

LEARNING

Digital and Difficulty-Differentiated Learning Modules in a Student Laboratory Context: A Pilot Study

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Table of Contents

- 01 Digitalchemlab: A Concept for Digital and Difficulty-Differentiated Learning**
- 02 The Digital Learning Module „Household Cleaners“ – A Pilot Study**
- 03 Conclusion and Outlook**

1. Digitalchemlab: A Concept for Digital and Difficulty-Differentiated Learning

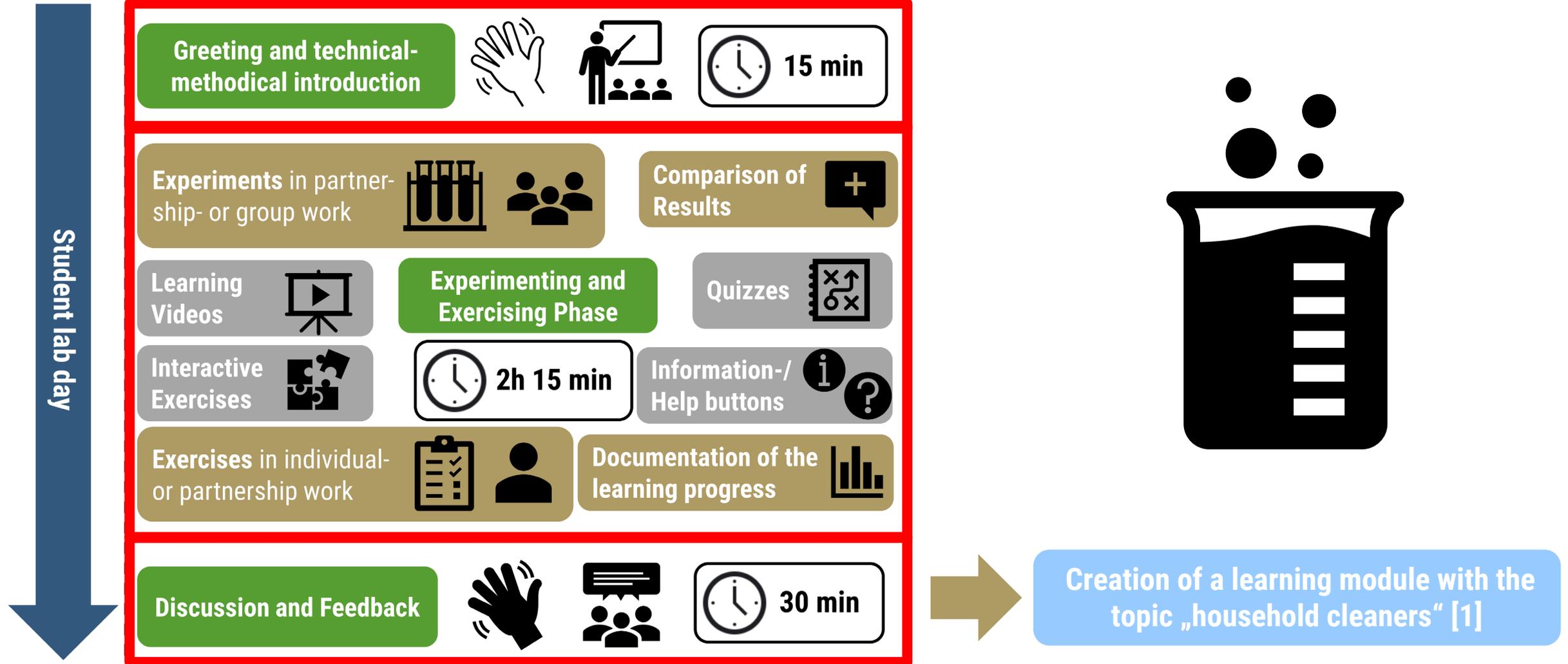
You cannot teach a man anything, you can only help him find it within himself.”

