pädagogische hochschule schwyz

Differences between quantity and quality-based measures of SRL in task-based student interviews

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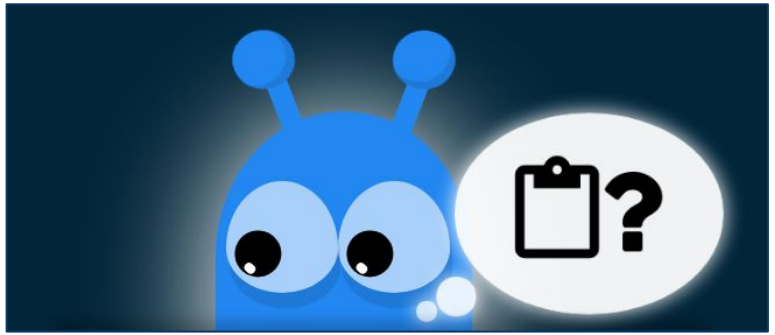

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EARLI SIG 16, 11.11.2022

Opportunities to support SRL in DLEs: digital metacognitive prompts

- Metacognitive prompts have the potential to promote SRL processes (e.g. the use of cognitive & metacognitive strategies) and improve learning outcomes.

  > e.g. Molenaar & Chiu, 2014; Zheng, 2016; Guo et al., 2022

- Digital Learning Environments offer new opportunities for prompt designs (> timing, flexibility & adaptivity)

- However: Metacognitive prompts are not always effective

  > e.g. Bannert & Mengelkamp, 2013; Baars et al., 2022; Engelmann et al., 2021; Wong et al., 2019

Possible reasons for lacking effects of metacognitive prompts

- Student characteristics
  (e.g. motivation for utilization of prompts)
- Intervention design
  (e.g. length of intervention, training before intervention)
- …
- **Type of SRL-assessment** (Omarchevska et al., 2022)
  (e.g. self report, think aloud, quantity vs. quality measures)

Type of SRL-assessments & measures

Self-report (questionnaire)	Task- / scenario-based	Think aloud / Write aloud
	hypothetical thinking & strategy use using vignettes / task scenarios	*real time thinking & strategy use while solving a task*
	=> *metacognitive knowledge*	..... *metacognitive performance*

Further challenges:

- pure quantity measures are biased by the overall frequency of statements by students (Meijer et al., 2006)
- quantity measures don't include the understanding and correct situational application of strategies (Veenman, 2005)

=> QUALITY measures of SRL?

Assessing quality of SRL: What are potential quality indicators?

Study	Type of measurement	Quality criteria used
Moning & Roelle (2021)	Learning protocol	**Concreteness**; planned self-regulation; **Reasons** for comprehension or comprehension gaps; cues to base judgement of understanding on
Schuster et al. (2020)	Scenario-based (vignette test)	**Completeness:** Learning is regulated by all types of metacognitive activities (planning, monitoring, evaluation); cognitive strategy use includes all important steps in solving the task
Gentner & Seufert (2020)	Notes learners took during learning	**Specificity** of cognitive and metacognitive strategies
Sáiz Manzanares et al. (2019)	Think-aloud	**Reflection** on learning process; systematic approach; monitoring (vs. error-correction)
Van der Stel & Veenman (2013)	Think-aloud	**Elaboration** of strategy
Heaysman & Kramarski (2022)	Written metacognitive description of strategies	**Explicitness**: Explicit reference to strategy use (vs. implicit)

Assessing quality of SRL: What are potential quality indicators?

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Van der Stel & Veenman (2013)	Think-aloud	
Heaysman & Kramarski (2022)	Written metacognitive description of strategies	

=> Potential quality indicators of SRL:

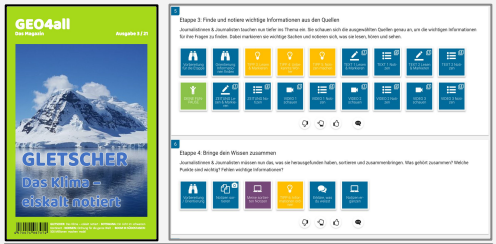
- **Completeness** regarding the description of different types of strategies and/or activities (“full circle”)
- **Concreteness** regarding strategy description
- **Explicitness** of metacognitive statements
- **Reasoning & Elaboration** (e.g. self diagnosis, contextual knowledge, ideas for possible regulation activities)

OUR STUDY

Learn2Learn Project: Impact of metacognitive prompts on SRL?

