

**Mission:** Automatically delivering highly informative feedback to students using learning analytics and AI



**HIKOF**

2021-2024

[hikof.uni-frankfurt.de](http://hikof.uni-frankfurt.de)

HESSEN



Hessisches  
Ministerium für  
Wissenschaft  
und Kunst



2021-2025

[impact.sd.uni-frankfurt.de](http://impact.sd.uni-frankfurt.de)



Bundesministerium  
für Bildung  
und Forschung



# Workshop: Lessons-Learned on the Design, Development and Evaluation of Highly-Informative Learning Analytics.

# Outline

1. Aims of the workshop
2. Highly Informative Learning Analytics (HILA)
3. Design for Learning
4. Misconceptions / Failathon
5. Data-enriched Learning Analytics (DeLA)
6. Evaluation of DeLAs
7. Take away messages



- 1. Understand rationale for explicit actions in Data-enriched Learning Activities (DeLA)
- 2. Rich discussion
- 3. Get to know each other

# Aims of the workshop



Age



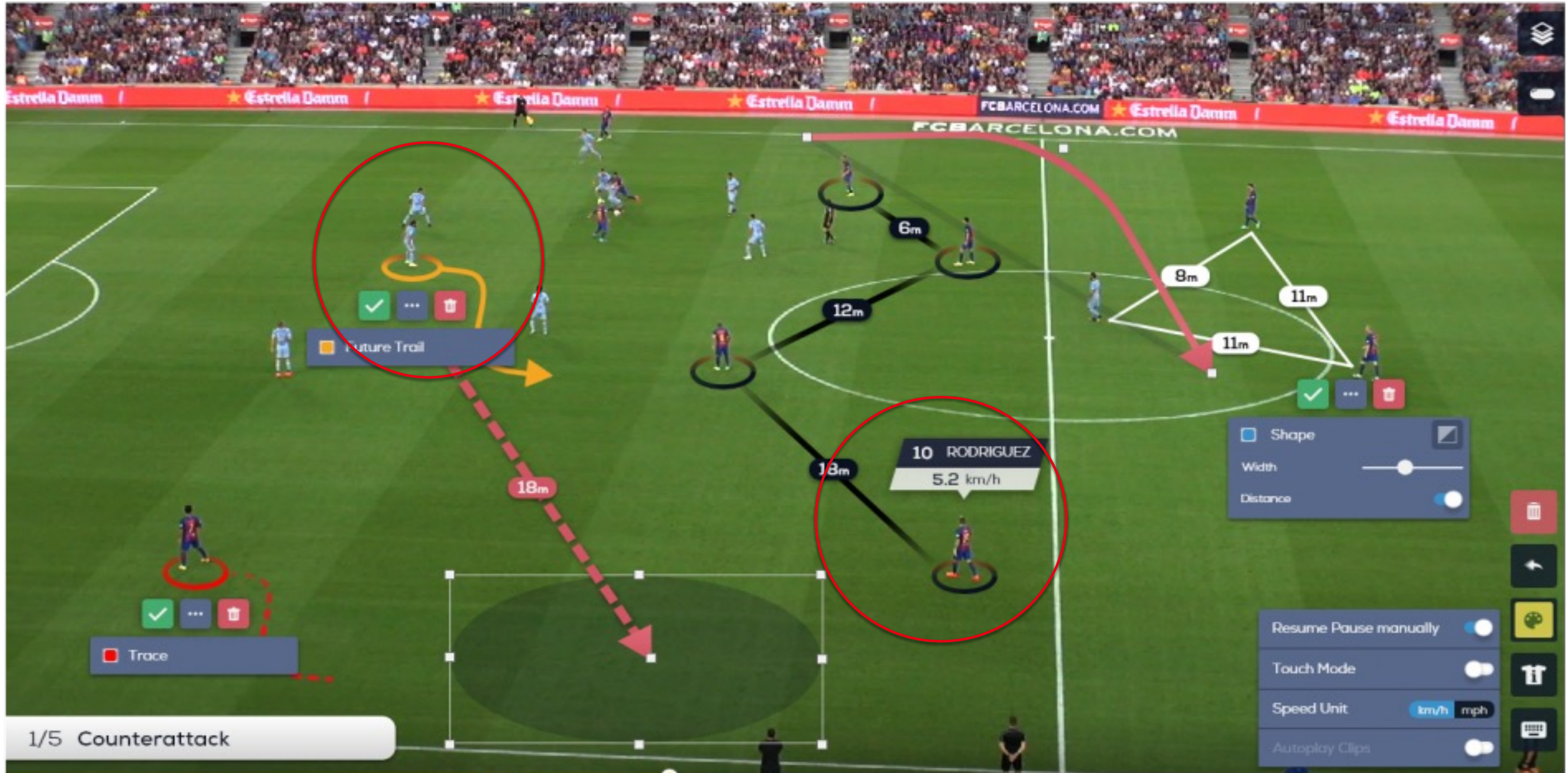
Eye color



Prior experience with Learning Analytics

- Just heard about it at the keynote
- Just know what it is
- Invested in the topic
- Use(d) it actively

**Mission:** Automatically delivering highly informative feedback to students using learning analytics and AI



In reality: Very little feedback in most cases



## Learning tracker



Hide

What is your goal for this MOOC?

Earn a certificate

Complete the course

Explore the course

Not sure yet

What would you like to get feedback on?

- |   |   |
|---|---|
| <input type="checkbox"/> Online presence                      | <input type="checkbox"/> Active learning time               |
| <input checked="" type="checkbox"/> Connectedness             | <input checked="" type="checkbox"/> Practice time           |
| <input checked="" type="checkbox"/> Time on platform          | <input checked="" type="checkbox"/> Practice quiz attempted |
| <input checked="" type="checkbox"/> Revisited material        | <input type="checkbox"/> Practice quiz efficiency           |
| <input checked="" type="checkbox"/> Timeliness of submissions | <input type="checkbox"/> Graded quiz attempted              |

Is there anything else that you would like to know?

Submit

Would these indicators help you in your studies?

Practice quiz attempted

Practice time

Timeliness of submissions

● Successful learners ● You



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# Learning Analytics (LA)

# Psychometrics (PSY)

User-centered Design

Construct evidence

Technology & Data

Bottom - up



## High-level interpretations

- Learning model variables
- PSY & LA feedback on: self-regulation, reading comprehension, creative thinking, problem-solving, ...



## Low-level features

- Learner performance indicators
- PSY: e.g. information given in a text accessed
- LA: e.g. combine footprints to indicators



## Data (Multimodal)

- Observable response
- PSY: highlighted text (explicit behavior)
- LA: location, time, clicks (digital footprints)

Top - down

Evidence centered Design

Construct evidence

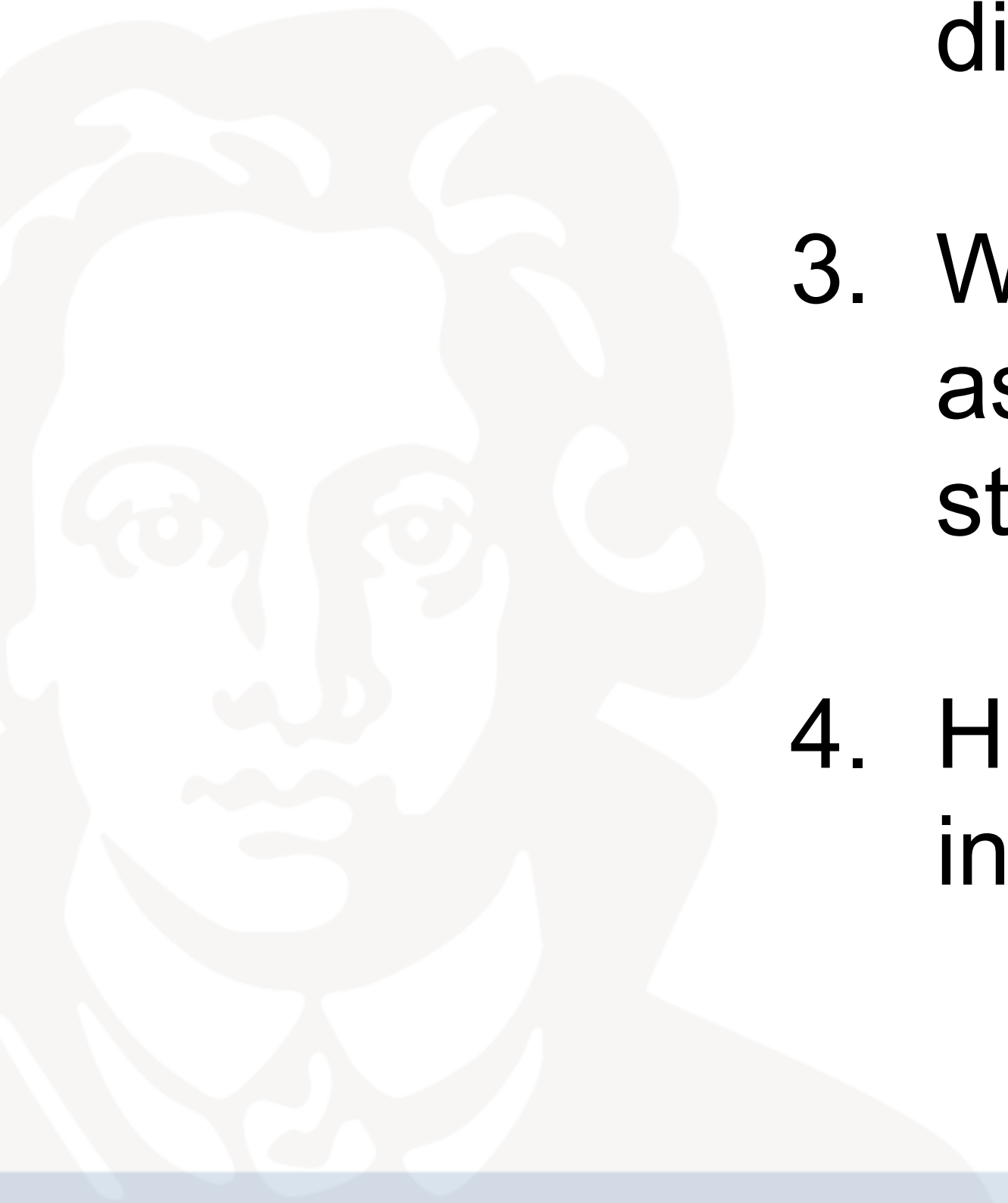
Data collection



Photo by [Annika Gordon](#) on [Unsplash](#)

*Highly informative feedback goes beyond feedback on right/wrong, it provides correct solutions, possibilities for improvement, hints on competence development and effective learning strategies.*

1. How can relevant data for the learner goals and outcomes of a course be extracted from digital learning environments?
2. How valid is the interpretation of indicators derived from digital traces?
3. What is the effect of different feedback types for assignment results, exam performance, and affective student variables?
4. How does feedback literacy influence students' interpretation and reaction to the received feedback?

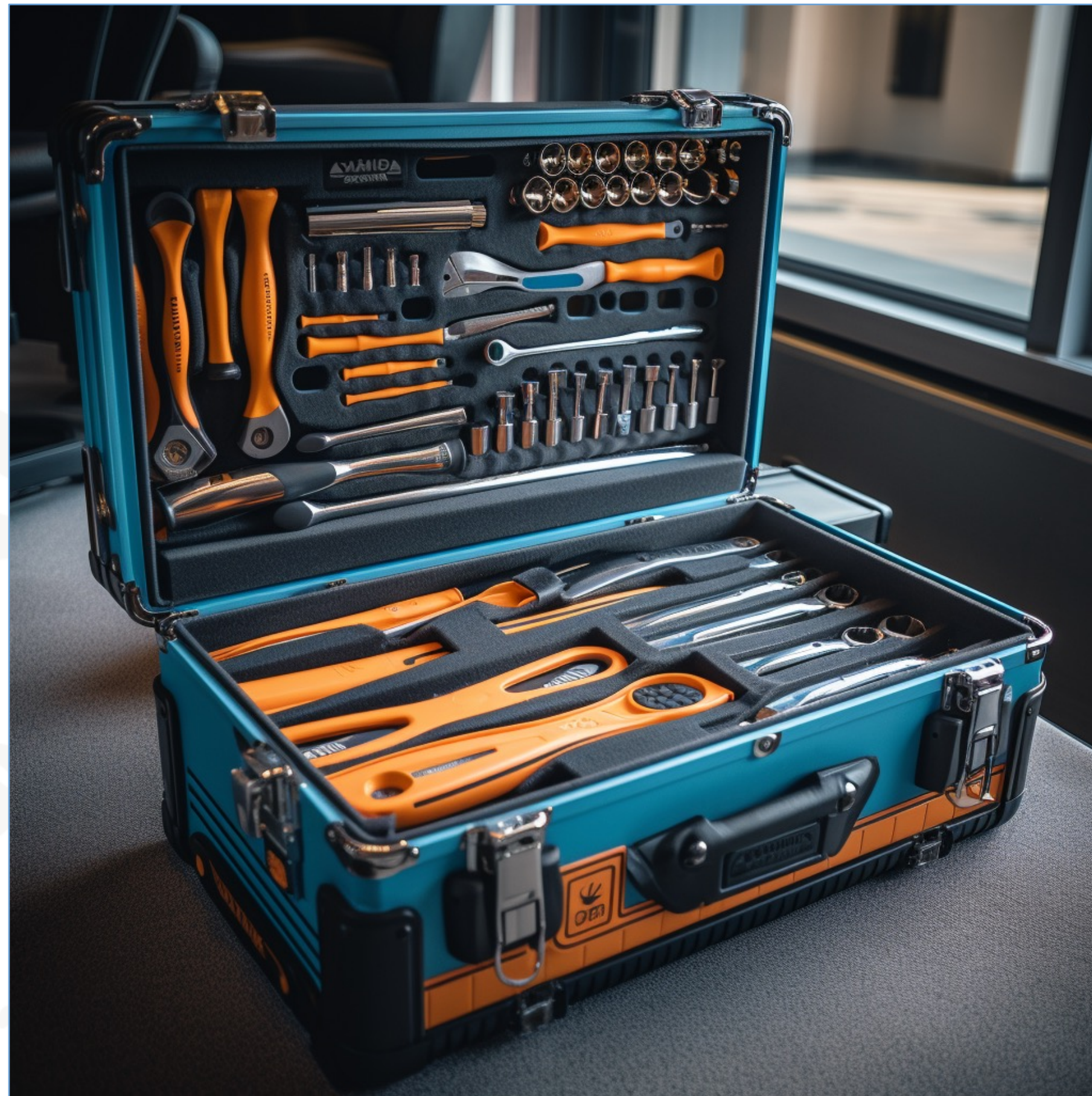


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# Design: Evidenzbasierter Designprozess



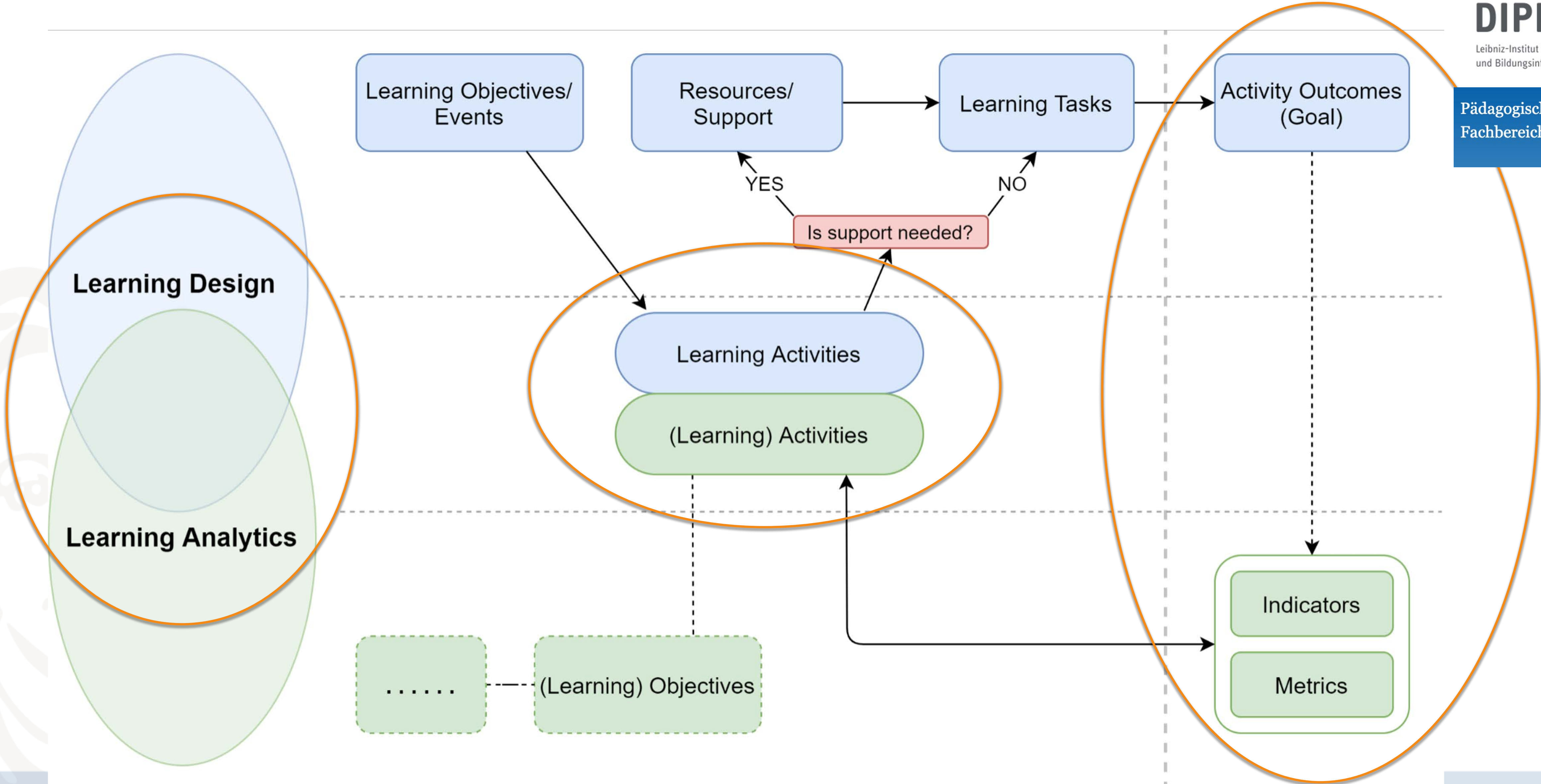
Learning Analytics *Mit Design*

Photo by [Alexander Schimmeck](#) on [Unsplash](#)

