Design, Entwicklung und Evaluation hochinformativer Learning Analytics.

Prof. Dr. Hendrik Drachsler

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Research Professor
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https://www.studiumdigitale.uni-frankfurt.de | www.edutec.science

SMS - transfer process

Scouting

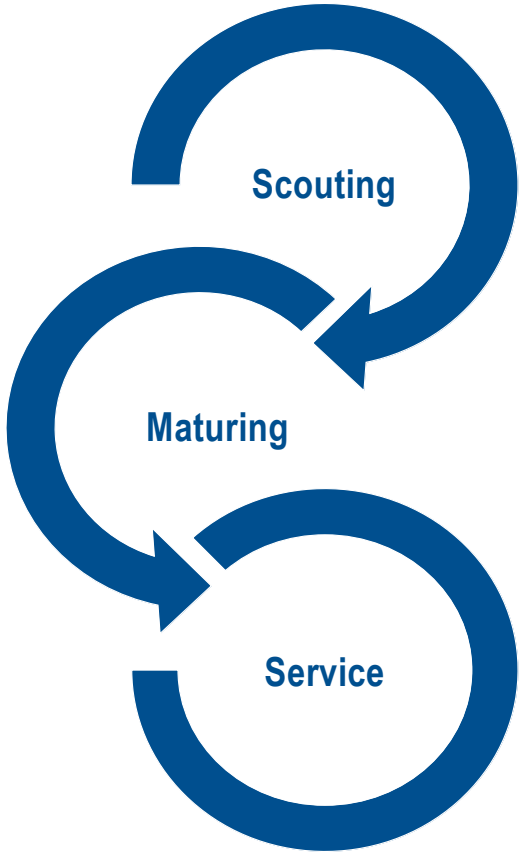
Identify, evaluate and test new with regard to possible application scenarios, conditions, opportunities and risks

Maturing

User-centred maturing process on the basis of practice-oriented iteration cycles

Service

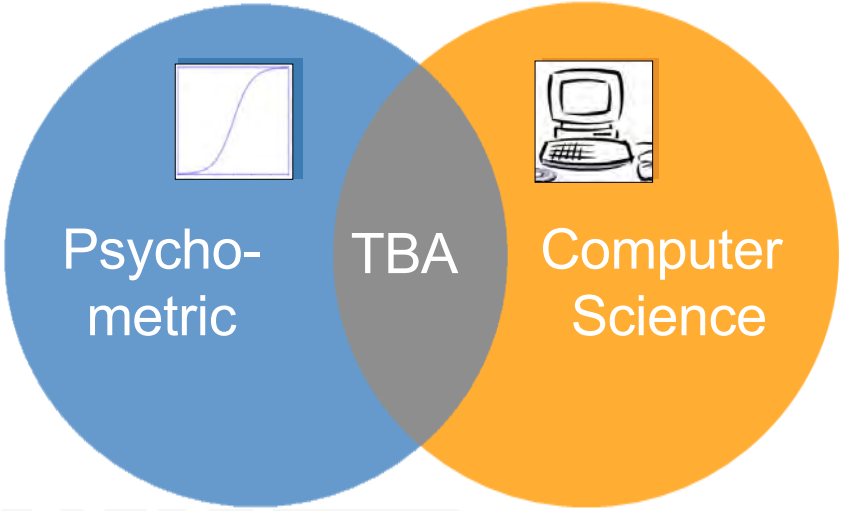
Creation of a low-threshold, streamlined and integrated service offers



SMS – transfer process

Prof. Dr. Frank Goldhammer

Dr. Daniel Schiffner



Frankfurter Allgemeine

Beruf & Chance

VERSTECKTE QUALIFIKATIONEN

Wie Flüchtlinge ihre Fähigkeiten beweisen sollen

VON NADINE BÖS - AKTUALISIERT AM 14.03.2018 - 19:59

Kein Zeugnis, kein Zertifikat und trotzdem viel Erfahrung im Auto-Schrauben? Solche versteckten Qualifikationen legt ein neuer Test offen.

SMS – transfer process

MYSKILLS
BERUFLICHE KOMPETENZEN ERKENNEN

Bundesagentur für Arbeit
Agentur für Arbeit
bringt weiter.

Beruf KFZ-Mechatroniker/-in
Ergebnisübersicht MYSKILLS

Name: @#Kundenname
Geburtsdatum: @#Kundengebda **Test-ID:** 12345678901234567890123 4
Kd.-Nr.: @#Kundennummer **Testort:** aäüüßööÄÜÖ
DSt.-Nr.: 5555 **Testdatum:** 12.02.2018 **Testsprache:** Deutsch

Der Test erfasst berufliches Handlungswissen in fünf zentralen Handlungsfeldern des Berufs KFZ-Mechatroniker/-in. Die Testung erfolgt durch Fragen zu berufstypischen Handlungssituationen am Computer. Die Handlungsfelder und -situationen sind aus den maßgeblichen Ausbildungsordnungen und Rahmenlehrplänen abgeleitet. Nachfolgend die Ergebnisse:

Berufliches Handlungswissen: Hohes; Mittleres bis hohes; Mittleres; Nicht nachweisbares bis mittleres; Nicht nachweisbares

MUSTER

Standardisierte Service- und Wartungsarbeiten durchführen
Standardisierte Service- und Wartungsaufgaben an Kraftfahrzeugen durchführen. Motoröl und Räder wechseln. Mechanische und elektrische Bauteile auf Verschleiß, Beschädigung und Funktion überprüfen

Verschleißbehaftete mechanische und elektrische Systeme instand setzen
Bremse, Abgasanlagen und Kupplung instand setzen. Die Beleuchtungsanlage, die Scheibenwischanlage und das Startsystem prüfen, messen und reparieren.

Mechanische und elektrische Systeme montieren und demontieren
Räder montieren und wuchten. Den Spurstangenkopf, die Zentralverriegelung, den Luftmassenmesser und den Injektor ersetzen. Die Anhängerkupplung nachrüsten.

Mechatronische Systeme reparieren
Airbags, Klimaanlagen, Luftfahrwerk und Automatikgetriebe prüfen und reparieren. Gefahren durch explosive Stoffe und elektrische Spannungen erkennen. Messungen, beispielsweise mit einem Oszilloskop, durchführen und die Ergebnisse beurteilen.

Fahrzeugsysteme mit Expertensystemen diagnostizieren
Mit einer Prüfsoftware eine geführte Fehlersuche durchführen. Fehler mit Messgeräten sowie Schalt- und Funktionsplänen bearbeiten und diagnostizieren, welche Bauteile oder Systeme nicht mehr funktionieren. Die Datenkommunikation zwischen Steuergeräten erfassen und bewerten. Gesetzlich vorgeschriebene Prüfungen (HU/AU) durchführen.

Hier finden Sie Beispiele für Testergebnisse der folgenden Berufe:

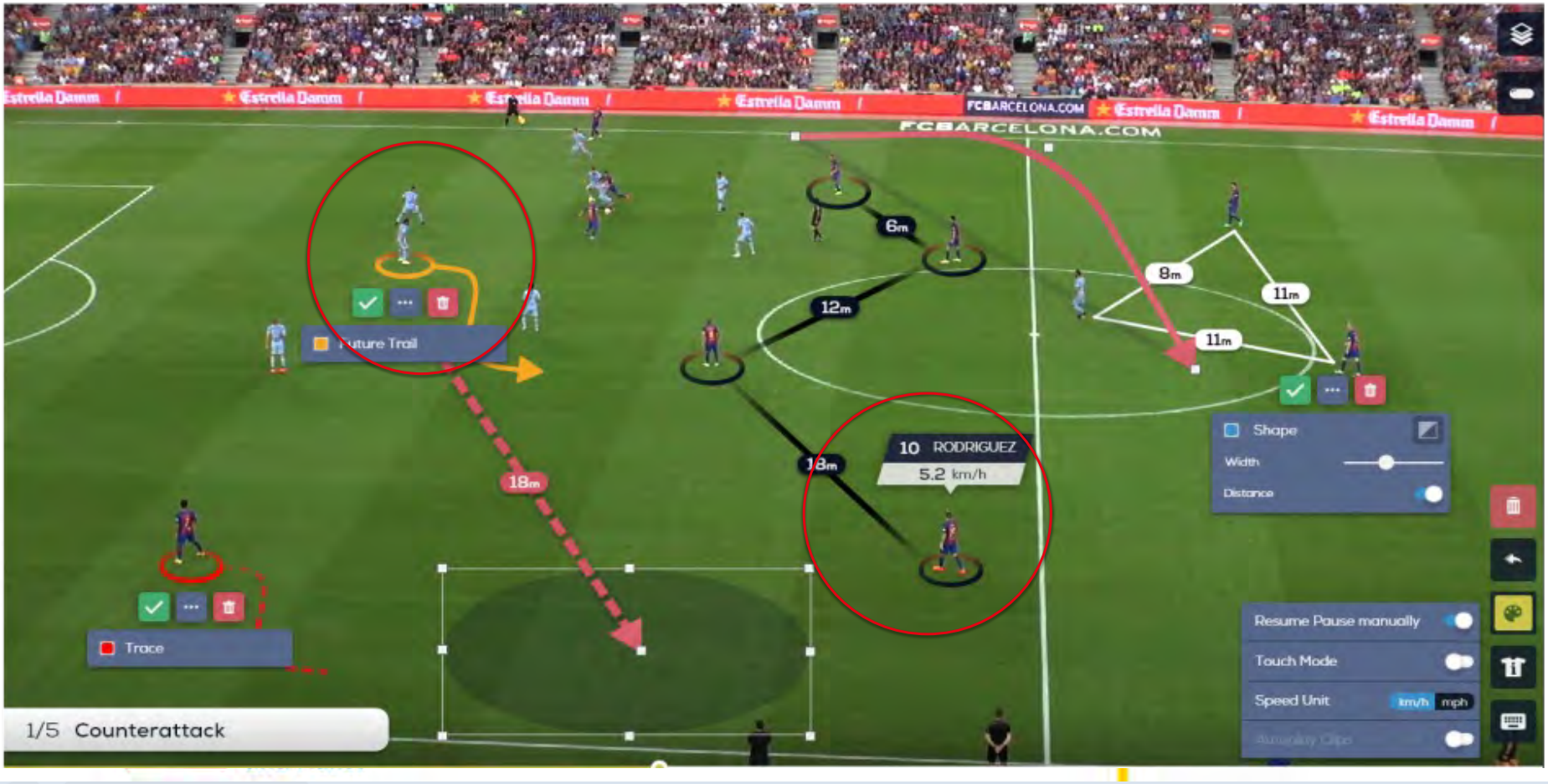
Kfz-Mechatroniker - PKW-Technik	Download	Fachkraft für Metalltechnik - Fachrichtung Konstruktionstechnik	Download
Verkäufer	Download	Hochbaufacharbeiter - Schwerpunkt Maurerarbeiten	Download
Landwirt	Download	Tischler	Download
Koch	Download	Bauten- und Objektbeschichter (Maler)	Download