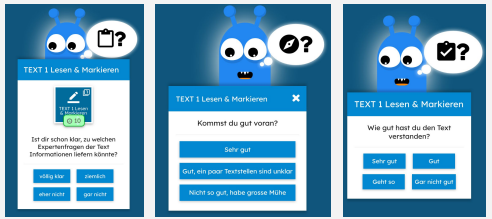
task-based interviews t1

questionnaires



Learning unit on glaciers ~ 12 lessons

L2L-Assistant > metacognitive prompts



task-based interviews t2

questionnaires

N = 362 primary school students

22 classes (age 10-12 years)

Task-based interviews to measure SRL-skills

Subsample:

Cognitive strategies

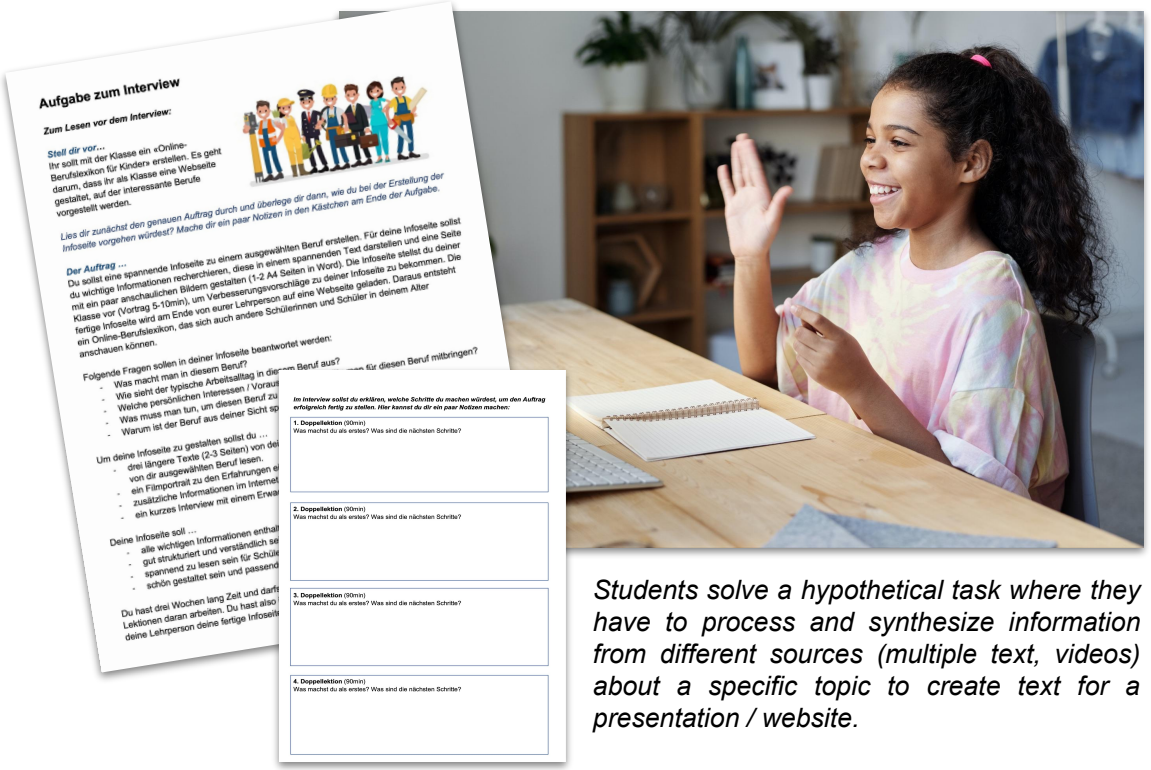
N_{total}= 40 students
(n_{TG}= 20, n_{CG}= 20)

Subsample:

Metacognitive activities

(tbc):

N_{total}= 26 students
(n_{TG}= 13, n_{CG}= 13)



Students solve a hypothetical task where they have to process and synthesize information from different sources (multiple text, videos) about a specific topic to create text for a presentation / website.

RESEARCH QUESTIONS & HYPOTHESES

Impact of metacognitive prompts …

Impact on cognitive strategy use (in solving a hypothetical task)

H1a: Quantity and quality measures *increase* from t1 to t2 (significant time effect).

H1b: There are *no differences* between TG and CG regarding the increase between t1 and t2 (no significant interaction effect of time & group).

H1c: Quality-measures show *no different* pattern compared to quantity measures.

Impact on metacognitive activities (in solving a hypothetical task)

H2a: Quantity and quality measures *increase* from t1 to t2 (significant time effect).

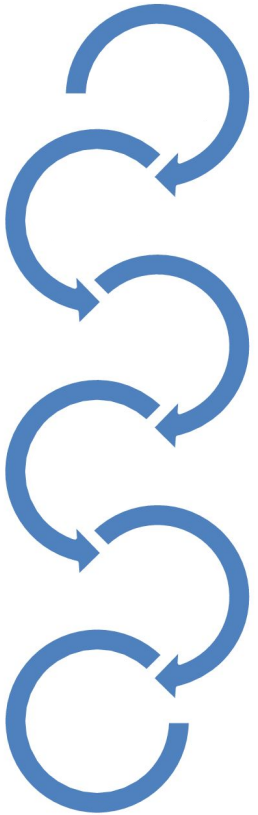
H2b: The increase between t1 and t2 *is higher* for TG than for CG (significant interaction effect of time & group).

