Using Learning Analytics Dashboards to Explore Student Performance and Engagement Across Educational Levels

Zeynab (Artemis) Mohseni

Postdoc at GSIC/EMIC Research Group, University of Valladolid, Spain

Biography

Nebrija University, Madrid, Spain
Scientific Researcher
Jan. 2017 – Jan. 2019

Linnaeus University, Växjö, Sweden
Doctoral candidate and researcher - PhD, Computer & Data Science
Aug. 2019 – Dec. 2024

Radboud University, Nijmegen, Gelderland, Netherlands
Visiting Scholar
Apr. 2022 – May. 2022

Autonomous University of Madrid, Madrid, Spain
Visiting Scholar
Oct. 2023 – Nov. 2023

University of Valladolid, Valladolid, Spain
Postdoctoral researcher – GENIELearn project
Mar. 2025 – Present

Problem Definition & Motivation

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"

DOI: 10.1145/2330601.2330661

Learning Analytics Dashboards (LAD): "a single display that aggregates different indicators about learner(s), learning process(es), and/or learning context(s) into one or multiple visualizations"

DOI: 10.1109/TLT.2016.2599522

Challenges:

1. Variety of Visualization & Machine Learning(ML) Methods
2. Research Gaps in the Context of Study
3. Data Management
4. Requirements

Photo by Getty Images

Research Questions

RQ1: How can visualization techniques be optimized to enhance teachers' understanding and decision-making when analyzing educational data?

RQ2: What design principles should guide the development of interoperable Learning Analytics Dashboards across different educational platforms and levels?

Methodological Approach

1. Exploring various visualization & ML techniques
2. *Scoping review (Link)*
3. *Technical solution for data management (Link)*
4. Human-Centered Design (HCD) approach for co-designing LADs
5. Scenario-based framework to ensure user transparency in development of Multiple Learning Analytics Dashboards (MLADs)

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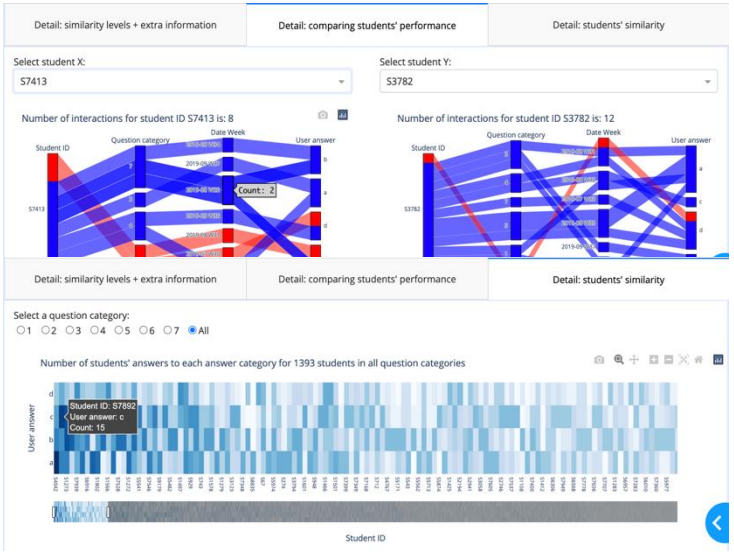
SAVis

Ref. [1]

"Overview first, zoom and filter, then details on demand"

