



From a Teaching Disaster to a Teaching Success

Evgenia Sikorski¹, Michael Canz², Christiane Zell¹, Gerhard Kachel¹

^{1,3,4}Offenburg University, Department of Mechanical and Process Engineering, ²Information Center (Germany)

¹evgenia.sikorski@hs-offenburg.de, ²michael.canz@hs-offenburg.de,
³christiane.zell@hs-offenburg.de, ⁴gerhard.kachel@hs-offenburg.de

Abstract

The subject group Mechanics is a “classical horror subject of engineering education”. Teaching Mechanics to a group of students with widely different pre-knowledge and motivation is a real challenge. Still, after several years of hitting and missing, the lectures in Mechanics-1 (Statics) became a real success story constantly earning full marks in students’ performance and satisfaction (100%).

A totally different situation arose with the lectures in the Mechanics-2 course (Elastostatics) which was added to the lecturer’s workload in 2013. The regular teaching load at Universities of Applied Sciences (UAS) in Germany is extremely high leaving little room for didactics in a new course. To help a bit, the lecturer was given two parallel groups in this particular semester. One group, which was very nice and fully satisfied with the lectures in Mechanics-1 given by the same lecturer in the previous semester, became totally monstrous and uncontrollable in Mechanics-2 resulting in an extremely low evaluation of 25%, whereas the second group was completely satisfied with the same lectures (100%). Interestingly, the latter group had experienced a total disaster with Mechanics-1 lectures delivered by another lecturer in a previous semester.

Three lines of action were taken:

- 1. The reasons for the success of the lectures in Mechanics-1 were analyzed. They were found to lay in the model-based teaching method which makes the subject almost tangible. Quite a number of such models were developed and then built for Mechanics-2.*
- 2. A recently appointed highly-qualified pedagogue was called in to help in appropriately dealing with the code-of-conduct issues.*
- 3. Colleagues were asked to audit the lectures, give feedback to the lecturer and students, and consider other probable reasons.*

The actions helped: In the summer semester 2015, students’ satisfaction hit the incredibly high mark of 100%.

1. Lecturers: A survival game versus didactics

In the beginning, there was a teaching success. Actually, not in the very beginning, to be precise. For in the beginning, it is always a survival game.

In Germany, newly appointed professors at Universities of Applied Sciences (UAS) are given the full teaching load of 18 SWS from the first teaching term, i. e. 9 lectures a week, each of 90 minutes. Additionally, they have to apply for third-party funds to do research and actually get it. The reasons for this situation are probably to be seen in the fact that universities are more and more run like business companies [1.] With their probation period in mind, newly appointed professors have no choice but doing all this. As a rule, the probation period lasts three years and has to be taken seriously. This leads to a 60-hour workweek, at the very least, with no time left for didactics.

Didactics has to be postponed to an unspecified time later-on which, however, might never come. For study programs are volatile: They are created, improved once in a while, die out, are absorbed in other study programs. As a result, new lectures have to be taken over, the “old” ones shortened, or extended, or put on the All-this-was-for-nothing pile. Then, current versions of technical regulations have to be implemented – a never-ending process. And there are difficult and/or unhappy and/or lazy students to be dealt with. Well, there are colleagues, too.

With absolutely no time to spend on didactics, there is no use in any didactical instructions. Newly appointed professors are offered (by an institution run by the Ministry of Education) a three-day workshop which they actually have to attend. In the workshop, they are not given the much needed survival manual but, almost ironically, an extended “instruction to cheerful self-exploitation”. After the workshop, denial is complete and every hope gone – welcome to a survival game!



2. Inappropriate students?

A noticeable rate of German freshmen has no serious ambitions to graduate; they get enrolled just for the sake of being enrolled for a while. Fresh from High School, they do not feel like being interested in a job or any kind of training. To avoid staying “nowhere” they get enrolled. In a program with no enrollment restrictions, that is. This applies to most of the Engineering study programs. In Germany, there are no tuition fees to be paid but significant benefits to be gained (low-cost health insurance, children’s allowance, financial assistance offered by the state).

Some of the students start studying merely for a lack of alternatives: Their school grades are so extremely poor that no company is prepared to accept them as apprentices. Depending on the study program, between 27% and 57% of our freshmen achieved school grades of 3.0 or lower. (In Germany, 1.0 stands for the best grade possible; 4.0 for the last passing grade.) With the study preconditions being that poor, the students are bound to drop out in most cases. Unfortunately, there is no statistics on their study progress yet.

On top of all this, attendance at lectures and tutorials is not compulsory. The attendance rate of freshmen might be anywhere between 50% and 70%. As the dropout rate is assumedly higher than the absence rate, there we have the logical consequence: The dropout rates in engineering study programs at Offenburg University are as high as between 20% and 60% (Table 1).