H2c: Quality-measures show *a different* pattern compared to quantity measures (interaction effects of time & group are stronger for quality measures).

METHODS

From a coding scheme to a rating system …

1. Development of an initial coding scheme using existing category systems and theoretical SRL-models*
2. Exploration of the text material and definition of main concepts / domains (→ macrolevel & microlevel processes)**
3. First coding round and (re)definition of subdomains / subcodes
4. Final coding round (two researchers, consensual coding)
5. Development of a rating system based on an analysis of task demands and scope of expectations*** to assess metacognitive knowledge (regarding description of cognitive strategies & metacognitive activities)
6. Rating of quantity and quality indicators (two researchers, *still in process*)



* e.g. Boekaerts, 1997; Greene et al., 2010; Muis et al., 2015; Pintrich, 2004; Schuster et al., 2020; Vandevelde, 2015
** compare Greene et al., 2010
*** compare Schuster et al., 2020

Main categories of the coding / rating system

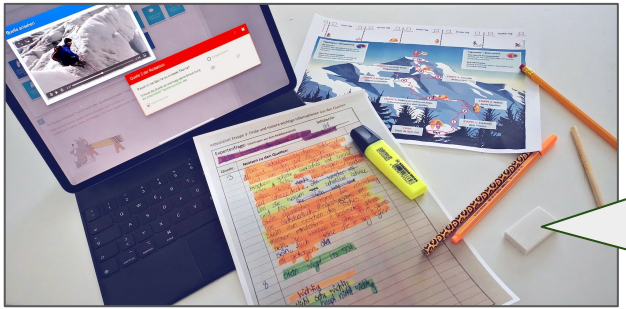
Metacognitive activities	Comprehension of content	monitoring of own (prior) knowledge and comprehension regarding content / task
	Relevance of information	monitoring of relevance and credibility of information
	Quality of intertextual integration	monitoring of integration of information from multiple texts / information resources (i.e. completeness, structure and comprehensibility of integrated information)
	Progress (time & goals)	monitoring of time and progress towards goals; monitoring of effective strategy use
	Motivation & Concentration	monitoring of motivational / emotional states; monitoring of concentration level
Cognitive strategies (regarding text comprehension)	Orientation & systematic reading (viewing)	application of cognitive strategies for orientation and systematic reading of the text and/or viewing of videos (e.g. skimming, reading titles, reading & viewing selectively)
	Intratextual integration	application of cognitive strategies for transforming, structuring and integrating information (e.g. taking notes, sorting and grouping information, creating a mindmap)
	Intertextual integration	

Assessing quality of cognitive strategy application

$cogn_{quantity}$ **Frequency** of cognitive strategy application

$cogn_{quality1}$ **Completeness:** strategies in all steps of the learning process (orientation & systematic reading, intratextual integration, intertextual integration)

$cogn_{quality2}$ **Reasoning & Elaboration:** the description is concrete and illustrative (e.g. encompasses examples); the reasoning includes specific reasons or conditions for applying certain strategies



Aber ich markiere meistens eben zu viel, habe ich das Gefühl. Dass ich auf eine Weise nicht nur Stichwörter markiere, sondern wirklich eigentlich ganze Textabschnitte und ich denke, da könnte ich jetzt besser entweder so sagen, von oben markieren: entweder von da bis dort, das ist wichtig, oder ich kann Notizen machen. Dann muss ich den Text ja nicht mehr lesen, sondern dann habe ich wie das wichtigste ja schon aufgeschrieben und ja ich würde sagen, so würde es am besten funktionieren. (MD0409E5B_T2, Pos. 31) to be translated

Assessing quality of metacognitive activities

meta$_{quantity}$ **Frequency** of metacognitive activities

meta$_{quality1}$ **Explicitness:** explicit metacognitive statements which are marked by use of “thinking words” and verbalization of thought processes

meta$_{quality2}$ **Reasoning & Elaboration:** the description is concrete and illustrative (e.g. encompasses examples); the reasoning includes reasons for monitoring (e.g. based on self diagnosis or contextual knowledge) and/or ideas for possible regulation activities

meta$_{quality3}$ **Completeness:** students show monitoring in all categories (comprehension of content, relevance of information, quality of intertextual integration, progress, motivation)

Assessing quality of metacognitive activities

meta$_{quantity}$ **Frequency** of metacognitive activities

meta$_{quality1}$ **Explicitness:** explicit metacognitive statements which are marked by use of “thinking words” and verbalization of thought processes

meta$_{quality2}$ **Reasoning & Elaboration:** the description is concrete and illustrative (e.g. encompasse
monitoring (e.g. ba
ideas for possible

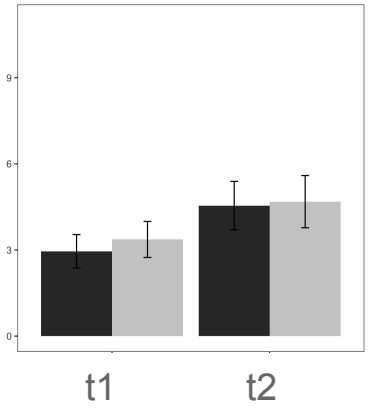
meta$_{quality3}$ **Completeness:** st
(comprehensi
integration, progr

