity, High Strength and Low Density*

### 3.2 Equipment

We promote the KISS principle regarding all studio and production equipment. KISS is an acronym for "Keep it simple, stupid". One could spend a fortune on professional production equipment. Professional equipment gives you a lot more options, yet operating it tends to be more complex, and you will need a professional to operate it. Having a low-threshold and easily manageable approach will reduce overall efforts as well as costs. Figure 5 simply demonstrates that projects concentrate on the product not on production.

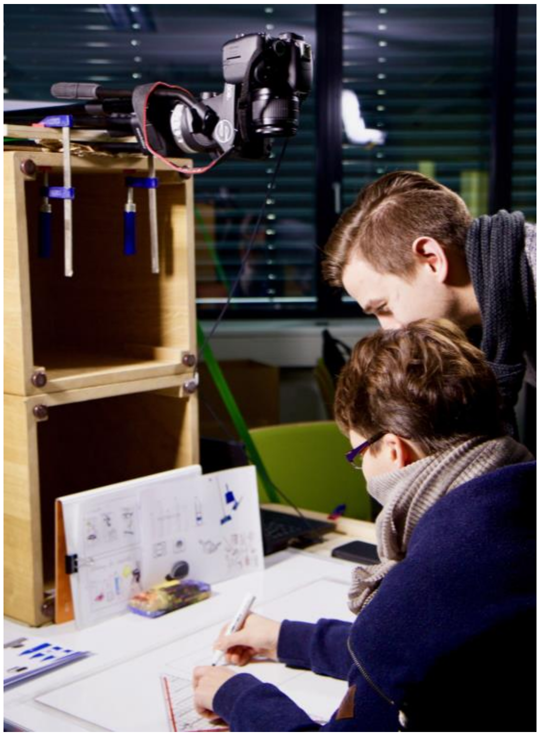


**Figure 5:** *DIY Setup of a Top Shot*

In the context of educational films we consider any cinematic approach towards filming equipment inadequate. To even advise a specific camera model seems to be disproportionate. One should use what she or he is used to and feels comfortable with, ease of use is most important. Even a smartphone, maybe with a dedicated photo/filming app, would be sufficient. Of course, the better the camera, the better the picture quality, if one knows how to use it. The quality of picture is secondary because the content makes a good film.

**Camera:** As a Camera we have mainly been using a Canon EOS 600D, a reasonably priced compact consumer range DSLR, but any other camera is good to use presumed it fulfills the following requirements. To meet basic demands and satisfy an average nowadays viewer, make sure the camera records footage:

- With an aspect ratio of 16:9
- The picture size is at least HD 720p (1280 x 720 pixels).
- Into standard formats and containers, that are transferable to a PC for post-production and editable. The mp4 container works fine, most platforms can handle it well.
- With a framerate of at least 25 frames per second (fps)
- With moderate compression rates. The higher the bitrate, the lower the compression, the better the picture quality. As a rule of thumb it's good to have a look at youtubes recommendations. Films with 720p should have 5 Mbps (Megabits per second) and 1080p should have 8 Mbps. Therefore the recorded footage shouldn't be of a lower bitrate

These requirements are met by most modern smart phone cameras.

Stabilizing the camera is of great importance. The shot should be steady and not shake during recording. You will therefore at least need a tripod. Leave the scene set up as is, because setup and deconstruction does not improve the shoot and does not add to productiveness.

A cutout animation is usually done via top shot meaning the camera films a table from the top. There are of course professional and dedicated tripods, jibs and booms to fulfil these needs, all of them are quite costly, so you would need quite a budget. This should not hold you back, you can easily realize a top shot with a camera on a side arm with a standard tripod and basic tools from a hardware shop.

**Software:** The kind of projects one is working on in the context of educational films usually don't need too much in-depth detailing in post-production, editing and delivering final versions of films. The set of features required for simple cutting, filtering and encoding tasks is pretty straightforward: e.g. text tools, transitions, filtering and basic color correction, maybe time lapse and slow motion, audio syncing and editing, simple animation of graphical content and the export into well-known end formats for delivery.

There are many software solutions available on the market. When choosing a software keep in mind that the aim should be to complete lecture films and not to make the students become feature film editors. So the software editing learning curve should be reasonable and preferably not very steep. Suitable products on the market are reasonably priced such as wondershares filmora, or even free and open source like OpenShot. Also a screencast software such as Camtasia is a good choice. We worked with several software solutions in post-production. Adobe Premiere or Apple Final Cut were involved and are good choices, the former addresses the more professional user, the latter is easier to use. Both require an investment in license fees. Black Magics DaVinci Resolve is a professional colorist tool and to our opinion a good choice. The recent versions has editing tools with the basic version being free of charge. The paid version DaVinci Resolve Studio with its extra features is more suitable for high-end post-production workflows.

