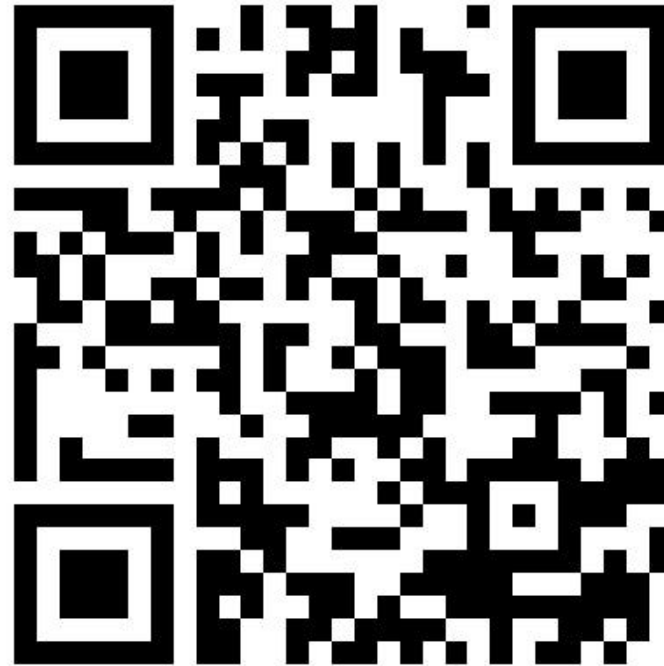


Development and Evaluation of an AI-supported Teacher Assistant Tool (AI-TAT) to foster Self-Regulated Learning

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Background

- COVID-19 pandemic has profound impact on teaching and learning (Burgsteiner & Krammer, 2022)
 - regulation of own learning necessary
- Learning materials not designed to support SRL (Brünner et al., 2024; Dignath & Veenman, 2021)
 - learning materials can enhance students SRL competencies (Leidinger & Perels, 2012)

Research Questions

- **RQ1:** To what extent can large language models (LLMs) generate pedagogically meaningful feedback (tool output version 1) that supports secondary school teachers in improving worksheets for self-regulated learning?
- **RQ2:** How do secondary school teachers perceive the usefulness and reliability of such feedback (tool output version 1)?

Methodology

- Design-based research
 - Ebner & Schön (2020)
- Three phases
 - challenge description
 - development and evaluation
 - process and result documentation

Challenge Description Phase

- Identification of the pedagogical problem
 - limited support of SRL in teaching materials
- Online questionnaire
 - > 100 secondary school teachers
 - high usage of worksheets for teaching and learning
- Teacher professional development (TPD) course
 - AI-TAT would be (very) useful

Development Phase

- SRLly ➡ Web-based Tool
 - SvelteKit/Node.js-based services (backend) and Svelte (frontend)
- Theoretical base
 - Zimmerman (2002) ➡ three-phase model
 - Dignath & Veenman (2021) ➡ powerful learning environment
 - Karlen & Held (2025) ➡ turbine model
- Combination of AI generation & human decision making (Buçinca et al., 2021)

