

The challenge of unprepared students in inverted classroom teaching scenarios

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Abstract

In higher education the more and more common teaching method “inverting classroom” comprises of 2 phases: the self-study phase prior to the course and second the in-class or online sessions where discussions take place and students work on projects, extended hands-on lectures or exercises in class. First year mechanical engineering students are offered different teaching materials (mainly lecture videos, lightboard videos and micro-module lectures) to study from a distance and comprehend the principle underlying science in theory. Presence or online plenary lectures offer the opportunity to apply knowledge and transfer different scientific aspects of the course to get the bigger picture. However, there are always students unprepared causing huge diversity, irritating the lecturer and classmates and therefore threatening to imperil the desired learning outcome. This paper offers different practical experiences with no, little and sufficient success from 10 years of experience with teaching inverted.

Keywords: *inverted classroom, flipped classroom, online teaching, unprepared students.*

1. Introduction

Inverting the classroom: Seteren et al. (2019), Pfennig (2021), Walsh, O'Brien, Costin (2021), Haynes and Currie (2020) is now a well known teaching approach where students are given more responsibility for their learning progress which was found to encourage critical thinking: CSU (2015) resulting in deeper learning outcomes: Goto and Schneider (2010). Inverting the classroom has a positive effect on self-efficacy beliefs and intrinsic motivation: Thai et al. (2017) especially in MINT courses: Setren et al. (2019) courses where fact-based teaching dominates such as introductory science courses: Pfennig (2021).

The principle of inverting the classroom requires students to study the science on their own before class or online session. Advantages are: no time limit and place independency. In class usually lecturers answer questions and discuss details. Students solve hands-on problems,

perform group work and master difficult problems. Because the method clearly enables students to discuss early and communicate in equal measure: Pfennig (2021).

1.1. Practical leads for inverted classroom teaching

During self-study periods of the blended learning: Eryilmaz (2015) – and in summer semesters SS2020-2021 fully online Material Science course at HTW Berlin approximately 45-70 students per semester individually chose, combine and study alone or in study groups from a distance. Exercises, worked solutions, self-assessed tests and peer-instruction during present time help students to check on their learning progress. To meet the course's learning outcome and overcome the diversity of a first year class different practical leads have been proven important to turn flipped classroom teaching into success related to formative assessment: Pfennig (2021):

1. Start with low threshold tasks when assessing the first flipped classroom lecture.
2. Close guidance of students' self-study period is highly advised.
3. The learning outcome is more successful in homogeneous study groups.
4. Transparency of learning outcome, assessment and workload right to the beginning.
5. Organize the online course formally (not by content). Alternative: arrange by week.
6. Use templates to summarize the learning outcome of each study session.
7. Use (online) face-time for interacting hands-on problems not content transfer only.

2. How to deal with unprepared students

Gulley et al. (2016) state that the understanding and retention of course material was improved along with effective use of time in class. However, the effective use of time in class is decrepid when students do not use the self-study period to thoughtfully and comprehensively prepare for in-class activities or even do not study at all → even if all practical leads are followed. The following practical experiences describe 4 different approaches to motivate students to prepare well during self-study periods.

2.1. No success: Relying on students' self-employment

Just because young adults entered (applied) universities does not turn them into fully self-relying individuals taking assignments as an offer to brighten their insight. When pandering to their matureness approximately 40% of the students are not or insufficiently unprepared. There are various reasons (all comprehensible) such as: too little time, too little understanding, familie/friends duties, lacking skills to work the content management system cms, etc.. Most of the time only the highly intrinsically motivated students are prepared and often those are the ones who are ahead of the class anyhow. Even if lecturers deny their role as in-front teacher a fully cooperative approach fails most of the time.

2.2. Little success: external guidance and assessment of self-study periods

Clear guidance of the weekly workload is necessary to give students a guideline of necessary learning items and transfer skills. However, even if announced early the formative assessment of the self-study period puts extra stress on students and is threatening to most of them because they are always insecure whether they studied the right content and amount. This extra pressure “brings them to work” but will lead to a disliking of subject, no inner understanding, lack of transfer skills in the long term.

