



Highly-Informative Learning Analytics: Evidence-Based AI for Feedback and Learning Support (2021 - 2026)

Welcome from Frankfurt am Main

Goethe's birthplace, Europe's financial centre, and a city of science.



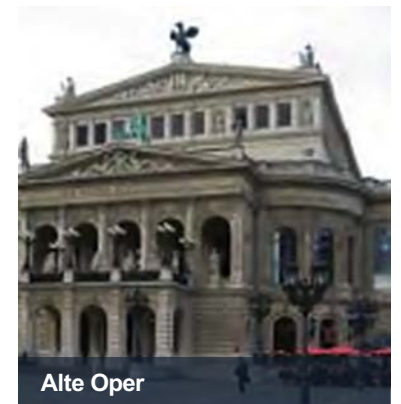
Campus Westend and the city skyline



The skyline above the river Main at dusk



DIPF Research Center



Alte Oper

Two partners, one city: Goethe University and DIPF

Where university teaching meets educational research.



Goethe University, Campus Westend: the IG Farben building

Goethe University Frankfurt

Founded in 1914 by the citizens of Frankfurt
One of the largest universities in Germany
studiumdigitale: the central unit for digital teaching and learning

DIPF | Leibniz Institute

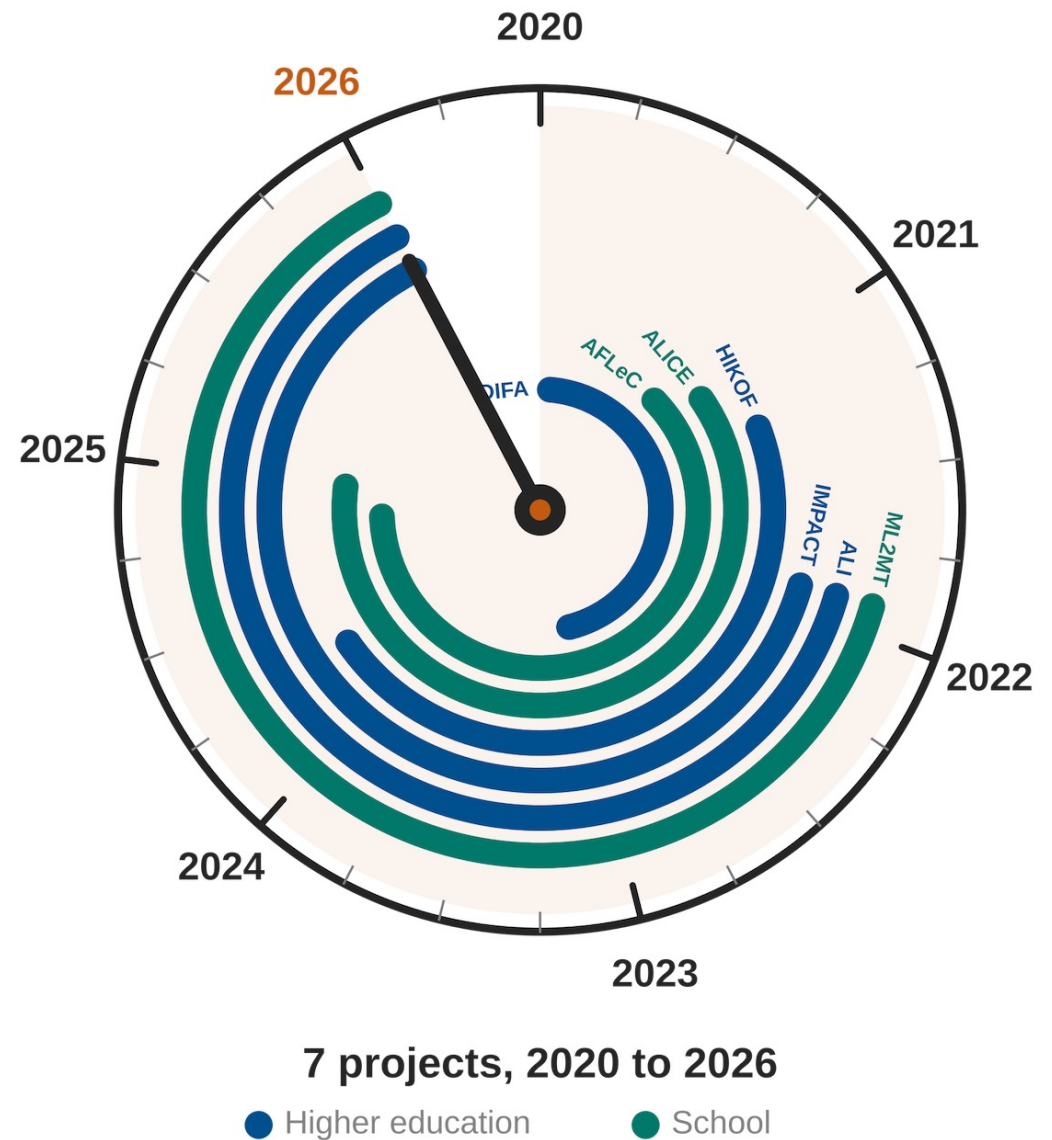
Leibniz Institute for Research and Information in Education

Research, digital infrastructure and transfer for education

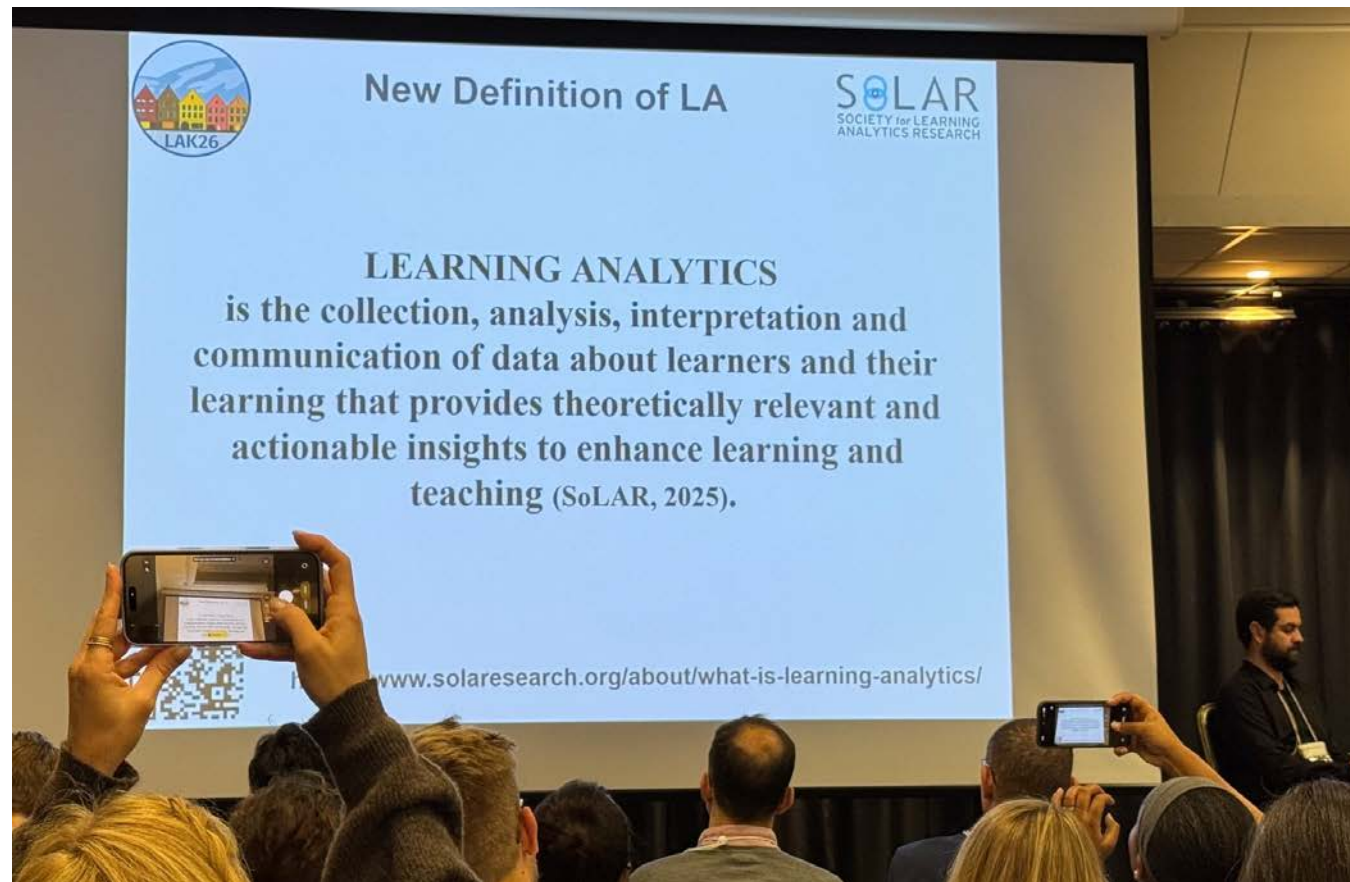
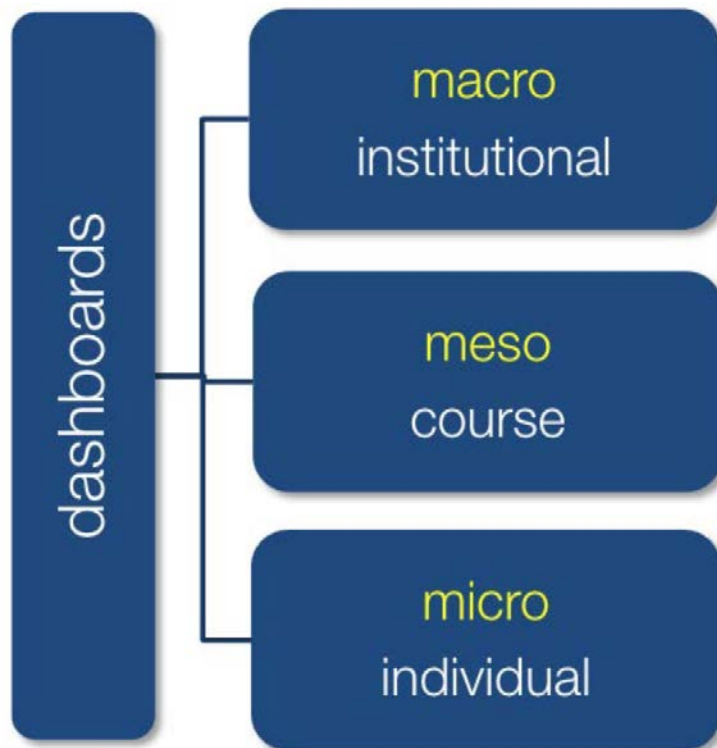
EduTec: educational technologies and learning analytics

