Teaching Portfolio

This is an application for the Teaching Academy which includes the following:

Sincerely,

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These reflections on teaching are entwined with a historical account of my teaching experiences spanning more than two decades. My recollection is selective, but it covers what I regard as the most notable influences on how I teach today and my future efforts. During this time, I have taught a variety of courses on engineering design, numerical optimization, operations research, advanced algorithms, machine learning, software engineering and co-taught many others. These courses are both at the undergraduate, advanced undergraduate, masters and doctoral levels. I have supervised several master's students, some of their thesis are available online. I have supervised five doctoral students, of which one will graduate this year, another is in her second year of study. For eight years I was faculty head of Industrial Engineering, vice-dean of department and I co-authored the first of a series of now mandatory self-evaluation reports for the department.

The faculty of Industrial engineering has systematically, over the last few years, completely updated its undergraduate program. However, one of our main concerns is the failure of students in applying what they "learn". Some of our students claim to be mathematically illiterate; they are unable to apply what they have learned in their mathematics and statistics classes. Furthermore, they are unable to apply what they have learned in computer programming. These introductory courses put an "emphasis on cookbook problem-solving rather than gaining a real understanding of the underlying concepts" (Bok, 2009). Despite the overwhelming evidence of the superiority of active learning methods for teaching (Freeman, et.al, 2014) passive lectures prevail within our university. For our engineering students it is of utmost importance that they apply what they learn and are capable of solving engineering problems. Active learning for me means I engage my students in deep discussions about a topic using small-group learning and problem solving. The cases presented in my reflections have the central focus of moving away from the surface approach to cookbook problem-solving and towards coaching students in the deeper art of problem solving. For this I assist students in constructing their own knowledge on how to solve problems in engineering. The active learning technique I employ is based on Team-Based Learning introduced to me by Larry Michaelsen while he was here in Iceland. His teaching method is designed to achieve small group learning for large classes and my classes are typically large.

Pedagogical reflection

My first real encounter as a teacher was in the late 90's at the start of my doctoral studies. The course handed to me was an advanced undergraduate course on design and optimization with the Faculty of Mechanical Engineering. The course content was of particular interest to me and related to the subject of my doctoral studies. In this course, like many of the engineering courses, a final design project was to be completed by the students. At the time I was involved in finding solutions to a fish packing problem. I decided to set it as their final project. This task was significant, practical, relevant to the local industry, but it was challenging. The students quickly realized that they could not solve it, they could not apply the methods given in the course, so they complained to the faculty head. My meeting with the head was brief, he handed me a piece of paper with the words: "The students are our clients; we are here to serve them and their needs". For the remainder of the course, I gave direct instruction on how the final project could be solved. The students and head were satisfied and the course a success. "Students expect the teacher to give them the answers to the questions. They want to know the right answer" (Keeley, et.al., 1995). My first teaching experience was precisely as expressed by Haas and Keeley, (1998) "…faculty who are good at dispensing information and capable of entertaining students typically receive good evaluations as well as direct praise from their students. They are also considered to be effective teachers by their colleagues." I set out to become an expert in dispensing information, a testimony of this are my lecture notes on Support Vector Machines from 2003. This course was also the climax in student evaluations and surpassed all other courses within the school that semester. However, factors influencing this may be due to the fact that I was co-teaching with a senior mathematician. We attended each other's lectures and were both actively engaged in discussions with each other during class. We were putting on a good show. Terry Gunnell at the end of a Teaching Centre's podcast (2020), winner of the teaching prize, talks about the necessity to keep students attentive during lectures and that there his knowledge of acting comes in handy for large classes. Gunnell also advocates small-group learning, something I now realize is key to successful teaching.

As head of faculty and vice-dean one of my first tasks, back in 2008, was to lead the revision of the learning outcomes for our courses and their alignment with the learning outcomes for the undergraduate programme in engineering. I organized meetings with the Teaching Centre for the department/faculty and this work resulted in a total revision of the learning outcomes for the engineering programmes, in collaboration with the other engineering departments. As a follow up to this work, I set up a series of open meetings with faculty members with the aim of reaching a common understanding of engineering. The obvious approach, being engineers, was to use a systems approach. A causal-loop-diagram was sketched on the whiteboard starting with an "issue". Once we were all comfortable with our view of engineering, I took our learning outcomes and placed them, with their help, on the diagram depicted in figure 1.

