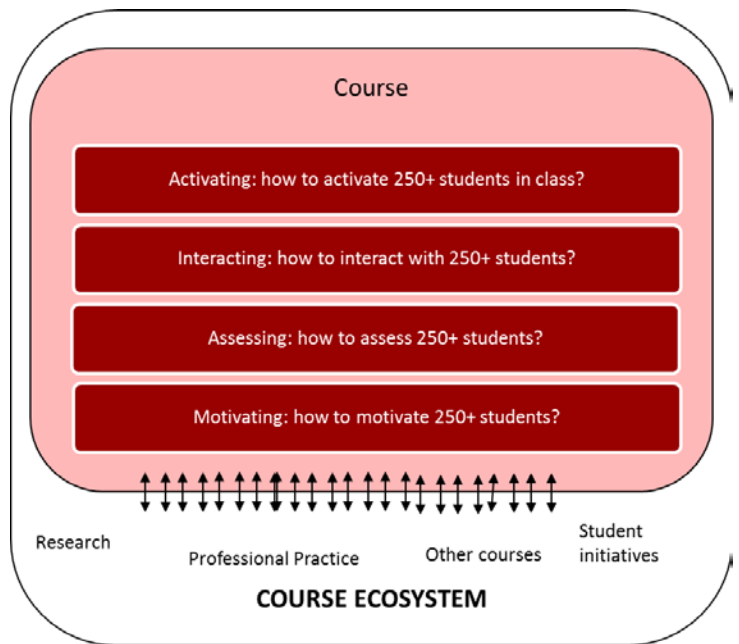Based on our experience, we identified four challenges involved in educating large groups, as well as the need for a fruitful ecosystem, displayed in this figure and described in the next paragraphs.



**Activating:** Biggs (1999) seminal research showed that students learn when they *actively* engage with the content of the class, as opposed to being lectured at (regardless of how good the lecturer really was). The research questions the effectiveness of the widely used 'church style' teaching, where one lecture gives, at best, a little show on the subject of the day.

Activating students in a large group can be challenging. Activating a few students into a topic is relatively simple, as it is easier to 'know your audience' and connect to what students are interested, or have experienced, or knowledge shared across the cohort. Moreover, small group discussions, conversations and debates are less time consuming and intimidating and can be powerful tools for activation. However, in large groups, there is often little common denominator across all students in the room. If the subject or example interests 25% of the class, the other 75% are bored and already deviated attention elsewhere. Group exercises where students will actively engage with subject is obviously also possible with large groups, however, lecturers have difficulties to overseeing and interacting with all the different groups, guiding the exercise and encouraging the required reflection. Often also the classroom itself doesn't enable group discussion. This leads to the challenge: How to activate 250+ students in class?

**Interacting:** Interaction between lecturer and students is known to be a key contributor to learning. Another evident problem of educating large number of students is that lack of individual attention and closer interaction with students at individual or small group level. A two-way communication in class is diminished and we have difficulties to understand what are the strengths and weaknesses of students, so we can help them develop even further. Moreover, changes to course design cannot be readily assessed. For example, how do we know that a single e-mail or comment is representative of the entire class or at least a reasonable fraction of it? We know a stronger interaction is relevant for learning, and yet it is impossible to interact at personal level with all students of a large group. Hence, we posit the challenge: How to interact with 250+ students?

**Motivating:** Education research suggests that the motivation to learn and the actual learning is highly correlated with the enthusiasm of the lecturer and the student's perceived relevance of the subject (Cooper & Robinson, 2000; Mulryan-Kyne, 2010). Motivation theory provides us with some other cues to enhance motivation. For example, recent studies like Pink (2011) suggest that autonomy, mastery and purpose are important components in motivating people in workplaces, and such findings can be expected to be reproducible in education. Hence, research thus far suggests that some elements of motivating are idiosyncratic, and hence based on a better understanding of the individual, or the provision of enough options that would cater to a wider variety of interests. As larger groups are more heterogeneous, the differences and sometimes conflicting interests between students become mind-blowing. Catering to such different audiences, while still having a common ground to discuss the content of the course is very hard. How can we make the subject relevant to each student? How can we convey the subjects in the course in an appealing and interesting way to all different students? How can we show our enthusiasm to students in a large group? In short, how to motivate 250+ students?

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**Assessing:** Assessment is a key component of course design, and will have a major influence in student's learning (Gibbs & Simpson, 2004). Assessing large number of students is though a challenge. It is much less time consuming and enjoyable to assess 30 than 300 essays. In some cases, grading a large number of essays, exams and oral exams requires a group effort, which increases the demand on coordination work and risks inconsistencies between evaluations. For example, in 2015 we conducted an oral examination of around 200 students. The exam required the coordination of approximately 15 sensors and faculty members, and was run for seven days fulltime. Thus, educating a large number of students will invariably lead to an assessment problem.



**Student's Syndrome**
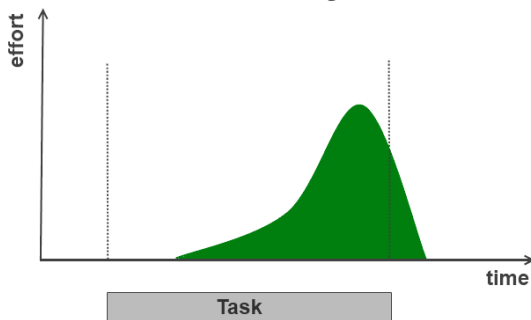
The problem becomes more pronounced as we raise our expectations in terms of the intended educational experience. The so-called student syndrome is a well-identified student behaviour in regards to assessment and deadlines. It postulates that the amount of effort dedicated to a task increases disproportionally as it gets closer to a deadline, as represented in this figure.

This behaviour decreases learning effectiveness, as it encourages short-term memorisation and cursory engagement with concepts. Provided used with care, and avoid overassessment, a mix of formative and summative assessments can be used distributed across the duration of the course (at least more than only once in a 13-week period) is useful approach to avoid the student syndrome and distribute workload of the course across time.

Thus, ideally, there will be not one assessment per student, but several, across the period of the course. In large classes, such approach consume too many resources, and hence hamper our academic and research progression. What other alternatives are there? Do we need to get back to multiple choice exams? If so, how? In summary: how to assess 250+ students?

**Ecosystem:** Unlike the other four challenges, the ecosystem is related to the analysis of the course within its larger context. Such context can help or hinder the development of larger classes. The key insight is that education is not confined to the classroom. Apart from the development of the course itself, there is also a need to develop a fruitful context for the development of the discipline within DTU. This includes solid and substantial research, understanding of the needs from practice (and avoid ivory tower approach to education), and provide students with opportunities to practice, research and further develop on the discipline during their studies. Such context is useful as more students become interested in the subject. However, it also means for example, more supervision of master thesis and other student related work, etc. The resources become again a bottleneck, and the coordination of the tasks itself becomes time consuming too. But it also means that we can empower students to develop opportunities for themselves, own and shape their learning journey. Therefore, how to shape the ecosystem of a course to help educating 250+ students?

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