2.3. Sufficient success: formative assessment after face-to-face or online time and clear routine during present time

The self-study routine and frequent testing has to be announced right from the beginning of the course. All grade-relevant activities need to be outlined and explained in detail to students ahead of the course and ahead of the distinct self-study period. It is highly advantageous to give students the learning objectives of each assignment and its arrangement in the entire course. Guiding questionnaires or questions for lectures, lecture videos, papers, etc. help students to stay focused. Clearly, the lecturer should encourage students to ask questions arising during the assignments or self-study periods so that she/he receives difficulties from many students that may be solved in class. Students appreciate that they are able to distribute the workload according to their own schedule and learning styles.

The face-to-face time should follow a clear routine. Lecturers should always give feedback and respond to questions in an appreciating manner, so that students may get used to the teaching method, adapt easily and lose timidity. Right from the beginning of the class or online-session students and lecturer get the picture of the class knowledge using questionnaires via class response systems such as: invote (<https://invote.com/>), kahoot (<https://kahoot.com/>), mentimeter(<https://mentimeter.com/>), etc. Answering questions is crucial after the self-study period. Also, important issues need to be explained individually – either by fellow students or by the lecturer. Soon students start to be less timid because they know, that this is their time to fill knowledge gaps without being judged or assessed always following the class rules. It is often advantageous when the lecturer keeps out of sight of the students and has two students moderate and take notes at the black board so that no question remains unanswered. Even break-out sessions in online courses are helpful because students collect questions, discuss answers and then contribute to the plenum. From experience students usually prepare questions well from the second inverted teaching scenario on. Therefore, it is helpful if the first topic covers introductions and explains the teaching method while performing it.

Even in the pandemic semester of 2021 there were students who stated that the micro exams and graded activities throughout the semester forced them to work during the semester when they usually would not do this intrinsically motivated. Testing students after every inverted

classroom scenario cuts the workload into small pieces easier to handle for most of the students. Students are aware of the lecture objectives and their assessment (% of total grade), have enough time to adapt and organize their learning procedure and focus on the testing/questioning afterwards. Moreover, one failure does not effect the entire grade. However, formative assessment throughout the semester puts extra stress on some of the students and might hinder them to perform equally as they would in a final exam.

2.4. Sufficient success: extra assignments, templates and appreciation of work

Along with the homework assignment (Moodle online micro-lecture, memory sheets and voluntarily reading of a simple and short scientific research paper) one specific technical term has to be explained in a topic related glossary. This is commented and corrected by the lecturer during the self-study week of the homework assignment. Here, students were able to offer their learning progress and understanding and collect easy points adding to the total grade.

Again, class response systems and time for questions and answers give the lecturer an overview of the student's knowledge and help students to assess their learning progress. Then students were divided into groups with 4-6 students each. As part of the inverted classroom scenario a special template had to be used to summarize the results (Figure 1) during face-to-face time or results were presented via a miro-board (<https://miro.com/>) or padlet (<https://padlet.com/>). Later these templates are used to gain class knowledge and provide short and correct learning material for every student.

To ensure nearly homogeneous working groups in terms of scientific background knowledge students who were not able to work properly at home were asked to form a separate group. The manner of announcing has to be very valueing so that unprepared students do not feel ashamed, excluded or even mobbed. The most successful route to address students is self-evident, e.g.: "Those who were not able to prepare sufficiently at home form group G. You will work on the problems from a different angle and enrich the other groups with new perspectives and fresh knowledge". There has never been a problem with any students up to now. However, next time most of the students are prepared. Talking to students in these separate groups the most important incentive to study properly during self-study time is to later work with their peer-group and friends. Also, some did not like that their fellow classmates knew that they did not prepare. At the same time did not want to bother those who worked at home because they still wanted to contribute to the group assignments.

