

Uncharted Territories: Learning Analytics Indicators from a Learning Design Perspective

Atezaz Ahmad



How this Uncharted Journey Started?

- How to apply Learning Analytics?
- Why apply Learning Analytics?
 - ◆ to support learning!



Challenges



Instructional challenge

Lack of alignment between instructional context and LA app. & data



Research challenge

Lack of Overview and comparability of effects of LA instruments



Standardization challenge

Heterogeneity (e.g., terminologies) in LA instruments



Lack of technology

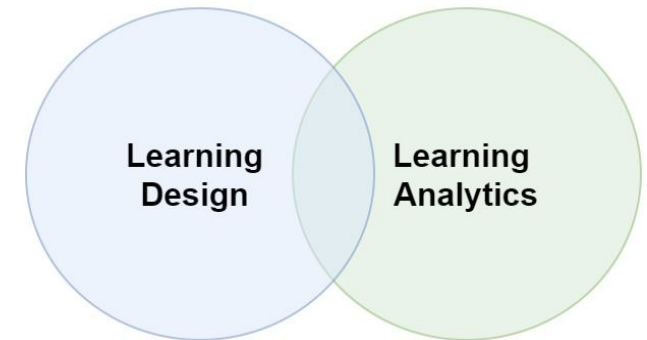
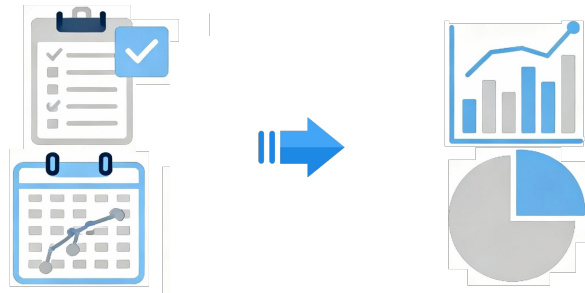
Standards to provide evidence-based repository

1st Study: Literature Review ””

Ahmad, A., Schneider, J., Griffiths, D., Biedermann, D., Schiffner, D., Greller, W., & Drachler, H. (2022). *Connecting the dots—A literature review on learning analytics indicators from a learning design perspective*. *Journal of Computer Assisted Learning*, 40(6), 2432-2470.

My Strategy

- Aligning Learning Design (LD) and Learning Analytics (LA)
- From Learning Design → Learning Analytics
 - LA relies heavily on LD
(Lockyer, L. et al. (2011), Chatti, M.A. et al. (2012), Ahmad, A. et al. (2022))



1st Study: Literature Review “

Ahmad, A., Schneider, J., Griffiths, D., Biedermann, D., Schiffner, D., Greller, W., & Drachsler, H. (2022). *Connecting the dots—A literature review on learning analytics indicators from a learning design perspective*. *Journal of Computer Assisted Learning*, 40(6), 2432-2470.

Learning Design (LD)

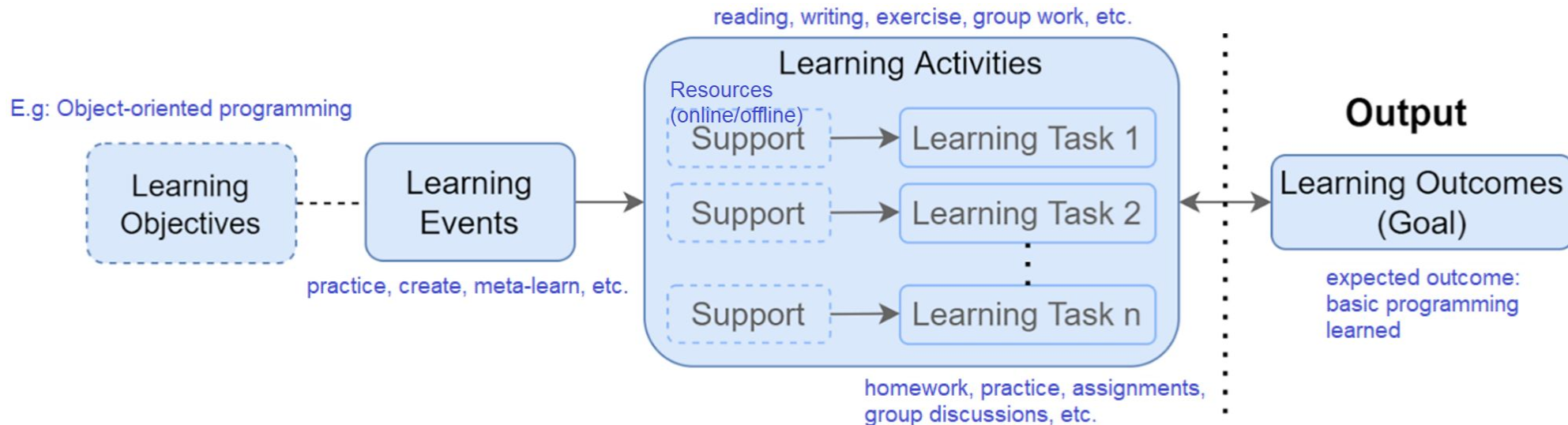


Also known as **planning for effective learning**, it is the framework that supports learning experiences. It reflects on what, when, where and how to teach



LD model

- Learning events/objectives
- Learning activities
 - Support → Learning tasks
- Activity outcome



Learning Analytics (LA)