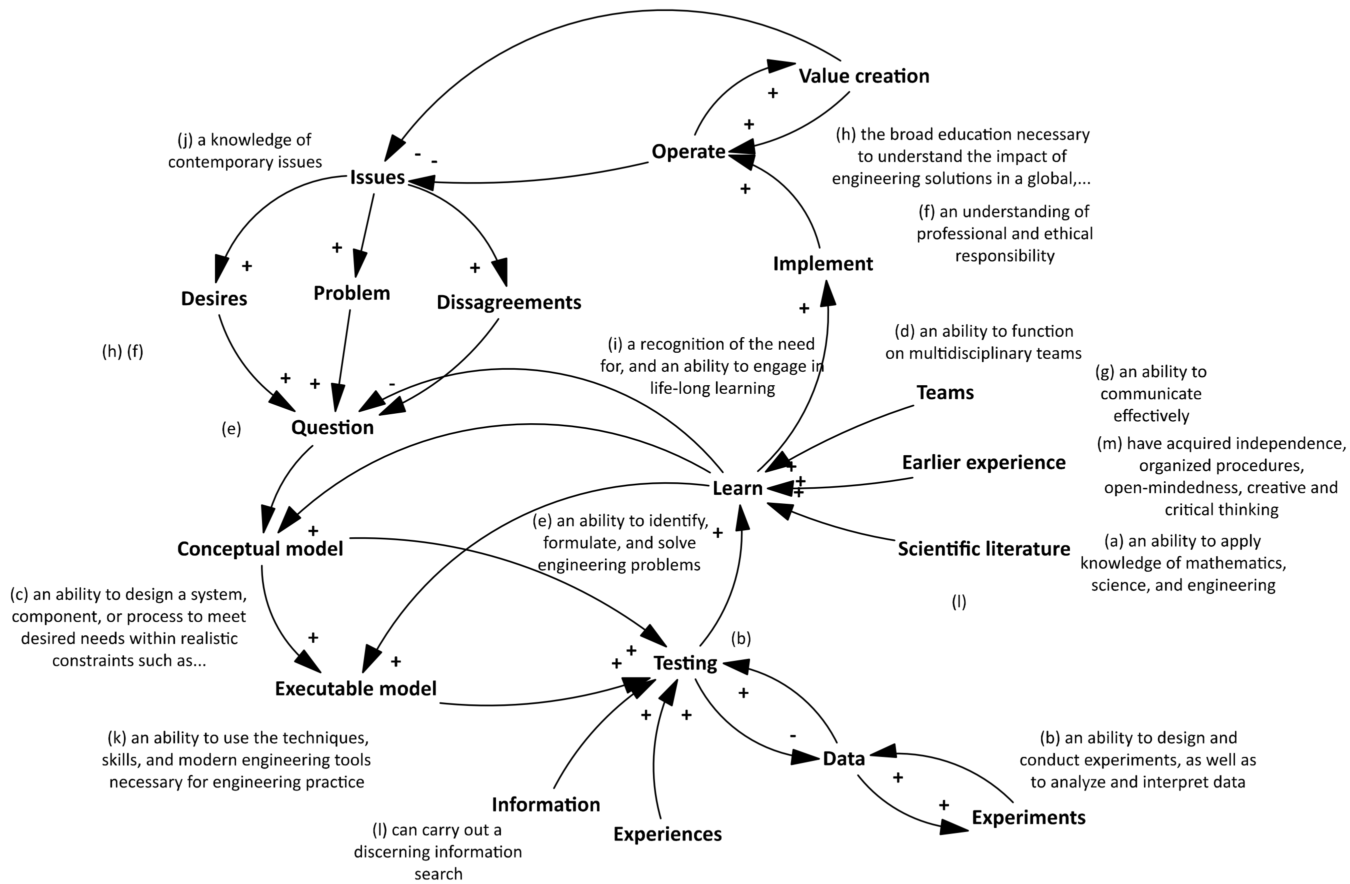

Figure 1. A causal loop diagram for engineering with the learning outcomes (a) to (m).

Our learning outcomes spread surprisingly uniformly on our diagram. The result of this work was perhaps in hindsight as expected, we effectively illustrated a problem-solving framework, including the scientific method. We discussed how the different engineering discipline would spend more or less effort on parts of the diagram and how our courses covered it. This view to me has now also a more significant meaning. It highlights not only what engineers do but illustrates how engineering should be taught and in what way life-long learning is recognised. This was the start of my quest for a different style of teaching.

The approach I take is founded on team-based learning (Michaelsen, et.al., 2004) which aligns agreeably with our view of engineering. Consider the inner learning loop in figure 1. The loop starts with a clear question then proceeds through the conceptual and executable models, then testing and finally learning. Let's start at the end of this loop. Let the input to "learn" be student teams discussing new material. I, the teacher, then propose an issue. The team formulates a question and then offers a conceptual model which they present for immediate testing or validation. The first testing may simply involve hints from me or clarifications for the issue at hand. The student team again discusses, reflects and learns, ready to enter learning loop again. They may rephrase the question or revise their conceptual model. If confident about their conceptual model they may execute or apply their model to generate a plausible solution. This solution is put to testing, where the executable model is verified, and the conceptual model again validated. This testing may be based on data given or generated by the students, feedback from me or other teams. It may take a number of iterations of the learning loop until the team is satisfied. The learning loop is a constructivism approach to learning (Biggs & Tang, 2011) and has many similarities to problem-based learning (Allen, et.al., 2011). Also, depending on how the testing is performed and how the issues are posed it could also be case-based learning (Jonassen & Hernandez-Serrano, 2002). Constructing meaning *is* learning. In practice the engineer exits the learning loop via the implement path, while the engineering student's exit may be a final report for grading or an exam. Still, for the practicing engineers the time and resources essential for solving an issue are far greater than that can be afforded by our students. Indeed, opportunities for constructive learning might not present themselves when learners are left unassisted (Alfieri, et.al. 2011). Furthermore, constructivist pedagogies have been criticized for their inability to achieving critical thinking ambitions (Boghossian, 2012). The argument is that for critical thinking there must be a way for learners to be shown that their reasoning is fallacious. However, the techniques cited are not purely unguided discovery learning (Hmelo-Silver, et.al. 2007). The challenge is to know how much and what kind of guidance to provide and to know how to feature the intended learning outcomes (Van de Pol, et.al., 2010).

