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VIDEOS IN INVERTED CLASSROOM SETTINGS – ADVANTAGES OF LIGHTBOARD LECTURES VERSUS LECTURE VIDEOS

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Abstract

HTW Berlin has successfully designed and manufactured a Lightboard, enabling lecturers to create engaging and accessible teaching units. A Lightboard, or learning glass, is a high-refractive transparent glass panel surrounded by LED lights, typically made from high-quality Opti-Glass allowing instructors to write with fluorescent markers while being filmed from the front. Lightboard videos, which allow lecturers to face students directly, have proven superior to traditional lecture recordings and animated lecture videos. Advantageous Lightboard videos maintain lecturer-student eye contact, offer clear and manageable content, and are easy to produce with minimal post-production. These videos, typically under 10 minutes, prevent students from feeling overwhelmed, making them an effective alternative to traditional recordings.

Keywords:
Lecture Films, Lightboard Lectures, Undergraduate Teaching, Material Science, Mechanical Engineering

1. Introduction

With the rise of online learning and innovative teaching methods, such as the inverted classroom approach (Pfennig, 2021, Setren et al., 2019) lecture videos have become essential in delivering quality education to future engineers. Since educational videos provide both auditory and visual stimuli (Gulley and Jackson, 2016), HTW Berlin has successfully implemented Lightboard lectures (Figure 1) als well as lecture videos in inverted classroom scenarios for the foundational subject of Materials Engineering, targeting first-year Mechanical Engineering and Automotive Engineering students since 2019. This was particularly beneficial during the COVID-19 pandemic. Generally, students perceive educational videos as low-threshold learning materials (Kay and Kletskin, 2012) and find them highly valuable for their personal learning progress (Kon et al., 2015).

1.1 Video Lectures

A video lecture comprises a recorded presentation where an instructor delivers educational content, often including visual aids such as slides or illustrations. It can be paused and replayed by students, allowing for flexible learning at their own pace. The format typically aims to replicate the experience of a live lecture, making complex concepts accessible and engaging through visual and auditory means.

1.2 Lecture Videos

Lecture videos aim to clarify the sometimes obvious but still complex scientific background and can fill this gap by visualizing the underlying science. To be effective and fully accepted by students, these videos must meet certain quality standards and be aligned with students' experiences and specific needs in Materials Science (Gomez-Pabloz et al., 2017). Various video techniques have been successfully employed at HTW Berlin according to the peer-to-peer approach (Pfennig, 2023): HTW Berlin Website (https://www.werkstofftechnik.htw-berlin) and YouTube Channel. (https://www.youtube.com/c/Werkstofftechnik-HTWBerlin). Note, that these lecture videos are not video lectures or screen casts where the video is 100% lecturer focused.

1.3 Lightboard Videos

A Lightboard, or learning glass, is a high-refractive transparent glass panel surrounded by LED lights, typically made from high-quality Opti-Glass (Pershkin, 2020). It allows instructors to write with fluorescent markers while being filmed from the front (McCorkle and Whitener, 2020) (Figure 1). The video is mirrored during post-production, making Lightboard lectures ideal

for self-study. Due to the unavailability of a purchasable Lightboard in 2018, HTW Berlin developed and implemented a custom Lightboard as a student project in 2019 (Pfennig, 2023-2).

Figure 1: *Producing Lightboard Lectures at HTW Berlin*

Due to the unavailability of an on demand delivery of a Lightboard in 2018, HTW Berlin developed and implemented a custom Lightboard as a student project in 2019 (outlines of possible solution are shown in Figure 2) (Pfennig, 2023, Pfennig, 2024).