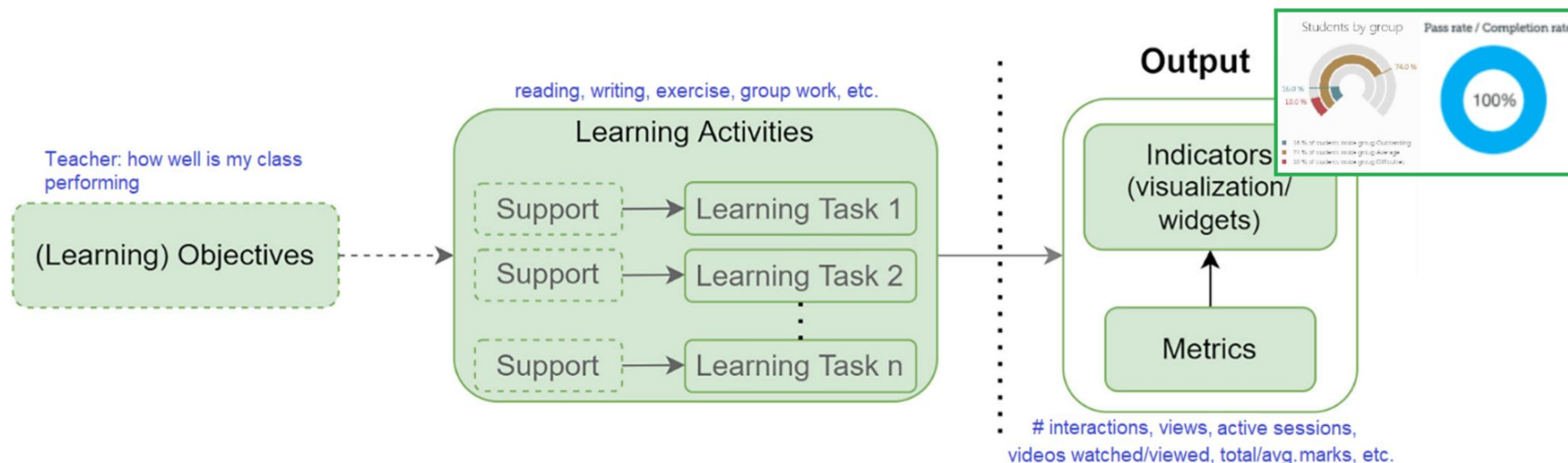


“The measurement, **collection**, **analysis**, and reporting of **data** about **learners** and their **contexts**, for purposes of understanding and optimizing learning and the environments in which it occurs” - Siemens, G. (2010)



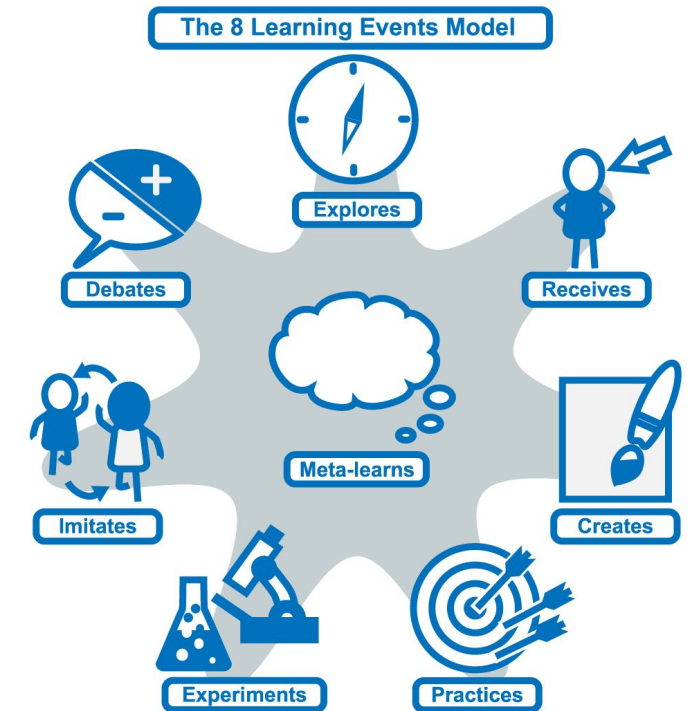
LA model

- Learning objectives
- Learning activities
- Metrics (Measurements)
- Indicators



Literature Review (1st Study)

- A literature review was conducted
 - Compiled 161 LA articles (2011-2020)
 - Manually extracted the LD-LA instruments
 - Found 135 indicators, 40 learning activities more than 1000 unique metrics
- Categorization
 - To make this data readable and applicable/usable
 - Grouped the LD-LA activities (and their metrics & indicators) by the 8 learning event model (8LEM)
 - 8LEM in an instructional design framework



(Leclercq & Poumay, 2005; Verpoorten et al., 2007, Gruber, 2019)

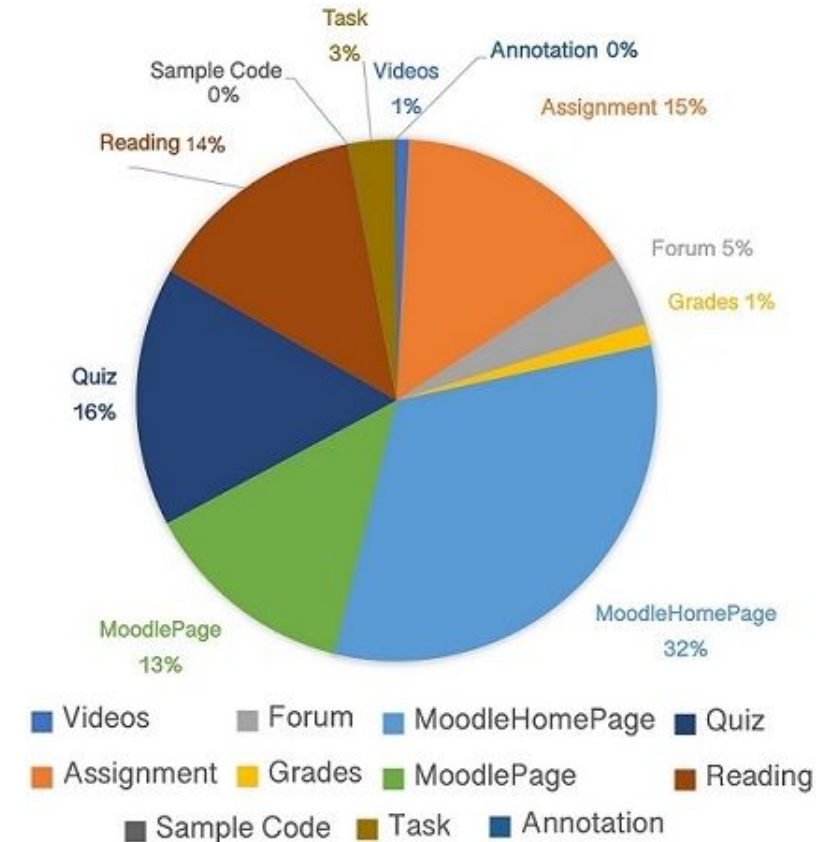
1st Study: Literature Review ”

