

# Engineering mathematics: Reflections on the dialectics of *in* and *for*

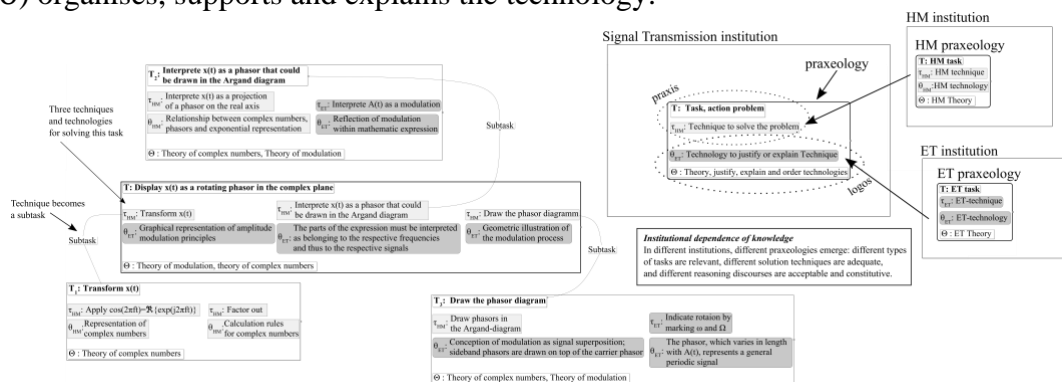
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## Institutional mathematical discourses *in* and *for* electrical engineering

This contribution<sup>1</sup> builds on our previous studies on mathematical practices in signal transmission, in which we reconstructed two mathematical discourses in electrical engineering mathematical practices based on subject-specific (Hochmuth & Peters, 2021) and societal-philosophic (Hochmuth & Peters, 2022) analyses. We introduced mathematical discourses (Peters, 2022) as a methodological tool of the Anthropological Theory of the Didactic (ATD, Chevallard, 2019). ATD is a research framework for studying practices from an institutional perspective, allowing the mathematical practices of engineers to be modelled in a way that takes into account their subject-specific particularities. ATD enables this, among other things, through the principle of institutional dependence of knowledge and the notion of praxeology (see Figure 1). In ATD a praxeology is a basic epistemological model to describe institutional knowledge in the form of two inseparable, interrelated blocks: the praxis block (know-how) consists of types of problems or tasks ( $T$ ) and a set of relevant techniques ( $\tau$ ) used to solve them. The logos block (know-why) consists of a two-levelled reasoning discourse. On the first level, the technology ( $\theta$ ) describes, justifies and explains the techniques and on the second level the theory ( $\Theta$ ) organises, supports and explains the technology.



**Figure 1: Discourses in an exercise on amplitude modulation (cf. Hochmuth & Peters, 2021)**

We reconstructed two different but interrelated institutional mathematical discourses in engineering mathematical practices: A mathematical discourse that refers to mathematics taught as an integrated part *in* electrical engineering (ET in Figure 1), and a mathematical discourse that refers to mathematics taught as a service subject *for* engineering (HM in Figure 1). The knowledge taught in an electrical engineering course contains both aspects of mathematical practices, *for* and *in* engineering (see Figure 1).

<sup>1</sup> The poster can be downloaded here: <https://www.repo.uni-hannover.de/handle/123456789/14419>

## **A dialectical view on the relationship between mathematics and engineering**

Considering the *in* and *for* and their relationship within engineering mathematical practices also relates to the question of how to understand the relationship between mathematics and engineering. Very briefly, the two mathematical discourses can be seen as contradictory orientations: Mathematics *for* engineering can be associated with mathematical rigour and formalism, and mathematics *in* engineering with pragmatism (Hochmuth & Peters, 2022). Here, pragmatic means that the mathematical practices of electrical engineering have been developed as historic-specific manifestation in societal institutionalised teaching contexts with a view to solve epistemological problems specific to engineering. In our previous work, the mathematical discourses have been worked out analytically as separate orientations.

In this poster contribution we would like to consider electrical engineering practices as the result of a dialectical process arising from contradictory orientations of the reconstructed mathematical discourses. The integration and transformation of mathematical practices from the *for* engineering courses with the mathematical practices *in* engineering suspends the contradiction. The result are mathematical practices that are neither applications of rigorous mathematics in an extra-mathematical engineering context, nor correspond exclusively to practices developed in engineering courses. Our analyses indicate that the dialectic between mathematical practices *in* and *for* engineering is important for the development of new mathematical practices. In this respect, the disconnectedness of mathematics in service courses and mathematics in engineering courses is considered as a problem and mathematics education research and teaching design projects aim at fostering connections. How can we promote interconnections without over-emphasising one side of the dialectics and ignoring the other? With this poster we would like to stimulate a deeper discussion on a dialectical view of the mathematics *in/for* engineering.

### **References**

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