BertelsmannStiftung

Outline

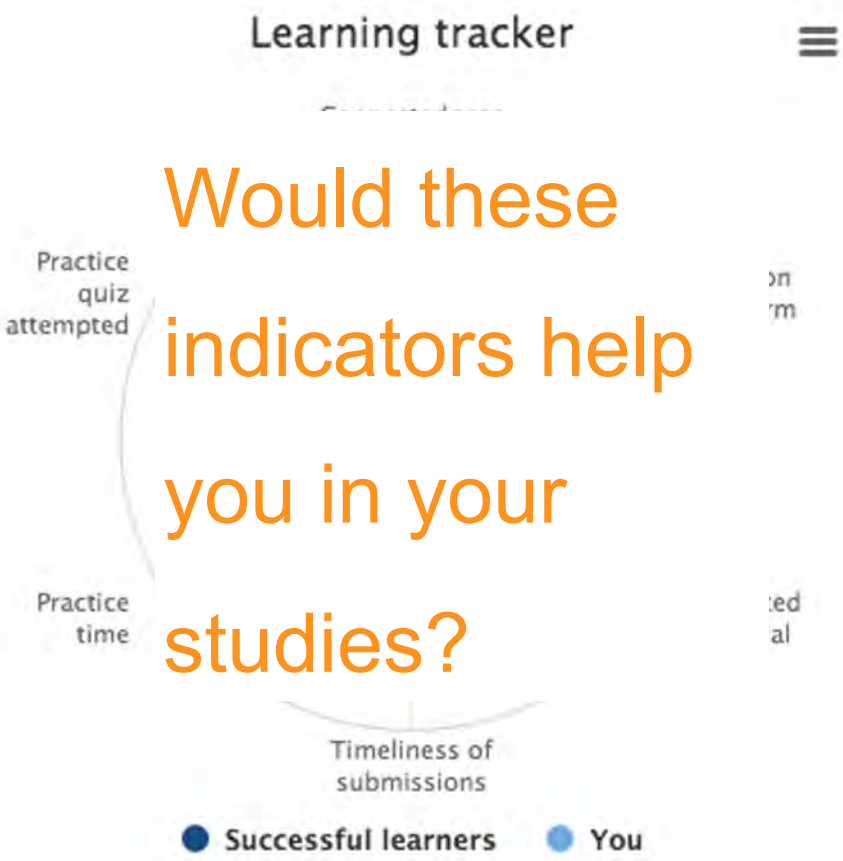
1. Motivation
2. Highly Informative Learning Analytics (HILA)
3. Design for Learning
4. Data-enriched Learning Analytics (DeLA)
5. Evaluation of DeLAs
6. Take away messages

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

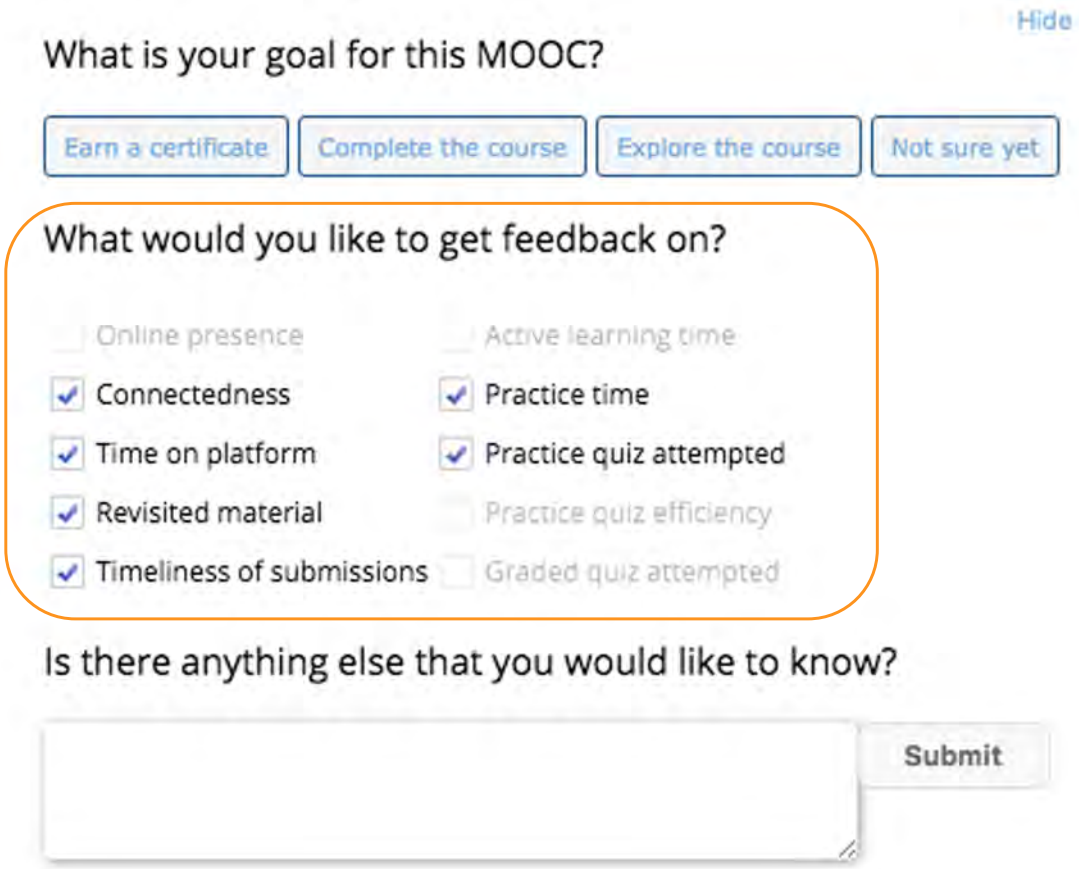


In reality: Very little feedback in most cases

Simplification gap of Learning Analytics



Would these indicators help you in your studies?



Jivet, I., Wong, J., Scheffel, M., Valle Torre, M., Specht, M., and Drachsler, H. 2021. ***Quantum of Choice: How learners' feedback monitoring decisions, goals and self-regulated learning skills are related.*** In *LAK21: 11th International Learning Analytics and Knowledge Conference*(*LAK21*). Association for Computing Machinery, New York, NY, USA, 416–427. DOI:https://doi.org/10.1145/3448139.3448179 ***Best paper LAK21**

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Model for Highly Informative Learning Analytics

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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

Drachsler, H., & Goldhammer, F. (2020). Learning Analytics and eAssessment—Towards Computational Psychometrics by Combining Psychometrics with Learning Analytics. In. Burgos, D. (Ed.) (2020). Radical Solutions and Learning Analytics. pp. 67-80. Singapore: Springer.

Highly Informative Learning Analytics

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****.*

Research Questions for HILA

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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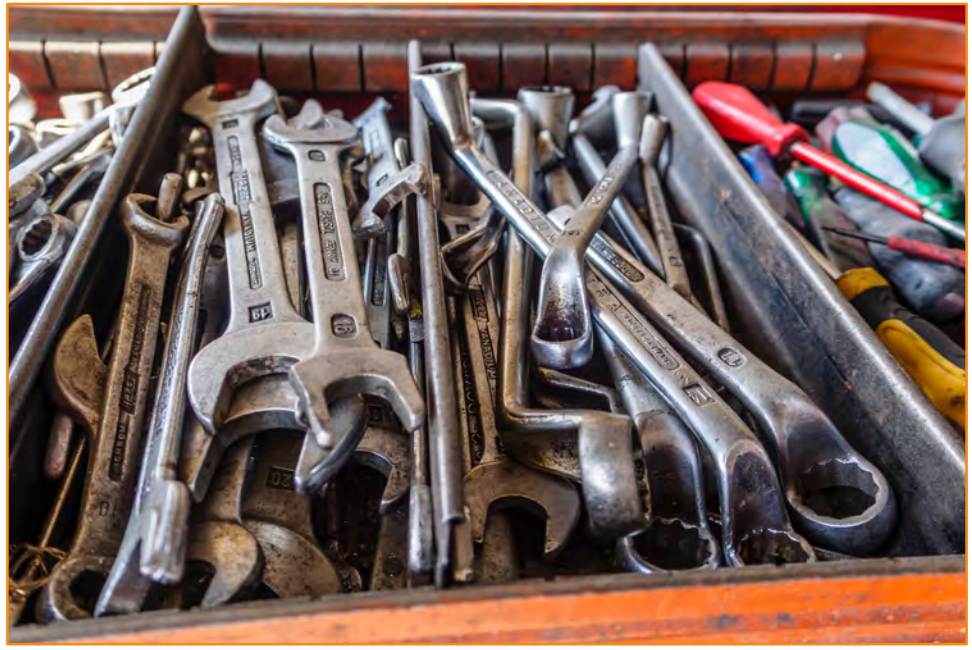
Evidence-Based Learning Design