*Ich **denke mir immer so eben** so eine Person, die nichts davon weiss. Und nachher versetze ich mich wie da rein und denke mir so: Okay, ich weiss jetzt nichts über das Thema. Dann lese ich es mal durch. Ja und nachher denke ich so: Ja okay, da habe ich vielleicht etwas übersprungen, was ich vielleicht noch erklären muss. (NZ0609S5_T2, Pos. 86) to be translated*

Quantity & quality-based measure of cognitive strategy application

FREQUENCY

$cogn_{quantity}$

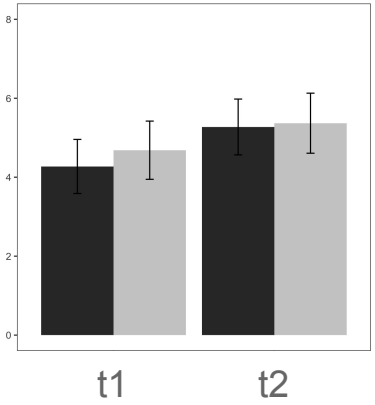


> sum of sub-categories

group: p=.494
time: p<.001, η^2 =.163
interaction: p=.691

COMPLETENESS

$cogn_{quality1}$

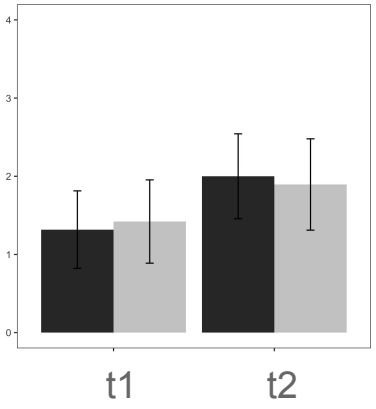


> sum of sub-categories

group: p=.525
time: p<.05, η^2 =.066
interaction: p=.619

REASONING & ELABORATION

$cogn_{quality2}$



> sum of sub-categories

group: p=.997
time: p<.01, η^2 =.057
interaction: p=.533

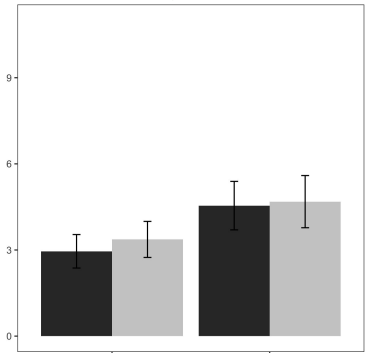
N=40 (n_{TG}=20, n_{CG}=20)

PRELIMINARY RESULTS

Quantity & quality-based measure of cognitive strategy application

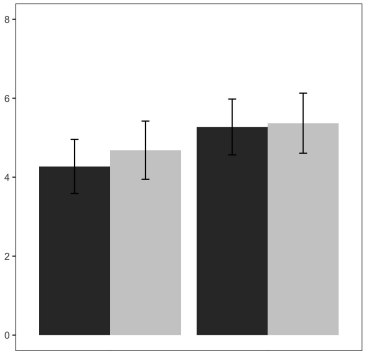
FREQUENCY

$cogn_{quantity}$



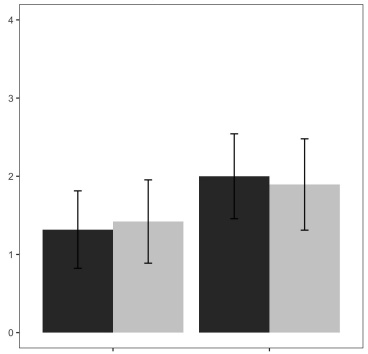
COMPLETENESS

$cogn_{quality1}$



REASONING & ELABORATION

$cogn_{quality2}$



Impact on cognitive strategy use (in solving a hypothetical task)

- H1a: Quantity and quality measures **increase from t1 to t2 > medium effect sizes***
- H1b: **No differences** between TG and CG regarding the increase between t1 and t2.
- H1c: **No different pattern** for quality-based measures.

*Cohen, J. (1988).