I will now present cases addressing significant challenges faced within this learning loop. The first reflection is on how I prepare students for the discussion of new concepts. The second case reflects on how I propose issues that provide learning opportunities and guidance for the intended learning outcomes. The third reflection is on how I *guide students towards building their own scaffolding* in conceptual modelling and testing to facilitate constructive learning. These three cases are inspired by the team-based learning approach. The fourth and final case reflects on the learning loop in the context of my student supervision.

Case 1. Preparing for class discussion

In a flipped or inverted classroom, a new topic is introduced outside of the classroom and students then discuss concepts at a deeper level in class (Strayer, 2012). This technique only works when the students enter the class properly prepared. I have found that the students require significant preparation for this level of discussion and have adopted the team-based learning (Michaelsen and Black, 1994) approach to *student readiness assurance*. The preparation involves three successive phases. First individual preparation outside the classroom, then team preparation inside the classroom, followed immediately by an off-line recorded clarification lecture from me. This approach offers also an incentive for preparation, the wish to make a contribution to their team, which is judged by peer-evaluation. However, there are usually some students that attend class unprepared, unless given some incentive. One such incentive could be a graded quick quiz at the beginning of class. In my initial attempt in using team-based learning I followed the recommended practice of using IF-AT tests for the individual and team readiness assurance test. The IF-AT should incite discussion and so obvious correct or incorrect answers are avoided, the focus is less on factual recall and more on conceptual understanding. These tests were graded and so the level of anxiety with the students was high. Some teams figured out a way of cheating the IF-AT scratch cards. As a consequence, they would hardly give any reflective feedback and they were ill-prepared for class. Furthermore, I find it problematic to grade student readiness, either you have prepared or not. I now take a pass or fail approach to readiness which also reduced anxiety levels. Moreover, I have developed an effective way of validating their preparations, while they are preparing out of class, using an interactive tutorial.

In recent years many new platforms for delivering interactive content have entered the stage. One such platform is interactive tutorials for R. This platform enables me to create a narrative with illustrations, videos, interactive components and complex mathematical equations using LaTeX. I am able to create coding exercises in Python or R for the students and they run their code directly from within the tutorial. The quiz questions allow for interactive feedback, informing the student immediately why a response was right and wrong. Furthermore, quiz questions are used to force the reader to reflect on the content. Interactive programming exercises are important as they give the tutorial an active learning experience, learning by applying and implementing the mathematics. As reported by Shute (2008) in this way the feedback is nonevaluative, supportive, timely, and specific. Coding hints are also supplied. The answers and exercises performed within the tutorial can then be downloaded to a single file, which is then handed in on Canvas before class for the start of any given learning module. The tutorials for each learning module in my undergraduate course on Operations Research may be viewed here:

1. https://learnor.shinyapps.io/Introduction/
2. https://learnor.shinyapps.io/Modelling/
3. https://learnor.shinyapps.io/LPalgorithms/
4. https://learnor.shinyapps.io/Duality/
5. https://learnor.shinyapps.io/Sensitivity

In general, student feedback for these tutorials have been very positive. Students that are less mathematically inclined have said that they look at the coding exercises to understand the mathematics. In some of my clarification lectures students have asked for an oral walk through, indicating that adding some short videos may be desirable. Nevertheless, this is my first version of these tutorials, adding variation in presenting and perspectives (Biggs and Tang, 2011) will promote their effectiveness. The interactive tutorials highlight what is important to *pay attention to*, similarly to a lecture. Students are asked to seek elaborations in textbooks and web searches, if need be, but the tutorial should be sufficient preparation for the team's in-class readiness assurance exercise.