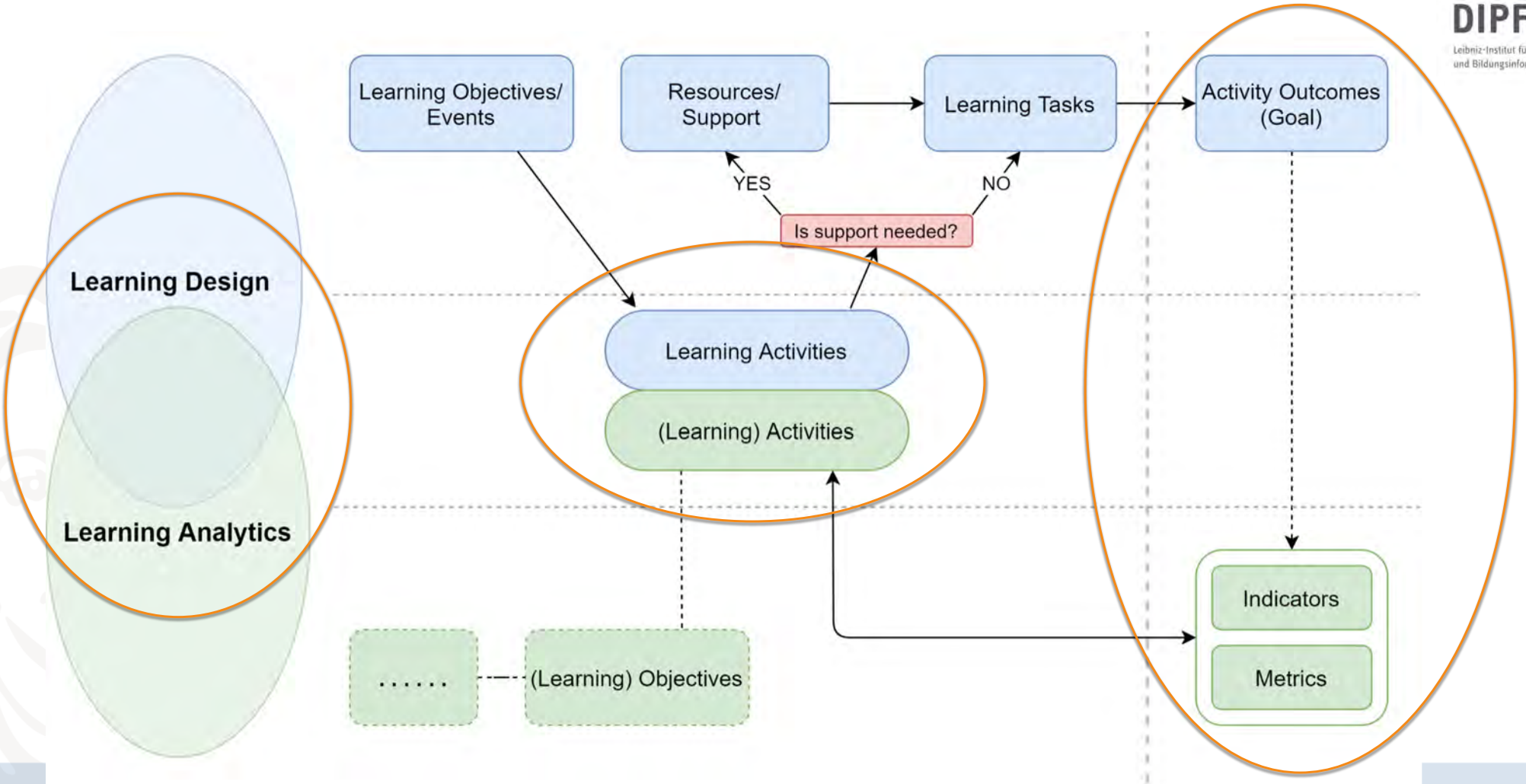
Photo by Alexander Schimmeck on Unsplash



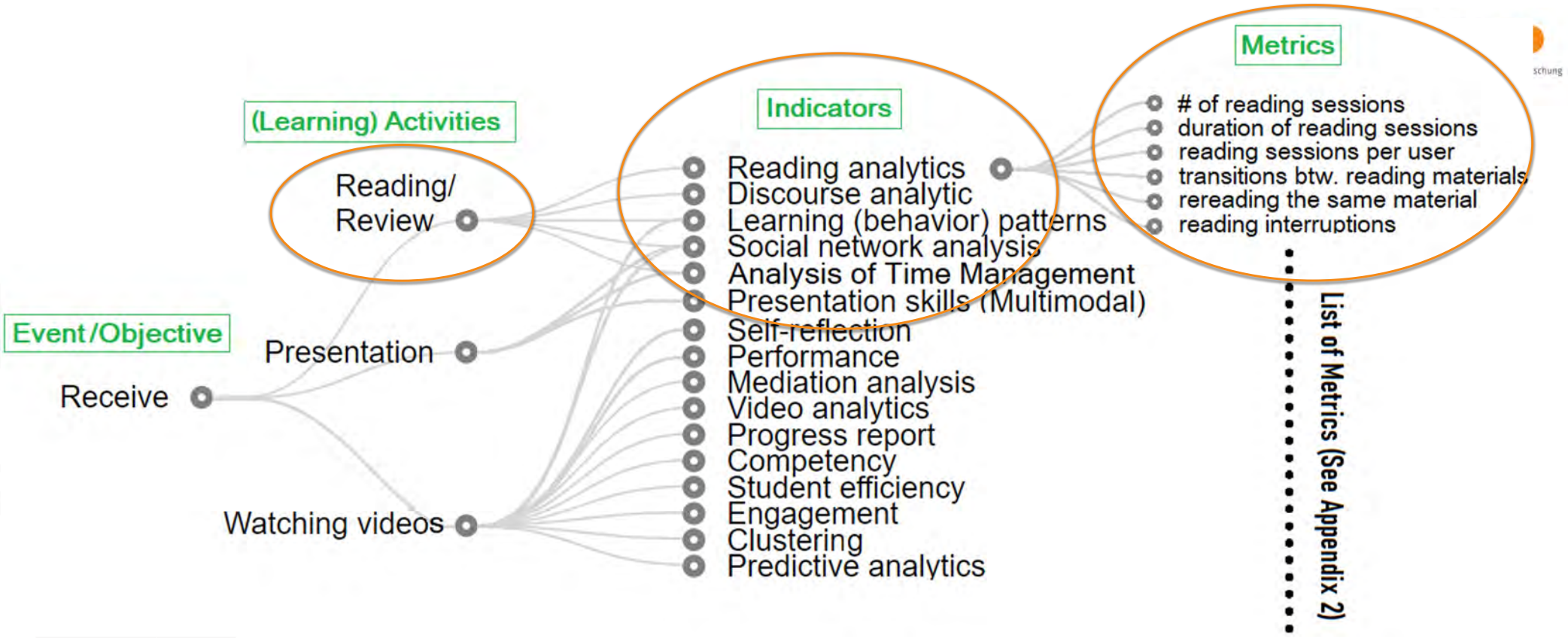
Learning Analytics *Mit Design*

Learning Analytics *OHNE Design*

Evidence-Based Learning Design

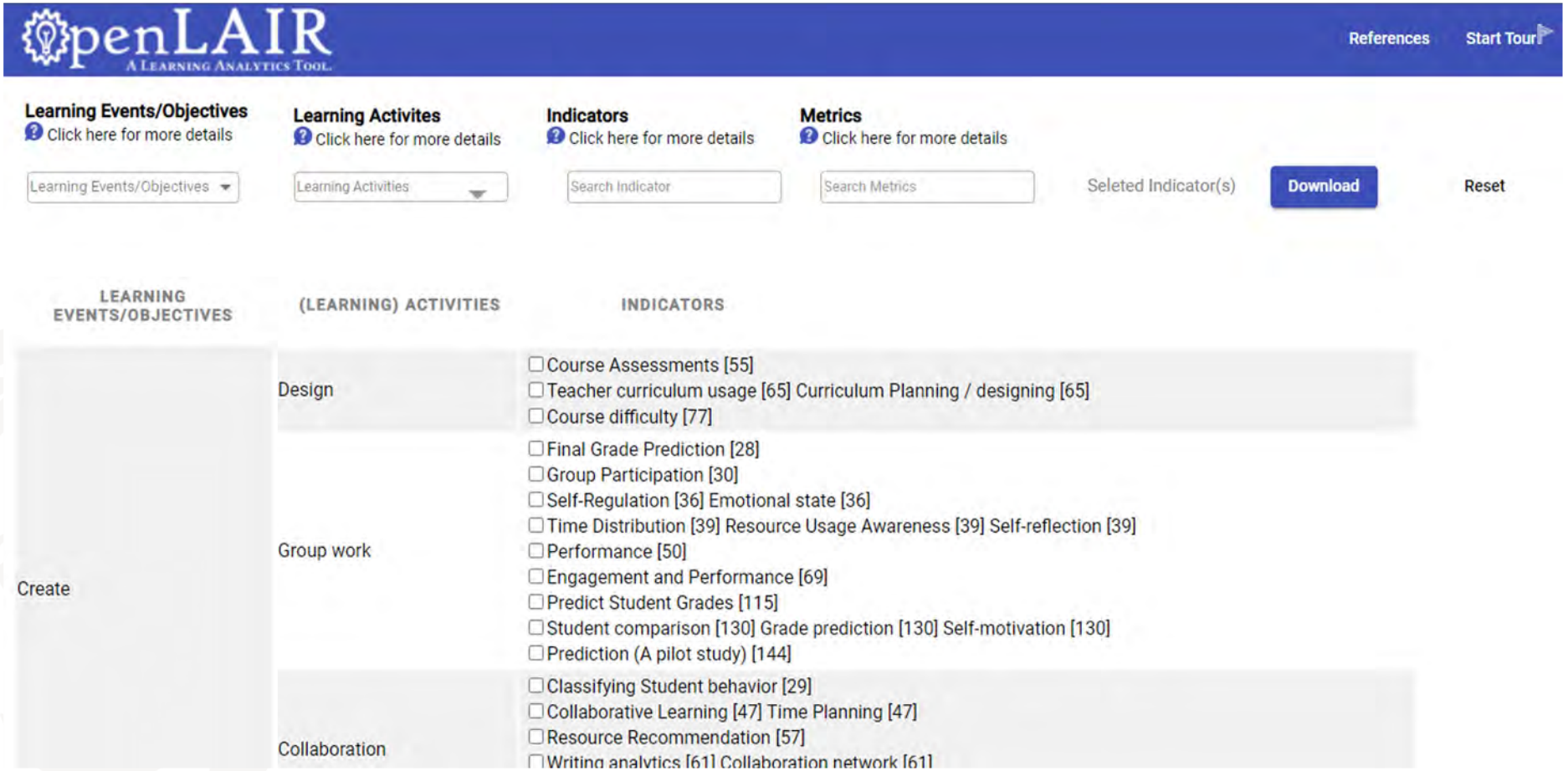


Evidence-Based Learning Design



Ahmad, A.; Schneider, J.; Weidlich, J.; Di Mitri, D.; Yau, J.; Schiffner, D. and Drachsler, H. (2022). **What Indicators Can I Serve You with? An Evaluation of a Research-Driven Learning Analytics Indicator Repository**. In Proceedings of the 14th International Conference on Computer Supported Education – Volume 1, ISBN 978-989-758-562-3, ISSN 2184-5026, pages 58-68.