Outline

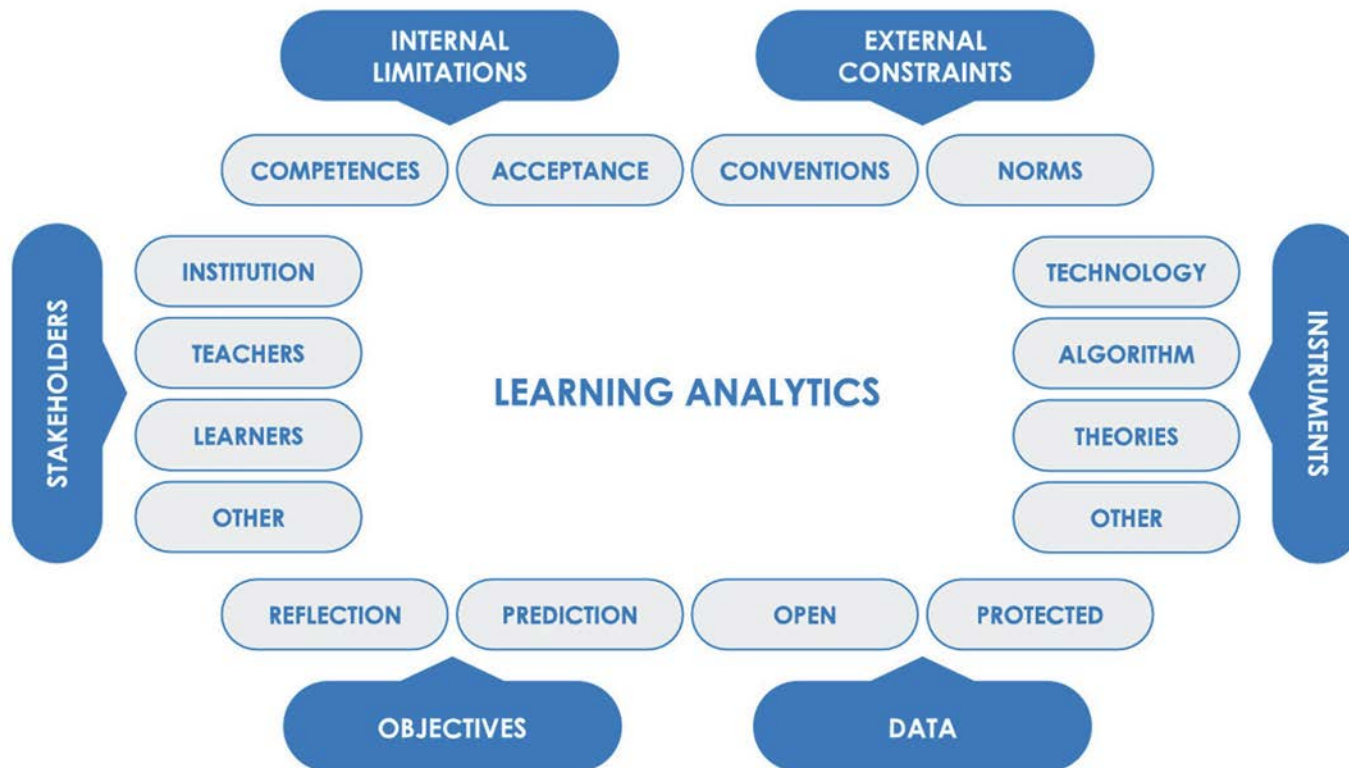
1. Grounding
2. Highly Informative Learning Anal
3. Data-enriched Learning Analytics
4. Research design
5. Evidence from our field studies (1
6. What we learned after 5 years



Definition



Learning Analytics in the Age of AI



Greller, W. & Drachsler, H. (2012). Turning Learning into Numbers. **Toward a Generic Framework for Learning Analytics.** Journal of Educational Technology & Society, 15(3), 42–57.

Challenges for the rollout of Learning Analytics



Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu



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: Ethics and Privacy.

Challenge 2: Weak pedagogical grounding.

Challenge 3: Ressource demands.

Challenge 4: Engagement and buy-in.

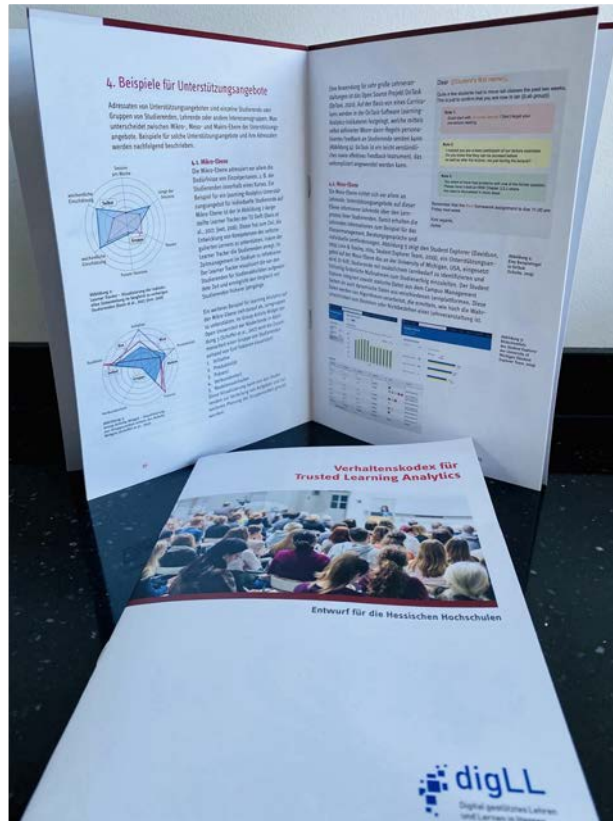
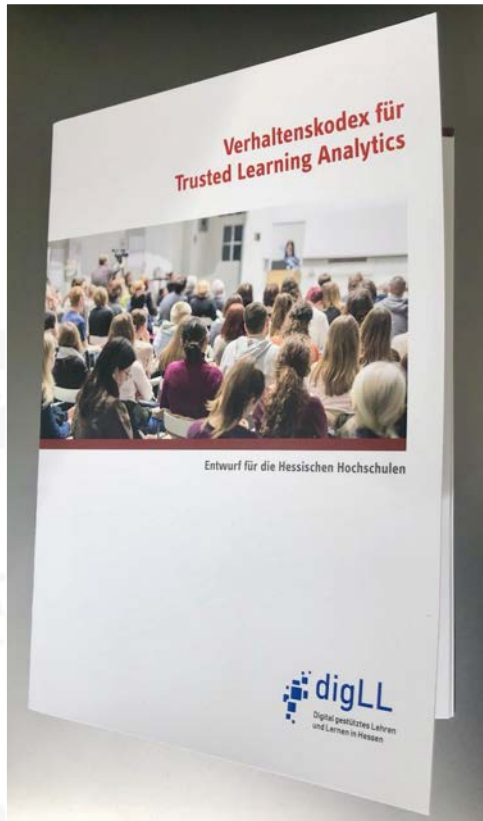
Tsai, Y-S, Rates, D., Moreno-Marcos, M. P., Muñoz-Merino, P. J., Jivet, I., Scheffel, M., Drachsler H., Delgado Kloos, C, Gašević, D (2020). *Learning analytics in European higher education-trends and barriers*, Computers & Education, 103933, <https://doi.org/10.1016/j.compedu.2020.103933>.

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1. Grounding
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6. What we learned after 5 years



