Using the ICAP model with classroom observations to improve active learning

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MOTIVATION

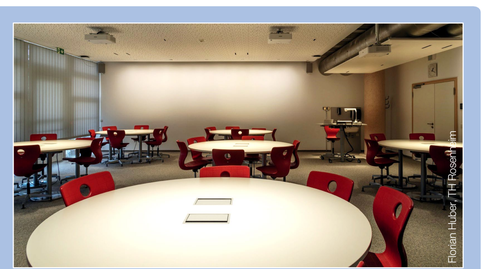
- to improve student learning in SCALE-UP settings
- to show that the ICAP-framework is a tool suitable for practitioners to plan and reflect on teaching
- to promote and spread the use of ICAP-framework additionally to learning goals

GOAL

- Investigation of students` cognitive engagement
- Development of appropriate learning materials and learning activities

SCALE-UP ROOM

- 7 circular tables (⌀ 1.80 m)
- 42 (+7) chairs
- 4 projection surfaces
- innovative lighting concept



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ICAP FRAMEWORK

4 levels (categories) to classify the engagement in learning activities
(Chi&Wylie (2014), Chi et al. (2018))

Level	Passive P *attending*	Active A *manipulating*	Constructive C *generating*	Interactive I ***co**-generative*
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 know-ledge of the team.
Cognitive engagement: Knowledge can be ...	... recalled verbatim in the same context.	... applied to similar examples.	... transferred 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

INCREASING DEPTH OF LEARNING

ICAP-Hypothesis: P < A << C < I

SCALE-UP TEACHING

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

Role of the instructor „guide on the side“

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

EXAMPLE OF A SCALE-UP CLASS

Self-study as preparation	Face-to-face event (SCALE-UP room)	Duration	ICAP level (intended)
Study assignment			A
Online-Quiz			A to C
	Welcome/Intro	2 min	P
	Retrieval practice on whiteboard in small groups	15 min	A to I
	Mini lecture (questions, taking notes)	8 min	A
	Whiteboard task in a small group	20 min	C and I
	Worksheet (calculation task)	20 min	C and I
	Peer Instruction	10 min	C and I
	Reflection	5 min	C and I
	Worksheet with exercise	10 min	C and I

(Summer term 2023 Applied physics for engineers)

CLASSROOM OBSERVATION WITH RESPECT TO ICAP

Goal:

- **Classification** of different **learning activities**
- **Comparison of intended and actual learning behavior**
- Reflection on teaching
- Improvement of learning tasks

Evaluation:

- ICAP levels over time, highest ICAP level in a time interval, time proportions

Method:

Two observers record in two-minute time intervals based on observation protocol ELCOT-3 (Sanders et al. (2018)):

- the **activities of the students** at a group table or in the whole room
- the **activities of the teacher**
- the associated learning tasks and note down further observations

Interrater reliability: agreement of ICAP levels > 95% of the time (less with peer instruction)