Evidence-Based Learning Design



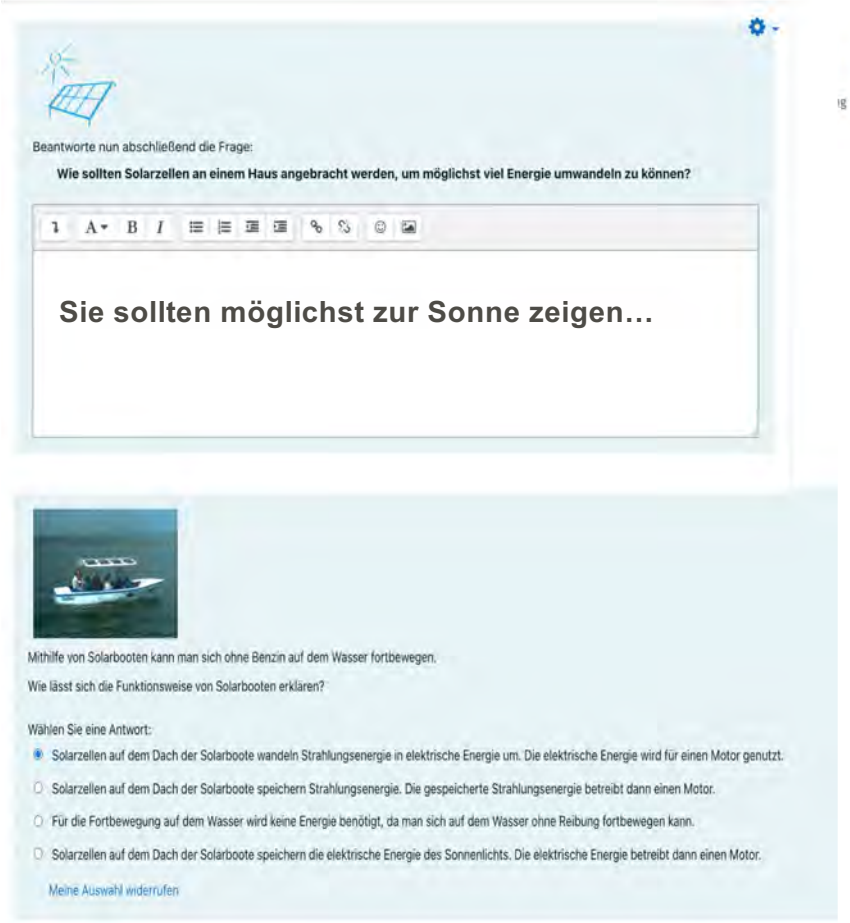
https://edutec.science/products/

Evidence-Based Learning Design

Limited Edition: LAK20 Version

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

Evidence-Based Learning Design



Kubsch M., Czinczel B., Lossjew J., Wyrwich T., Bednorz D., Bernholt S., Fiedler D., Strauß S., Cress U., Drachsler H., Neumann K. and Rummel N. (2022) **Toward learning progression analytics — Developing learning environments for the automated analysis of learning using evidence-centred design**. Front. Educ. 7:981910. https://doi.org/10.3389/feduc.2022.981910

BETA Version

FoLA

Feedbackorientierte Lern-Designs und Analytics

inspiriert von FoLA²

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FoLA.digital

Jointly planning, analyzing, and improving teaching online

Evidence-Based Learning Design

fola.digital

- **Role-based collaborative development** and reflection of learning designs in **real-time** (Design).

- Interfaces for the integration of new tools and methods **for precise implementation at one's own university** (Implement).

- **Data-driven, iterative improvement of teaching (Evaluate).**

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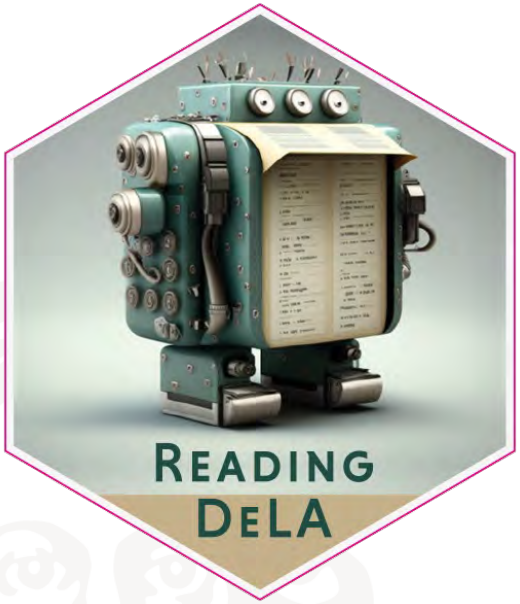
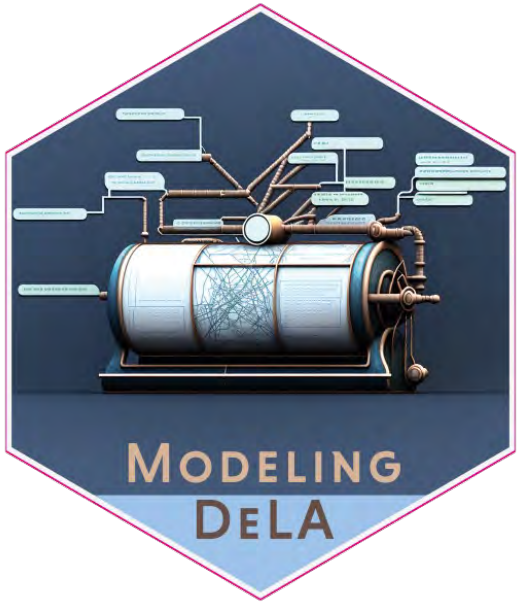
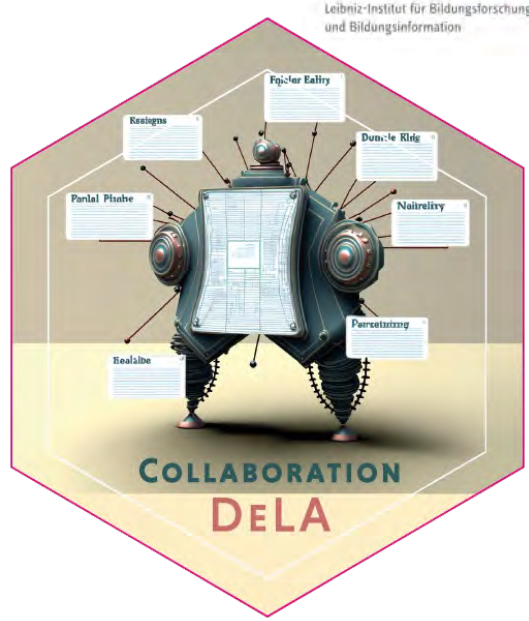
Development: Data-enriched Learning Activities



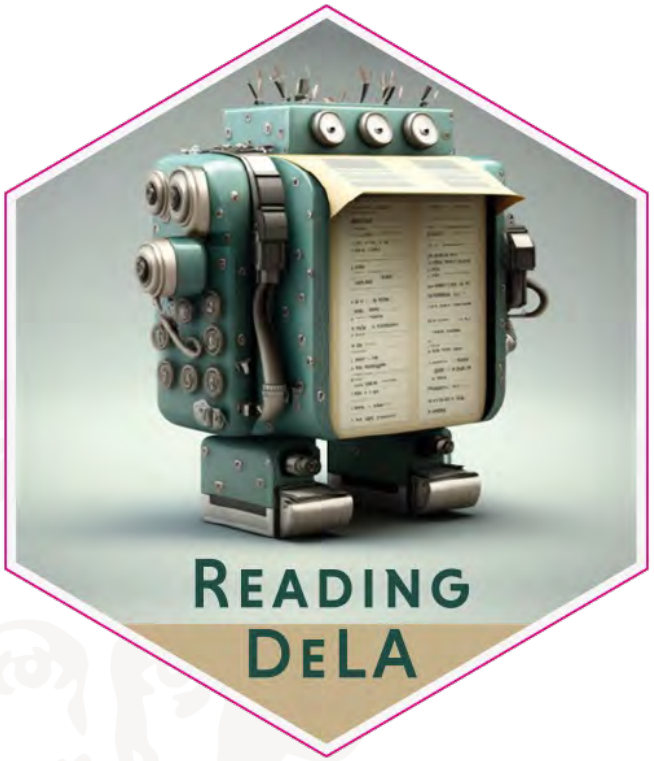


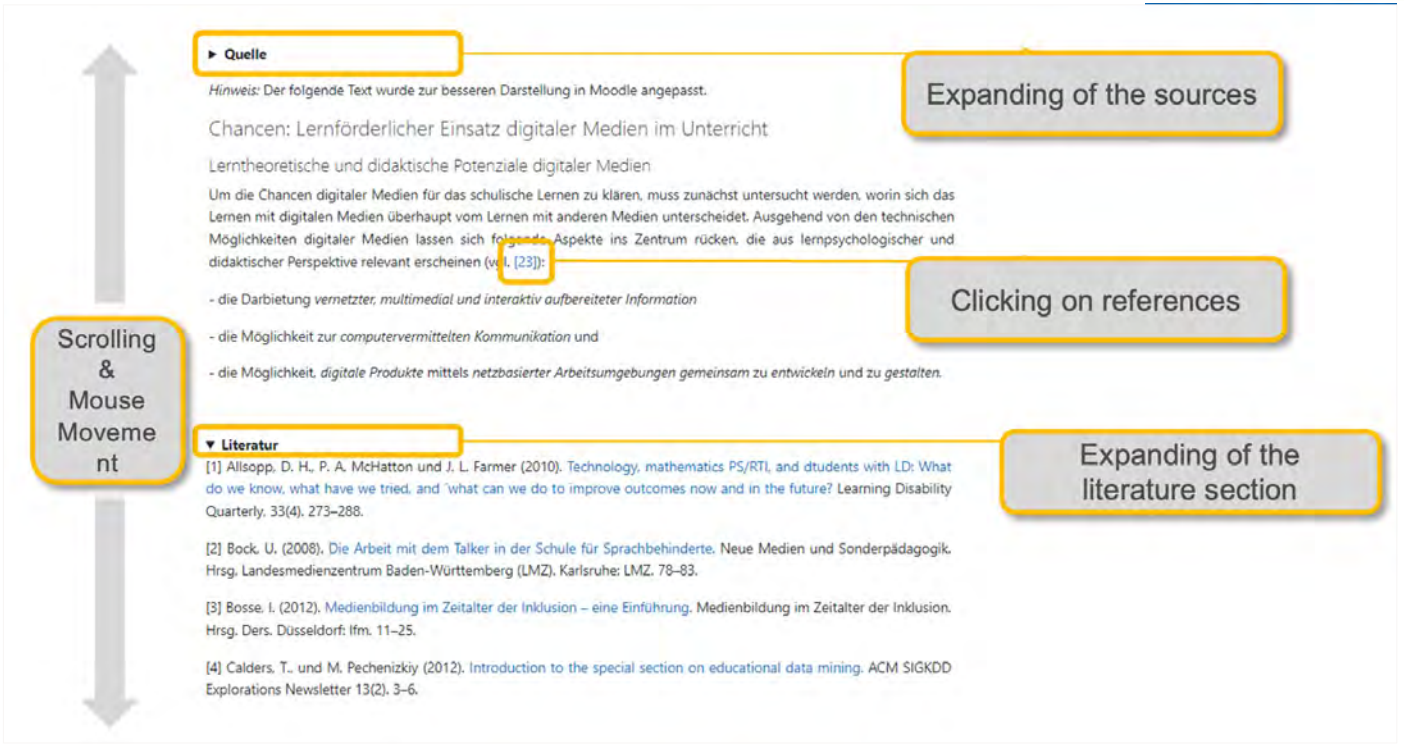


DeLA for the most common learning activities.