**Lighting:** The lighting of the scene is important and shouldn't be underrated. A well illuminated set allows for photography with a faster shutter speed, that is: shorter exposure times, that lead to less motion blur.

Table 1 comprises an example of a recommended very good basic studio of the following components as an example:

**Table 1:** *Example of a Recommended Very Good Basic Studio, Components, Price and Url*

| Type | Description | AMT | € | Total | |
|---|---|---|---|---|---|
| **LED panels** | SWIT S-2430CS | 2 | 1.160,25 | 2.320,50 | http://www.mbfshop.de/de/swit/leuchten/flaechenleuchte/26299/swit-s-2430cs-100w-bicolor-led-softpanel-2500lx?c=1114 |
| | SWIT S-2440CS | 1 | 887,00 | 887,00 | http://www.mbfshop.de/de/swit/leuchten/flaechenleuchte/26300/swit-s-2440cs-50w-bicolor-led-softpanel-1250lx?c=1114 |
| **lights tripod** | Manfrotto 1051BAC-3 3-Pack | 1 | 176,00 | 176,00 | https://www.teltec.de/manfrotto-1051bac-3.html?listtype=search&searchparam=Manfrotto%20bac |
| **camera stand** | Avenger A2033FKIT C-STAND KIT 40" STANDARD BASE | 1 | 213,00 | 213,00 | http://www.mbfshop.de/de/licht/stative-tripod/avenger-century-stands-kits/1594/avenger-a2033fkit-c-stand-kit-40-standard-base |
| | Avenger A2033F C-STAND 40" | 1 | 145,00 | 145,00 | https://www.videodata.de/shop/products/de/Licht/Lichtstative/Avenger-A2033F-C-STAND-33.html |
| **adjustable camera fixture** | Manfrotto 244RC Magic Arm | 1 | 139,00 | 139,00 | http://www.photospecialist.de/manfrotto-244rc-magic-arm-mit-handrad?channable=e13529.TUFOMjQ0UkM&gclid=Cj0KEQjwmIrJBRCRmJ_x7KDo-9oBEiQAuUPKMrIwDx-rdH2Dfzt8PfA98ArsTSbLl2a8CHgkpi5mHjIaAtsp8P8HAQ#group145 |
| **superclamp** | Manfrotto 035 Super Clamp | 3 | 15,90 | 47,70 | https://www.thomann.de/de/manfrotto_035.htm?ref=search_rslt_Manfrotto+035_144444_0 |
| | | | | **3.301,01** | **excl. VAT** |
| | | | | **3.928,20** | **incl. VAT** |

Although the effect is not tremendous pictures with more contrast are simply more interesting than flat pictures. Of course one could spend a fortune on lighting equipment but daylight is a very good solution. As long as they match in colour any set of strong lamps are suitable. We do not recommend a mix of differently coloured light sources. The filmed material will have different temperatures in one picture. So it's very important to always correctly set the white balance of the camera. This cannot easily be done in hindsight. In post-production, trying to match colours of recorded material with different colour temperature can be very tedious, so being thoughtful before starting to shoot will really pay off.

### 3.3 Script, Text and Treatment

Words before picture!

The script is the most important vulnerable and agile part in the "making-of" production. Because after the recording of the text it is time consuming to change during the cutting procedure and generally students motivation is reduced. Moreover, results are often of minor quality and the entire workflow is out of balance. We strongly to only accept the script if all criteria of the lecture videos content have been taken care of thoughtfully.

Language has to be clear (thinking of producing a pod cast helps students), sentences should be kept rather short as well as easy words and extra explanations for technical terms are highly advised. Even without pictures explaining the scene the overall sense of sentences has to be clear and precise. Lecture should carefully proof read and correct the screen play, because each word is important and the meaning has to be correct without any exception. Avoid abbreviations because an external speaker only reads what is written. It may take 3 to 7 revisions to gain a final script which contains the setting of the scene, the content, the time of the scene and included texts and sketches of the graphics (Figure 6). Although students focus on the text they already think about the visualization and production of a scene. Measuring and documenting the time while reading the text out loud, focusses on the most important contents and the 5 minute time limit.