In the first in-class student meeting, for each new learning module, student teams discuss the preparation material. I then let them restate the main ideas using their own words on a one-page cheat-sheet. Many difficulties in understanding are resolved when the students explain to each other the material. In order to start the students off in their discussion, I would tell them that one of the quiz questions had more than one correct answer and ask them to find it. This forces them to reflect together on the entire tutorial. In later tutorials I would have direct questions to the teams for deliberation. With this I enforce peer-learning where students reflect on the material, criticize the tutorial, describe the main ideas and resolve concerns. Any issues needing further clarification and are unresolved by the team will be listed in writing by the team and returned to me. Immediately afterwards, I respond to the feedback, both directly to the teams and then to the whole class by recording immediately a clarification lecture confronting and hopefully eliminating students' misunderstandings. Helping students with what they are struggling with is undeniably superior to telling them everything I know in a lecture. In some cases, I may request some teams to update their cheat-sheet, allowing them to improve. The questions asked by students for the offline clarification lecture were reflective, their recap of the material (cheat-notes) revealing, and this gave me the assurance that they were prepared. The teams are now ready to proceed with the team application exercise and discuss concepts at a *functional* level.

The feedback given by the students at the end of each learning module helped me improve the subsequent tutorials during the semester. This way they had a direct influence on how the tutorials were crafted. The concerns unsettled at the end of the semester were that the students would like to have had an Icelandic version and that the shinyapps.io server would die when the whole class of 66 students would open it at once, as I only had a basic subscription to shinyapps.io. There were two main reasons for writing this tutorial in English, the first was consistency with the course textbooks, the second was that it could be read by a wider audience for peer review.

Case 2: Motivating and inviting discovery

From the very start of my teaching career, I considered it essential for our students to experience prevailing meaningful issues in engineering faced within their profession. For this reason, rather than solving abstracted textbook problems, I would take the students for field trips to manufacturing companies. For example, in an advanced undergraduate course on Simulations we would visit Össur and simulate their production of carbon fibre prosthetic feet. For three consecutive years we would visit, take a tour of the factory and have a Q/A session with the production manager. In return we would send the company a summary of our main findings. Each returning year some changes had been made to their production and so the case was always slightly different for next year's students. A more complete MSc version was also done. The students received first-hand knowledge of real contemporary issues in the industry. We also worked with other private companies. I also looked for projects closer to home. In my Operations Research course, I let the students optimize the school's timetable and later the University's exam timetable. These projects had a direct impact on their lives, they had a sense of urgency, the students were fully engaged. I would call in administrative staff and the director of examination for Q/A sessions with the students. Again, extended versions became MSc projects and even summer jobs. The school timetabling model was used for a few years by our school and the exam timetabling model is still applied for the entire university. I also created projects with the public sector, Árnastofnun, Marine Research Institute, Statistics Iceland and many with our National Hospital. Engineering, like science, is about solving puzzles and mysteries, a successful project should reflect this and arouse our natural curiosity. However, industrial projects are client centred and may not necessarily inspire all students. When I become directly involved in the problem-solving process, the projects could even be construed as teacher centred. In an attempt to create more student-centred projects, I let students pick their own projects. Recently I also let my students act as *clients* in my undergraduate OR course, where each team would create a project and other teams would then bid for them as *consultants*. There are learning opportunities in writing up a project (request for proposals) and I recently discovered that someone else had the same idea for their OR course. The students are clearly motivated. For one of these projects the students continued working on it after the course and with our supervision ended up winning the President's Student Innovation Award!

The client issues or those posed by the students do not necessarily involve all of the intended learning objectives or they may make them unreasonably difficult to reach. For this reason, when proposing an issue, I must foresee how the intended learning outcome will be met. Furthermore, I know where the students commonly fail. Simple modelling examples are typically given in textbook, but each is specially prepared to illustrate the application of a specific model or algorithmic procedure discussed in the text. For this reason, we should not expect the students to be capable of taking the leap from illustrative problems to solving real-world problems. The popular completion of such a course is an exam where students regurgitate these illustrative problems. We should not be surprised when students completing such courses think that problem solving is about searching for solutions. However, there exist textbooks dedicated to a collection of real-world problems, where they admit that “academic curricula in general emphasize the teaching of techniques and theory, and do not pay much attention to cultivating good modelling skills in their students” (Murty, 2015). However, these texts simply illustrate worked out real-world problems. The teaching notes for case articles published by Informs Transaction on Education are more insightful. Though these teaching notes also primarily focus on the different ways of resolving proposed issues, they also illustrate very different approaches to case-based learning. The general consensus is that the focus should be on conceptual understanding and less on learning a set of tools and procedures. Some issues posed are based on complex real-world applications while others choose “realistic” issues where students don’t need any background reading to understand. Those that discuss scaffolding (Van de Pol et.al., 2010) do so by supplying helpful questions with their cases and propose specific tasks to direct students in the right direction. Learning objectives are presented and can be general to very specific, such as illustrating common pitfalls.