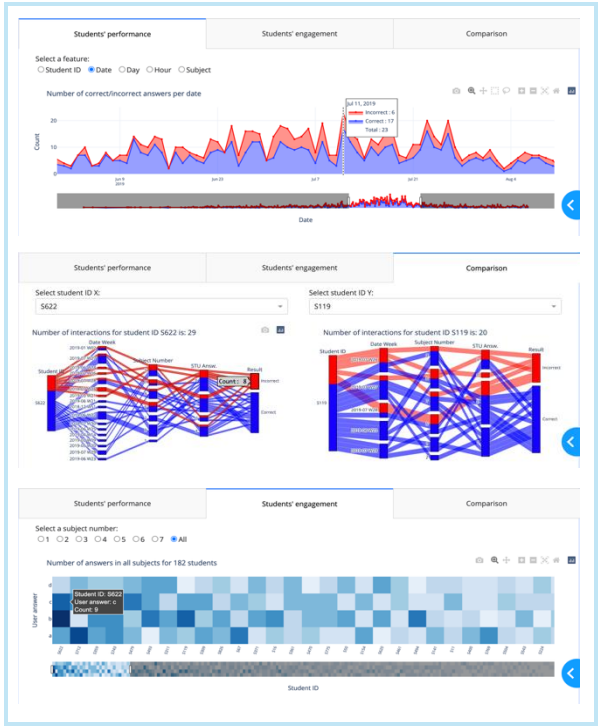
DOI: 10.1109/VL.1996.545307

SBGTool



Ref. [2]

SBGTool V2.0



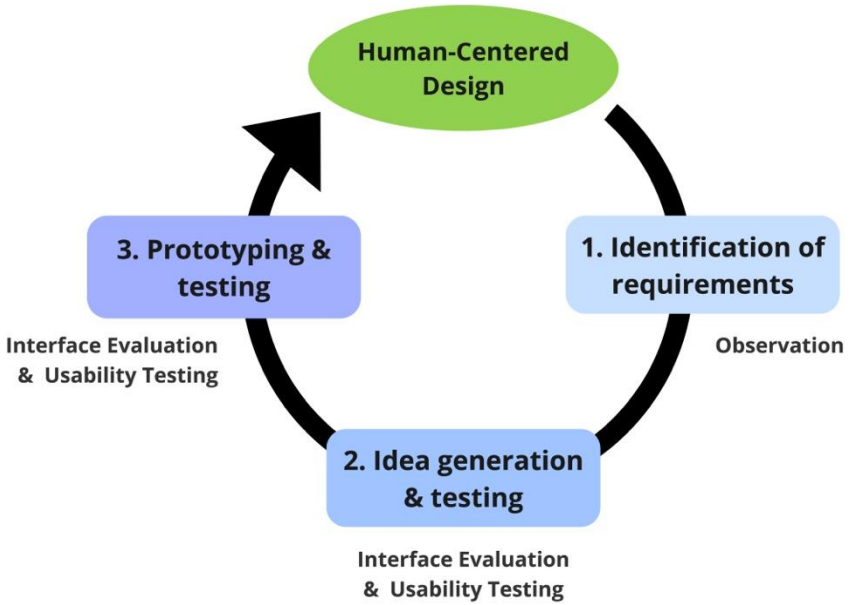
Ref. [3]

Three-Step Human-Centered Design Approach

Human-centered design: "*approach to systems design and development that aims to make interactive systems more usable by focusing on the use of the system and applying human factors and usability knowledge and techniques*"