In the whole production pipeline, text and voice-over are key and guideline. The whole film is produced around what is explained by the voice-over. The authors recommend the use of precise, plain language at moderate speaking speed. In that way the audio-track determines the pace and length of the whole film. This has to be observed well and with accuracy, as the text makes a great deal of the films dramatic composition.

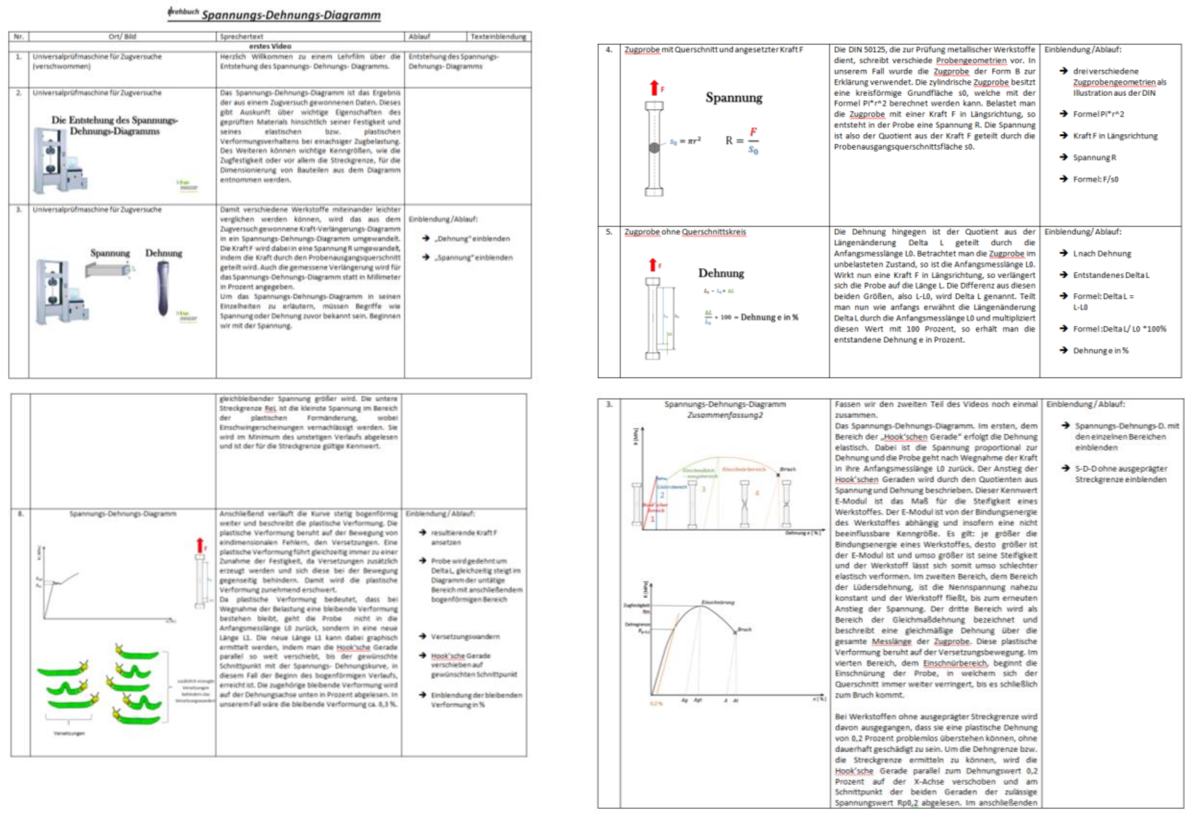


**Figure 6:** *The Stress-Strain-Diagram Script*

### 3.4 Voice-Over

As mentioned earlier, the text and its content are crucial to the films reception, frame and pace. A voice actor has to be chosen carefully. An amateur speaker with an interesting voice and excitement for the content arises a lot of sympathy while a professional standard voice-over artist, who is simply doing a job, can sound hollow. To awaken sympathy is crucial to catch the audience's attention and willingness to study the content. In our productions we had both professional voice-over artists and students who were willing and felt comfortable giving their voice talents and both worked out well.

When recording voice overs in the studio there are some things to keep in mind.

