Design, Entwicklung und Evaluation von KI-Anwendungen für die Lehre an der Goethe-Universität Frankfurt

Tag der Lehre Universität Bremen

EduTec
Educational Technologies @ DIPF

Prof. Dr. Hendrik Drachsler
29.11.23

Universität Bremen

Director
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Research Professor
@ Leibniz DIPF

www.Edutec.science

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

SMS – transfer process

Scouting

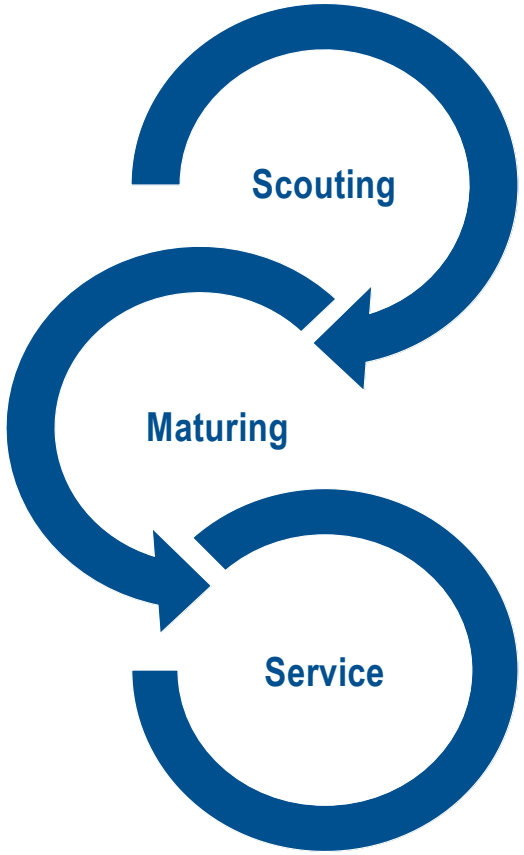
Identify, evaluate and test new with regard to possible application scenarios, conditions, opportunities and risks

Maturing

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

Service

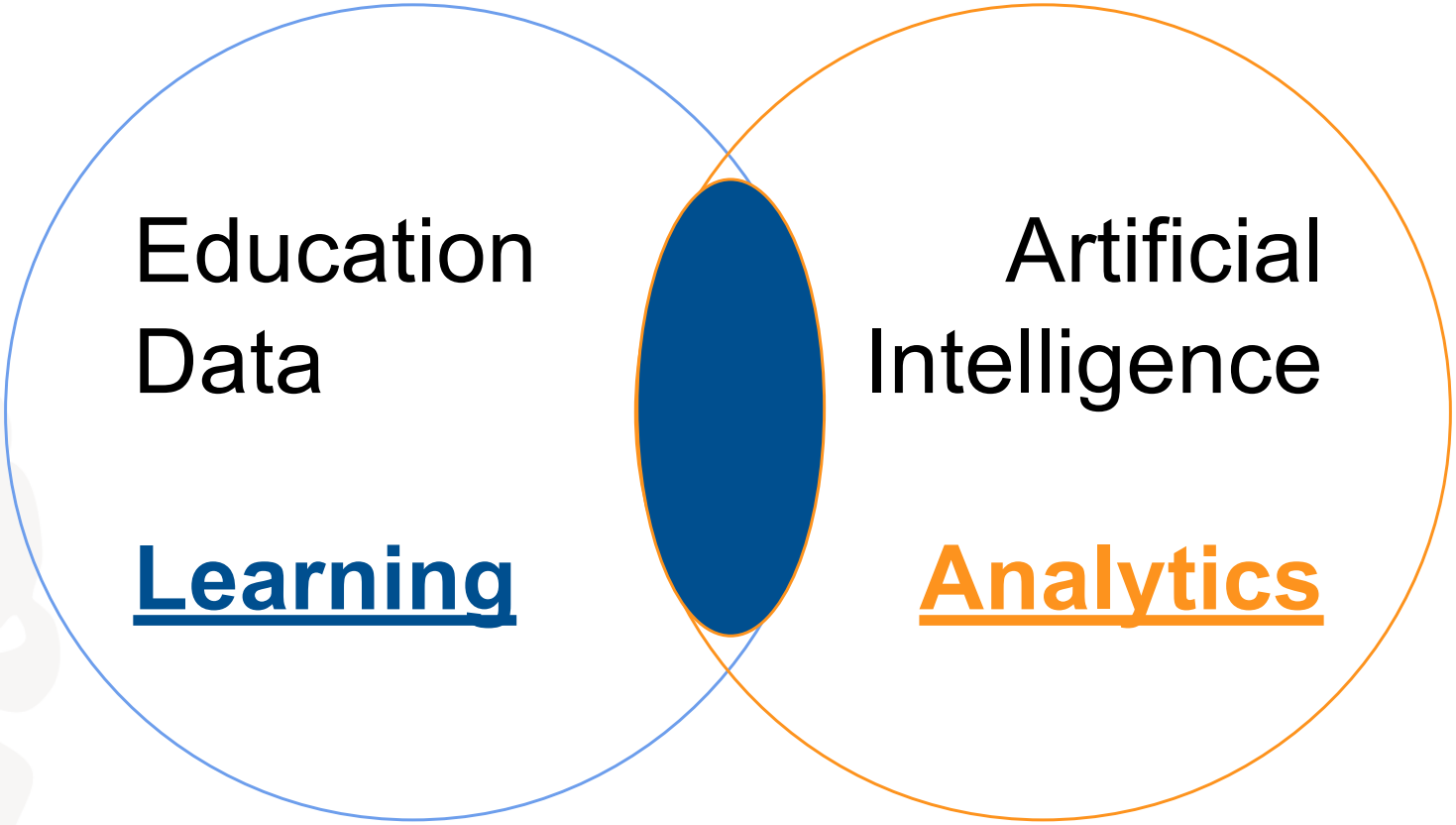
Creation of a low-threshold, streamlined and integrated service offers



Outline

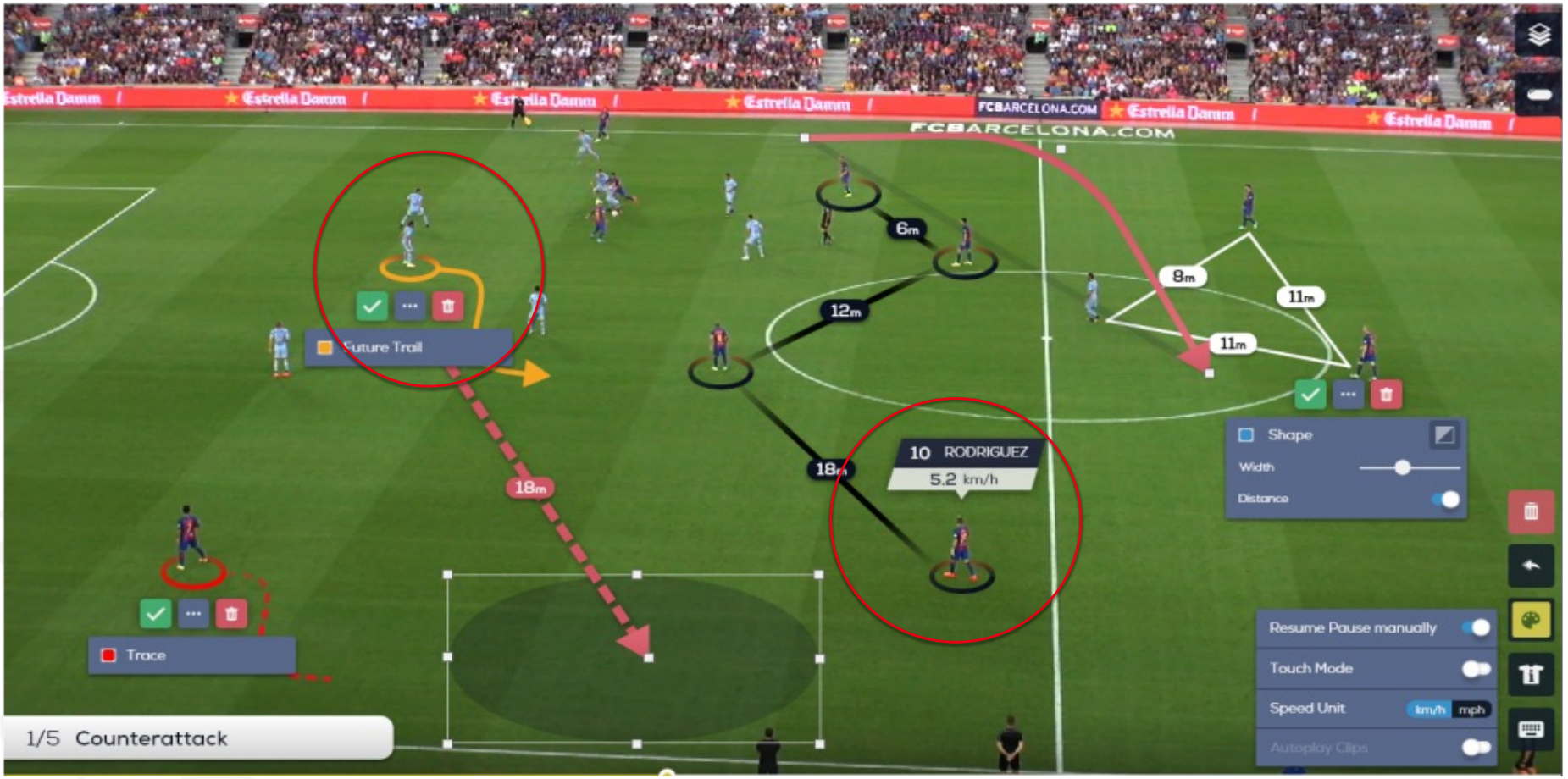
1. Grounding
2. Highly Informative Learning Analytics (HILA)
3. Design for Learning
4. Data-enriched Learning Analytics (DeLA)
5. Evaluation of DeLAs
6. Take away messages

Definition of learning analytics



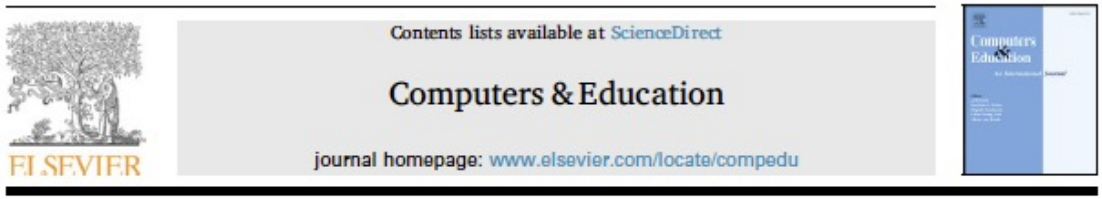
Greller, W., & Drachsler, H. (2012). **Translating learning into numbers: A generic framework for learning analytics.** *Journal of Educational Technology & Society, 15*(3), 42–57.

Personalised Feedback



In reality: Very little feedback in most cases

Challenges for the rollout of Learning Analytics



Learning analytics in European higher education—Trends and barriers☆

Yi-Shan Tsai[a,*], Diego Rates[b], Pedro Manuel Moreno-Marcos[c], Pedro J. Muñoz-Merino[c], Ioana Jivet[d], Maren Scheffel[d], Hendrik Drachsler[e,d,1], Carlos Delgado Kloos[c], Dragan Gašević[a,2]

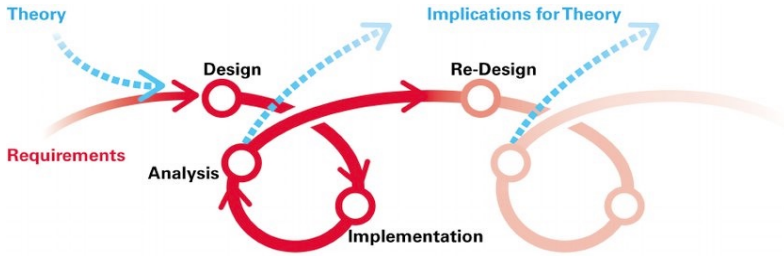
Challenge 1: Stakeholder engagement and buy-in.

