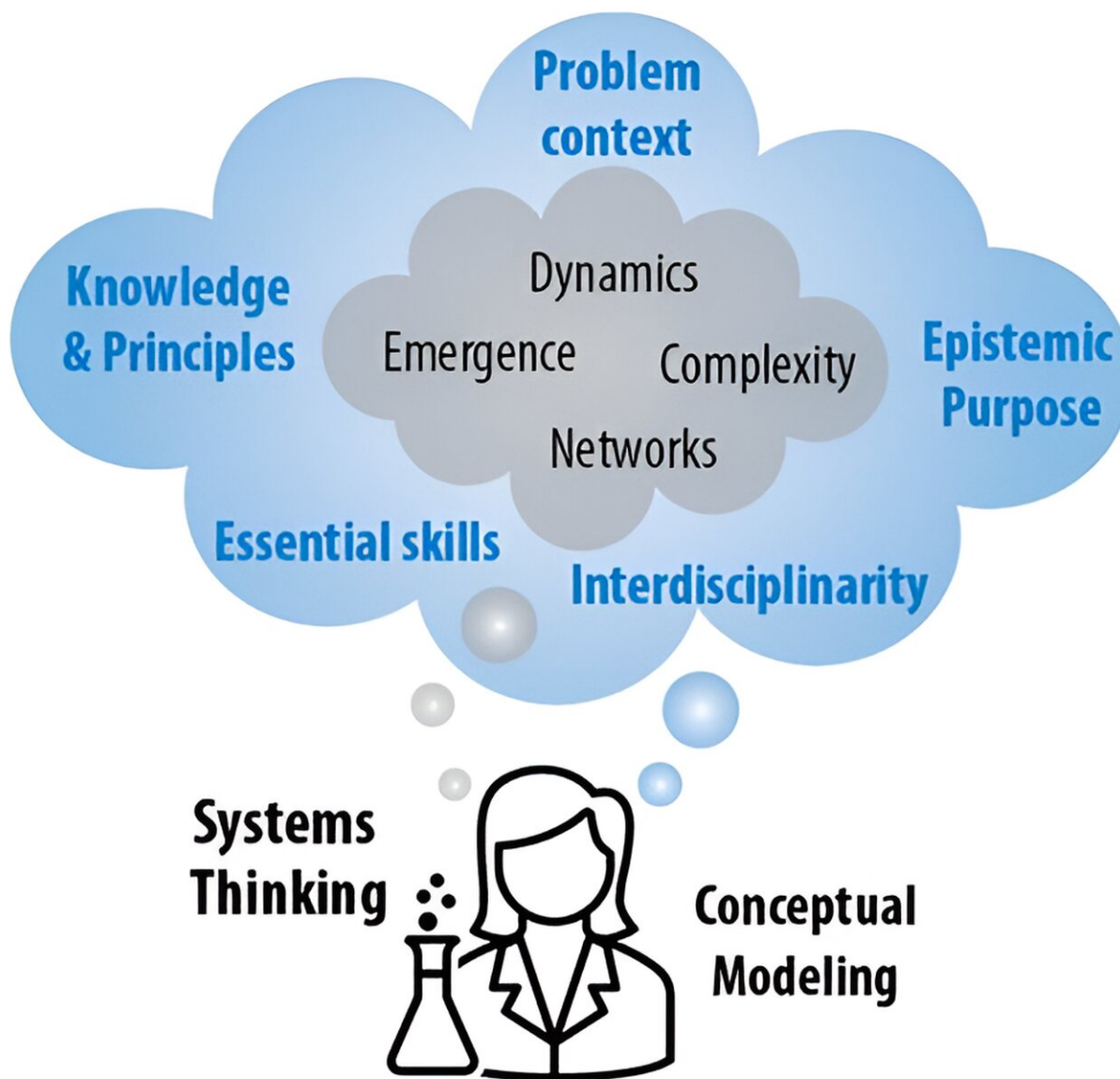


# Facilitating learning chemistry with conceptual modeling

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A team of researchers and teachers from the University of Twente have developed a novel teaching method that uses conceptual modeling to facilitate learning and foster creativity in classrooms of chemical science and engineering students. The students tackled real-world problems related to sustainability.

Many real-world challenges, including those related to sustainability, require an understanding of how various elements are interconnected. Students must learn the critical competence called systems thinking to analyze these global and often complex problems. But how to implement systems thinking into chemistry education is remains challenging.

A method that could be used to guide students in systems thinking is conceptual modeling. It focuses on the reasoning ability of scientists and is a way to formally describe specific aspects of the real world around us. It can be used as a methodology to focus on scientific reasoning for the purpose of designing experiments.

The researchers gave a group of 48 students a project to work on in teams of five or six. "The students were all from very different backgrounds, not only different schools but also different nationalities. The different backgrounds showed them varying perspectives for the same problem," explains Leonie Krab-Hüsken, first author of the paper and director of the Chemical Science & Engineering program.

They published their findings in an article titled "[Conceptual Modeling enables Systems Thinking in Sustainable Chemistry and Chemical Engineering](#)," in the journal *Chemical Education*.

The students had to find solutions to problems related to sustainability. The students could choose from "[methane emissions](#) from waste dumps," "PFAS in the environment" and "heavy metals in water." Within these challenges, the [student](#) groups would find and pick a specific problem to solve.

"These problems created a tangible direction towards which the students could apply conceptual modeling," says Albert Wong, corresponding author, and leading researcher of the study. The students had to design their experiments and come up with a hypothesis.

This study showed that it's important for students to combine their knowledge of chemistry with other important skills like collaborating, communicating, searching literature, and academic writing. "During the project, we kept the future engineers we want to educate in mind; what kind of skills do they need and what attitude should they have?" says Linlin Pei, educational consultant from the Center of Expertise in Learning and Teaching.

Using this method, they can improve their critical thinking skills and their ability to apply their knowledge in solving real-world problems. It helped students think more deeply and broadly about [complex problems](#), and with practice and reflection, it could be used in different subjects to help all students reach their full potential in their studies.

The method developed for this publication is now used as a standard BSc project in the Chemical Science & Engineering program and gained recognition through lectures from Leonie Krab-Hüsken and Albert Wong at the 2023 UT Inspriatiedag and 2023 Woudschoten Chemie Conferentie.

This [research](#) was based on a unique collaboration between several researchers, teachers, and [students](#) within the Faculty of Science and

Technology (S&T): Dr. Leonie Krab-Hüsken, Linlin Pei, Pepijn de Vries, Dr. Saskia Lindhoud, Dr. Jos Paulusse, Prof. Dr. Pascal Jonkheijm and Dr. Albert Wong.

**More information:** Leonie E. Krab-Hüsken et al, Conceptual Modeling Enables Systems Thinking in Sustainable Chemistry and Chemical Engineering, *Journal of Chemical Education* (2023). [DOI: 10.1021/acs.jchemed.3c00337](https://doi.org/10.1021/acs.jchemed.3c00337)

Provided by University of Twente

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