PRELIMINARY RESULTS

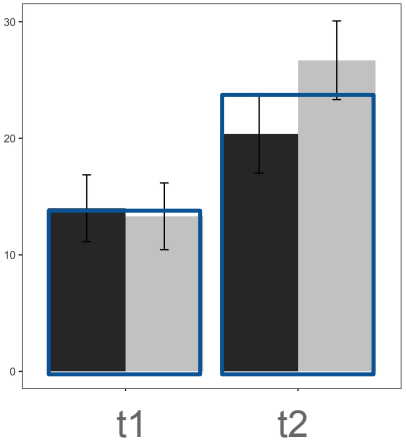
Quantity & quality-based measure of metacognitive activities

Impact on metacognitive activities (in solving a hypothetical task)

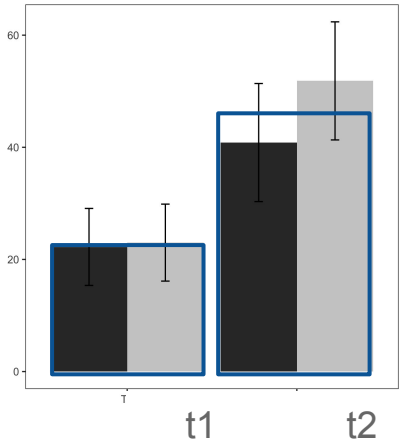
H2a: Quantity and quality measures **increase** from t1 to t2.
> all sub-category variables p<.01: comprehension of content, relevance of information, quality of intertextual integration, progress (except motivation > p=.07)

FREQUENCY
$meta_{quantity}$

> sum of sub-categories



time: p<.001, η^2 =.470



time: p<.001, η^2 =.387

EXPLICITNESS
$meta_{quality1}$

> sum of sub-categories

Control

Treatment

Quantity-based measure of metacognitive activities

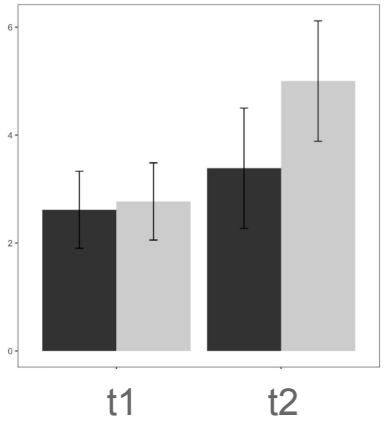
Impact on metacognitive activities (quantity-based measure)

H2b: The increase between t1 and t2 **is higher** for TG than for CG.

But with exceptions: quality of intertextual integration (p=.16), motivation (p=.71)

Relevance of information

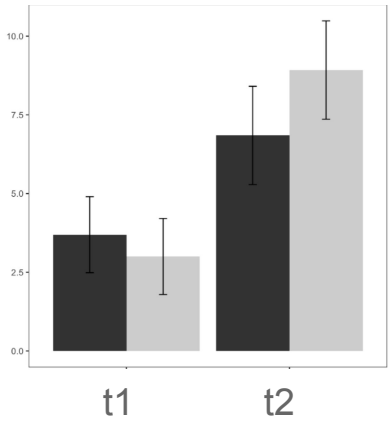
$meta_{quantity}$



interaction: p=.037, η^2 =.051

Progress

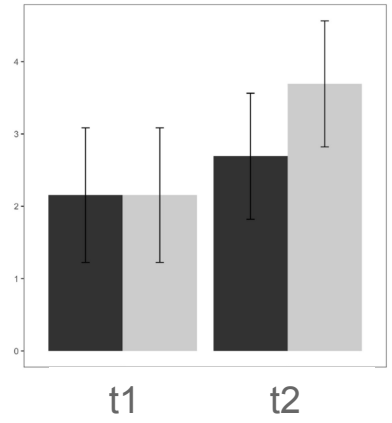
$meta_{quantity}$



interaction: p=.012, η^2 =.080

Comprehension

$meta_{quantity}$



interaction: p=.109+, η^2 =.027

Control

Treatment

Quality-based measure of metacognitive activities

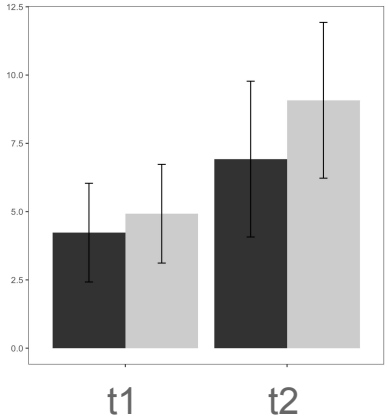
Impact on metacognitive activities (quality-based measure)

H2b: The increase between t1 and t2 *is higher* for TG than for CG.

Only tendencies for progress and overall (sum of sub-categories, p=.72, η^2 =.029)