Development Phase

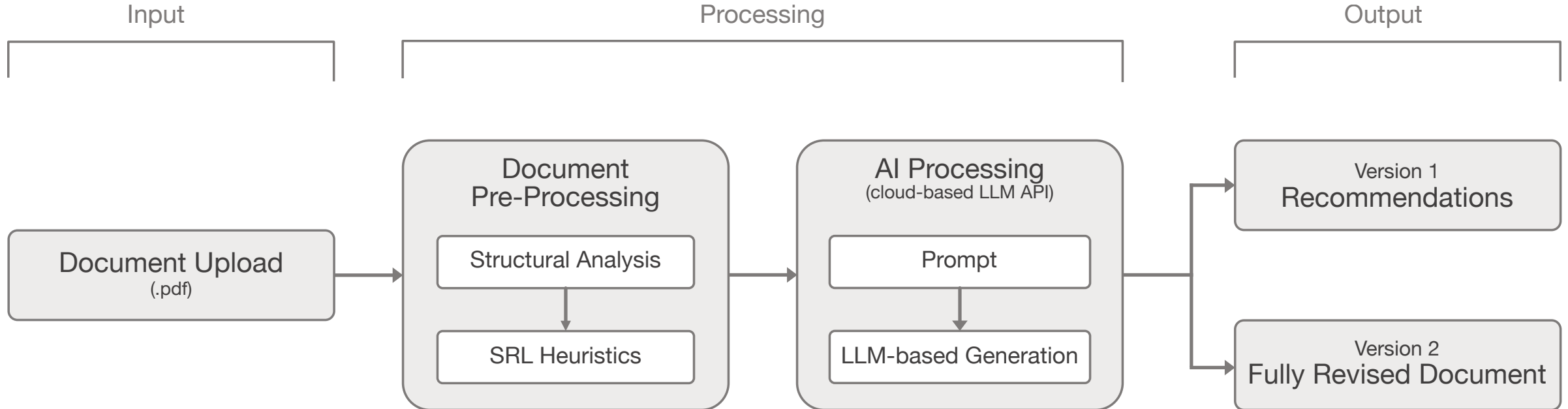


Figure 1: Schematic representation of the core components of SRLly

Document Pre-Processing

- PDF upload
 - school subject
 - grade level
- Retrieval-augmented generation approach (Lewis et al., 2020)
 - reduce inaccuracy and hallucinations
 - cost-effective

Document Pre-Processing - Structural Analysis

- First iteration
 - document reconstruction
 - blocks with necessary information (identifier, positional information, page number, text snippet)
- Second iteration → [Docling toolkit](#)
- Better structural quality
 - high-quality PDF rebuild as additional benefit

Document Pre-Processing - SRL Heuristic

- Find existing SRL elements
 - reduce complexity for LLM
 - provide structured evidence for recommendations
- Examples
 - learning goals, strategy hints, monitoring prompts, reflection questions

AI Processing

- Cloud-based LLM API
 - Azure OpenAI - Sweden
- Curated payload instead of complete PDF
 - LLM not as end-to-end system (Lewis et al., 2020)
- System & user prompt

AI Processing

- Six SRL dimensions
 - planning
 - strategy
 - monitoring
 - reflection
 - motivation (added after iteration one)
 - self-efficacy (added after iteration one)

AI Processing

- Specific JSON response format
- Material overview (added after iteration one)
 - topic, learning goal, learning activities, product
- Strength, risks, SRL profile

Analysis result

SRL feedback for the worksheet

global-srl-report.v1

Material Topic The outbreak and early causes of World War I (events around 1914, Sarajevo/Attentat/Vidovdan).	Learning goal Learners investigate the events of 1914, explain the role of the Sarajevo assassination and alliances, and represent the early war course on timelines and maps (inferred from multiple 'Ich kann...' learning statements and task instructions).	Learning activity Learners work independently or in stations to analyse sources (texts, images, newspaper headers), complete a crossword, draw front lines on a map and create timelines, then discuss findings at a 'Bus Stop' peer exchange.	Product A combination of short written summaries (2-3 sentences), a timeline, a coloured map of fronts, completed crossword answers, and a justified answer to whether the war could have been prevented.																		
Strengths • Clear central topic with many authentic source materials and varied tasks (texts, images, map, headlines). • Stations design gives learners choice and includes time estimates for many activities. • Tasks include peer exchange and a concrete debate prompt, supporting argumentative practice.	Risks • No explicit success criteria or clear rubrics for the main products (timeline, map, argument), which may make goal attainment unclear. • No structured reflection or metacognitive prompt for learners to evaluate what they learned and plan next steps. • Few concrete source-analysis steps are provided; learners may struggle to extract and weigh evidence consistently. • Self-monitoring is limited to checking with the teacher rather than learner-led checkpoints, reducing autonomous error-detection.	SRL profile <table><tr><td>Planning</td><td>★★</td><td>Goals and estimated times are present and choice of stations supports planning, but explicit success criteria are only implicit.</td></tr><tr><td>Strategies</td><td>★◊</td><td>Some strategy hints appear (source hints, modelling), but method steps for analysing sources are generally sparse.</td></tr><tr><td>Monitoring</td><td>★★</td><td>There are time cues and a teacher-check, yet few learner-led checkpoints for self-correction.</td></tr><tr><td>Reflection</td><td>◊☆</td><td>The material lacks prompts asking learners to summarise learning gains or set next steps.</td></tr><tr><td>Motivation</td><td>★★</td><td>Varied activities and choice of station plus authentic materials support relevance and engagement.</td></tr><tr><td>Self-efficacy</td><td>★★</td><td>Short time estimates and mixed-difficulty stations give achievable entry points, but staged task steps are rare.</td></tr></table>		Planning	★★	Goals and estimated times are present and choice of stations supports planning, but explicit success criteria are only implicit.	Strategies	★◊	Some strategy hints appear (source hints, modelling), but method steps for analysing sources are generally sparse.	Monitoring	★★	There are time cues and a teacher-check, yet few learner-led checkpoints for self-correction.	Reflection	◊☆	The material lacks prompts asking learners to summarise learning gains or set next steps.	Motivation	★★	Varied activities and choice of station plus authentic materials support relevance and engagement.	Self-efficacy	★★	Short time estimates and mixed-difficulty stations give achievable entry points, but staged task steps are rare.
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Figure 2: Analysis result