Table 1: Dropout rates, average school grades and time of study in Engineering programs

Study program	Dropout rates	Average school grades	Average time of study ^{*)}
Mechanical Engineering	20% ... 28%	2.5	8.0 semesters
Process Engineering	33% ... 50%	2.7	8.7 semesters
Energy Systems	40% ... 60%	2.9	no data

^{*)} Regular study period is 7 semesters.

The diagnosis is easily made: the need for appropriate enrollment restrictions! Yet, a distinct increase in the academic penetration rate is a proclaimed goal in Germany, especially so in engineering education. These results not only in a dramatically increasing heterogeneity in freshmen’s study qualification and motivation – the ratio of “inappropriate” students is getting higher from year to year. Students who do not attend the lectures are a problem for the university to be solved, though. For the lecturer, the real problem is students who show up only once in a while, do not participate, and do not do any homework. A number of private conversations revealed that, with neither midterm exams nor intermediate homework checking, students keep assuming for too long that, somehow, they will get away with it in the end. They think that a policy of no-compulsory-attendance means there actually is no need to attend. In the middle of the term, they eventually get unhappy, nervous, and even nasty. Can they be cheered with Mechanics? Yes, as a matter of fact, they can.

3. A teaching success with Mechanics-1 (Statics) lectures

It takes more than a couple of years of teaching experience and more than one really-really nice and hard-working students’ group to bridge the gap between Mechanics being a “classical horror discipline of engineering education” which has to be taught to “partly incapable, lazy, and nasty monsters who should not be here” on the one hand and “Let’s-have-fun-Mechanics!” on the other.

There is no secret to it; it is hours over hours spent on collecting (from colleagues, books like [2], the Internet), developing, building-up a set of obvious, easy-to-understand, and funny problems that gradually leads to the point and creates a feeling of “You can easily see what it is all about”.

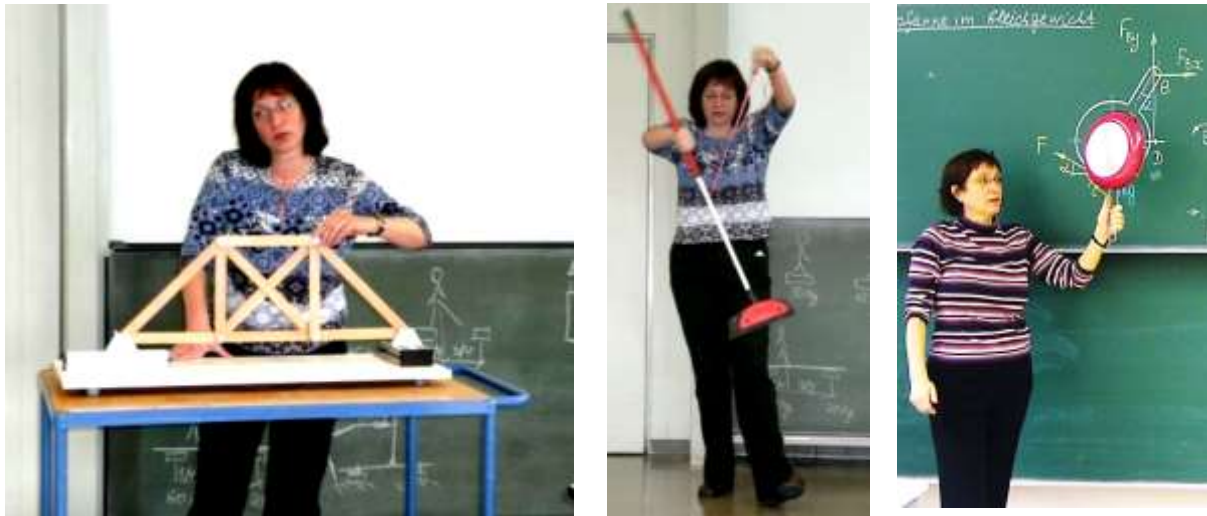


Fig. 1: Models for Mechanics-1:

left: A model of a truss bridge made up of 10 rods; every rod can be removed separately;
middle: A sweeping broom at equilibrium; right: A frying pan at equilibrium.

One main model was developed at least for each topic and there are several side-models, too, so that in the end almost every third lecture could profit from a model. And last but not least: Every student who comes up to the blackboard, shows or explains his/her point or opinion, or otherwise contributes to the subject gets “a reward” – a nice paper-clip with the logo of Offenburg on it. Students who are not in possession of a clip at the end of the term get one “at the parting”. Accepting the clip, they are asked to promise (merely to themselves) to do their best in the exam.