Challenge 1: Ethics and privacy

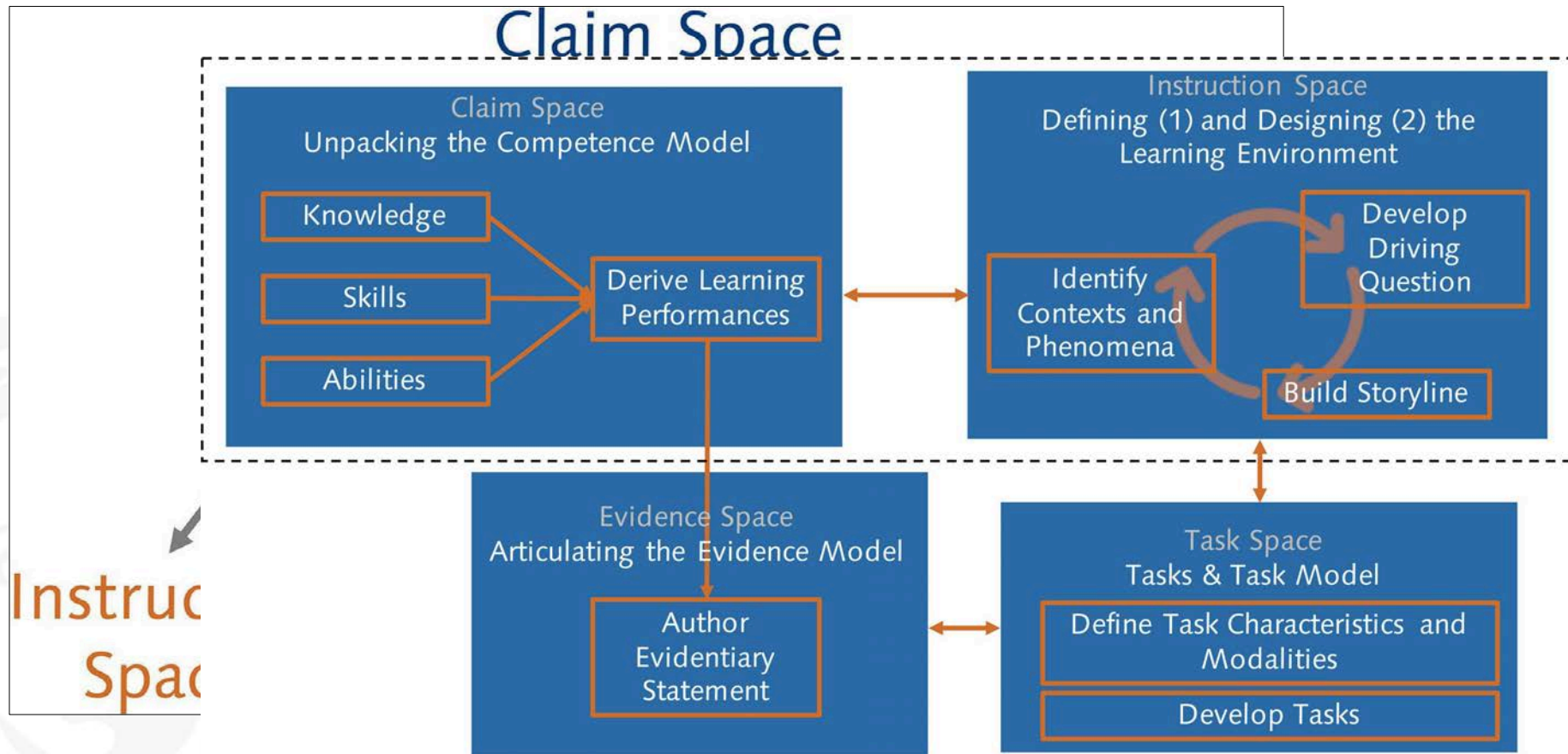


7 Principles

- 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

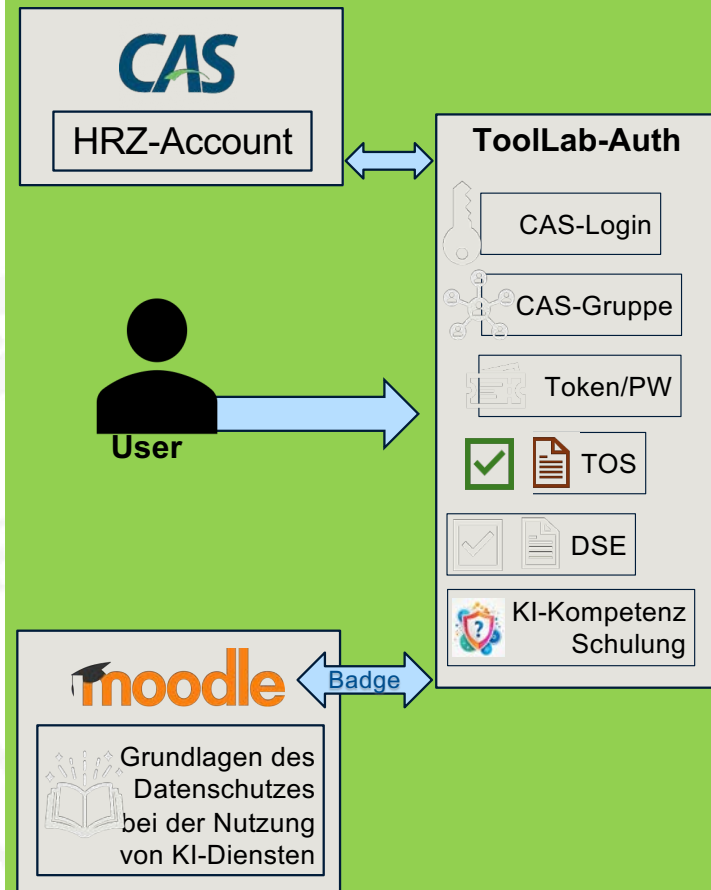
Challenge 2: Weak pedagogical grounding



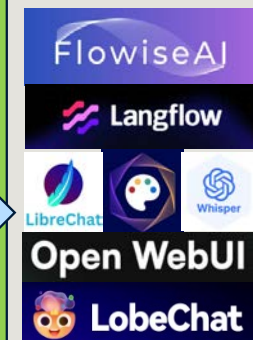
Kubsch M., Czinczel B., Lossjew J., Wyrwich T., Bednorz D., Bernholt S., Fiedler D., Strauß S., Cress U., Drachsler H., Neumann K. and Rummel N. (2022). **Toward learning progression analytics — Developing learning environments for the automated analysis of learning using evidence-centred design.** Front.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

Challenge 3: Ressource demands

Service

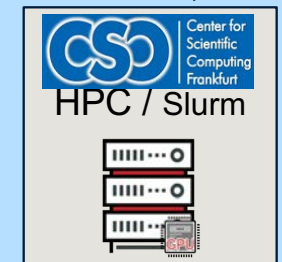
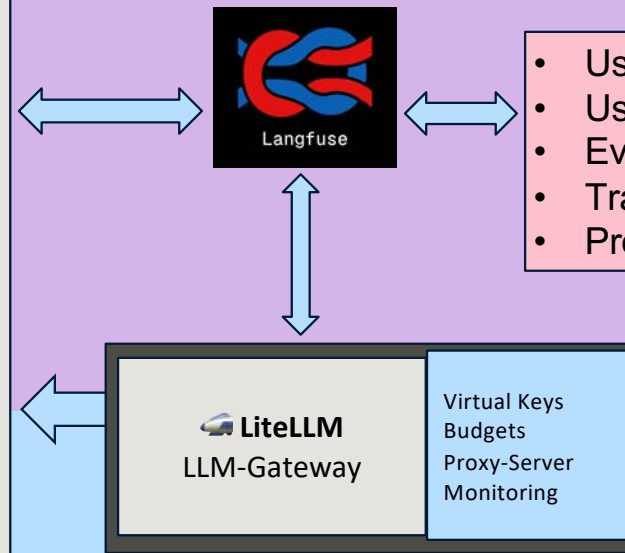


AI Tools



Research

- Use tools for research
- Use models for usage
- Evaluate tool usage
- Train models
- Projects



Infrastructure

Challenge 4: Engagement and buy-in



Tsai, Y-S, Gasevic, D, Whitelock-Wainwright, A, Muñoz-Merino, PJ, Moreno-Marcos, PM, Rubio Fernández, A, Delgado Kloos, C, Scheffel, M, Jivet, I, Drachsler, H, Tammets, K, Calleja, AR, Kollom, K, Haywood, J, Cantero, N, Gourdin, A, Kelo, M & Benke-Åberg, R 2018, **SHEILA: Supporting Higher Education to Intergrate Learning Analytics Research Report**. The University of Edinburgh, Edinburgh, UK

Model for Highly Informative Learning Analytics

Learning Analytics (LA)

Psychometrics (PSY)

Data-enriched Learning Analytics (DeLA)

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 Learning Analytics Solutions. pp. 67-80. Singapore: Springer.

Highly Informative Feedback with Learning Analytics



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

*Highly informative feedback goes **beyond feedback on right/wrong**, it provides **correct solutions, hints for personal improvement** and **competence development** and is ideally given **during the learning process**.*

The other side of the coin: Feedback Literacy



Hypothesized dimensions

(1) Openness to feedback

agency→
function→
model→
readiness→

(2) Engagement with feedback

appraisal→
emotion→
engaging & processing→
decoding→
seeking→

(3) Enactment of feedback

adaptation→
enactment→
monitoring→

Empirical model

Dimension A
Feedback attitudes

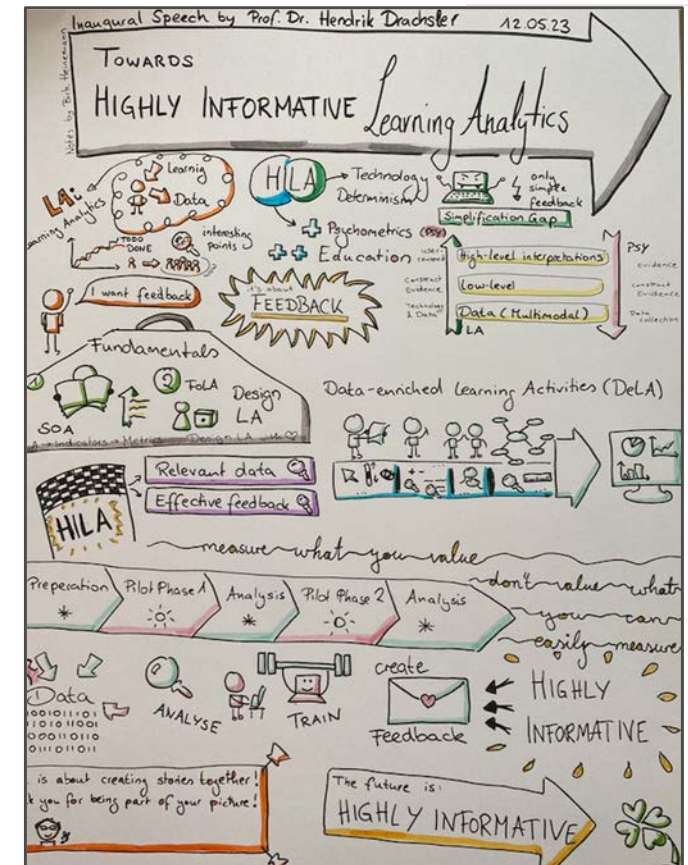
Dimension B
Feedback practices

Woitt, S., Weidlich, J., Jivet, J., Orhan Göksün, D., Drachsler, H., & Kalz, M. (2023). **Students' feedback literacy in higher education: an initial scale validation study**. Teaching in Higher Education, 1-19.

