ENG-622   **Science and Engineering Teaching and Learning (2019)**

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Cursus	Sem.	Type
EDOC General and external courses		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Project report
Workload	60h
Hours	**52**
Courses	8
Exercises	8
TP	36
Number of positions	**24**

Remark

Registration via IS-Academia

Summary

This course introduces contemporary research findings in the teaching and learning of science and technology subjects in higher education, develops participants' teaching skills, and provides a framework for on-going development of their skills through evaluation of their own teaching practices.

Content

There have now been multiple reviews of the implication of learning sciences research for teaching. While it is impossible to distil such a rich body of work into a few catchphrases, certain key features do emerge:
1. Learning is an effortful process, which requires the student to process information or to practice using skills. The goal of teaching therefore, is to facilitate student work. This implies trying to avoid learning situations where students are mentally passive (e.g. the traditional frontal lecture).
2. Students and pupils learn best when goals are clear, and when they get feedback on how well they are meeting those goals and how they can improve. In higher education the use of techniques like student response systems ("clickers"), on-line quizzes, and mid-term tests, can maximize ongoing feedback to students. Peer evaluation and grading rubrics can be used to help to clarify learning goals.
3. People learn best in emotionally secure environments in which they can try, make mistakes, and get feedback without being made to feel inadequate or ridiculed. There is also evidence that, in higher education, in classes experienced as emotionally safe by teachers, their teaching approaches become more student-centered and less focused on simply 'transmission of information'.
4. Students learn best when they get to revise material over time. In particular, periodic low-stakes testing, and practiced recall have been found to have strong positive impacts on learning. In university contexts, where courses typically continue to introduce new material each week, mid-term tests and self-assessment quizzes can play an important role in ensuring long-term learning.
5. Students who are taught how to independently plan, monitor, de-bug and review their own learning, on average, outperform students who are not educated in such metacognitive regulation strategies. Students can be helped to develop this independence through the provision of clear learning goals, self-assessment activities, opportunities to review their own learning and chances to discuss their learning strategies with other students.
While these issues apply across teaching and learning of all disciplines, specific issues arise in teaching science and engineering. The epistemologies of natural science disciplines are distinct from those in humanities and social sciences and these require teaching methods appropriate to these goals (such as, for example, inquiry-based methods, mathematical modelling of physical phenomena etc.). Engineering disciplines also have specific features such as the need to transfer analytical skills learned in classrooms into practice situations, and the key role of enginering design. Teaching science and engineering, therefore, requires pedagogies which are distinctive as well as evidence-informed. The goals of this course are:
(a)   To introduce novice teachers in higher education (doctoral teaching asistants) to these contemporary research-informed approaches to teaching
(b)   To provide opportunities for novice teachers to practice these skills
(c)   To provide a framework within which novice teachers can adopt research-informed strategies in practice, and can

evaluate the impact of such strategies as part of a process of continual self-development.

The course is organised in four parts: (a) lectures and flipped classes on research on teaching and learning in higher education (12 hours of class), (b) reading of research evidence on teaching and learning (9 hours of independent student work) (c) skills workshops in which participants can practice and get feedback (8 hours in class) and (d) the implementation of research-informed teaching approaches in a course on which the participant works, and the evaluation of this intervention (21 hours independent work).

This course focuses on the teaching and learning of science and engineering in higher education and does not lead to a recognized teaching qualification for primary or post-primary schools.

LEARNING OUTCOMES

By the end of the course, the student must be able to:

• Evaluate up-to-date developments in learning sciences related to teaching and learning of science and engineering in higher education; Demonstrate skills in presenting for learning, in tutoring and in giving students feedback; Apply this knowledge to their own teaching practice through the design of a teaching input

• Improve their own practice through systematically evaluating their own teaching input

Note

• Participants must be a teacher/tutor/ teaching assistant on an EPFL course at the time of undertaking this course

• Registration via IS-Academia Portal (maximum attendees: 24)

Keywords

Teaching and Learning Science and Engineering
Research and Development of Teaching Practices

Assessment methods

The course is assessed through a written exam covering parts (a) and (b) and a project report integrating learing from parts (a) to (d).

Resources

Bibliography

Hattie, J. (2009) Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement. NY: Routledge
Ambrose, S. et al. (2010) How Learning Works: Seven Research-Based Principles for Smart Teaching. San Francisco: Jossey-Bass
Blessenger (2015) Inquiry based learning for science, technology engineering, and math (STEM) programmes. Bingley, UK: Emerald.