1. Having a text printed for reading is different from printing it out for a voice-over recording. Readability is most important. So before recording, the text should be printed with a bigger font size (16 pt) to guarantee better readability. Blanks should indicate short pauses and new passages should highlight longer pauses. There should be some blank space left for voice actors notes e.g. what to emphasize.
2. A good recording quality of the voice over is important, but the bar shouldn't be set too high. The recording doesn't have to be perfect, a little reverb is tolerable, understandability is most important. Professional audio recording equipment is nice,

but it’s not really necessary. A semi-professional microphone is absolutely sufficient. We have been using plug & play USB large diaphragm microphones like the Rode NT-USB.

3. Little reverb and ambient noise should be guaranteed by the recording room. Rooms looking onto a busy road or located close to a workshop are obviously not a good choice. Professional recording studios have a sound booth that is decoupled from the rest of the building, a so called room-in-a-room silencing or noise reduction respectively. A rather small room (< 15 sqm) with possibly some soft material, like foam material on the wall as sound absorbers, carpet and curtains as well as upholstered furniture will do the trick.

**3.5 The Film Shoot – The Actual Production**

Production itself, shooting the film, takes less time in the whole project than most people might think. The shoot seldom takes more than 40 % of the overall time budget depending on efficiency of pre- and post-production. Planning and project management is very important. It’s a truism, but it can’t be overrated, because false planning or misjudging, details forgot in pre-production will decelerate the production worst to a standstill and the team has to go back to the drawing board.

One is tempted to say, production is only executing what pre-production dictates. On one hand this is true, but bear in mind that on other hand it is very important to use this time efficient as possible. Usually a shoot involves many people and intense planning, so if you miss something during the shoot, it will be costly and time-consuming to retrieve. Because pickup shots are sometimes impossible it is important to follow the script 100 % closely and execute it well. If there is time left, double check missing details in the script, think further, outside the box, what could be added that nobody thought of, what could enhance the film? Alternate takes provide choices during post- production. Use your time, you will most probably never have a second chance.

Using a dedicated studio offers freedom and planning security, but it is also possible to set up the scene for every film separately at different locations. If you produce more than one film at the time it is more efficient to shoot in sprints in rather short time frames. In all film shoots a close supervision and support by studio personnel with knowledge in film or photo production is highly recommended. If you cannot get hold of skilled personnel, don’t be put off.

A basic set of photographic skills can be sufficient. Lighting, focus and exposure times should carefuly be considered. Basically just make sure the scene is well-lighted, exposure is set correctly and everything important is in focus. Most cameras have auto settings for exposure and focus and they are fine to be used. Once the settings have been made and confirmed it's recommended to switch the camera to manual mode, to make sure there is no change in settings from then on. Especially auto-focus can cause a pumping blur when looking for objects to focus. The set and all its conditions should stay as they are and shouldn't be changed at all. This is to guarantee that the picture will always look the same and there are no unwanted changes.

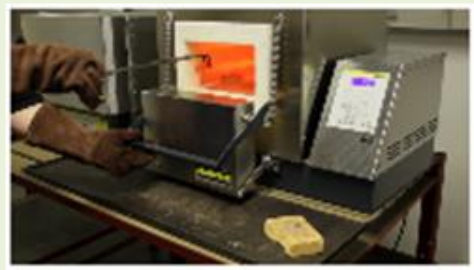
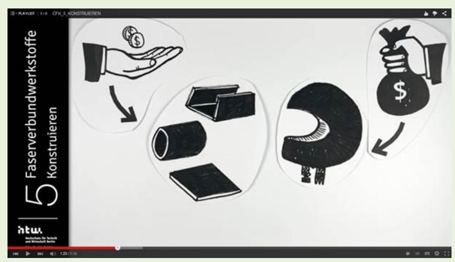
### 3.6 Post Production – Editing

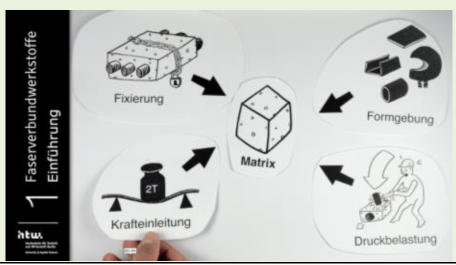
Post production is the place where all the magic happens. It's the place where everything comes together, audio recordings, film recordings, animations etc. and are compiled into a movie. It's the place where you finally feel, if everything that was done so far works out or if you missed something. If the script, planning and recordings were done well, post production is a piece of cake. In many cases, if not even in most cases, you will find something that doesn't sit well, or you can't find it because it was forgotten. Then you will have to save it in post-production. As well as the Director and the DOP (Director of Photography) the Editor has a very important role in production. There are whole theories and philosophies behind editing styles and techniques since day one in film history. Keeping the principle of KISS in mind, the goal is not to become a feature film editor, but to produce high quality lecture films. So learning the basic skills of editing of course involves a learning curve, but it can be done in short time. In this stage also a supervision and support is very important to keep the students motivated and to keep up a good spirit.

