Relation between pre-service teachers' CAS performance and self-assessments
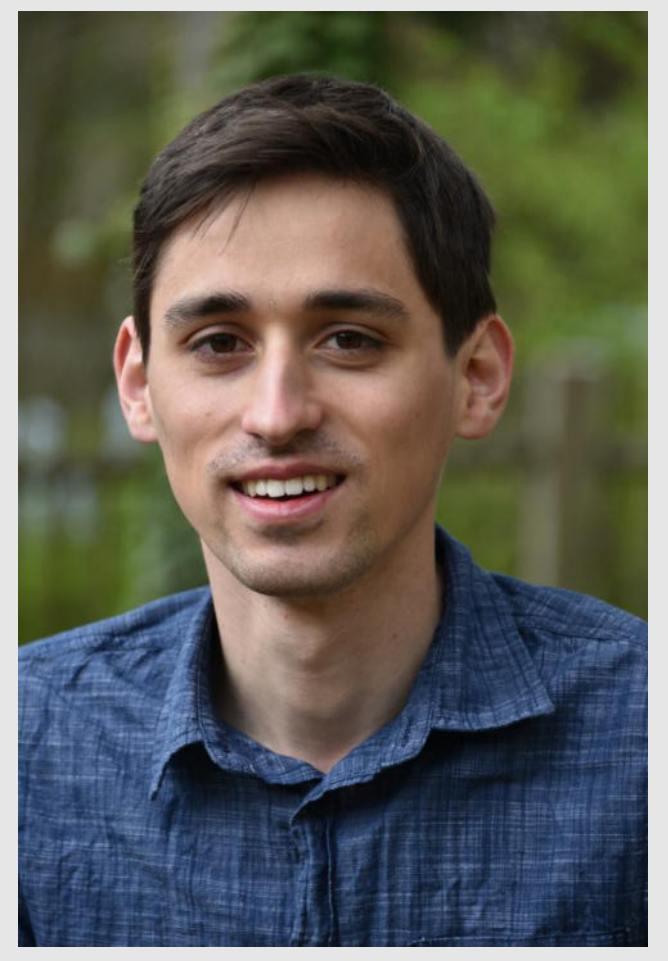
Hannes Seifert, Anke Lindmeier (Germany)

hannes.seifert@uni-jena.de

DIGITAL COMPETENCE (DC)

For using information and communication technology (ICT) in classrooms, teachers need digital competence which, according to Ferrari (2012), can be (subject-unspecifically) described as a set of:

KNOWLEDGE

Teachers need professional knowledge, e.g., as described by the *Technological Pedagogical Content Knowledge* framework (TPACK, Mishra & Koehler, 2006).

SKILLS

Teachers need to master demands with ICT in a classroom context, e.g., for using the digital tools correctly (*Technological Mathematical Skills*, TMS) or creating exercises and evaluating students' solutions (*Technological Pedagogical Mathematical Skills*, TPMS).

ATTITUDES

Teachers have to hold positive attitudes towards ICT, a high self-efficacy, and an open mindset to innovations.
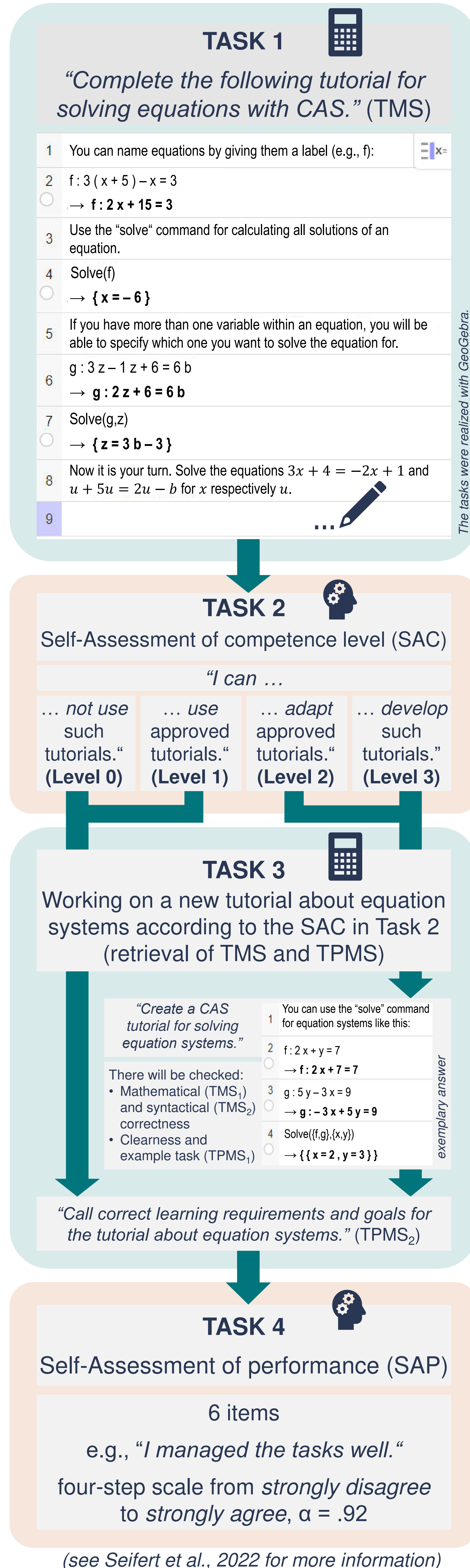
MEASURING DC