Relevance of information

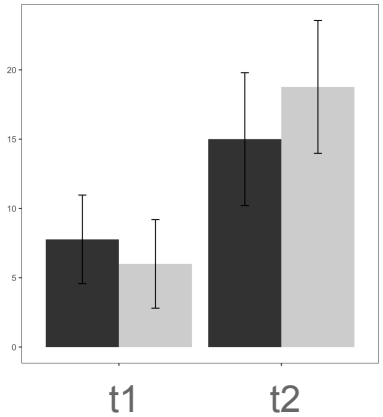
$meta_{quality1}$



interaction: p=.442, η^2 =.008

Progress

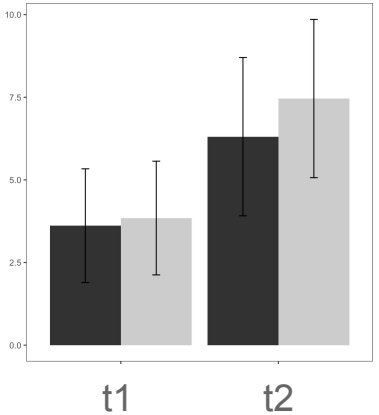
$meta_{quality1}$



interaction: p=.081+, η^2 =.039

Comprehension

$meta_{quality1}$



interaction: p=.497, η^2 =.004

Control

Treatment

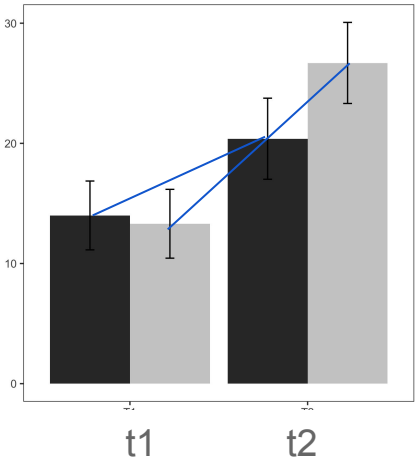
Quantity & quality: metacognitive activities

Impact on metacognitive activities (quality-based measure)

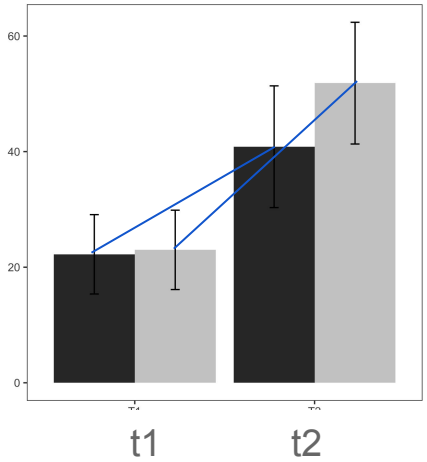
H2c: Quality-measures show *a different* pattern compared to quantity measures.
> not for overall measure (sum of sub-categories) nor any of the subcategories

FREQUENCY
$meta_{quantity}$

> sum of sub-categories



interaction: p<.001, η^2 =.100



interaction: p=.072, η^2 =.029

EXPLICITNESS
$meta_{quality1}$

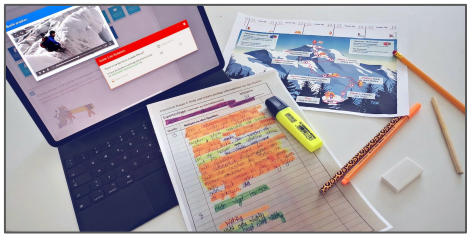
> sum of sub-categories

Control
Treatment

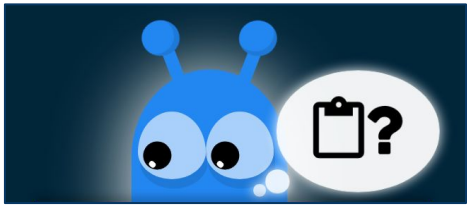
CONCLUSION

Promoting SRL in Digital Learning Environments

Our intervention in general (with and without prompts) …



- succeeded in promoting cognitive skills
  (i.e. medium effect size for quantity- and quality-based measures of cognitive strategy application)
- succeeded in promoting metacognitive skills
  (i.e. large effect sizes for overall and almost all subgroup measures, even in the control group).



Our intervention providing metacognitive prompts (TG) …

- succeeded in promoting metacognitive skills specifically in the treatment group (i.e. small to medium effect sizes for relevance of information monitoring, progress monitoring and comprehension monitoring ($p \leq .10$)

CONCLUSION

Quantity vs. Quality?

Our quality-based measures (in a task-based interview method) *...*

- did not (yet) show an advantage over quantity-based measures
  (... but will undertake more analysis with remaining students & quality ratings).
- provide an insight into the quality and complexity of metacognitive thinking of primary school children.
- offer opportunities to design valid and reliable instruments for the assessment of SRL (metacognitive activities and cognitive strategy use).