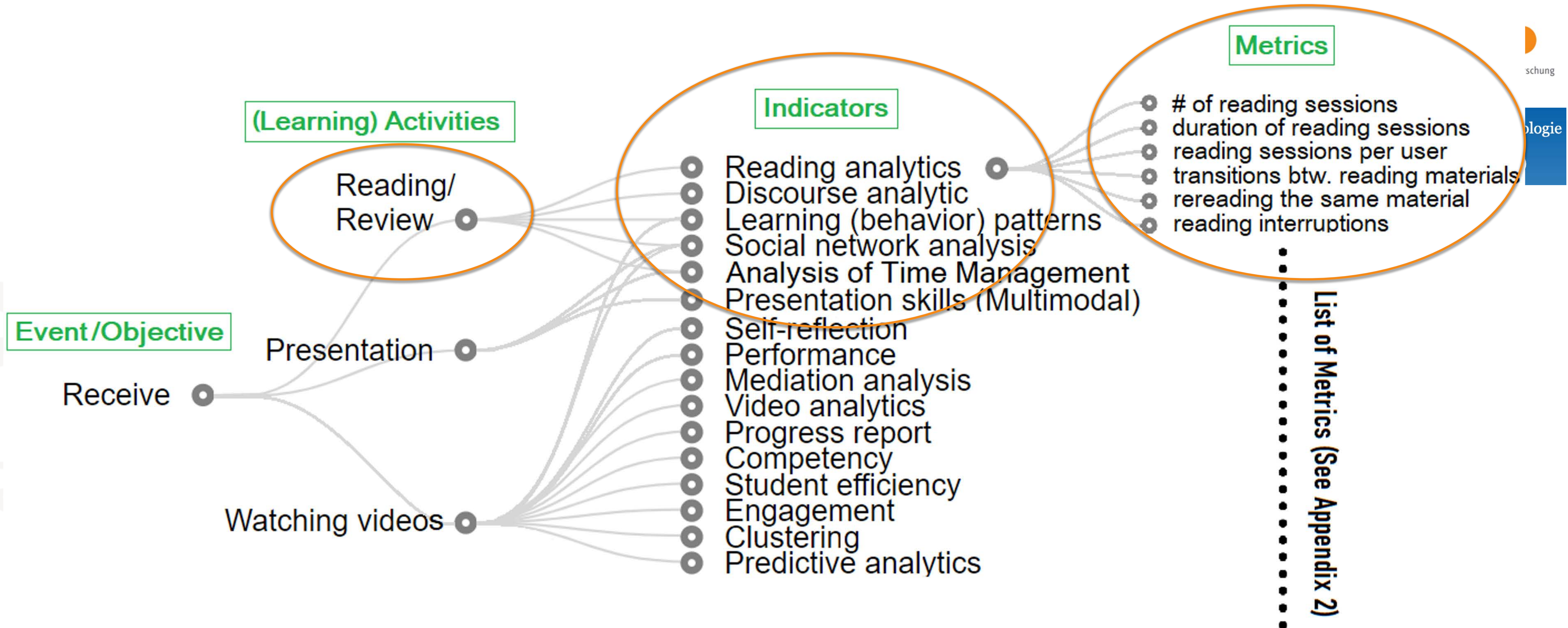


Learning Analytics *OHNE Design*

# Design: Evidenzbasierter Designprozess



# Design: Evidenz-basierter Designprozess





# Design: Evidenzbasierter Designprozess



References

Start Tour ▶



Leibniz-Institut für Bildungsforschung und Bildungsinformation

Pädagogische Psychologie  
Fachbereich 05

**Learning Events/Objectives**  
? Click here for more details

**Learning Activities**  
? Click here for more details

**Indicators**  
? Click here for more details

**Metrics**  
? Click here for more details

Learning Events/Objectives ▼

Learning Activities ▼

Search Indicator

Search Metrics

Selected Indicator(s)

Download

Reset

LEARNING  
EVENTS/OBJECTIVES

(LEARNING) ACTIVITIES

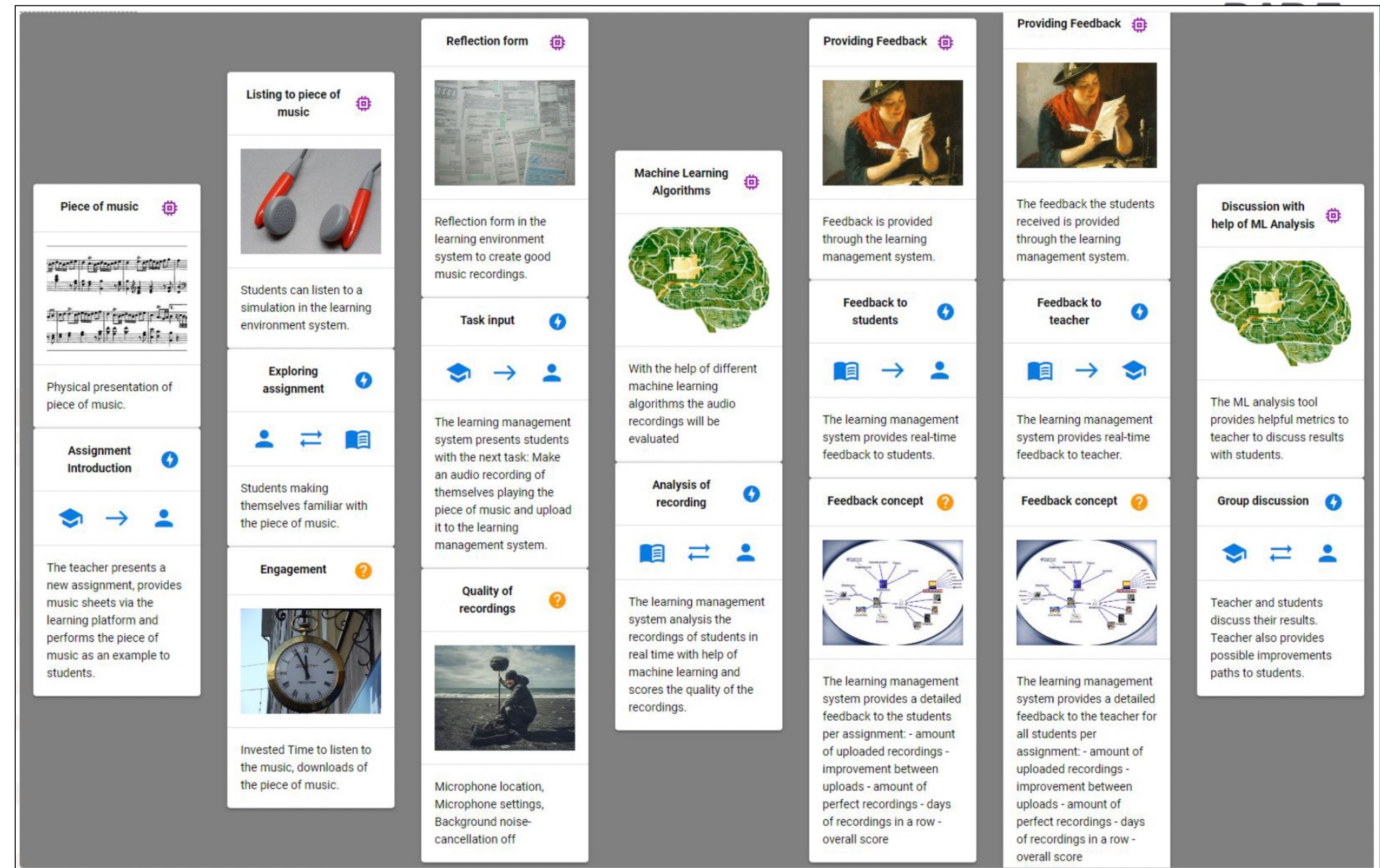
INDICATORS

Create

Design	<input type="checkbox"/> Course Assessments [55] <input type="checkbox"/> Teacher curriculum usage [65] Curriculum Planning / designing [65] <input type="checkbox"/> Course difficulty [77]
Group work	<input type="checkbox"/> Final Grade Prediction [28] <input type="checkbox"/> Group Participation [30] <input type="checkbox"/> Self-Regulation [36] Emotional state [36] <input type="checkbox"/> Time Distribution [39] Resource Usage Awareness [39] Self-reflection [39] <input type="checkbox"/> Performance [50] <input type="checkbox"/> Engagement and Performance [69] <input type="checkbox"/> Predict Student Grades [115] <input type="checkbox"/> Student comparison [130] Grade prediction [130] Self-motivation [130] <input type="checkbox"/> Prediction (A pilot study) [144]
Collaboration	<input type="checkbox"/> Classifying Student behavior [29] <input type="checkbox"/> Collaborative Learning [47] Time Planning [47] <input type="checkbox"/> Resource Recommendation [57] <input type="checkbox"/> Writing analytics [61] Collaboration network [61]

<https://edutec.science/products/>

# Design: Evidenzbasierter Designprozess



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Schmitz, M., Scheffel, M., Bemelmans, R., & Drachsler, H. (2022). **FoLA2 — A Method for Co-creating Learning Analytics–Supported Learning Design**. Journal of Learning Analytics, 9(2), 265-281. <https://doi.org/10.18608/jla.2022.7643>

# Design: Evidenzbasierter Designprozess



Beantworte nun abschließend die Frage:  
**Wie sollten Solarzellen an einem Haus angebracht werden, um möglichst viel Energie umwandeln zu können?**

Sie sollten möglichst zur Sonne zeigen...

Mithilfe von Solarbooten kann man sich ohne Benzin auf dem Wasser fortbewegen.  
Wie lässt sich die Funktionsweise von Solarbooten erklären?

Wählen Sie eine Antwort:

- Solarzellen auf dem Dach der Solarboote wandeln Strahlungsenergie in elektrische Energie um. Die elektrische Energie wird für einen Motor genutzt.
- Solarzellen auf dem Dach der Solarboote speichern Strahlungsenergie. Die gespeicherte Strahlungsenergie betreibt dann einen Motor.
- Für die Fortbewegung auf dem Wasser wird keine Energie benötigt, da man sich auf dem Wasser ohne Reibung fortbewegen kann.
- Solarzellen auf dem Dach der Solarboote speichern die elektrische Energie des Sonnenlichts. Die elektrische Energie betreibt dann einen Motor.

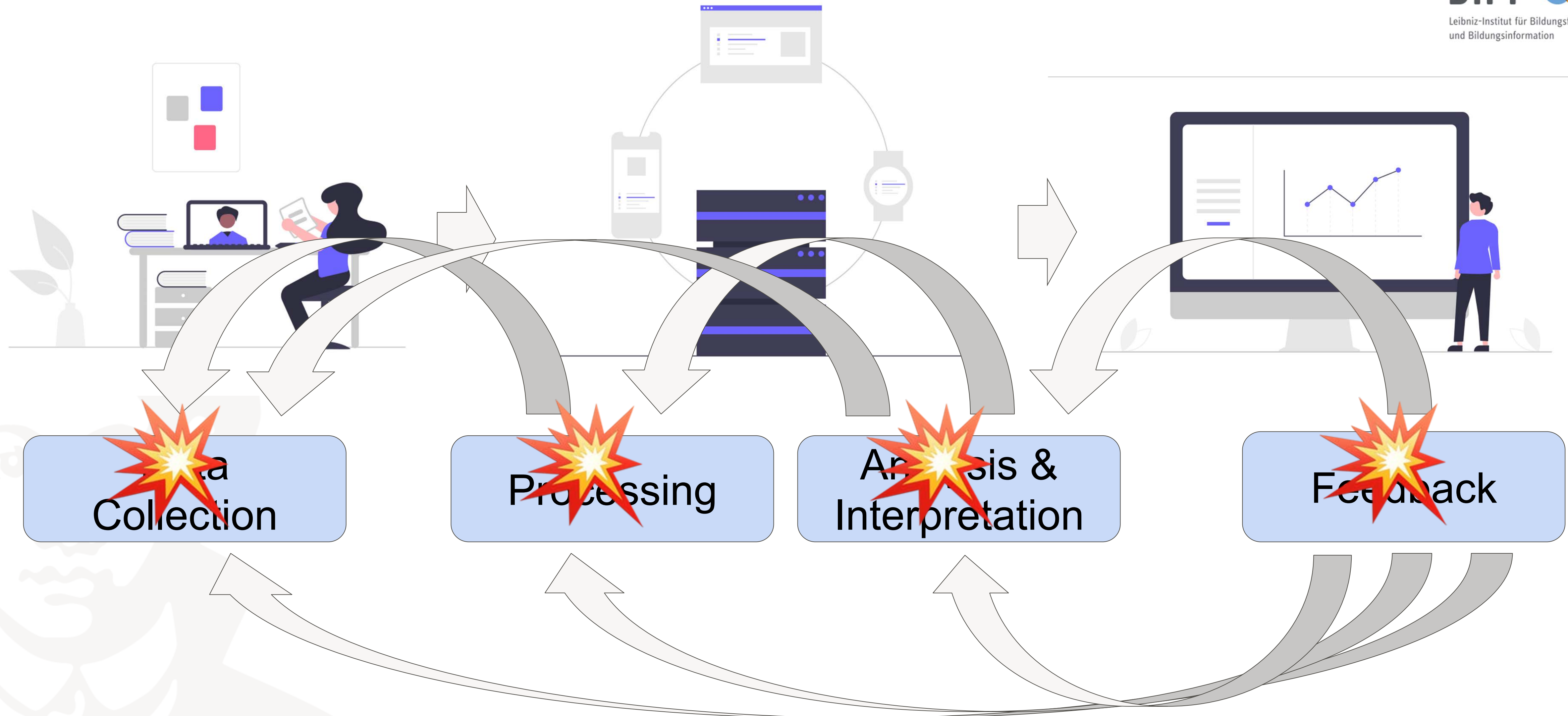
[Meine Auswahl widerrufen](#)

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# From Feedback to Learning



We started with:

*“What is a good indicator for [XYZ]?”*

Examples of XYZ:

- Learning motivation
- Collaborative problem solving
- Presentation skills
- Reading
- etc.