Challenge 2: Weak pedagogical grounding.

Challenge 3: Resource demand.

Challenge 4: Ethics and privacy.

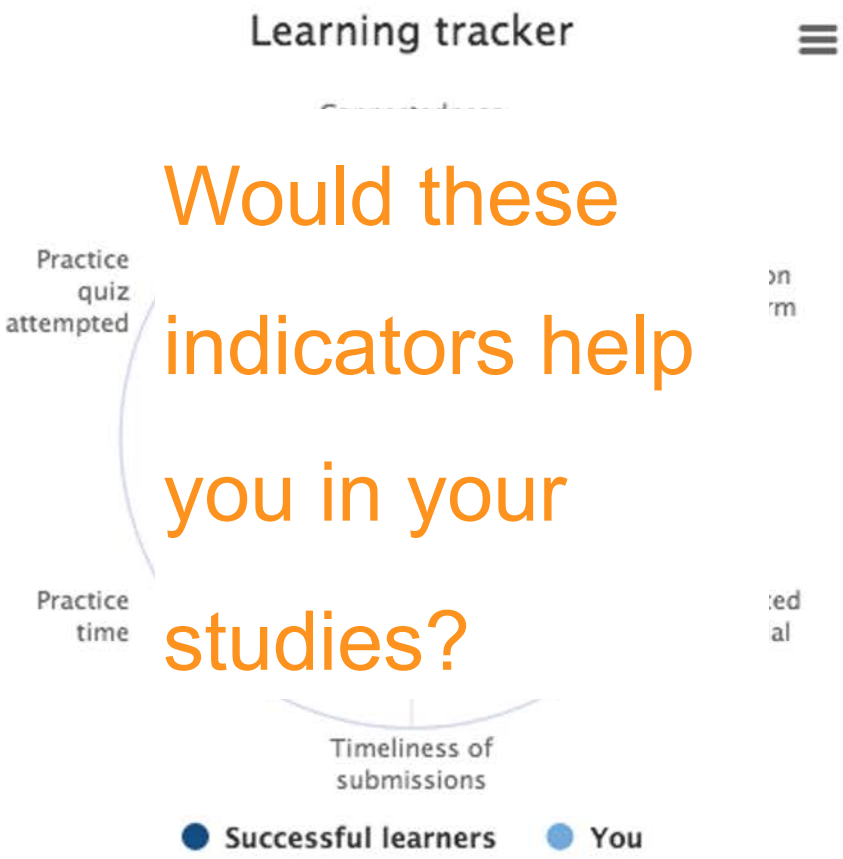
Design-Based Research Methodology

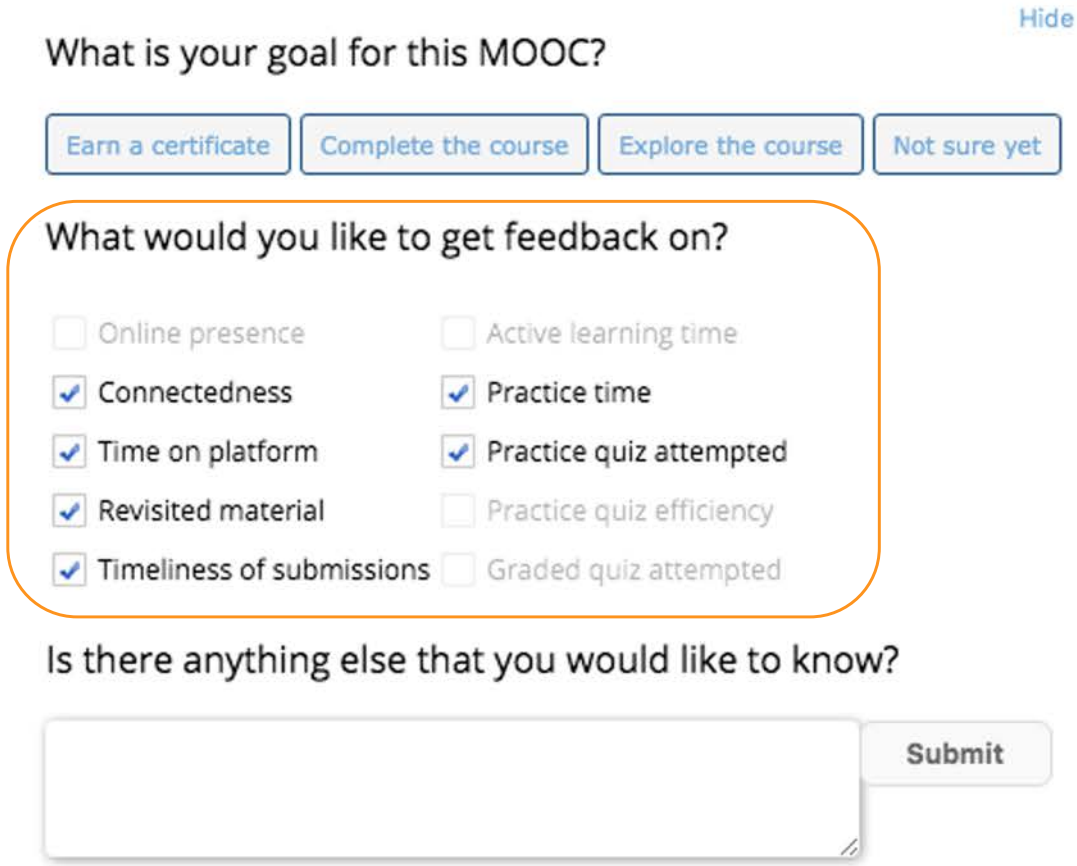


Tsai, Y-S, Rates, D., Moreno-Marcos, M. P., Muñoz-Merino, P. J., Jivet, I., Scheffel, M., Drachsler H., Delgado Kloos, C, Gašević, D (2020). ***Learning analytics in European higher education–trends and barriers***, Computers & Education, 103933, https://doi.org/10.1016/j.compedu.2020.103933.

Challenge 2: Weak pedagogical grounding

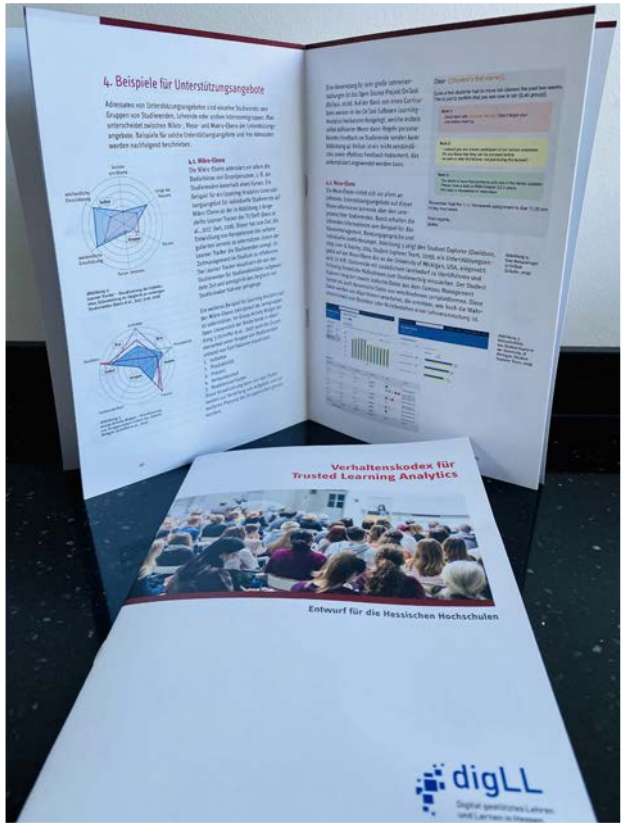
Would these indicators help you in your studies?





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**

Challenge 4: Ethics and privacy



7 Principles

1. Improving conditions for learning and teaching
2. Support services for all students
3. Transparent handling of data
4. Critical handling of data
5. Human control
6. Managerial responsibility
7. Commitment to continuing training

Hansen, J., Rensing, C., Hermann, O., & Drachsler, H. (2020). **Verhaltenskodex für Trusted Learning Analytics: Entwurf für die Hessischen Hochschulen**. Frankfurt am Main, Germany. https://bit.ly/German_CoC_LA

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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. What is the effect of different feedback types for assignment results, exam performance, and affective student variables?

3. How does feedback literacy influence students' interpretation and reaction to the received feedback?

Outline

1. Aims of the workshop
2. Highly Informative Learning Analytics (HILA)
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Evidence-based Learning Design

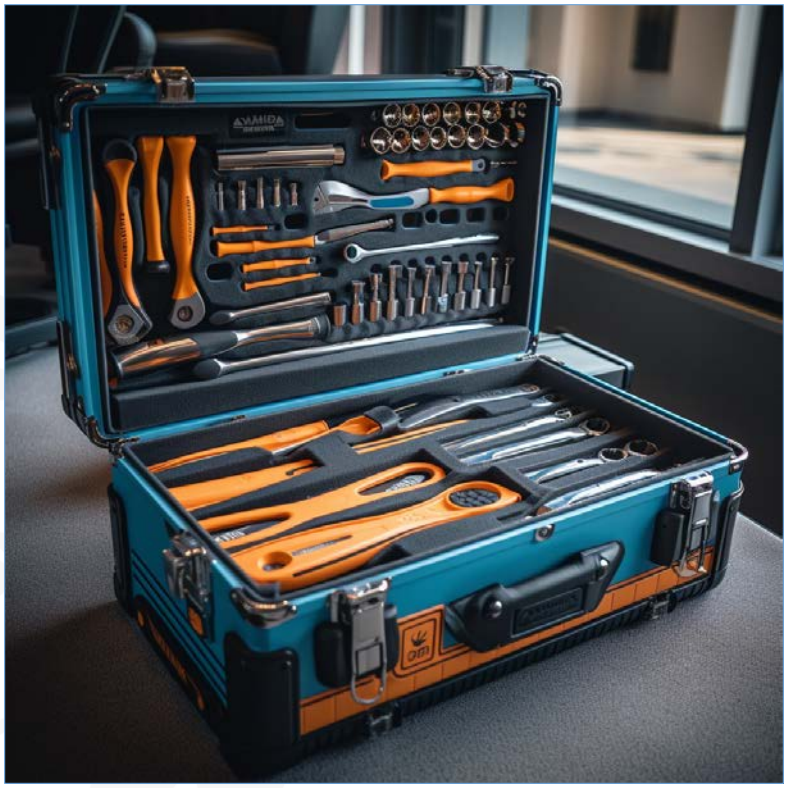
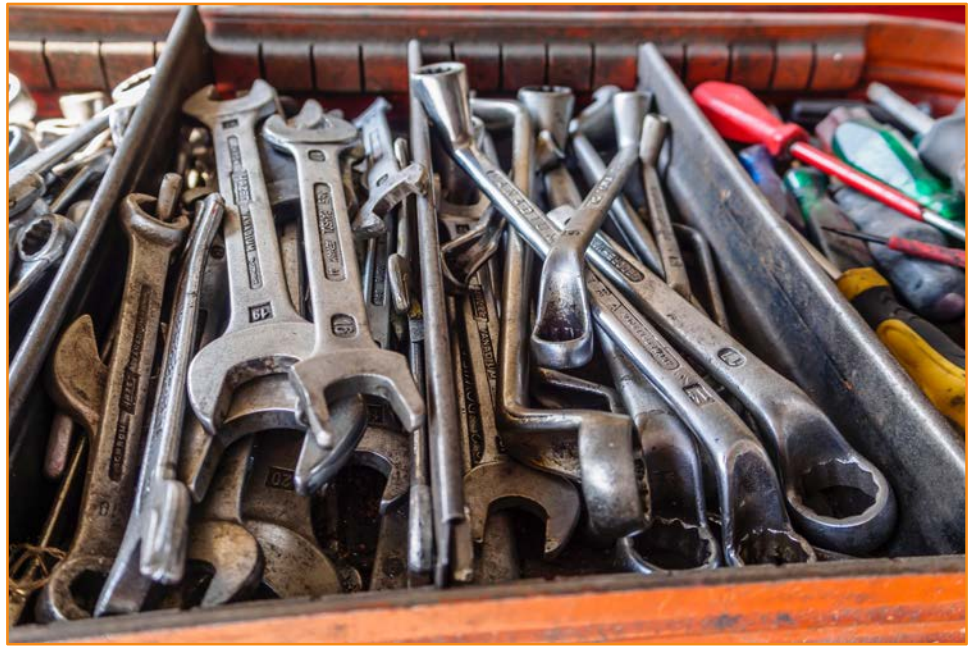