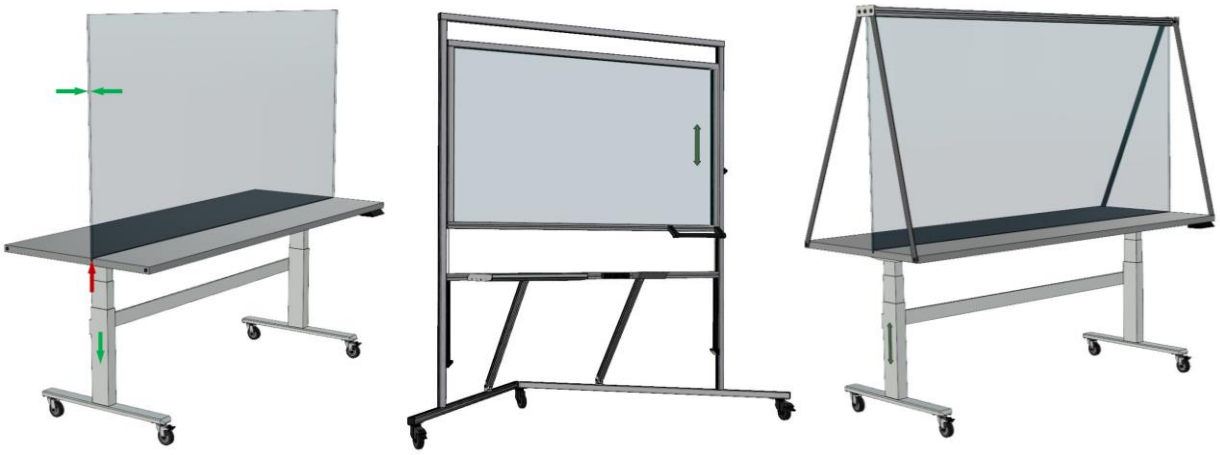

Figure 2: *Concepts of a Lightboard Realized in 2019 at HTW Berlin*

2. Producing Lightboard Lectures

Producing Lightboard videos is straightforward, with detailed guides and calculations available to perfect the technique (Pfennig, 2023-1/2024, Wach and Jan, 2020). The lecture content should fit a 16:9 screen, similar to a blackboard/whiteboard in traditional lecture rooms. Lightboard videos essentially develop scientific chalkboard drawings in real time, as seen in in-person lectures. The setup involves a darkened, soundproofed room (Figure 1) with a fixed camera distance and consistent device settings.

To create effective instructional films without extensive preparation (Pfennig, 2024):

- Keep videos under 10 min., ideally 4-5 minutes; split longer content into parts.
- Plan a double-board chalkboard image.
- Sketch your image on an A4 sheet folded to the 16:9 format and attach it to the Lightboard frame for reference.
- Use fluorescent markers from EXPO for visibility and easy erasure with a dry microfiber cloth.
- Leave a 5 cm margin to ensure all writing fits on the screen.
- Use appropriate spacing, colors, and clear headings.
- Do not cut out mistakes; erasing them makes the video feel more human and relatable.
- Introduce the video and end with a “Goodbye.”
- Maintain eye contact as much as possible, smile, speak slowly and clearly.
- Wear solid, medium-dark colors like green or dark red, and avoid patterns.

By following these recommendations, any instructor can create engaging and effective Lightboard videos.

3. Reactions towards Lightboard Videos

Lecture videos offer a flexible and accessible way for students to learn and review complex engineering concepts. By recording and sharing lectures, professors can build a library of resources available for on-demand access, enabling students to reinforce their understanding and catch up on missed content. Producing Lightboard videos is technically simple and low-cost, with minimal post-production, allowing for "just-in-time" creation based on student needs (Aslanidou, 2022). The videos feature a single board image, making the content manageable for students and easily integrated into the self-study phase of inverted classroom scenarios alongside other teaching materials (Pfennig, 2023, 2023-1, 2024). For instructors, the benefits include the technical simplicity of creating Lightboard lectures and not needing to learn new skills or techniques. This ease of use ensures the functionality and effectiveness of the lectures, making them a valuable teaching tool. Instructors can assess individual learning success through the congruence of educational videos with the teaching sequence, adding didactic value.

Unlike traditional lecture recordings and screencasts where the instructor often turns away from the camera, Lightboard lectures maintain eye contact with students, enhancing engagement. The instructor looks directly into the camera, maintaining a connection with the students and simultaneously explaining and writing, which students find advantageous (Figure 3).

