



Concepts for beneficial teaching under pandemic conditions

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Abstract

In diesem Report wollen wir aufzeigen, wie Lehre unter Pandemiebedingungen nicht nur bewältigt wurde, sondern tatsächlich zu einem Mehrwert für die Studierenden geführt hat. Dazu analysieren und vergleichen wir unsere Erfahrungen aus drei Lehrveranstaltungen. Alle Veranstaltungen wurden vollständig virtuell und live gehalten und abschließend von den Studierenden evaluiert. Das positive Feedback wird Einfluss in die zukünftige Gestaltung dieser Veranstaltungen auch nach Bewältigung der Pandemie haben.

In this report, we want to show how teaching under pandemic conditions was not only managed, but actually led to added value for the students. To this end, we analyse and compare our experiences from three courses. All courses were held completely virtually and live and were finally evaluated by the students. The positive feedback will have an influence on the future design of these events, even after the pandemic has been overcome.

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1. Introduction

In the summer semester 2020 and winter semester 2020/21, the lectures "Solid-Fluid-Substance Exchange Processes" (FF-SAP) and "Product and Production Integrated Environmental Protection" (PIUS) were held by our chair as part of the optional module VNT-36 (K. Eckert). In addition, the optional lecture "Bubbles, Foam and Froth" (BFF, S. Heitkam) was offered for the first time.

In FF-SAP we lay the physical-technical foundations for relevant processes in resource extraction (including electro- and hydrometallurgical processes, nitrification in activated sludge tanks, fixed-bed adsorption or particle separation) and recycling (e.g. de-inking flotation for waste paper). The PIUS lecture, which was held by Dr Brummack until last year, has been completely relaunched to better link it to FF-SAP. PIUS is dedicated to environmental protection strategies as well as important aspects of the circular economy such as resource conservation and sustainability; eco-balancing is also included. The main goal of our PIUS lecture is to enable students to critically and ideology-free analyse problems at the interface of environmental protection and society/economy.

The BFF lecture was purely optional. It was created in connection with the Emmy Noether Junior Research Group on the topic of "Fluid Dynamics of Foams and Froth", which has been anchored at the Institute since May 2020. The lecture is intended to arouse interest in foams, convey the basics and introduce the methods and results used in the project into teaching.

2. Implementation

All lectures were held at the time announced in the lecture schedule via GoToMeeting or Zoom using PowerPoint. In addition, there was a calculation exercise every two weeks, primarily connected to FF-SAP. The recorded lectures were then placed on the ZIH cloud and the lecture PDFs were placed on OPAL before the lecture. The module exams, both of which had to be taken orally according to the current PO, were taken as presence exams.

As "pen people" who develop lectures live via tablet PC, the digital semesters initially presented us with considerable problems, as we had the feeling that the students would "fall asleep" in front of the PC if we kept this concept. Therefore, a lot of time has gone into digitising the lectures throughout the semester, as we are sure everyone has. In principle, however, the revision and specification of the FF-SAP lecture required for this has done us good. However, we were shocked to discover that we are now much faster than with the previous face-to-face lectures. We have counteracted this with four measures: (i) explain facts longer and (ii) usually offer 15-20 min repetition of the previous lecture. (iii) Provide additional computational tasks that can be worked on when time is available, thus creating a flexible buffer. (iv) We have made a special effort to link lecture content with current research topics of our chair or department at the HZDR. This has met with approval and has currently brought us an enormous number of student workers.

The BFF lecture pursues various goals and addresses different audiences: the lecture is intended to familiarise students of process engineering and natural materials technology with the very special but highly relevant topic of "foams". Furthermore, students of all disciplines should be enthused about foam and thus be won as future assistants or employees. In addition to students of process engineering, doctoral students in the engineering sciences should also be addressed here. Many international doctoral students feel that there is a lack of English-language courses at TU Dresden, especially in the field of fluid mechanics. Since doctoral students need appropriate courses to take their viva, an English-language alternative should be created with the optional BFF lecture.

Since the lecture had to take place virtually in the 2020/21 winter semester anyway due to the pandemic, the idea arose to make the lecture accessible to students and doctoral candidates at other universities. Therefore, the lecture announcement was published via subject-specific email distribution lists and in corresponding subject forums. Since no comparable lecture is currently offered throughout Europe,

the offer met with good interest, especially among doctoral students in foam-related subjects. In at least three cases, doctoral researchers were explicitly invited by their PI to attend. A total of about 30 listeners initially took part. According to a Mentimeter survey [1], about 20% of them were TU Dresden students at the beginning, 30% were doctoral students from the TU Dresden and other Dresden research institutes, and 50% were external scientists. In the course of the semester, the number of participants fell to around 20, with students from the TU Dresden in particular losing out. This could possibly be counteracted through laboratory practicals in presence.

The problem with a public announcement was access control. Without access control, there was a risk of misuse or disruption of the event. Therefore, the link to the Zoom meeting was only distributed individually upon email request. This procedure proved successful, as there were no disruptions.