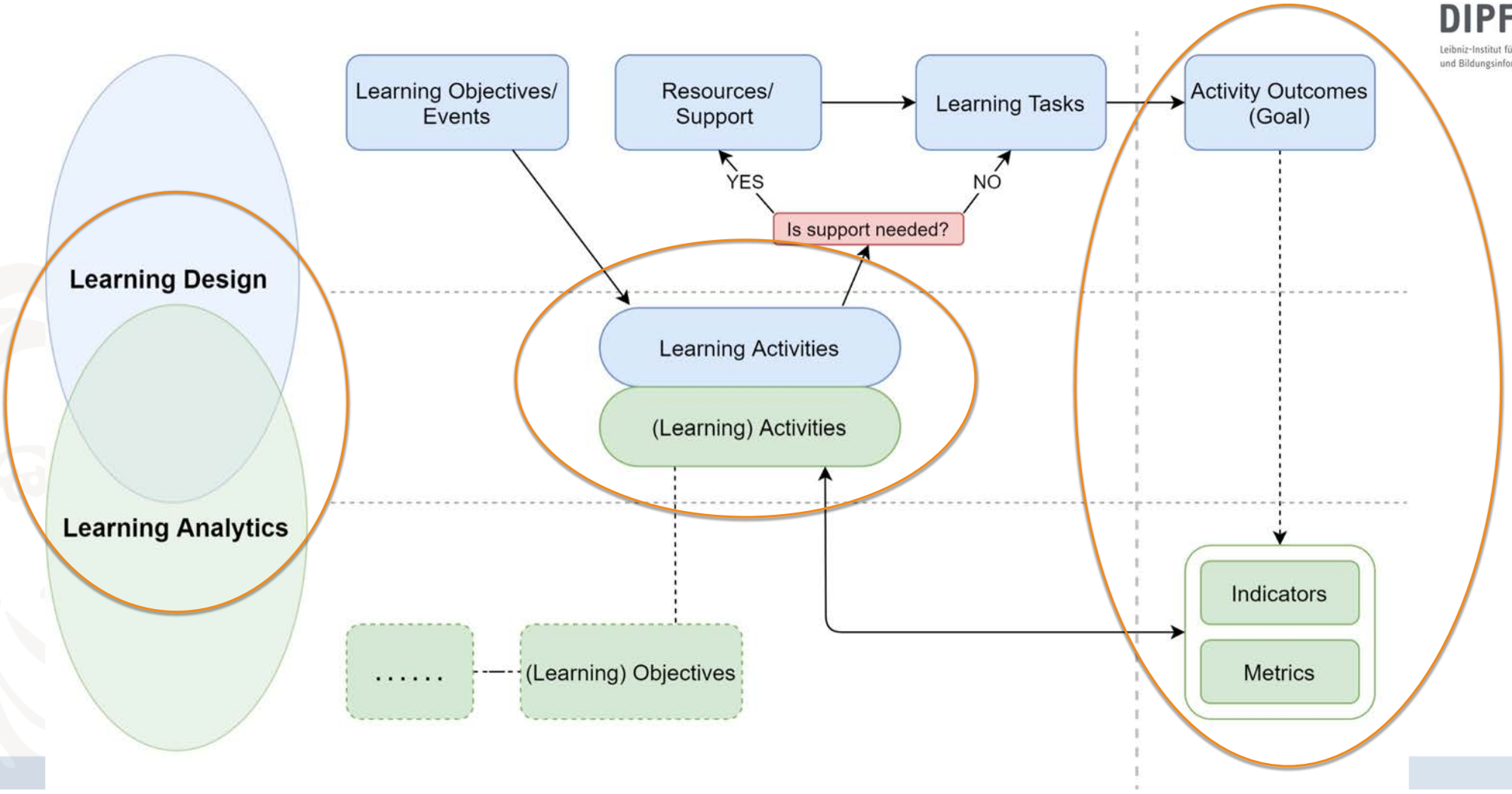
Photo by Alexander Schimmeck on Unsplash



Learning Analytics *Mit Design*

Learning Analytics *OHNE Design*

Evidence-based Learning Design



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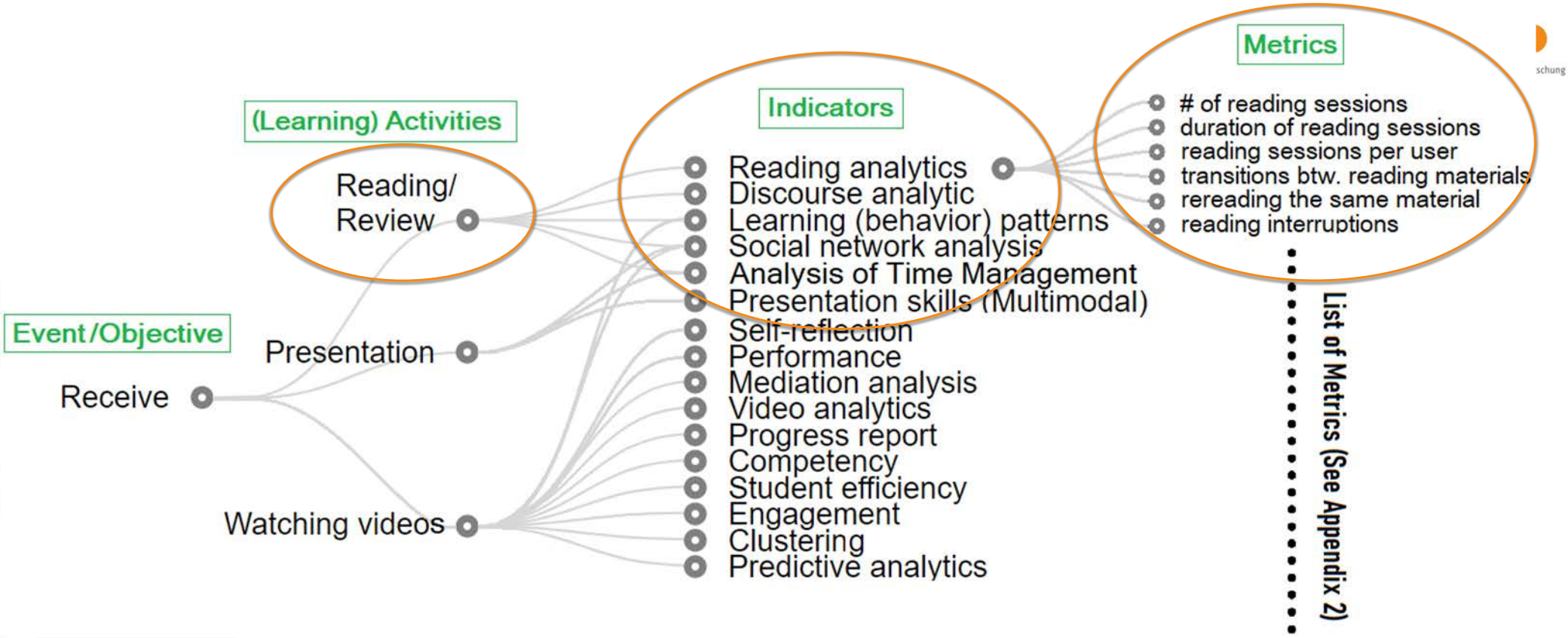

Ahmad, A.; Schneider, J.; Weidlich, J.; Di Mitri, D.; Yau, J.; Schiffner, D. and Drachsler, H. (2022). **What Indicators Can I Serve You with? An Evaluation of a Research-Driven Learning Analytics Indicator Repository**. In Proceedings of the 14th International Conference on Computer Supported Education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

Evidence-based Learning Design

Limited Edition: LAK20 Version

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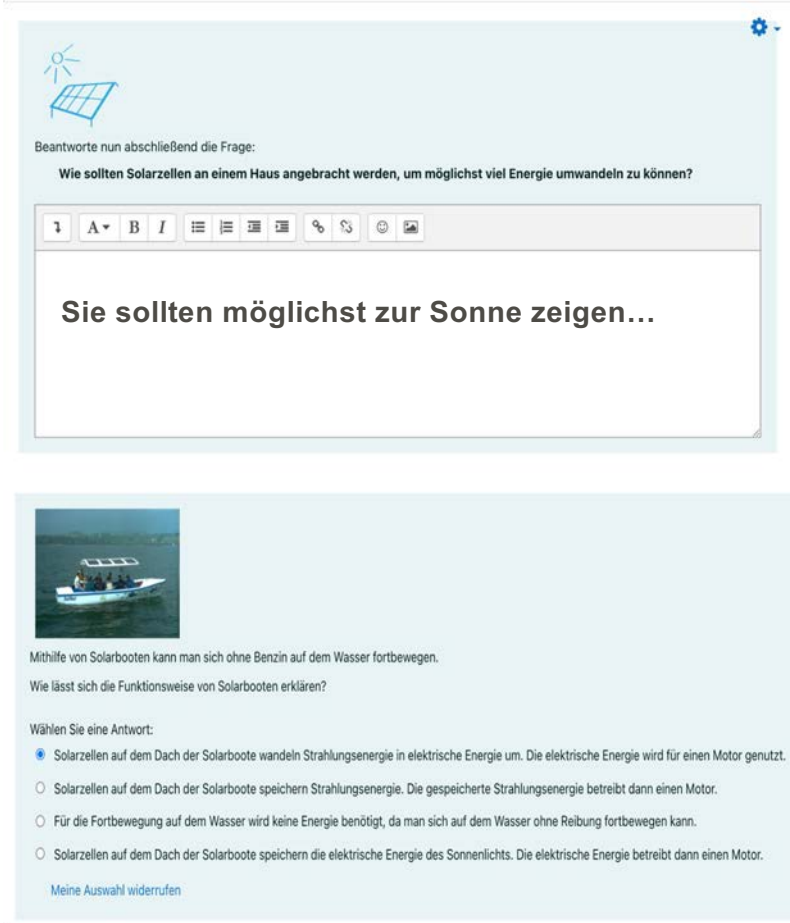
Schmitz, M., Scheffel, M., Bemelmans, R., & Drachsler, H. (2022). **FoLA2 — A Method for Co-creating Learning Analytics–Supported Learning Design**. Journal of Learning Analytics, 9(2), 265-281. https://doi.org/10.18608/jla.2022.7643