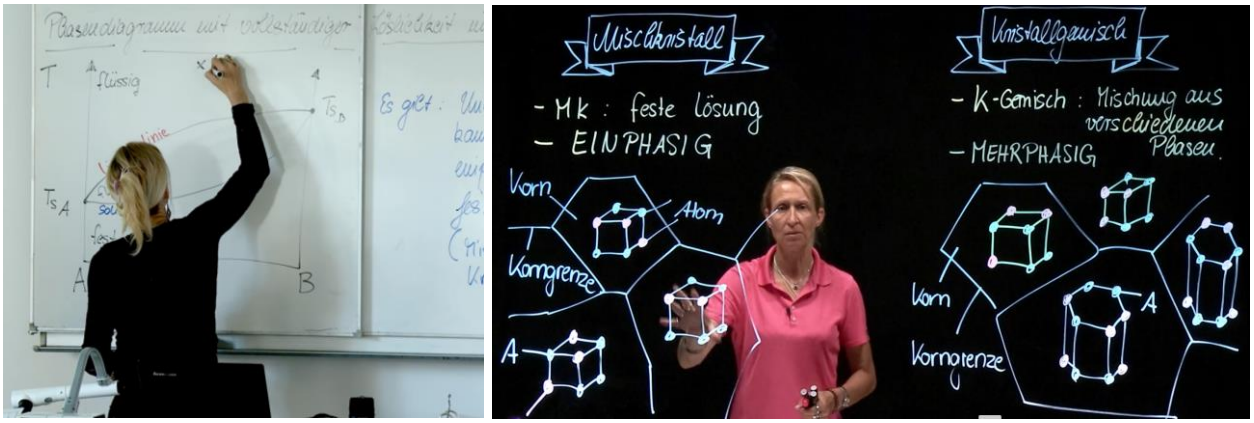

Figure 3: *Producing Lightboard Lectures at HTW Berlin Difference in Addressing Students: Facing Directly (Right), Mostly Backwards (Left)*

This method increases satisfaction and learning performance by creating a more personal and interactive learning experience (Aslanidou, 2022, Reveloa and Florez, 2023). The simplicity of the Lightboard is notable, moving away from "glossy digitization" towards a straightforward technique that emphasizes content and instructor engagement over perfect camera work. When an instructional film or Lightboard lecture aligns with the course's learning outcomes (Havergal, 2015), students see it as a supplement rather than a replacement for traditional lectures (Al-Jandan et al., 2015) This approach captures students' attention better and increases their attention span. Research by (Kim et al., 2014) on MOOC courses found that 61% of viewing drop-offs occurred near visual transitions (Lubrick et al., 2019), a disruption absents in Lightboard lectures. While there are indications of improved outcomes, particularly when graphics are a significant part of the content, students often overestimate their learning from video modules (Szpunar et al., 2022) and there is no quantifiable data on increased learning performance with Lightboard lectures (Rogers et al., 2019).

Since their introduction in 2020, students have widely accepted Lightboard lectures, showing high willingness to learn and engage, especially during the COVID-19 pandemic (Figure 4). Students appreciate the personal connection implied by the instructor's direct contact, the ability

to replay or pause the lecture, and the manageable amount of material presented in a chalkboard format. The consistency and lack of distracting technical elements also contribute to their effectiveness. For optimal results, it is important that the self-study phase using Lightboard lectures includes opportunities for self-assessment and that the content aligns with course goals.