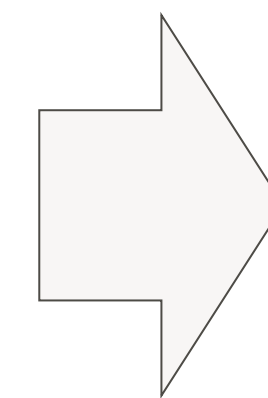
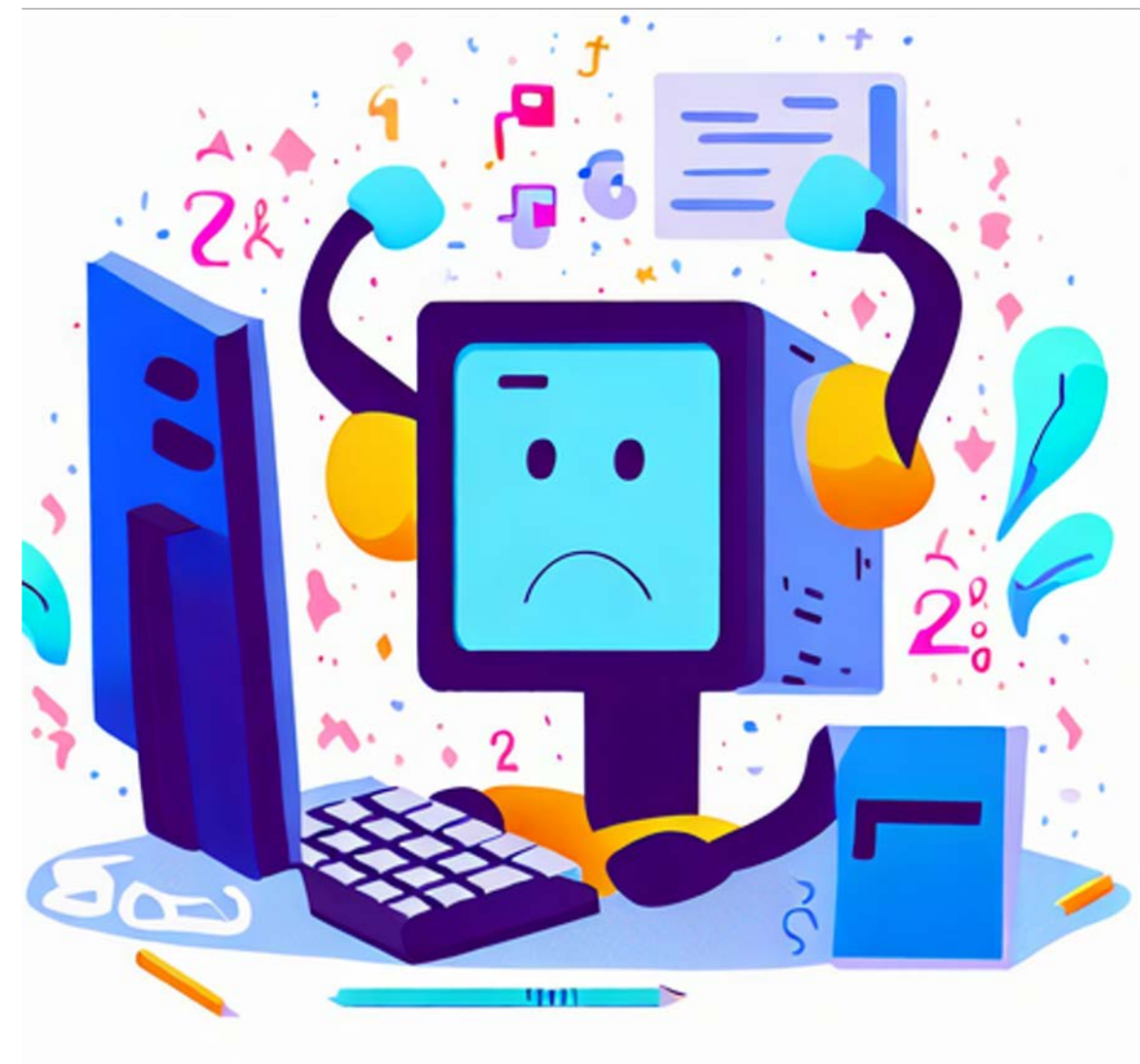
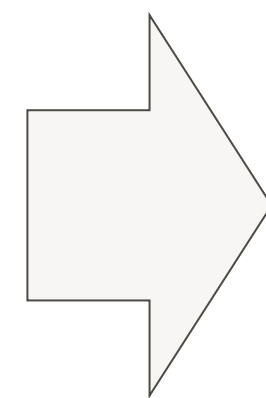


“It will be *somewhere* in the data”

The data:

- number of clicks on a learning resource
- speed of mouse movement

“We just need the right algorithms”



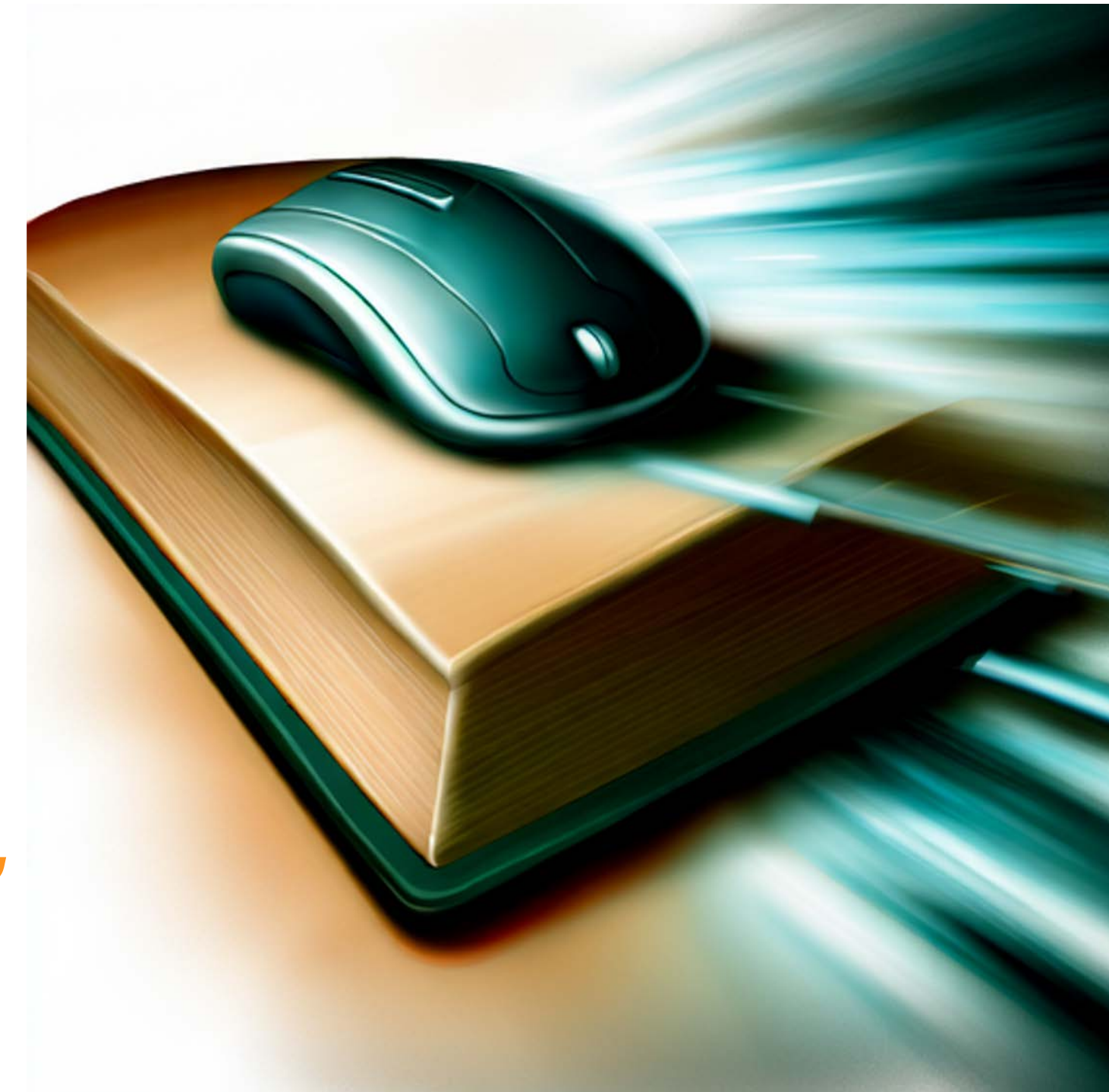
Imagine finding:

*Mouse movement speed correlates well with better reading skills!*

Interesting research result?

But what about feedback:

*“Move your mouse more quickly to read better?”*





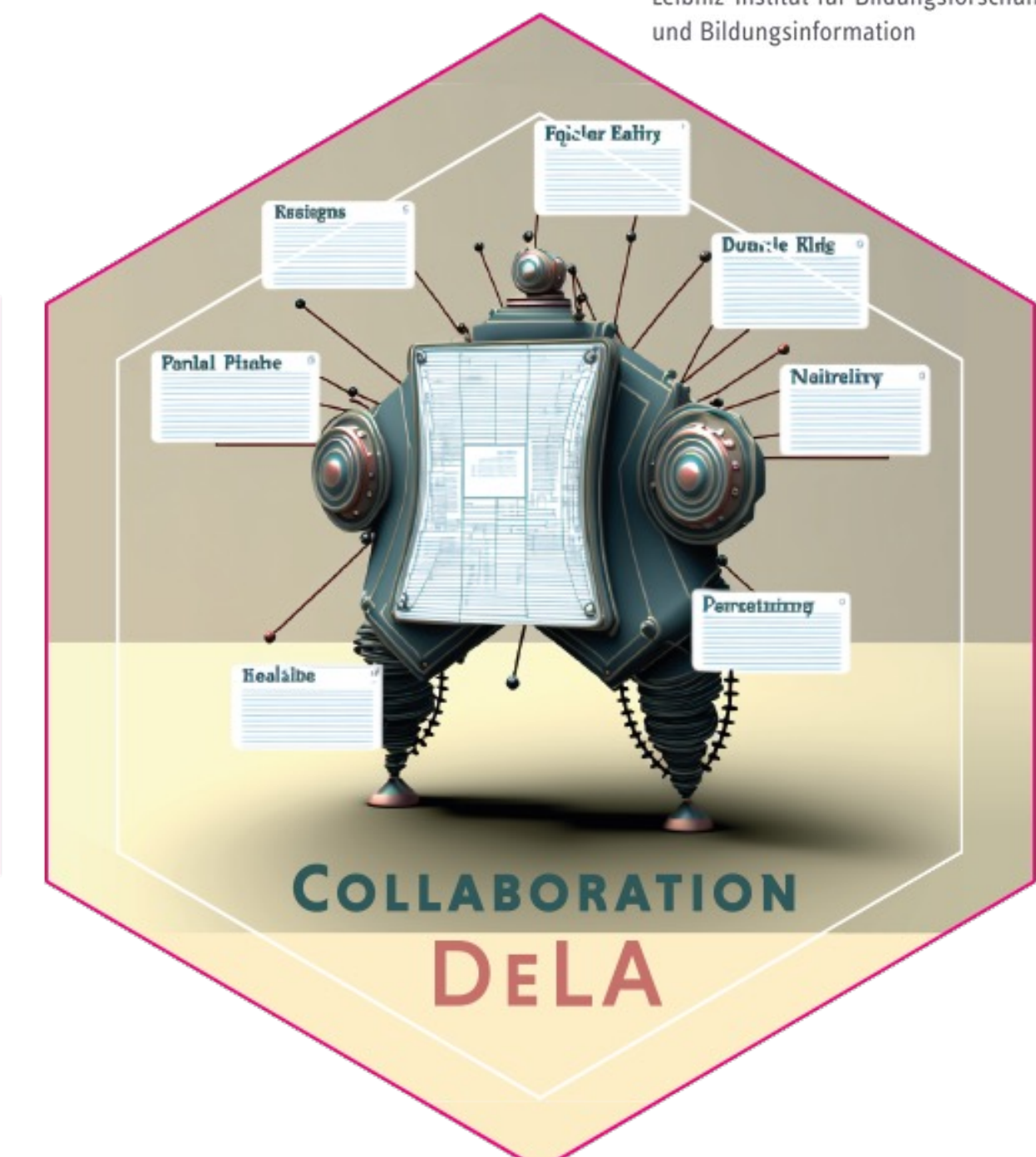
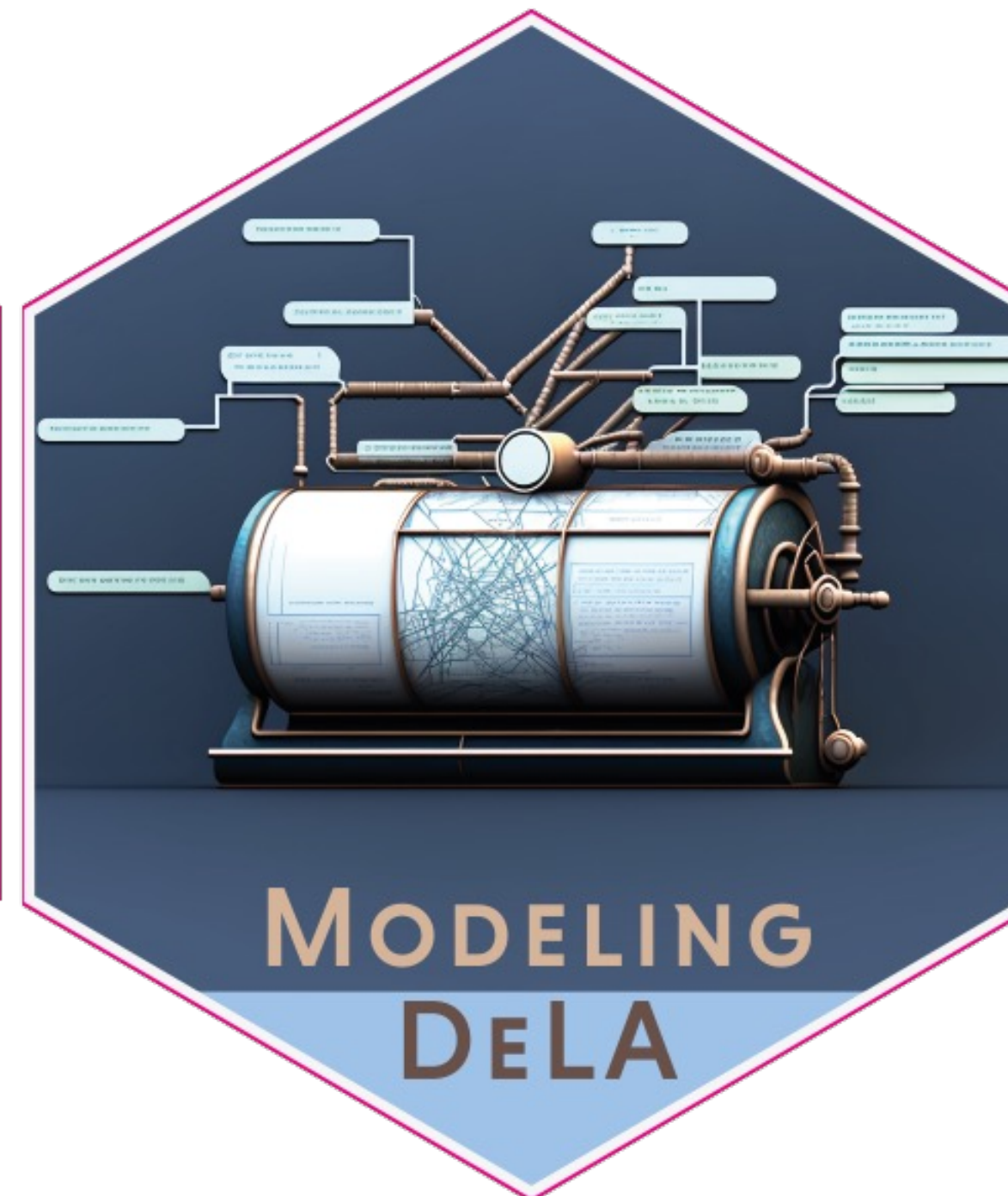
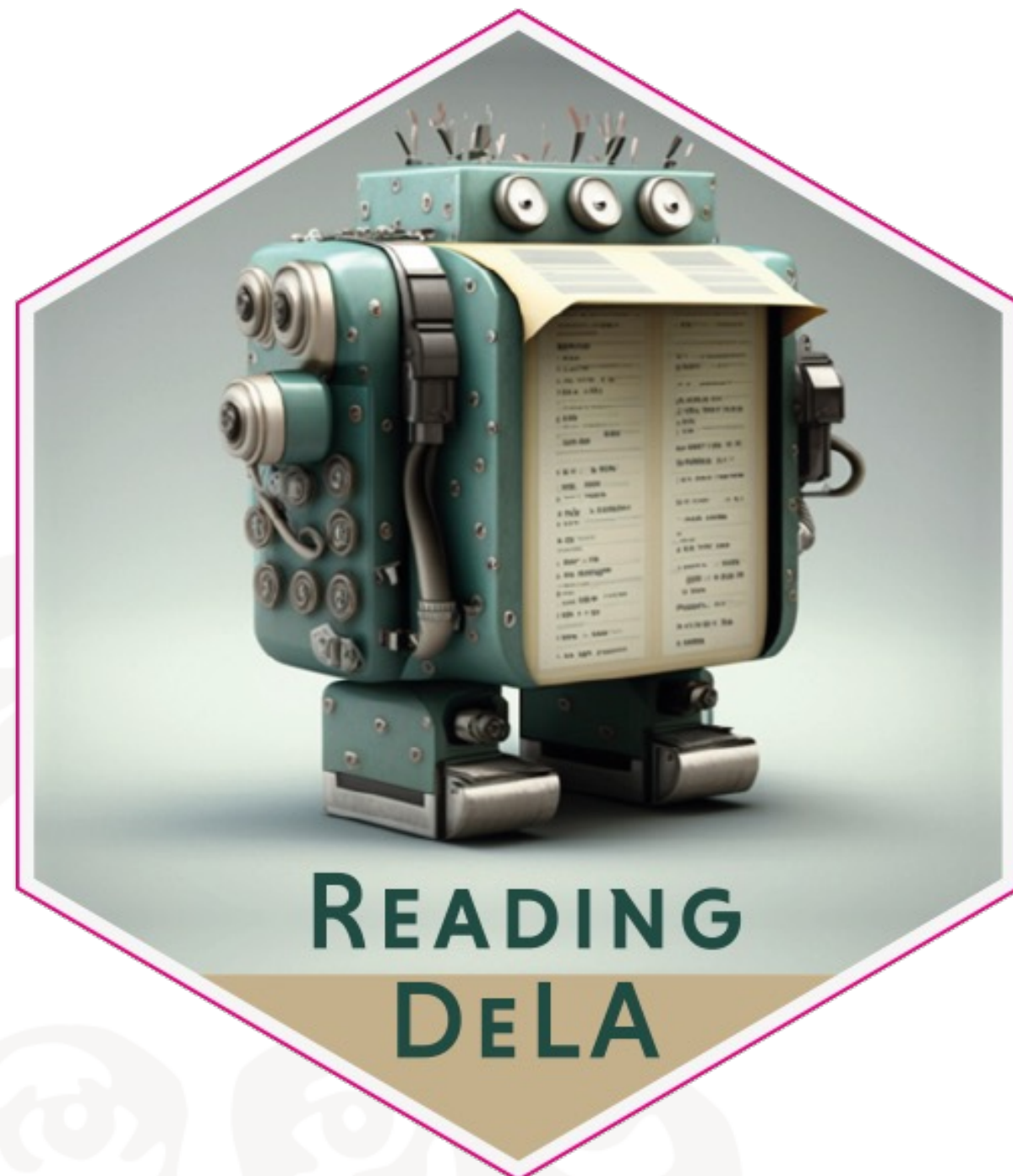
- Come up with constructs
- Come up with learning activity
- Come up with data to track in the learning activity