Ahnad, A., Schneider, J., Griffiths, D., Biedermann, D., Schiffner, D., Greller, W., & Drachler, H. (2022). *Connecting the dots—A literature review on learning analytics indicators from a learning design perspective*. *Journal of Computer Assisted Learning*, 40(6), 2432-2470.

LA Heterogeneity (e.g., Terminologies)

Standardization challenge: Heterogeneity in LA instruments ✓

- **Metrics:** LA applications collect data from the interaction between learners and LMSs. To make sense of these captured data, they need to be categorized in a corresponding **unit of measurements** (e.g., number of views/posts, login/logout frequency, etc.). We refer to this unit of measurements as metrics
- **Indicators:** Metrics are used to create indicators; an indicator the **outcome of one or more metrics** that gives a **more comprehensive picture** on a particular (abstract) learner status, e.g., reading analytics, self-reflection, student engagement etc.



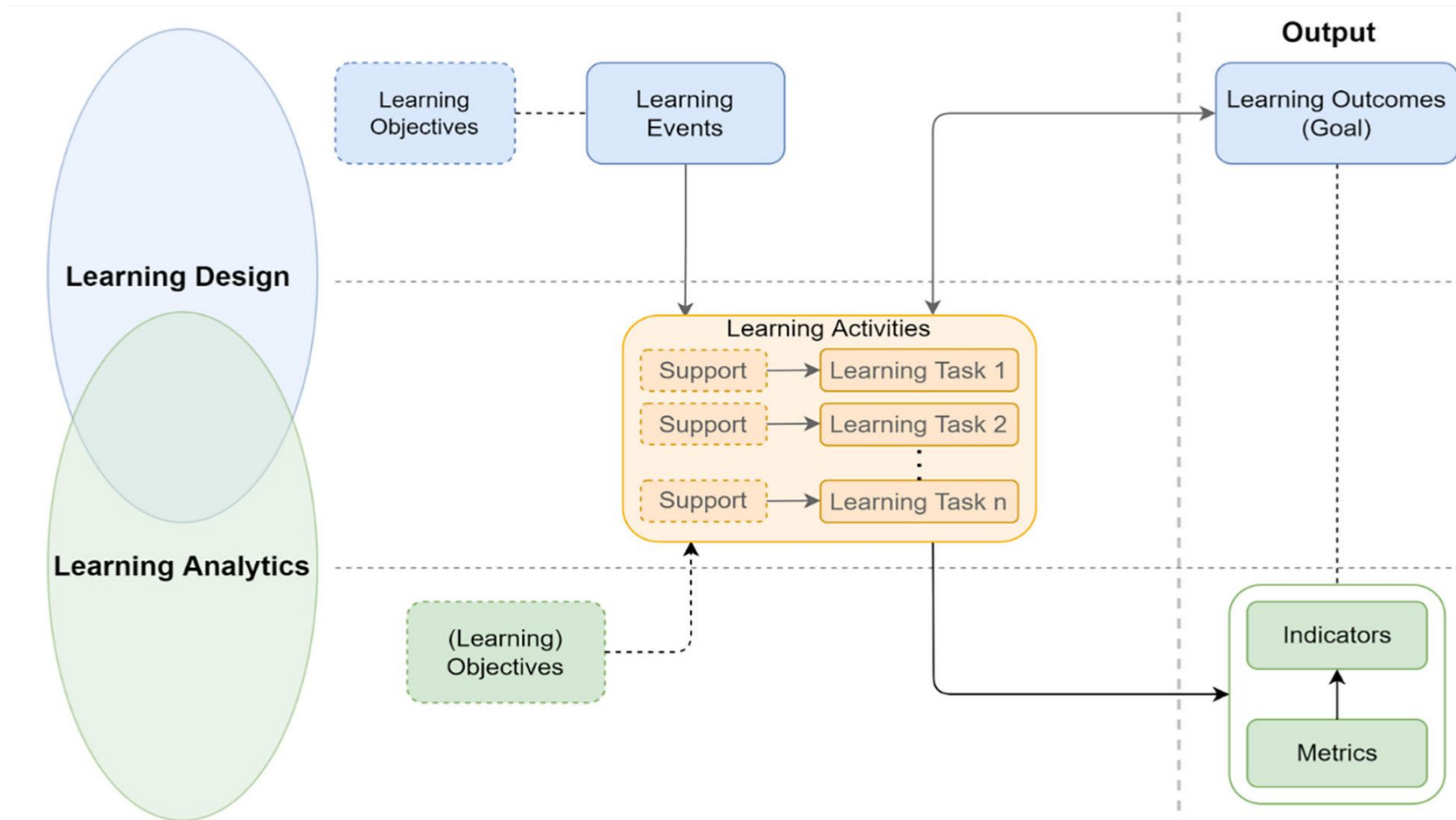
Student Engagement Indicator

1st Study: Literature Review ”

Ahnad, A., Schneider, J., Griffiths, D., Biedermann, D., Schiffner, D., Greller, W., & Drachler, H. (2022). *Connecting the dots—A literature review on learning analytics indicators from a learning design perspective*. *Journal of Computer Assisted Learning*, 40(6), 2432-2470.

