A REFLECTION ON THE ENGINEERING SIGNATURE PEDAGOGY AND ITS APPLICATION TO THE DESIGN OF FLIPPED-LEARNING ACTIVITIES IN AN ADVANCED ENGINEERING COURSE

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Abstract

Engineering sciences are characterized by a wide and deep body of theoretical knowledge, built on physical observations and mathematical principles. Following the epistemological considerations proposed by Meyer and Land (2005), this core theoretical knowledge can be analyzed through the principle of *threshold concepts*. Two main *threshold concepts* of engineering can be identified: *model* and *accuracy*. The first concept refers to the ability and the possibility of developing a set of equations and/or algorithms to predict the behavior of a system, i.e. a *model* of the system. However, different such sets of predictive tools (different *models*) are always possible for the same system (*multiplicity of models*). At this point, the concept of *accuracy* comes into play: predictions of different models reach the target to different degrees, i.e. with a different accuracy. It is a trade-off between the level of accuracy required and the cost, in terms of time and money, of model implementation that determines the use of one specific model among the pool of available ones (*model selection*). Shulman (2005) proposed to look at signature pedagogies, i.e. how one is taught or "nursed", in order to understand how members of a profession act and think. A glance at the classic, teacher-centered, engineering signature pedagogy reveals a structure geared toward teaching students the *threshold concepts* of *model* and *accuracy*, albeit in a passive way. Flipped-learning approaches, as those for example presented in (Kim, Kim, Khera, & Getman, 2014), (Kanelopoulos, Papanikolaou, & Zalimidis, 2017) and (McCabe, 2018), have tried to engage students in more active and interactive learning activities, focusing mainly on in-class problem-solving and leaving the knowledge-building part of the pedagogy to passive activities (videos, readings) outside the class. Thus, the learner still assumes in a passive way the key concepts of *model* and *accuracy* and the fundamental skills of model development, validation and evaluation. By analyzing the deep structure of the classic engineering signature pedagogy, an innovative flipped-learning approach is proposed here that puts the construction and the evaluation of models at the center of students in-class active learning.

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