# Outline

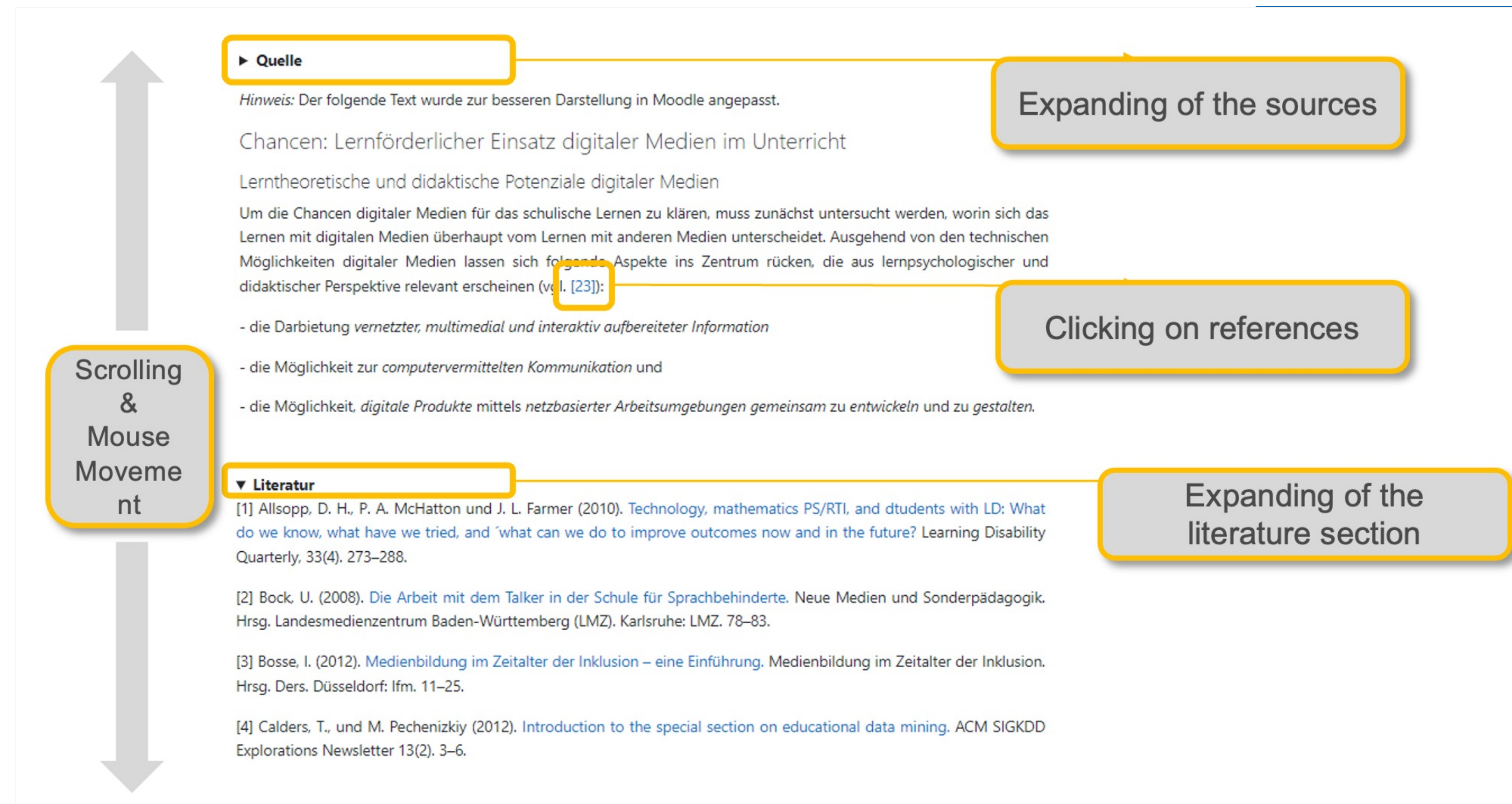
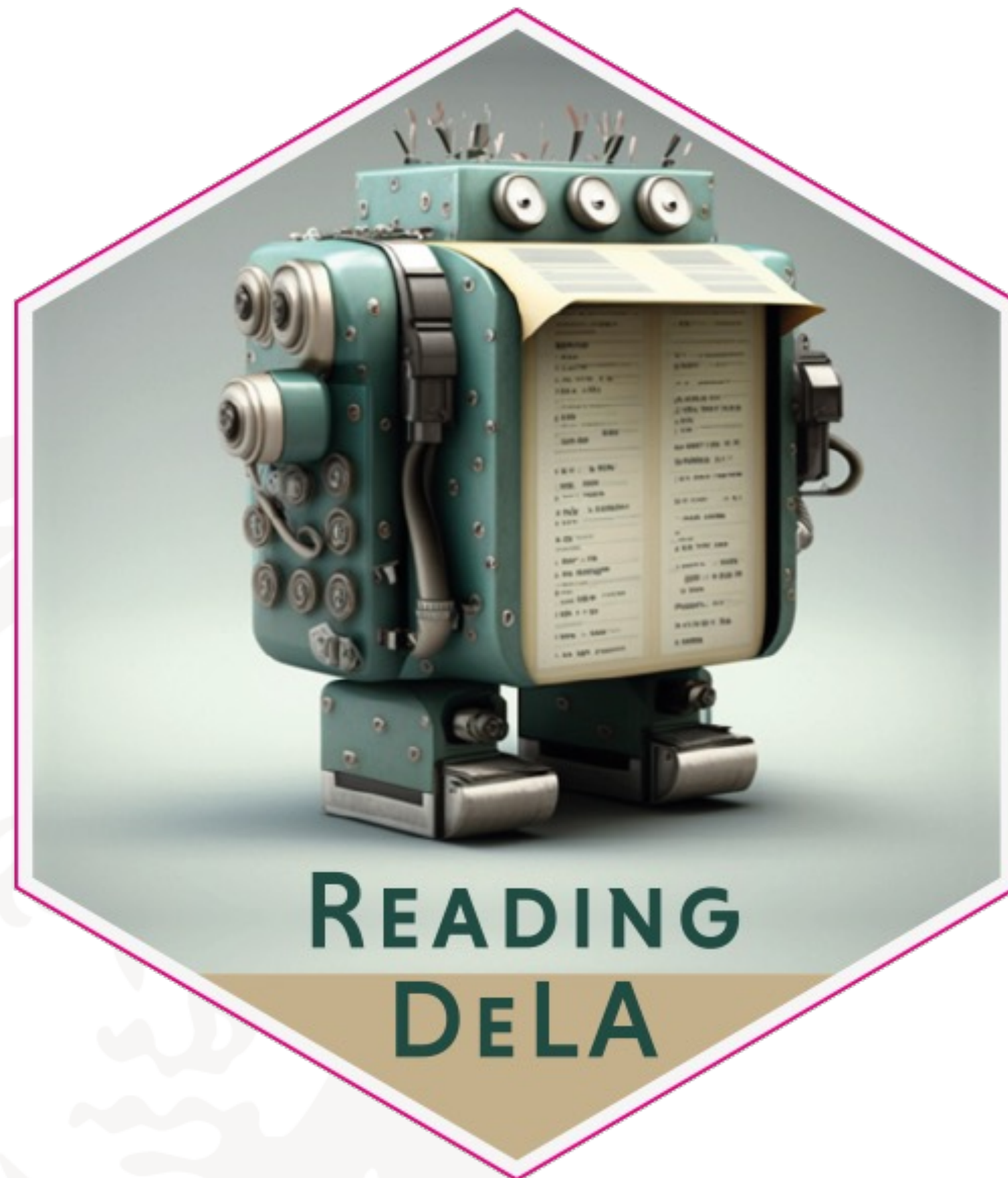
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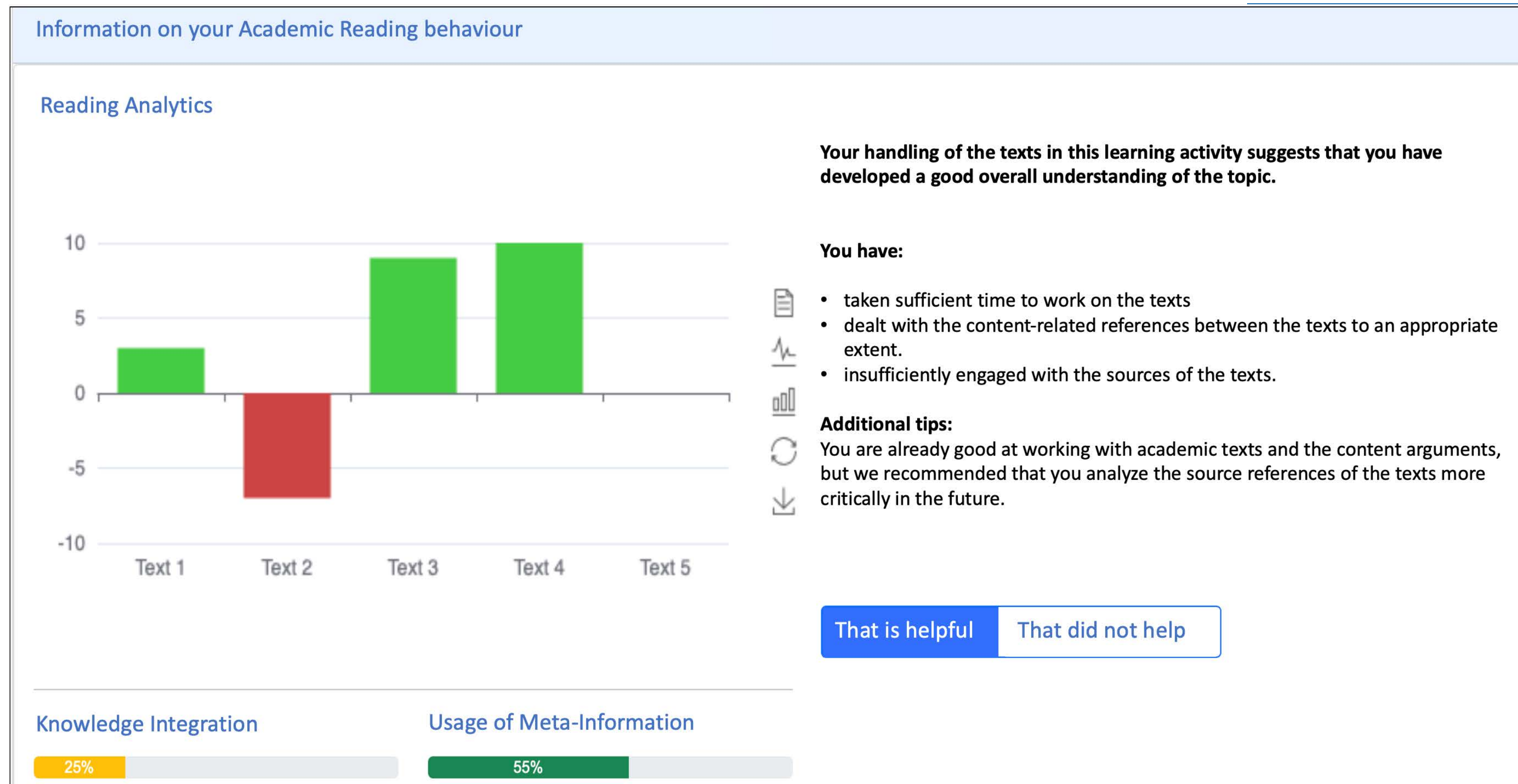
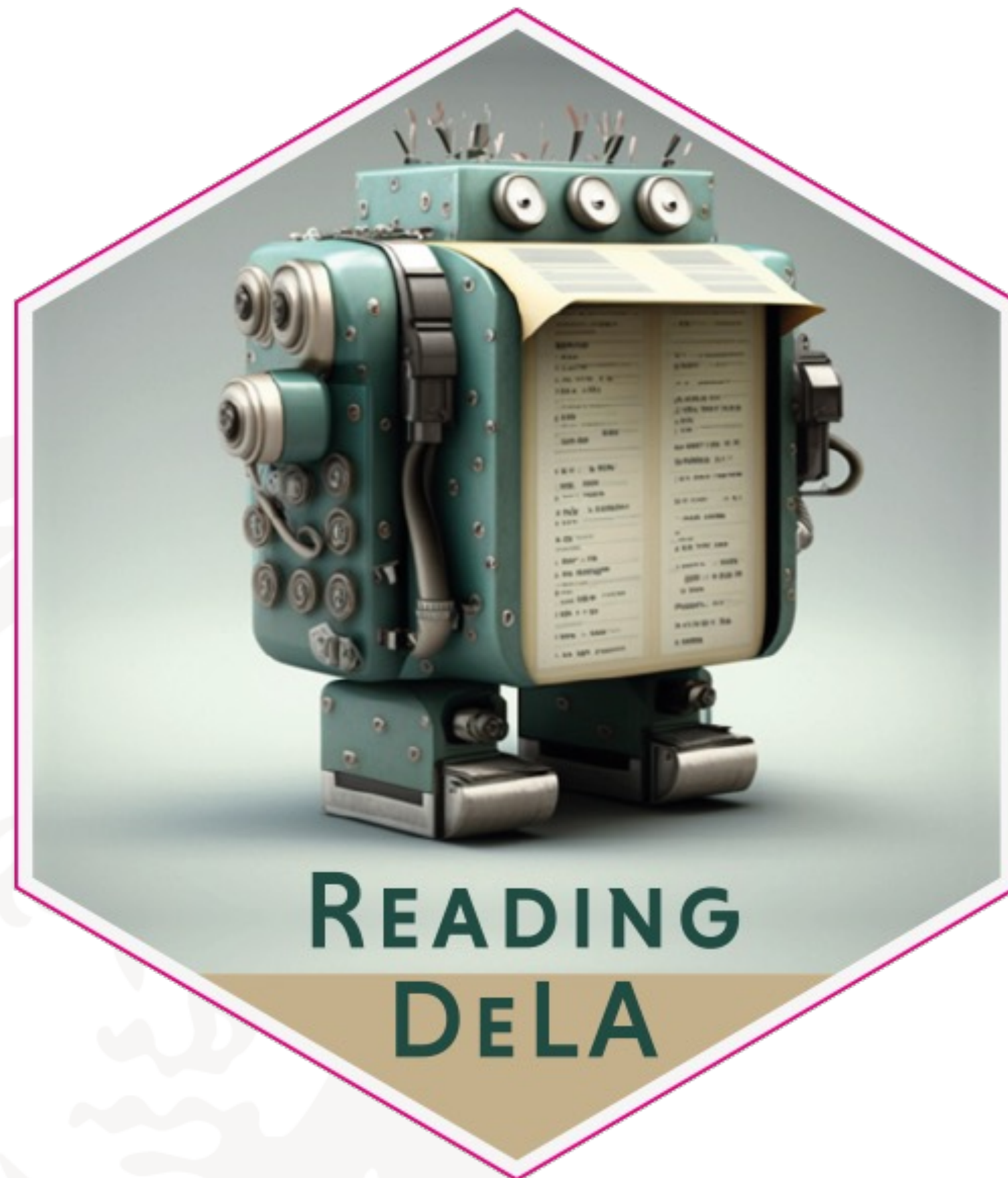


# Entwicklung von Data-enriched Learning Analytics (DeLA)



DeLA für die am häufigste vorkommenden Unterrichtsaktivitäten.