LADA Framework

Instructional challenge: Lack of alignment between LD-LA instruments ✓



Learning Analytics and Design Alignment (LADA) Framework

1st Study: Literature Review ””

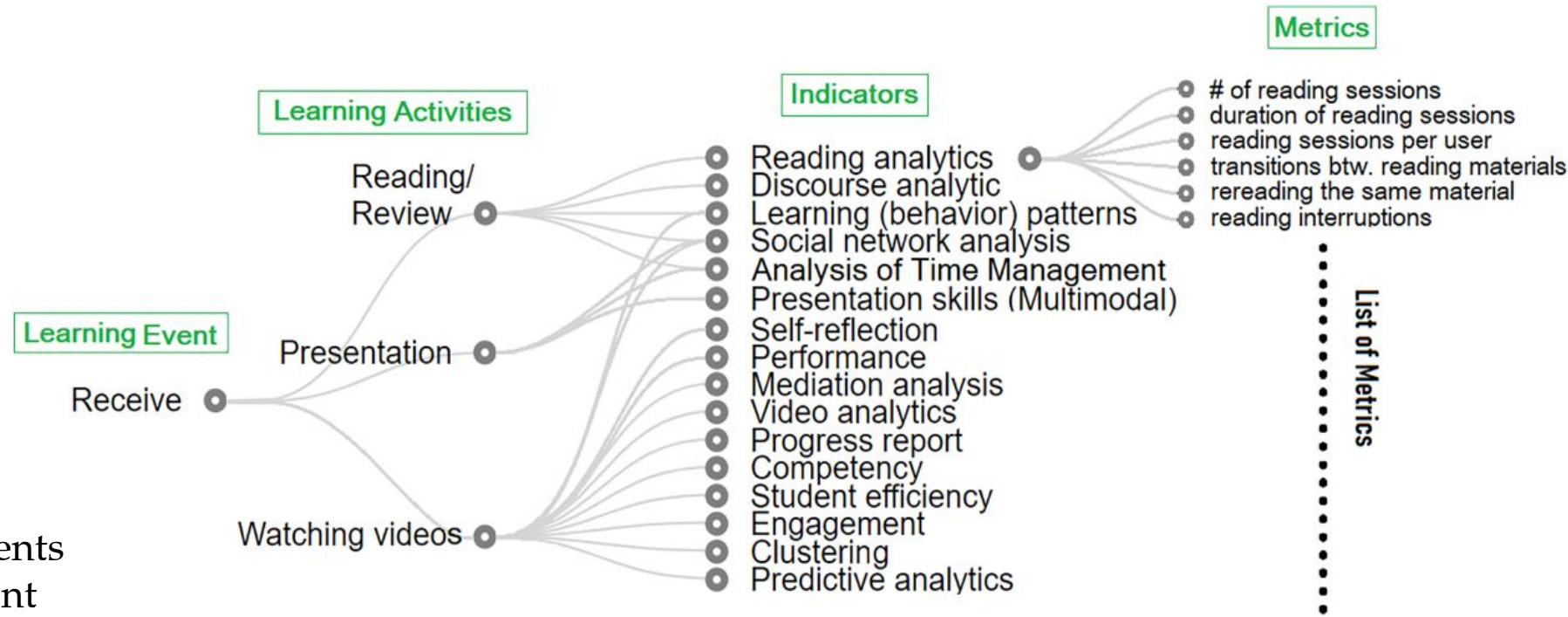
Ahmad, A., Schneider, J., Griffiths, D., Biedermann, D., Schiffner, D., Greller, W., & Drachsler, H. (2022). *Connecting the dots—A literature review on learning analytics indicators from a learning design perspective*. *Journal of Computer Assisted Learning*, 40(6), 2432-2470.

Overview of LD-LA instruments

Research challenge: Lack of Overview and comparability of LA instruments ✓

- **Outcome** of:

- Literature review
 - LADA framework



- **Represents:**

- Arrangement of instruments
- Grouped by learning event (from 8LEM)

A tree view of 'Receive' event (Example)

1st Study: Literature Review “

Ahmad, A., Schneider, J., Griffiths, D., Biedermann, D., Schiffner, D., Greller, W., & Drachsler, H. (2022). *Connecting the dots—A literature review on learning analytics indicators from a learning design perspective*. *Journal of Computer Assisted Learning*, 40(6), 2432-2470.

