



## Innovative Teaching Award

**Hadi Hajibeygi is an associate professor and lecturer on Reservoir Simulation and Rock Fluid Physics at the Faculty of Civil Engineering and Geosciences. In November 2018 he won the Innovative Teaching Talent Award. Therefore, we asked him to give us an insight about his vision on integrated approach for effective development.**

Educating young talents to increase prosperity and wellbeing of our planet Earth inhabitants is our core responsibility as teachers at universities. Even conducting research at universities is part of our educational activities, in the sense that we, professors, train young talents to develop the necessary skills for conducting research on a new subject, and to disseminate its findings transparently and comprehensively. Studies on university professors have shown that being a good researcher does not correspond to being a good educator [Rev. of Edu. Res., doi: 10.3102/00346543066004507]. Therefore, we, professors, need to improve our teaching skills constantly, and take this task very seriously. After a couple of years of study, our graduates leave us with the hope that their education has made them ready to pick up their role responsibly and effectively in the society.

Our societies develop and face new challenges. Our graduates, therefore, will also face predictable and unpredictable challenges in their professional careers. They may end up changing their careers a few times before their retirement. One of the main components of our society development is related to the technological revolution, which is expected to broaden its scope and enter new areas that interfere even further with classical human technical skills. At the same time, these technological advancements offer enormous opportunities such as convenient connectivity between people and swift access to massive amount of information. The need to be innovative in education is, as such, essential due to the 'intellectual evolution' of the human societies. The society asks more for a proactive professionals who invent innovative solutions in their jobs, rather than passively perform their well-described structured job responsibilities. It is seriously doubtful whether classical university education methods and in-the-box professionals will get any place in the future; e.g. the necessity of a knowledge-based university diploma for a job may soon indeed fade away. It is questionable, now more than ever, that based on what skills universities should license their graduates such that they

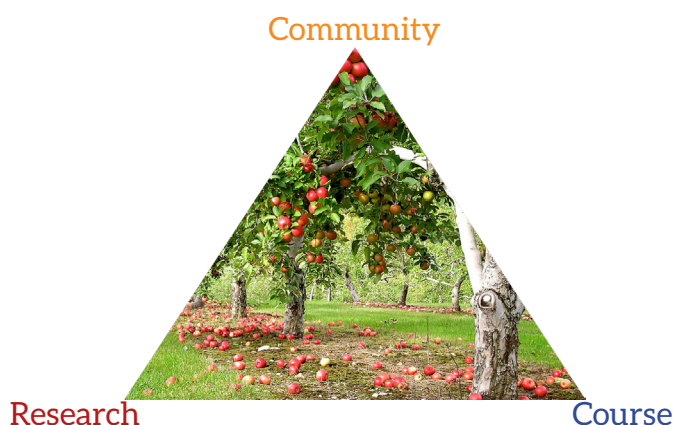
By H. HAJIBEYGI

can place themselves in the right position in the society after graduation.

With this introduction, I would like to express my view on education. Before doing so, let me first share with you an experience that happened to me a while ago. It was in winter of last year, when I was in my backyard garden planting a dead dry plant. Soon after, in spring, I found it had become a beautiful flower full of blooms. I could not believe it was the same dry plant in the winter. A complete surprise!

That made me wonder isn't it what we want to achieve with our students: "having them flourish"? Not only the smart ones whom can lead their own success, but also those we do not expect (like my dry plant in winter) and, specially, those who don't expect (believe in) themselves!

To achieve this goal, we often look into our course as the source of nutritious (soil of my garden)! So we plant our students in our course, with the hope that they flourish. And if they don't, hopefully, we invest a lot of effort to improve our course (more fertilizer in the soil). But we all know for a flower to flourish it takes the right 'environment for growth'! Soil is just one component, and certainly necessary but not enough!



▲ Figure 1: Education environment

Education to me is an integration of all activities, thus an environment, that we design at universities to facilitate students to develop; and unless in balance, harmony and connected, we cannot achieve our goal, i.e. flourishing students, who are ready for unexpected future challenges. Those who generate scientific solutions (like an apple tree), rather than memorizing solutions or skills in their minds (holding apples in their baskets). The environment leads to growth, not the isolated courses we teach! The education environment has other components beside the 'course': 'research' and 'community'. (Figure 1)

Research can be seen as the series of activities that a student performs under supervision of a professional to absorb a complex problem (capacity), find its relation with (possibly many) disciplines and stakeholders, decompose it into logically connected smaller modules, design or synthesize or invent an applicable solution, and disseminate it comprehensively to the stakeholders. In fact, in our MSc curriculum, only after successfully conducting a final research project we offer the students with a diploma.

Another component of educational environment is the 'community'. Community is the network of people who share challenges, goals, and concerns. Their connection and team makes them stronger, more effective, and increases the chance of their success. It gives them identity, and makes them be units of a big whole. The crucial role of community in the education environment cannot be disregarded, nor can it be left out of the focus and scope of the teachers. Note that the community should not stay only among students' peers within their departments (like student associations etc.), but with students and teachers and also technology owners and policy makers. Unless the community is in place and connected to other education components, the environment is incomplete.

Let me provide an example on how I create the educational environment. The first component is effective course development. I teach "Rock Fluid Physics" and "Reservoir Simulation" MSc courses. I also contribute in "Grand Challenges in Applied Earth Sciences" course, which is a BSc 1st quarter course. The topics I teach are mainly about physics of flow and transport in porous media, more on the modeling and simulation side. I have designed my course contents, even for these fundamental topics, based on "affordable experience of science". In my courses, we experience the science by designing an easy (affordable) yet creative setup inside the class to curiously study what we model. We engage together to discover, justify, debate and develop collectively fundamental modeling science for predicting the fluid dynamics and heat transfer in porous media. I distribute syringes to the students, with sand, a thermometer and a bottle of water. Of course, they need their phones (to measure, for example, discharge time of water and some physical properties from the internet) but that's pretty much it! I avoid



▲ Figure 2: Experiencing flow in porous media in the class

fancy isolated experiments, as they are not affordable in our daily life! In simulation course, I connect my laptop to the projector while students are behind their computers too, and we develop codes together based on the scientific bases and discussions. (Figure 2, 3 & 4)



▲ Figure 3 & 4: Experiencing flow in porous media in the class

As for the research and community development, I have established Delft Advanced Reservoir Simulation (DARSim) research group in 2013 and several activities around it. DARSim hosts several graduate and PhD students who work on simulation of flow and transport (mass, energy, momentum) in porous media (mainly geoscience applications). Now together with my colleagues, we host several DARSim lectures to invite external experts to come to Delft so our students get engaged with their research and visions. I explicitly ask our invited lecturers to present their materials understandable for an average MSc student. We also send our students outside to connect with external collaborators, whether at industry (through internships or visits) or other universities. We chair international events, and involve our students to connect with our network. This has made DARSim connected to the international research community, which has increased our students' visibility and impact, and finally has helped them to secure a proper position for themselves after graduation. (Figure 5)



▲ Figure 5: DARSim lecture 2014

To end, my example is, of course, one way of constructing the healthy 'teaching environment', and definitely there can be several other ways to make it. Nevertheless, my main message to all is: for flourishing students, create an integrated environment for growth! Do not put all your efforts only on one local isolated course. Education is a global, integrated, and environmental activity. The right environment makes students flourish, even those who don't believe in themselves!