DOI: [10.1080/13562517.2023.2263838](https://doi.org/10.1080/13562517.2023.2263838)

Highly Informative Learning Analytics in a nutshell

1. **Focus on micro-level of learning and teaching**
 - a. Individual and group learning
 - b. Feedback for learners & teachers
 - c. Considering the learning context and skills of the learners
2. **Create Data-enriched Learning Activities (DeLA)**
 - a. Involve LA at the stage of Learning Design
 - b. Address common learning activities
 - c. Improve learner outcomes
3. **Contribute to evidences about its effects**
 - a. Reliability and validity of LA applications
 - b. Contribute empirical evidence on LA in practice
 - c. Release open data sets



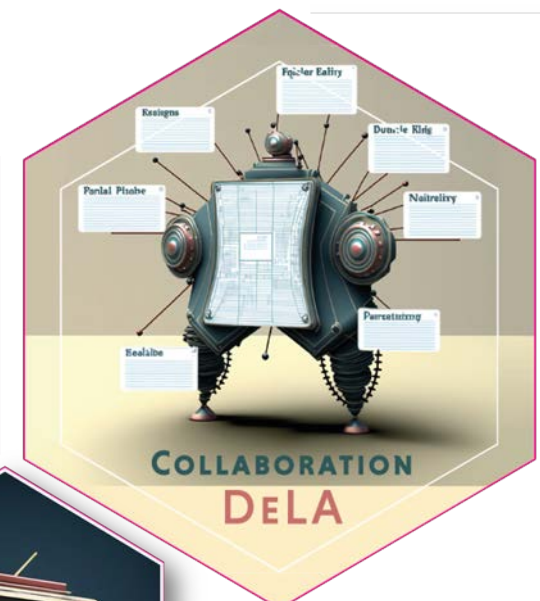
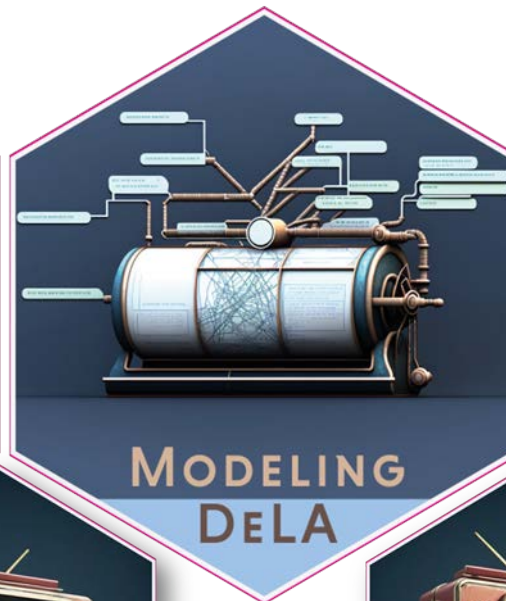
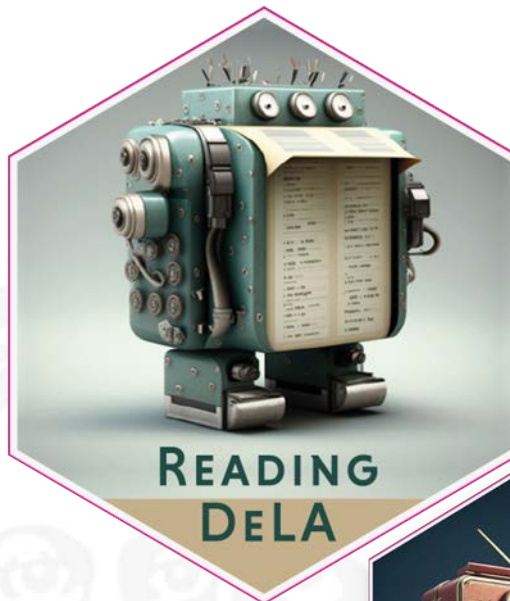
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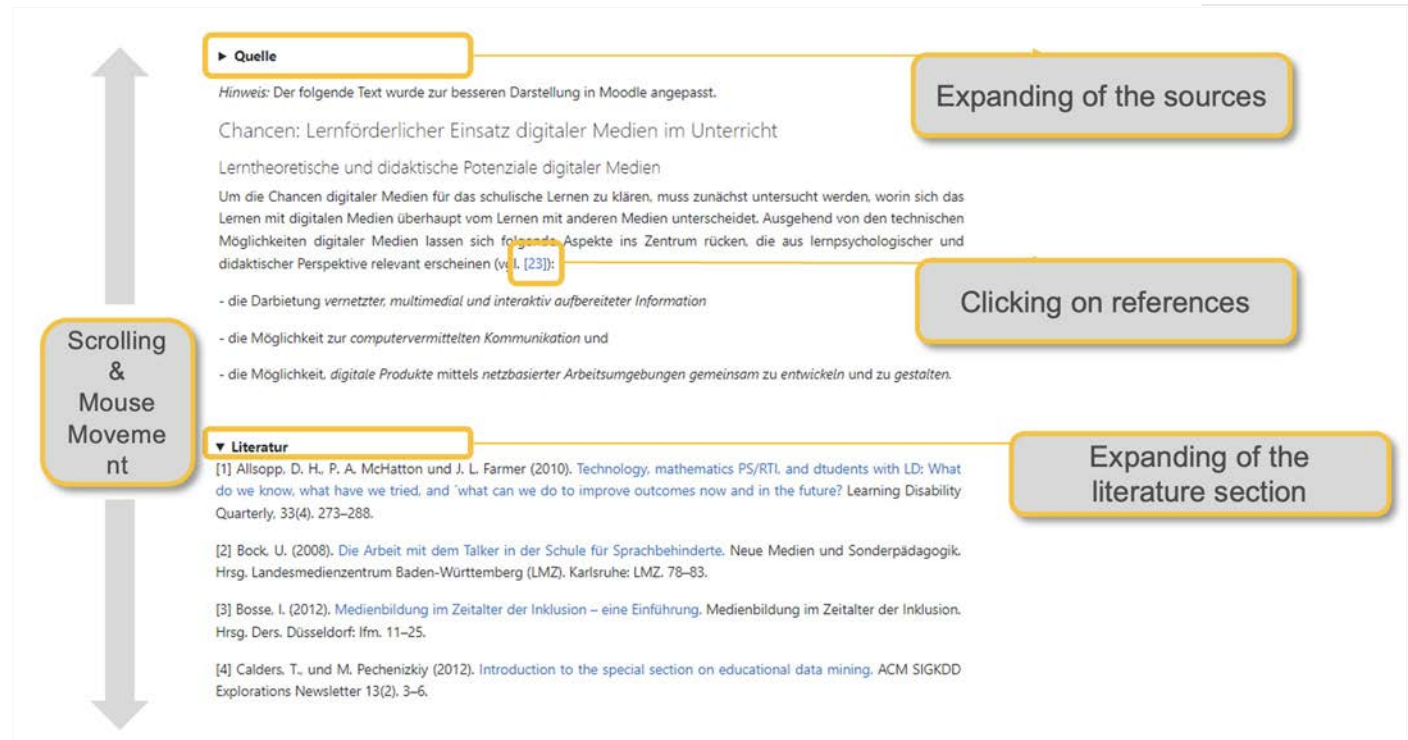
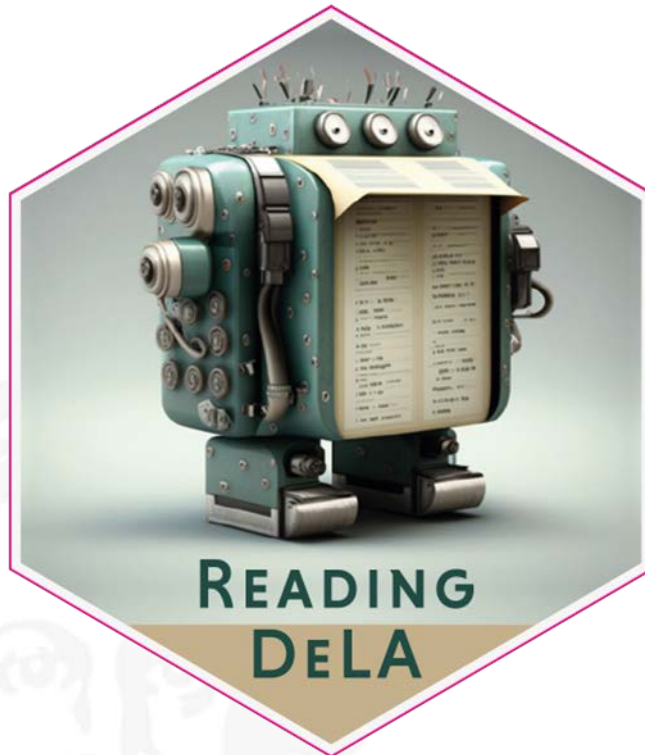


Data-Enriched Learning Activities

DeLA for the most common learning activities.



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.

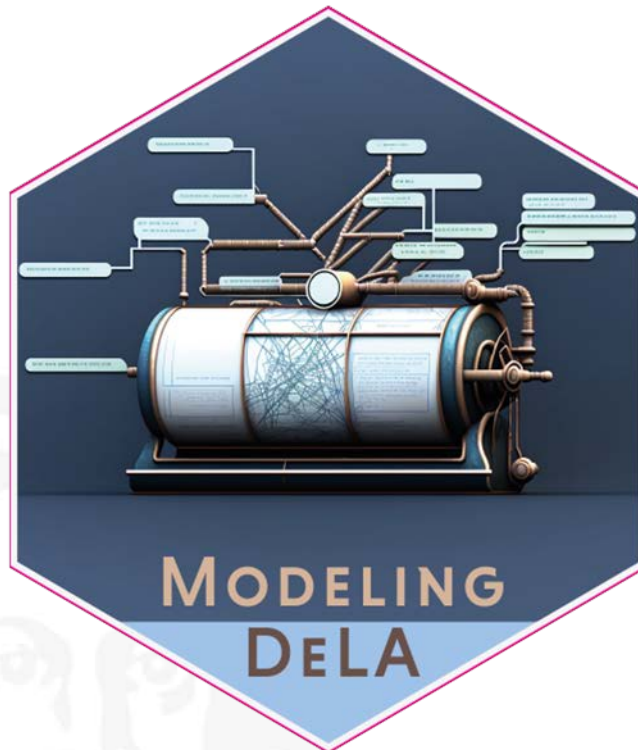
DeLA – Writing Analytics

A diagram illustrating energy transfer. A sun labeled "Sonne" emits rays labeled "Strahlungsenergie" (radiation energy) towards a large black pyramid. Below the large pyramid are four smaller black pyramids, each receiving a portion of the energy. A button labeled "Prüfen" (Check) is located at the bottom left of the diagram area.