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

https://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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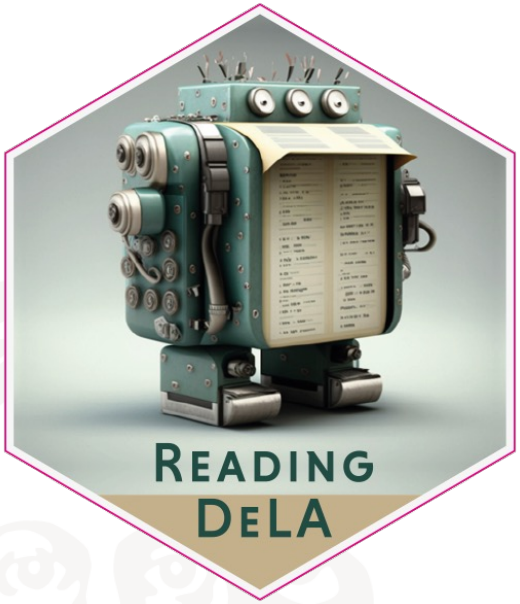
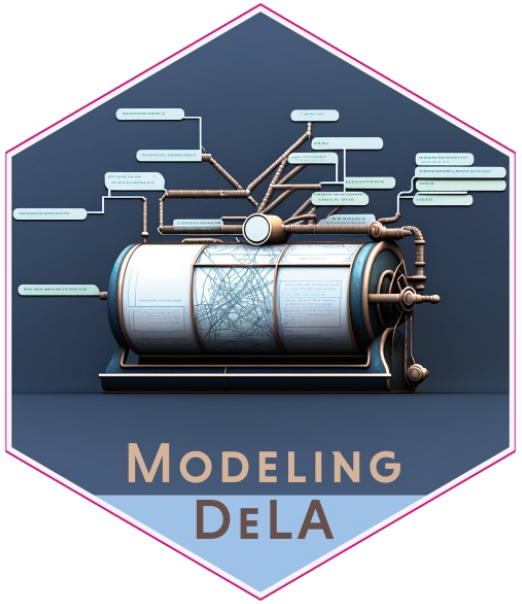
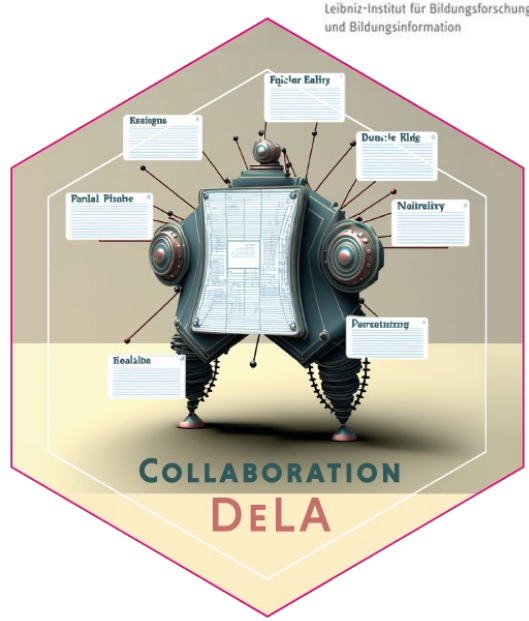
Data-Enriched Learning Activities



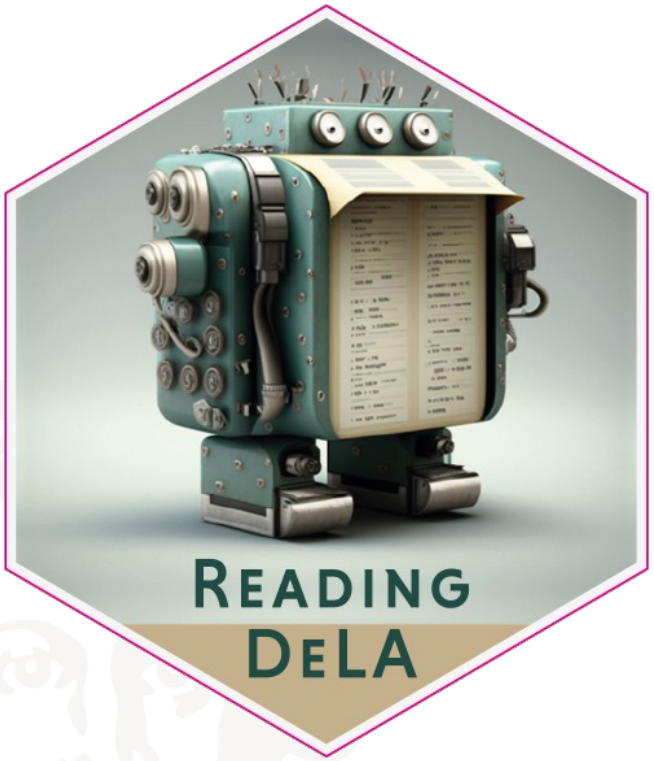


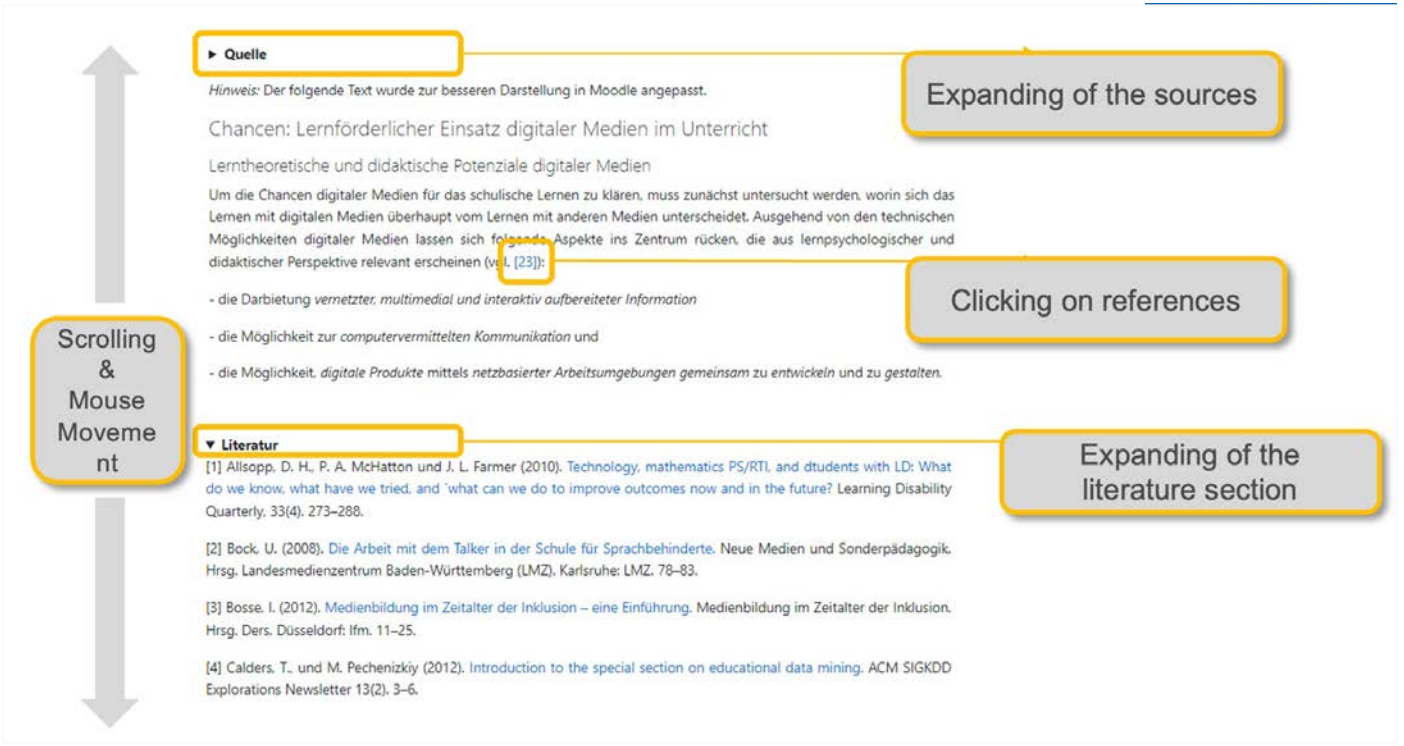


DeLA for the most common learning activities.

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

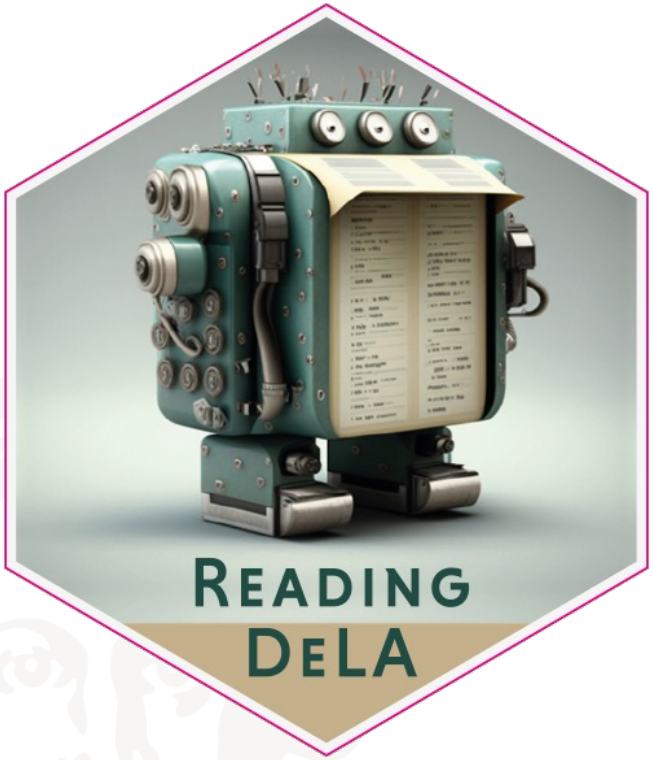
DeLA – Reading Analytics

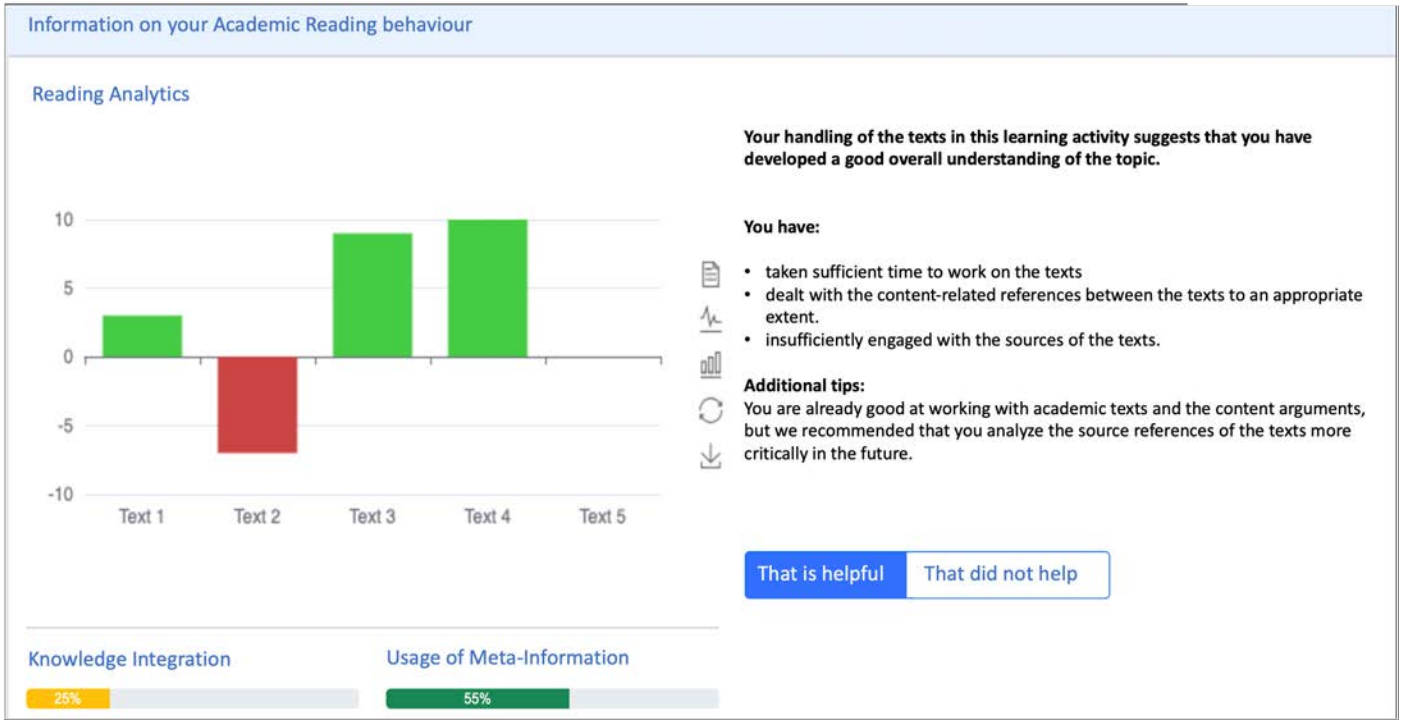




Biedermann, D., Schneider, J., Ciordas-Hertel, G., Eichmann, B., Hahnel, C., Goldhammer, F., Drachsler, H. (2023). ***Detecting the Disengaged Reader – Using Scrolling Data to Predict Disengagement during Reading***. In LAK23: 13th International Learning Analytics and Knowledge Conference. ACM.