AI Processing

- 3-5 recommendations based on the six SRL dimensions
- Recommendation description (added after iteration one)
 - diagnosis
 - value
 - change
- Concrete text block for copy-paste

Recommendations

Planning

1 recommendation(s)

Clarify success criteria and time plan per station

Priority: medium

Support: medium

Placement: before the task

Type: Checklist

Copy text block

Implementation planned ?

Diagnosis:

Stations show suggested durations but do not state concrete success criteria for products like timelines, maps or summaries.

Value:

Clear criteria let learners plan work efficiently and self-assess product quality before peer exchange.

Change:

Add a two-line success checklist before each station specifying what a 'good' product looks like and suggested time.

Text block (copy-paste)

Vor dem Start – Kurzplan (fülle aus)

Station: _____

1) Ich will produzieren: (z. B. Zeitstrahl / Karte / 2–3 Sätze) → _____

2) Zeit: Ich plane zu arbeiten: ____ Minuten (Orientierung: siehe Vorschlag)

3) Erfolgskriterien (kreuze an): ☐ korrekte Reihenfolge der Ereignisse ☐ mindestens 2 Quellen verwendet ☐

~~kurze Begründung vorhanden~~

Figure 3: Recommendation example

Evaluation Phase

- TPD
 - 30 secondary education teachers
 - three-hour training session
- Agenda
 - basics and importance of SRL in education
 - SRLly

Evaluation Phase

- Online questionnaire (n=25)
 - demographic data
 - perceived usefulness
 - trustworthiness & traceability
 - feasibility in everyday teaching
 - overall evaluation

Evaluation Phase - Demographic Data

- School subject
 - most frequent: mathematics (n=8)
- Years of service
 - most frequent: 6 to 15 years (n=15)
- Experience with AI-based Tools
 - most frequent: slightly familiar (n=11)