Sonne

Strahlungsenergie

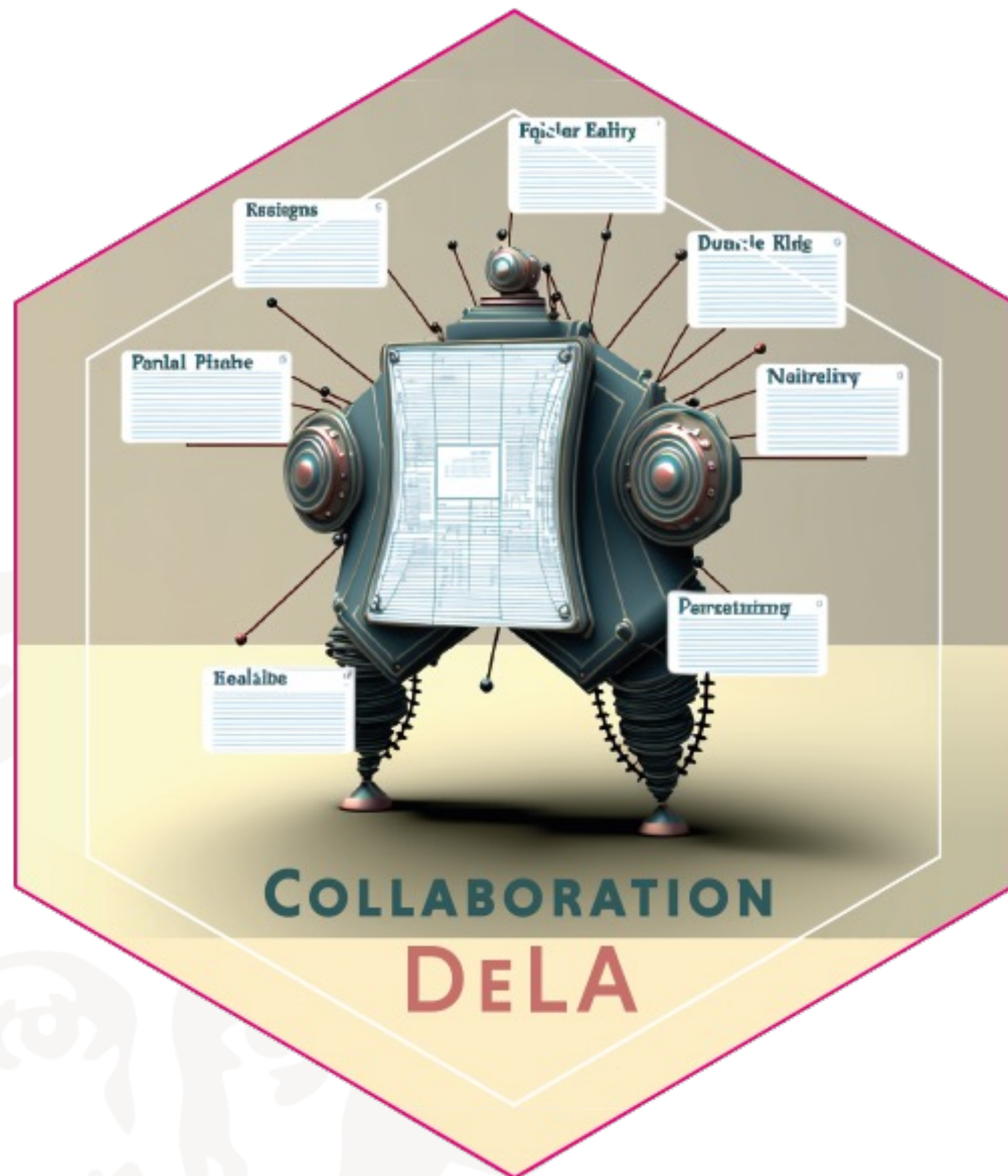
Prüfen

**Free text answer of students**



**Students Scores based on Learning Goals**

<input type="checkbox"/> Schüler*innen	Elektrische.. Avg: 38%	Strahlungse.. Avg: 44%	Umwandlung.. Avg: 38%	Erklären Avg: 44%	Versuche Pl.. Avg: 38%	Daten Auswe.. Avg: 50%	Energieform.. Avg: 0%	Umwandlung.. Avg: 0%	Alle goals
<input type="checkbox"/> Peter Kahn	<div style="width: 38%;"></div>	<div style="width: 44%;"></div>	<div style="width: 38%;"></div>	<div style="width: 44%;"></div>	<div style="width: 38%;"></div>	<div style="width: 50%;"></div>	<div style="width: 0%;"></div>	<div style="width: 0%;"></div>	57%
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Discussions List > View Topic Settings

## Introductions

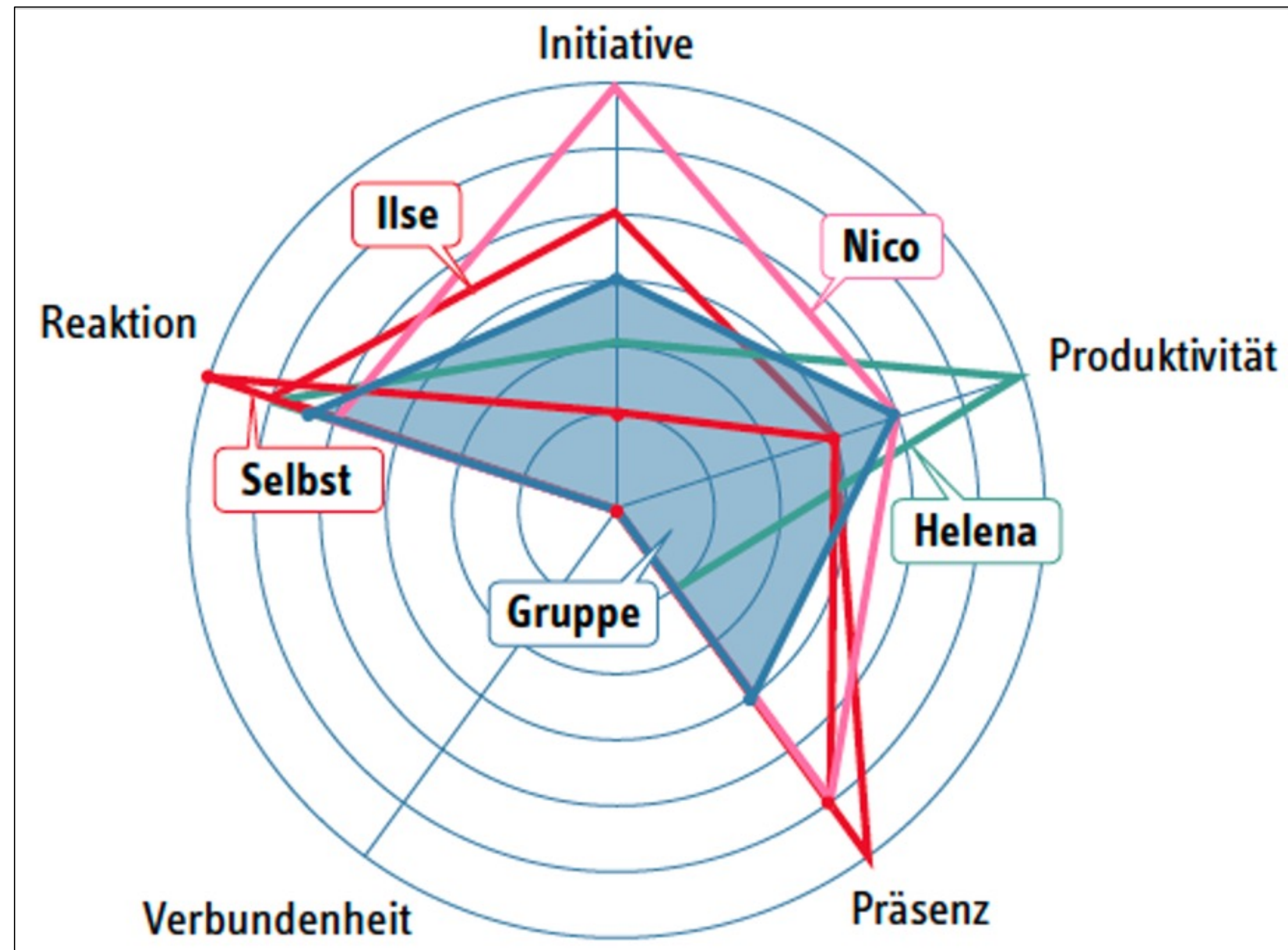
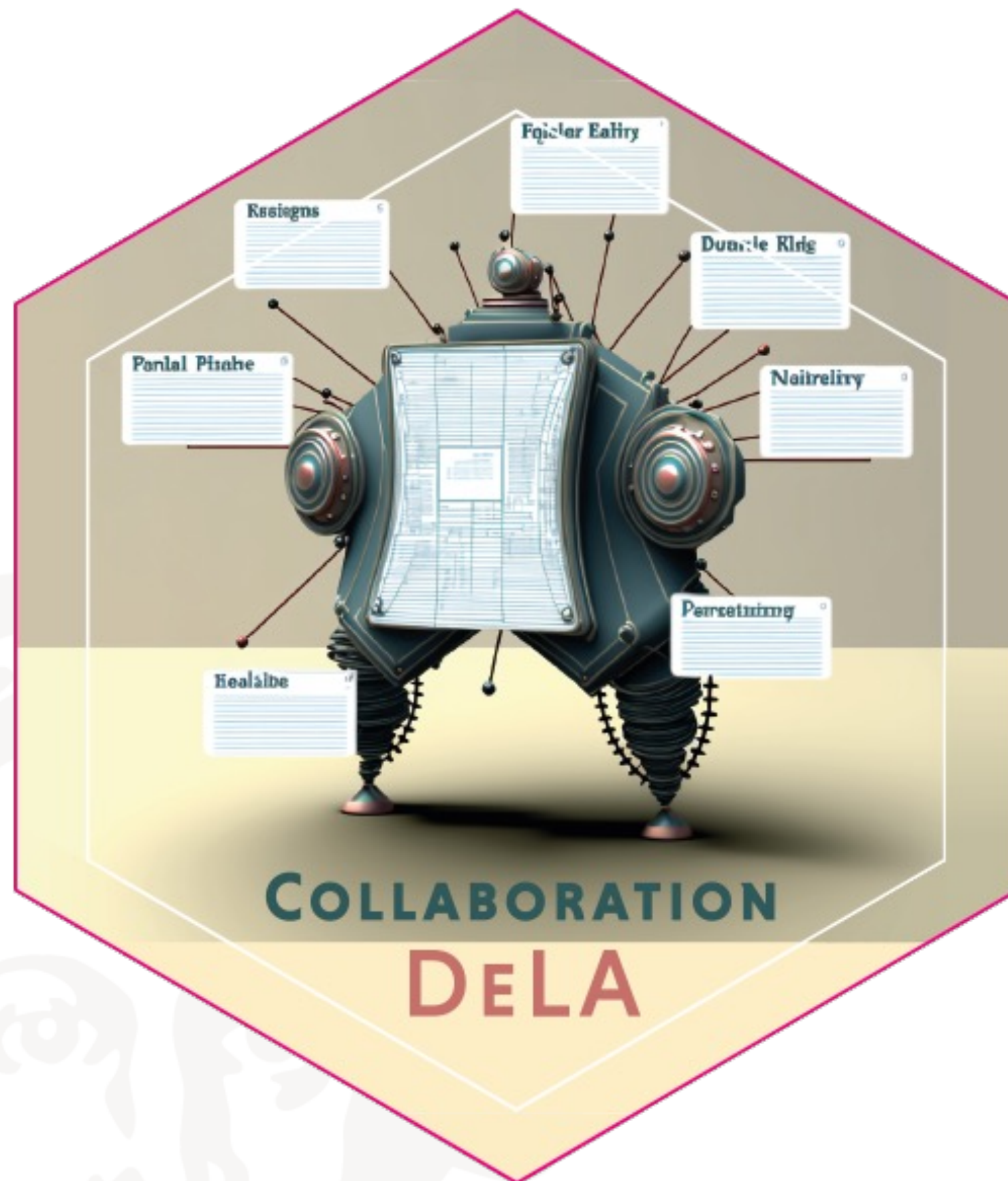
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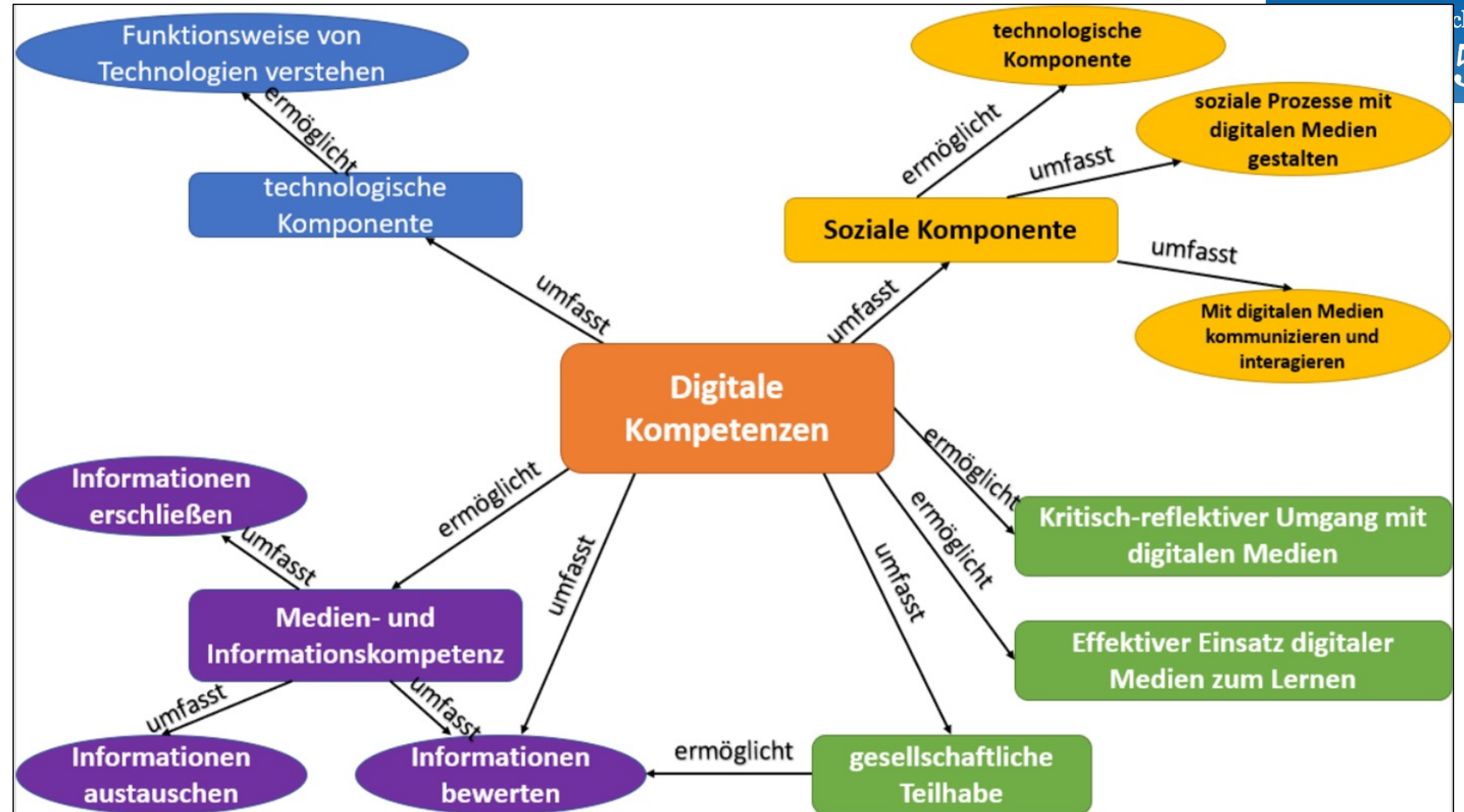
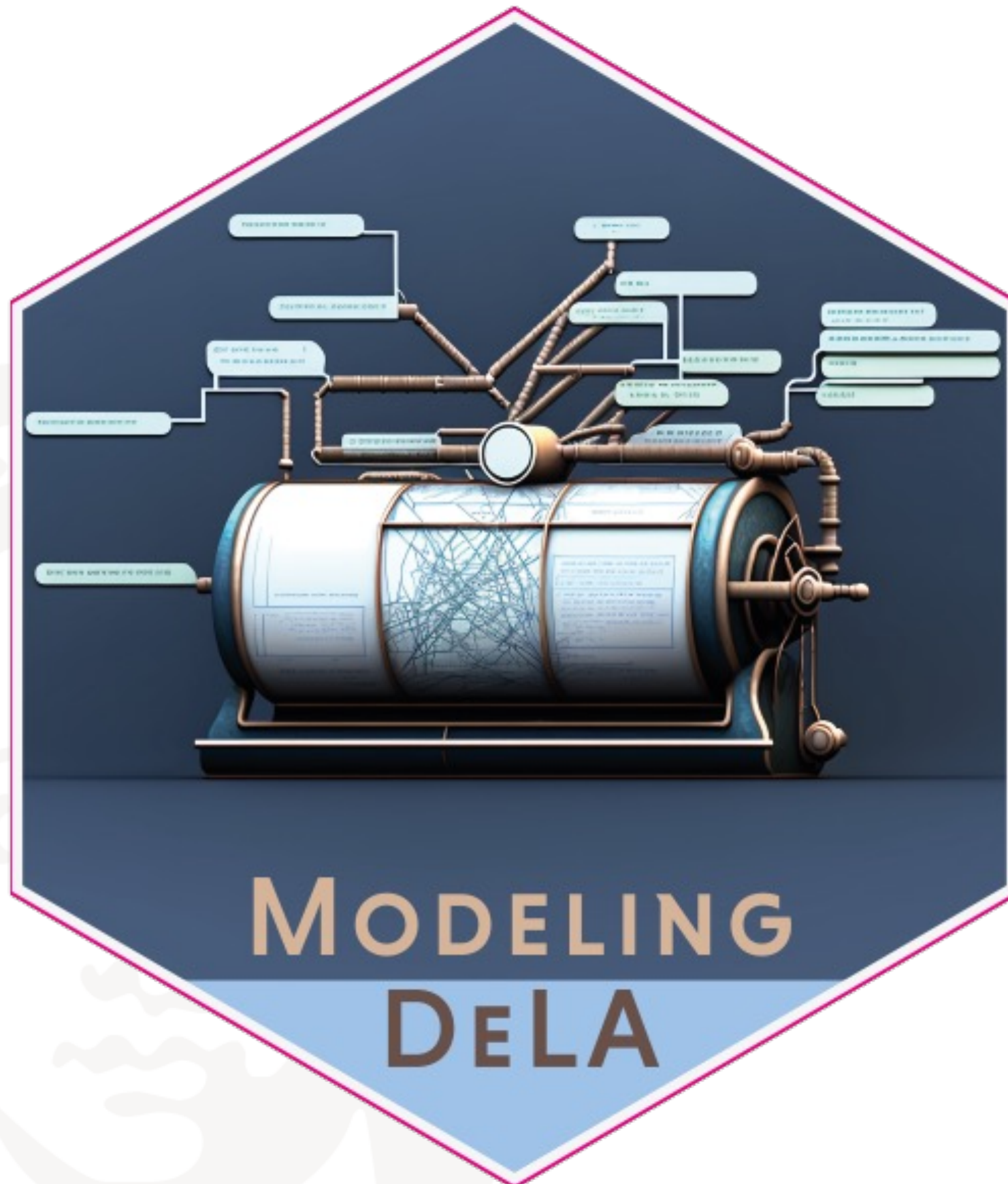
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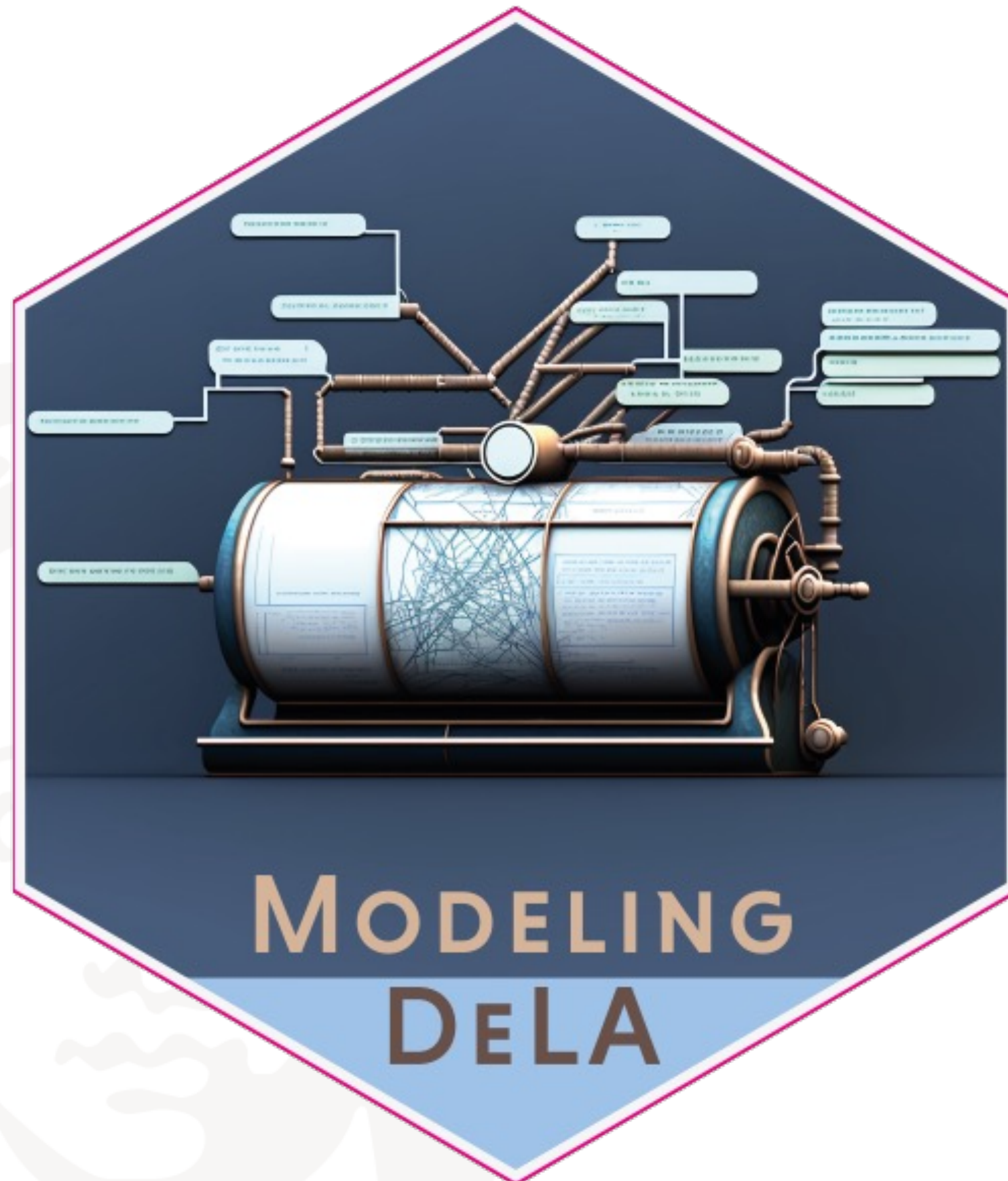
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	★	▼ My name is Cynthia	Cynthia Student	Jul 10, 2019 10:14 AM
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	★	My name is Cynthia	Evelyn Instructor	Jul 10, 2019 10:28 AM
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	★	▶ My name is Evelyn	Evelyn Instructor	Jun 12, 2019 9:54 AM