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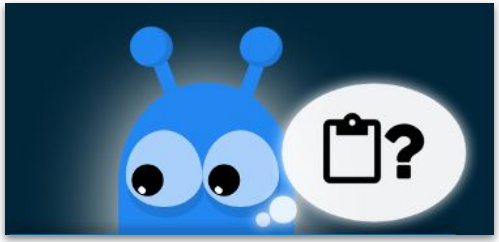
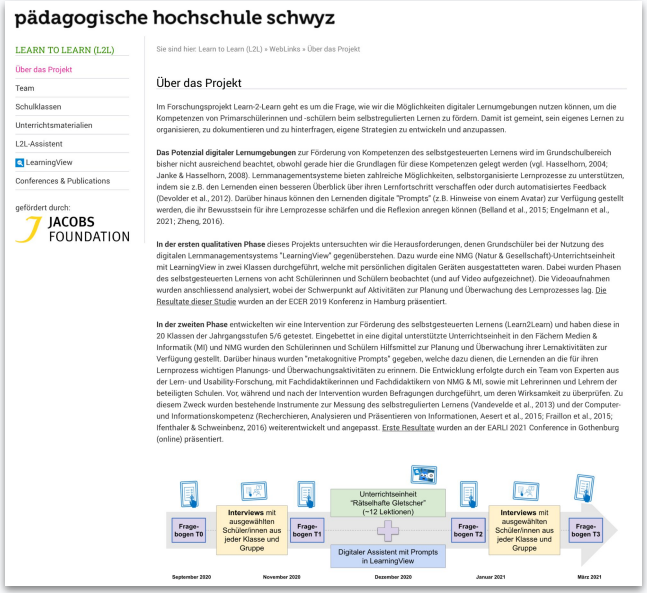


THANK YOU VERY MUCH !

ANY QUESTIONS ?

OUR WEBSITE

https://ims.phsz.ch/L2L/DasProjekt



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LEARN TO LEARN (L2L)

- Über das Projekt
- Team
- Schulklassen
- Unterrichtsmaterialien
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- LearningView
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Über das Projekt

Im Forschungsprojekt Learn-2-Learn geht es um die Frage, wie wir die Möglichkeiten digitaler Lernumgebungen nutzen können, um die Kompetenzen von Primarschülerinnen und -schülern beim selbstregulierten Lernen zu fördern. Damit ist gemeint, sein eigenes Lernen zu organisieren, zu dokumentieren und zu hinterfragen, eigene Strategien zu entwickeln und anzupassen.

Das Potenzial digitaler Lernumgebungen zur Förderung von Kompetenzen des selbstgesteuerten Lernens wird im Grundschulbereich bisher nicht ausreichend beachtet, obwohl gerade hier die Grundlagen für diese Kompetenzen gelegt werden (vgl. Hasselhorn, 2004; Janke & Hasselhorn, 2008). Lernmanagementsysteme bieten zahlreiche Möglichkeiten, selbstorganisierte Lernprozesse zu unterstützen, indem sie z.B. den Lernenden einen besseren Überblick über ihren Lernfortschritt verschaffen oder durch automatisiertes Feedback (Devolder et al., 2012). Darüber hinaus können den Lernenden digitale "Prompts" (z.B. Hinweise von einem Avatar) zur Verfügung gestellt werden, die ihr Bewusstsein für ihre Lernprozesse schärfen und die Reflexion anregen können (Belland et al., 2015; Engelmann et al., 2021; Zheng, 2016).

In der ersten qualitativen Phase dieses Projekts untersuchten wir die Herausforderungen, denen Grundschüler bei der Nutzung des digitalen Lernmanagementsystems "LearningView" gegenüberstehen. Dazu wurde eine NMG (Natur & Gesellschaft)-Unterrichtseinheit mit LearningView in zwei Klassen durchgeführt, welche mit persönlichen digitalen Geräten ausgestatteten waren. Dabei wurden Phasen des selbstgesteuerten Lernens von acht Schülerinnen und Schülern beobachtet (und auf Video aufgezeichnet). Die Videoaufnahmen wurden anschliessend analysiert, wobei der Schwerpunkt auf Aktivitäten zur Planung und Überwachung des Lernprozesses lag. Die Resultate dieser Studie wurden an der ECER 2019 Konferenz in Hamburg präsentiert.

In der zweiten Phase entwickelten wir eine Intervention zur Förderung des selbstgesteuerten Lernens (Learn2Learn) und haben diese in 20 Klassen der Jahrgangsstufen 5/6 getestet. Eingebettet in eine digital unterstützte Unterrichtseinheit in den Fächern Medien & Informatik (MI) und NMG wurden den Schülerinnen und Schülern Hilfsmittel zur Planung und Überwachung ihrer Lernaktivitäten zur Verfügung gestellt. Darüber hinaus wurden "metakognitive Prompts" gegeben, welche dazu dienen, die Lernenden an die für ihren Lernprozess wichtigen Planungs- und Überwachungsaktivitäten zu erinnern. Die Entwicklung erfolgte durch ein Team von Experten aus der Lern- und Usability-Forschung, mit Fachdidaktikerinnen und Fachdidaktikern von NMG & MI, sowie mit Lehrerinnen und Lehrern der beteiligten Schulen. Vor, während und nach der Intervention wurden Befragungen durchgeführt, um deren Wirksamkeit zu überprüfen. Zu diesem Zweck wurden bestehende Instrumente zur Messung des selbstregulierten Lernens (Vandevelde et al., 2013) und der Computer- und Informationskompetenz (Recherchieren, Analysieren und Präsentieren von Informationen, Aesert et al., 2015; Fraillon et al., 2015; Ifenthaler & Schweinbenz, 2016) weiterentwickelt und angepasst. Erste Resultate wurden an der EARLI 2021 Conference in Gothenburg (online) präsentiert.