- Galileo Galilei

1. **Self-regulated learning** can be a **key ingredient** for **knowledge gain** and thus **learning outcome**.
2. **Digital media** offers **great potential** for **self-regulated learning**.
3. How can we **organically integrate digital media** into **science teaching contexts**, while also promoting **self-regulated learning** in students?



1. Digitalchemlab: A Concept for Digital and Difficulty-Differentiated Learning



1. Digitalchemlab: A Concept for Digital and Difficulty-Differentiated Learning

Cognitive Complexity [2]:

4. Analysing/ Creating		A4 Further household cleaners / 20 min	B4 Tensides-means for every use? / 20 min	C4 Calculating acid and base proportions / 20 min
3. Applying		A3 Ingredients of household cleaners / 30 min	B3 Decalcifying and Derusting (effects of acid cleaners) / 30 min	C3 Neutralization of drain cleaner solution / 30 min
2. Understanding		A2 Classification of household cleaners / 25 min	B2 Cleaning the drain (effects of alkaline cleaners) / 25 min	C2 Conductivity of washing powder and washing solution / 25 min
1. Knowledge		A1 pH-value of household cleaners / 15 min	B1 Stain-free surfaces with acids and bases / 15 min	C1 Acid-Base-Chemistry and Household cleaners / 15 min
Topic Complexity		A. Classification and Ingredients of Household Cleaners	B. Acids and Bases Combating Dirt	C. Acid-Base-Chemistry Made Easy!

1. Digitalchemlab: A Concept for Digital and Difficulty-Differentiated Learning

Pilot Study

- **April/May 2022:** Pilot Study with experts (work group, university students)
- **June/July 2022:** three classes, 8th grade (2xTH,1xSN), N=65
- **Evaluation design:** pre-test, intervention, post-test, follow-up-questionnaire; furthermore student interviews and questionnaire for each field
- **Inquiry of** knowledge, interest, learning emotions, valuation and usage of the digital learning module „household cleaners“



Questions:

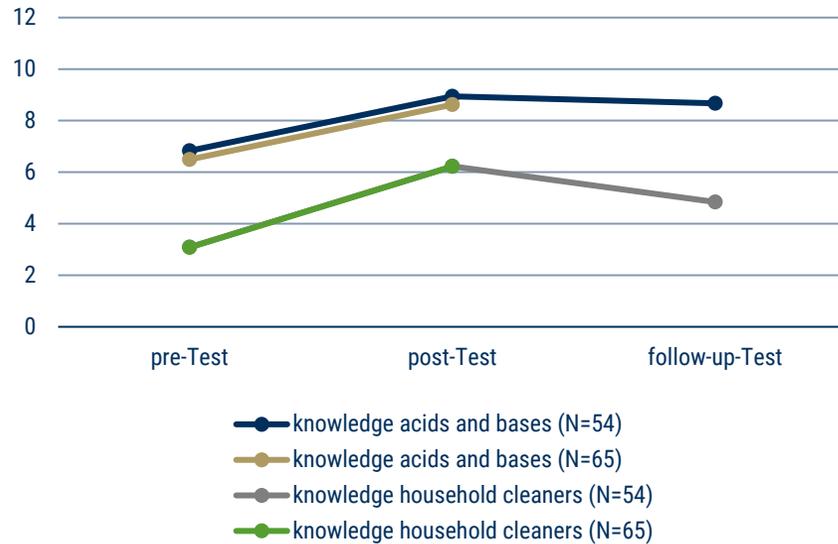
1. How does the **execution of the digital learning module „household cleaners“** influence **knowledge** (acid-base-chemistry, household cleaners), **interest** (subject, topic) and learning **emotions** of the participants?
2. How do the participants **rate the digital learning module** and especially the **usage of digital media**?
3. How do the participants **use the digital learning module** (choice of tasks, usage of provided material)?