How to deal with unprepared students in inverted classroom teaching scenarios

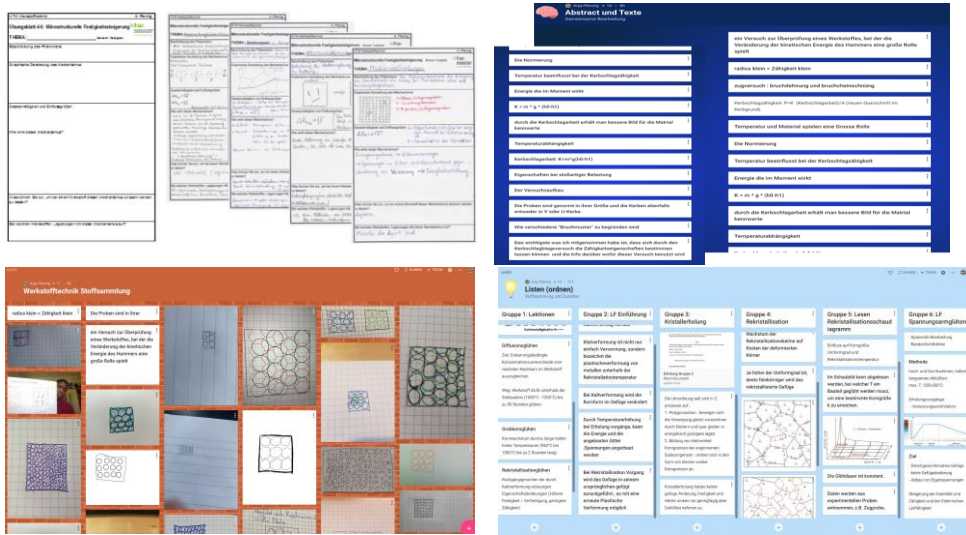


Figure 1. Securing learning outcome using templates during group work or break-out sessions and padlet/miro boards to visualize results.

The assignments in the “extra”-group is generally more basic and circumferential with distinct focus on certain aspects depending how large the group was. Later these students were then intermixed with groups working on the hands-on problems.

During presentation of the results most of the time students volunteered to moderate who were part of the “unprepared” group before. The lecturer collaborates and cooperates with the presenting student groups. Formerly unprepared students in general contribute equally. Advantage of this class peer-review system is that students work independently on their summaries and learning basis for preparation of the micro-assessment. The lecturer only intervenes if there are scientific mistakes or insecurities and in the end approves the outcome. The revised templates and learning summaries are made available for all students. After the presentations usually more advanced micro projects were performed in groups of two students where usually all students – prepared and unprepared – performed equally well.

3. Evaluation of methods with sufficient success

Testing the following day proves sufficient understanding and delivered little diversity of prepared and unprepared students when considering high performing students. But, more of the unprepared students fail (Figure 2) because time and deep understanding seems to be crucial to perform well which may not be achieved in a four hour face-to-face or online session. As an example the overall grades of the covid 19 summer semester 2021 (Figure 2) are in alignment with other semester. However, the topic heat treatment is one of the most difficult topics of material science in the first semester and therefore grades are mediocre – especially in the

pandemic semester of 2020 and 2021. Note, that these practical experiences do not show summatively whether unprepared students are turned into prepared other than feedback from colleagues teaching advanced courses who confirm improvement during the last semester.

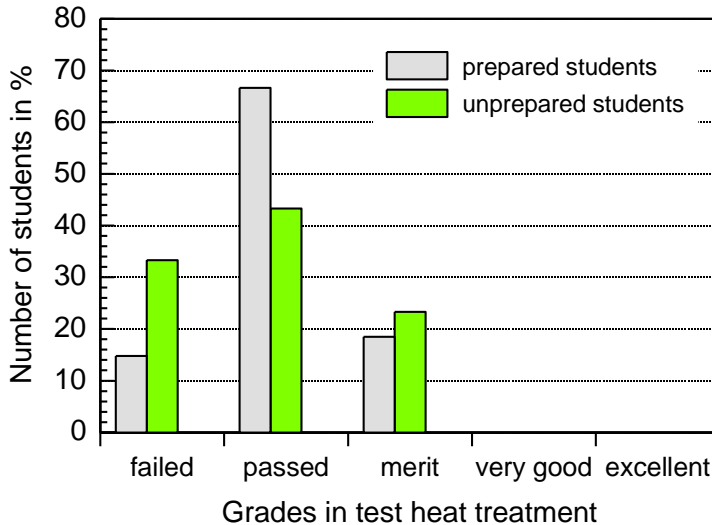


Figure 2. Example of typical results of compulsory online exam on hardening mechanisms SS2021 (chosen to demonstrate the performance of students in fully online semesters due to the Covid-19 pandemic)

