

# Of students and chemistry calculations: Results of three waves of research among Czech freshman chemistry teacher students

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## *Abstract*

The paper presents results of long-term research focused on freshman chemistry teacher students' results in chemistry calculations. This topic traditionally belongs among the co-called "triad of terror", being considered difficult and useless by students and problematic by teachers (Rychtera et al., 2019). Yet, it is a crucial part of chemistry (Fach et al., 2007). In the talk, results of three consecutive research waves are presented. First, only one student class was submitted to a test (Rusek et al., 2021). Based on the results, a new test was developed and students from more universities (and faculties were added) (Rusek et al., 2022). In the third study, the sample was extended even more and chemistry teacher students were compared with chemistry students.

The results clearly indicate chemistry calculations to be a significant hurdle for vast majority of students regardless of their field. Generally problematic calculation types were identified, word problems were found to cause students more problems only in certain calculation types. Qualitative analysis of students' progressions identified student groups according to their approach towards this specific problem solving.

Overall, the research showed freshman university courses need to consider students' lack of skills, knowledge and experience in this field and set them on a successful study path by addressing the discovered problems, limits or even void.

## *References*

- Fach, M., de Boer, T., & Parchmann, I. (2007). Results of an interview study as basis for the development of stepped supporting tools for stoichiometric problems. *Chemistry Education Research and Practice*, 8(1), 13-31. <https://doi.org/10.1039/B6RP90017H>
- Rusek, M., Vojíš, K., Bártová, I., Klečková, M., Sirotek, V., & Štrofová, J. (2022). To what extent do freshmen university chemistry students master 1 chemistry calculations? *Acta Chimica Slovenica*, 69(2), 371-377. <https://doi.org/0.17344/acsi.2021.7250>
- Rusek, M., Vojíš, K., & Chroustová, K. (2021). An Investigation into Freshman Chemistry Teacher Students' Difficulty in Performing Chemistry Calculations. In M. Nodzyńska (Ed.), *Scientific Thinking in Chemical Education* (pp. 67-74). Pedagogical University of Kraków. Rychtera, J., Bílek, M., Bártová, I., Chroustová, K., Kolář, K., Machková, V., & Wolfová, R. (2019). Kritická místa kurikula chemie na 2. stupni základní školy I. Západočeská univerzita v Plzni.

## *Keywords*

chemistry calculations; freshman chemistry student teachers; sustainability in education