Learning to use a digital workbench to develop competence-based tests in vocational education: **guided or explorative?**

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Learning Lab

exploring the future of learning

ASPE
digital
workbench

Bundesministerium
für Bildung
und Forschung

ASPE = Assessment for Professional Exams

Goals:

- Competence-based exams → professionalization
- Exam administration → **digital workbench**

1 https://learninglab.uni-due.de/forschung/projekte/aspe-kompetenzorientierte-pr-fungen

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Guided vs. Unguided

- Minimal guidance does not work! (Kirschner et al., 2006; Sweller et al., 2007)
- Works, with scaffolding! (Hmelo-Silver et al., 2007)
- Depends on learning goals? (e.g. Renkl, 2015)
  - Productive failure (Kapur, 2008)
  - Challenge may overcome overload (Likourezos & Kalyuga, 2017)
  - Exploration promotes motivation, interest, attitudes, … (e.g. Newman & DeCaro, 2019)
  - Basic knowledge or near transfer? (Halmo et al., 2020)

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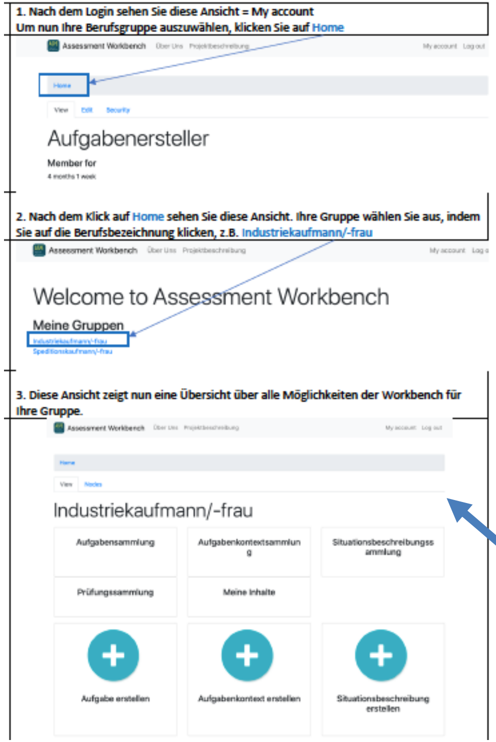

Contribution to empirical evidence base

Comparison of:

- Fully guided approach with **worked examples***
- Explorative approach without further guidance

**Worked examples are elaborated samples of problems that lead step by step to the solution to the problem* (e.g. Atkinson & Renkl, 2007).

RQ and predictions

How do a fully guided approach affects different learning goals compared to an explorative approach?

- **H1:** Worked examples group scores better on tasks related to the quantity and quality of the prepared exams.
- **H2:** The explorative group scores better on tasks related to the testing of the functionalities of the digital workbench.
- **H3:** Worked examples group reports lower cognitive load.
- **H4:** Worked examples group shows more positive attitudes toward the workbench.
- **H5:** Attitude toward the workbench positively influences cognitive load.

Method

Randomized field experiment

- 31 Participants, four women, $MD_{age} = 50.6$ ($SD = 8.9$)
- Teachers and research assistants who will use the digital workbench for preparation of exams
- Small group work on the instructions → preparing tasks in the digital workbench

Lecture on the design of competence-based tasks
N = 31

Fully guided (FG)
N = 16

Unguided (UG)
N = 15

Nasa-TLX
(Hart, 2006)

Digital assistants attitude survey
(Cheng, 2017)

Learning achievement: Measured through tasks created in the workbench
→ anonymous

H1: Does the FG group score better?

Variable	FG		UG		t(11)	p
	M	SD	M	SD		
Learning Obj. 1 – quantitative	3.50	1.38	1.71	0.95	-2.75	0.019
Learning Obj. 1 – qualitative	6.50	5.68	4.00	3.00	-1.02	0.33

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H2: Does the UG group tested more functionalities?

Variable	FG		UG		t(11)	p
	M	SD	M	SD		
Learning Obj. 2 – functions	8.00	5.40	10.00	6.90	0.57	0.58

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H3: Does the FG group reported lower cognitive load?

- No main effect for overall cognitive load: ***t*(29) = 1.63, *p* = 0.12**
- No effect for the scales: **mental demand, physical demand, effort and frustration**

Variable	FG		UG		t(29)	p	Cohen's d
	M	SD	M	SD			
Temporal Demand	4.00	3.76	8.92	4.73	3.12	0.004	1.21
Performance*	8.50	4.65	12.20	4.78	2.18	0.037	0.78

*Scale performance is reverse coded

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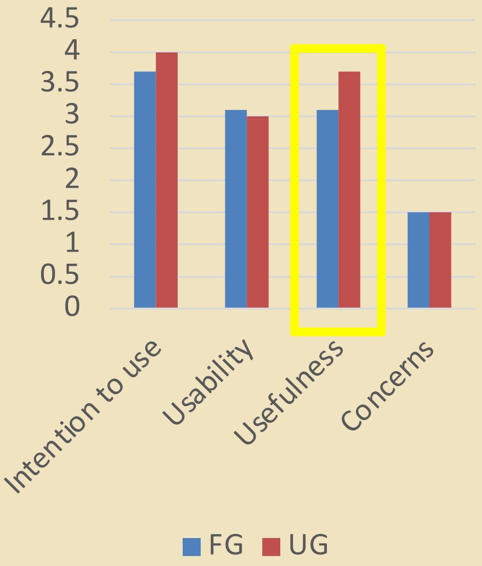
H4: Does the FG group show more positive attitudes toward the workbench?

- No sig. differences between the groups
- Both groups report positive attitudes towards the workbench (max. = 5)



H5: Does the attitude influence cognitive load?

	Unstandardized		Standardized		Coefficients Std. Error	
Variable	FG	UG	FG	UG	FG	UG
(Constant)	19.19***	6.45				
Usability	-3.92**	-1.23	-0.54**	-0.20	1.32	1.78
Usefulness	-1.43*	1.50	-0.48*	0.57	0.66	1.07
Concerns	0.52	3.00	0.07	0.54	1.38	1.89
Intention to Use	1.03	-1.02	0.29	-0.31	0.72	1.28
R^2	0.67	0.36				
corr. R^2	0.55	0.11				
F-FG(4,11), F-UG(4,10)	5.63**	1.41				
f^2	1.11	-				

*p=0.05, **p<0.05, ***p<0.01

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Additionally:
usability (p = 0.02) and usefulness (p = 0.01) sig. predictors of performance in FG group

Discussion

- Clear learning goals – create N exams: FG > UG (e.g. van Gog & Rummel, 2010; Kapur, 2008)
- Quality of exams: FG = UG, explainable via prior knowledge (e.g. Sweller et al., 2019)
- Exploration of functionalities: FG = UG (with slight advantages)
- No main effect for cognitive load → Limitation: task to simple? (e.g. Ashman et al., 2020)
- Temporal demand and performance: FG > UG
  - Explorative approaches need more time (Kirschner et al., 2006)
  - Perception of performance can influence learning (Bandura, 1977)
- No influence on attitudes → future research with focus on usefulness?
- Usability and usefulness as predictors in FG group

Limitations

- Small sample → more are not doing this job ☺
- Too easy task
- Knowledge gained from the lecture not controlled
- Complex design and data analysis → addressing different learning goals

Conclusion

“take home message”

Consider the learning goals in instructional design and the consequences that a learning approach may have.*

*see also Hattie & Donoghue, 2016; Yeo & Fazio, 2019

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Thank you!

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ASPE project

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ASPE digital workbench

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