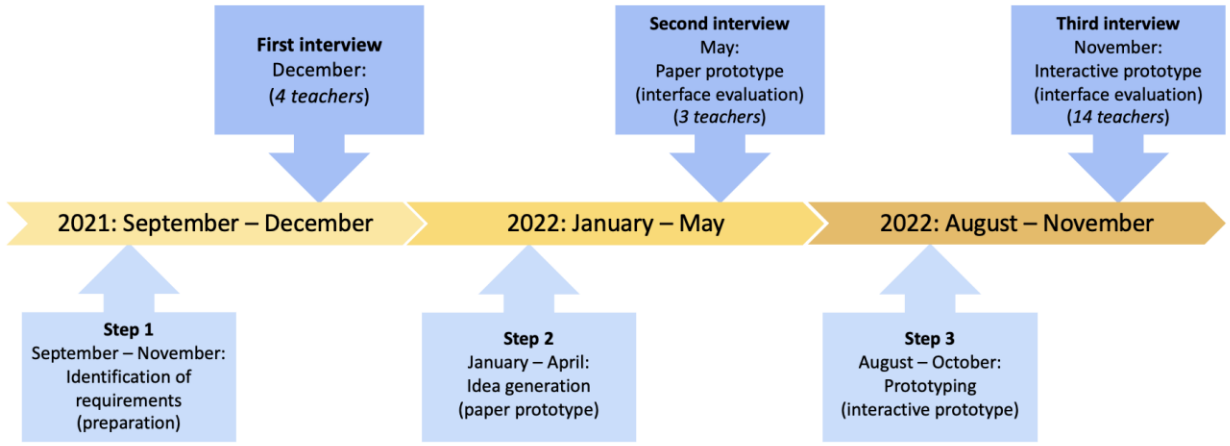
DOI: 10.2752/175630614X14056185480186

Methodology (a three-step HCD approach):



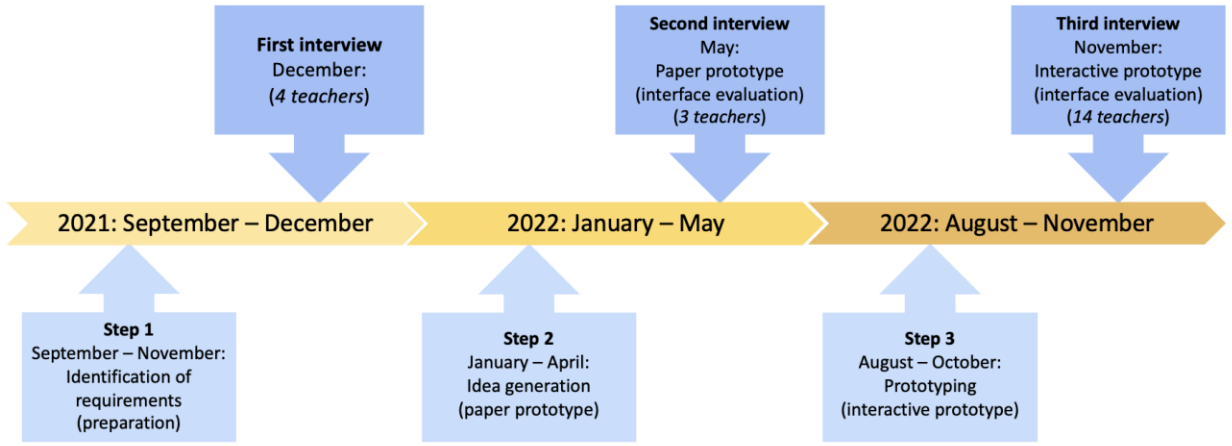
Ref. [4]