Evaluation Phase - Perceived Usefulness

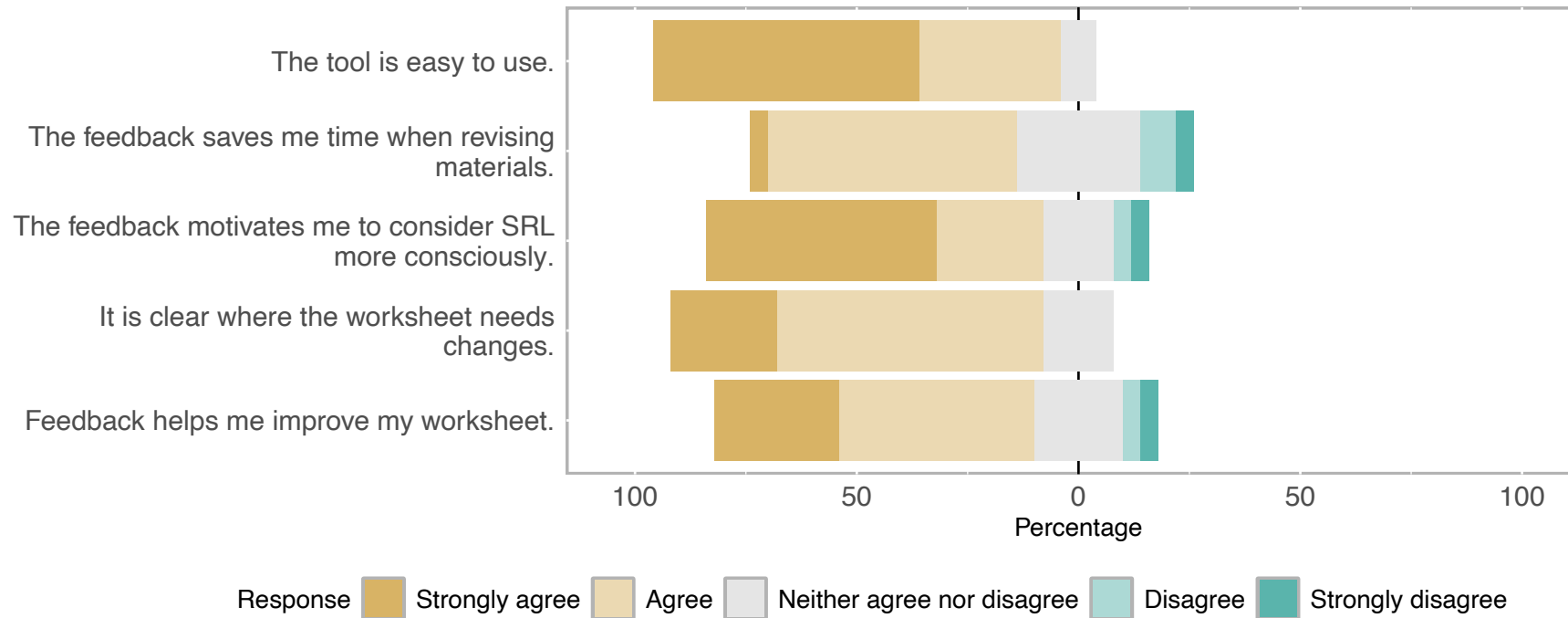


Figure 4: Results on the perceived usefulness of SRLly displayed in a Likert plot