DeLA – Reading Analytics





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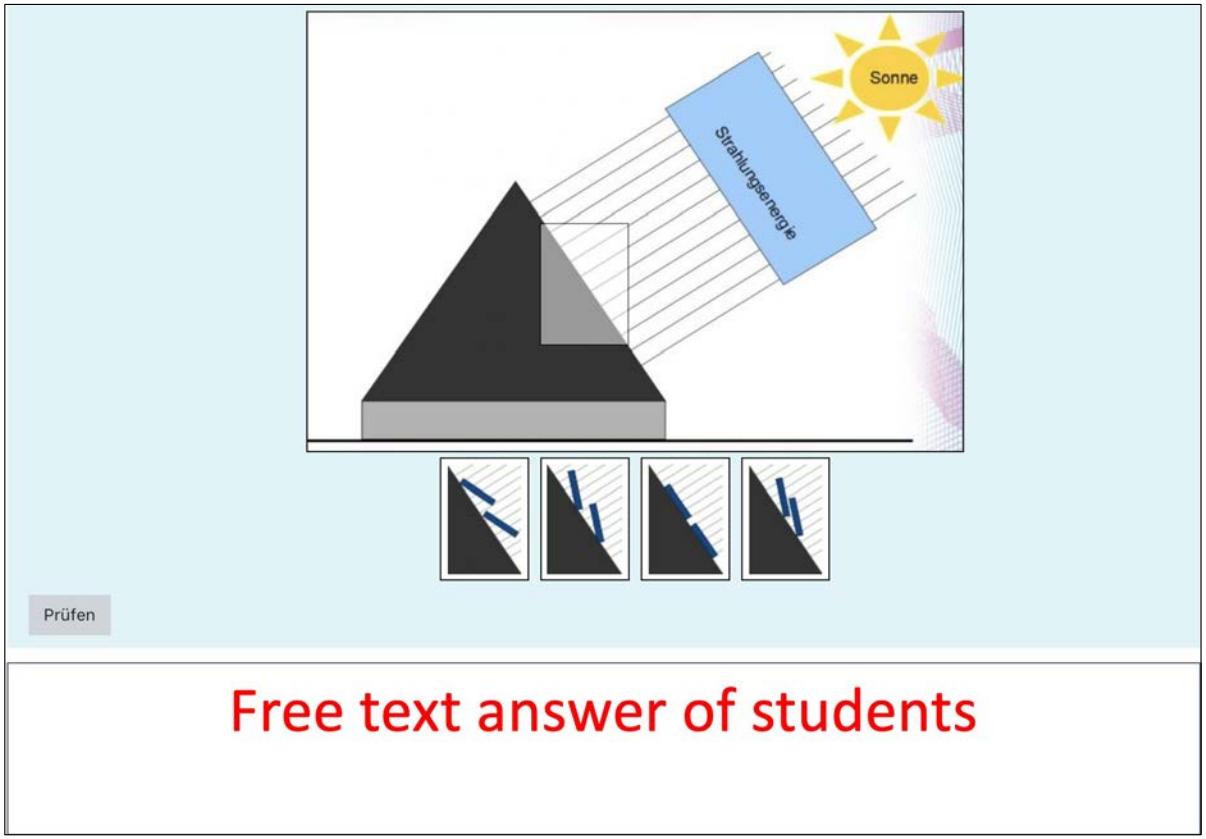
DeLA – Writing Analytics



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

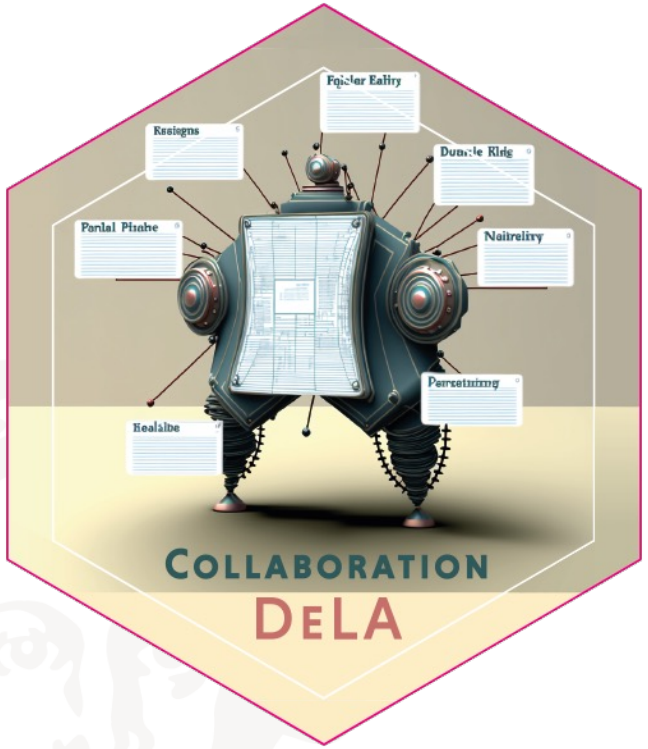
DeLA – Writing Analytics

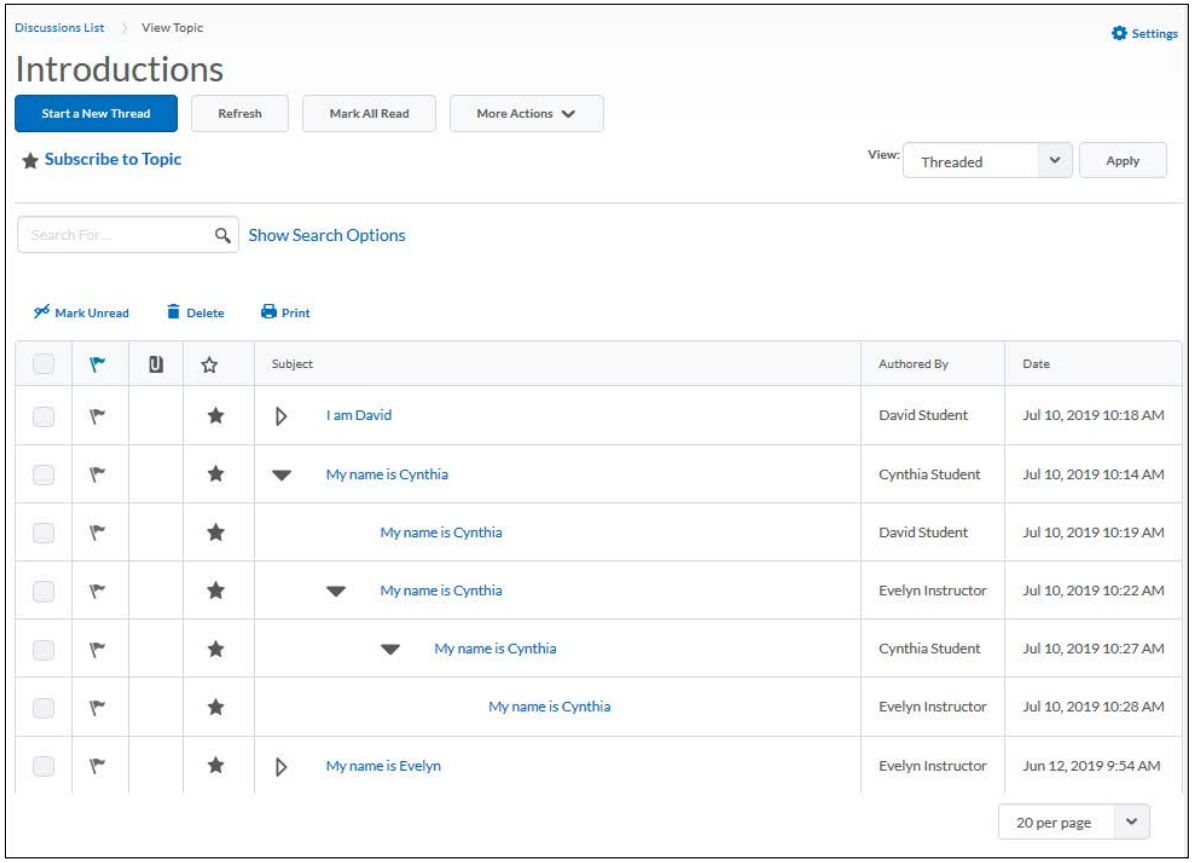
Students Scores based on Learning Goals

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





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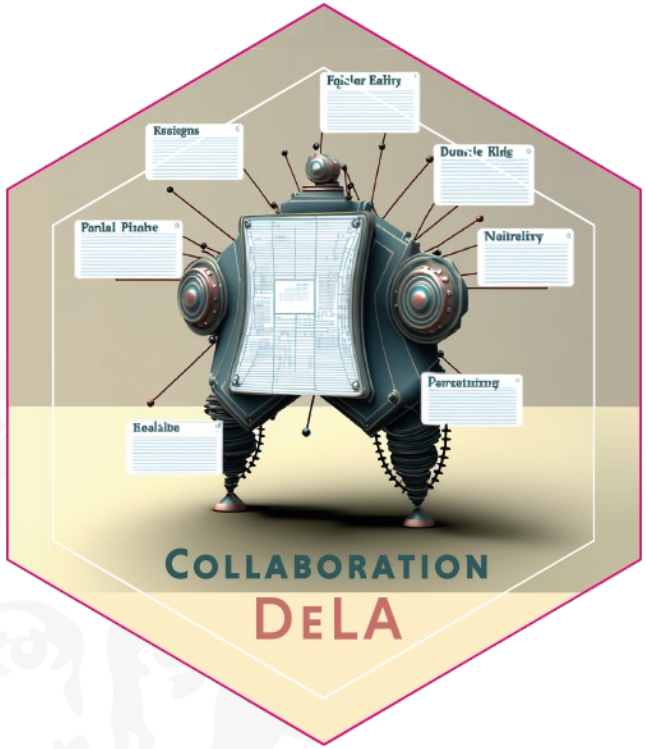
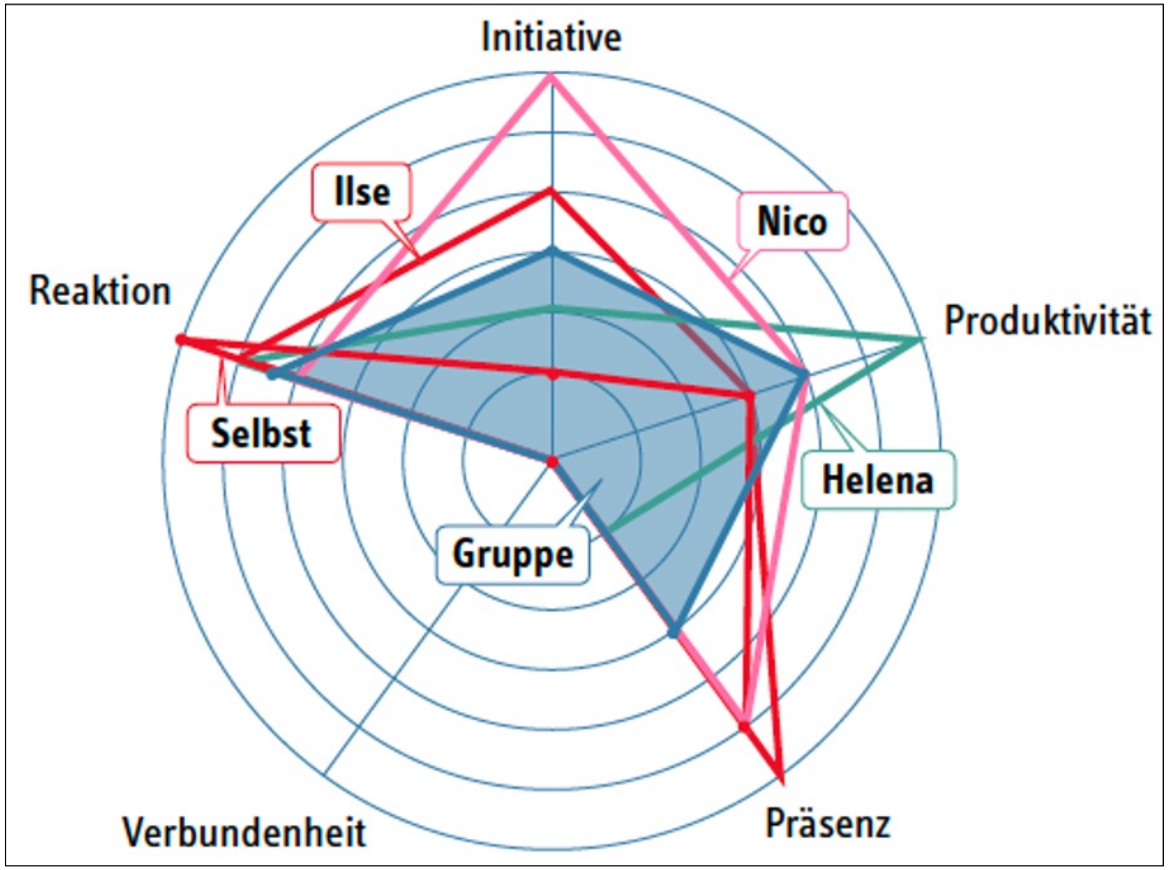
DeLA – Collaboration Analytics