Once the lecturer has got all this, easy goes the rest! There is a nice song to be sung “Don’t panic with Mechanics!” [3]; and it is sung cheerfully (quite remarkably so, given that singing is not exactly widespread in engineering education)! Ask the students to come up to the blackboard, and they do so readily! Ask them “What about a nice and pretty piece of homework to present in the next lecture? – Any volunteers?”, and there always are some volunteers! The best of students are actually pleased when asked if they would like to be tutors in Mechanics next term!

Given the nice working atmosphere, everybody agreed to video-recording of the lectures. They were uploaded on the e-learning platform. Students keep logging in literally all the time (except for Christmas Eve, to be precise).

All in all, the lectures in Mechanics-1 work brilliantly, are great fun for everybody and have been evaluated with 100%, term after term. Unfortunately, this was one of the reasons for the teaching disaster with the Mechanics-2 lectures in the summer term 2013.

4. A teaching disaster with Mechanics-2 (Elastostatics) lectures

How much fun are students entitled to during their studies and who is in charge of that fun? It is close to a miracle that some (!) Mechanics lectures can be fun. However, it does not revoke the fact that Mechanics remains what it has ever been – a classical horror discipline of engineering education.

As it happened, a nice students’ group, prettily happy with the Mechanics-1 lectures, met the same lecturer in Mechanics-2. The students were expecting the great fun to continue and immediately got disappointed when it did not.

The stepping-stones of the teaching disaster were disastrous students’ behavior. Some of the students repeatedly showed up late by up to thirty minutes in the early lectures (beginning at 08:00), dropping in with no greeting, no excuse, and no explanation on the reason for being late. Some students were almost constantly talking to each other or frequently using gadgets like smartphones. A few students were about to eat their lunch, chewing gums, yawning at length. Many a request to behave properly brought no results. After a while, the lecturer had no choice but to send a next trouble maker packing. This helped the behavior but was too late to save the learning atmosphere. Accordingly, the evaluation of the lectures was extremely poor – some 25% of satisfied students (nothing under 50% is considered acceptable).



Admittedly, the Mechanics-2 lectures were new for the lecturer and, given the usual, extremely heavy workload, no lecturer can be didactically good at a new course in the first go. The seemingly obvious conclusion would have been that the lectures were just poor due to the first go. However, there is more to the story.

To help the lecturer a bit to survive the first go, the lecturer was giving the lecture in question in two parallel groups in this particular semester. While the first group got totally monstrous and uncontrollable, the second group was completely satisfied (evaluation of 100%)! Interestingly, this second group had experienced a total disaster with Mechanics-1 lectures delivered by another lecturer in a previous semester (all but one student failed the exam). Probably for this reason, they were taking Mechanics very seriously at last and thankful for every help.

Given the extremely different evaluations by the two groups, it was even presumed that the students of the first group were waging a proxy war. The basis of such a war might have been extended heated arguments between colleagues which involved the first students' group only. It is very unlikely that lengthy intense disputes between colleagues have no effect on the students, especially when the students-are-always-right attitude is a trump card in these arguments. The students were even summoned to vote the particular lecture course in Mechanics-2 out of their curricula, so that the guess about a proxy war being waged by the first group might be not be that far-fetched.