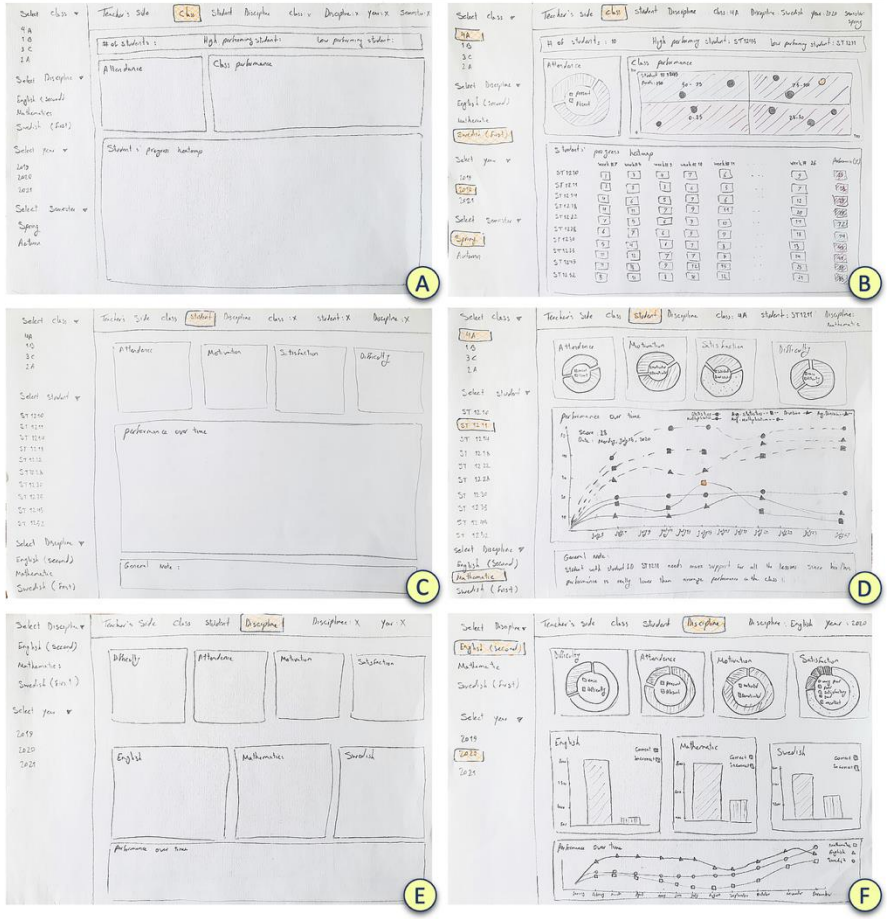
Three-Step Human-Centered Design Approach: Step 1



Ref. [4]

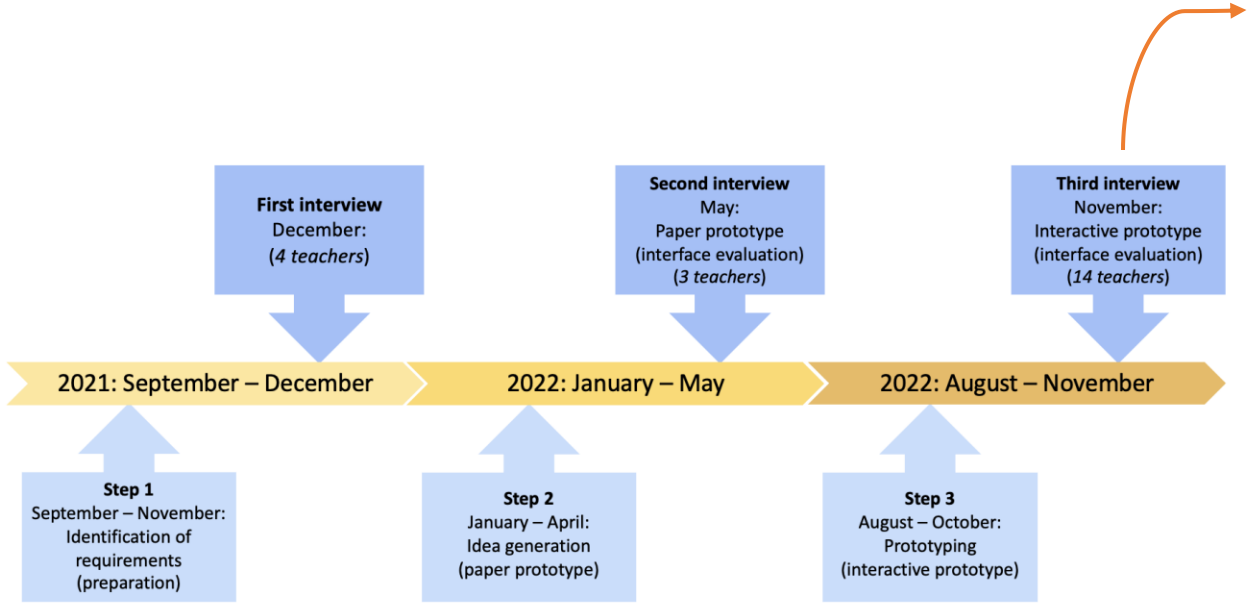
Three-Step Human-Centered Design Approach: Step 2