Evaluation Phase - Trustworthiness & Traceability

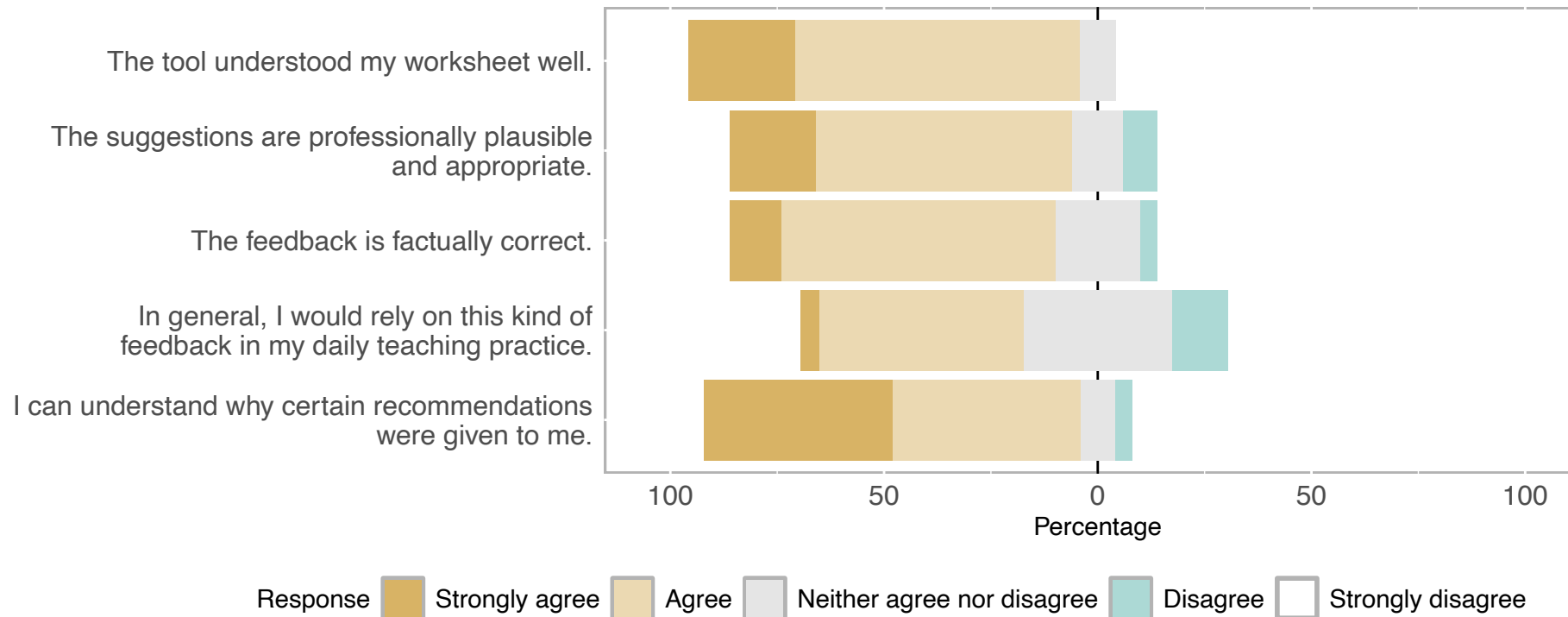


Figure 5: Results on the trustworthiness and traceability of SRLly displayed in a Likert plot

Evaluation Phase - Feasibility

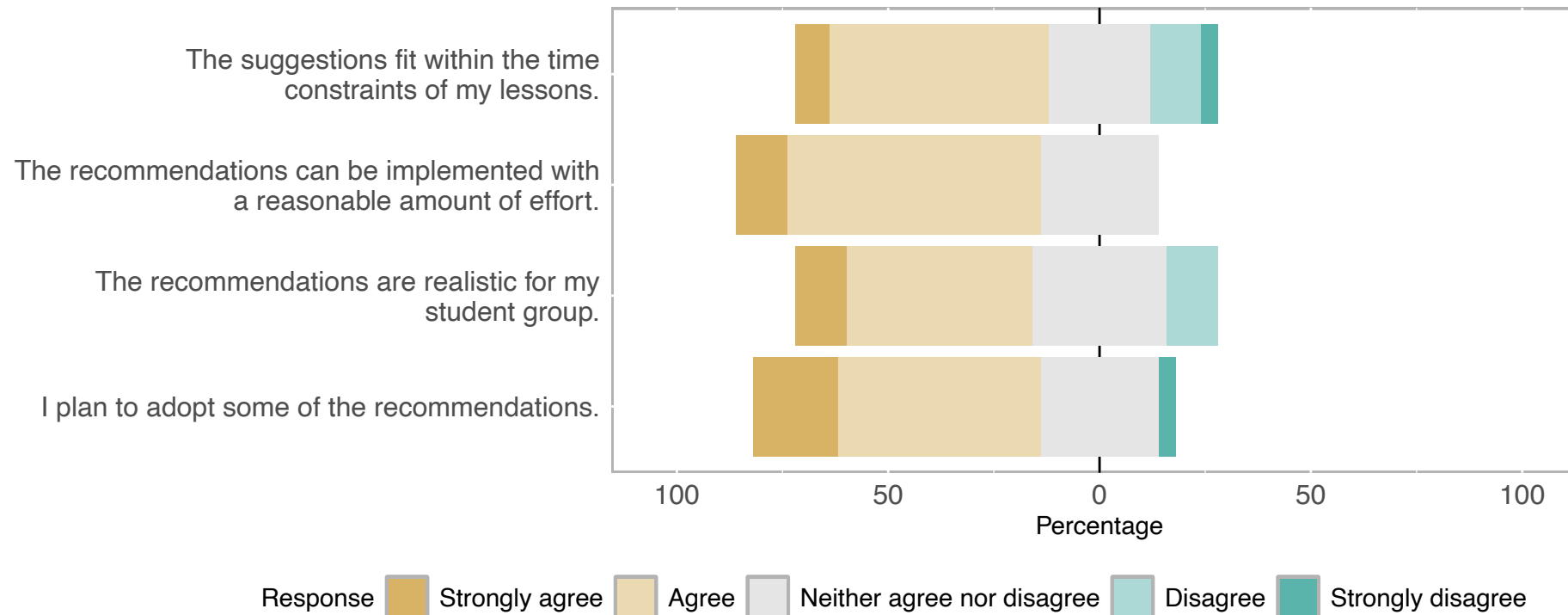


Figure 6: Results on the feasibility in everyday classrooms of SRLly displayed in a Likert plot