Table of Contents

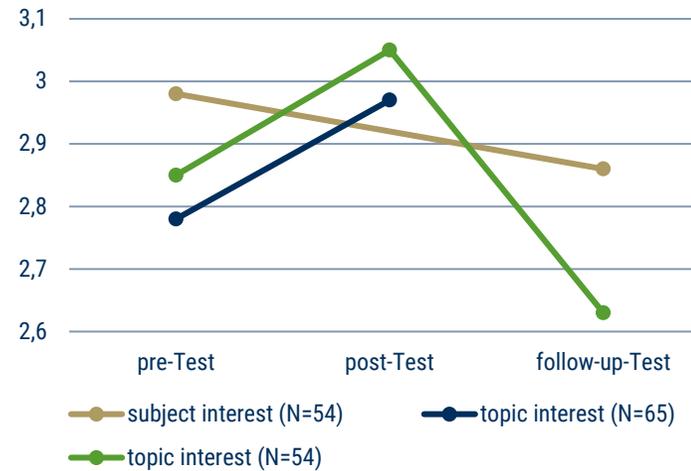
- 01 Digitalchemlab: A Concept for Digital and Difficulty-Differentiated Learning
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2. The Digital Learning Module „Household Cleaners“ – A Pilot Study: Question 1

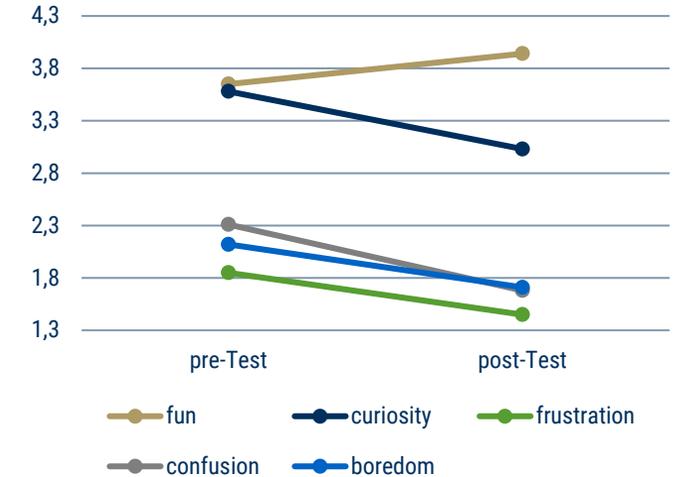
Development of knowledge



Development of interest [3,4]



Development of learning emotions [5]



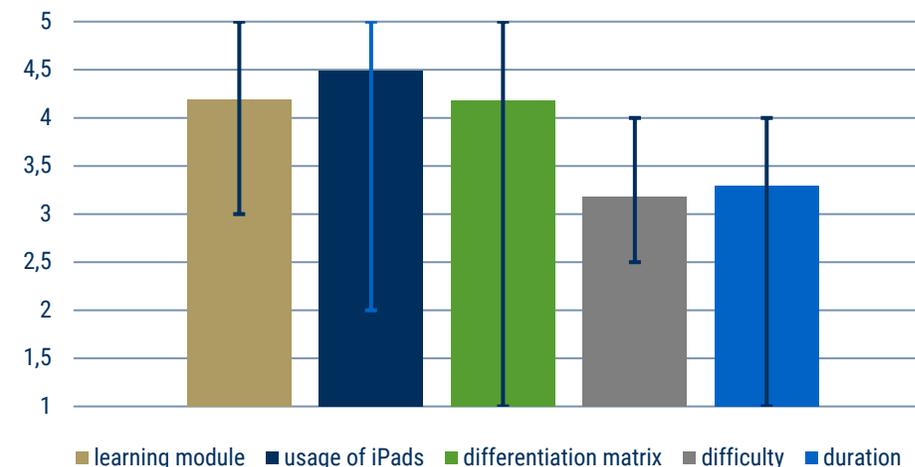
- The **knowledge about acids and bases** and concerning **household cleaners increases significantly** after the intervention and **remains higher than before** the intervention after two months
- The **topic interest increases slightly** but not significantly after the intervention and **decreases after two months**. The **subject interest largely remains the same** and even **decreases slightly after two months**. Both interests remain slightly less than average.
- The intervention **effects the learning emotions significantly positively**. While the **fun increases** compared to expectations before, **negative emotions** (frustration, confusion, boredom) **decrease**. The **curiosity decreases** significantly as well though.