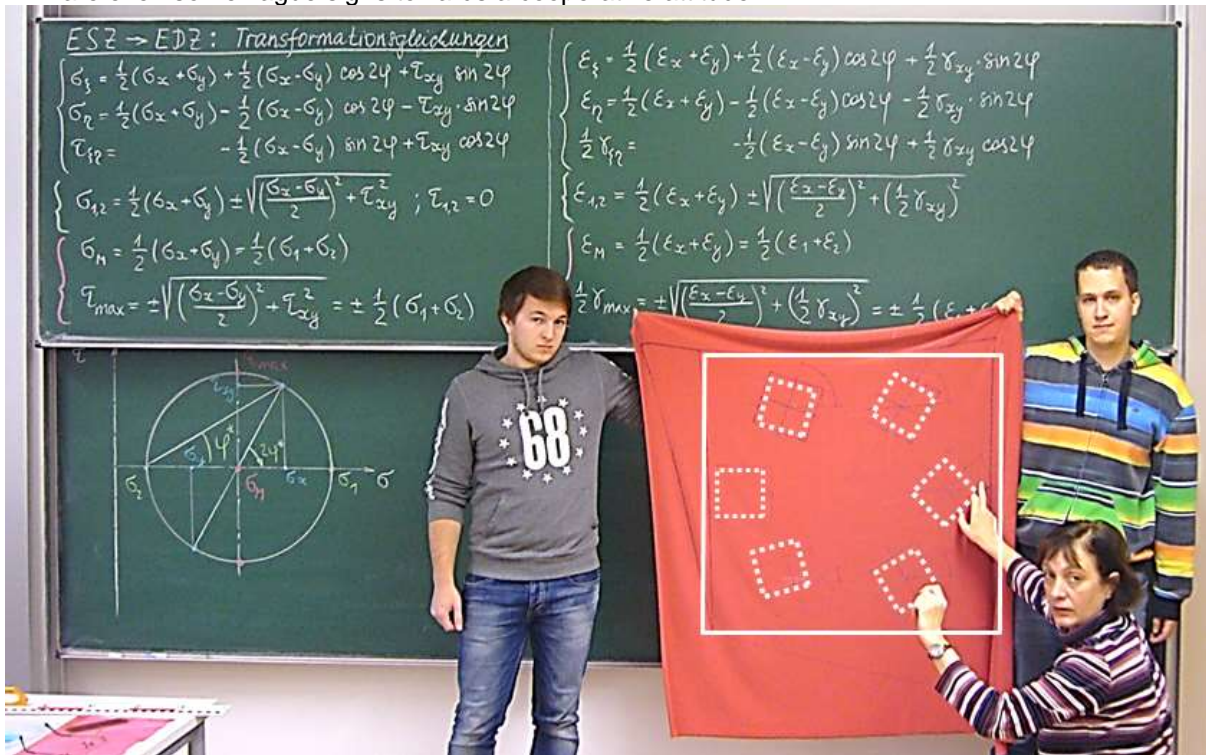
Three lines of action were taken:

1. The reasons for the huge success of the Mechanics-1 lectures were analyzed. They were found to lay in the cheer-and-challenge-approach made possible by the model-based teaching method. Quite a number of such models were then developed and built for Mechanics-2. Even with most of them not working properly in the summer term 2015, they helped a lot.
2. A recently appointed highly qualified pedagogue was called in to help in appropriately dealing with the code-of-conduct issues.

The solution seems easy: no showing-up late, no gadgets, no eating, no chewing gums allowed in the lectures. The rules have to be announced at the very beginning of the course and implemented firmly. It remains to be seen how this approach is going to work with the next "nasty" group. (There has been no other such group yet.)

3. Colleagues were asked to audit the lectures, give feedback to the lecturer and students, and consider other probable reasons.

For reasons too complex to be gasped, disagreements between colleagues got to a hold. There are even some vague signs towards a cooperative attitude.



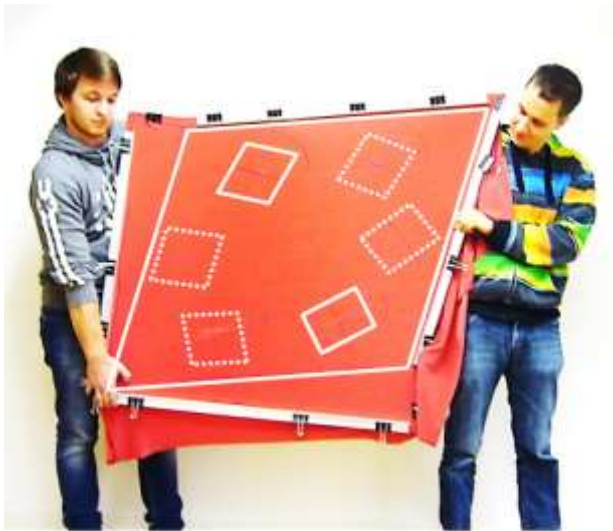


Fig. 2: The most illuminating model for Mechanics-2: Deformations caused by plain stress and strain are made obvious; it took around 100 working hours to develop; built by Werner Falk.

There is no way of telling apart which one of the actions helped to what extent - but they helped: In the summer semester 2015, the students' satisfaction with Mechanics-2 lectures hit the ceiling showing the incredible 100%.

References

- [1] Clemens Knobloch, *Wir sind doch nicht blöd! Die unternehmerische Hochschule (We are not that stupid! The Entrepreneurial University)*, Verlag Westfälisches Dampfboot, 2010.
- [2] Oliver Romberg, Nikolaus Hinrichs, *Don't panic with Mechanics!*, Vieweg-Verlag, 2006.
- [3] *As an Engineer: Herr Dr. Hüser & Herr Dr. Romberg*, 2011, Track 05.
- [4] Michael Canz, Evgenia Sikorski, *Enhancing students' learning skills by enriching the lecture "Mechanics 1 / statics" in various interactive ways*, *New Perspectives in Science Education*, Florence, 2015, 4 p.