Carefully designed scaffolding and illustrations of common pitfalls is easier to plan when creating one’s own case. This is the approach I take today and do so using a “realistic” story. As Jonassen and Hernandez-Serrano (2002) point out “stories are the most natural and powerful formalism for storing and describing experiential knowledge that is essential to problem solving.” The story can already have some of the scaffolding in place, communicated by the client and consultant, to get the students off to a start. An alternative would be to provide worked examples of how to succeed in the task. This can be nicely incorporated into the story, where the consultant explains to the client what has been done to solve his issues, but then the client tells the consultant about all the wrong assumptions made and what is missing. This way the students have been given an example of how the consultant took one cycle through the learning loop and it’s now their turn to take the next rounds. For exercises that involve algorithmic procedures, I have given the students the means of finding the answer using software, but they must illustrate how the answer is determined. In this way they have a direct way of testing their reasoning and when their algorithm fails. The idea here is to create a mechanism for timely and specific feedback (Shute, 2008).

In team-based learning one designs a learning module backwards. One starts with the application exercise and then works backwards to the readiness assurance for that module. However, before one starts the learning goals must be clarified and the following question answered, “What do I want my students to be able to do at the end of the session that they could not do before?” The application exercise should follow the 4s (Parmelee, 2012), significant, same, specific choice and simultaneous reporting. That the application is significant means that students can immediately and meaningfully apply the concepts they are learning. They are all working on the same problem, this will make between team discussions meaningful and effective. Students will learn from their peers. A specific choice means the problem is *not open-ended* and simultaneous reporting is necessary when the answer to a problem is a specific choice. At the end of the operations research course, I want them to resolve an issue. The students should perform all the tasks within the learning loop pictured in figure 1. for a specific class of problems and therein lies the crux, I don’t necessarily have a specific choice. Indeed, I tell them there exists different conceptual models to resolve the same issue and that the same conceptual model may be interpreted differently. For example, duality is about interpreting an issue from another client’s perspective. This was one of the surprises expressed by the students, “how could there exists such dissimilar perspectives to their conceptual model?” Nevertheless, my application exercises follow the 4s principle. They do not have a specific choice, rather the specific choices are the teams' solution. The solutions are compared by the teams and ranked. Each team had 5 or 6 members and there were 12 teams in total. The teams were assigned to one of three rooms and asked to create critical *why* or *how* question for each of the other teams within that room. They would then rank the other teams' solution and justify their highest and lowest ranks. Their questions and reasoning for their ranking became part of their team's final grade. What was expected of them was at all times given to them in a rubric on Canvas. These sessions not only exercised critical thinking and created learning opportunity for the teams but gave me an insight into how they were thinking about the subject. Their grade was also affected by their peer-evaluation score for their team performance. This way they not only constructed their own knowledge but also influence their final score.

In summary, the issues posed are the same, they are significant for the intended learning outcome (ILO), "realistic" and arouse student curiosity. If the teams write a request for proposal the entire class should vote for the same project, essentially selecting the issue of interest for the class. The teacher would then need to revise the proposal, so the ILOs can be guaranteed, and scaffolding put in place. The specific choice would be the teams' and conceivably the teacher's solutions. For a more detailed description of the course design see the introduction webpage.

Case 3: Learning how to think

For the last readiness assurance of the course the team's final feedback reflected on all learning modules in their entirety, what they thought they had learned, why and what was most exciting to learn, hardest and surprised them the most. I wanted to know if the learning method was working. Many of their responses were similar to that reported in the literature (Michaelsen, et. al., 2004). For example, the academic students felt that they were teaching the non-academic students during the readiness assurance, they could not understand how some of their team members could be so apathetic to learning. One team said, "we had to learn everything ourselves" and construed it as something negative. Another team remarked that they knew more at the end of a learning module than they did at the start of the module, again with the attitude "you could have just told us these things." These two teams were not aware of the fact that they were engaged in constructive learning, learning to them meant being told what to think. I believe for this reason there is a prejudiced resistance to active learning. However, the majority of teams understood, with hindsight, the point of this learning method.

