# The Interplay of Learning Analytics and Artificial Intelligence

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# Talk outline

**01** AI in education and Learning Analytics (LA):
A quick background

**02** The interplay of LA and AI:
The LA cycle perspective

**03** The interplay of LA and AI:
An outlook and takeaways

# 01

# AI in education and Learning Analytics

# AI in education (AIED)

→ Long tradition, dates almost from the inception of the AI field

→ The overarching objective: personalized instruction/learning at scale

→ Intelligent tutoring systems as the most prominent form of AIED

→ Plenty of beautiful ideas, but the technology was not mature enough

→ Primarily research prototypes, with little real-world applications

# A big shift in AIED with Generative AI

# A big shift in AIED with Generative AI

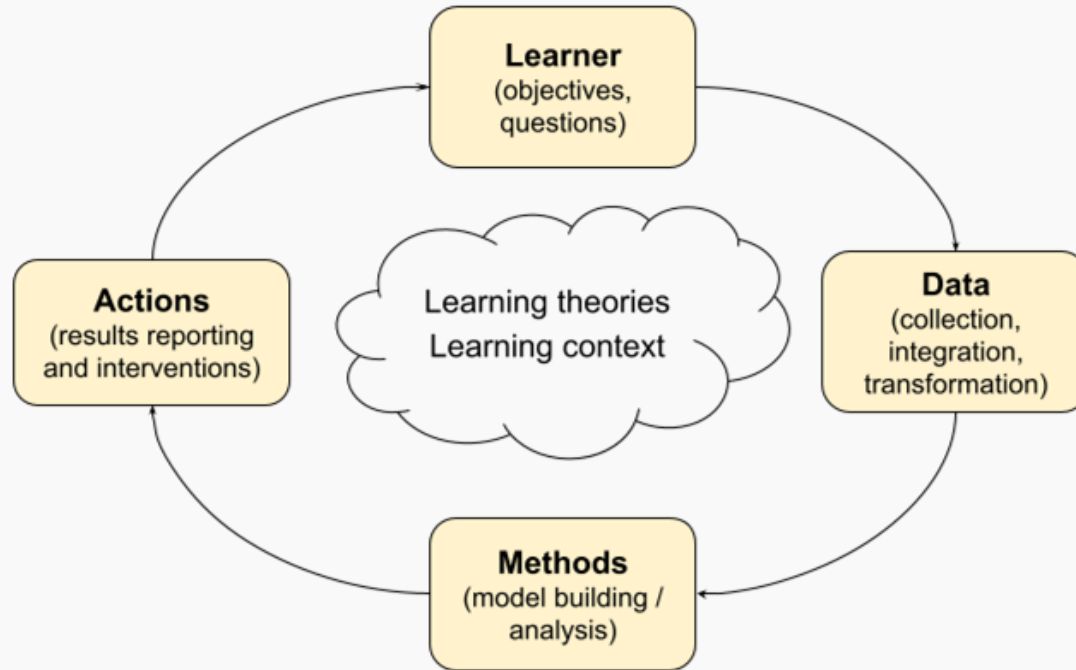| | **Up to the launch of ChatGPT** | **From the launch of ChatGPT onwards** |
|---|---|---|
| **The overall approach to AIED** | Top-down, led by interdisciplinary teams of researchers and/or practitioners | Bottom up (grassroots), led by teacher enthusiasts |
| **Instructional approach** | Deeply thought out, well grounded in the research and literature | Mostly ad-hoc, based on individual "feeling" how AI could be used |
| **Technology (AI)** | Well tested and safe, but limited to a specific domain and lacking creative traits | Not fully predictable, prone to factual errors; when errs, it does so "with confidence"; but also can be highly creative and useful |
| **Required skills** | Self-regulation and AI literacy skills not essential; the student is to follow the instruction | Self-regulation and AI literacy skills highly relevant |