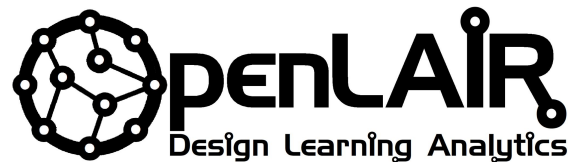
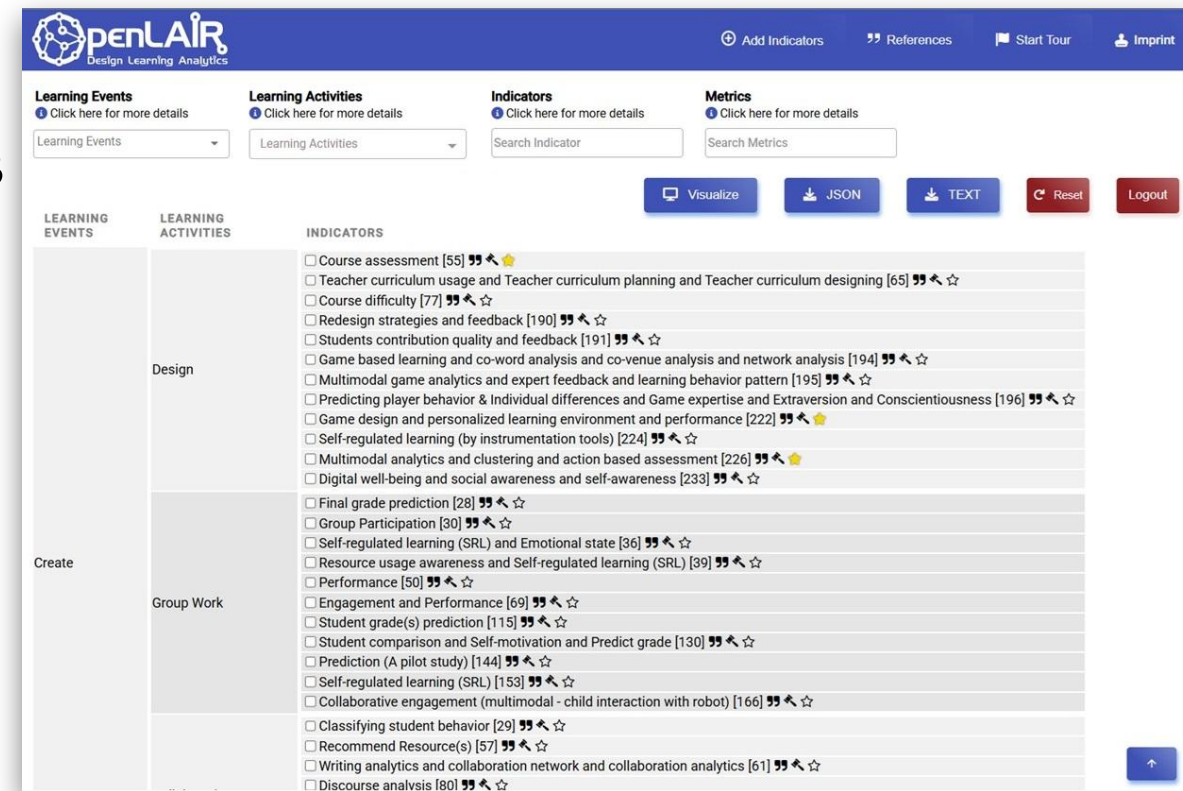
OpenLAIR (2nd Study)

Lack of technology: Standards to provide evidence-based insights



- Open Learning Analytics Indicator Repository (OpenLAIR)

- OpenLAIR is a repository to collect and curate knowledge indicators and metrics used in LA research
- Evidence-based insights
- Support the application of LA
- OpenLAIR was **evaluated** with 12 Postdocs, 13 PhD Students and 13 MS/BS Students
 - SUS for **usability**
 - TAM for **technology acceptance**
 - General questions



2nd Study: OpenLAIR ”

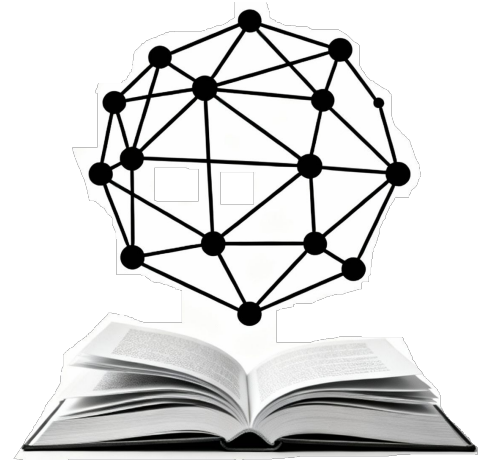
Ahmad, A., Schneider, J., Weidlich, J., Di Mitri, D., Yau, J. Y. K., Schiffner, D., & Drachsler, H. (2022, April). *What Indicators Can I Serve You with? An Evaluation of a Research-Driven Learning Analytics Indicator Repository*. In *International Conference on Computer Supported Education (1)* (pp. 58-68).

OpenLAIR - Challenge

- How to keep it **up to date** with the latest **LA literature**?
 - With minimal efforts



- Took **~9 months** to extract and organize this manually
- Need a solution

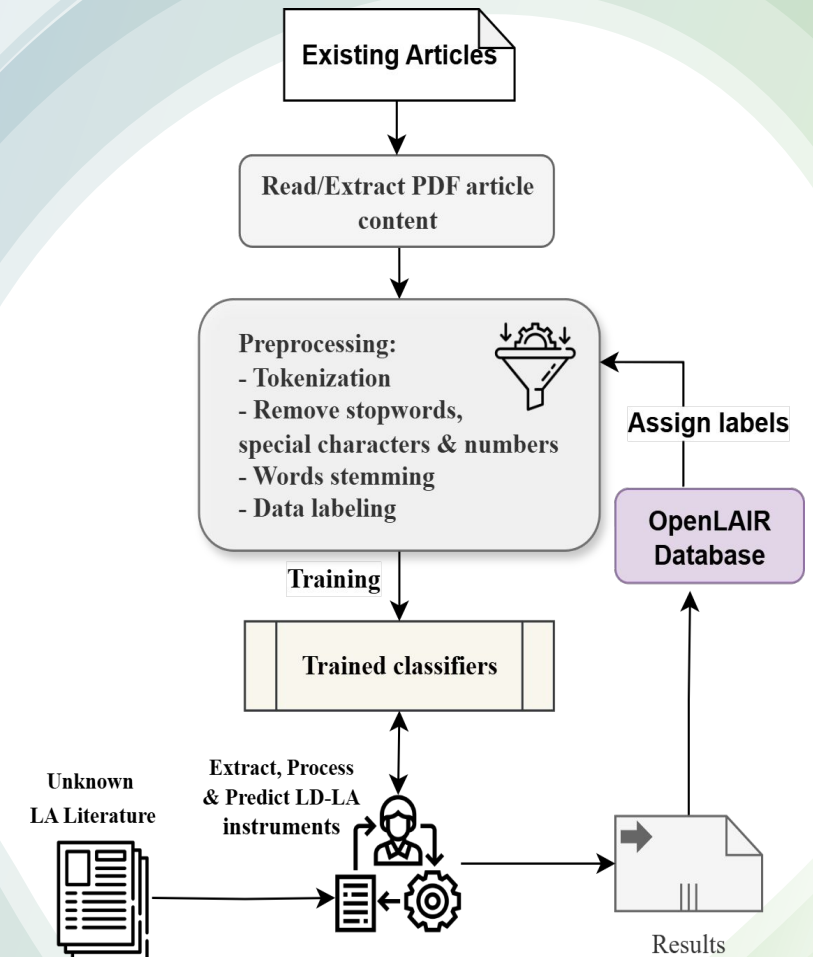


Automatic Knowledge Acquisition (3rd Study)