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DeLA – Modeling Analytics

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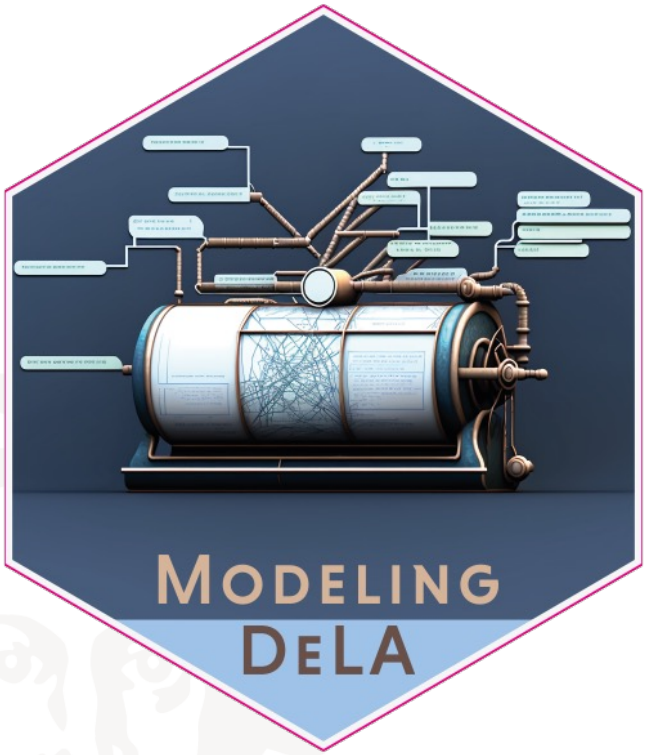

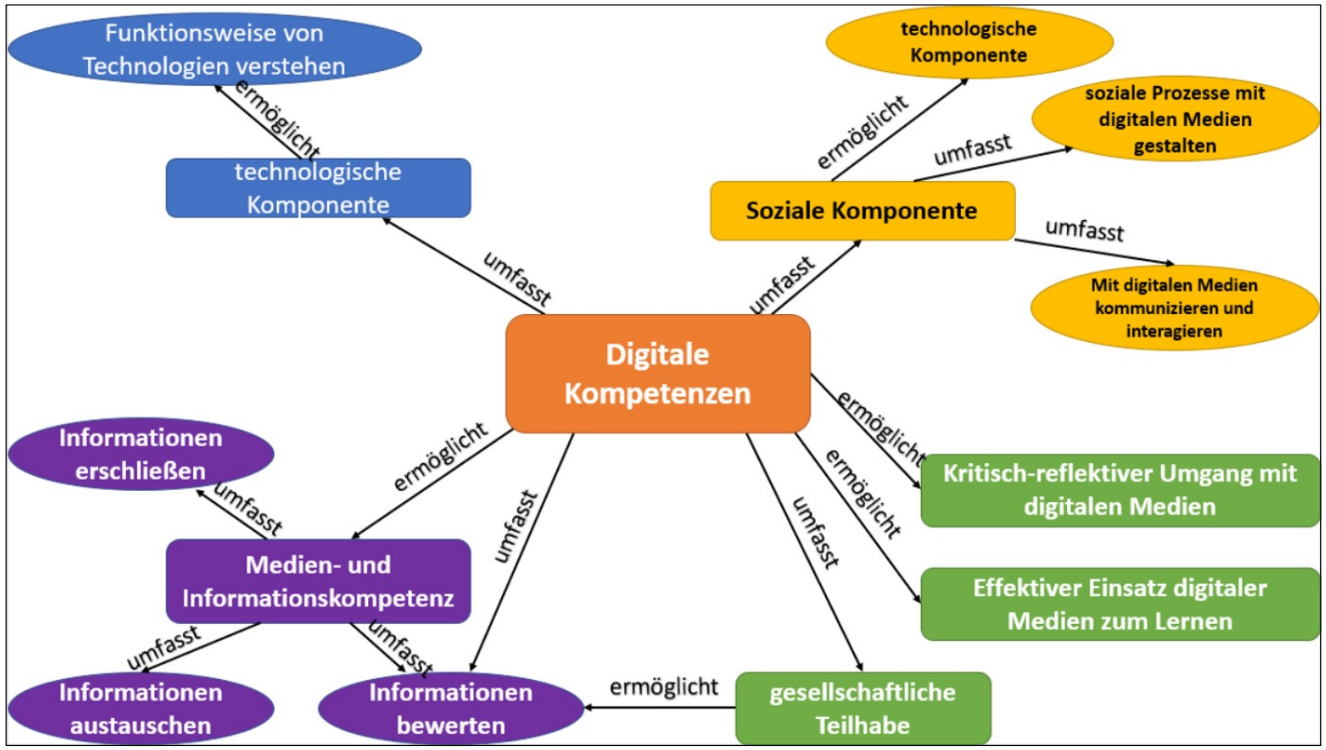

DeLA – Modeling Analytics

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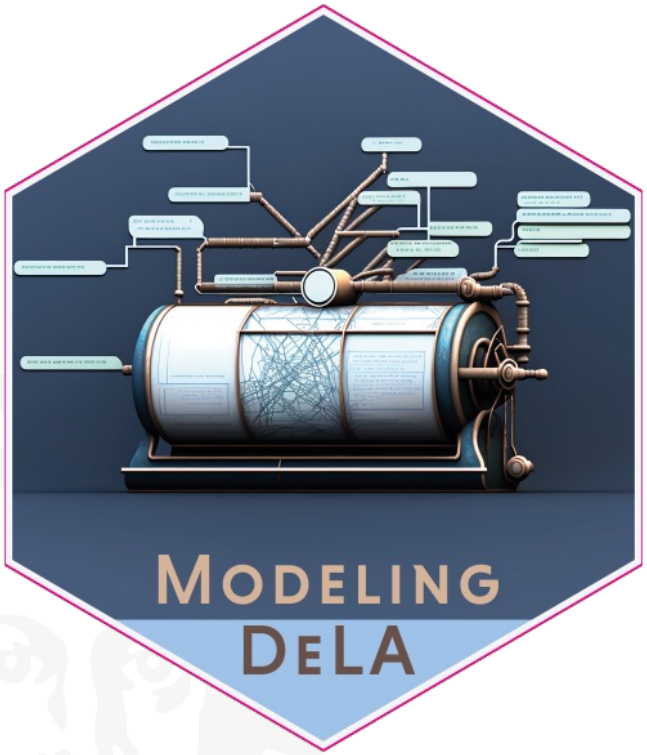


Feedback to your assignment

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 %

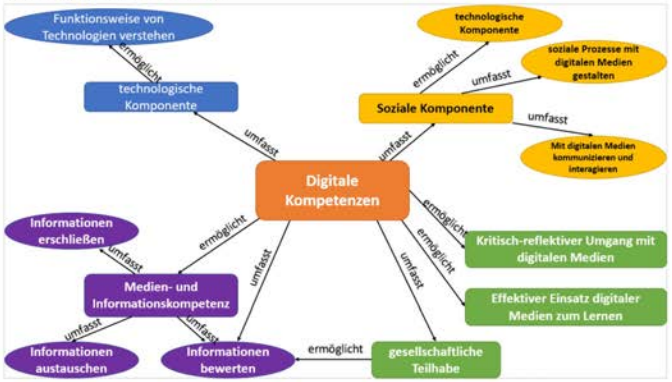
The assessment of your competences in learning activity 12:
Digital media competences of pupils

