

# Increased number of high-quality digital laboratories for building materials courses through inter-university collaboration across Sweden.

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**Abstract**—Civil engineering and architectural studies comprise of a variety of courses including also building materials. Usually laboratory sessions are included as students can learn hands-on about materials. This way of learning is highly appreciated by the students. Covid-19 shifted all teaching and learning to e-learning, including student labs. A network of four lecturers from four different Swedish universities - LTH, Chalmers, KTH and LTU – was established to start a common repository of high quality digital student labs covering all kinds of building materials and materials testing.

**Index Terms**—building materials, collaborative work, engineering students, laboratories, video sharing,

## I. INTRODUCTION

**B**UILDING materials laboratories are an essential part of civil engineering and architecture education at universities. Here students can gather experience hands-on with different building materials like concrete, timber or steel. Not only are the laboratories informative but also students experience them as rewarding.

Pre-recorded video laboratory sessions were known before [1], but the Covid-19 pandemic accelerated the use of digital content [2,3] in online teaching. Determined to use the challenge of distance learning as an advantage to offer high-quality teaching, four lecturers from four different Swedish universities started to collaborate in producing and sharing lab videos. Collaborations between universities and industry [4], cross-sectoral like university and administration or non-governmental institutions [5], university laboratories [6] and universities and community colleges [7] are known worldwide. Nevertheless, successful collaborations between higher education institutions (HEIs) in the field of teaching are less common.

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## II. BACKGROUND

Civil engineering and architectural students commonly have to take at least one course in building materials. The most common course literature for this course in Sweden is “Building materials - Manufacturing, properties and use” by Per Gunnar Burström and Kjell Nilvér. Part of the training in building materials courses is carried out in the student laboratory. Traditionally, building materials courses often have a high number of students. These are commonly split into laboratory groups of 3-6 persons leading easily to 20+ student groups. These laboratory groups work hands-on several days in the laboratory, e.g. by learning on day 1 how to mix and cast a concrete while they come after seven or 28 days to measure the properties of the hardened concrete mix. This laboratory work can last several hours and requires laboratory safety equipment like safety glasses, laboratory coats, safety masks and protective gloves.

Due to the Corona pandemic, all teaching at Swedish universities was forced to switch to online teaching. This included also the student laboratories. Due to covid-19, building materials laboratories were not possible to be taught in the traditional way as the infection risk was too big and the protective garment incredible expensive or not even available.

## III. METHOD AND RESULT

As the building materials courses at all involved universities, KTH, LTH, Chalmers and LTU, are based on the same course literature networking between the institutions was easy. This collaboration led to the production of digital student labs and subsequent deposition in a common repository.

Due to the fact that all lecturers have different focus areas,

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e.g. timber or cementitious materials enabled a broad variety of digitalised laboratory experiments. In our case, it spans from the classic concrete casting via the building material timber, density calculations and the principle functioning of a pycnometer to durability testing and asphalt production. The video production was framed by regular online meetings to discuss content, progress and problems.

After completion of this project, all four universities can fall back on informative high-quality videos in Swedish created by experts that can be directly implemented in the teaching for the benefit of the students. This not only expands the student's range of high-quality course material but also gives teachers the possibility to an easy access of premium video content. The involved researchers agreed to produce additionally teacher manuals to make the videos free standing. These manuals should cover why this experiment is of interest, what students should be able to learn and important specifics of the experiments.

Moreover, during one of meetings it became obvious that another common repository for building materials related photos should be established. This will lead to another way to improve the teaching material of all institutions free-of charge.

#### IV. DISCUSSION AND CONCLUSION

COVID-19 has clearly shown the challenges and the opportunities of online teaching and learning; including the need for high-quality and interesting digital laboratories. Moreover, even after the pandemic this content can contribute to a better teaching and learning experience. Due to pre-recorded online laboratories, more labs can be offered to the students due to the time-lapse nature of the videos and the reduced teacher workload.

This work shows that collaboration in the area of teaching a specific course can lead to variety of interesting and useful results. In this case, it let not only to a repository of high quality videos, which can be readily used by any of the four partner institutions.

It also let to a cooperation between colleagues, which facilitated interesting and fruitful discussions. Each partner can learn something from the others as each is contributing with videos of their own field of expertise.

Moreover, another repository of building materials related photos was started. These pictures can be another source of information in lectures online or in face-to-face classes.

It can be clearly seen that combining forces of lecturers and teachers even or especially via institutional borders can lead to promoting teaching by enabling the utilization of a broader set of teaching tools.

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