

Teaching Portfolio

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Teaching profile

My special interests are in the area of Energy system analysis, Energy process modelling and integration, Fuel cell systems, Energy conversion technologies, and my teaching experience revolves around some of these disciplines.

Primarily, I am teaching 4 courses at the University of Southern Denmark (SDU) at the moment in addition to a few lectures for other courses. Due to our inherent nature of research crossing over multiple disciplines, most of our courses attract students from energy, chemical and environmental engineering programs. In addition to teaching, I am also involved in student supervision for masters and bachelors projects.

During my PhD at the Technical University of Denmark (DTU), I was involved in the capacity of course assistant for a few courses. The department of mechanical engineering at DTU offers electable MSc courses in addition to undergraduate programs. Each semester, I assisted the course instructor by delivering some of the lectures and also helping out students with their class assignments, numerical problem solving, course projects and familiarizing them with simulation tools. Prior to this, I was inducted as a lecturer at the National University of Sciences & Technology (NUST), Pakistan. My primary responsibilities included teaching courses to undergraduate students at the energy division of the mechanical department.

Professional Background:

My professional career and educational experience revolves around energy engineering and sustainable energy technologies. The focus of my current research is on energy system analyses and design on a macro-level, with emphasis on potential synergies of system integration in societal sectors such as transport, industries, waste management and agriculture.

My education also falls along similar lines. I secured my Master's Degree in Sustainable Energy Systems from LTU, Sweden and followed my PhD studies in modelling and simulations of fuel cell systems at Thermal Energy Section of Mechanical Engineering Department in DTU, Denmark.

Prior to this, I provided my services to NUST consulting for projects involving integration of renewable energy technologies in industry and later joined National University of Sciences & Technology, Pakistan as a lecturer. My educational background along with expertise in industrial projects has enabled me to teach courses and disseminate my knowledge in energy disciplines.

Teaching experiences

I constantly try to reflect and learn from my teaching experiences and endeavours in order to pursue my career in academia as I continually strive to grow as a scholar and disseminate my knowledge through effective teaching. I anticipate that my portfolio will serve in aiding myself to assess my teaching performance and prove to be a gauge for improvement in my teaching philosophy and methodologies.

Teaching in courses

My teaching responsibilities can be categorized basically as an instructor/lecturer and course assistant. Since my focus in the courses taught has been mainly influenced by the discipline of energy and my professional experience, my teaching methodologies and learning objectives are steered with appropriation to the specific subject.

2020 - present	Renewable hydrocarbons & transport sector integration
2017 - present	Techno-economic analysis of district heating systems
2016 - present	Energy system analysis - tools & cases
2015 - present	Resource savings by process integration
2015 - present	Individual activity courses (energy systems)
2011 - 2013	Heat transfer, Advanced power plants (guest lectures)
2009	Heat transfer
2009	Power plants

Student supervision

Below is the list of student projects I have been involved in the capacity of supervisor or co-supervisor:

2020	MSc - Future role of gas grid in a 100% renewable energy system
	MSc - Environmental impact assessment of a low-carbon district heating system
	BSc - Future potentials of sustainable energy production through biogas in Denmark

	MSc - The future production of district heating at Fjernvarme Fyn, Denmark
	MSc - System integration of synthetic fuel production for Fyn in 2025
2019	MSc - Renew Biogas – Reduction of GHG emissions in Biogas Production
	MSc - Central Hydrogen Production in Denmark
	BSc - Biomethane based jet fuel production
	MSc - Green District Heating Systems, Development of a tool
	BSc - Analysis of Biogas in Heavy Transport, CNG/LNG
	MSc - Interconnectivity potential in a renewable European energy system
2018	MSc - Tragedy of the Planet? - Characterizing Climate Change as a Tragedy of the Commons Type of Challenge
	MSc - Optimization of district heating supply by inter-connection of local networks
	BSc - Utilization of industrial excess heat into Danish district heating system
	MSc - Feasibility study of the HTTES technology in the Danish energy system
	MSc - Green fuels for the future transport sector in Denmark
	BSc - Revision of Energy Plan Funun, with integration of large server parks
	BSc - Feasibility study of High Temperature Thermal Energy Storage, CASA and Lithium batteries
	BSc - Energysavings and optimization of Emmelev Biodiesel production
2017	MSc - Future conversion potential of industrial boilers to renewable fuels
	BSc - Utilizing excess heat from cooling installations at supermarkets in Denmark
	MSc - Integrating electrical busses in Odense municipality - scenario optimization
	BSc - Dimensioning of a Siemens E-road System across Funen
	MSc - Fjernvarme og fjernkøle løsning SDU/OUH
	BSc - Feasibility Study on E-highways on Funen
	MSc - Hydrogenering på biogasanlægget i Heden
2016	MSc - Waste & Energy integration with focus on DH & heat pump systems
	MSc - District heating island solutions for small towns - the case of Aarup
	BSc - Seawater heat pump integration into Faaborg district heating network
	BSc - Potential of heat pumps in heat recovery from waste water systems
	MSc - Hydrogen as a key player in synthetic fuel production for future transport systems
	BSc - Technical and socioeconomic implications of BEVs on the energy system
	BSc - Operational strategies for electrolyzers in future renewable energy scenarios