# A big shift in AIED with Generative AI

There is a clear need for a systematic approach

to understanding the role and impact of AI on education

to support evidence-based decision making

in a wide variety of learning settings

# Learning analytics

"*Learning analytics is the measurement, collection, analysis and reporting of*

*data* about *learners and their contexts*,

*for purposes of* understanding and optimising learning *and*
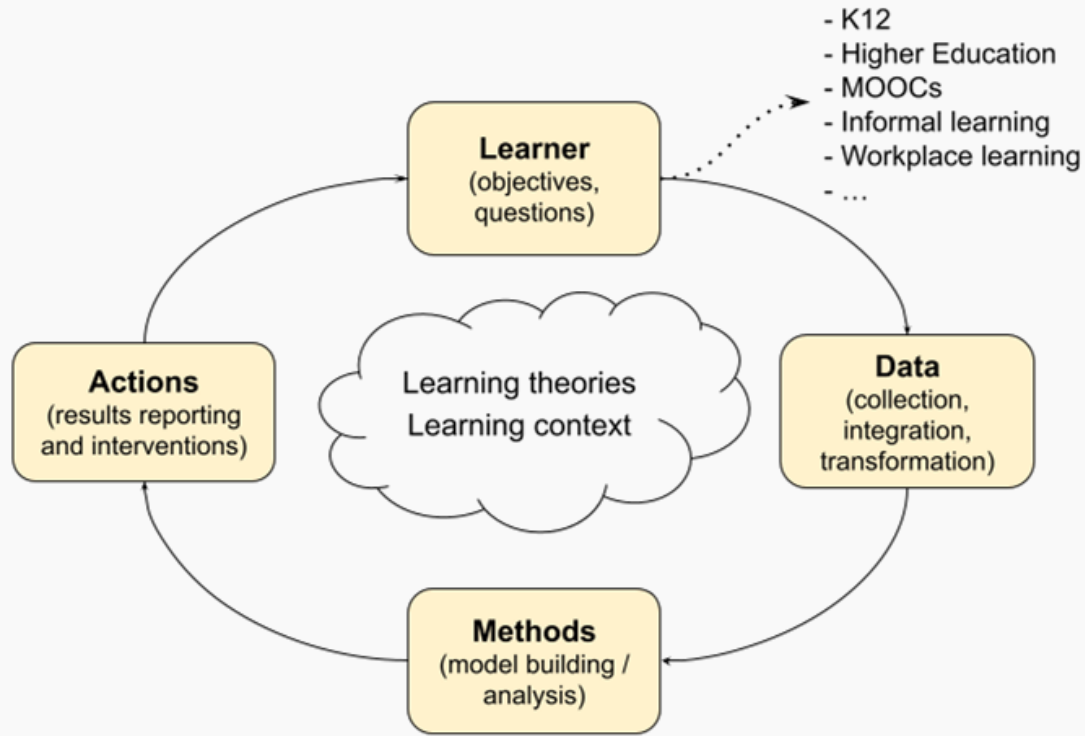
*the environments in which it occurs*"

# The cyclical model of LA



Learner
(objectives, questions)

Data
(collection, integration, transformation)

Learning theories
Learning context

Actions
(results reporting and interventions)

Methods
(model building / analysis)

# 02

The interplay of LA and AI:

the LA cycle perspective

# Learner



Learner (objectives, questions)

- K12
- Higher Education
- MOOCs
- Informal learning
- Workplace learning
- ...

Learning theories
Learning context

Actions (results reporting and interventions)

Data (collection, integration, transformation)