The organisation of the course via OPAL was also problematic. Although external persons could download the lecture slides here using a password, they could not enrol in the course or be active in the forums.

The content of the BFF lecture was essentially based on three pillars. Firstly, scientific facts were taught. Secondly, calculation exercises were discussed in order to internalise the interrelationships learned. And thirdly, examples of the application of what was learned in academic and industrial practice were explained.

These columns have been adapted for the virtual format.

Pillar 1: Foams are generally a very interdisciplinary field of research. They combine physical, chemical, mathematical and engineering approaches. Since 50% of the listeners were external scientists and scholars, there was also a certain dispersion of training here. A Mentimeter survey at the beginning showed 70% from engineering, 20% from physics and 10% from chemistry. Because of this distribution, little prior knowledge was assumed. Instead, subject-specific basics were extensively introduced or repeated. In a face-to-face course,

more basics would probably have been assumed here and then further explanations added based on the direct feedback from the students. Based on the students' feedback (Figure 1), all listeners were able to follow the content well.

Pillar 2: The scientific basics were underpinned with 1-2 calculation exercises in each session. These were done in the middle part of the session to create a break and activate the listeners.

Compared to calculational exercises in presence, there were very few questions or discussions. Presumably, the students were uncomfortable presenting mistakes or ignorance for all to see. Instead, there was only a competition to see who could write the correct result in the chat first. A possibility for anonymous questions should be created here in future events, e.g. via Mentimeter.

Pillar 3: Since the lecture was originally designed for students of process engineering, there was a focus on the practical application of the scientific fundamentals. To this end, topic-related current measurement techniques or simulation methods were discussed in each lecture. At appropriate points, gaps in knowledge and the connection to our own research were also pointed out. Due to the participation of external scientists, Pillar 3 in particular led to very interesting discussions after the events. These discussions were very enriching as they demonstrated to all listeners how complex and diverse foam research is. If external guests cannot participate in future events, guest speakers should be invited or virtually integrated to demonstrate different points of view.

As just outlined with the BFF lecture, it was also necessary to break new ground with PIUS. The entire PIUS lecture was an intellectual adventure that kept me (KE) spinning the whole semester. I have rarely read so many books on current topics in one semester, in addition to textbooks, and incorporated them into a lecture. One really recommendable book that I

take the liberty of quoting is Christian Berg's [2].

Since, unlike FF-SAP, PIUS did not have a pre-fabricated framework to which one could adhere, the following concept was applied.

(i) It was important to activate the students in the "corona isolation". This was attempted by including current, also political topics and occasionally provocative theses. Great importance was attached to actively inciting the students to form an opinion. After the lecture, there was always a 10-15 minute post-session in GoToMeeting, where problems were discussed together with interested students.

(ii) According to the motto "why should only we struggle with the troubles of digitalisation", there was a podcast project in the first third of the lecture series. Here, the students were encouraged to critically approach important, lecture-relevant problems, e.g. economic growth vs. sustainability, from several sides and to come to an opinion. This was actively accepted by 2/3 of the students and very nice contributions were produced in groups of 2, 3 and 4 using Audacity. These were uploaded to the OPAL course upload folder and were thus accessible to the others. In a relaxed evening session, which was suggested by the students themselves, we went through the podcasts again. Overall, the podcasts were seen as a profitable venture by all: The students found the exploration of the topics exciting and had fun in the production with Audacity and we were able to do something about the Corona isolation. We had the chance to see what makes our students tick and were very taken with the depth of engagement.

(iii) The PIUS lecture also included discussions on sustainability concepts (such as efficiency/sufficiency/consistency etc.), which also included an examination of individual lifestyles. Optionally, there was an offer to go through everything in order to calculate the individual CO₂ footprint. Almost everyone participated voluntarily and uploaded their results to OPAL.

(iv) Life cycle assessment now plays a role in many projects. It was therefore important to us to offer an introduction to the topic coupled with a practical software exercise using free software (OpenLCA). This project had a scope

of 4 lectures: Introduction, installation instructions, three exercise blocks. In the exercise blocks, there were questions formulated by us, which the students were to investigate independently. The starting point was the official OpenLCA tutorial on mineral water bottle evaluation (advantage: well documented, accessible to all). We gradually expanded this to include more complex questions (e.g. different transport routes, multiple fillings, etc.). These 3 blocks, which included a free-style variant (i.e. a question that the students had to come up with themselves), were to be worked on in the time window of the last 3 lectures (June/July). During this time, the GoToMeeting channel was open and the students could discuss problems with us. The solutions found were to be uploaded to OPAL.

In the end, we did not use the option originally approved by the examination board to include 30% of the OpenLCA solutions in the examination. The technical and social precondition of the students were too uneven. However, almost all of them took part in the project. 90% completed at least one block; 70% uploaded solutions to all three blocks.

3. Our conclusion

Despite the high time commitment, we considered the semesters to be profitable. We were very positively surprised by the oral exam results. In FF-SAP, there were no differences to previous years. We were particularly enthusiastic about the PIUS examinations. It was a pleasure to experience the high number of smart and critically arguing students.