Teaching Philosophy

Focus on learning rather than teaching

I believe in a combined effort of students and the teacher in accomplishment of mutual learning objectives. I would prefer a classroom where students are enthusiastically engaged in discussions to comprehend and understand new concepts. I would oblige them to work in teams and together learn from each other's specific skills to solve engineering problems. In principle, a teacher's job is to create a conducive atmosphere where students are encouraged to think instead of memorizing. They are comfortable enough to express themselves and are not afraid to make mistakes and in the process learn from their mistakes. As their teacher, I would guide, motivate and inspire them to take up on challenges to learn something new.

In order to be an effective teacher, one has to be certain of:

Reaching the entire class: Each student is different and therefore, has a different outlook. I try to take out time to know each student by name and make myself available to each of them thereby recognizing their individuality.

Invoke thinking and curiosity: I am of the opinion that the process of finding the answer is more important than the solution itself. I believe that each step taken to resolve the underlying problem invokes thinking and enables the students to question themselves. Therefore, I encourage my students to indulge in dialogues and debates with their

classmates before jumping to any conclusion.

All questions are good: “there is no such thing as a dumb question” . A teacher should be flexible enough to take on questions of any nature. I give my students the freedom to continually ask questions and present their rebuttals even when these questions are presented by their teachers. I believe that it is also equally important that students feel comfortable when I ask them questions even when they are uncertain of their answers.

Always have a response: A teacher should always be prepared for he might be bombarded with questions any day. I always try to answer more than one times. If my first explanation is unsatisfactory I find another perspective or angle. If a student asks a question that I do not immediately know the answer to, I will respect the question by letting him know an answer will be sought after and provided.

Teamwork and collaboration: As a teacher, I always try to integrate soft skill development into my teaching. Students are benefitted by working in teams and mutual collaboration to acquire these skills besides developing their problem solving and critical thinking skills.

Aiming high: I believe it is important to be persistent in one’s focus towards goals; therefore I strive to continually develop myself as a teacher by reflecting on my teaching techniques, update my knowledge and setting higher goals for future. I look to instil my students with the same zeal and passion so that they will always try to improve themselves.

Do your homework: I acknowledge that it takes one level of knowledge to complete a task yourself and it takes whole other level to teach someone else to do it as well. My homework for teaching is based upon the building blocks of breaking the teaching material into teachable, imaginable and memorable portions that gradually build upon the other in a progressive manner. First research and then lots of practice is an integral part of my homework.

Teaching and learning is a partnership: Maintaining that teaching and learning is a two way street, I hold my end of the bargain by researching to attain a comprehensive knowledge on my subject and to always be prepared before coming to the class. As for my students, I see it as their responsibility to attend class on time, not knowing the answers but filled with questions and focused.

Change with times: There were times when students used calculators, triangles, T–squares and compasses as rudimentary tools and sketch with pencil but within a span of few years the technology has been revolutionized. Each and every day brings along a new advancement in all fields of science and technology. I believe a professional should constantly keep upgrading his abilities and skills along with changing times in order to stay up to date, understand new developments and bring innovation into his profession.

No fixed timings for learning: I strongly adhere to the point that my responsibilities are not limited to the classroom, nor are they narrowed down to those who are enrolled in my classes. It is my duty to respond to the needs of my students in every possible way. Encouragement and motivation to continue to learn and explore are the tools for boundless learning, which I choose for teaching.

Acknowledgements and recognition: For me as a teacher, the greatest satisfaction comes

from watching a student advance through various stages of learning that challenged their abilities and stretched their limits. Everyone has the ability to overcome obstacles and develop, if they do not recognize it in themselves – show it to them. Acknowledging their accomplishments and efforts will render them to accept the next challenge.

Awareness of our student body: I strongly believe that efficient teaching with optimal results is only possible by recognizing and adapting to the needs of student body which usually comprises of diverse cultural groups, broad spectrum of backgrounds with the added challenges of developing language skills and requirements. In response to individual needs, I always try to be understanding and supportive so all of them have equal opportunity to thrive.