2. The Digital Learning Module „Household Cleaners“ – A Pilot Study: Question 2

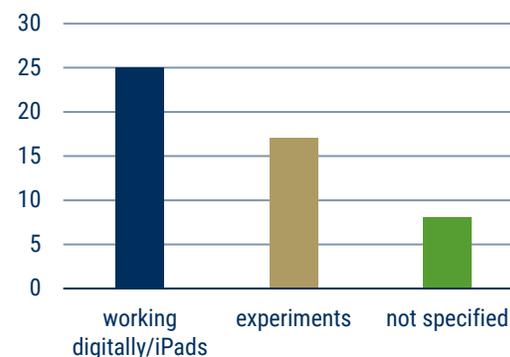
- quantitative items :
 - How do you rate...?
 - Learning module, usage of iPads, differentiation matrix, difficulty, duration
- qualitative items:
 - What did you like most about the learning module?
 - Working digitally, iPads (38.5%)
 - experiments (26.2%)
 - Not specified (12.3%)
 - What can be improved about the learning module?
 - Not specified (66.15%)
 - technical aspects (18.5%)
 - Content aspects (12.3%)

Overall the learning module in its current state is rated very highly. Specifically, the students appreciated the usage of iPads and the conduction of experiments.

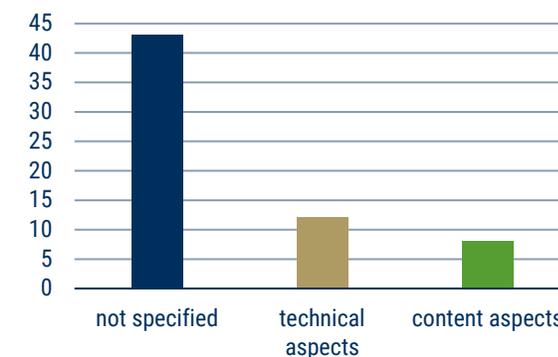
Valuation of the learning module



What did you like most about the learning module?



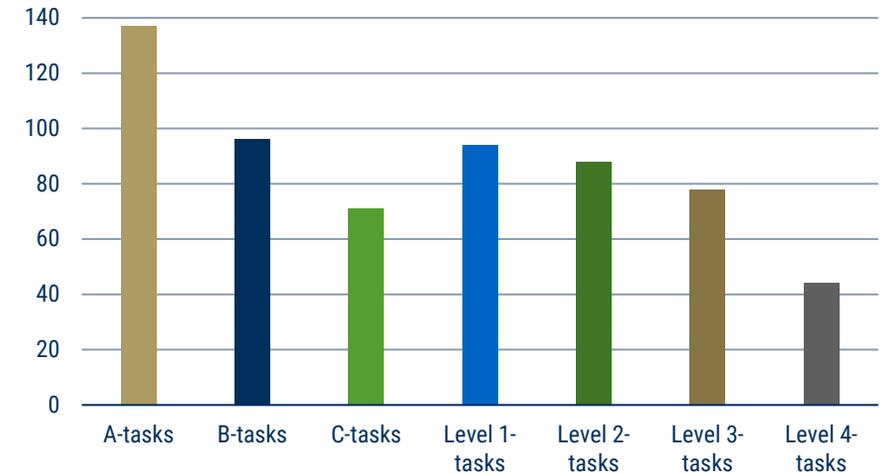
What can be improved about the learning module?