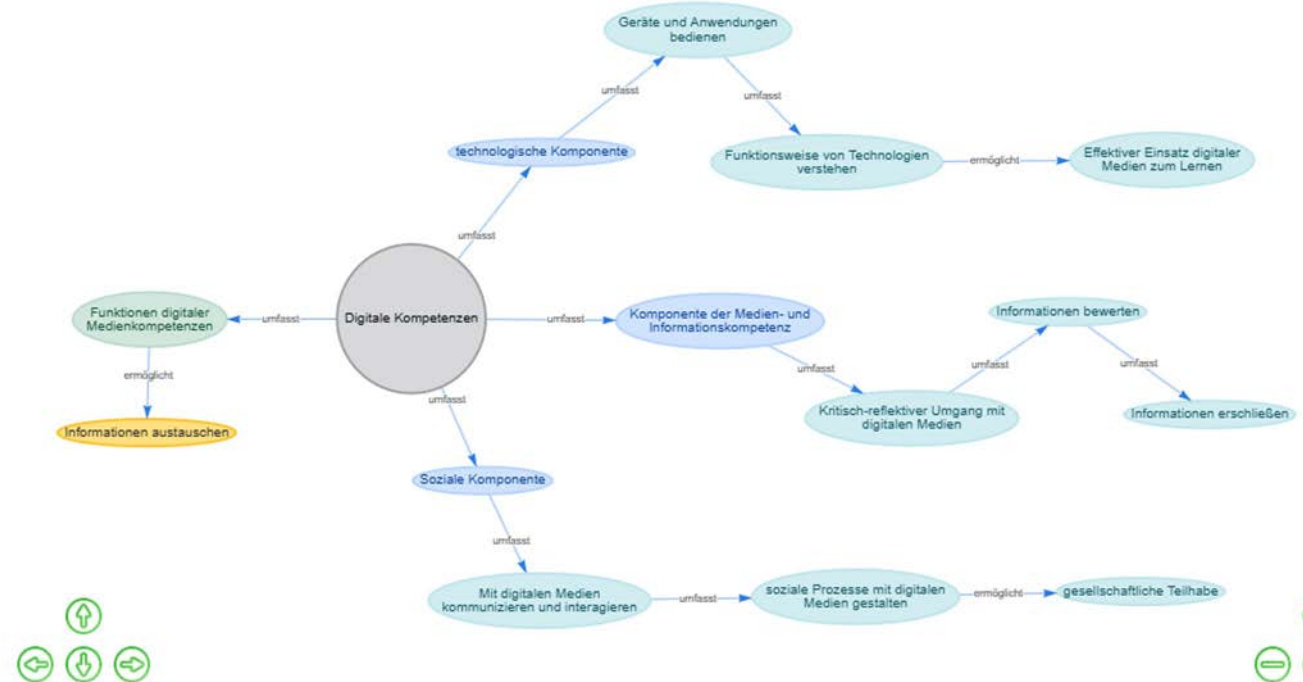
Free text answer of students

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 – Modeling Analytics

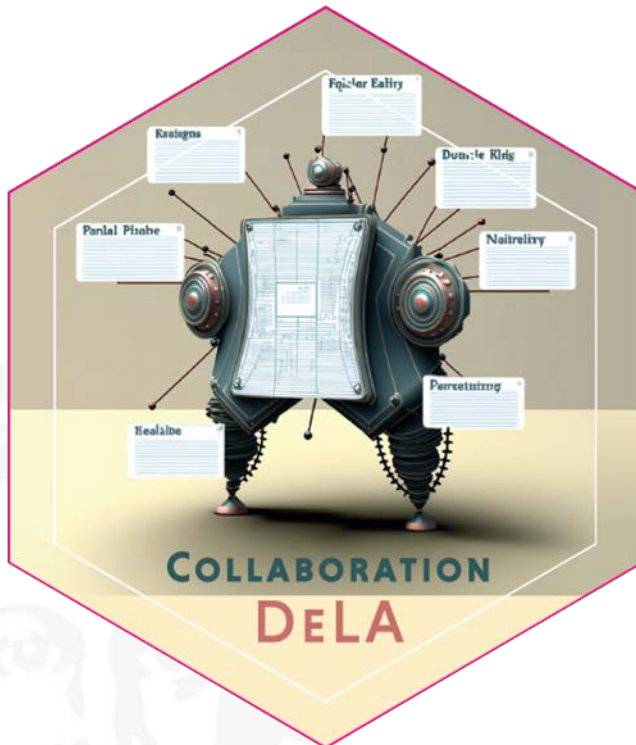


Eingereichte Lösung:



Vossen, P. V., Gasparini, I., Oliveira, E. H. T., Czinczel, B., Harms, U., Menzel, L., Gombert, S., Neumann, K., & Drachsler, H. (2024). **Concept map assessment through structure classification**. In Workshop on Automated Evaluation of Learning and Assessment Content, 25th International Conference on Artificial Intelligence in Education (AIED 2024), Recife, Brasil.

DeLA – Collaboration Analytics



Discussions List > View Topic

Introductions

Start a New Thread Refresh Mark All Read More Actions

★ Subscribe to Topic

View: Threaded Apply

Search For... Show Search Options

Mark Unread Delete Print

				Subject	Authored By	Date
☐			★	I am David	David Student	Jul 10, 2019 10:18 AM
☐			★	My name is Cynthia	Cynthia Student	Jul 10, 2019 10:14 AM
☐			★	My name is Cynthia	David Student	Jul 10, 2019 10:19 AM
☐			★	My name is Cynthia	Evelyn Instructor	Jul 10, 2019 10:22 AM
☐			★	My name is Cynthia	Cynthia Student	Jul 10, 2019 10:27 AM
☐			★	My name is Cynthia	Evelyn Instructor	Jul 10, 2019 10:28 AM
☐			★	My name is Evelyn	Evelyn Instructor	Jun 12, 2019 9:54 AM

20 per page

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 – Feedback System

Feedback Activity 1 & Student Cluster n

Sie haben sich in der Konversation durchgehend stark eingebracht.

{if : *Internal cohesion* > .33} Dabei waren Ihre Beiträge inhaltlich sehr zusammenhängend. {end if}

{if₁ : *Social impact* > .25} {if₂ : *Newness* > .25} Sie haben dabei oft neue Information eingebracht, die später eine wichtige Rolle im Diskurs spielten.. {else₂} Ihre Beiträge haben im Diskurs eine wichtige Rolle gespielt. {end if₂}

{if₂ : *Uncertainty* > .25} Wenn Sie mit etwas unsicher waren, haben Sie das in Ihren Beiträgen deutlich gemacht. Damit konnten Sie dazu beitragen, die Diskussion aufrecht erhalten. {end if₂} {end if₁}

{if : co-occurred with *Driver*} Mit einigen Ihrer Gruppenmitglieder haben Sie intensiv zusammengearbeitet. Sie waren ein gutes Team, weiter so! {end if}

{if : co-occurred with *LeftBehind* or *Deferrer*} Wir vermuten, dass einige Ihrer Gruppenmitglieder hatten kaum Möglichkeiten hatten, sich einzubringen. Versuchen Sie gegebenenfalls, Ihren Gruppenmitgliedern künftig ein wenig Raum zu lassen, indem Sie ihnen etwas mehr Zeit geben zu antworten. {end if}

Feedback Activity 2 & Student Cluster k

{if : *Newness* > .5} Sie haben überdurchschnittlich viel neue Informationen in die Diskussion eingebracht. {end if} {if : *Social impact* > 0.25} Ihre Beiträge waren in der Diskussion relevant: Ihre Gruppenmitglieder sind oft auf Ihre Beiträge eingegangen. {end if}

{if₁ : *Uncertainty*₂ > 1} Sie formulieren Ihre Beiträge in der Diskussion sehr unsicher. Das ist kein Problem, falls Sie daran denken zu zeigen, wenn Sie sich einer Sache sicherer werden. Wenn Sie tatsächlich verunsichert waren: Denken Sie daran, dass Ihre Gruppenmitglieder in der gleichen Situation sind, wie Sie {if₂ : co-occurred with *Driver*}, auch wenn diese oft voranpreschen {end if₂}. {end if₁}

{if : *Responsivity* < .5} Laut unseren Messungen sind Sie nicht sehr stark auf Ihre Gruppenmitglieder eingegangen. Dies wäre wichtig für den gemeinsamen Diskurs. Wir empfehlen Ihnen daher, ihre Gruppenmitglieder inhaltlich stärker aufzugreifen. {end if}

Meine Abgabe und mein personalisiertes Feedback

INHALTSORIENTIERTES FEEDBACK

Anzahl der Konzepte: 14 von 14
Anzahl der Verbindungen: 13 von 13
Anzahl der richtig beschrifteten Verbindungen: 11 von 13
Übereinstimmung mit der Musterlösung: 73 %

Die Bewertung Ihrer Kompetenzen in UE 3: Digitale Medienkompetenzen von SuS basiert auf der Zuordnung der Konzepte zu den jeweiligen Hierarchieebenen mithilfe von Farben und Verbindungsarten und deren Beschriftungen.

Funktionen von digitalen Kompetenzen: Ausreichend
Technologische Komponente: Mangelhaft
Soziale Komponente: Ausreichend
Medien- und Informationskompetenzen: Hervorragend

Zusammenfassung: Sie haben noch einige Schwierigkeiten, digitale Kompetenzen zu klassifizieren, voneinander abzugrenzen und miteinander in Zusammenhang zu bringen. Der Entwicklungstrend ist bei technologischer Komponente und Funktionen von digitalen Kompetenzen am höchsten.

IM VERGLEICH ZUR MUSTERLÖSUNG

EINE FELDIGE VERBINDUNG MIT BESCHRIFFUNG

- von "Technologische Komponente" zu "Geräte und Anwendungen bedienen"
- richtig: "Technologische Komponente" umfasst "Geräte und Anwendungen bedienen"

DREI ÜBERFLÜSSIGE VERBINDUNGEN

- "Soziale Komponente" ermöglicht "Geräte und Anwendungen bedienen"
- "Digitale Medienkompetenzen" umfasst "Informationen bewerten"
- "Gesellschaftliche Teilhabe" ermöglicht "Informationen bewerten"

ZWEI FALSCH BESCHRIEBENE VERBINDUNGEN

- "Technologische Komponente" ermöglicht "Fundamentale von Technologien verstehen"
- richtig: "Technologische Komponente" umfasst "Fundamentale von Technologien verstehen"
- "Digitale Medienkompetenzen" umfasst "Gesellschaftliche Teilhabe"
- richtig: "Digitale Medienkompetenzen" ermöglicht "Gesellschaftliche Teilhabe"

MEINE ABCARTE



UMSETZUNGSORIENTIERTES FEEDBACK

	Eigene Aktivität	Durchschnitt ihrer Mitschülerinnen	Mittelwertschicht mit korrekter Lösung
Bearbeitungs-Sessions	7	10	9
Zeit investiert total	2,5 Stunden	3,1 Stunden	2,3 Stunden
Ergebnis kontrolliert	3-mal	3-mal	3-mal

Information zu Ihrem Leseverhalten

Leseanalyse



Ihr Umgang mit den Texten in dieser Lerneinheit lässt darauf schließen, dass Sie ein insgesamt gutes Verständnis vom Thema entwickelt haben.