Serving as a mentor: As a thriving professional I represent what many of my students aspire to be and this aspiration serves as a responsibility. I believe that the students can reach their true potentials under the guidance of an enthusiastic mentor.

Methodology & Approach

As a lecturer, I see myself more of a facilitator of learning as well as a motivator than a tutor. I believe that the learning process should always be student-centered. I try to create the classroom environment as informal, stimulating, interesting and creative as possible. In my opinion, a lecturer never stops learning and always gains knowledge in the teaching process. Therefore, I consider each of my courses as an opportunity from which I, too, can learn something new. I mostly learned from students' feedback and response to constantly improve myself, which gives me the liberty to experiment and try out innovative methods to reach my students. Over the years, I have gained experience through professional development and personal experiences which I try to impart into my teaching on a regular basis. The presented techniques are not cumbersome or extremely involved. In fact they are fun and very straightforward. Through my professional development, I have learned that these techniques will help both new lecturers like me and experienced ones in excelling at teaching and becoming more effective lecturers.

Inductive learning

I first came upon this technique when I attended a course on teaching and learning at DTU. The idea here is to present a scenario or a real time application to the students and then identify the problem or the main objective of the topic under study. The lecturer can start with the concepts and methods he is teaching to the class after that. Once the main concept is explained to the students and they are able to comprehend the underlying process of reaching the solution, the example described earlier could then be presented again. This helps the students to grasp the applications of the topic more easily. During the lecture, the audience is more involved since they already have an idea of the real time problem and can more effectively relate the topic to the outer world.

I used the same technique when I was giving the lecture on radiation for heat transfer course at DTU. Before this, the students had many lectures on conduction and convective heat transfer, both of which require a medium to occur. However, radiative heat transfer was something new to the students. So, I started my lecture with the example of the terrestrial bodies and briefly touching the solar system. During this introduction, I subliminally put few questions about sunlight and heat reaching earth in students mind. I then asked students if they had any questions and almost more than half the class raised their hands. Starting the lecture in this manner had raised students' curiosity and made them more interested in learning about radiation. After that, I started with the fundamentals and textbook theory to explain them about radiation. By the end of the first session, I again asked the students if they had any questions. By now, the number of hands had decreased to only a few. During the break when I asked about their feedback, they said now they understood the concept better and not only they could relate the topic to the problems, but they could also formulate such problems associated with similar applications.

Group learning

Another effective teaching method which I found very beneficial for students is group learning technique. Here, the students are paired in groups to perform a task, assignment or work on a project. Basically there are three core principles which an instructor has to keep in mind: promoting individual and group accountability, devise tasks that build a bridge between individual work and team work, encouraging practices that stimulate interaction between different members of groups or other groups.

Most of the engineering problems require a degree of collaboration. Keeping that in mind, I usually formulate assignments and projects for students where they have to work in teams. During the course I would allow groups to share their research, which benefitted them in realizing their level of skills, team work, task management and methods among their colleagues.

In cleaner technology & process integration course, the students were given a few assignments. I try to experiment by making groups by randomly using their members. Similarly, the group members are changed for the next assignment. This

way the students are exposed to different working groups and develop the skills to adjust with their working environment as well as appreciate their peers' input. Some students have problems in assimilating; however this is also a point of making them ready for their future endeavours. For my courses on power plants and energy system analysis, I always have a design project in the course outline. The students are required to model and simulate power plants of their choice using computational simulation software. Group projects demand students to work together on some level of the project but could also be devised so that students produce their own independent work or their contributions to the project. Presentation of their work at the end of the semester helps students to build certain soft skills including collaboration, project management and leadership qualities. For the course of advanced power plants, we used the peer grading method where the students would discretely grade their colleagues within the group. This helped us to assess and grade the students according to their contributions and efforts put into the project.

Problem based learning

Another approach which is becoming increasingly popular is problem based learning. It has proven to be more active and enhances student learning on a variety of disciplines. I have successfully tried this method by incorporating it in my assignments which are also meant for group work. Design projects in modelling & simulation are also another suitable form of testing this technique. The students achieve the learning objectives by working on their own in teams of 3 or more, while the teacher takes the role of a facilitator and mentor, sometimes as project manager. The students solve the problem by using the resources available to them in the form of textbooks, lecture notes, open literature and internet.