Drachsler, H. (2023). **Towards Highly Informative Learning Analytics**. https://doi.org/10.25656/01:26787

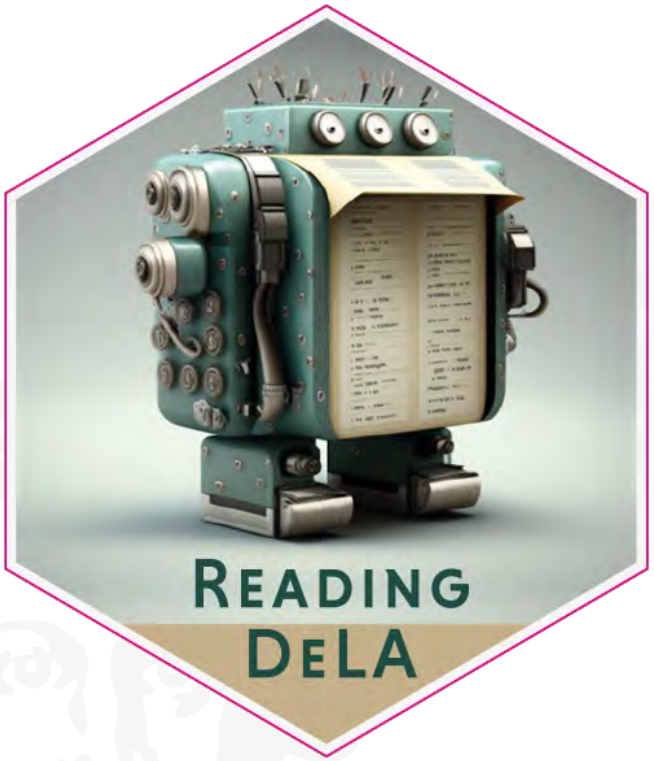
DeLA – Reading Analytics

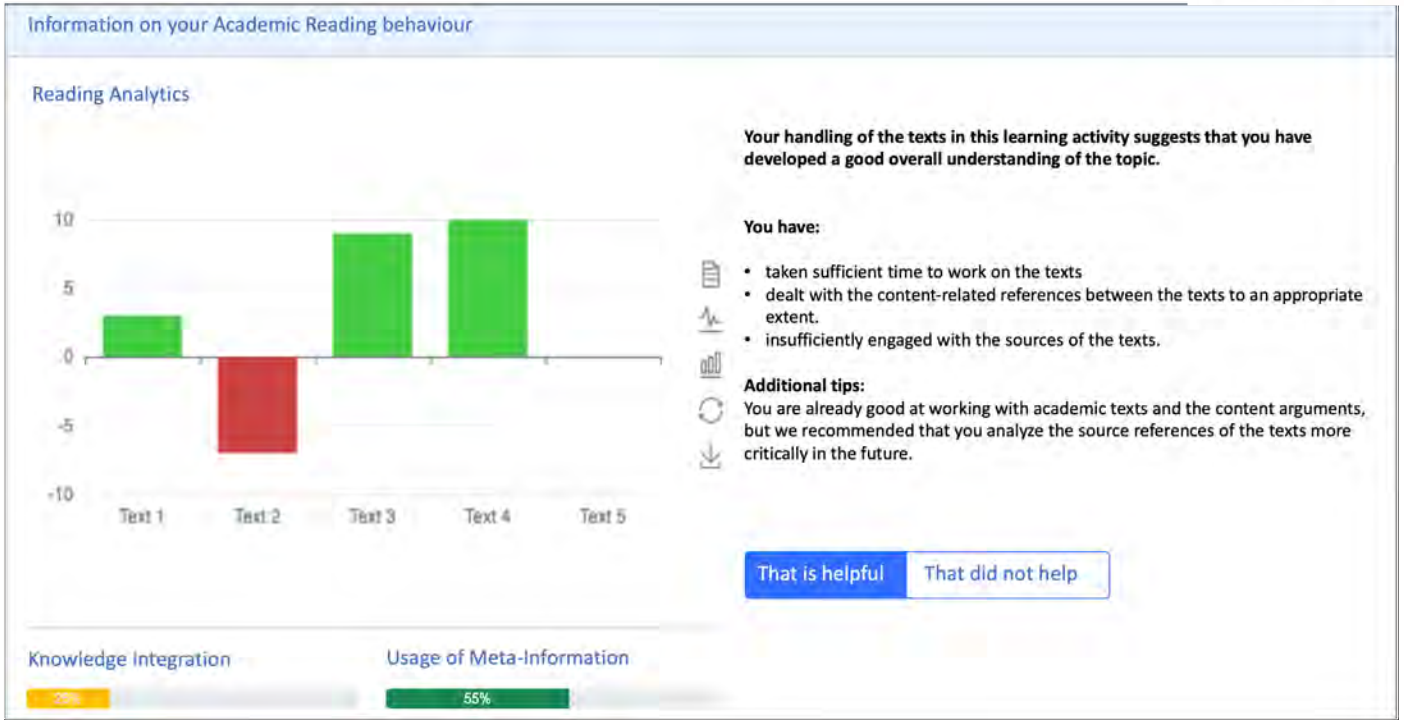




Biedermann, D., Schneider, J., Ciordas-Hertel, G., Eichmann, B., Hahnel, C., Goldhammer, F., Drachsler, H. (2023). ***Detecting the Disengaged Reader – Using Scrolling Data to Predict Disengagement during Reading***. In LAK23: 13th International Learning Analytics and Knowledge Conference. ACM.

DeLA – Reading Analytics





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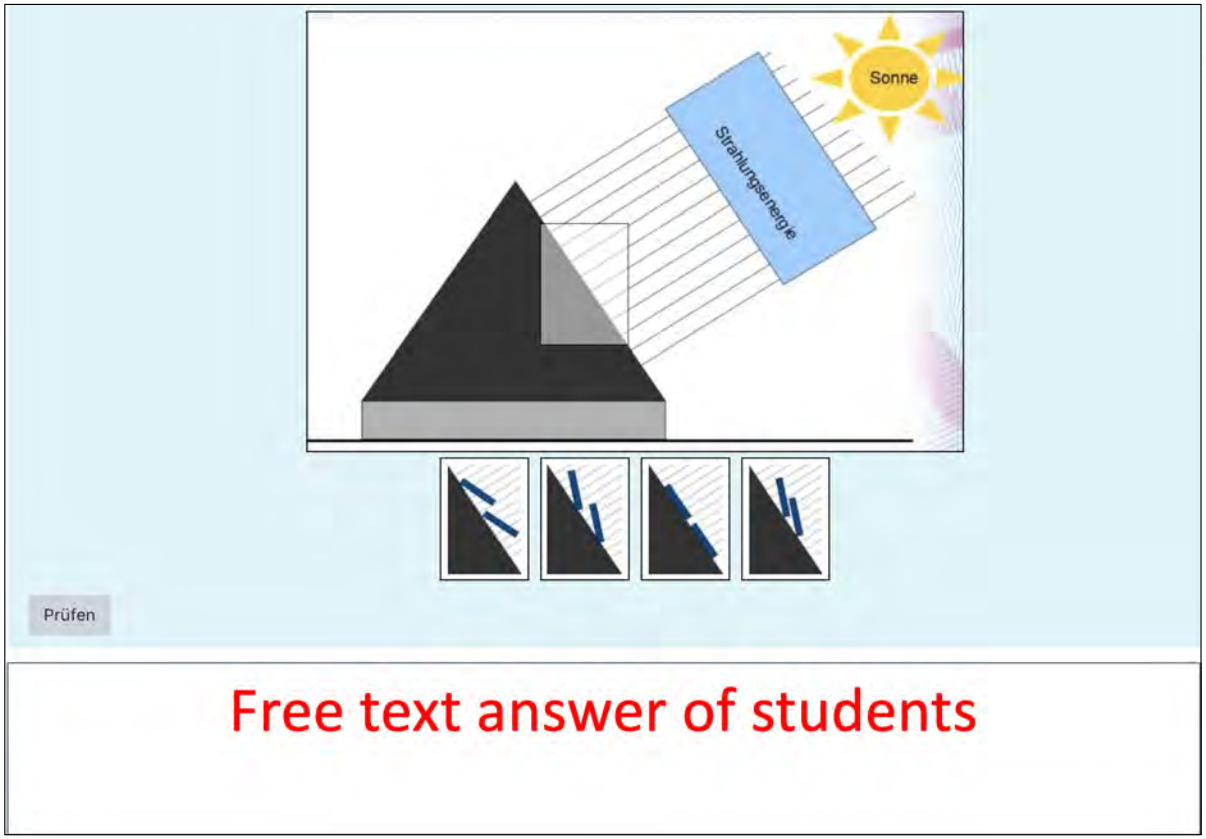
DeLA – Writing Analytics



Gombert, S., Di Mitri, D., Karademir, O., Kubsch, M., Kolbe, H., Tautz, S., Grimm, A., Bohm, I., Neumann, K., & Drachsler, H. (2022). **Coding energy knowledge in constructed responses with explainable NLP models**. Journal of Computer Assisted Learning. https://doi.org/10.1111/jcal.12767