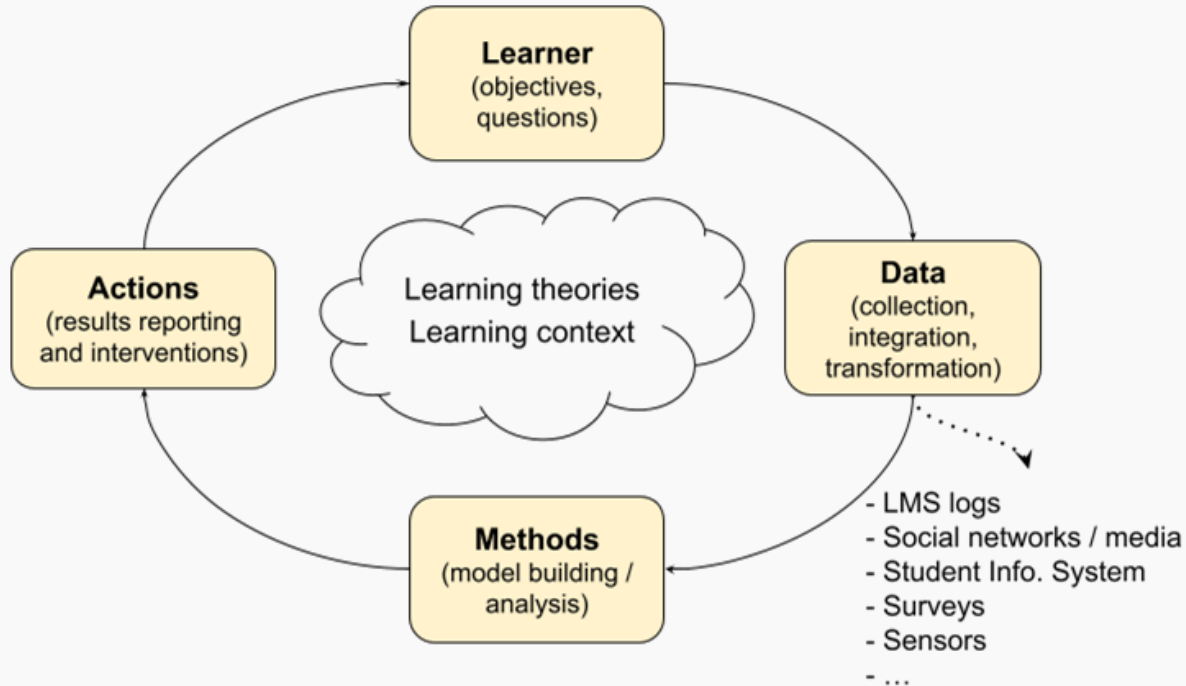Methods (model building / analysis)

# Learner

Evolving notion of learner

→ Hybrid intelligence (Jarvela et al., 2023)

→ Human-AI collaboration (Joksimovic et al., 2023)

→ Hybrid human-AI regulation of learning (Molenaar, 2022)

# Data



Learner
(objectives, questions)

Actions
(results reporting and interventions)

Learning theories
Learning context

Data
(collection, integration, transformation)

Methods
(model building / analysis)

- LMS logs
- Social networks / media
- Student Info. System
- Surveys
- Sensors
- …

# Data sharing while privacy preserving

LA faces challenging dual objectives of

→ preserving data privacy, while

→ making data publicly available, to foster research and Open Science practices

# Data sharing while privacy preserving

Recent efforts empowered by Generative AI:

→ Synthetic data generation, allows for preserving both data privacy and data utility for LA (Liu et al., 2024; Zhan et., 2024)

→ LLMs have been tested for detection and removal of personally identifying information from learner messages (Singhal et al., 2024)

# Methods



- Prediction (grades, dropout)
- Clustering (learner profiling)
- Sequence and process mining
- Network analysis
- Discourse analysis
- Qualitative analysis
- …