Each learning module exercised a part of the learning loop. The first module was on the *art of mathematical modelling* and the application exercise a continuation of the interactive tutorial, where an example was given on how one applies guiding heuristics to build mathematical models. For the application exercise it was sufficient to add conditions to the problem that would tease out all the modelling facets I expected them to learn. Then I asked them a question they could answer experimentally using the model but could be answered mathematically in a later learning module. I asked the teams to reflect back on the previous assignment and use what they had learned in the new module. In their feedback students remarked on this experience as an eye-opener. They were revisiting previous exercise with a completely different perspective, thus creating new learning opportunities. Next in the learning loop is the executable model. I used this as an opportunity for them to learn about the programming of algorithms and computational complexity by actively experimenting with their own coding. In the between team discussion, they would see how different models could give the same results and that some models were more elegant than others. For the programming exercise they would see how different computer code could look and again how some implementations were smarter than others. They also realized the importance of clearness and legibility, often expressed as their reason for ranking a team's solution low. As recommended in team-based learning all assignment can be neatly reported on a single page. One student in her reflection remarked about this, “we cannot split the job among us, we have to do it all together”. The exercise must be performed as a team not in isolation, as they would commonly do in other courses. All application exercises, be it code, text or mathematics is performed with Google Colabs and handed in as such, requiring only a web browser. The fourth module was about duality, a different perspective for a model. In this application exercise, the model was given but the exercise centred on interpretations. The students were also asked to interpret the dual models for the first two learning modules, again revisiting past issues with new perspectives. At the students request they were given a week extension for this exercise. Time was clearly needed for reflection on these new experiences (Hrynchak & Batty, 2012). Interpreting models is hard and requires deeper reflections. Their fifth learning module centred around a mathematical technique used for sensitivity analysis. In this learning module they were also given a paper to read that criticizes what they had just learned. They were asked if they could use the same argument for their application exercise, and I chose the parameters so that it could be. Some teams figured it out while others were not too far off. One student remarked, “I thought this would be just another math course, but we are expected to think critically about the problems”. This is encouraging and convinces me that I’m on the right track. With each new learning module, I would also deliberately “up the complexity” of the model or its implementation. For their final learning module, they were asked to reflect on all the learning modules. The teams would also create a one-page cheat-sheet for the entire course. Their final application exercise required knowledge from all learning modules, for an issue that would explore their modelling skills, their model interpretation, implementation and testing. They would need to design tests for their model in order to answer their client’s queries. The issue I designed is an art barter problem for a real art Gallery, where I tell the students the gallery owner found about the kidney exchange problem from a friend and wondered if a similar approach could be taken for their art barter. The problem is significant and “authentic”. At the same time, if successful, the art gallery would be interested in their solution. At the end of this final application exercise, the students were asked to criticize selected models from other teams, this time as an individual exercise. Putting an individual assessment at the end of the learning module, based on the work of their team, encourages student commitment. Furthermore, I gave them my model to reflect on and amend by revealing additional conditions. I plan to use variations of this type of individual assessment for all learning modules in the future.

When the teams are working on the application exercises, they may ask for clarification on different matters. When several teams asked similar questions, I would call the entire class together and discuss with all. When this happens, it is necessary to have some scaffolding in place. However, instead of having ready-made questions or tasks we would reflect on how one creates one’s own scaffolding by reflecting on the guiding heuristics for problem solving. I would perhaps help them in considering which heuristic was important at this point in time. I would reflect with them on the typical questions asked by experts when building conceptual models. What are the comparable questions we must ask here? In one team’s reflection this exploration phase was an agonizing time but looking back they understood it’s importance. Another team remarked that they would have wanted more time with me and perhaps an assistant teacher was needed. I don’t agree with this, there appeared to be a natural resistance from the students to this approach. Their defaulting behaviour was to demand direct instruction from me, and I must admit I had to resist the temptation of doing exactly that sometimes. However, when a concern of a technical nature surfaced, often software related, I would demonstrate and even send an announcement to all. During the semester I noticed a change in the way students asked, they did not demand to know what they should do, but rather to my pleasant surprise they were telling me why something did not make sense. They were creating counter examples for specifics in the textbook. When this happened, I asked the respective team to share their discovery with the entire class, with the aim of supporting their learning confidence (Yadav, et.al., 2014).

The application exercises require students to apply and theorise. When reflecting on the team applications exercises, students were surprised that there was no single best answer to exercises, and found it was surprisingly difficult to interpretate solutions. During the brainstorming or explorative sessions, it appeared that the playing field levelled out between the Susans and the Rogers, as described by Biggs and Tang (2011). Who is the client? What does the client want? How can we simplify the problem? What extreme cases we can use to test out hypothesis? etc. The readiness assurance instructed the students on what to think (declarative knowledge), but the application exercises are about how to think (functioning knowledge). For engineering students this is the most valuable part of their education and the most essential to exercise for the practicing engineer.

Case 4. Student supervision

Many of the MSc and PhD projects are client based. They are all about problem solving and so naturally follows the learning loop described in figure 1. This time the question is called a research question. The issues are the *motivation* for their thesis, the *objective* are the undertakings needed to answer the research question and how it is answered their *contribution*. Understanding the significance of their contribution requires placing it within the context of the related scientific literature. At the start of any student supervision, I make sure that the student has a good working environment. I make sure that a PhD student is not sitting somewhere alone but with other PhDs and postdocs. It is necessary for the students to be in dialog with other students. They motivate one another and by doing so are likelier to complete their studies on time. In the past my PhD students have worked closely with me and the client. My latest PhD student is one of 15 ECRs in the Infans project, which means there is a larger team working on the same topic. This has many benefits for the PhD student, not only secure funding but also secondments with other institutions and summer schools we organize as a team. Research is a team effort. I also deliberate with my students their job prospects and further academic ventures for when they complete their studies. This also means I introduce them to other researchers and emphasise the importance of networking with other researchers within the field.