DeLA – Writing Analytics

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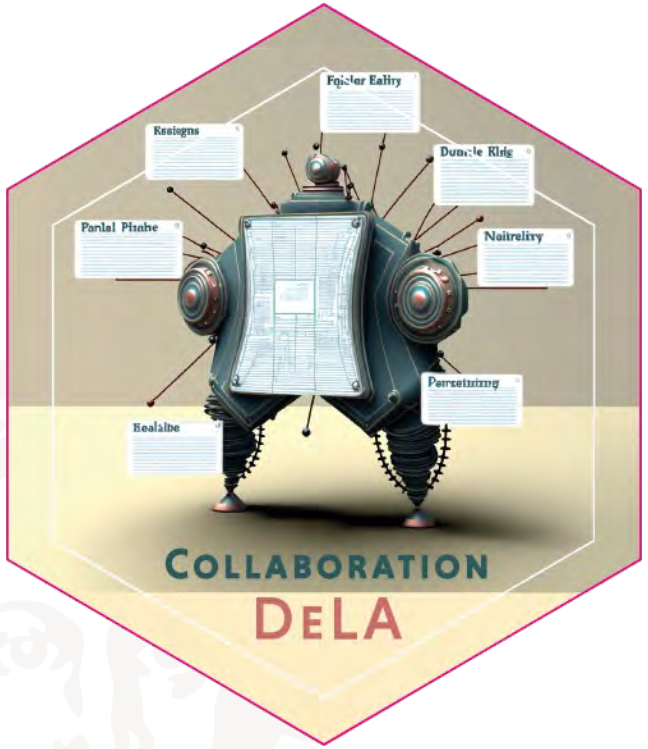
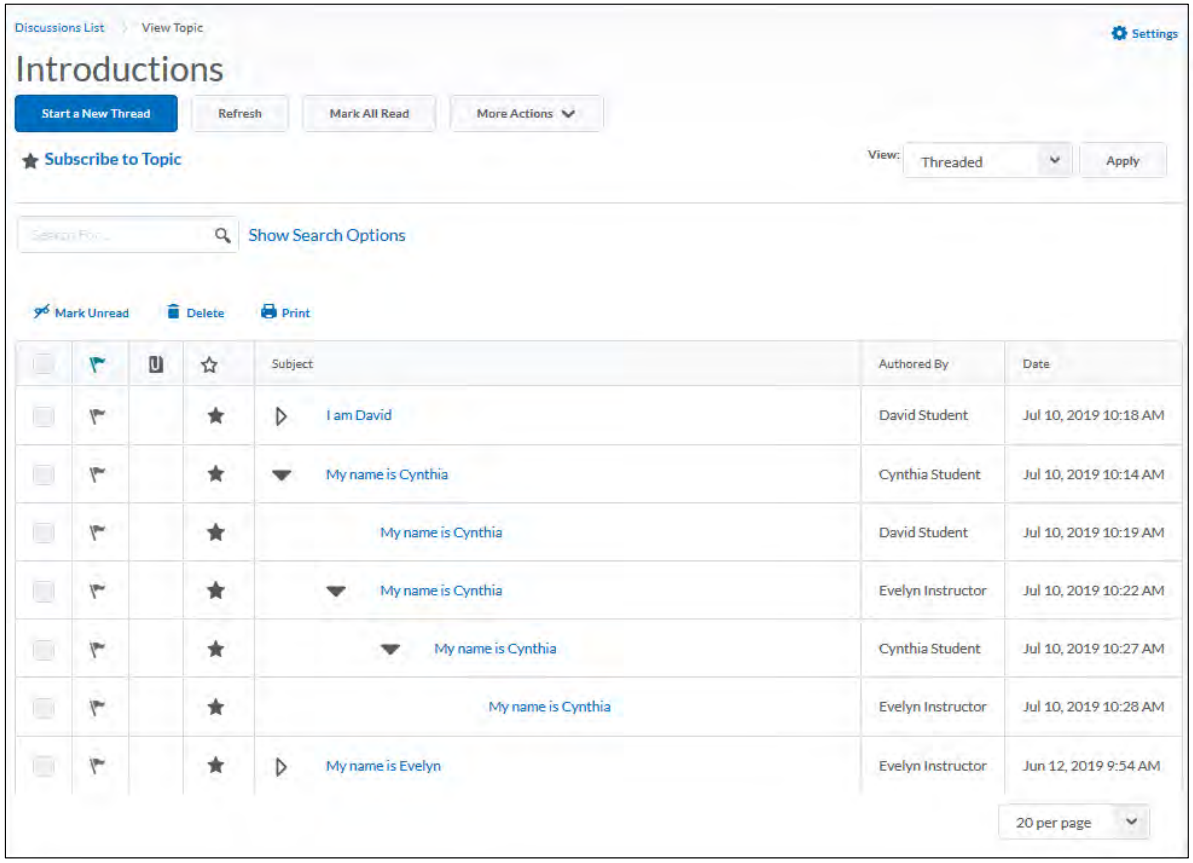
Students Scores based on Learning Goals

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
Peter Kahn									57%
Tom Müller									55%
Bob Boyy									55%
Peter Kahn									51%
Peter Kahn									49%
Bob Boyy									47%

Karademir, O., Borgards, L., Strauß, S., Di Mitri, D., Kubsch, M., Brobeil, M., Grimm, A., Gombert, S., Rummel, N., Neumann, K., & Drachsler, H. (submitted). **Following the Impact Chain: An Intervention Study Investigating a Teacher Dashboard's Prolonged Effect on Student Learning in Secondary Education**.

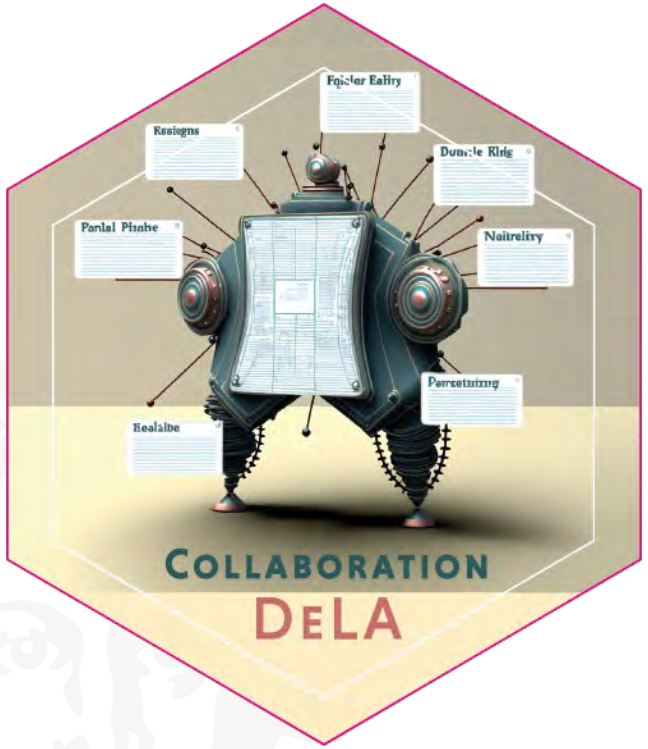
DeLA – Collaboration Analytics

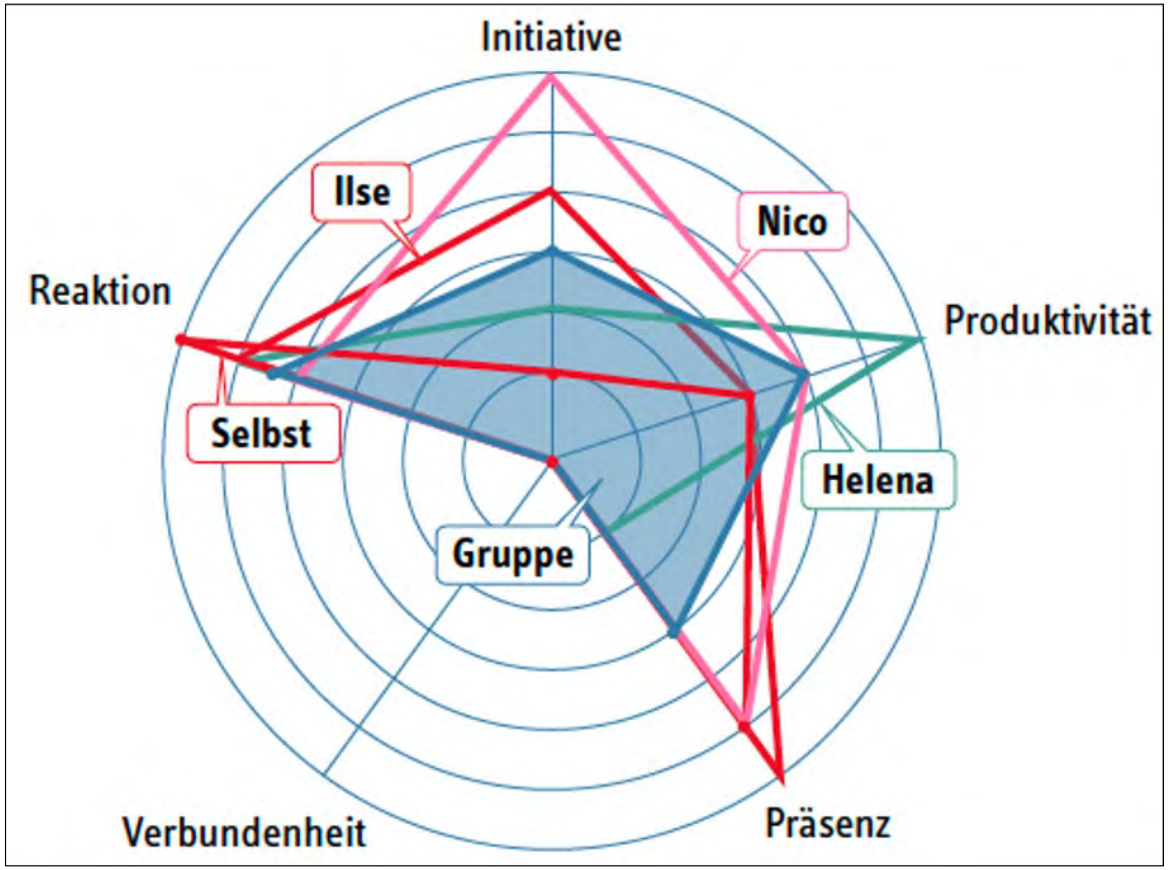




Menzel, L., Gombert, S., Weidlich, J., Fink, A., Frey, A., Drachsler, H. (2023). **Why You Should Give Your Students Automatic Process Feedback on Their Collaboration: Evidence from a Randomized Experiment.** EC-TEL 2023. LNCS, vol 14200. Springer, Cham. https://doi.org/10.1007/978-3-031-42682-7_14