Evaluation Phase - Overall Evaluation

- 76% of participants → very good or good
 - 16% → satisfactory
 - 8% → sufficient
- Requested improvements
 - most frequent: automatic creation of improved worksheet

Discussion/Conclusion

- Support teacher's professional judgement rather than autonomous decision-makers (Amershi et al., 2024, Luckin & Cukurova, 2019, Luckin et al., 2022)
- LLMs can potentially generate useful SRL recommendations (RQ1)
 - but SRLly recommendations to generic
 - quality depends on different phases along the tool pipeline
- Usefulness & feasibility: Teacher's perceptions positive (RQ2)
- Trustworthiness and time constraints as main barriers for everyday use (RQ2)

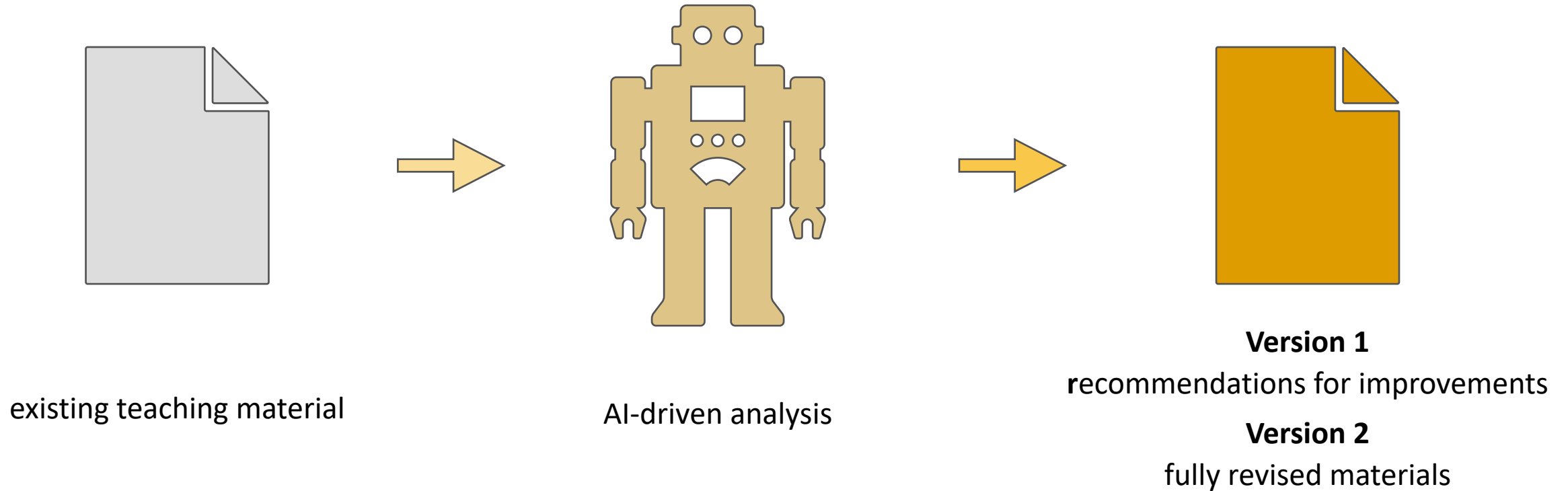
Limitations

- Early tool version
 - first iteration of version 1 evaluated
- Initial evaluation
- Only PDF processing

Outlook

- Second iteration of version 1 already in evaluation
- bachelor and master thesis
 - tool pipeline
 - possible SRL improvements with integrated recommendations
 - impact of improved worksheets
- SRL-oriented learning materials in the conventional school system

AI-Supported Teacher Assistant Tool (AI-TAT)



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Questions?

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