At the start of my supervision, I spend time with the student mapping out tentative research questions and conceptual models. Before doing a thorough literature study, I ask the students to spend some time thinking about how they might answer the research question. This helps them focus their search of the literature and approach the issue in an unprejudiced manner. Following the initial survey of the literature, we enter the learning loop again, revisiting the research questions and conceptual models. Many of the issues undertaken by my students are also new to me, so my guidance is inherently always of an explorative nature, asking questions and trying to create simpler toy-problems with the student to understand the nature of the issue. Very quickly I expect the student to be asking the explorative questions and taking charge of the learning loop. Iterations through the learning loop are taken at regular meetings with the student. These meetings will typically focus on testing and how to validate the conceptual model. When we are both content, the student will write up the thesis or paper in the case of the PhDs. Our students take a course on how to write their thesis, this has been a time saver for us. I emphasize the importance of telling a complete and interesting story, emphasising their contributions. The PhD student, as required, publish their work in reputable journals. Furthermore, some of my MSc students have published their work in reputable conferences proceedings. When possible, I involve my PhD students in paper reviews, peer review benefits them with their own writing. I encourage my students to attend conferences and involve them in my teaching. Thus, they exercise their oral presentation skills and reasoning of research findings.

Way forward

The way forward requires facing a real resistance to active learning from both students and teachers. The teacher's resistance described by Haas and Keeley (1998) as "the pressures to publish and score well on traditional student evaluations are much more likely to drive faculty behaviour than will an interest in increasing the ability of students to 'learn' or to perform at the higher order levels of cognition". I have been fortunate to receive the support from my faculty for my experiments in active learning. Admittingly, the student's resistance to active learning has me sometimes questioning why I'm making my life so difficult. Does the university want me to go back to optimizing the student evaluations? I don't feel I am teaching engineering when the students are incapable of applying what they learn. Being able to transfer what they learned in one context to new contexts. What worries me the most is that the students believe they have learned something, when they regurgitate the "right" answers in an exam.

Within our faculty I have had endless discussions on teaching with professors Guðmundur Valur Oddson and Rögnvaldur Sæmundsson. It is also an asset to have three of our faculty staff (including myself) having completed a teaching diploma, this lifts our discussions about teaching to another level. I have also been fortunate to have professor Guðrún Geirsdóttir from the Teaching Centre to talk to and take a focus group meeting with my students. I have recruited two of my students to work with me part time on improving the Team-based learning experience. I look forwards to working with them this summer and letting them to contribute towards their own study.

The faculty has (pre Covid) held teaching bootcamps at Skálholt where we would stay overnight. These meeting were extremely fruitful and instrumental to the complete over hall of our undergraduate program. We aim for reforms to our master program too, for example we are considering the possibility of a master's program without a thesis and more direct collaborations with the industry. Then there are many practical aspects of teaching to discuss, for example value rubrics for the program's learning outcomes, that can be adopted to individual courses. These will be shared between the different engineering fields of study. In the past I have organized small social workshops for faculty members, for example one on Python programming. Similarly, I plan to organize case writing workshops for our faculty. I believe some cases could also be used over multiple courses using different perspectives and intended learning outcomes. Still, courses taught by other faculties are beyond our direct control. It has been for many years a concern for us that our students having completed, for example, an introductory statistics and programming course are unable to apply either. I believe we may need to address this within our cases.

My philosophy to engineering education today is that it should be in small-groups and integrated with engineering practice underpinning life-long learning. The challenge is teaching large classes in small-groups and developing application exercises that encourage creative thinking. I believe the most valuable outcome for a student is critical thinking and learning to learn.

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Appendix

All teaching surveys and student feedback can be accessed through the University system ugla.hi.is. Likewise, a list of all courses taught, and students supervised may be found within this system. All teaching material can be obtained from Canvas or Moodle for the last 5 years. Prior to that other teaching material is available on ugla.hi.is. Other educational material available on the web are given as hyperlinks within this document (click the underlined texts with the mouse).

CV

The CV is attached to the application.

Letter of recommendation

The letter from the dean is attached to the application.

KENNSLU AKADEMÍA
OPINBERU HÁSKÓLANNA

Tómas Philip Rúnarsson

Expert assessment of pedagogical qualifications of Professor Tómas Philip Rúnarsson for the admission to the Teaching Academy

Introduction

This report gives the evaluation of Tómas Philip Rúnarsson´s application for the status as a member of the Teaching Academy. The Teaching Academy is a forum based on a Nordic model that aims to promote pedagogical development and improve teaching methods. The main goal of the Teaching Academy is to strengthen dialogue about quality teaching and pedagogical development within and between the four public universities, as well as to reward academic staff who excel in teaching.

The Teaching Academy was established in the beginning of 2021 with the support and encouragement of the Ministry of Education in Iceland with the involvement of all four public universities in Iceland. Workshops for interested applicants were held in March 2021 where Anders Ahlberg, an Associate Professor, Excellent Teaching Practitioner (ETP) and Faculty Study Director of Doctoral Education, Lund University and Roy Andersson, an Associate Professor at the Faculty of Engineering at Lund University guided and supported teachers in the writing of portfolios along with their application. The application deadline was on May 25th, 2021, where all applicants turned in a professional portfolio along with their application.