EX.: STUD. ENGAGEMENT IN 2 WHITEBOARD ACTIVITIES

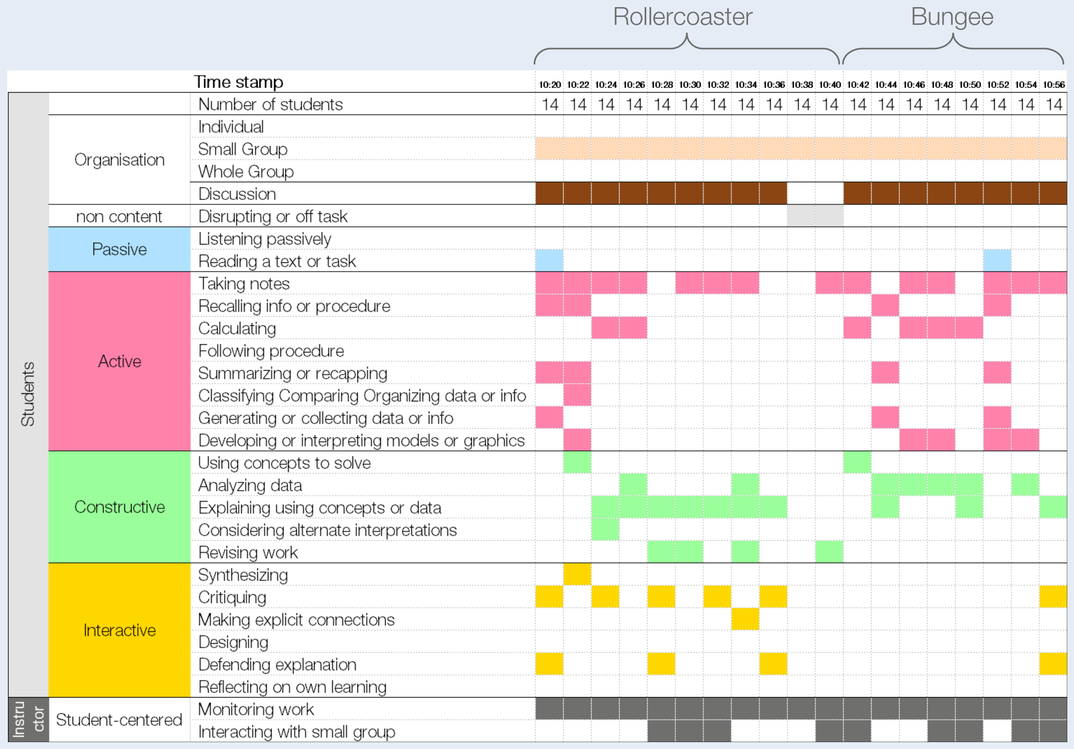
What is the minimum height from which the carriages on a roller-coaster must start that they can roll through a vertical loop without losing contact with the track?

Roller-coaster

A bungee jumper with a mass of 60 kg jumps from a bridge. She is attached to a bungee cord that is 12 meters long when unstretched and she falls a total of 31 meters.

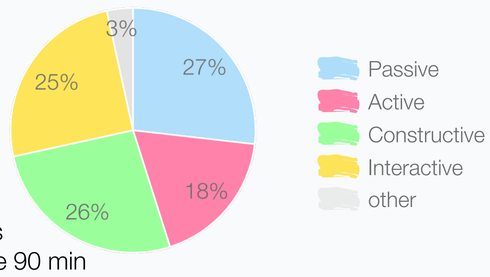
Bungee

a) Determine the spring constant k of the bungee cord.
b) Calculate the maximum acceleration experienced by the jumper, apart from the free fall.
c) The jumper moves up and down periodically after some time. Calculate the oscillation period.



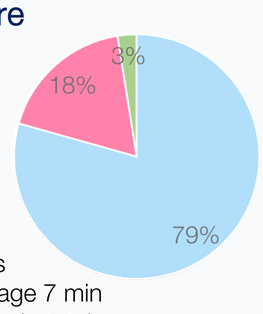
COMPARISON OF DIFFERENT LEARNING ACTIVITIES

All courses



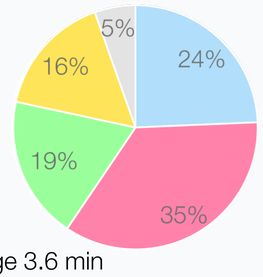
12 courses
→ average 90 min
→ total 1100 min lesson observation
highest observed level in 2-minute intervals

Lecture



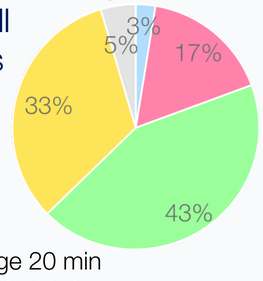
26 times
→ average 7 min
→ 320 min total

Peer Instruction



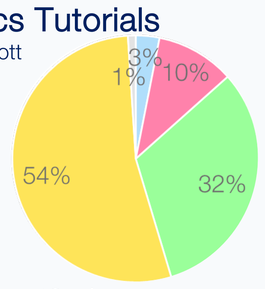
21 times
→ average 3.6 min
→ 76 min total

Whiteboarding in small groups



20 times
→ average 20 min
→ 392 min total

Physics Tutorials (McDermott et al.)



4 times
→ average 49 min
→ 194 min total

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