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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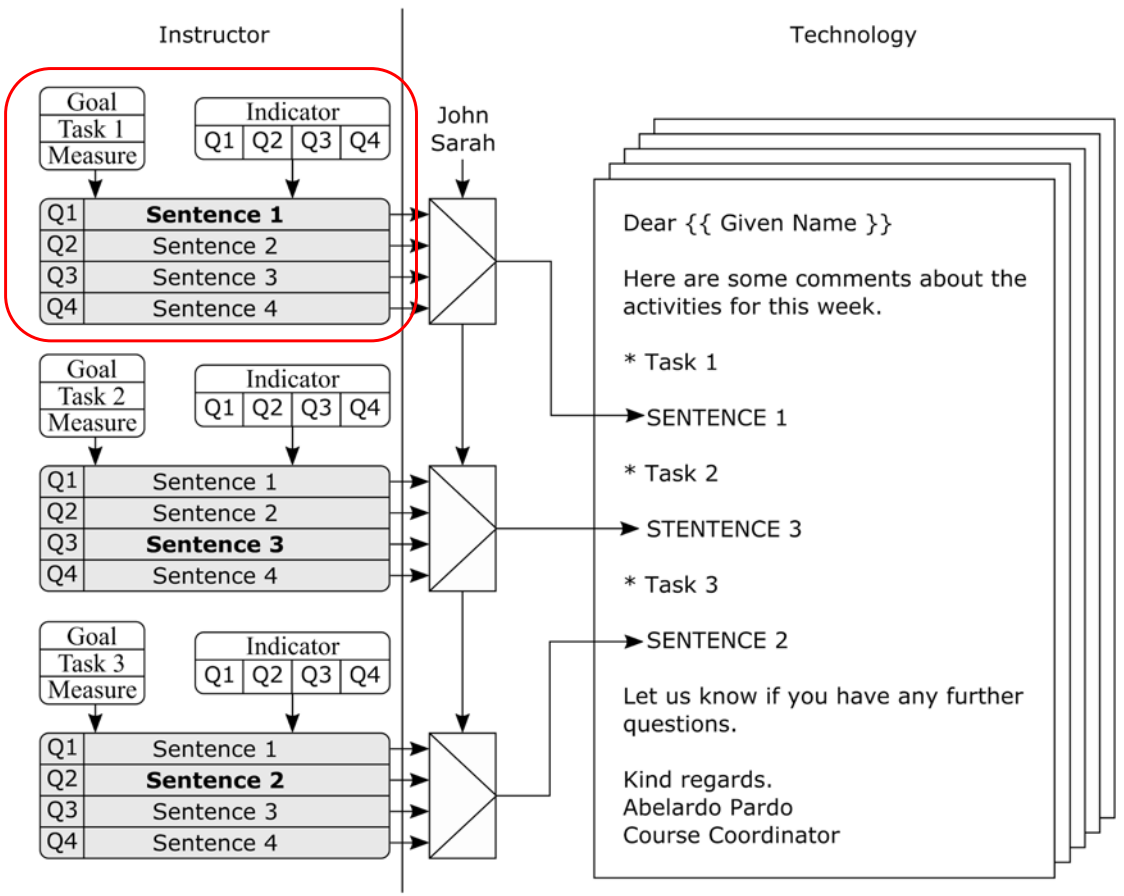
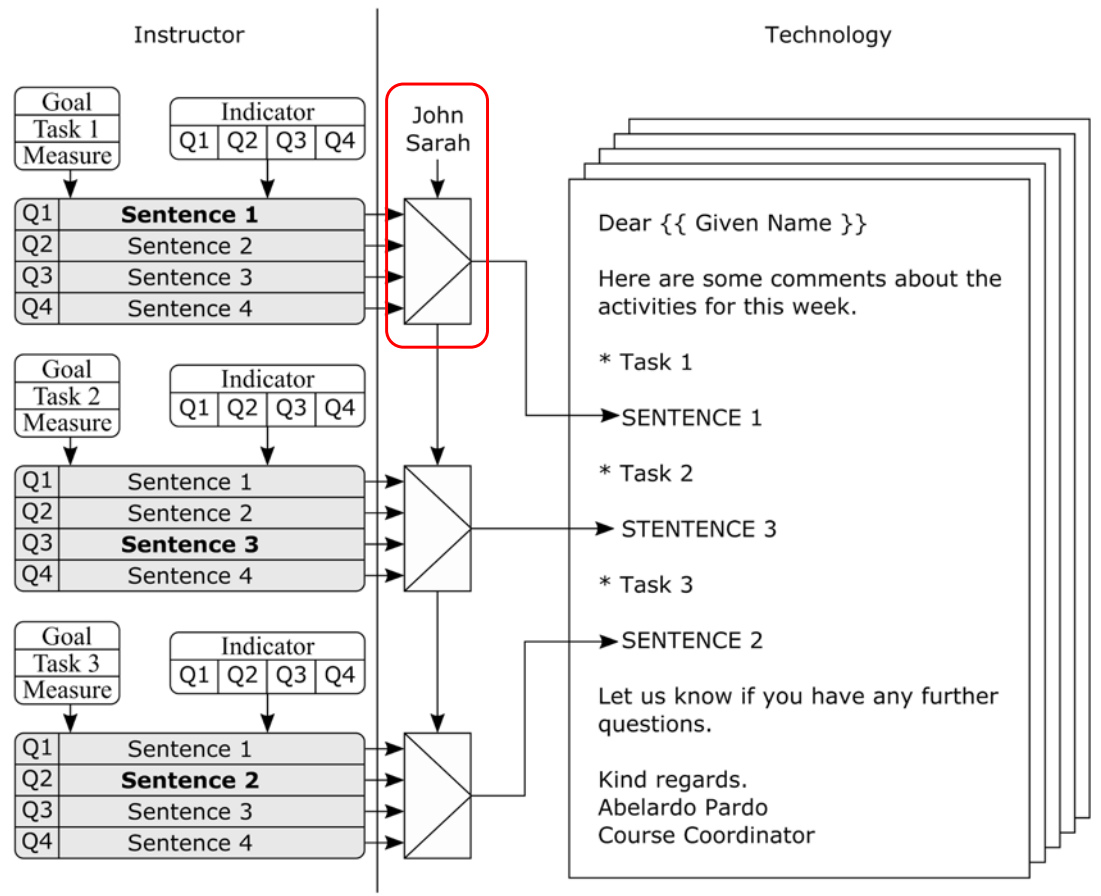
DeLA – Feedback System



Pardo, A., Bartimote, K., Shum, S. B., Dawson, S., Gao, J., Gašević, D. & Vigentini, L. (2018). **OnTask: Delivering data-informed, personalized learning support actions.** Journal of Learning Analytics, 5(3), 235-249. https://learning-analytics.info/index.php/JLA/article/view/5988

DeLA – Feedback System



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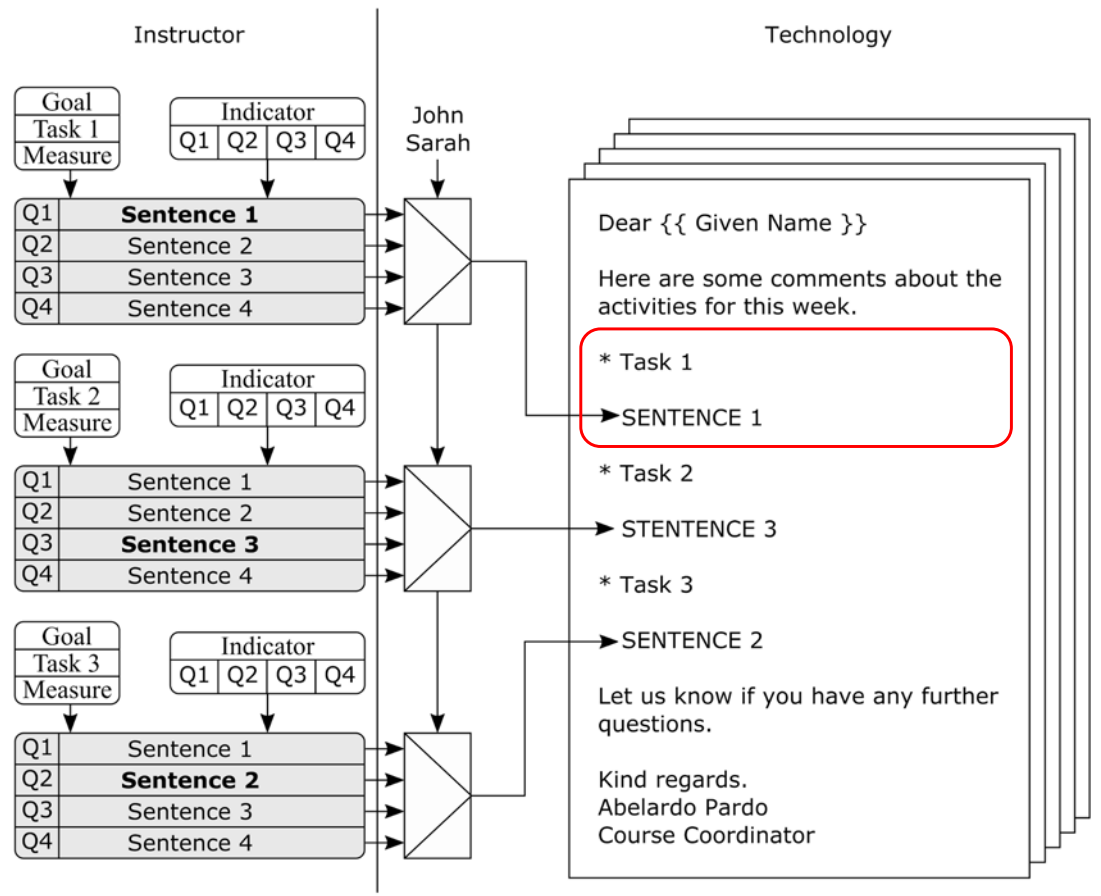
DeLA – Feedback System



Currently:
A template based feedback system,

Future:
LLM based feedback system

Pardo, A., Bartimote, K., Shum, S. B., Dawson, S., Gao, J., Gašević, D. & Vigentini, L. (2018). **OnTask: Delivering data-informed, personalized learning support actions.** Journal of Learning Analytics, 5(3), 235-249. https://learning-analytics.info/index.php/JLA/article/view/5988

Research Design for HILA & DeLAs

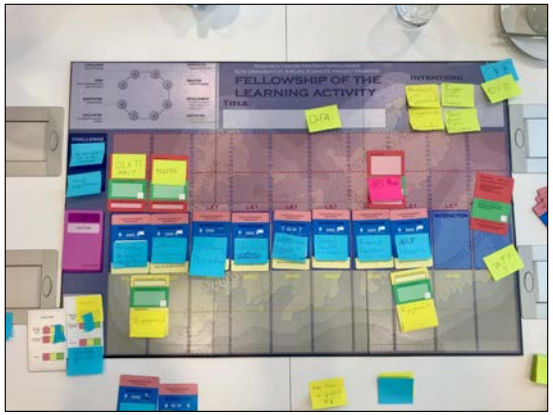
Preparation phase

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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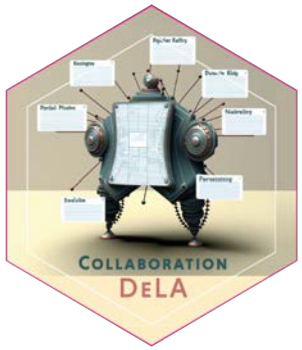
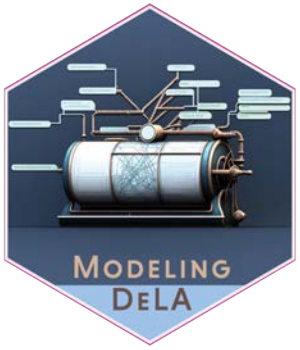
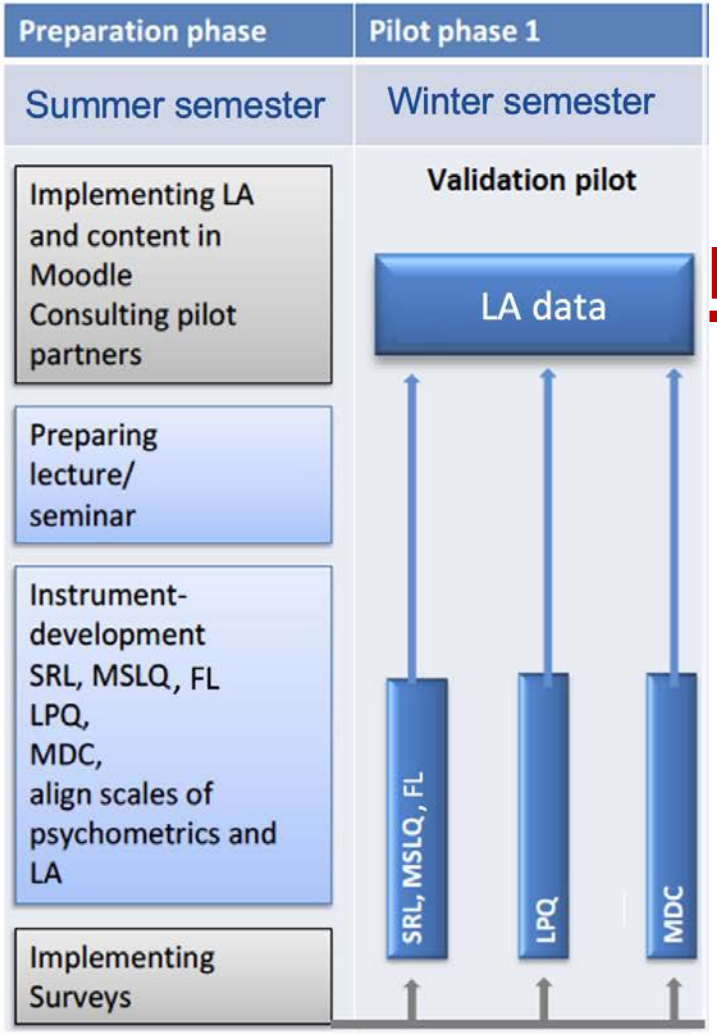
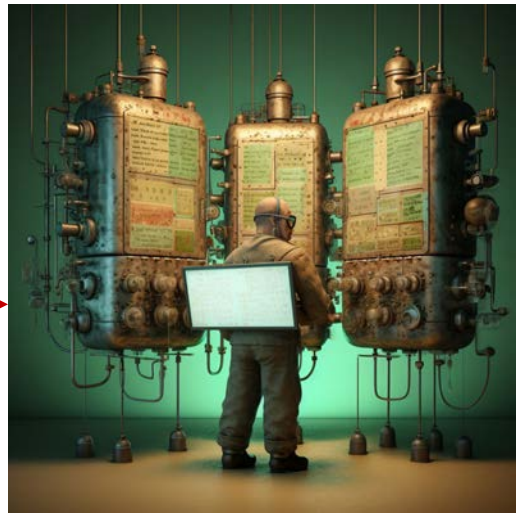