Evaluation Process

The Teaching Academy received 20 applications. All the applications were thoroughly reviewed by at least two experts and were then further reviewed and discussed by the evaluation committee of three Nordic and one Icelandic expert. The evaluation committee decided to conduct interviews in August and September. Following each interview an evaluation of the candidate was made in a discussion and reviewed by the evaluation committee to ensure consistency between the evaluations. The interviews sought to expand and clarify themes from the written applications, with emphasis on how the four governing criteria were met. After the interviews were completed, a final joint meeting of the evaluation committee was held to reach a final recommendation based on the written applications, portfolios, and the interviews. Of the 20 applications, 11 applicants are being awarded the status of members of the Teaching Academy based on the strength of their portfolios and other submitted documents along with the interviews. Those applicants that were not successful in this round are strongly encouraged to work further on their portfolios and apply again.

Evaluation Committee:

- Thomas Olsson, Associate Professor of Engineering Education and Educational Developer, Lund University.
- Guðrún Geirsdóttir, Associate Professor of Education and Head of the Centre for Teaching and Learning, University of Iceland.
- Oddfrid Terese Kårstad Førland, Advisor and Education Developer, University of Bergen.
- Petter Holm, Professor of Fisheries and Resource Management and Senior Advisor for Academic Development, UiT – The Arctic University of Norway.

Non-evaluation members:

- Róbert H. Haraldsson, Professor of Philosophy and Director of Academic Affairs.
- Íris Björk Eysteinsdóttir, Project Manager for the Teaching Academy.

Criteria

There were four main criteria for the admission for the Teaching Academy and evaluations were based on those criteria:

1. **Student-centred teaching.** Pedagogical practice, teaching vision and student-centred approach. Knowledge on how students learn and how to communicate with the students. Correlation between learning outcomes, teaching methods and assessment in teaching.
2. **Professional knowledge.** The extent to which the applicant has a scientific approach to the teaching assignment, teaching and learning.
3. **Clear pedagogical development for the future.** How has the applicant worked to improve their teaching and what ideas does the applicant have about future development?
4. **An active participant in conversation about learning and teaching.** How does the applicant create and share knowledge of learning and teaching in their field? How does the applicant collaborate with other professionals on pedagogical development and teaching methods? Has the applicant been an active participant in pedagogical collaboration such as working groups, teams, workshops, conferences, or publications?

Expert Assessment

Tómas Philip Rúnarsson is a Professor of Operations Research with Industrial Engineering, Mechanical Engineering, and Computer Science, University of Iceland. He received the Dr Scient. Ing. degree from the University of Iceland, Reykjavik, in 2001. He was appointed Research Associate Professor at the Applied Mathematics and Computer Science Division and Adjunct in the Department of Computer Science, University of Iceland. Tómas P. Rúnarsson has been teaching core issues in engineering, with operations research as a focus. His teaching experience is extensive, covering all levels, and has supervision experience at bachelor, master as well as and PhD level.

Tómas P. Rúnarsson develops his portfolio based on clear teaching principles firmly embedded in disciplinary ideas and work methods. Relevant pedagogical perspectives and research explicitly inform his reflections on teaching and learning and draw on detailed descriptions of how his ideas are implemented in his courses. The portfolio portrays a teacher with a strong engagement with a clear commitment to student learning. He has introduced team-based learning in the engineering program, combining engineering ideas and pedagogical approaches – often fighting student resistance and teaching tradition within the university.

The portfolio is built around cases. The first three contain Runarsson´s reflections of different dimensions of his educational practice, vividly illustrated with examples drawn mainly from his undergraduate course in Operations Research. Here he covers the challenges of the flipped classroom, i.e. how to engage students in active and deeper learning through preparation for class discussions. He describes his work to motivate students to discover and problem solving and reflects on the challenges involved in teaching students how to think systematically. In the fourth case, he describes his approach to supervision, focusing again on problem solving and engagement as key issues. The cases give a detailed and colourful description of Runarsson´s interaction with the students and his constant engagement to understand and improve student learning.

Runarsson has taken a strong and consistent interest in pedagogical development, including completing the Teaching Studies for Higher Education post-graduate diploma. He has also dedicated considerable effort to educational development projects. Runarsson holds a leadership role within his faculty and has initiated several educational actions, curriculum redesign, and dialogue on practice. He has a diploma in higher education pedagogy and very strong educational underpinnings for his approach to teaching. The systematic effort to develop his educational competence is clearly visible in his practice as a teacher and educator.

Tómas P. Runarsson is an exceptionally dedicated, creative, and knowledgeable teacher and educational leader, strongly committed to a student-centred approach. His portfolio is exemplary in how it brings the reader into the classroom and the actual teaching practice. The interview confirmed the impression from the portfolio of an excellent, reflective, and scholarly teacher.

Based on this assessment, we recommend that Tomas Philip Runarsson is accepted to the Teaching Academy.