Assessing collaborative problem-solving skills in chemistry education research

Problem Statement

There are two approaches in CPS assessment:

- human-to-human (H-H)
- human-to-agent (H-A)

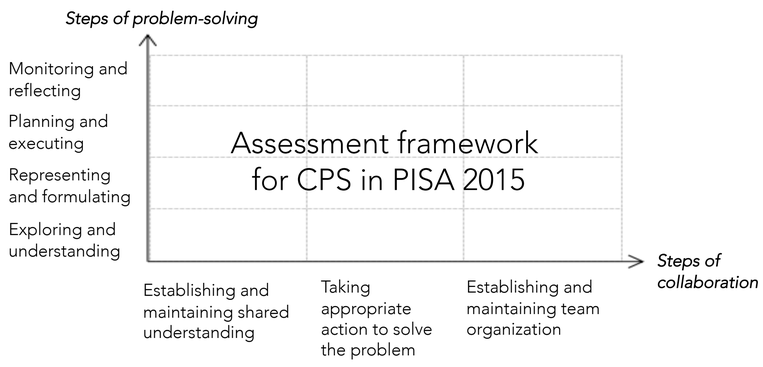
Student's behaviors by H-H approach are analyzed by looking at their dialogue or behavior in group work or discussions, and their interactions need to be recorded by multimedia. So there are some problems as follows:

- controlling context factors (Rosen & Foltz, 2015; OECD, 2013)
- time consuming data collection and analysis
- only few studies on H-A approach (Kuo, 2020)
- only few studies have examined online CPS in science (Slotta & Linn, 2000; Turcotte, 2012)

Theory

Collaborative problem-solving, or team-based problem-solving,

- is one of the core competencies of the 21st century (Hendarwati, 2021; Griffin, 2014)
- has multi-disciplinary applications (O'Neil, 2004; Pazoy, 2012; Rummel, 2005)
- is a crucial competence in education Avry , 2020; Chang , 2017)