Keeping OpenLAIR up to date challenge ✓

● LExplore for OpenLAIR

- Uses NLP techniques for training models
- Extracting LD-LA instruments from LA literature
- Evaluation
 - Semi-automatic extraction
 - Four Postdocs and six PhD candidates
 - TAM & SUS (Usability and Technology)
 - Automatic extraction
 - Classifiers vs expert comparison
 - F-score (recall and precision)
 - ~75%

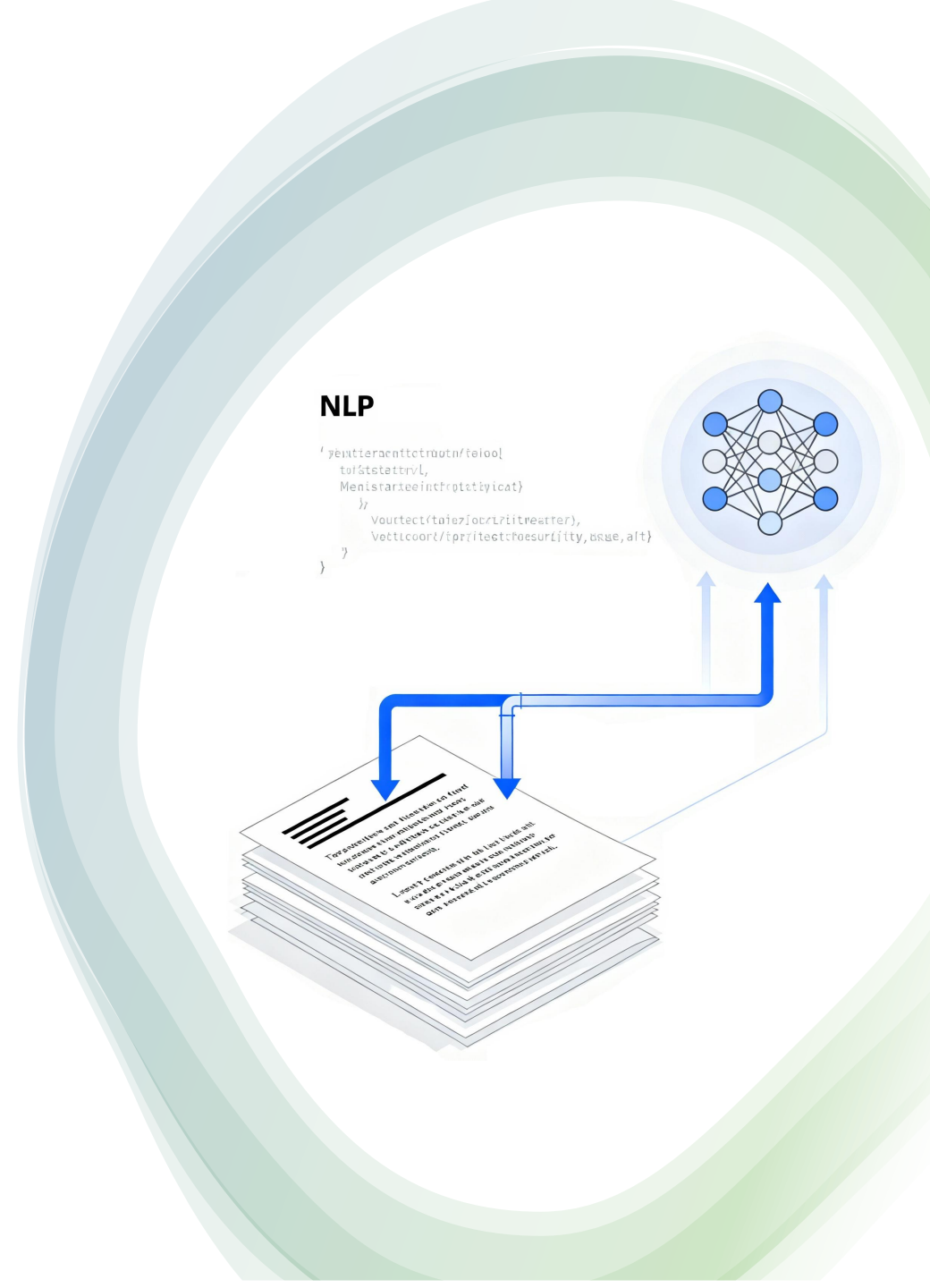


3rd Study: LExplore ”

Ahnad, A., Schneider, J., Schiffner, D., Islamovic, E., & Drachler, H. (2023). LExplore: An NLP-Based Tool for Distilling Learning Analytics and Learning Design Instruments out of Scientific Publications. In International Conference on Knowledge Discovery and Information Retrieval (pp. 230-239).