We see the following things as needing improvement in VNT-36: (i) Exercises in GoToMeeting are a difficult undertaking. In face-to-face exercises students always dare to ask more; in GoToMeeting rather less. Then you speak into the mic without seeing students, which was not much fun. That's why we mostly held the exercises as pre-calculus exercises with some questions live from the auditorium or via chat. Here we are very interested in an exchange for optimisation. (ii) Due to time constraints, the PDFs always had to be uploaded without further editing, i.e. without deliberately placed gaps. An efficient solution is

still missing here. (iii) In some lectures, Menti-meter was used to activate and test knowledge for concrete questions. This should have been done more often here. But on the one hand, there was not enough time for preparation; on the other hand, the scope of services of the free version was clearly less convenient than before. An alternative is, for example, umfrageonline.com.

4. Feedback from the students

An anonymous evaluation of the BFF lecture was carried out after the conclusion of the last event. Figure 1 shows the results.

It can be seen that all participants found the content of the lecture interesting. Most participants found the scope appropriate and were also able to follow the lecture well digitally. All participants found the online exercises helpful. These points speak for a successful implementation of the virtual event with the chosen format. However, 50% of the participants spent less than 10 minutes per week, in some cases even no time at all, on preparing and following up the course. This could be due to the optional nature of the event, but possibly also to a feeling of anonymity in the virtual space. Poor preparation on the part of the students is not noticeable.

The FF-SAP lecture was in the official course evaluation and was given an overall grade of 1.27, which made us very happy. We are trying to implement the remaining criticisms (better structuring now and then, incorporating more exam questions directly into the chapters, quizzes at the beginning).

Equally motivating was the spontaneous feedback from several students after the oral PIUS exam. They had rarely had so many exciting discussions among themselves about topics in a lecture as they had this semester.

This encourages us to offer academic content linked to current and, in part, political issues from time to time in order to stimulate students to take an active stance and form opinions.

5. Outlook on a hybrid teaching offer

We can imagine shortening some of the lectures to 30 min online video on a specific topic.

We would use the freed-up time, on the one hand, for the students to have to think about the problem and find solutions for it. On the other hand, for a consultation and discussion

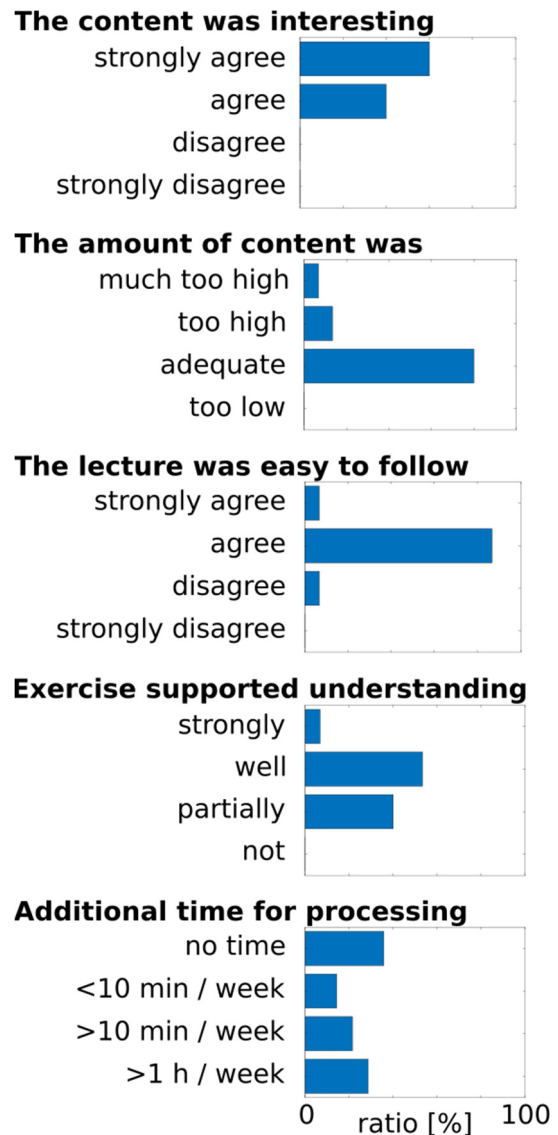


Fig. 1: Anonymous evaluation of the BFF lecture in the winter semester 20/21

session to discuss the questions that have arisen and the solutions that have been found. Apparently there is no dedicated lecture in the field of foams in Europe. Due to the very positive feedback from international students and doctoral candidates on the BFF lecture, the lecture could also be held virtually and openly in the future. Alternatively, a live stream from the lecture hall would also be conceivable. In addition to the pure teaching task, this would also strongly serve international networking and

student exchange. However, a laboratory practical should be added in the future for students in attendance.

Acknowledgement

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Literature

- [1] <https://www.mentimeter.com>
- [2] Christian Berg, Ist Nachhaltigkeit utopisch? Der neue Bericht an den Club of Rome, oe-kom-Verlag (2020)