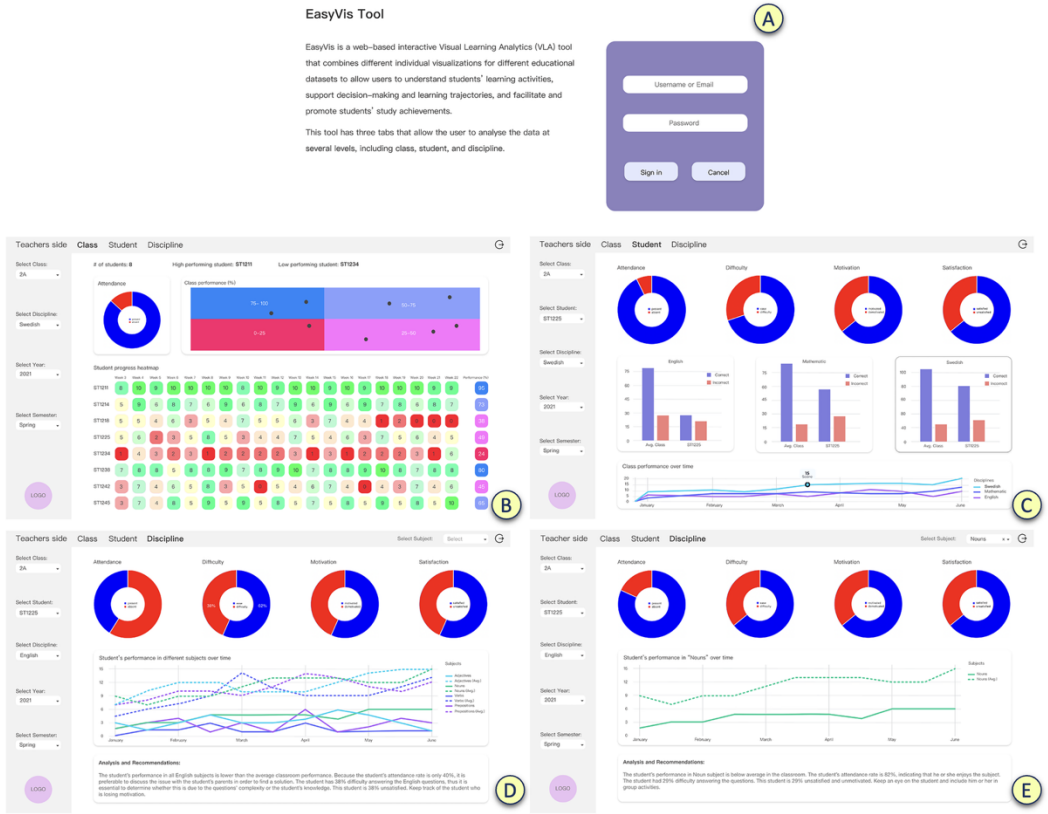




Ref. [4]

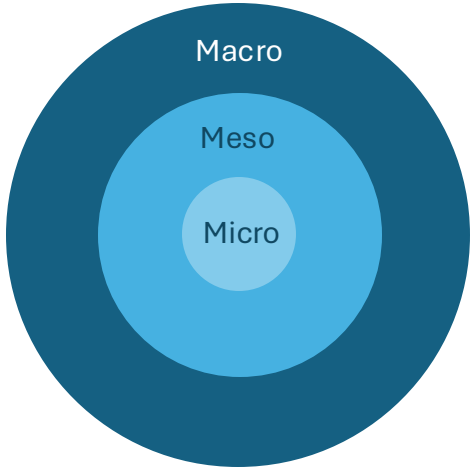
Three-Step Human-Centered Design Approach: Step 3