## 4. Examples of Lecture Film Techniques and Evaluation

Table 2 comprises of different film formats, such as: power point, comic, swipe-technique or animation.

**Table 2:** *Examples of different film formats produced via peer-to-peer approach*

<table>
<tr><th>Film formate</th><th>Topic, of films / minutes in total</th><th>Teaser</th><th>URL of playlist</th></tr>
<tr><td>How to video<br>Motion picture</td><td>Laboratory introduction<br>5 /11:42`</td><td></td><td>https://www.youtube.com/playlist?list=PLUOlZMSZYz5wHGs9vEu-5DWqmsktUvtx7</td></tr>
<tr><th>Film formate</th><th>Topic, of films / minutes in total</th><th>Teaser</th><th>URL of playlist</th></tr>
<tr><td>Cut out animation technique<br>Black/white</td><td>Fibre reinforced polymers<br>6 / 35:31`</td><td>


</td><td>https://www.youtube.com/playlist?list=PLUOlZMSZYz5y8XYE1S09HlH60tSxlUERe</td></tr>
<tr><td>Cut out animation Colour<br><br>Adding motion pictures</td><td>Materials families<br>(metals, glass, ceramic, hybrids, polymers, elastomers)<br>8 / 41:16`</td><td>
</td><td>https://www.youtube.com/playlist?list=PLUOlZMSZYz5zu5oBgrsbpySESNdJ3Cupx</td></tr>
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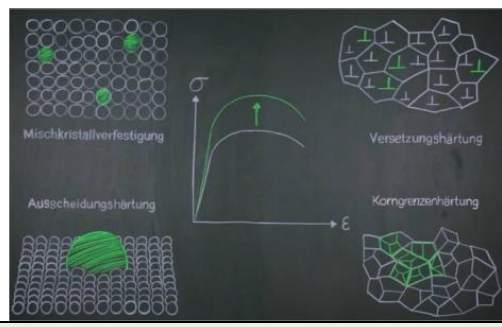
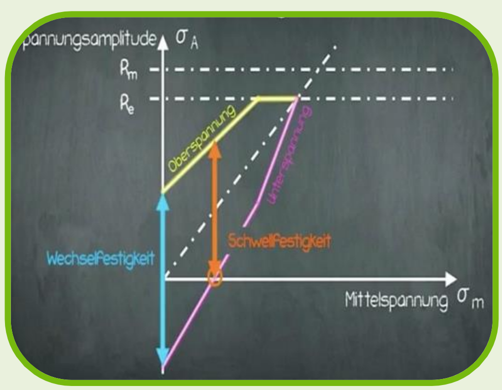
| | | | |
|---|---|---|---|
| **Time lapse real time drawing**<br>**Adding motion pictures** | Polymers<br>4 / 22:43 |  | https://www.youtube.com/playlist?list=PLUOlZMSZYz5wUlfwge0VTxKokobD_OOK7 |
| **Screenplay**<br>**Included: PowerPoint animation** | Corrosion<br>1 / 10:10`<br>3 |  | ttps://www.youtube.com/playlist?list=PLUOlZMSZYz5z_aPBqnCjjr5OXqF997-dJ |
| **Film formate** | **Topic, of films / minutes in total** | **Teaser** | **URL of playlist** |
| **Hand drawing**<br>**Stop-motion technique** | Plastic deformation<br>5 / 38:17` |  | https://www.youtube.com/playlist?list=PLUOlZMSZYz5wm7m-ahbD8r4dCjDU498mV |
| **Powerpoint animation** | Reading oft he smith diagram<br>1 / 12:25<br><br>Reading the stress-strain-diagram<br>3 / 31:55 |  | https://www.youtube.com/playlist?list=PLUOlZMSZYz5wm7m-ahbD8r4dCjDU498mV |