REFERENCES

Baars, M., Khare, S., & Ridderstap, L. (2022). Exploring students' use of a mobile application to support their self-regulated learning processes. *Frontiers in psychology*, *13*.

Bannert, M., & Mengelkamp, C. (2013). Scaffolding hypermedia learning through metacognitive prompts. In *International handbook of metacognition and learning technologies* (pp. 171-186). Springer.

Boekaerts, M. (1997). Self-regulated learning: A new concept embraced by researchers, policy makers, educators, teachers, and students. *Learning and Instruction, 7*(2), 161–186.

Cohen, J. (1988). Statistical power analysis for the behavioral sciences. Erlbaum.

Engelmann, K., Bannert, M., & Melzner, N. (2021). Do self-created metacognitive prompts promote short-and long-term effects in computer-based learning environments?. *Research and Practice in Technology Enhanced Learning*, *16*(1), 1-21.

Gentner, N., & Seufert, T. (2020). The double-edged interactions of prompts and self-efficacy. *Metacognition and learning*, *15*(2), 261-289.

Greene, J. A., Bolick, C. M., & Robertson, J. (2010). Fostering historical knowledge and thinking skills using hypermedia learning environments: The role of self-regulated learning. *Computers & Education*, *54*(1), 230-243.

Guo, L. (2022). Using metacognitive prompts to enhance self-regulated learning and learning outcomes: A meta-analysis of experimental studies in computer-based learning environments. *Journal of Computer Assisted Learning, 38*(3), 811–832.

Heaysman, O., & Kramarski, B. (2022). Enhancing students' metacognition, achievement and transfer between domains: Effects of the simulative "SRL-AIDE" parallel teacher–student program. *International Journal of Educational Research,* 116.

Sáiz Manzanares, M. C., Queiruga Dios, M. Á., García-Osorio, C. I., Montero García, E., & Rodríguez-Medina, J. (2019). Observation of Metacognitive Skills in Natural Environments: A Longitudinal Study With Mixed Methods. *Frontiers in Psychology, 10*.

Meijer, J., Veenman, M. V., & van Hout-Wolters, B. H. (2006). Metacognitive activities in text-studying and problem-solving: Development of a taxonomy. *Educational Research and Evaluation*, *12*(3), 209-237.

Molenaar, I. & Chiu, M.M. (2014). Dissecting sequences of regulation and cognition: Statistical discourse analysis of primary school children's collaborative learning. *Metacognition and Learning, 9* (2), 137-160.

Moning, J., & Roelle, J. (2021). Self-regulated learning by writing learning protocols: Do goal structures matter? *Learning and Instruction*, *75*.

Muis, K. R., Psaradellis, C., Chevrier, M., Di Leo, I., & Lajoie, S. P. (2015). Learning by preparing to teach: Fostering self-regulatory processes and achievement during complex mathematics problem solving. *Journal of Educational Psychology, 108*(4), 474–492.

Omarchevska, Y., Lachner, A., Richter & Scheiter, K. (2022). Video modeling and metacognitive prompts improve self-regulated scientific inquiry? *Educational Psychology Review,* 1-37.

Pintrich, P. R. (2004). A conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*(4), 385–407.

Schuster, C., Stebner, F., Leutner, D., & Wirth, J. (2020). Transfer of metacognitive skills in self-regulated learning: an experimental training study. *Metacognition and Learning*, *15*(3), 455-477.

van der Stel, M., & Veenman, M. V. J. (2013). Metacognitive skills and intellectual ability of young adolescents: A longitudinal study from a developmental perspective. *European Journal of Psychology of Education, 29*(1), 117–137.

Vandevelde, S., Van Keer, H., Schellings, G., & Van Hout-Wolters, B. (2015). Using think-aloud protocol analysis to gain in-depth insights into upper primary school children's self-regulated learning. *Learning and Individual Differences, 43*, 11–30.

Veenman, M. V. J. (2005). The assessment of metacognitive skills. C. Artelt & B. Moschner (Eds.), *Lernstrategien und Metakognition. Implikationen für Forschung und Praxis* (p. 7–11). Waxmann.

Veenman, M. V., Kok, R., & Blöte, A. W. (2005). The relation between intellectual and metacognitive skills in early adolescence. *Instructional Science*, 33, 193–211.

Wong, J., Baars, M., Davis, D., Van Der Zee, T., Houben, G. J., & Paas, F. (2019). Supporting self-regulated learning in online learning environments and MOOCs: A systematic review. *International Journal of Human–Computer Interaction*, *35*(4-5), 356-373.

Zheng, L. (2016). The effectiveness of self-regulated learning scaffolds on academic performance in computer-based learning environments: A meta-analysis. *Asia Pacific Education Review, 17*(2), 187–202.