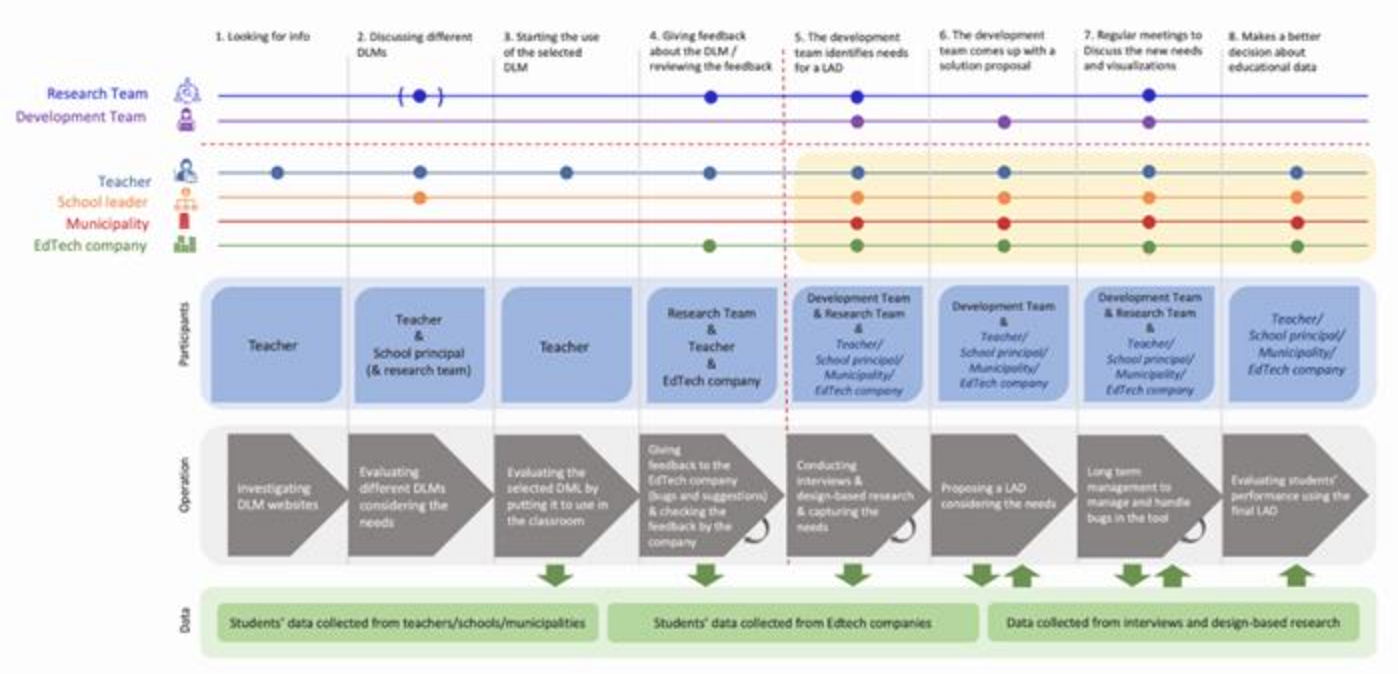




Ref. [4]

Scenario-Based Framework (MLADs)