The main objective here is that the students first have to define and identify the problem, formulate methodology to find out the solutions, test their methods, and finally document their findings with comments in the form of a report. During the course, I came to realize that this approach requires additional time, since one cannot spare time from the lectures. The instructor has to set off-class time where his student could discuss all the intricacies of the tasks they are involved in. I had more than 45 students in most of my classes; therefore I had to designate a time every week for discussions as well as to assess the progress of their work. This extra time became very handy for the students in overcoming certain obstacles in their work. One advantage of this technique is that the students become more independent learners, acquire work management skills, get a broader perspective of the applications, learn to use available resources and develop confidence in solving problems independently.

Active and cooperative learning

Active learning is also a method to engage students in the classroom. It is quite vague by definition and therefore be implemented in any context depending on the dynamics of the course. A simpler example involves improvement in traditional lecture format by integrating active learning activities. This technique is very useful for long lectures where student motivation and interest fades with time. Such short activities bring out more class involvement and also tutor-student interaction is given a boost.

Cooperative learning shares a lot of similarities with group learning method. However, it might also involve having the students work individually on a task or a solution for some time, and then they could discuss and share their solutions with a colleague or a group member. These solutions could then be discussed in the class and the lecturer can then summarize it with his input.

In most of the engineering disciplines, problem solving is the main topic of the course. Active learning combined with cooperative method of learning becomes one of the effective approaches for the instructors. For large classes, it becomes cumbersome to assess and present solutions from all the students in the given timeframe. I adopted this method for solving numerical problems in thermodynamics courses. After a session of lecture, each student was given a problem or a part of a bigger problem to solve in a given period. The students were then asked to share their solutions with each other. By thinking-pairing-sharing, the students first of all learn to analyse the problem individually, then they are exposed to the ideas and methods of their neighbours, get a bigger picture of the problem, at last by discussing their outcomes with the class the discrepancies between students are resolved. Sharing and discussing the results clarifies many doubts students have and they get instant feedback which helps them in rectifying their work at the same moment. Cooperative learning can therefore synthesize the whole lecture into a cohesive learning unit. For power plants course, I aimed at developing numerical modelling and simulation skills among students. They were presented with a design project in the course, where they would utilize the lecture fundamentals to design and model power plants. In a similar manner, they were encouraged to share their methods with other groups. Each group had something new to share in their approach which would help others to refine their numerical techniques. This would generate a healthy debate and competition among the students making the end result of all the groups impressive and elevated.

Teaching skills, process and student learning

The purpose of the instructor is to enable students to understand, analyse, synthesize and implement newly acquired knowledge. For this reason, the lecturers have to make sure that the learning environment they have created is conducive to students' growth. Ultimately, the main objective is to enable the students to think and solve complex engineering problems, make best use of the available learning resources, get beforehand experience of working in teams, are able to effectively disseminate their findings in written or verbal form, and last but not least pursue to learn persistently. I consider a few things to be important in order to achieve my teaching goals:

Course preparation:

I always try to be well-prepared and organized before the class. This makes me confident that the knowledge I am imparting is not disorganized and distracting for the students. Teaching a course consecutively becomes one of my

priorities. This way I have the freedom to fully understand the dynamics of the class in context of the course and helps in declaring room for improvisation in the next course. As part of my course preparation I take time to thoroughly create detailed lecture hand-outs, assignments, quizzes, software tutorials and PowerPoint presentations.

Classroom management:

I put in a lot of time and effort before the start of the course. If it is a new course, I spend hours on preparation and making lecture notes and learning material. On the other hand if I am teaching an old course, I review my material and based on the feedback I modify my techniques if need be. Outline of my teaching process is as follows:

Pre-class activity:

- Research on the subject
- Prepare supplementary reading material
- Formulate the lecture outline
- Send the lecture pdf to students beforehand
- Prepare and solve numerical problems/assignments
- Ask the students to read some material before coming to the class
- Distribute readme document if any computer program is used in the lecture

Class activity:

- Clearly define the learning objectives at the start
- Begin by posing an interesting question or an activity
- Allow students to ask many questions to increase interaction
- Take notes of important points
- Use all available resources to enhance learning
- Summarize the lecture in context of learning objectives
- Briefly outline next times lecture

Post-class activity:

- Review of the lecture
- Registering class notes for future reference
- Note down students feedback (if any)

Multimedia aid:

In addition to PowerPoint, I try to incorporate multimedia support in the classroom for student learning. e.g. In power plants course, we showed the students videos of power plants just to give them a sense of huge plant sizes. Also, it makes it more interesting for the students once they have a real application in front of them. In most of my classes student have full access to internet. Providing students with such liberty has its drawbacks on the other hand. For one, it becomes a distraction for most students in the classroom. Secondly, other people's work can easily be copied on the internet.