Sie haben:

- sich genug Zeit für die Bearbeitung der Lernmaterialien genommen.
- sich in einem angemessenen Umfang mit den inhaltlichen Bezügen zwischen den Materialien auseinandergesetzt.
- sich in herausragendem Umfang mit Metainformationen zu den Lernmaterialien auseinandergesetzt.

Zusätzliche Tipps:
Wir empfehlen Ihnen, diese Verhaltensweisen beizubehalten

Das war hilfreich Das war nicht hilfreich

Wissens-Integration

98,33%

Umgang mit Meta-Informationen

55%

Feedback of the Writing Analytic DeLA



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., Di Mitri, D., Schneider, J., Jivet, I., Allmang, J., Gombert, S., Kubsch, M., Neumann, K., Drachsler, H. (2024). **I don't have time! But keep me in the loop: Co-designing requirements for a learning analytics cockpit with teachers.** Journal of Computer Assisted Learning. <https://doi.org/10.1111/jcal.12997>

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Research grants behind the evidence

Field trials with LA in higher education and school

HIGHER EDUCATION

DIFA - Digital Formative Assessment

Unfolding its Full Potential by Combining Psychometrics with Learning Analytics

Leibniz Coop. Excellence | Feb 2020 – Jan 2023

N = 1,307 students | 2 cohorts: 565 | 742

PI

HIKOF-DL

Highly Informative and Competence Supporting Feedback for Digital Learning

Fund of the State of Hesse | Apr 2021 – Mar 2024

N = 1,310 students | 4 cohorts: 698 (2 cohorts) | 257 | 355

PI

IMPACT

Implementing of AI-based Feedback and Assessment with Trusted Learning Analytics in Higher Education

BMBF | Dec 2021 – Dec 2025

N = 1,676 students | 4 cohorts: 689 | 408 | 296 | 283

PI

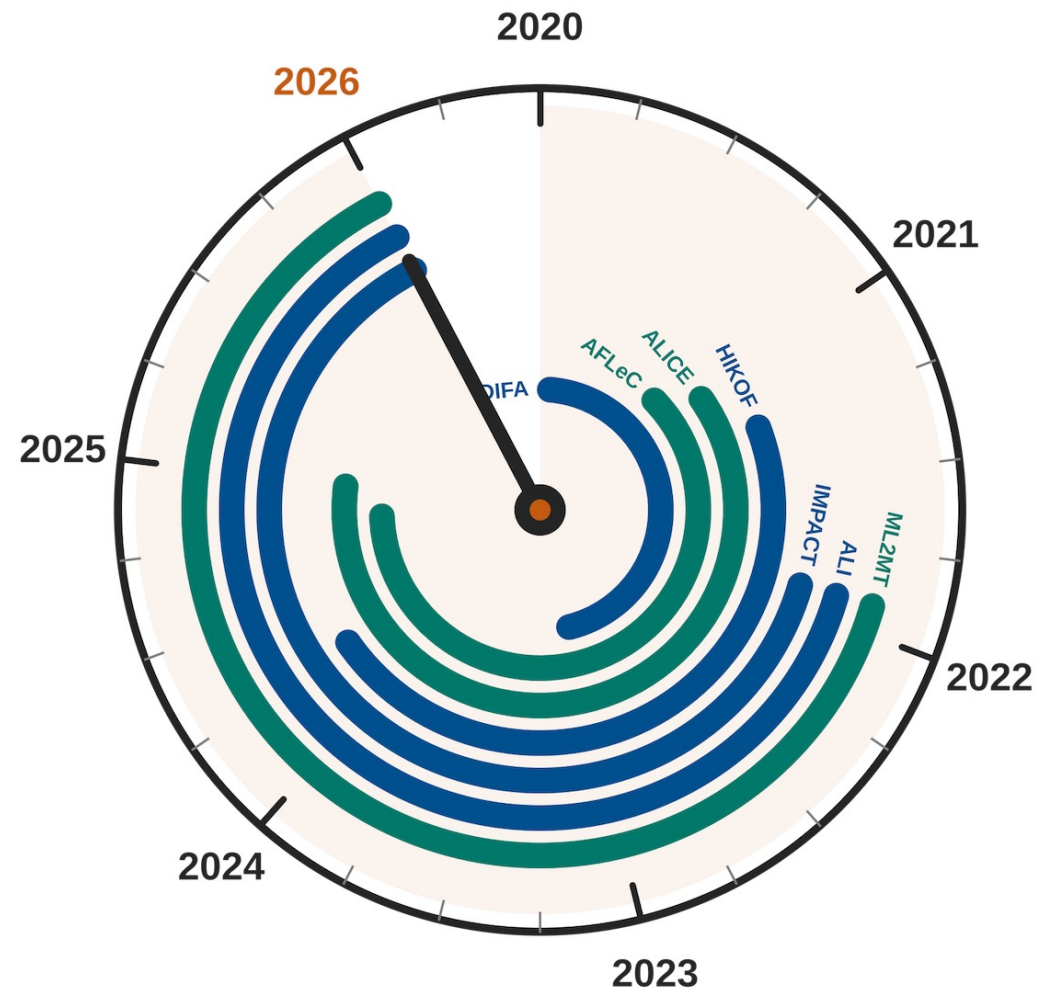
ALI

Development of the Master AI and digital Technology in Learning and Instruction

BMBF | Dec 2021 – Dec 2025

Study programme, no field trial sample

Co-PI

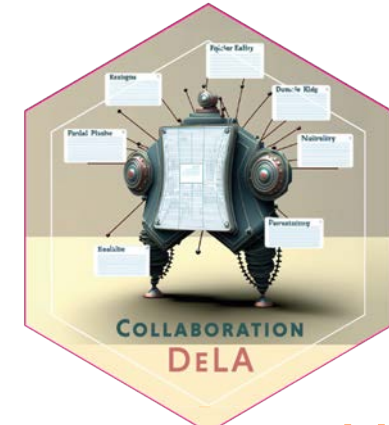
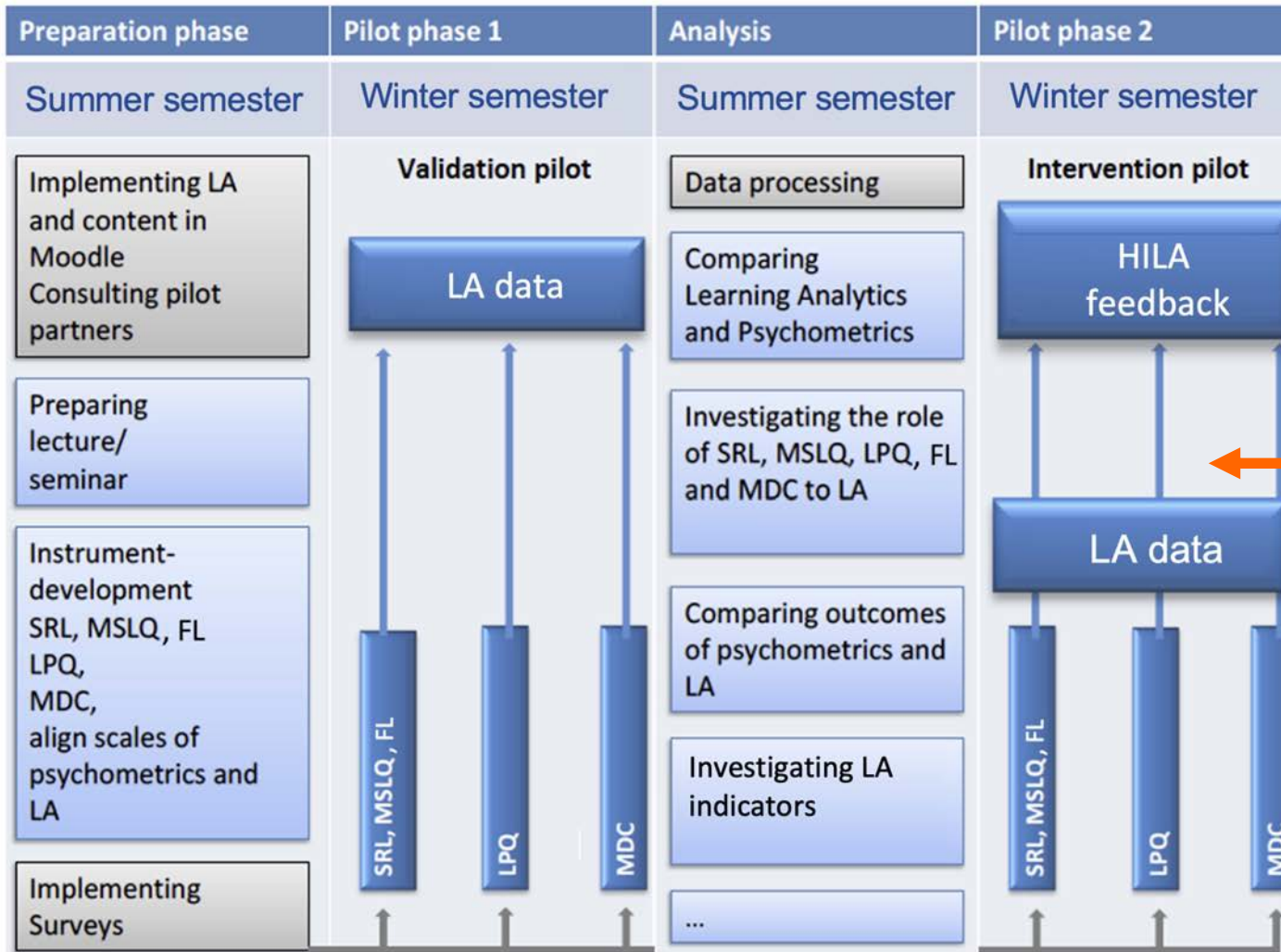