LExplore - Challenge

- Reliance on **predictions**
 - **Risk** of prediction **errors**
- The user is **required** to **validate** the results from the **source**
 - Still **time-consuming** and **tedious**



NLP

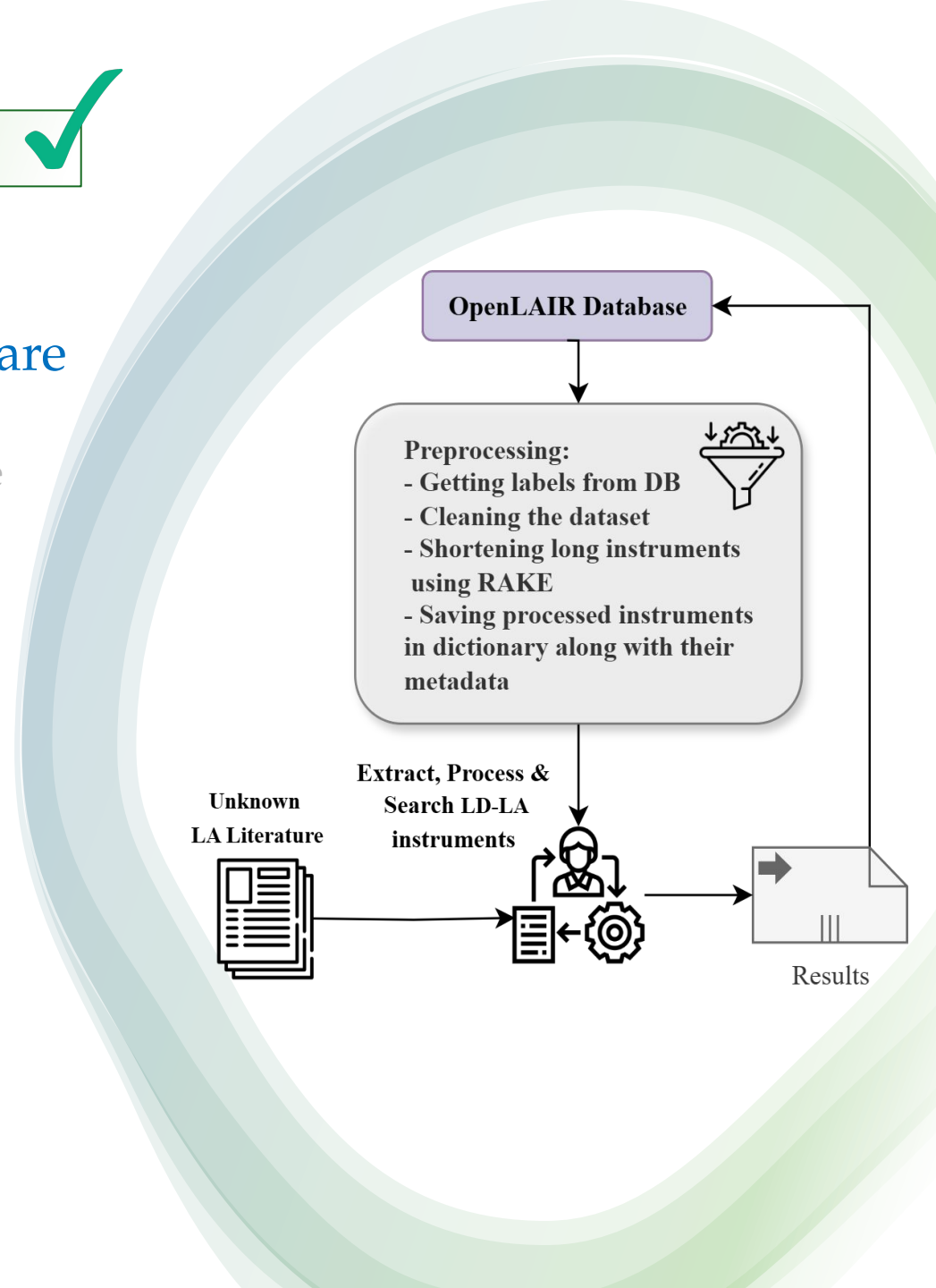
```
{  
  "pentieranttotruatn/foioo/  
  to/ststetrvL,  
  Menisariseinrtottyicat)  
  }  
  "Vourtect(foierjocrl/itreatter),  
  Vetticoor/itpr/itctfoesurjitty,ssae,alt)  
  }  
}
```

LExplore 2.0

LExplore Accuracy & Trust Challenge ✓

- It is an alternative solution for LExplore
- It **utilizes** fundamental **keyword search** and **compare algorithms** by leveraging **Python dictionaries**
 - For keyword extraction and simplification of text, we are using Rapid Automatic Keyword Extraction algorithm (RAKE)

- The results are now **accurate**
- Now, users can **immediately validate** the **results** without reading the paper



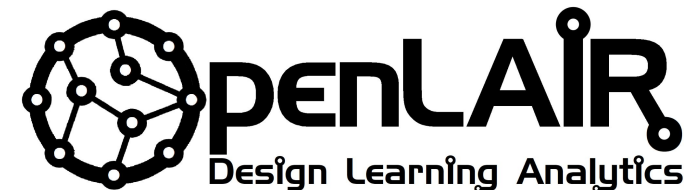
Evaluate OpenLAIR using FoLA² (4th Study)

OpenLAIR Applicability Challenge ✓

- We used FoLA² method for co-designing a course called the Fellowship of Learning Activities and Analytics
 - Procedure
 - Two groups: novices (six students) and experts (six TEL)
 - Task: use OpenLAIR while following the FoLA² method
 - Epistemic Network Analysis (ENA)
 - To find similarities & differences
 - Thematic analysis (content-based)
 - Discourse analysis
- OpenLAIR helped both groups in course designing



(Schmitz et al., 2022; and 2023)



4th Study: Course designing with OpenLAIR and FoLA² ”

Ahmad, A., Schneider, J., Schmitz, M., Schiffner, D., & Drachslar, H. (2024). *Students Want to Experiment While Teachers Care More About Assessment! Exploring How Novices and Experts Engage in Course Design*. In *International Conference on Computer Supported Education (1)* (pp. 15-26). - *Best paper nominee*