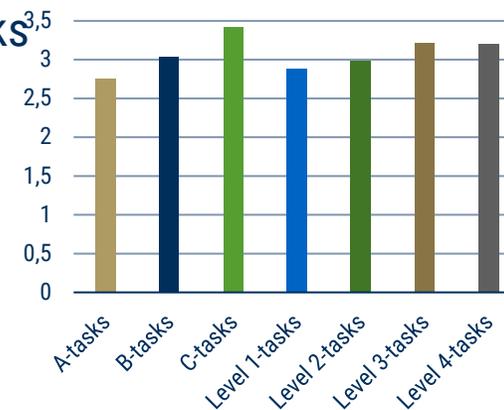
2. The Digital Learning Module „Household Cleaners“ – A Pilot Study: Question 3

- **Number of times task has been carried out:** 4/12 tasks in average, decreases from A- to C-tasks and Level 1 to Level 4 tasks
- **Usage of provided material:**
 - frequently used:    
 - Regularly used/ for specific tasks:  
 - rarely used:  
- **Difficulty:** increases from A- to C-tasks and Level 1 to Level 3 tasks
- **Effort:** increases from A- to C-tasks and Level 1 to Level 3 tasks

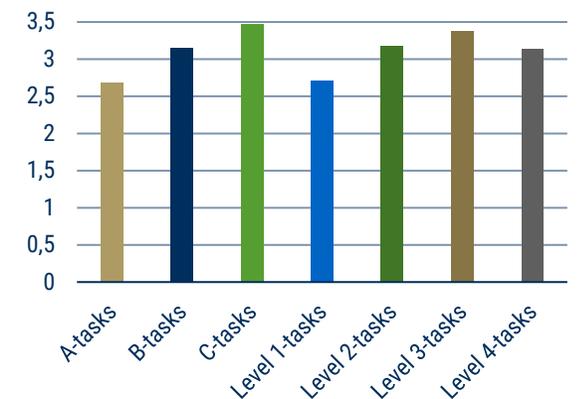
Number of times task has been carried out