**Learner** (objectives, questions)

**Data** (collection, integration, transformation)

**Methods** (model building / analysis)

**Actions** (results reporting and interventions)

Learning theories
Learning context
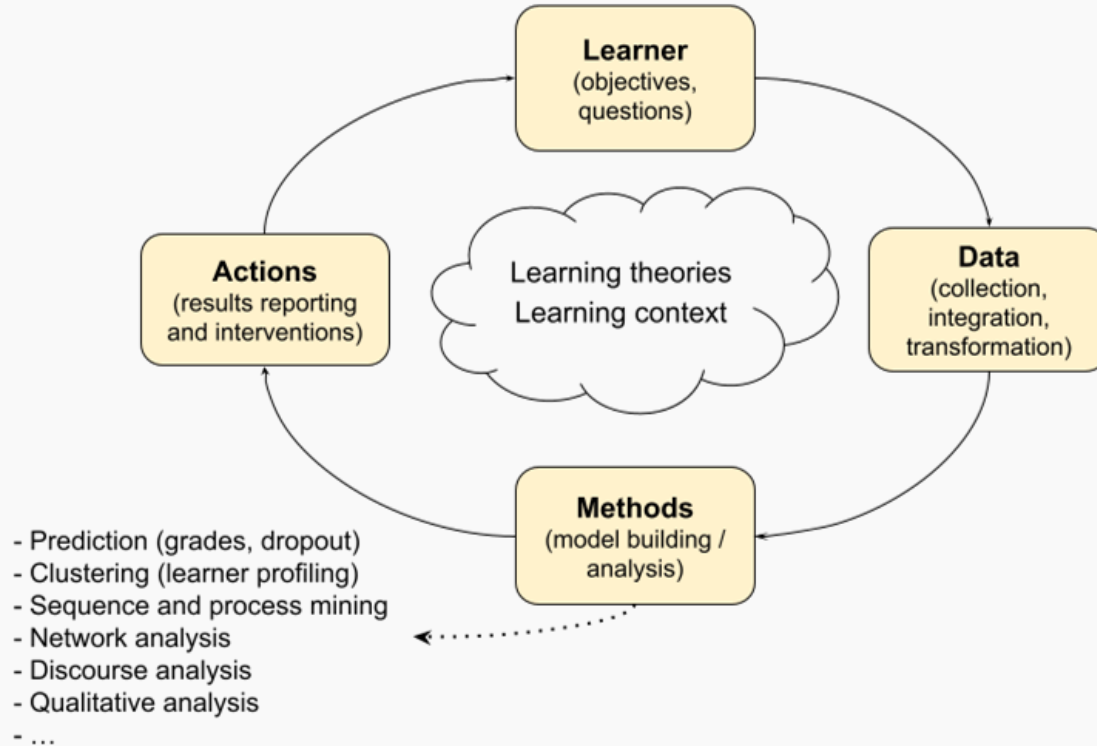
# AI augmented LA methods

Semi-automated development and application of qualitative coding schemes

→ May greatly facilitate analytics of distinct kinds of learning-related social interactions

→ Still in early phase, best results for deductive, context-independent coding (see e.g., Hou et al., 2024; Barany et al., 2024)

# LA methods for studying human-AI interaction

Applying LA methods to study learner interaction with Generative AI in different learning contexts

→ Essay revision task in an EFL undergrad course (Fan et al., 2024)

→ Programming tasks in a graduate robotics course (Brender et al., 2024)

→ Peer feedback in multiple undergrad courses (Darvishi et al., 2023)
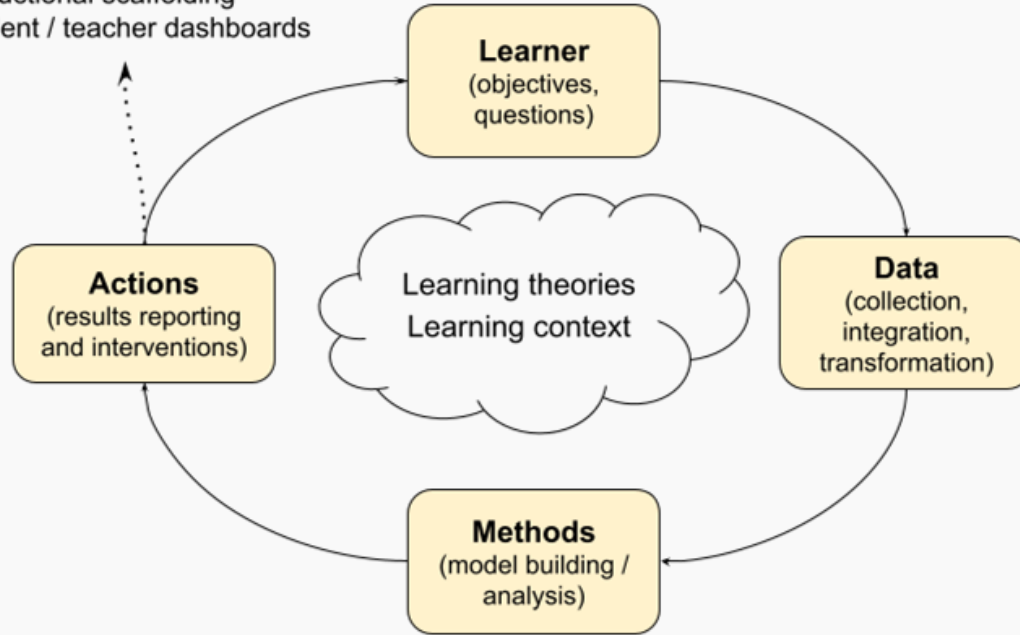
# LA methods for studying human-AI interaction