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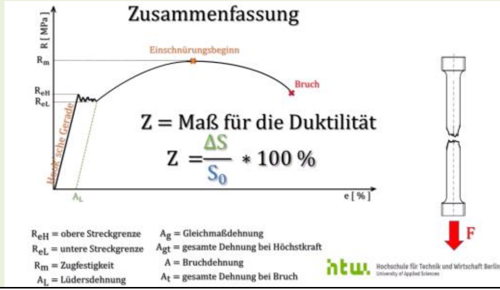
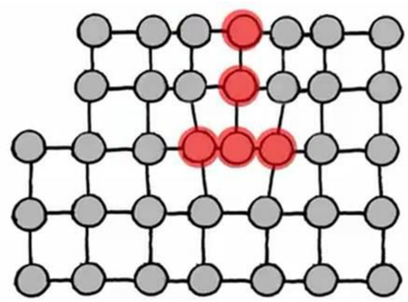
| | |  | |
| **Video scribe using hand drawn scetches** | Defects in crystals and deformation<br>6 / 32:55 |  | https://www.youtube.com/playlist?list=PLUOlZMSZYz5wlO3gea5jLFhxgAr3IiOja |

From the perspective of film-making the motion picture is the most advanced technique, because it requires actors` skills combined with scientific depth. On the one hand most students are overstrained when asked to act in front of the camera. On the other the underlying lecture might easily get out of focus, because students enjoy the screen play without listening and learning. If a student group decides on the motion picture technique the possible difficulties (acting, changing of camera handling and lighting in different settings, etc.) and boundary conditions (scientific depth, precise words, message and the requirement that the video is in alignment to the aspired learning outcomes of the lecture.

Table 3 evaluates and comments on the requirements when choosing the film format because a lecture film format has to suit the recommended boundary conditions:

**Table 3:** *Evaluation of Different Film Formats*

| Film Formate | Set Up and Production | Recommended Content | Definitely Requires<br>Illustr. | Speak. | Cutter | Dir. Phot. |
|---|---|---|---|---|---|---|
| **Swipe Technique** | Easy to Medium | All | X | X | X | X |
| **Adding Motion Pictures** | Medium | Samples and Examples | | X | X | X |
| **Fast Motion Real Time Drawing,** | Medium | All | X | X | X | X |
| **How to Video**<br>**Motion Picture** | Easy | Laboratory, Manuals | | X | X | X |
| **Screenplay**<br>**Included: Power Point Animation** | Advanced | Overview | (X) | X | X | X |
| **Handdrawing**<br>**Stop-Motion Technique** | Advanced | All, Detailed Scientific Information | X | X | X | X |
| **Power-Point Animation** | Easy | All, Detailed Scientific Information | (X) | X | X | X |
| **Video Scribe using Hand Drawn Scetches** | Easy to Medium | All | (X) | X | X | X |

## 5. Evaluation

Because appealing to many students lecture films provide excellent requirements for inverting the classroom and are suitable media to fortify students to self-study.

In winter semester 2016 and summer semester 2017 lecture films were main teaching resource in the first year material science course. The film format hardly influences the “joy of use” and students` learning progress (Figure 7). Still most students prefer lecture videos. However, these were not “add on”, but the only source of material with no face to face lecture on the particular theme. Videos produces via swipe technique were fully voluntarily explaining the rather low acceptance rate of the students not voting for videos that they did not watch (fair enough).

