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Classroom observation in SCALE-UP settings – first results

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MOTIVATION

➢ SCALE-UP (student-centered active learning environment for upside-down pedagogies)fosters active and collaborative learning through a modified room and teaching concept.

➢ Significant increased student conceptual understanding and problem solving abilities, improved attitudes and higher success rates have been shown. [Beichner et al., 2007]

GOAL

➢ Investigation of students` cognitive engagement.

➢ Development of appropriate learning materials and learning activities.

SCALE-UP ROOM

Florian Hamberger, TH Rosenheim

➢ 7 circular tables (ø 1,80 m)
➢ 42 (+7) chairs
➢ 4 projection surfaces
➢ innovative lighting concept

www.th-rosenheim.de/scale-up

SCALE-UP TEACHING

➢ Just-in-Time Teaching (JiTT): study assignment + quiz
➢ Peer Instruction
➢ Worksheets
➢ Whiteboard-Tasks
➢ Physics Tutorials (McDermott)
➢ Small experiments
➢ Simulations

Role of the instructor „guide on the side"

Lisa Linzinger, TH Rosenheim

Each of the round tables seats 6 students, working in groups of 2 or 3.

EXAMPLE OF A SCALE-UP CLASS

(summer term 2023, Applied physics for engineers)

Topic:	Introduction to heat transport in building physics	
Learning goals (extract):	The concepts of heat flux, thermal resistance and U-value is applied correctly to problems of thermal insulation in building physics.	Communicated to students
	The heat flux through a multi-layer wall can be calculated correctly in analogy to Ohm's law.	
Pre-Learning:	study assignment with warm-up quiz (JiTT)	Creating basic knowledge

Course:		
2 min	**Welcome, Intro**	
15 min	**Retrieval practice … from memory** in small groups, sparring by instructor.	Recall from reading assignment, use testing effect, activate pre-knowledge, peer learning, interaction with instructor, creating a common knowledge base in the small groups
8 min	**Mini lecture** on heat transfer mechanisms, addressing students difficulties in the warm-up quiz	Receiving explanations and feedback on quiz
20 min	**Whiteboard Task** in small groups, sparring by instructor	Develop conceptional understanding, problem solving, collaborative and active learning, receive immediate feedback from peers and instructor
20 min	**Worksheet**: Conceptual questions and problem solving, multilayer-wall	
10 min	**Peer Instruction** with discussion on Ohm's law of heat transfer, analogy	Conceptional understanding
5 min	**Reflection** on learning up to now– written down	Save results and insights
10 min	**Worksheet**: Applied task	Problem solving

… from memory!

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Write down everything you know about heat transport: what types there are, physical quantities with units, laws, formulae, …

Whiteboard Task

a. Sketch the temperature profile of a building wall in winter. Name all variables relevant to heat transport.
b. Determine the heat flux density and the amount of heat flowing through a wooden wall in one day (3.5 cm thickness, height 3.0 m, width 5.0 m), if the wall surface temperatures are -6.0 °C outside and 19.0 °C inside.
c. What means "temperature gradient"? Determine the temperature gradient in this case.

GORP TOOL & ELCOT3 PROTOCOL

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Categories:
➢ Student organization (individual, small group, whole group)
➢ Type of communication
➢ Assess if work is productive (content relevant)
➢ Cognitive engagement (overt behavior)
➢ Observation period: 90 min with intervals of 2 min

Screenshot of GORP with ELCOT3 Protocol, coloured frames ICAP levels (Passive (blue), Active (red), Constructive (green), and Interactive (yellow))

[Sanders et al. (2108), Tolnay et al. (2017), GORP (2016)]

DETAIL OF OBSERVATION: WHITEBOARD TASK

The observation data for the whiteboard task:

The ELCOT3 protocol in the GORP observation software is used to carry out the classroom observation. The observed behavior when working on a learning activity is assigned to an ICAP level (Passive (blue), Active (red), Constructive (green), and Interactive (yellow)). The learning activity is also documented.

ICAP FRAMEWORK

4 levels (categories) for observing the cognitive engagement of learning activities [Chi et al. (2018), Chi et al. (2014)]

Level	**P**assive	**A**ctive	**C**onstructive	**I**nteractive
Students …	… are attentive to the content, receive information.	… work within the learning material provided.	… generate additional output beyond the material offered.	… work in constructive mode and collaboratively as a team.
Knowledge change processes: New knowledge is …	… stored.	… integrating with existing knowledge.	… inferring with existing knowledge.	… co-inferring with existing knowledge of the team.
Cognitive engagement: Knowledge can be …	… recalled verbatim in the same context.	… applied to similar examples.	… transfered to a new context or to a different problem; knowledge of concepts allows interpretation & explanation of new concepts.	… co-creatively applied. Knowledge and perspectives can enable partners to develop new interpretations, explanations and ideas.
Expected cognitive outcome	Minimal understanding	Superficial understanding	Conceptual understanding	Deepest understanding

HOW COGNITIVELY ENGAGED ARE STUDENTS IN THE SCALE-UP ROOM?

Classroom observation with regard to the ICAP framework

Percentages of time spent working at the respective ICAP level

- other 4 %
- Passive 13 %
- Active 22 %
- Constructive 16 %
- Interactive 45 %
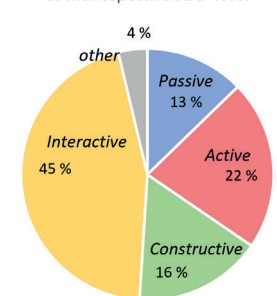
Average value across various physics and maths courses for engineers in the SCALE-UP rooms at TH Rosenheim (7 classroom observations, 6 teachers, 122 students) during summer term 2023.

Method: Classroom observation with ELCOT3 [Sanders et al. (2108), Tolnay et al. (2017), GORP (2016)] and ICAP framework [Chi et al. (2018), Chi et al. (2014)]

➢ On average, students work more than 67 % of the time in Constructive (green) and Interactive level (yellow). This increases the probability that they will develop a deeper understanding.

➢ Effective use of course time!

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