Common themes have emerged across the study findings

→ Over-reliance on GenAI and metacognitive "laziness"

→ Being more at ease to seek help from a GenAI tool

→ The use of GenAI improves task performance but not learning gains

# Actions



- Early warnings
- Feedback provision
- Instructional scaffolding
- Student / teacher dashboards

**Learner**
(objectives, questions)

Learning theories
Learning context

**Data**
(collection, integration, transformation)

**Actions**
(results reporting and interventions)

**Methods**
(model building / analysis)

# Actions

## Augmentation of LA dashboards with GenAI

# Actions

Communicating LA feedback via GenAI-augmented storytelling
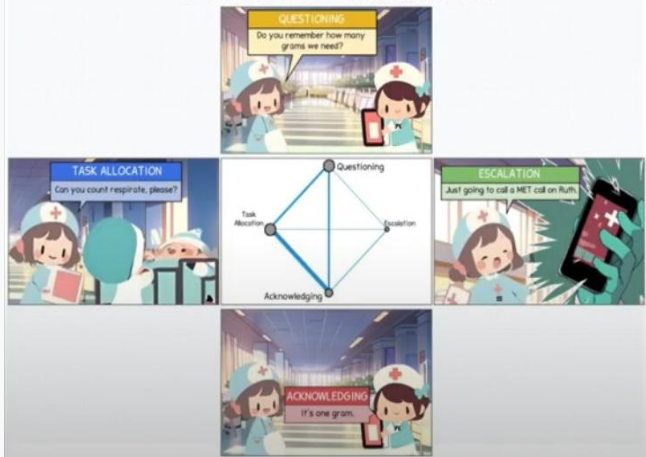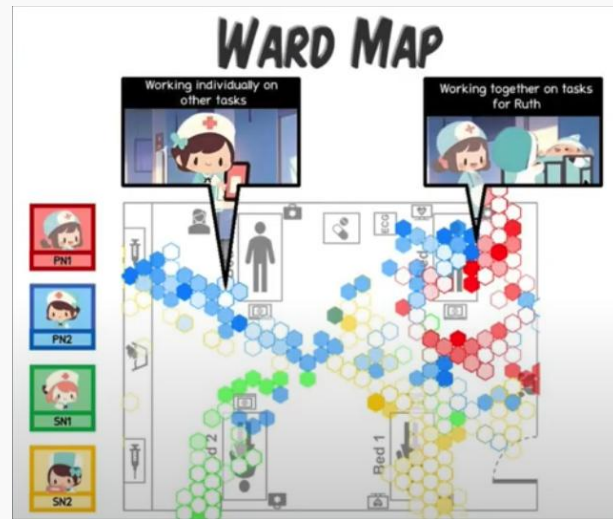


Milesi et al., 2024

# 03

The interplay of LA and AI:

An outlook and takeaways

# An outlook

→ Dialogic feedback

→ Real-time feedback in learning simulations (Fan et al., 2024)

→ Assessment of human-AI collaborative work (e.g., writing) (Cheng et al., 2024)

→ Synthetic generation of textual data (e.g., messages, annotations)

→ ...