20 per page









## Feedback to your assignment

### CONTENT-BASED FEEDBACK

Amount of nodes	● 14 von 14
Amount of connections	● 15 von 13
Amount of correct labels	● 11 von 13
Comparison to master solution	● 73 %

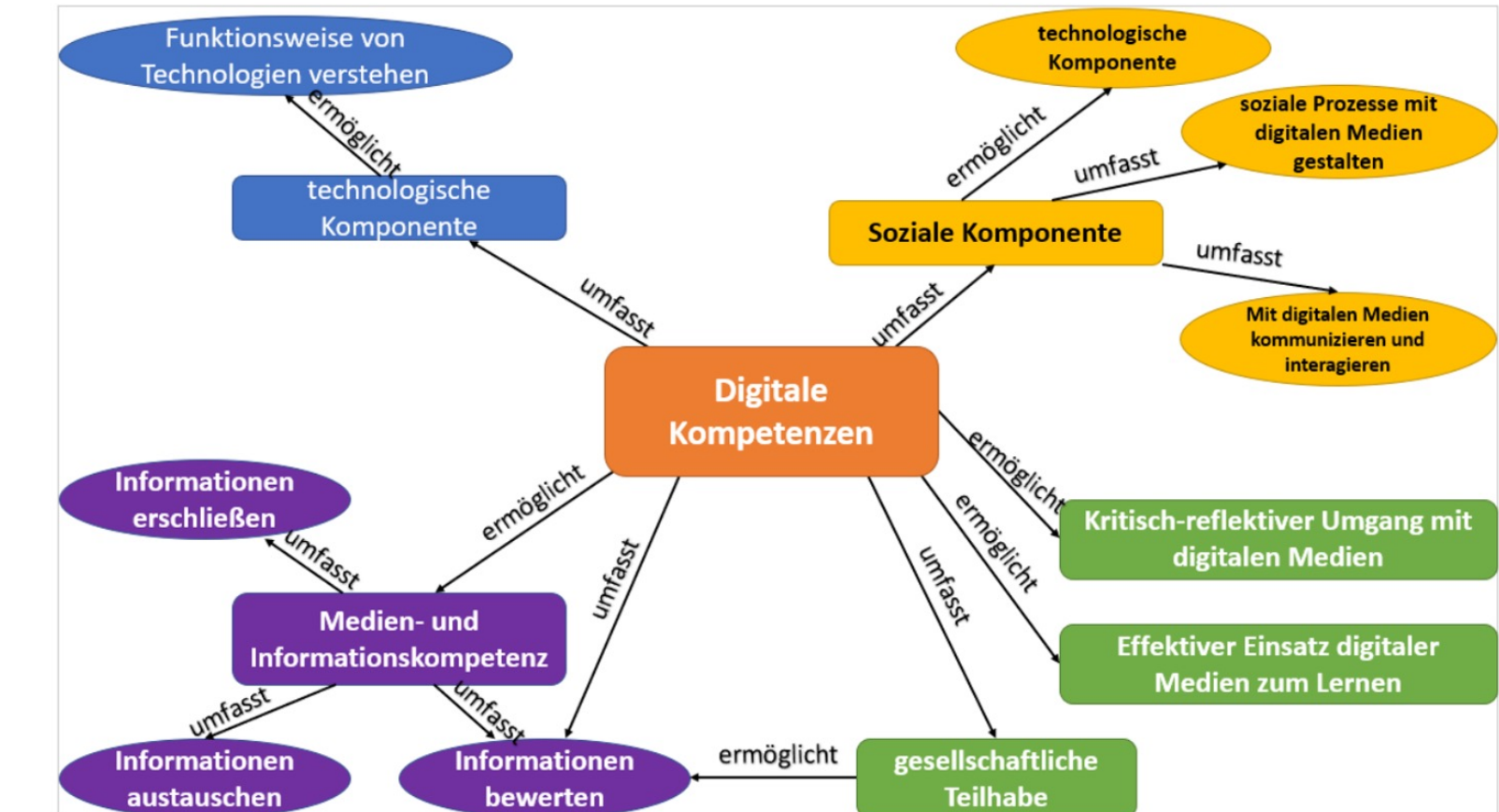
The assessment of your competences in learning activity 12:  
Digital media competences of pupils

Function of digital competences	● Good
Technological components	● Sufficient
Social components	● Good
Media- and Information competences	● Excellent

**Summary:** You still have some difficulties in classifying, differentiating and relating digital competences. The need for development is highest for technological components and functions of digital competences.

● Excellent | ● Good | ● Sufficient | ● insufficient

## Your assignment result



## PROCESS-ORIENTED FEEDBACK

	Own activity	Avg. of peer students	Avg. of peer students with correct solution
Editing-Sessions	7	10	8
Time invested	2,5 hours	3,1 hours	2,3 hours
Results controlled	2 times	3 times	3 times

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# Research Design for HILA & DeLAs

## Preparation phase

### Summer semester

Implementing LA and content in Moodle  
Consulting pilot partners

Preparing lecture/seminar

Instrument-development  
SRL, MSLQ, FL  
LPQ, MDC,  
align scales of psychometrics and LA

Implementing Surveys

## DMiU Zeitplan neu. Stand 06.10.2022

17.10.-24.10.22	24.10.-07.11.22	07.11.-21.11.22	21.11.-05.12.22	05.12.-19.12.22	19.12.22-16.01.23 <i>Winterpause!</i>	16.01.-23.01.2023	23.01.-06.02.23	06.02.-13.02.23
1 Woche	2 Wochen	2 Wochen	2 Wochen	2 Wochen	2 Wochen + Winterferien	1 Woche	2 Wochen	1 Woche
Prä	L1	LE2	LE3	LE4	LE5	Post	LE6	LE7
	5 Texte	3 Texte	5 Texte	Foliensatz	3 Texte		2 Texte	Aktuelle Forschung zu Themen des Seminars
		3 Videos		VL Aufz.	3 Videos		2 Videos	
		Forum	Concept-Map	Forum	Concept-Map		Activity-Annotation	TN an Studien



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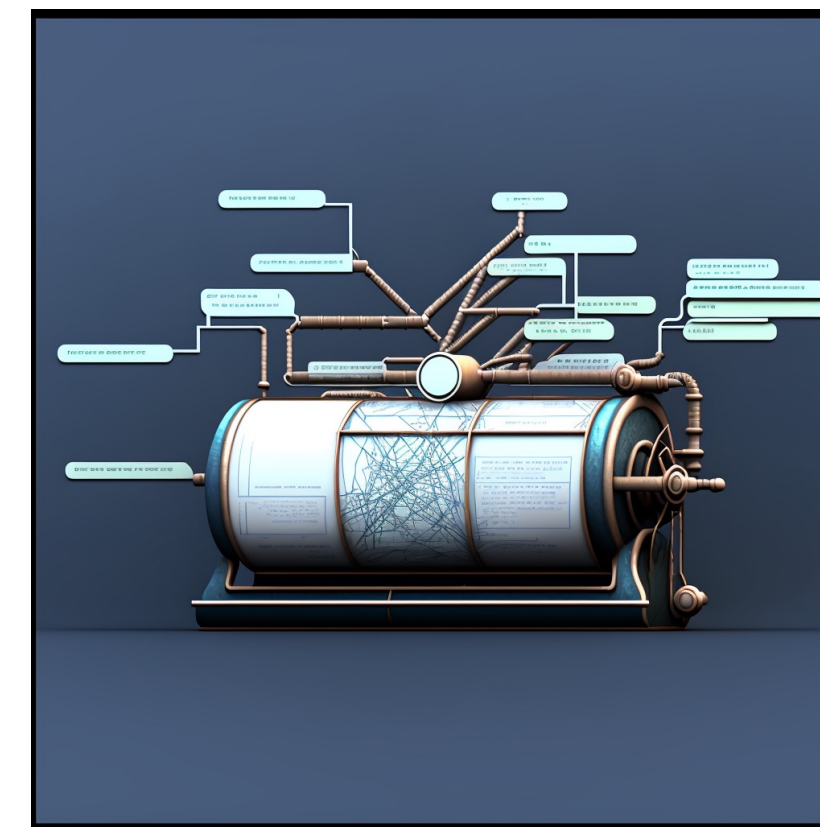
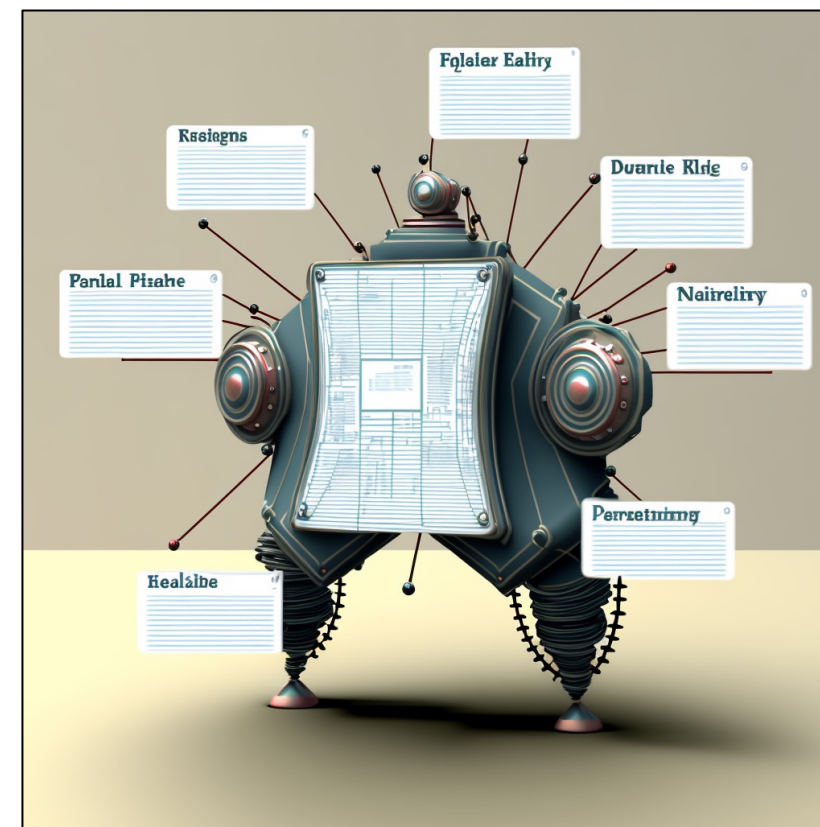
## DMiU Zeitplan neu. Stand 06.10.2022

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1 Woche	2 Wochen	2 Wochen	2 Wochen	2 Wochen	2 Wochen + Winterferien	1 Woche	2 Wochen	1 Woche
Prä	L1	LE2	LE3	LE4	LE5	Post	LE6	LE7
	5 Texte	3 Texte	5 Texte	Foliensatz	3 Texte		2 Texte	Aktuelle Forschung zu Themen des Seminars
		3 Videos		VI Aufz.	3 Videos		2 Videos	
		Forum	Concept-Map	Forum	Concept-Map		Activity-Annotation	TN an Studien