Research Design for HILA & DeLAs



Data Collection



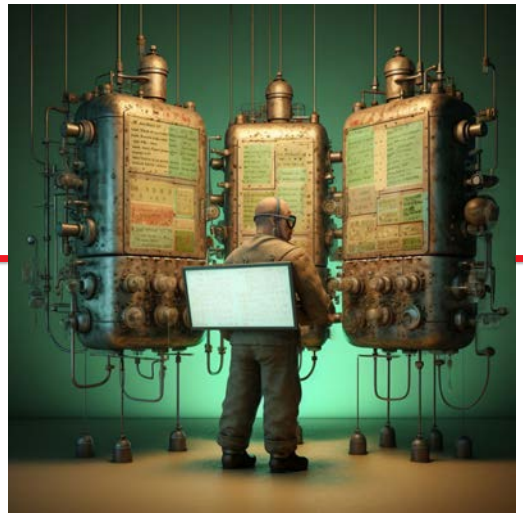
Research Design for HILA & DeLAs

studiumdigitale
Zentrale eLearning-Einrichtung Goethe-Universität Frankfurt am Main

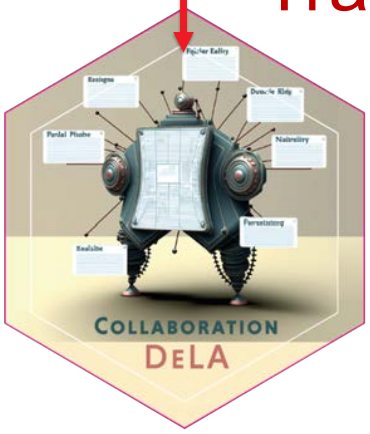
GOETHE UNIVERSITÄT FRANKFURT AM MAIN

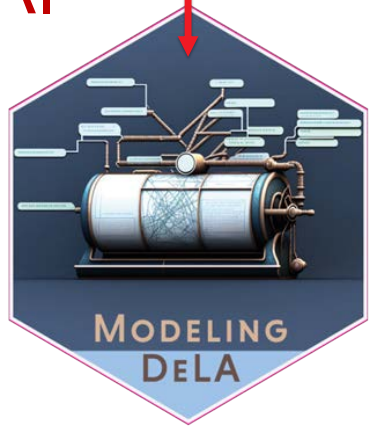
DIPF
Leibniz-Institut für Bildungsforschung und Bildungsinformation

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 ...

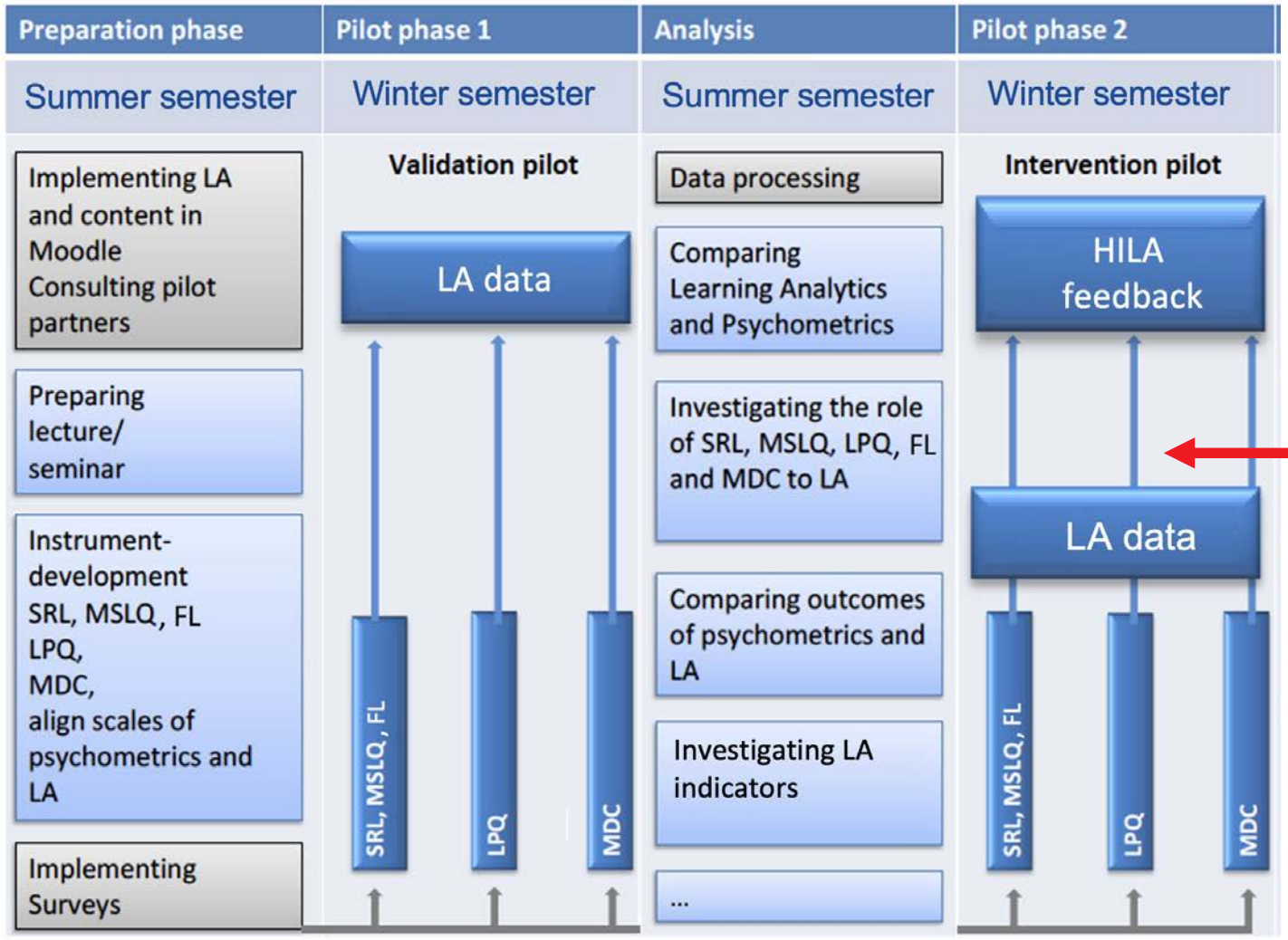


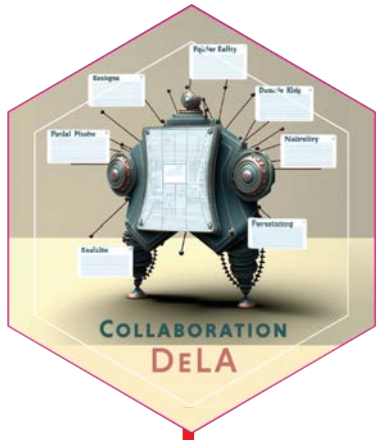
Training of AI



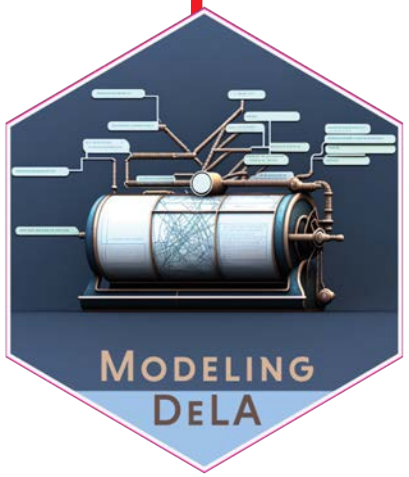


Research Design for HILA & DeLAs

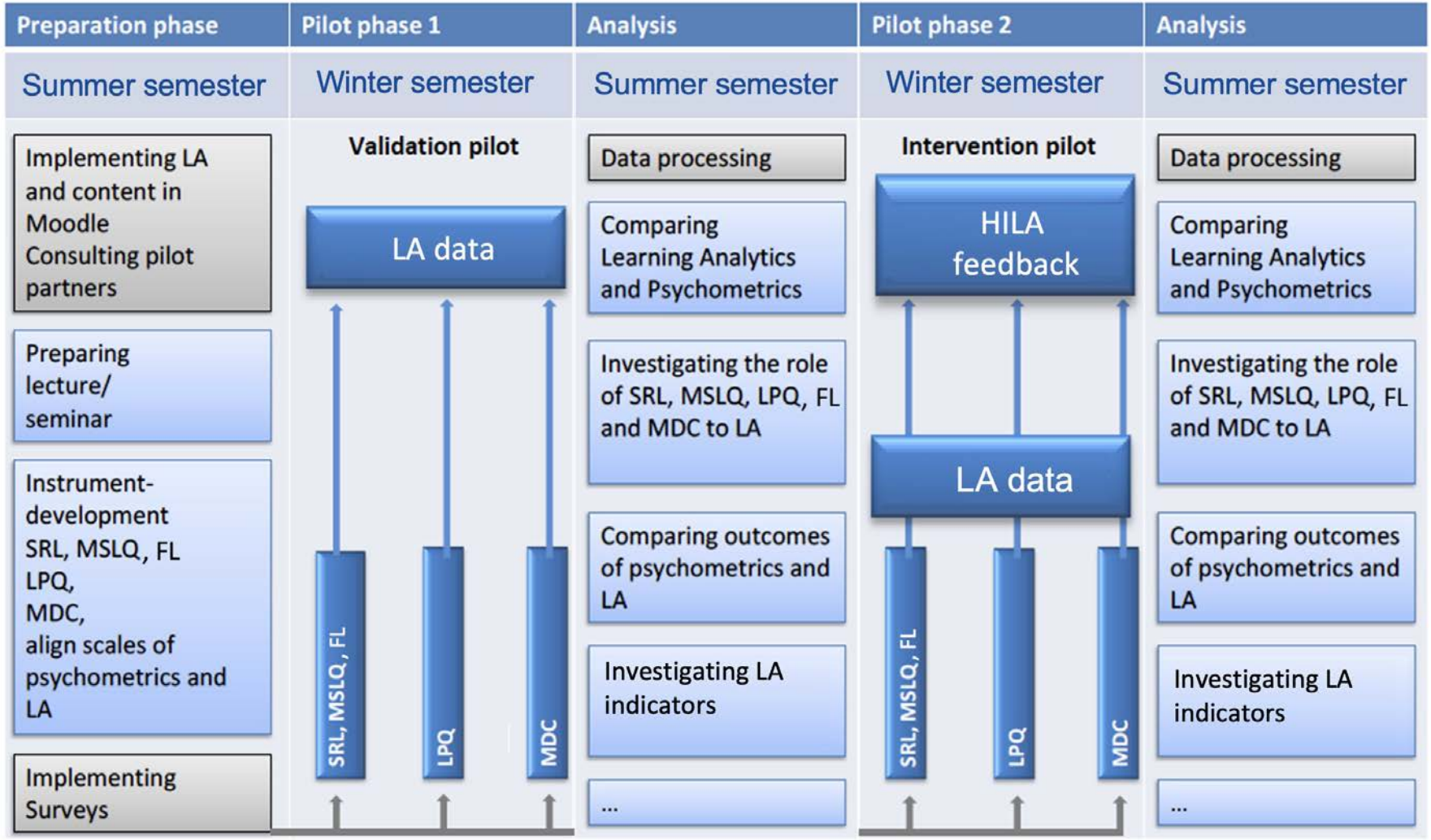




Feedback



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

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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