Generally, students rate the self-study periods useful to get self-organized and learn complicated scientific issues according to their own independent time schedule and learning velocity (Figure 3). Self-study periods prepare well for class are not too difficult or enhance insecurity upon correctness of the study contents but are time consuming (Figure 3). There are many reasons for students to not prepare well for face-to-face time during assigned self-study periods such as: lack of self-efficacy and attentiveness, inefficient learning habit, family to take care, lack of motivation and/or interest for the subject, missing of the connection to mechanical engineering, missing seriousness of studying, etc. No matter what reason, there will always be unprepared students who are hard to integrate and may spoil an entire face-to-face time –even a carefully planned course session. Pressure or exposure of those students is no solution at all because the embarrassment normally discourages students and negatively influences their study motivation. However, even if intrinsic motivation of students remains the overall objective, formative assessment accompanied by clear and open advice and discussions is sufficiently successful to reach the desired learning outcome. The well prepared extra topic for unprepared students that are intermixed with the regular working groups later seems to be one of the best choices to deal with unprepared students. They study during class and contribute their newly gained knowledge to enrich the group work. Hence, mild pressure and special assignments along with forthrightness of the course structure and assessment as well as learning outcome seems

to be the best option – even if it requires more time to prepare these inverted classroom teaching scenarios. The author wants to note that these strategies also help prepared students but aim at integrating unprepared students into ongoing activities throughout the semester.

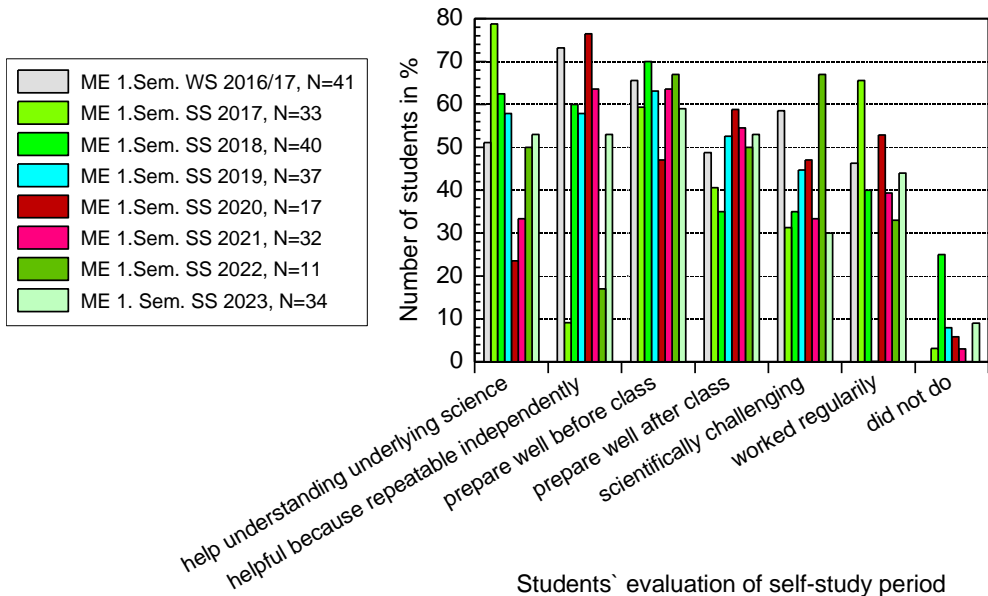


Figure 3. Students evaluation upon the self-study periods in inverted classroom teaching SS2016 to SS2023. Note, SS2020 and SS2021 were fully online semesters due to the Covid-19 pandemic.

4. Conclusion

Inverting the classroom challenges lecturers because unprepared students may spoil an entire face-to-face session leaving frustrated lecturers and even more important frustrated fellow students. This teaching method, however, offers a profound solution to achieve a more homogenous learning outcome with students individually choosing, combining and studying alone or in study groups during self-study periods. To meet the course learning outcome there are possibilities to deal with unprepared students besides relying on students' self-employment which is unsatisfying most of the times. External guidance and assessment of self-study periods (formative assessment) offers little success only addressing conscientious, ambitious and high-achieving students. Formative assessment and clear routines in class are a good approach to meet the desired learning outcome. However, the mild pressure of formative assessment and special assignments for unprepared students along with forthrightness of the course structure and assessment as well as learning outcome seems to be the best option – even if it requires more time to prepare these inverted classroom teaching scenarios.

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