DeLA – Collaboration Analytics





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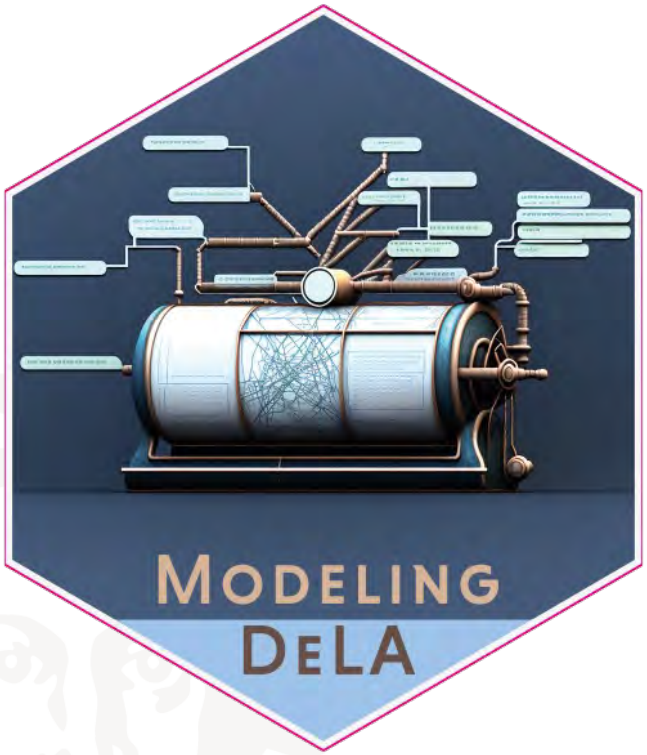
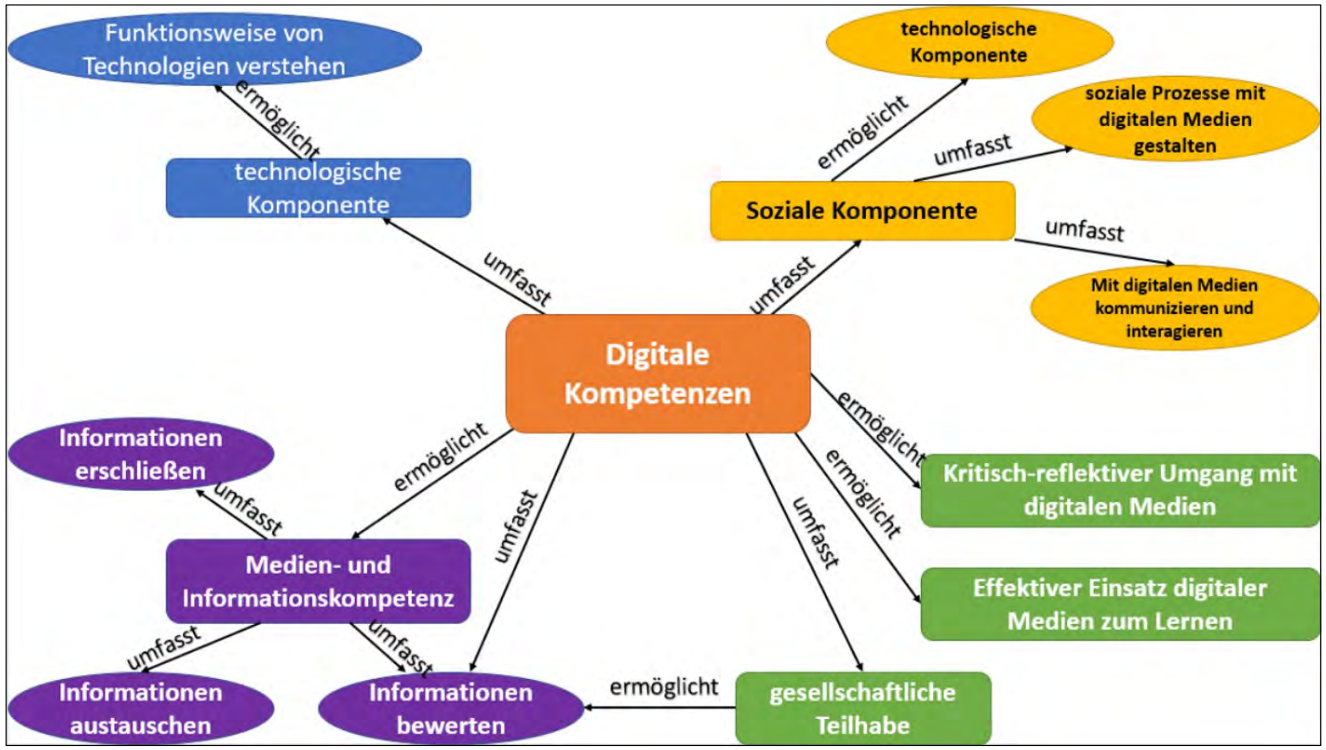
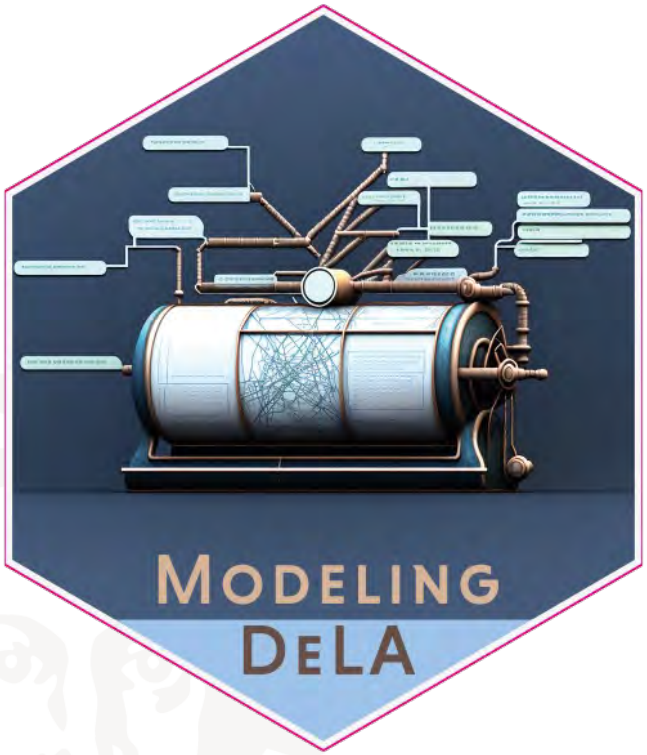
DeLA – Modeling Analytics





DeLA – Modeling Analytics



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 %

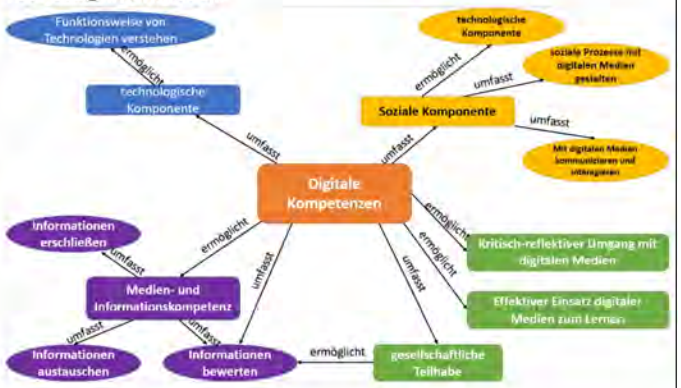
The assessment of your competences in learning activity 12:
Digital media competences of pupils

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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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

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-*Winterpause!* 16.01.23	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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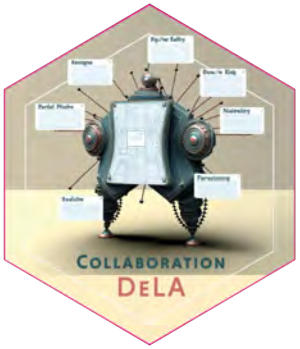
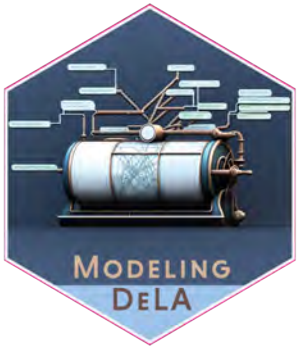
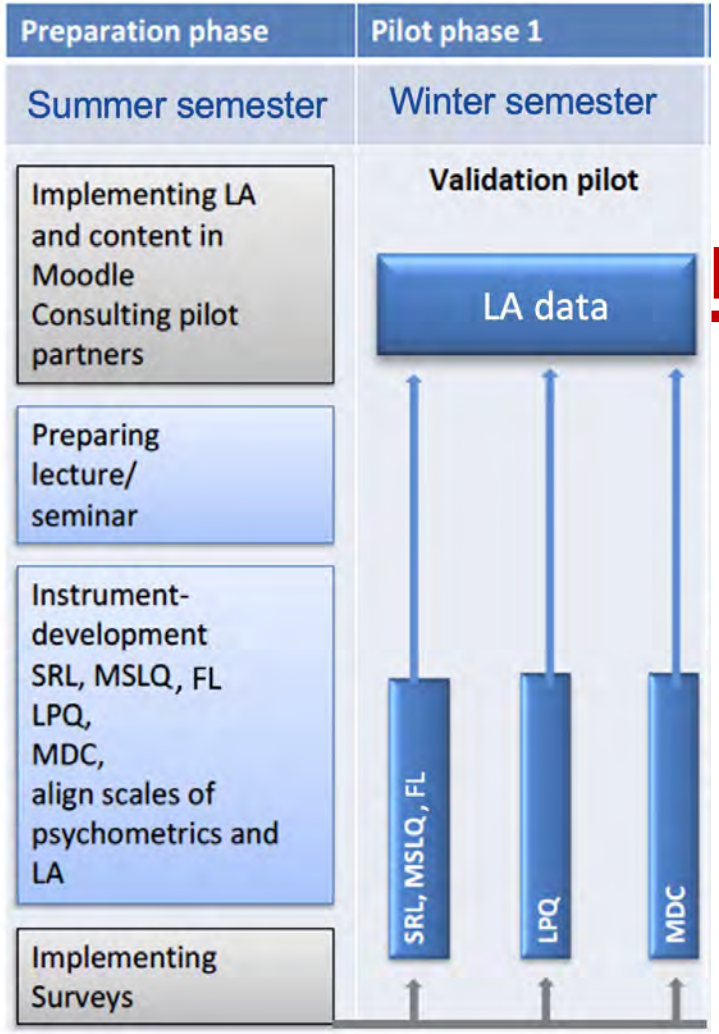
1 Woche	2 Wochen	2 Wochen	2 Wochen	2 Wochen	2 Wochen + Winterferien	1 Woche	2 Wochen	1 Woche
Prä	L1	LE2	LE3	LE4	LE5	Post	LE6	LE7
	5 Texte	3 Texte	5 Texte	Foliensatz	3 Texte		2 Texte	Aktuelle Forschung zu Themen des Seminars
		3 Videos		VL Aufz.	3 Videos		2 Videos	
		Forum	Concept-Map	Forum	Concept-Map		Activity-Annotation	TN an Studien





Research Design for HILA & DeLAs



Data Collection

Research Design for HILA & DeLAs

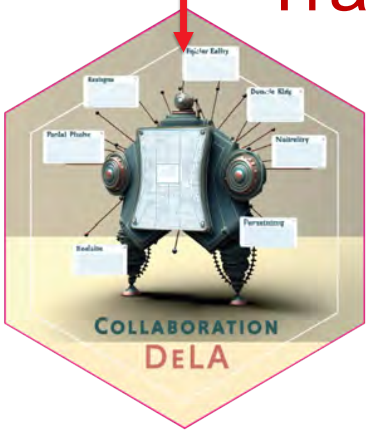
studiumdigitale
Zentrale eLearning-Einrichtung Goethe-Universität Frankfurt am Main