# Key takeaways

LA and AI in education have established a beneficial dynamics:

→ AI is augmenting the LA process and its key elements

→ LA is enhancing our understanding of AI in education

# Key takeaways

The established AI - LA dynamic promises to
continually yield relevant insights into
the evolving role and effect of AI on learning

It is up to us to make effective use of such insights for
advancing educational practice

# The 15th International Learning Analytics & Knowledge Conference

**LAK25**

The Open University

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

T U DUBLIN
TECHNOLOGICAL UNIVERSITY DUBLIN

MEET IN IRELAND

**March 3 - 7, 2025**

**Dublin, Ireland**

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SOCIETY for LEARNING ANALYTICS RESEARCH

acm In-Cooperation

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The LAK25 conference main theme:
**Expanding the Horizons of Learning Analytics**

## IMPORTANT DATES FOR LAK25

All LAK25 Deadlines are **11:59pm AOE**.

### Research Track

| | |
|---|---|
| Full / Short Submission Deadline | **23 Sept 2024** |
| Rebuttal submission open | **28 Oct 2024** |
| Deadline for rebuttals | **4 Nov 2024** |
| Notification of Acceptance | **22 Nov 2024** |
| **Deadline for camera ready** | **9 Dec 2024** |

### Practitioner Reports

| | |
|---|---|
| Practitioner Submission Deadline | **7 Oct 2024** |
| Notification of Acceptance | **22 Nov 2024** |
| **Deadline for camera ready** | **20 Dec 2024** |

### Poster / Demos

| | |
|---|---|
| Poster/Demo Submission Deadline | **4 Nov 2024** |
| Notification of Acceptance | **2 Dec 2024** |
| **Deadline for camera ready** | **20 Dec 2024** |

### Doctoral Consortium

| | |
|---|---|
| DC Submission Deadline | **7 Oct 2024** |
| Notification of Acceptance | **22 Nov 2024** |
| **Deadline for camera ready** | **20 Dec 2024** |

### Workshops / Tutorials

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|---|---|
| Workshop/Tutorial Submission Deadline | **9 Sept 2024** |

# Thank you!

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# References

Barany, A., Nasiar, N., Porter, C., Zambrano, A. F., Andres, A. L., Bright, D., Shah, M., Liu, X., Gao, S., Zhang, J., Mehta, S., Choi, J., Giordano, C., & Baker, R. S. (2024). ChatGPT for Education Research: Exploring the Potential of Large Language Models for Qualitative Codebook Development. In Artificial Intelligence in Education (pp. 134–149). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-64299-9_10

Brender, J., El-Hamamsy, L., Mondada, F., & Bumbacher, E. (2024). Who's Helping Who? When Students Use ChatGPT to Engage in Practice Lab Sessions. In A. M. Olney, I.-A. Chounta, Z. Liu, O. C. Santos, & I. I. Bittencourt (Eds.), *Artificial Intelligence in Education* (pp. 235–249). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-64302-6_17

Cheng, Y., Lyons, K., Chen, G., Gašević, D., & Swiecki, Z. (2024). Evidence-centered Assessment for Writing with Generative AI. Proceedings of the 14th Learning Analytics and Knowledge Conference, 178–188. https://doi.org/10.1145/3636555.3636866

Clow, D. (2012). The learning analytics cycle: Closing the loop effectively. Proceedings of the 2nd International Conference on Learning Analytics and Knowledge, 134–138. https://doi.org/10.1145/2330601.2330636

Darvishi, A., Khosravi, H., Sadiq, S., Gašević, D., & Siemens, G. (2023). Impact of AI assistance on student agency. Computers & Education, 104967. https://doi.org/10.1016/j.compedu.2023.104967

Dawson, S., Joksimovic, S., Poquet, O., & Siemens, G. (2019). Increasing the Impact of Learning Analytics. Proceedings of the 9th International Conference on Learning Analytics & Knowledge, 446–455. https://doi.org/10.1145/3303772.3303784

Fried, E. I., Papanikolaou, F., & Epskamp, S. (2022). Mental Health and Social Contact During the COVID-19 Pandemic: An Ecological Momentary Assessment Study. Clinical Psychological Science, 10(2), 340–354. https://doi.org/10.1177/21677026211017839

Hou, C., Zhu, G., Zheng, J., Zhang, L., Huang, X., Zhong, T., Li, S., Du, H., & Ker, C. L. (2024). Prompt-based and Fine-tuned GPT Models for Context-Dependent and -Independent Deductive Coding in Social Annotation. Proceedings of the 14th Learning Analytics and Knowledge Conference, 518–528. https://doi.org/10.1145/3636555.3636910