(perceived) Difficulty



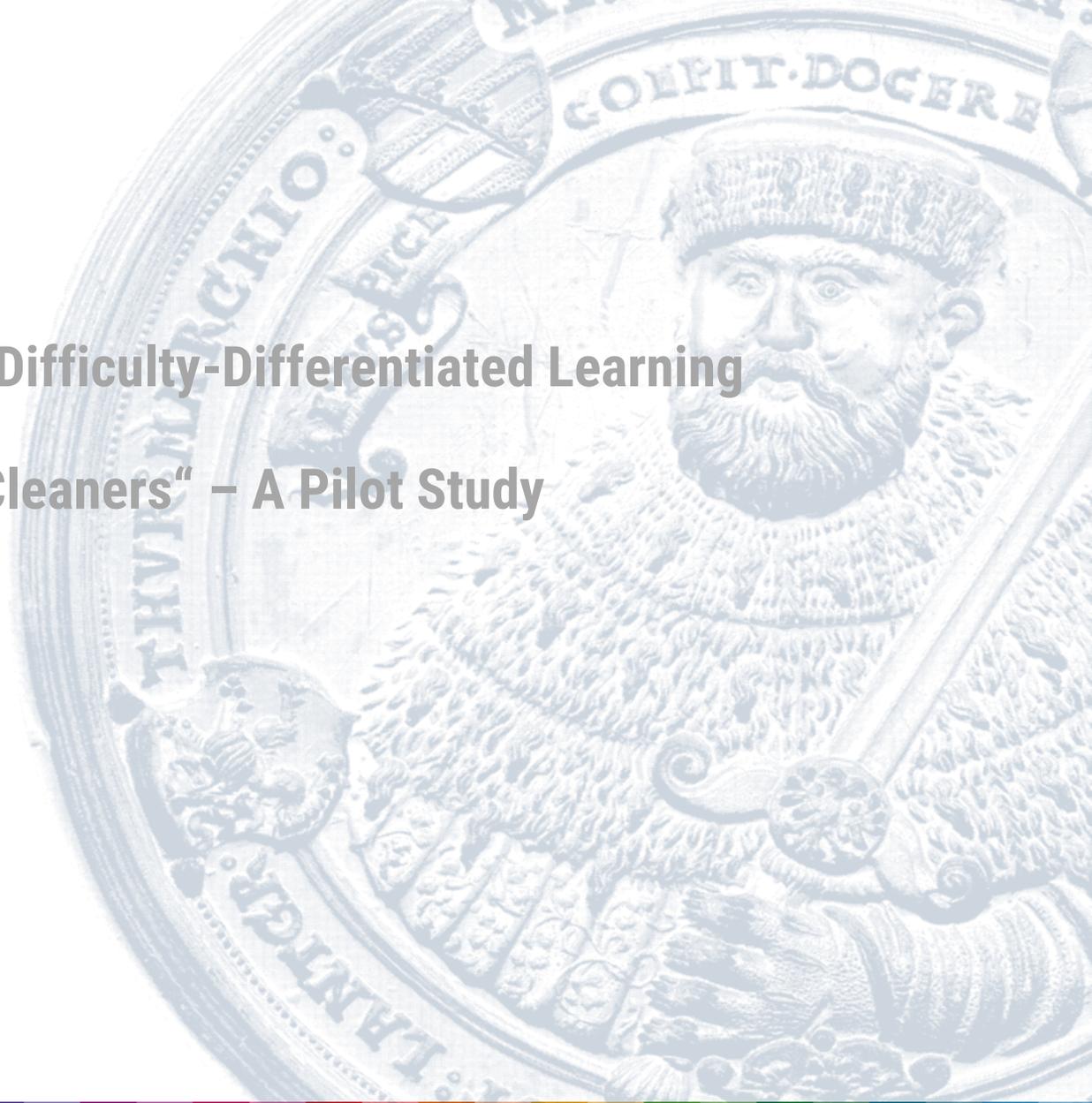
(perceived) Effort



The intended levels of complexity match mostly with the choice of tasks, the perceived difficulty and the perceived effort. Thus, easier tasks are being preferred.

Table of Contents

- 01 Digitalchemlab: A Concept for Digital and Difficulty-Differentiated Learning
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3. Conclusion and Outlook



1. The **digital learning module „household cleaners“** shows **significant effects on the knowledge and emotional experience of the students** (increase in positive and decrease of negative emotions).

2. The **learning module in general**, specifically the **experiments** and the **use of digital media/ iPads** were **rated highly**. **Difficulty and duration** were perceived as appropriate.

3. A number of **four of 12 tasks** were **completed in average**. The **intended levels of complexity match** with the perceived levels of effort and difficulty and also **influence the choice of tasks**.

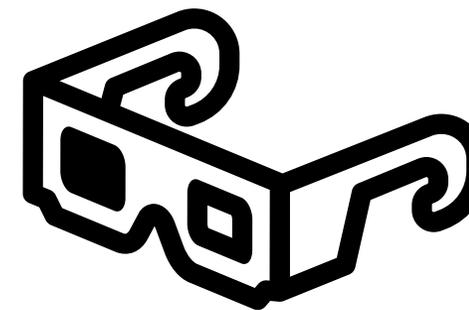
3. Conclusion and Outlook



- Overall, this is **good news** for the **current way the learning module is conducted**.
- **Open questions remain** concerning
 - **the choice of tasks** and its **dependency** on certain **individual traits** plus
 - **the identification of** possible (typical) **learning pathways** (order of tasks).

Revised questions:

1. **Questions 1 to 3** of the pilot study **remain** with the hope of **confirming the results** with a larger group.
2. Which **tasks do students choose depending on their individual background** and are there **typical learning pathways**?



Main Study

- **April:** Pre Study (N = 50, 8th grade)
- **June/July 2023:** thirteen classes, 8th grade (all from TH), N = 303

Sources

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Further Reading:

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Thanks for listening!

GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung

Die Friedrich-Schiller-Universität Jena wird im Rahmen der gemeinsamen „Qualitätsinitiative Lehrerbildung“ von Bund und Ländern aus Mitteln des Bundesministeriums für Bildung und Forschung gefördert.

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Chemie an der Universität Jena
Video: simonroloff.de (2020)



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