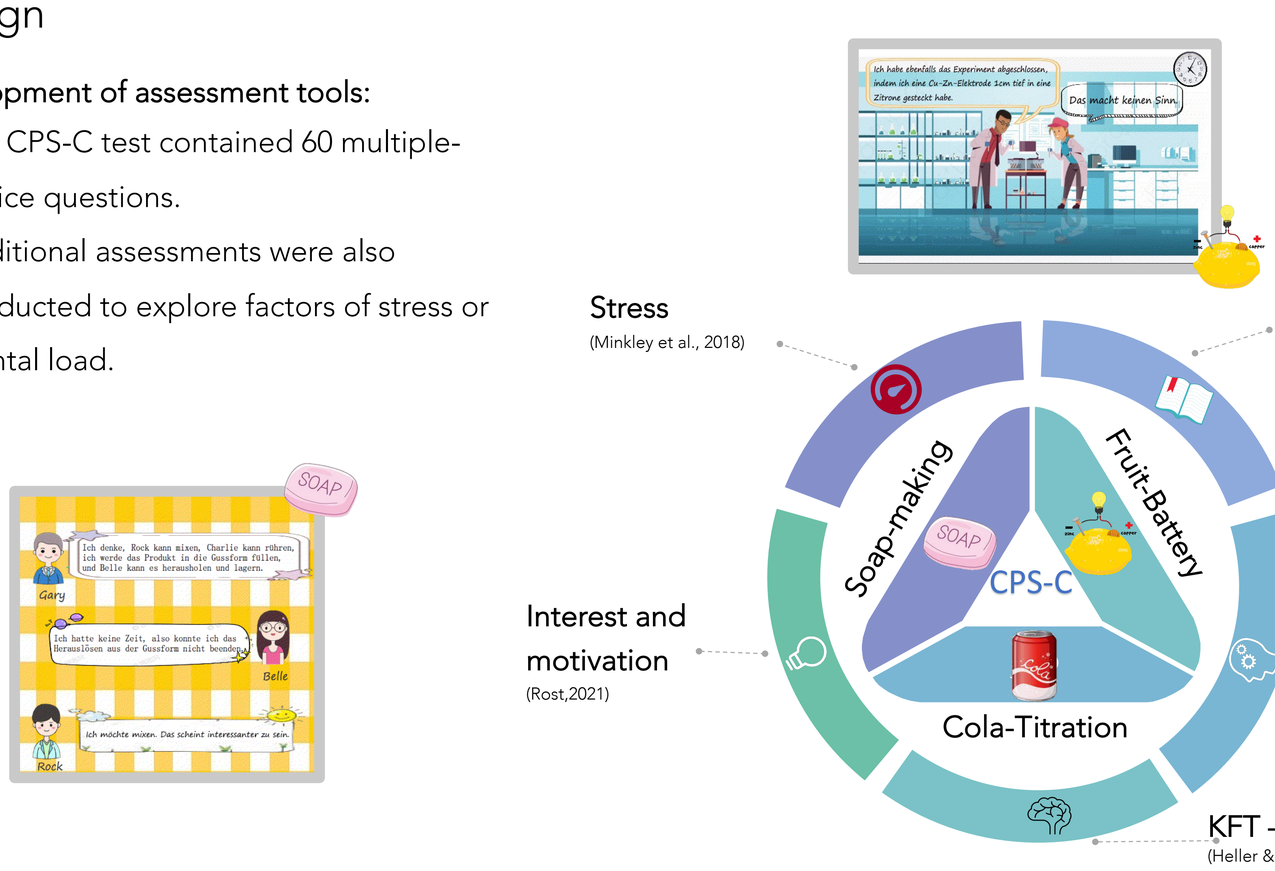
Research questions

- RQ1: How could collaborative problem-solving skills in chemistry be measured in a standardized way?
- RQ2: How do German and Chinese students differ and correlate in collaborative problem-solving skills in chemistry?

Design

Development of assessment tools:

- The CPS-C test contained 60 multiple-choice questions.
- Additional assessments were also conducted to explore factors of stress or mental load.



Data collection:

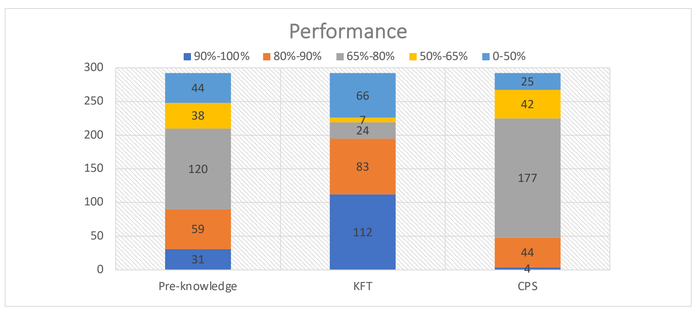
- Location: Yuyao, Zhejiang Province, China
- Pre-study: N=50 (32m/18w), Guided interviews (N=10, ca. 10 mins/student)
- Main study: N=292(205m/87w)

Results: CPS model

- The results of EAP/PV reliability coefficients (0.61-0.71) and the value of the (0.8-1.1) showed a good fit with the CPS model.
- Multiple linear regression analysis showed KFT (B=0.722, p<0.001, VIF=1.112) and prior knowledge (B=1.636, p<0.001, VIF=1.159) on CPS were statistically significant, while stress (B=-0.317,p=.0.345>0.05, VIF=1.076) was not.
- Analysis of the Wright Map showed a largely complete coverage between -3 and 3 logits and a good fit with the CPS skills.

Results: Co-Variables and CPS

- Interest and motivation (M=3.38, SD=0.62) were high, while their stress (M=3.52, SD=2.13) and mental load (M=4.07, SD=1.73) were low.
- Good cognitive ability and prior knowledge, with over 200 students scoring over 65%.
- Collaborative problem-solving skills are at an intermediate level, with most students scoring between 65% and 80%.



Conclusion and future work

The following conclusions were drawn for CPS-C based on the results of the analysis.

- Students have intermediate levels of CPS skills and are able to convey a common understanding of the issue and required knowledge to solve problems.
- Prior knowledge and cognitive ability had a significant effect on students' CPS performance.

Next step

- The CPS test will be conducted by German high school students (N=300) compared with Chinese students.

Rüdiger Tiemann, Prof. Dr.
Humboldt-Universität zu Berlin
Fachdidaktik und Lehr-/Lernforschung Chemie
ruediger.tiemann@hu-berlin.de

Literatur

Yike Ying, M. Ed.
Humboldt-Universität zu Berlin
Fachdidaktik und Lehr-/Lernforschung Chemie
yingyike@hu-berlin.de