# CALCULUS AND APPLICATIONS – LEARNING FROM HISTORY IN TEACHER EDUCATION

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*More than many other mathematical subjects, calculus covers pure and applied mathematics. The current scientific body of calculus may appear as if it were developed linearly without many optional possibilities made along the historical processes. However under a historical perspective stressing the conditions of its genesis there were many decisions made along the way. This contribution emphasizes the importance of generating an awareness of history of calculus when addressing student teachers.*

## TOWARDS AN AWARENESS OF HISTORICAL DEVELOPMENT

Modern calculus textbooks are characterized by an axiomatic representation and often offer physical applications. The main concepts are the real numbers, the notion of a function and notions of a limit, all of which are presented by certain formalizations (definitions, theorems, proofs, added by a few examples illustrating the propositions). This way of representing calculus was developed during the first half of the last century and is still regarded as "modern". This is a result of a long historical non-linear development with discontinuations.

From a "postmodern" point of view questions arise and the necessity for a broadened perspective: Are there alternative ways that calculus could have taken? Why was the idea of Archimedes concerning "exhaustions" not fruitful for centuries? Why were the steps which Newton, Euler and Weierstrass took (a dynamical preconcept of the limit, notion of a function, epsilon-delta-concept) widely accepted?

## EDUCATIONAL ASPECTS FOR STUDENT TEACHERS

Within the context of teacher training students should receive a deepened insight in the process of mathematics and develop an appropriate concept of science by considering historical circumstances. Infinitesimal calculus is both – a branch of pure mathematics as well as a tool in applied mathematics, and it often happens that its use lacks critical reflection. This situation provides a favorable opportunity to discuss the diversity of doing research – within and through mathematics.

Taking account of the difference between pure and applied mathematics, calculus shows an odd ambivalence. On the university level lectures are usually considered to

be a part of pure mathematics. Otherwise it embodies strong connections to numerical mathematics. Additionally, the methods of infinitesimal calculus play more and more a decisive role in mathematical modelling. Besides well-known modelling procedures in “exact” sciences such as physics, contemporary modelling is concerned to an increasing extent to other initially non-mathematical scientific issues such as economy or social sciences. These subjects deal with quantities that are not originally discrete in every case. This raises the question of whether infinitesimal concepts are a suitable tool for describing the “reality” in those subject areas. There are different possible answers; they depend on the perspective, the targets under investigation and the perception of science. Future teachers should know about it.

## WAY OF REPRESENTING – THE POSTER

History of mathematics as well as concepts of education are often subjects of visualizations. There are timelines, cycles, network plans and other schemes that can be represented graphically.

The poster will display the important correlations predominantly in the form of a concept map and include several text passages, giving guidelines and showing some of student’s elaborations and (mis-)conceptions. Proposals concerning teacher education will be included.

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