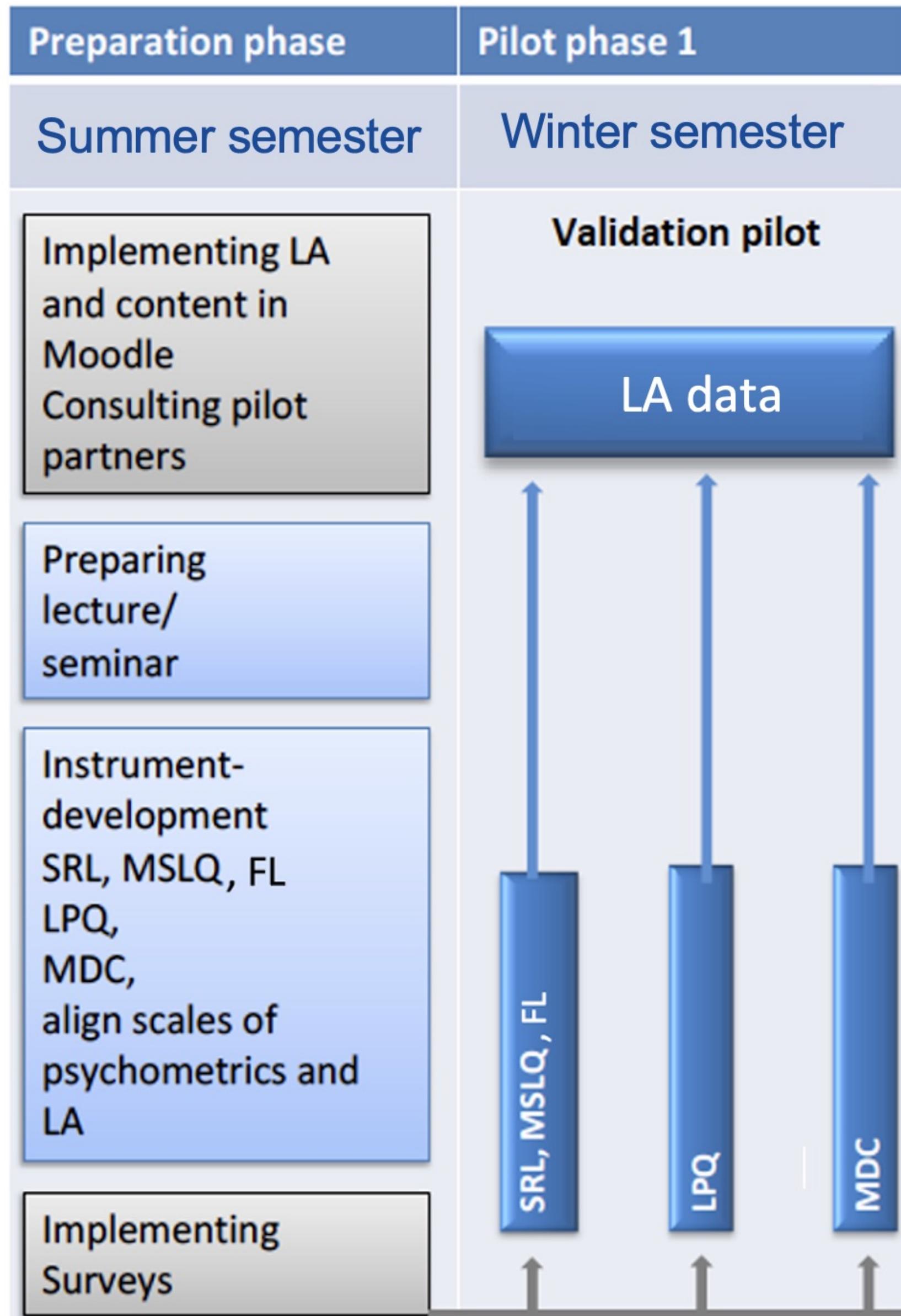


forschung

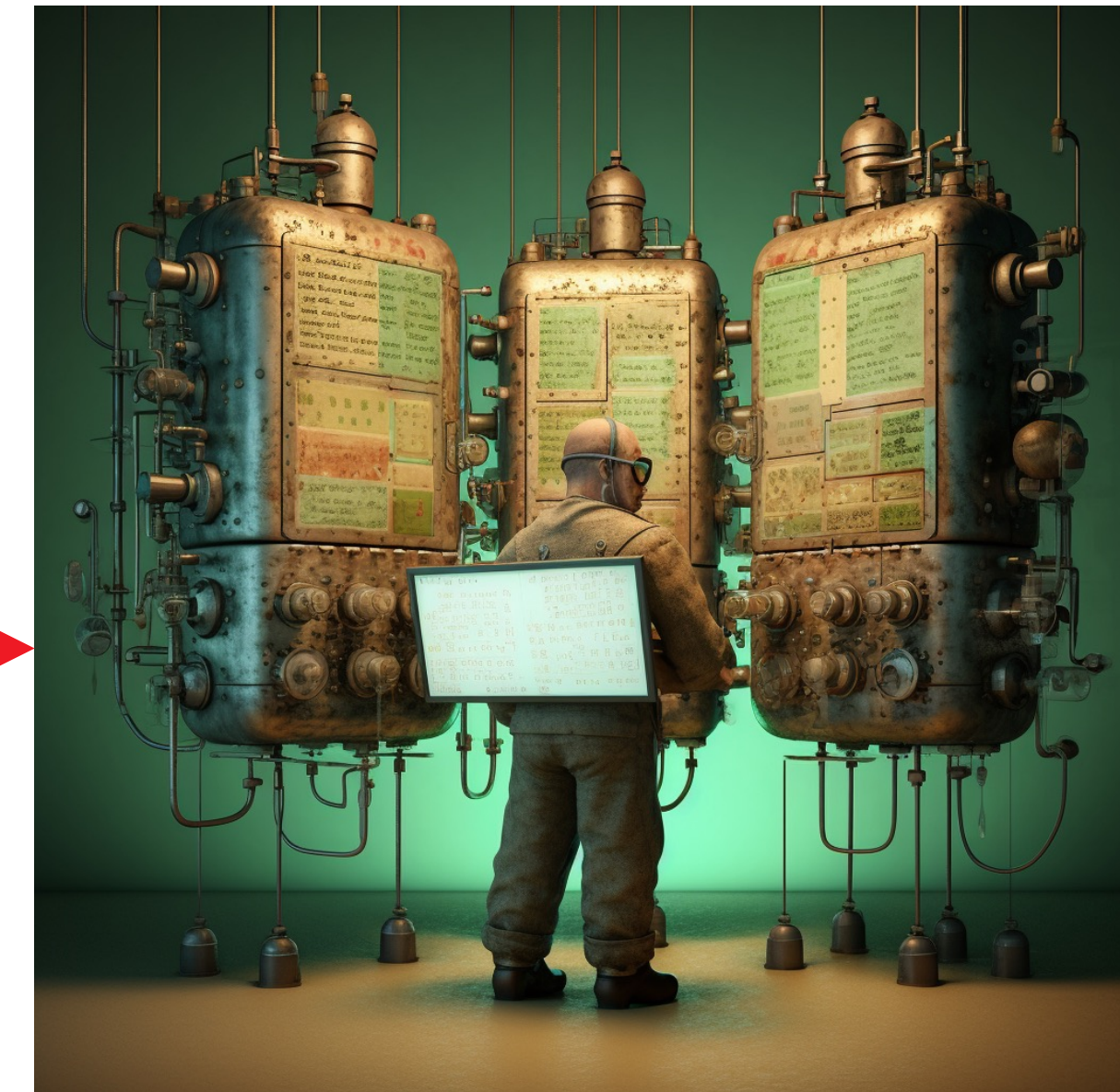
hologie  
5



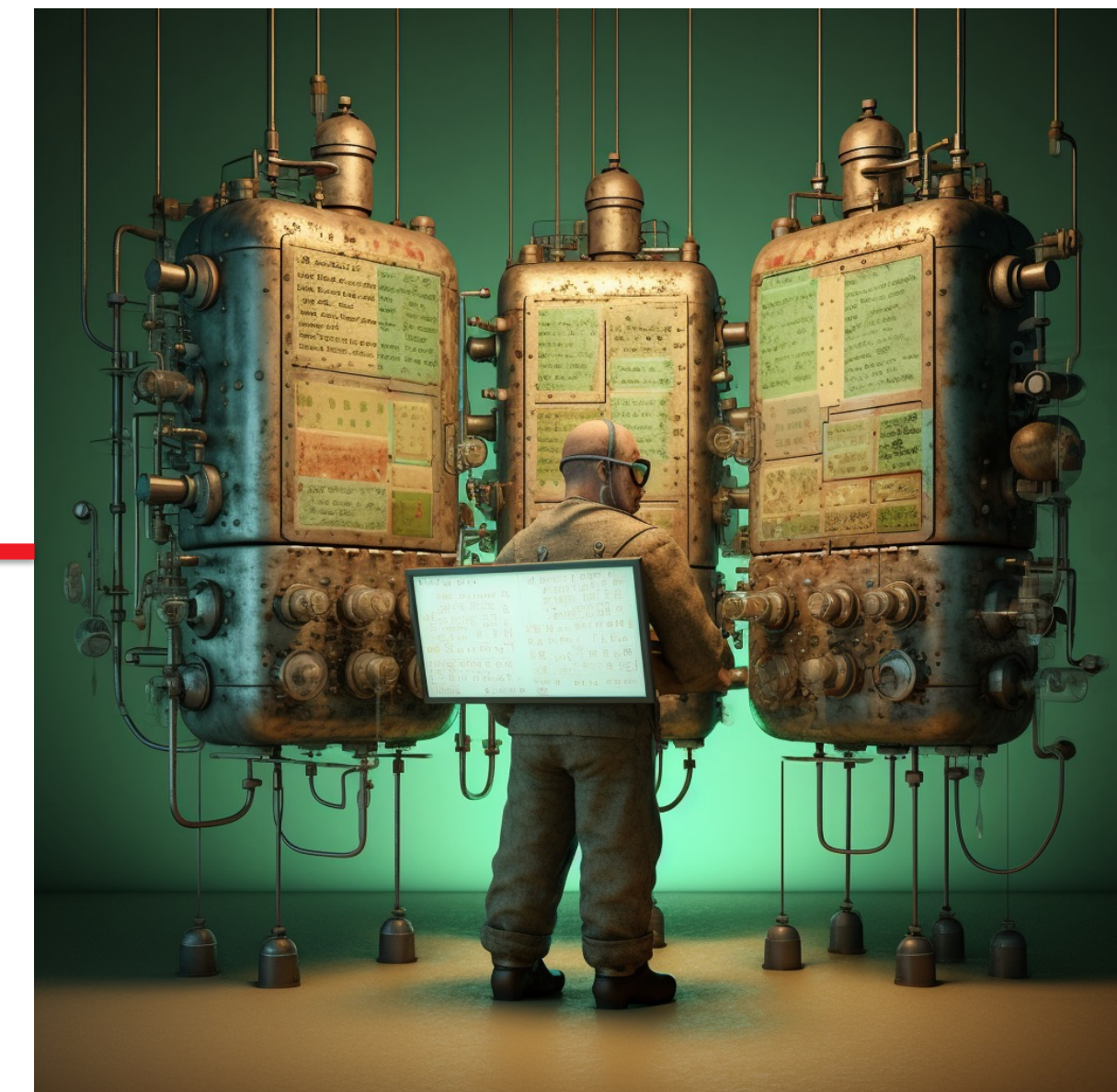
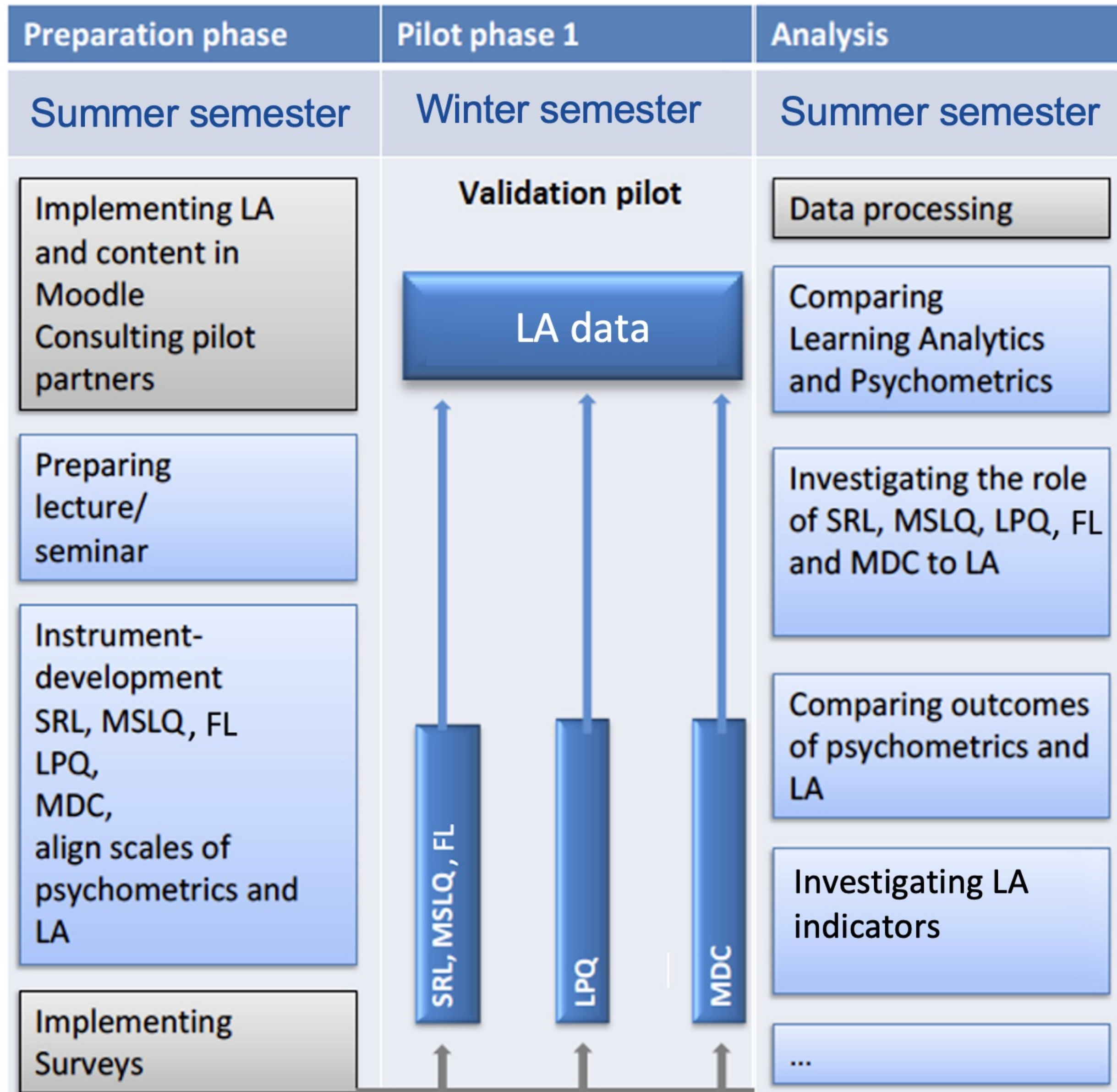
# Research Design for HILA & DeLAs



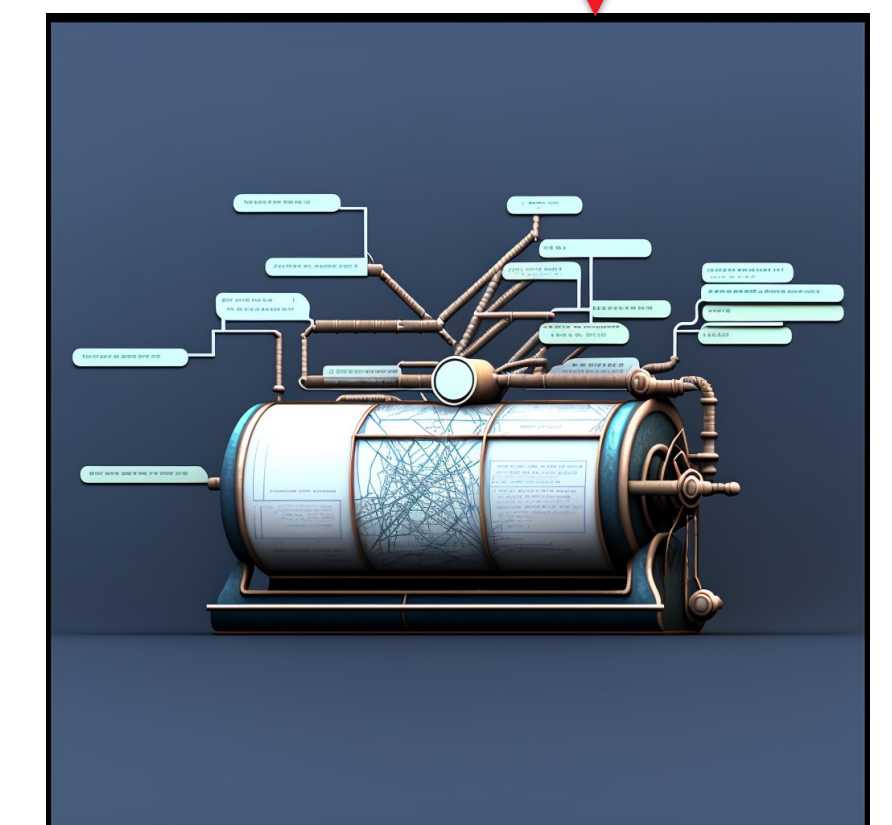
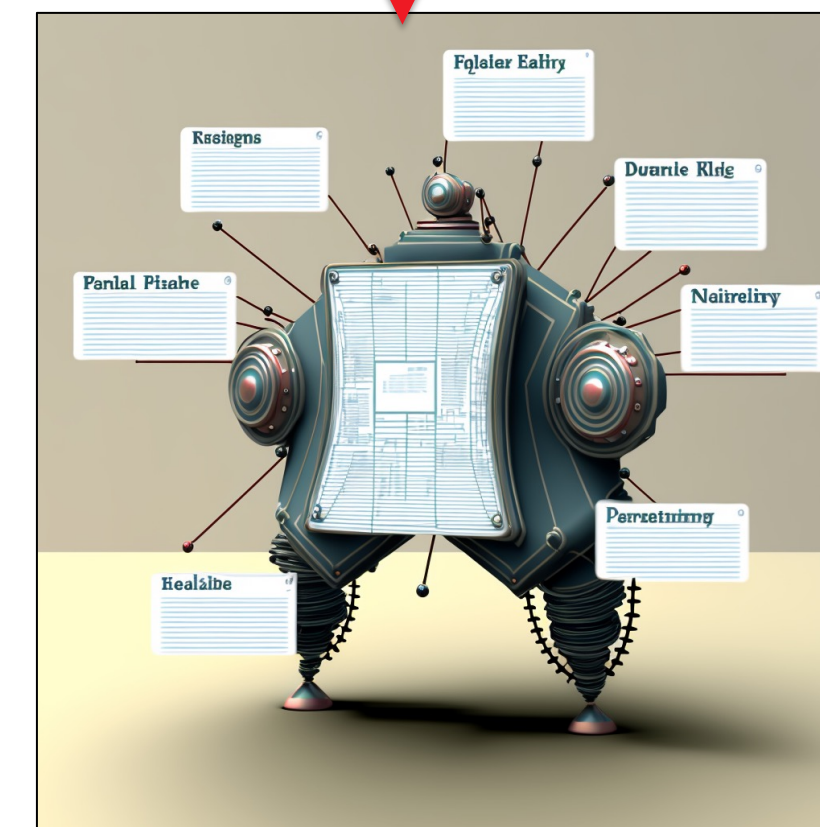
Data Collection