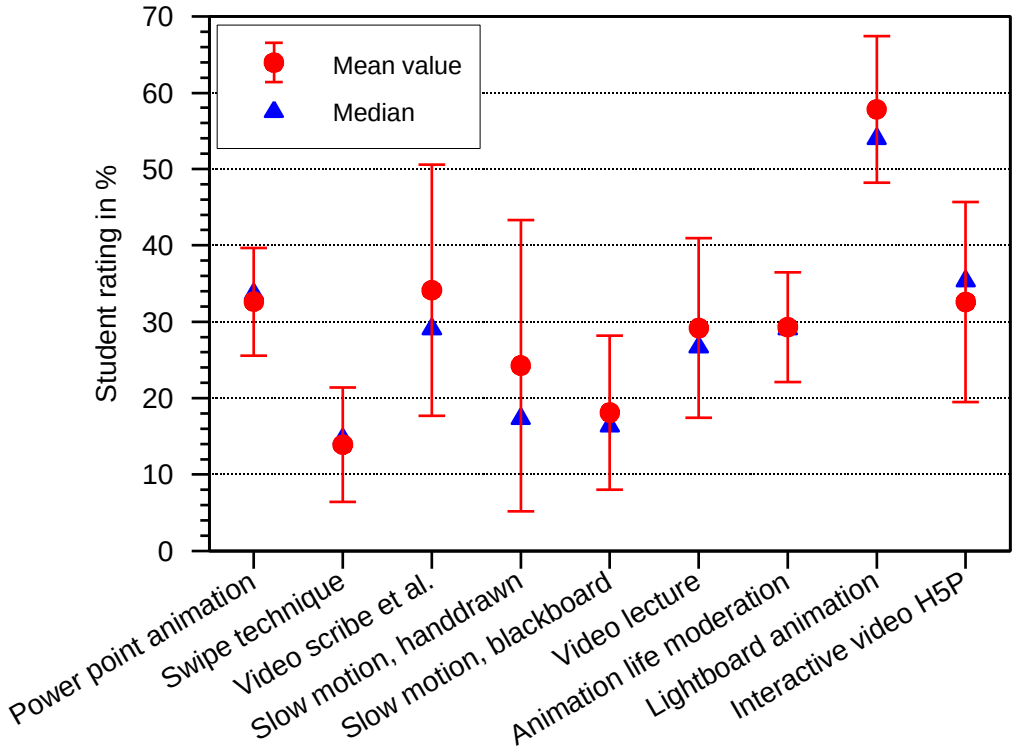

Figure 4: *Rating of Lecture Film Techniques 2016 until 2025*

4. Advantages of Lightboard Lectures over Lecture Videos

Table 1 highlights the key differences and advantages between Lightboard lectures and traditional video lectures as well as lecture videos.

Given the enhanced engagement, ease of production, and effectiveness in content delivery, Lightboard lectures offer significant advantages over traditional video lectures. Despite the initial setup requirements, the benefits for both students and instructors make Lightboard lectures a preferable choice for modern, interactive, and efficient teaching. Lightboard lectures are therefore a probate supplement of lecture videos and interactive teaching methods suiting the course setting Materials Science in Mechanical and Automotive Engineering at HTW Berlin. For this reason, the research was to study consumer behavior:

Table 1.1 *Comparison of Lightboard Lectures and Traditional Video Lectures*

Topic	Lightboard lectures	Traditional video lectures / lecture videos
Direct interaction	Lecturers face students directly, maintaining eye contact throughout the session.	Lecturers often turn their backs to the camera while writing on boards, reducing engagement.
Personal connection	Students feel personally addressed, enhancing engagement.	Students may feel less connected to the instructor.
Technical simplicity	Low-threshold production with minimal post-production, allowing for immediate availability.	Higher production effort with extensive setup and post-production.
flexibility	Can be created "just-in-time" based on student needs.	Not as easily adaptable for immediate student needs.
Content presentation	Real-time illustration similar to traditional chalkboard drawings, aiding in better comprehension.	Often involves straightforward lecture recordings without dynamic visual elements.
Video length	Typically under 10 minutes, preventing cognitive overload.	Longer video duration can overwhelm students.
Replay and pause	Students can control playback, reinforcing understanding at their own pace.	Limited ability for students to engage with content actively.
Consistency	No distracting technical transitions, maintaining focus on the content.	Visual transitions and other elements can disrupt focus.
Technical distractions	Lack of technical distractions maintains focus on the material.	Visual transitions and other technical elements can be distracting.
Production ease	Simple setup and minimal post-production allow for quick, on-demand video creation.	Requires more extensive setup and post-production.
Student control	Ability to replay and pause videos helps students learn at their own pace.	Less control over playback, which may hinder personalized learning.

Enhanced learning	Real-time development of scientific chalkboard drawings supports better understanding and retention.	Static delivery without dynamic visual elements may not be as effective in supporting understanding.
Attention Management	Short, focused videos keep students from feeling overwhelmed and help maintain their attention.	Longer videos can lead to decreased attention and cognitive overload.
Learning Experience	Direct eye contact and personal address enhance student engagement and satisfaction, improving learning performance.	Limited personal connection and engagement may reduce learning effectiveness and student satisfaction.

5. Conclusion

HTW Berlin manufactured a Lightboard for all lecturers to create accessible teaching units. A Lightboard, or learning glass, is a high-refractive transparent glass panel surrounded by LED lights. It allows instructors to write with fluorescent markers while being filmed from the front. The main advantage of Lightboard videos over traditional lecture recordings and lecture videos is the direct interaction. Therefore, Lightboard instructional videos offer an advantageous effective alternative to traditional recordings, as the lecturer maintains eye contact, making the content easy to follow. Videos are typically under 10 minutes, preventing students from feeling overwhelmed.

Main advantages of Lightboard lectures compared to traditional recordings are:

- Low-threshold: easy for anyone to start
- Can be produced on demand
- Minimal post-production time
- Lecturer maintains eye contact with students
- Good pace and short length (less than 10 minutes)

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