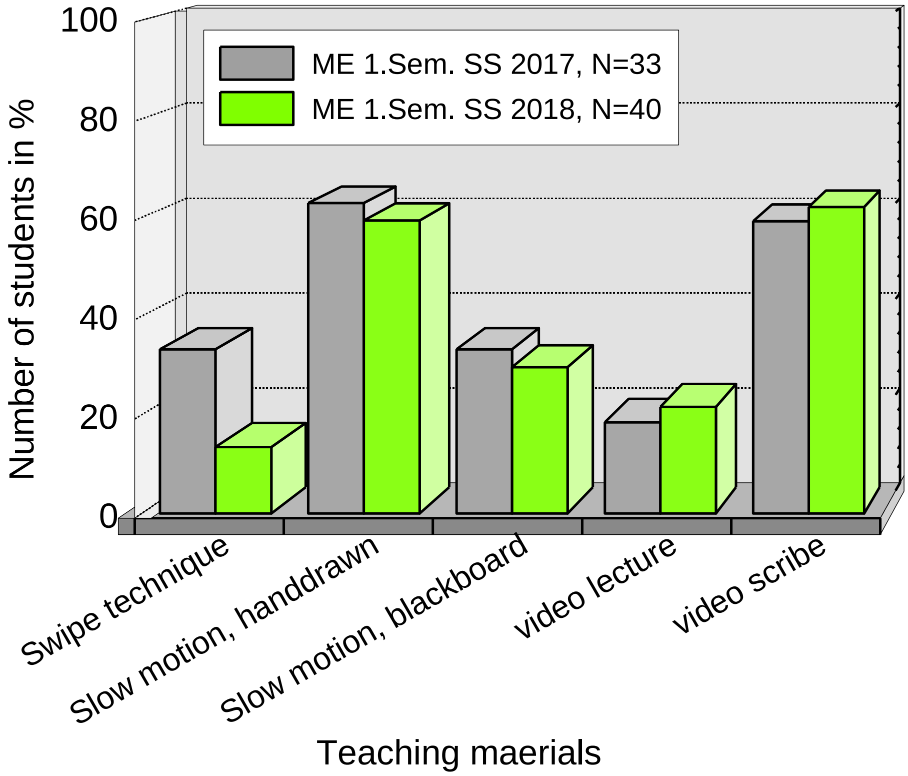



**Figure 7:** *Favoritism of Lecture Video Format in First Year Material Science. (Multiple Choices)*

Most students watched lecture films after the face-to-face or online lecture (Figure 8). To prepare for either tests or present group work students preferred lecture videos by a factor of 3 compared to books or the face-to-face lecture. One third of the students rate lecture videos give as an extra degree of freedom regarding their learning styles. Embedded in the Moodle-based grading: Pfennig (2017-2), students prefer lecture videos for self-studying, because the explanation is given directly. Lecture videos may be used at any time provided a working internet connection helping students who have to take care of family or work. Combining interactive online lectures, quizzes and tests and the lecture videos generally allocates a well received learning environment.

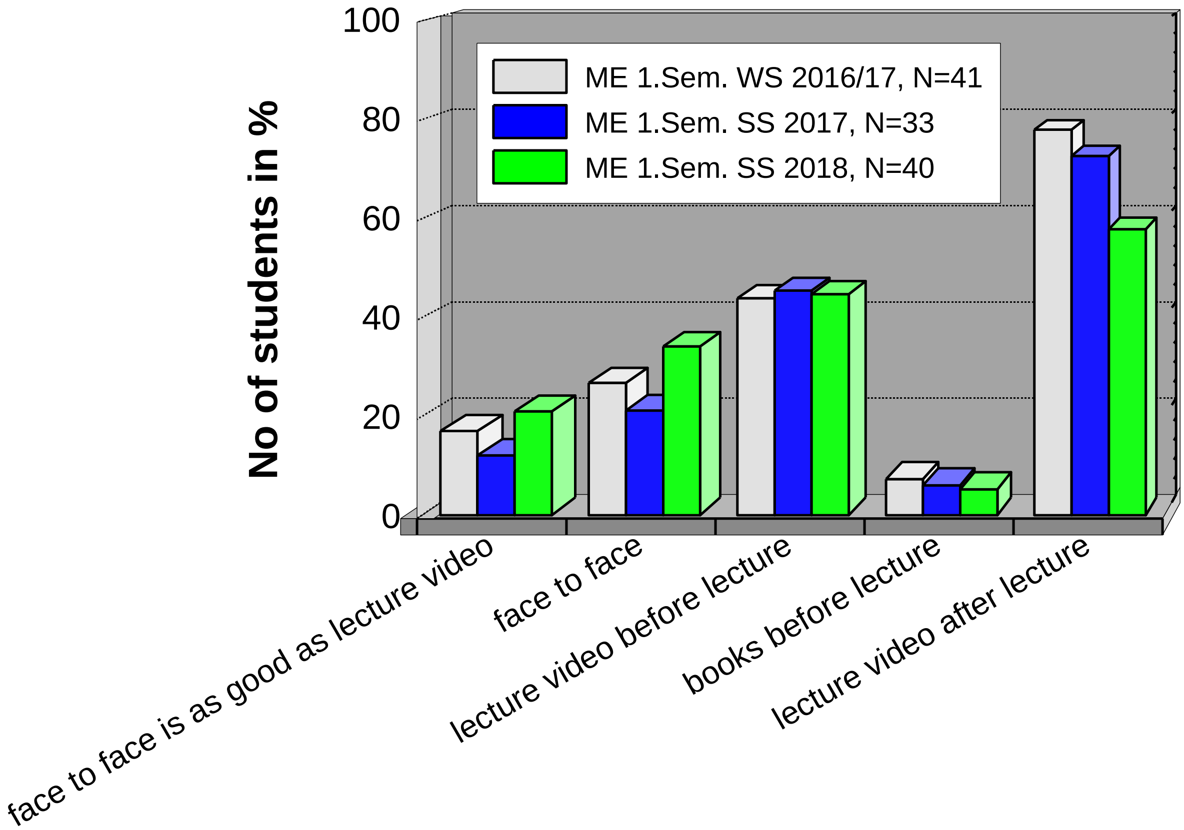



**Figure 8:** *Favoritism of Lecture Material in First Year Material Science. (Multiple Choices)*

First year students of material science ask for lecture films on contents where a high level of abstraction is necessary to understand the content. For example microstructure in relation to mechanical properties will definitely be one of our future projects.