Quizzes and intermediate assessment:

Small quizzes are an effective tool to gauge students understanding of the subject. I try to conduct some basic quizzes and tests from time to time just to have an idea of what the students have learned so far or have they learned something at all. It is a good system to review the teaching method if the results are disappointing. This way, the instructor has some time to save a potential disaster before the final exams. I use a similar technique for courses with design projects and computer simulation projects. I distribute the project into 2 or 3 phases; each phase with its own deadline. If some groups are having any problems I get to know them in the 1st phase. Remedial actions are taken to help them understand and clear out the obstacles. In addition to in-class exercises, I rely on projects and realistic homework problems to allow the students to gain more practice with the material.

Grading and Rubrics:

Before the start of the each course, I would explain the assessment process to all the students. Distribution and weightage of each element of the course was clearly defined ahead of the course. This made it easy for the students to follow my method. All graded papers were handed back to the students for review and most of them were discussed in one of the classes. In addition, I use the online assessment tool "turnitin.com" to ascertain originality and devise rubrics for the grading material. During my time at NUST, I used the university grading software to assess and grade the students. All the data of assignments, quizzes, sessional exams, projects and final exam was compiled by the program to grade the students. It contained several functions to analyse the results and gave an overview of class learning objectives by histograms and bell-curve graphs. The final report was based on relative grading. While at DTU, I assisted in all of the courses. For heat transfer course, I checked on 25% of the final exams. I was responsible for grading design project in power plants course. Overall result of the project was determined by the self-evaluation of students, which illuminated the amount of work each group member had put in the project.

Further development of teaching

Teaching improvement efforts

I am constantly looking to find ways so that I can reflect, re-assess and evaluate my teaching methodologies. Following are some of the efforts in this regard:

Revision of syllabi

From student and peer feedback I have persistently updated the curriculum of courses I have taught. This is still an on-going process and continues to be in the future. I added design projects in few of the courses and started use of computer tools which I reckoned important in the context.

Courses Related to Teaching and Learning

Teaching and Learning UDTU, DTU, Denmark, 2012

NUST Faculty development program, NUST headquarters, Islamabad, 2009

Co-Teaching & Co-Preparation

I find co-teaching an effective method which would be beneficial both to lecturers and students. The involvement of another experienced teacher would serve to improve the course content as well as learning for new lecturers like me. Students would benefit by having two viewpoints on the same subject and could get more help from two instructors simultaneously.

Learn from my students

In my opinion, students are a constant source of learning for teachers as well. Each student is unique and possesses traits new to many. I am constantly learning from my students as they are most likely to adapt to newer technologies and modes of interaction. I have seen many group presentations where students have employed fantastic graphic representations. They also come up with new methods to conveniently communicate their work with each other.

Adaptability to new methods

I always look to integrate new and untried methods into my classroom. Since dynamics of each subject and class are different, it is a great idea to experiment if one is not getting the desired outcome. For this reason, I am willing to take advantage of the new technologies as well. Attending seminars and courses on learning would therefore be an excellent way to keep myself up to date.

Other activities

Updating assignments and course notes every semester

Upgrade teaching methodology based on feedback

Re-evaluate my teaching philosophy by constantly updating my teaching portfolio

Get intermediate evaluations from students

Increase my knowledge by reading and writing to well-recognized journals

Continue to up-grade my e-learning materials

Review new and related textbooks for supplementary support

Convert course content to e-learning for convenient dissemination of the material

Future Teaching Goals

My future teaching goals are focused on the enhanced learning of my students. I believe that keeping me upbeat to take on new challenges and continually striving for learning will be the stepping stone for my success. Regardless of the current success in any course, I would not hesitate to test and integrate new techniques. I believe that students have different learning capabilities which vary from person to person and topic to topic; therefore I feel that it is crucial to try different forms of learning in order to reach the masses. In this regard, I would continue with my pedagogical approach to identify and rectify issues that are highlighted in my teaching. To achieve my future teaching goals I am considering the following steps:

Build up on student feedback and try to make it convenient and more elaborate for students

Exploring additional modes of communication with students to get their comments and improve the quality of feedback

Have regular consultation with peers on teaching methods, course materials and learning activities

Obtain a gradual increase in my teaching evaluations and attain exemplary comments from departmental and peer reviews

Updating my portfolio and create a network of faculty and students which would help these students in preparing their portfolios

Increase the development of collaborative skills in my students

Participate in learning community workshops and initiate cross disciplinary teaching collaborations

Continue my own personal development through pedagogical studies

Learn and integrate new technologies into teaching

Development of new and alternative techniques to improve student learning

Write textbooks or chapters on my core subjects

Expand my teachings to other platforms such as online video lectures

Build a bridge between industry and academia to keep abreast of new developments as well as arrange for field experience for students.