Hutt, S., Grafsgaard, J. F., & D'Mello, S. K. (2019). Time to Scale: Generalizable Affect Detection for Tens of Thousands of Students across An Entire School Year. Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems, 1–14. https://doi.org/10.1145/3290605.3300726

Hutt, S., DePiro, A., Wang, J., Rhodes, S., Baker, R. S., Hieb, G., Sethuraman, S., Ocumpaugh, J., & Mills, C. (2024). Feedback on Feedback: Comparing Classic Natural Language Processing and Generative AI to Evaluate Peer Feedback. *Proceedings of the 14th Learning Analytics and Knowledge Conference*, 55–65. https://doi.org/10.1145/3636555.3636850

# References

Jarvela, S., Zhao, G., Heikkilä, J., Järvenoja, H., Rvenoja, H., Mikkonen, K., & Kaleva, S. (2023). Hybrid Intelligence – Human-AI Co-Evolution and Learning in Multirealities (HI). In HHAI 2023: Augmenting Human Intellect (pp. 392–394). IOS Press. https://doi.org/10.3233/FAIA230107

Joksimovic, S., Ifenthaler, D., Marrone, R., De Laat, M., & Siemens, G. (2023). Opportunities of artificial intelligence for supporting complex problem-solving: Findings from a scoping review. Computers and Education: Artificial Intelligence, 4, 100138. https://doi.org/10.1016/j.caeai.2023.100138

Liu, Q., Khalil, M., Jovanovic, J., & Shakya, R. (2024). Scaling While Privacy Preserving: A Comprehensive Synthetic Tabular Data Generation and Evaluation in Learning Analytics. Proceedings of the 14th Learning Analytics and Knowledge Conference, 620–631. https://doi.org/10.1145/3636555.3636921

Liu, S., Liu, S., Liu, Z., Peng, X., & Yang, Z. (2022). Automated detection of emotional and cognitive engagement in MOOC discussions to predict learning achievement. Computers & Education, 181(C). https://doi.org/10.1016/j.compedu.2022.104461

Milesi, M. E., Alfredo, R., Echeverria, V., Yan, L., Zhao, L., Tsai, Y.-S., & Martinez-Maldonado, R. (2024). "It's Really Enjoyable to See Me Solve the Problem like a Hero": GenAI-enhanced Data Comics as a Learning Analytics Tool. Extended Abstracts of the 2024 CHI Conference on Human Factors in Computing Systems, 1–7. https://doi.org/10.1145/3613905.3651111

Molenaar, I. (2022). The concept of hybrid human-AI regulation: Exemplifying how to support young learners' self-regulated learning. Computers and Education: Artificial Intelligence, 3, 100070. https://doi.org/10.1016/j.caeai.2022.100070

Saqr, M., Cheng, R., López-Pernas, S., & Beck, E. D. (2024). Idiographic artificial intelligence to explain students' self-regulation: Toward precision education. Learning and Individual Differences, 114, 102499. https://doi.org/10.1016/j.lindif.2024.102499

Singhal, S., Zambrano, A. F., Pankiewicz, M., Liu, X., Porter, C., & Baker, R. S. (2024). De-Identifying Student Personally Identifying Information with GPT-4. 559–565. https://doi.org/10.5281/zenodo.12729884

Yan, L., Zhao, L., Echeverria, V., Jin, Y., Alfredo, R., Li, X., Gaševi'c, D., & Martinez-Maldonado, R. (2024). VizChat: Enhancing Learning Analytics Dashboards with Contextualised Explanations Using Multimodal Generative AI Chatbots. In Artificial Intelligence in Education (pp. 180–193). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-64299-9_13

Zhan, C., Joksimović, S., Ladjal, D., Rakotoarivelo, T., Marshall, R., & Pardo, A. (2024). Preserving Both Privacy and Utility in Learning Analytics. IEEE Transactions on Learning Technologies, 17, 1655–1667. IEEE Transactions on Learning Technologies. https://doi.org/10.1109/TLT.2024.3393766