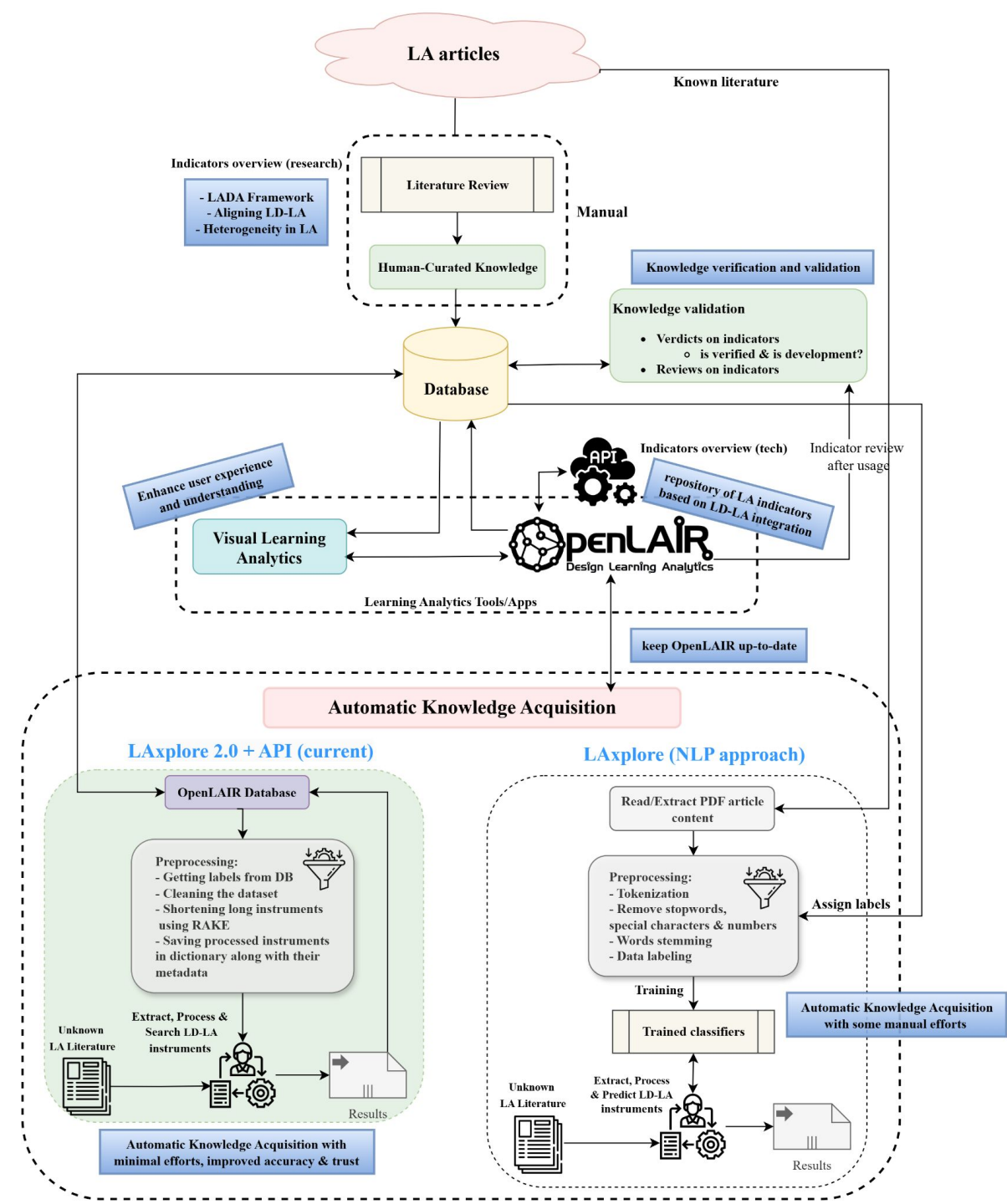
Conclusion

- Overview of the system architecture

- Technical and scientific contributions
- Literature review
 - Proposed LADA framework
 - Aligned LD-LA
 - Identified heterogeneity in LA (terminologies)
- OpenLAIR + API (an evidence-based repository)
- LAxplore (NLP tool - to keep OpenLAIR current)
- LAxplore 2.0 + API (to improve accuracy and trust)
- Assessed OpenLAIR for LA applicability

- Future work and direction

- Responsible AI + OpenLAIR
 - Recommending indicators
 - Supporting course design
- LLMs → improving LAxplore 2.0 results





**THANK
YOU!!**

Questions?

References

- Leclercq, D., & Poumay, M. (2005). The 8 Learning events model and its principles. Retrieved August, 20, 2006.
- Verpoorten, D., Poumay, M., & Leclercq, D. (2007). The eight learning events model: A pedagogic conceptual tool supporting diversification of learning methods. *Interactive Learning Environments*, 15(2), 151-160.
- Gruber, Marion. (2019). Design Thinking for Technology Enhanced Learning. https://www.researchgate.net/publication/334170760_Design_Thinking_for_Technology_Enhanced_Learning
- Chatti, M. A., Dyckhoff, A. L., Schroeder, U., & Thüs, H. (2012). A reference model for learning analytics. *International journal of Technology Enhanced learning*, 4(5-6), 318-331.
- Lockyer, L., & Dawson, S. (2011, February). Learning designs and learning analytics. In *Proceedings of the 1st international conference on learning analytics and knowledge* (pp. 153-156).
- Schmitz, M., Scheffel, M., Bemelmans, R., and Drachsler, H. (2022). "FoLA 2–A Method for Co-Creating Learning Analytics-Supported Learning Design." In: *Journal of Learning Analytics* 9.2, pp. 265–281.
- Schmitz, M., Scheffel, M., Bemelmans, R., and Drachsler, H. (2023). "Evaluating the Impact of FoLA 2 on Learning Analytics Knowledge Creation and Acceptance during the Co-Design of Learning Activities". In: *Interaction Design and Architecture (s)* 55.55, pp. 9–33.
- <https://www.flaticon.com/>