- *Self-assessments* are the de-facto standard for measuring teachers' digital competence. They are prone to biases (e.g., social desirability, Dunning-Kruger effects, Kan et al., 2018).

- It is suggested to shift towards *performance assessments*, requiring teachers to work on standardized problems close to practice (Tabach, 2021).

- There is a lack of systematic research on the suitability of self-assessments as performance indicators, especially regarding retrospective self-assessment.

RESEARCH QUESTIONS (RQ)

Are pre-service teachers able to correctly self-assess their performance before (RQ1) and after (RQ2) working with CAS?

To answer RQ1 and RQ2, the pre-service teachers worked on the performance assessments using CAS. Retrieved TMS and TPMS scores were compared with pre- and post-self-assessment scores.

DESIGN OF THE PILOT STUDY

TASK 1

"Complete the following tutorial for solving equations with CAS." (TMS)

1	You can name equations by giving them a label (e.g., f):
2	$f : 3(x+5) - x = 3$
○	$\rightarrow f : 2x + 15 = 3$
3	Use the "solve" command for calculating all solutions of an equation.
4	Solve(f)
○	$\rightarrow \{x = -6\}$
5	If you have more than one variable within an equation, you will be able to specify which one you want to solve the equation for.
6	$g : 3z - 1z + 6 = 6b$
	$\rightarrow g : 2z + 6 = 6b$
7	Solve(g,z)
○	$\rightarrow \{z = 3b - 3\}$
8	Now it is your turn. Solve the equations $3x + 4 = -2x + 1$ and $u + 5u = 2u - b$ for x respectively u.
9	

The tasks were realized with GeoGebra.

TASK 2

Self-Assessment of competence level (SAC)

"I can …"

… *not use* such tutorials." **(Level 0)**	… *use* approved tutorials." **(Level 1)**	… *adapt* approved tutorials." **(Level 2)**	… *develop* such tutorials." **(Level 3)**

TASK 3

Working on a new tutorial about equation systems according to the SAC in Task 2 (retrieval of TMS and TPMS)

"Create a CAS tutorial for solving equation systems."

There will be checked:
- Mathematical (TMS$_1$) and syntactical (TMS$_2$) correctness
- Clearness and example task (TPMS$_1$)

You can use the "solve" command for equation systems like this:

1	
2	$f : 2x + y = 7$
○	$\rightarrow f : 2x + 7 = 7$
3	$g : 5y - 3x = 9$
○	$\rightarrow g : -3x + 5y = 9$
4	Solve({f,g},{x,y})
○	$\rightarrow \{\{x = 2, y = 3\}\}$

exemplary answer

"Call correct learning requirements and goals for the tutorial about equation systems." (TPMS$_2$)

TASK 4

Self-Assessment of performance (SAP)

6 items

e.g., *"I managed the tasks well."*

four-step scale from *strongly disagree* to *strongly agree*, α = .92

*(see Seifert et al., 2022 for more information)*

SAMPLE AND PROCEDURES

- We worked with N = 50 pre-service teachers (third/fourth Bachelor semester) of the Friedrich Schiller University Jena in 2021 and 2022.
- For scoring the CAS performance (TMS and TPMS), we inductively developed a manual.