7 projects, 2020 to 2026

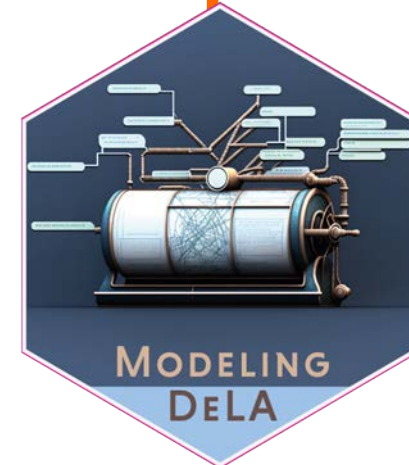
● Higher education

● School

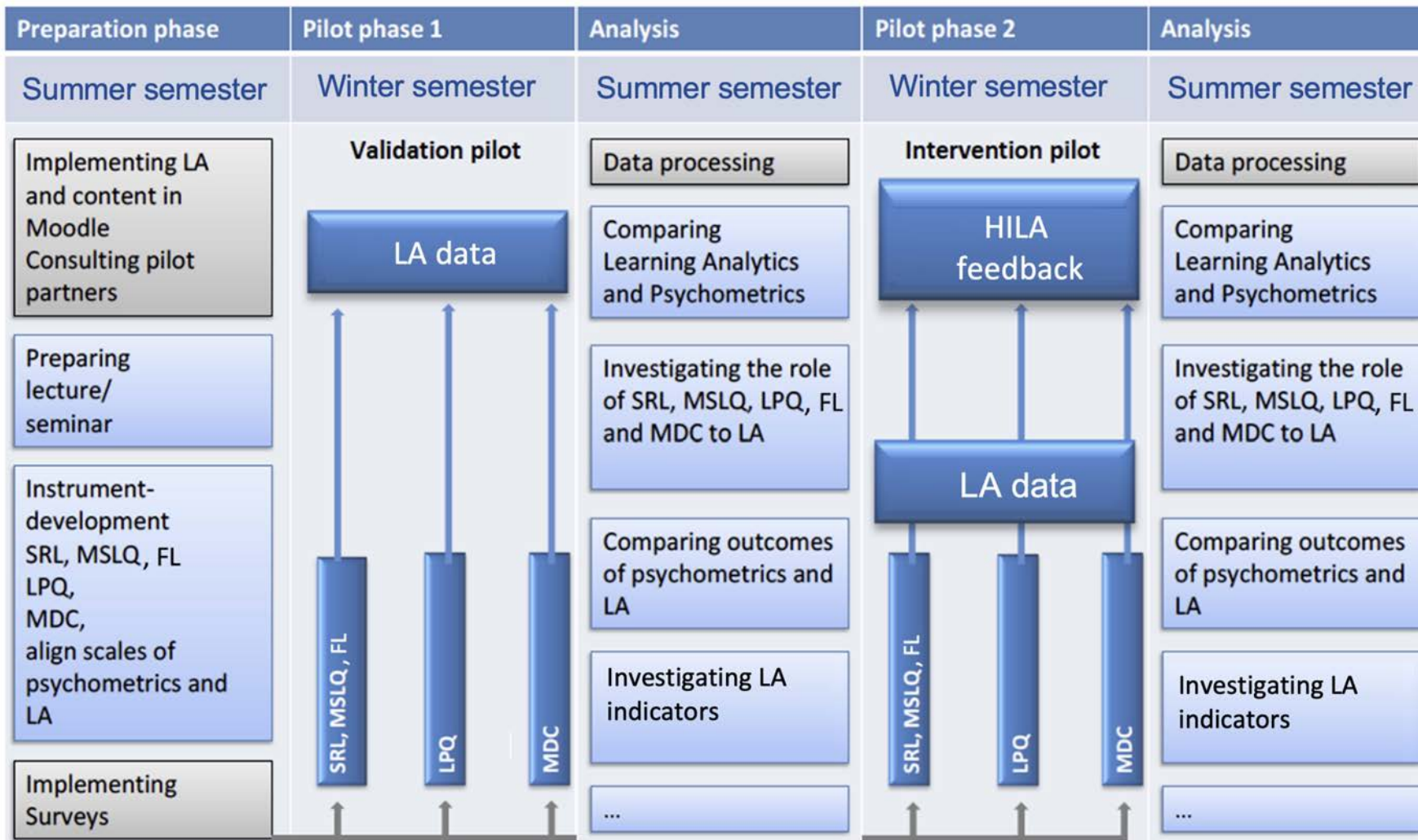
Research Design for HILA & DeLAs



HILA
Feedback



Research Design for HILA & DeLAs



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Your turn: true or false?

Capture

- 1 Learning Analytics makes learning processes measurable in school and higher education.

Interpret

- 2 Learning Analytics can reliably assess learning outcomes and turn it into usable feedback.

Feedback

- 3 Students (and teachers) value highly informative feedback.

Impact

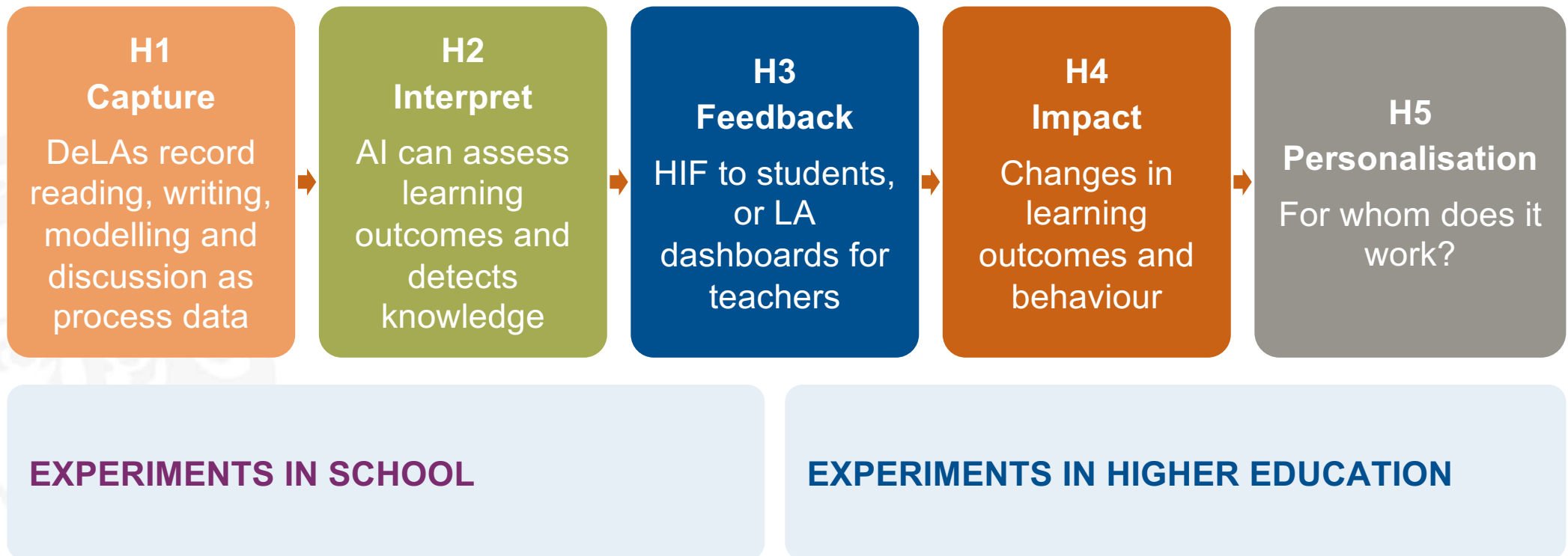
- 4 Highly informative feedback improves learning outcomes.

Personalisation

- 5 Highly informative feedback benefits all learners in the same way.

Towards a DeLA model: our evidence engine

Data-enriched Learning Activities produce the data along the whole chain towards highly informative feedback.



Hypothesis 1: Can DeLAs make learning measurable?

Learning Analytics makes learning processes measurable in school and university.

Capture

Interpret

Feed
back

Impact

Tailor

studiumdigitale

GOETHE
UNIVERSITÄT
FRANKFURT AM MAIN

DIPF
Leibniz-Institut für Bildungsforschung
und Bildungsinformation

HIGHER EDUCATION Biedermann et al. (2023)

Scrolling data could flag disengaged readers early, but the model did not work well on new texts.

PARTLY

SCHOOL Wyrwich, Kubsch, et al. (2025)

DeLA could distinguished productive from unproductive learning, but prior knowledge was the stronger predictor.

PARTLY

SCHOOL Domenichini et al. (2025)

Students took different learning paths through learning content, complex tasks in the middle were most diagnostic.

SUPPORTS

SCHOOL Bernholt et al. (2026)

Knowledge networks from student answers predicted post-test performance well. Core concepts can serve as early-warnings.

SUPPORTS

SUPPORTED, WITH LIMITS

DeLAs can make learning processes measurable in school and higher education.

Models still need to show that they transfer across contexts and tasks.

1. Biedermann, D., Schneider, J., Ciordas-Hertel, G.-P., 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 (pp. 585-591). ACM. <https://doi.org/10.1145/3576050.3576078>
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3. Domenichini, D., Strauß, S., Gombert, S., Rummel, N., Drachsler, H., Neumann, K., Chiarello, F., Fantoni, G., & Kubsch, M. (2025). **Leveraging AI and network analysis to uncover learning trajectories of energy to foster knowledge-in-use in science education**. Disciplinary and Interdisciplinary Science Education Research, 7, Article 28. <https://doi.org/10.1186/s43031-025-00150-y>
4. Bernholt, S., Lossjew, J., & Gombert, S. (2026). **Analyzing students' conceptual understanding over the course of a teaching unit: Tracking changes in knowledge structures over time**. Unterrichtswissenschaft, 54, 291-323. <https://doi.org/10.1007/s42010-026-00244-0>

Hypothesis 2: Can LA reliably assess learning outcomes?

Learning Analytics can reliably assess learning outcomes and turn it into usable feedback.

Capture

Interpret

Feed
back

Impact

Tailor

HIGHER EDUCATION Gombert et al. (2024)

LA models classified essay content with high agreement to human raters.