# Research Design for HILA & DeLAs

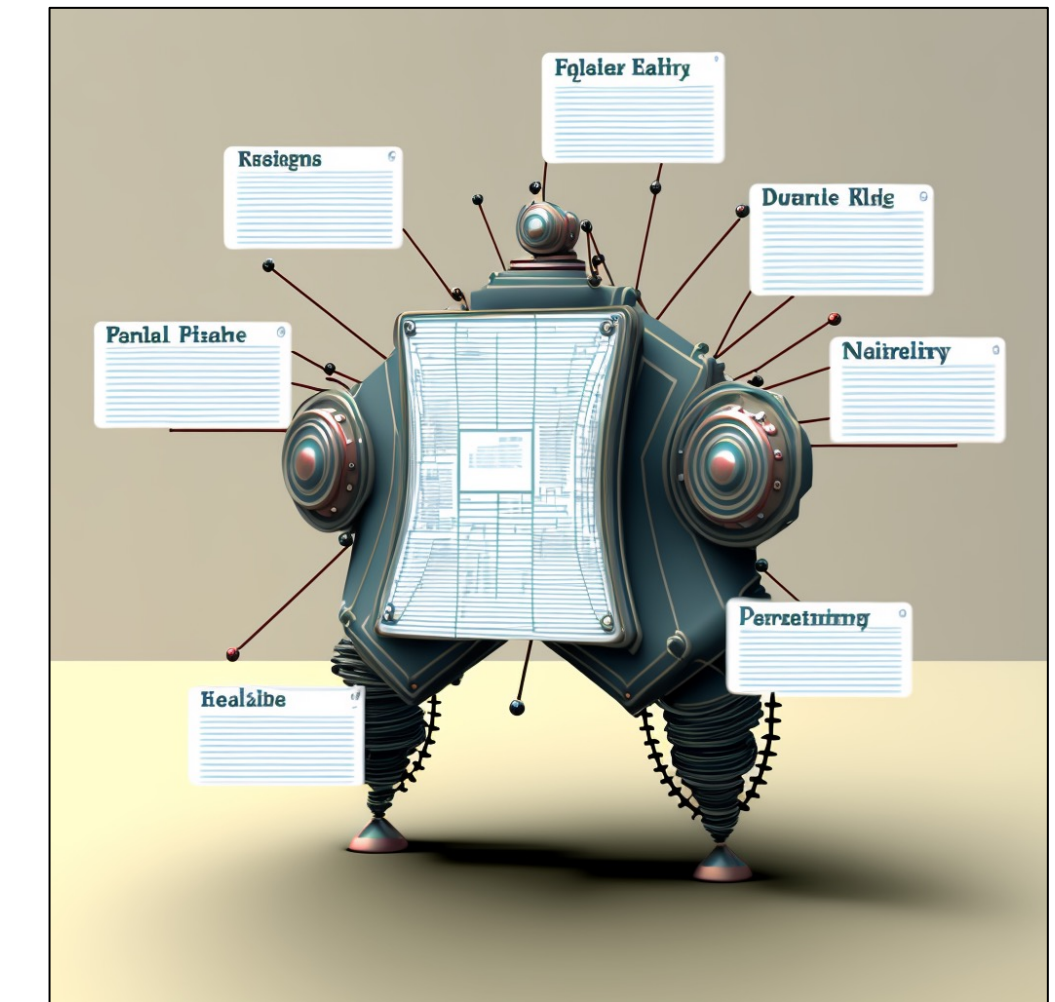
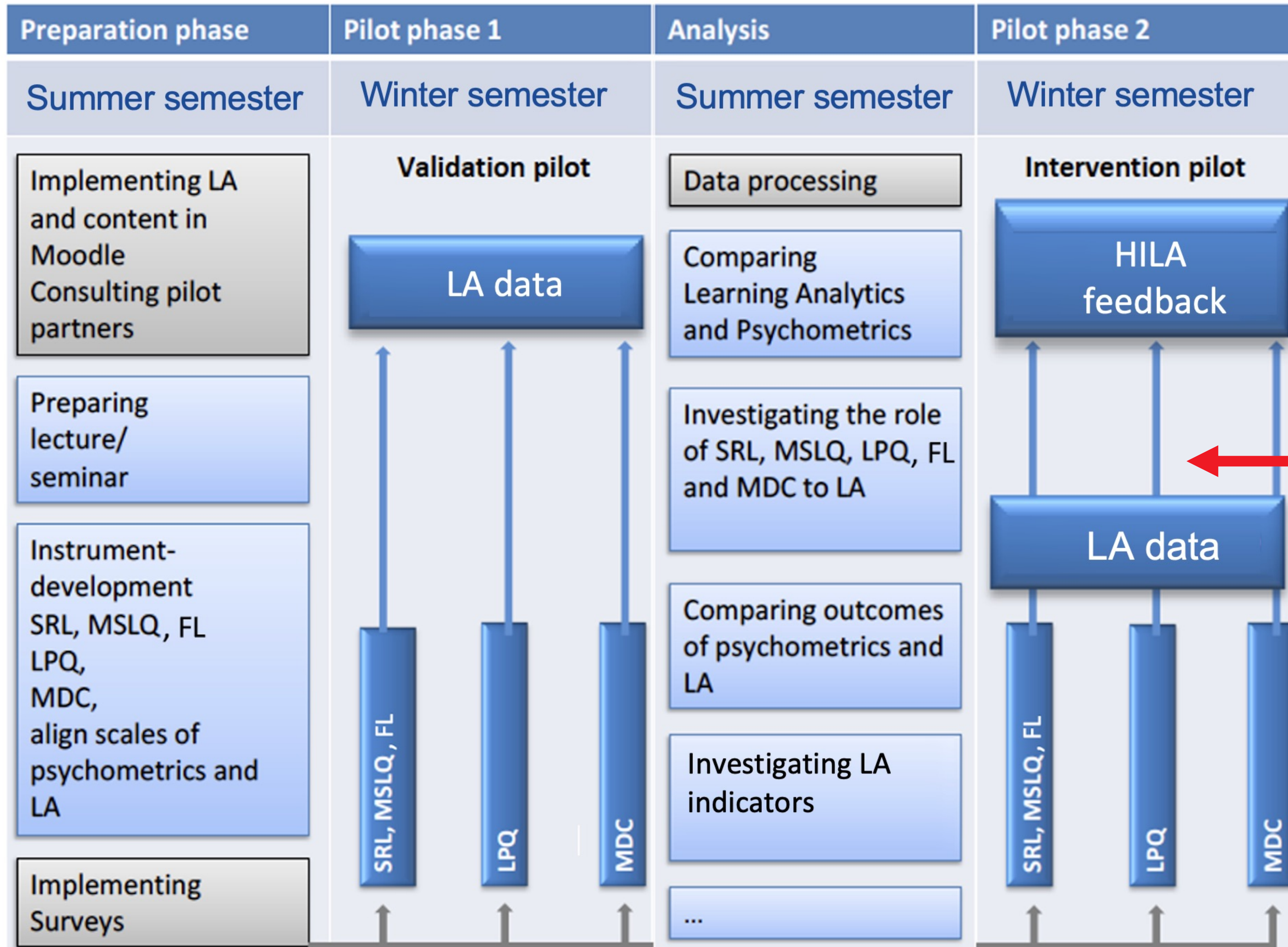


## Training of AI

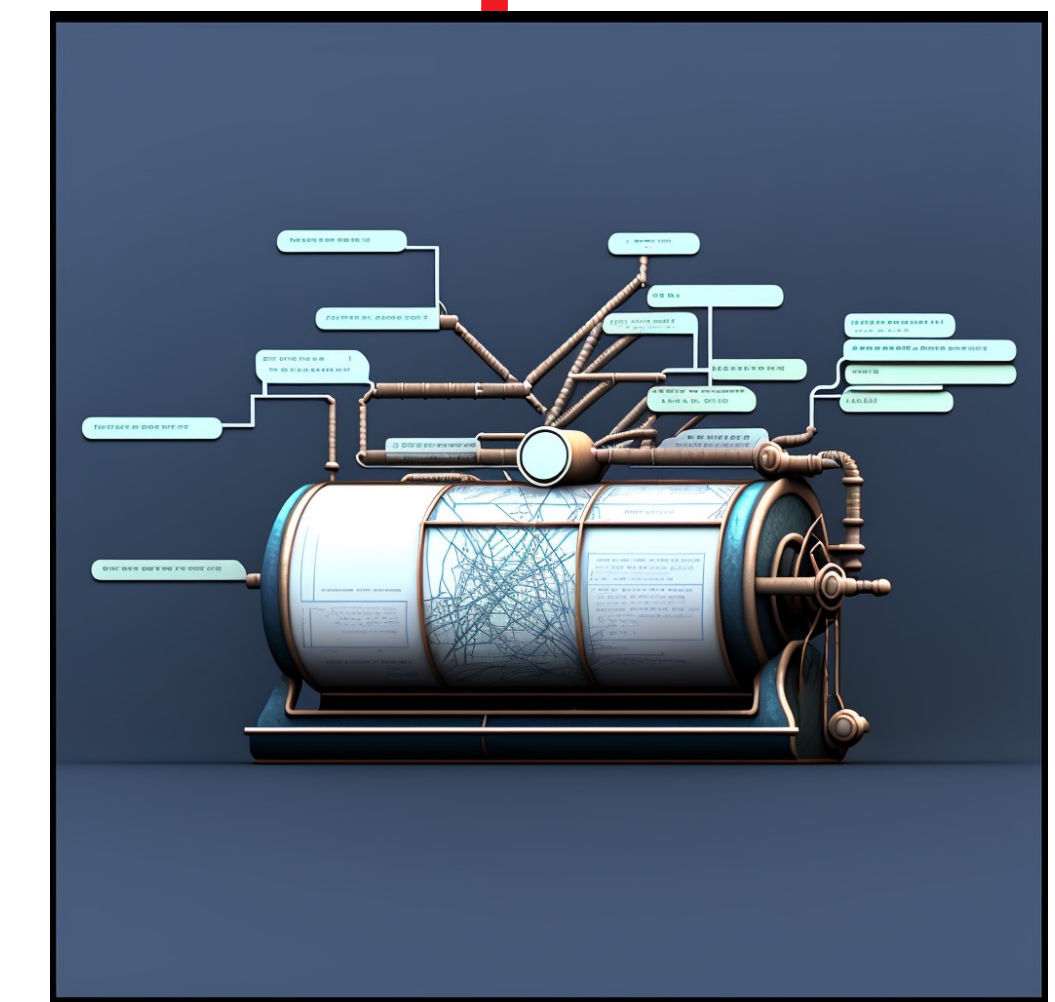




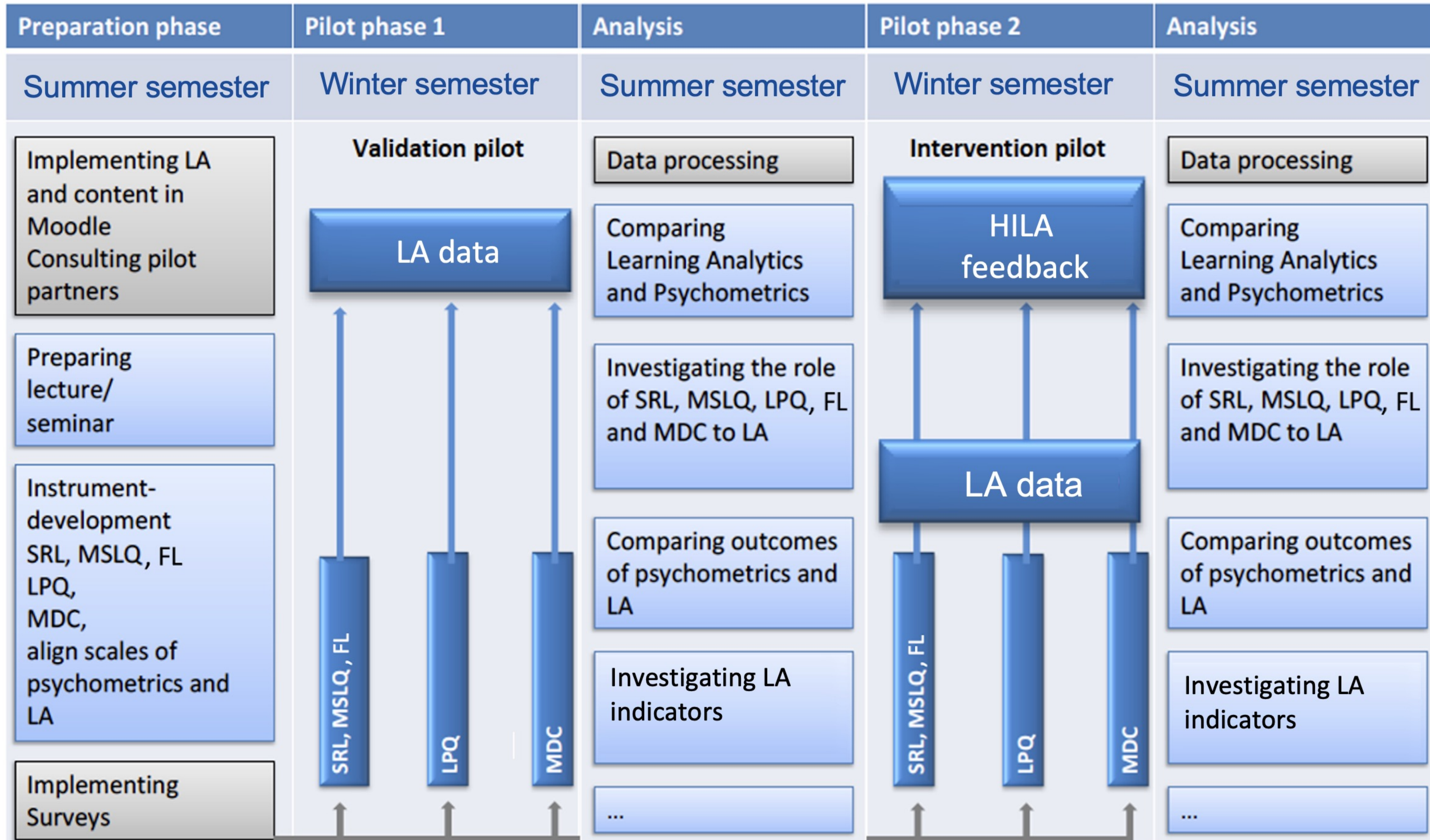
# Research Design for HILA & DeLAs



Feedback



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# HILA: Take away messages



## 1. Interdisziplinäre Zusammenarbeit

Verbindung von Unterrichtswissenschaften, Informatik und Bildungspraxis notwendig zur Schaffung für nachhaltigen Mehrwerte & Plattformen für die Bildungsakteure.

## 2. Forschungstransfer

Notwendigkeit der Zusammenarbeit mit Praktikern für ökologisch valide Ergebnisse.

## 3. Authentische Daten

Maschinelles Lernen bedarf authentischer und aussagekräftiger Daten für Lernprozesse von SuS.

Vielen Dank für Ihre Aufmerksamkeit.  
Fragen jetzt oder später?



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