RESULTS

RQ1: The weak correlation (r = .24, n.s.) between pre-service teachers' performance in the first tutorial (Task 1) and their SAC (Task 2) was not significant. See diagram 1:

Diagram 1: Relation between Task 1 and self-assessed competence level
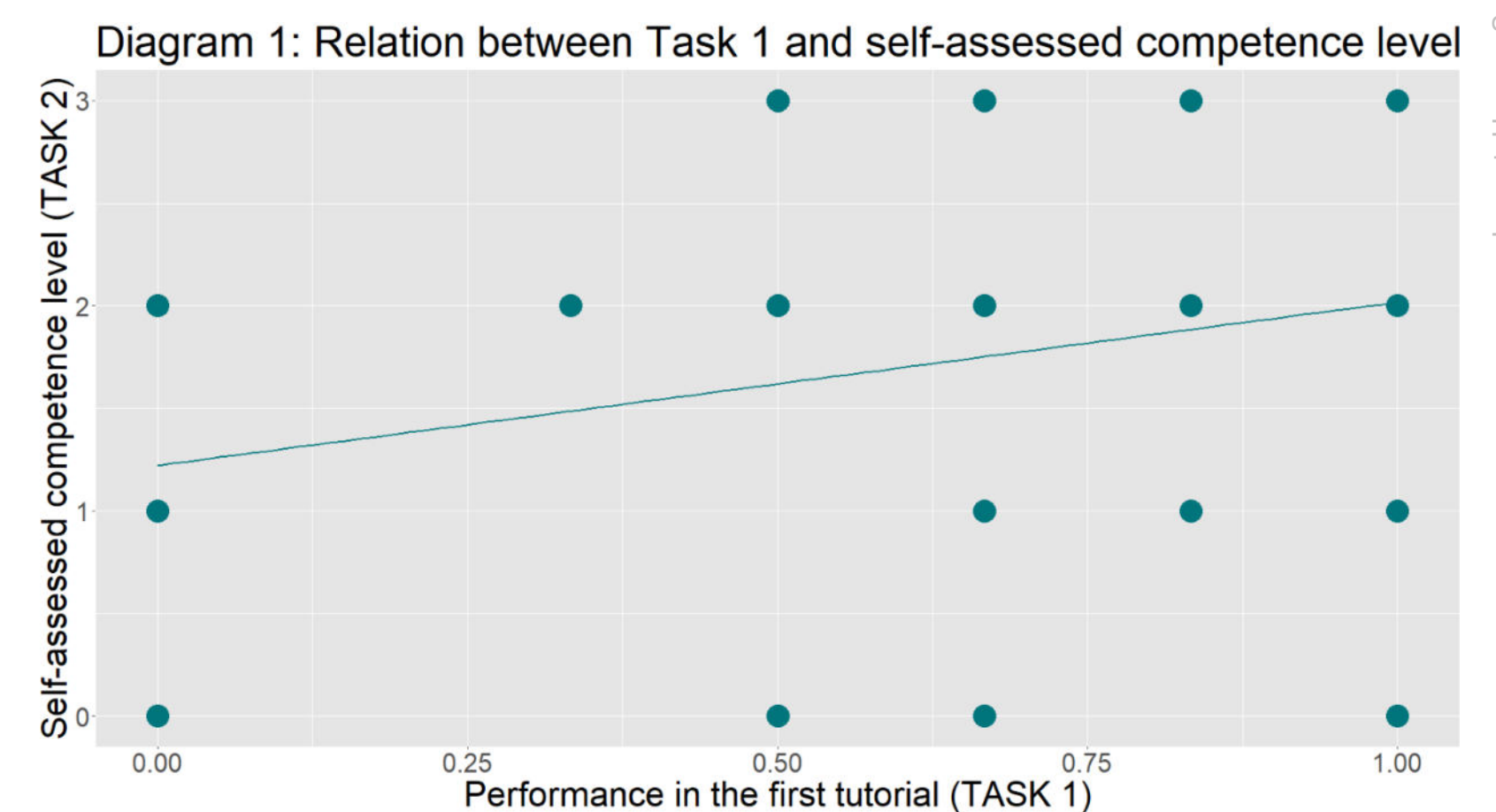
RQ2: The correlations between the CAS-specific TMS, TPMS (Task 3) and the SAP (Task 4) were zero-to-weak and not significant: TMS$_1$–SAP: r = .24; TMS$_2$–SAP: r = .27; TPMS$_1$–SAP: r = .07; TPMS$_2$–SAP: r = .03 (all n.s.). See diagram 2:

Diagram 2: Relation between performance and self-assessment
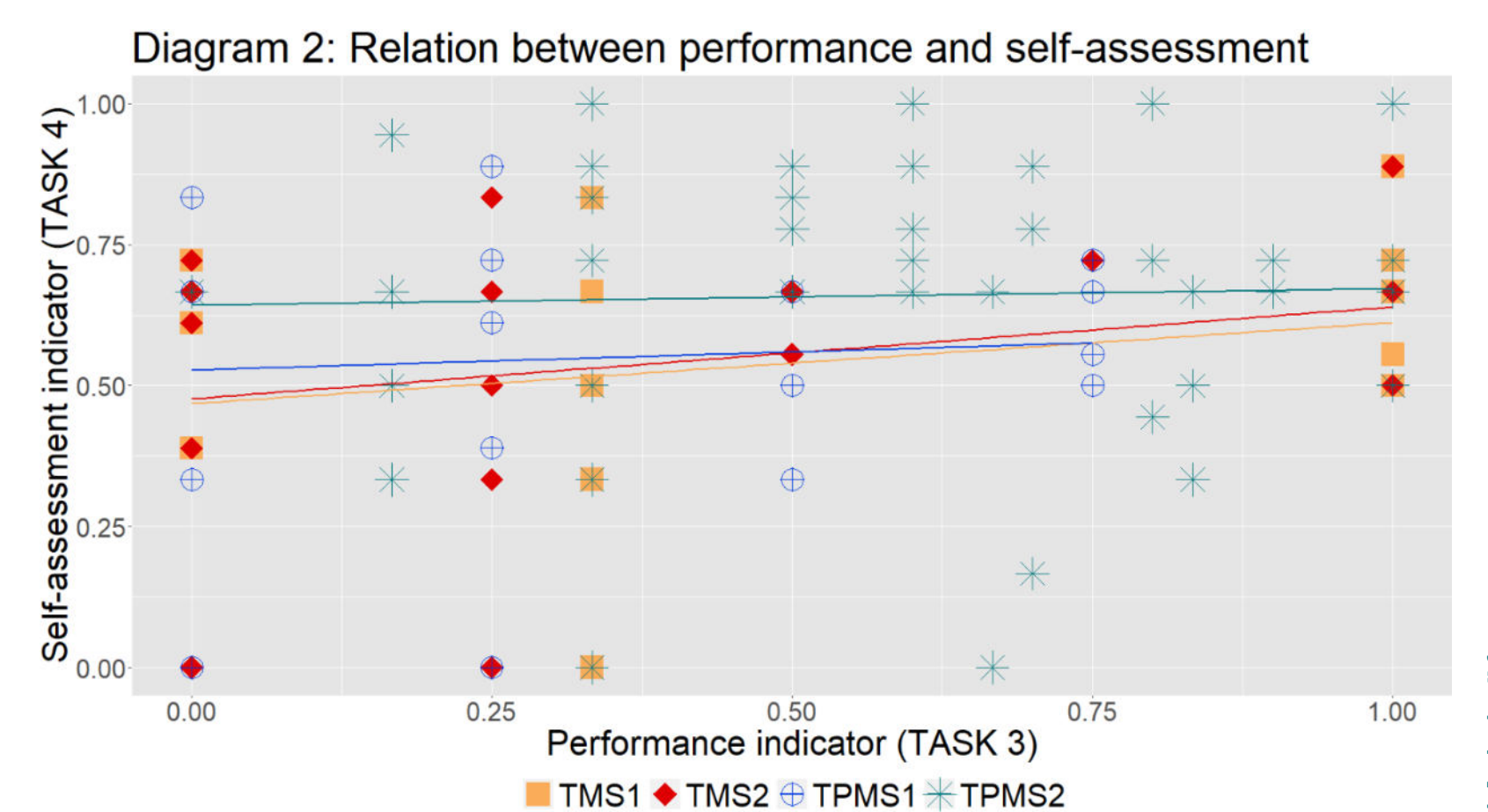
DISCUSSION AND IMPACTS

- As hypothesized, TMS, TPMS, and self-assessment did not show clear relations, regardless of whether the self-assessment was collected before or after performance.
- Some tendencies might hint at a positive bias of post-self-assessment (Dunning-Kruger effect).

Self-assessments were found to be a poor indicator of prospective teachers' CAS-specific digital competence in our study, even when collected directly following a performance task.

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Scan here for the digital poster.

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