SUPPORTS

HIGHER EDUCATION Fink et al. (2024)

Again LA models often agreed with human raters, but some scored unfairly! Combining models reduced this problem.

PARTLY

SCHOOL Bernholt et al. (2026)

LA models worked well when answers were clearly right or wrong, but struggled with partial understanding!

PARTLY

SCHOOL Gombert et al. (2026)

LA models agreed well with human raters on familiar questions, but less well on new questions.

PARTLY

CONDITIONAL

Reliable for right-or-wrong answers.

Partial understanding, new domains, and fairness across students still need more work.

- Gombert, S., Fink, A., Giorgashvili, T., Jivet, I., Di Mitri, D., Yau, J., Frey, A., & Drachsler, H. (2024). *From the automated assessment of student essay content to highly informative feedback: A case study*. International Journal of Artificial Intelligence in Education, 34, 1378-1416. <https://doi.org/10.1007/s40593-023-00387-6>
- Fink, A., Gombert, S., Liu, T., Drachsler, H., & Frey, A. (2024). *A hierarchical rater model approach for integrating automated essay scoring models*. Zeitschrift für Psychologie, 232(3), 209-218. <https://doi.org/10.1027/2151-2604/a000567>
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- Gombert, S., Sun, Z., Zehner, F., Lossjew, J., Wyrwich, T., Czinczel, B. K., Bednorz, D., Bernholt, S., Neumann, K., Harms, U., Heinze, A., & Drachsler, H. (2026). *Report on the BEA 2026 shared task on rubric-based short answer scoring for German*. In Proceedings of the 21st Workshop on Innovative Use of NLP for Building Educational Applications (pp. 1179-1192). Association for Computational Linguistics.

Hypothesis 3: Is highly informative feedback valued?

Students and teachers value highly informative feedback.

Capture

Interpret

Feed back

Impact

Tailor

HIGHER EDUCATION Menzel et al. (2023)

Students rated highly informative feedback for COLLABORATION more helpful than usual feedback.

SUPPORTS

HIGHER EDUCATION Gombert et al. (2024)

Students also rated highly informative feedback on individual ESSAYS more helpful than usual feedback.

SUPPORTS

HIGHER EDUCATION Weidlich, Fink, et al. (2025)

Students also reported more incentive for reflection and regulation with highly informative feedback.

SUPPORTS

SCHOOL Karademir, Borgards, et al. (2024)

Teachers found the dashboard easy to use and mainly provided feedback on learning strategies.

SUPPORTS

SUPPORTED

Our most robust finding:

Students value highly informative feedback, and teachers can use feedback tools effectively.

1. 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.** In (Eds.), **EC-TEL 2023** (Lecture Notes in Computer Science, Vol. 14200). Springer. https://doi.org/10.1007/978-3-031-42682-7_14
2. Gombert, S., Fink, A., Giorgashvili, T., Jivet, I., Di Mitri, D., Yau, J., Frey, A., & Drachsler, H. (2024). **From the automated assessment of student essay content to highly informative feedback: A case study.** International Journal of Artificial Intelligence in Education, 34, 1378-1416. <https://doi.org/10.1007/s40593-023-00387-6>
3. Weidlich, J., Fink, A., Frey, A., Jivet, I., Gombert, S., Menzel, L., Giorgashvili, T., Yau, J., & Drachsler, H. (2025). **Highly informative feedback using learning analytics: How feedback literacy moderates student perceptions of feedback.** International Journal of Educational Technology in Higher Education, 22, Article 43. <https://doi.org/10.1186/s41239-025-00539-9>
4. Karademir, O., Borgards, L., Di Mitri, D., Strauß, S., Kubsch, M., Brobeil, M., Grimm, A., Gombert, S., Rummel, N., Neumann, K., & Drachsler, H. (2024). **Following the impact chain of the LA Cockpit: An intervention study investigating a teacher dashboard's effect on student learning.** Journal of Learning Analytics, 11(2), 215-228. <https://doi.org/10.18608/jla.2024.8399>

Hypothesis 4: Does it improve learning outcomes?

Highly informative feedback improves learning outcomes.

Capture

Interpret

Feed
back

Impact

Tailor

SCHOOL Karademir, Borgards, et al. (2024)

LA + teacher use led to greater learning gains than **NO LA + teacher**.

SUPPORTS

SCHOOL Khazanchi et al. (2025)

LA + teacher outperformed **LA without teacher**. LA alone did not improve learning outcomes.

PARTLY

HIGHER EDUCATION Giorgashvili et al. (2025)

Highly informative feedback led to more concrete learning plans, but actual behaviour was not measured.

PARTLY

HIGHER EDUCATION Menzel-Wuttig et al. (2026)

Students valued the feedback, but it did not change how they collaborated!

AGAINST

MIXED

Learning gains appear when teachers act on the learning analytics.

LA or automated feedback alone has not yet shown clear gains.

1. Karademir, O., Borgards, L., Di Mitri, D., Strauß, S., Kubsch, M., Brobeil, M., Grimm, A., Gombert, S., Rummel, N., Neumann, K., & Drachsler, H. (2024). **Following the impact chain of the LA Cockpit: An intervention study investigating a teacher dashboard's effect on student learning**. Journal of Learning Analytics, 11(2), 215-228. <https://doi.org/10.18608/jla.2024.8399>
2. Khazanchi, R., Di Mitri, D., & Drachsler, H. (2025). **The effect of AI-based systems on mathematics achievement in rural context: A quantitative study**. Journal of Computer Assisted Learning, 41(1), e13098. <https://doi.org/10.1111/jcal.13098>
3. Giorgashvili, T., Jivet, I., Artelt, C., Biedermann, D., Bengs, D., Goldhammer, F., Hahnel, C., Mendzheritskaya, J., Mordel, J., Onofrei, M., Winter, M., Wolter, I., Horz, H., & Drachsler, H. (2025). **From reflection to action: A controlled field study on how learners interpret and respond to feedback in learning analytics dashboards**. Journal of Computer Assisted Learning, 41(4), e70073. <https://doi.org/10.1111/jcal.70073>
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Hypothesis 5: Does HIF benefit all learners?

Highly informative feedback benefits all learners in the same way.

Capture

Interpret

Feed
back

Impact

Tailor

HIGHER EDUCATION Weidlich, Fink, et al. (2025)

Only students with **strong feedback skills** found highly informative feedback **more motivating**.

AGAINST

HIGHER EDUCATION Gombert et al. (2024)

Highly informative feedback **was less motivating than basic feedback**.

AGAINST

SCHOOL Wyrwich, Domenichini, et al. (2025)

Students with **low prior knowledge** experienced more **cognitive load and negative emotions** with highly informative feedback.

AGAINST

NOT SUPPORTED

Feedback literacy, emotions and cognitive load shape who benefits from HIF.

So we need better feedback skills, not just better technology.

1. Weidlich, J., Fink, A., Frey, A., Jivet, I., Gombert, S., Menzel, L., Giorgashvili, T., Yau, J., & Drachsler, H. (2025). **Highly informative feedback using learning analytics: How feedback literacy moderates student perceptions of feedback**. International Journal of Educational Technology in Higher Education, 22, Article 43. <https://doi.org/10.1186/s41239-025-00539-9>
2. Gombert, S., Fink, A., Giorgashvili, T., Jivet, I., Di Mitri, D., Yau, J., Frey, A., & Drachsler, H. (2024). **From the automated assessment of student essay content to highly informative feedback: A case study**. International Journal of Artificial Intelligence in Education, 34, 1378-1416. <https://doi.org/10.1007/s40593-023-00387-6>
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Outline

1. Grounding
2. Highly Informative Learning Analytics (HILA)
3. Data-enriched Learning Analytics (DeLA)
4. Research design
5. Evidence from our field studies (2021-2026)
6. What we learned after 5 years



Kirkpatrick evidence: school and university



Frey, A., Schenk, C., Weiß, L., König, C., Ramesh, V., Fabriz, S., Drachsler, H., & Horz, H. (2026). **A theoretical framework and evaluation instrument for the competence to use artificial intelligence and digital technology in educational processes**. Systems, 14(5), 583. <https://doi.org/10.3390/systems14050583>

Kirkpatrick evidence: school and university

The five hypotheses mapped onto the four evaluation levels and the next research step for each.

	1 Reaction Perceptions: WELL EVIDENCED (H3)	2 Learning Knowledge: MIXED (H4)	3 Behaviour Action: NOT SHOWN YET (H4)	4 Results Programmes: OPEN
Higher education	Highly informative feedback is valued: Students rated highly informative feedback as more helpful. Motivation was higher mainly for students with stronger feedback skills.	Learning effects still unclear No study has yet directly measured positive effects on learning outcomes in higher education.	Intentions change, behaviour does not: Feedback led to more concrete learning plans, but did not clearly change collaboration behaviour	Long-term impact still open No evidence yet for effects at programme or institutional level.
School	Teachers can use feedback tools effectively: Teachers found the dashboard easy to use and mainly used it to give feedback on learning strategies.	Teacher use drives learning gains Learning gains appeared when teachers used the LA dashboard. LA alone showed no advantage over teacher-led instruction.	Behaviour effects not yet tested No school study has yet measured whether feedback changes learner behaviour	
Next study	Personalise the feedback Personalise feedback to feedback literacy, prior knowledge and learner needs.	Test what effects learning gains Compare no feedback, automated feedback and teacher-mediated feedback.	Test what learners do next Examine whether feedback changes actual learner behaviour.	Test lasting impact: Study whether effects remain over time and scale to programmes or institutions.

1. Frey, A., Schenk, C., Weiß, L., König, C., Ramesh, V., Fabriz, S., Drachsler, H., & Horz, H. (2026). [A theoretical framework and evaluation instrument for the competence to use artificial intelligence and digital technology in educational processes](https://doi.org/10.3390/systems14050583). Systems, 14(5), 583. <https://doi.org/10.3390/systems14050583>
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3. Wissenschaftsrat. (2026). [Intellektuelle Souveränität: Empfehlungen für die Hochschulbildung in Zeiten von generativer KI](https://doi.org/10.57674/1evx-t906) (Drs. 3319-26). <https://doi.org/10.57674/1evx-t906>

Thank you for travelling through five years of research with me!

Measure what you value; don't value what you can easily measure.



h.drachsler@dipf.de



[hendrik.drachsler](https://www.linkedin.com/in/hendrik.drachsler)



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