**5.1 Example: Polymers as Grade Relevant Stand-Alone Lecture Video**

Polymer structures are not studied in presence sufficiently due to the nature of a first year material science course for mechanical engineers. Polymers were assigned as self-study lectures based on lecture videos with the possibility to ask questions via chat set for a certain time (here: 19.00 to 22.00 o`clock). A compulsory moodle online exam (2 pm to 2 am) was part of the courses credit points (Pfennig, 2017-2). Over three semester (SS2016 until SS2017) approximately 50% of the students passed the exam with A- and better demonstrating deep learning outcome and at the same time good study skills (Figure 9). Less than 25% scored C or worse.

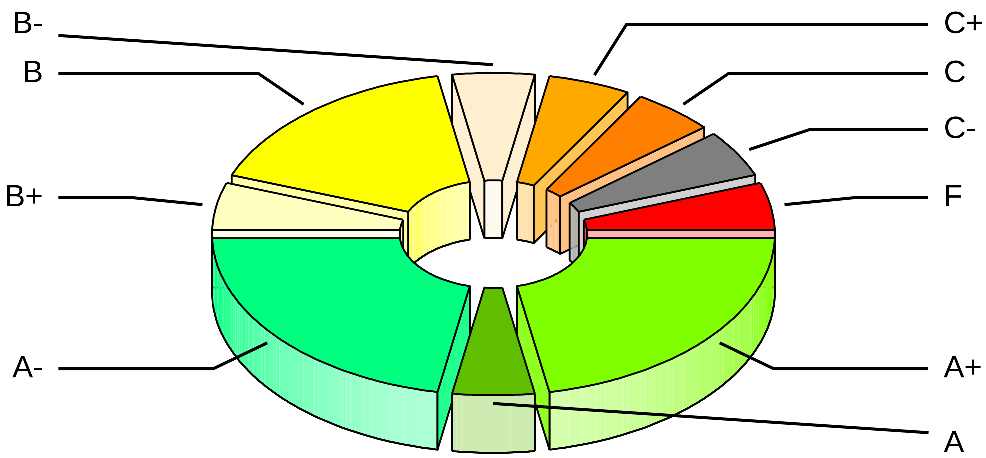



**Figure 9:** *Results of Online Exams on Polymers*

## 6. Conclusion

Lecture videos via peer-to-peer approach providing for "inverted classroom" lecture scenarios in an interdisciplinary blended learning concept of teaching materials science. Implementing lecture videos is beneficial regarding concentration and attentiveness, grades and face-to-face time during class. The peer-to-peer approach of involving students into the production of lecture videos in semester projects (groups of 1-10 students, 5 min of lecture film per student) worth 5 ECTS with a workload of 180 h was chosen to produce different film formats (swipe-technique, comic, animation or power point). Because a high standard is necessary to attract students and accept lecture films as worthy learning material the lecture screen play and the final film have to be proof read and corrected carefully by lecturers – always keeping in mind that every word is important and needs to be scientifically correct. Sentences have to be precise, clear and understood without pictures. The setting of the scene and cutting was directed by student groups with assistance of a professional director for documentaries with the final cut being approved by the lecturer. Approximately 5.000 (?!) Euro can be sufficient to set up a well working film studio, using commercial or non-commercial software for post-production. Any kind of camera of sufficient quality is suitable (see chapter 3.1.). Generally, students rate lecture videos as beneficial and entertaining because material science is known to be high in workload introducing a subject not having been taught at school before.

Lecture videos may successful be produces conforming to the following proposals:

1. Highly benefit from students` learning experience by including then in the lecture film production process (peer-to-peer approach)
2. Do not exceed 5 min length of the lecture film

3. Always start from a perfect screencast/treatment before illustration
4. Graphics should conclude the meaning of the entire sentence not only the keyword (example: ceramics are fire resistant: not the ceramic, fire resistant is the meaning).

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