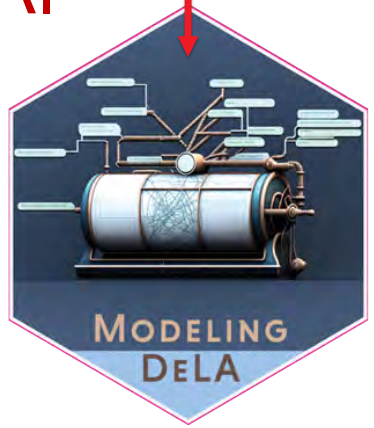
GOETHE UNIVERSITÄT FRANKFURT AM MAIN

DIPF
Leibniz-Institut für Bildungsforschung und Bildungsinformation

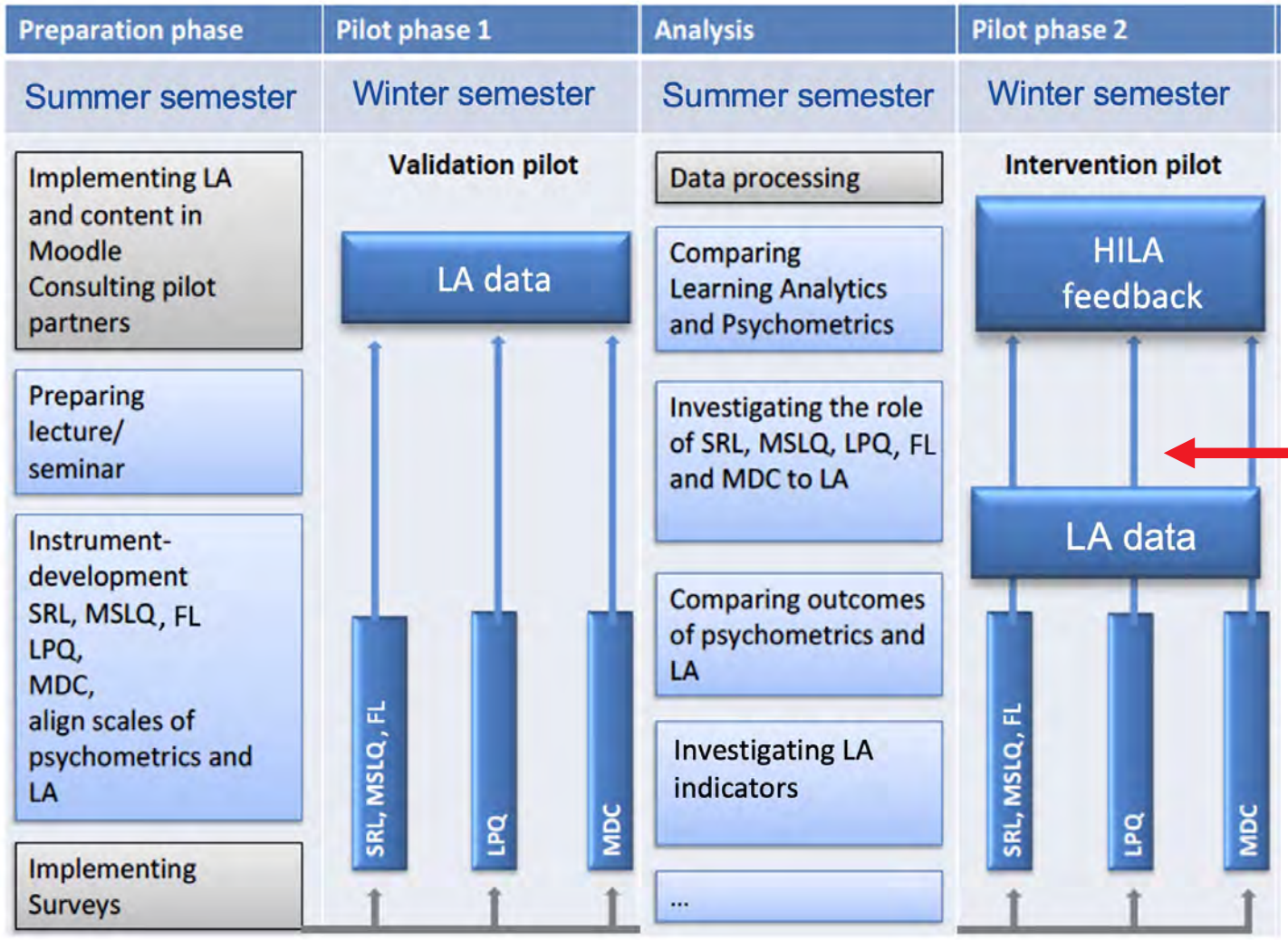
Preparation phase	Pilot phase 1	Analysis
Summer semester	Winter semester	Summer semester
Implementing LA and content in Moodle Consulting pilot partners	Validation pilot LA data	Data processing Comparing Learning Analytics and Psychometrics
Preparing lecture/ seminar		Investigating the role of SRL, MSLQ, LPQ, FL and MDC to LA
Instrument-development SRL, MSLQ, FL LPQ, MDC, align scales of psychometrics and LA	SRL, MSLQ, FL LPQ MDC	Comparing outcomes of psychometrics and LA
Implementing Surveys		Investigating LA indicators ...

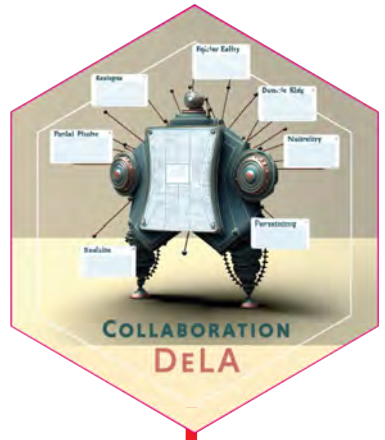
Training of AI



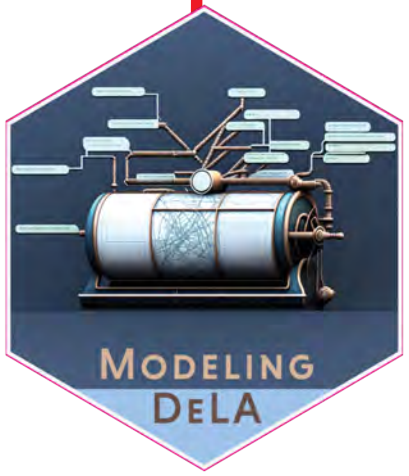


Research Design for HILA & DeLAs

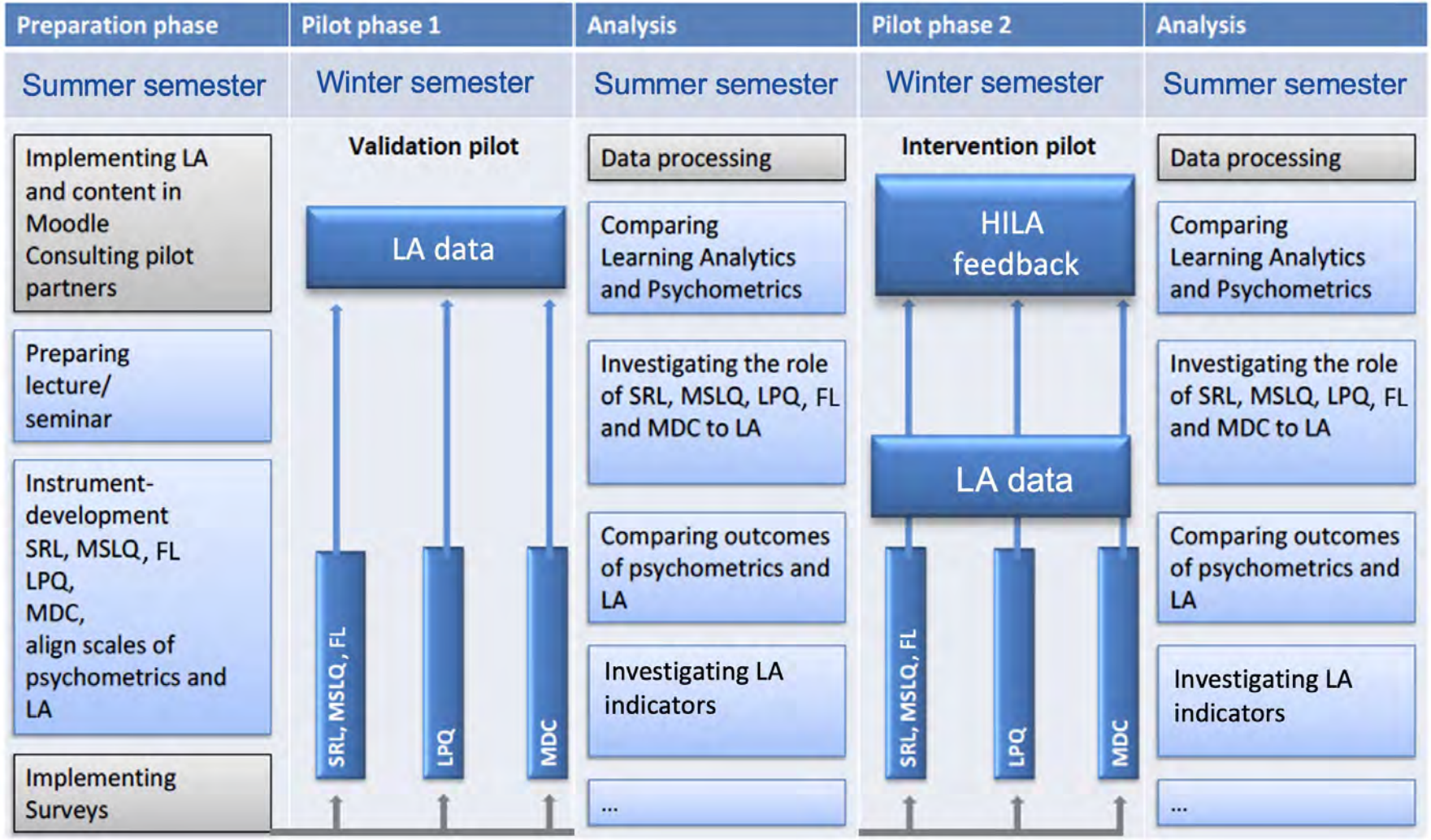




Feedback



Research Design for HILA & DeLAs



Outline

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

HILA: Main findings so far

1. How can relevant data for the learner goals and outcomes of a course be extracted from digital learning environments?
   => Importance of constructive alignment (FoLA method), applying tailored DeLA that measure relevant data for learning goals in authentic environment.

2. What is the effect of different feedback types for assignment results, exam performance, and affective student variables?
   => Still building an empirical basis, quite promising study outcomes from RCT, need to be further generalised and evaluated in different settings and domains.

3. How does feedback literacy influence students' interpretation and reaction to the received feedback?
   => 1st psychometric scale on feedback literacy (Woitt et al., 2023), rich data collected from students analysis ongoing

HILA: Take away messages

1. Interdisciplinary Collaboration
The connection of educational sciences, computer science, and educational practice is necessary to create sustainable added value & platforms for educational actors.

2. Research Transfer
The necessity of collaboration with practitioners for ecologically valid results.

3. Authentic Data
Machine learning requires authentic and meaningful data for the learning processes of students.

Many thanks for your attention.

Questions now or later?

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