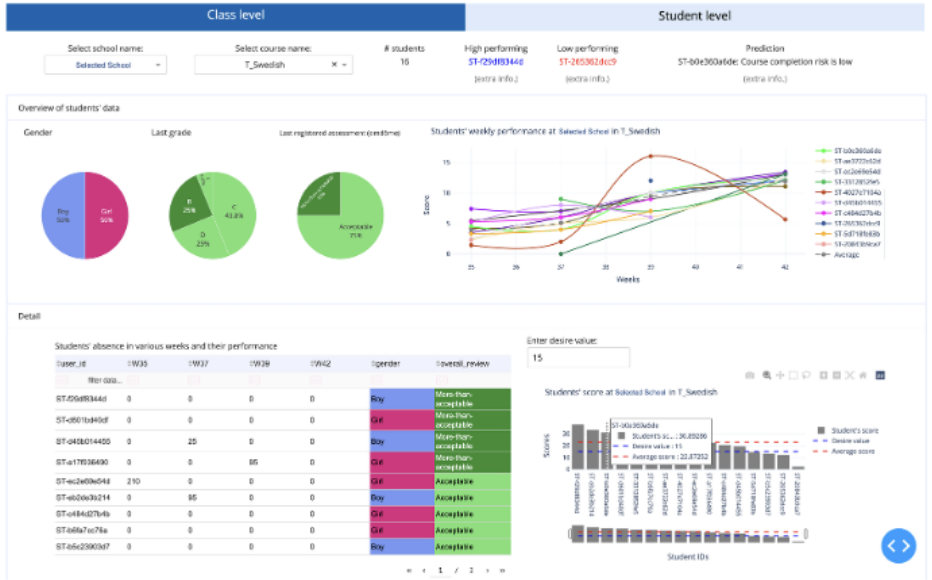


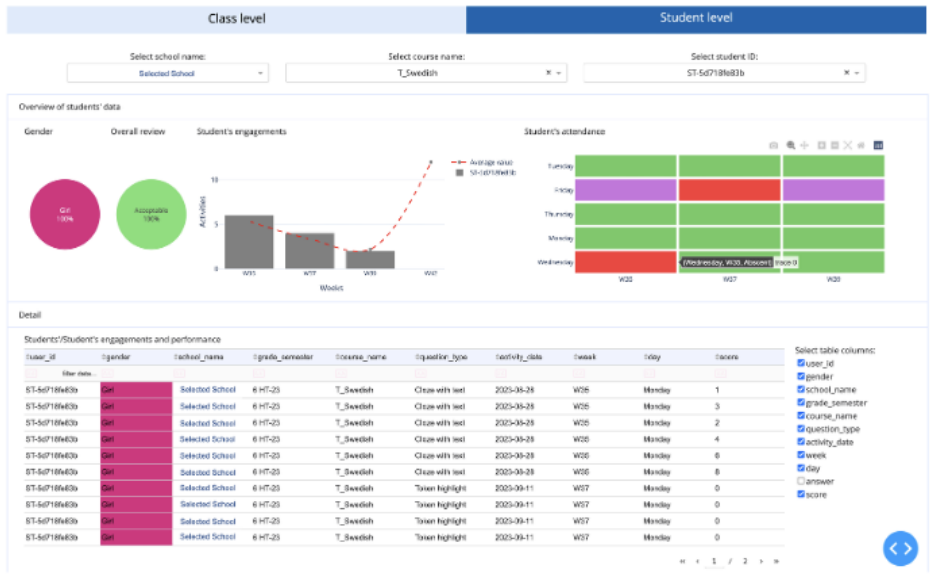


Ref. [5, 6]

Scenario-Based Framework (MLADs)

Teacher LAD (Micro Level):





Ref. [6]

Design-Based Research

Design-Based Research: "*a systematic yet adaptable methodology designed to enhance educational practices through iterative analysis, design, development, and implementation. This involves collaboration between researchers and practitioners in real-world settings, ultimately leading to the formulation of contextually-sensitive design principles and theories*"

DOI: 10.1007/BF02504682

A Design-Based Research approach:

1. Identification of requirements
2. Idea generation & testing
3. Intervention, evaluation & testing of the solution
4. Development & implementation

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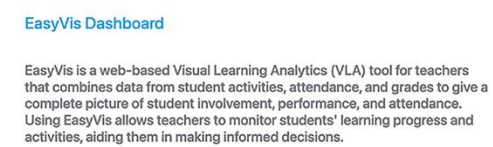
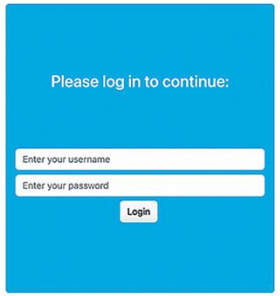
Design-Based Research

Teacher LAD (Micro Level):





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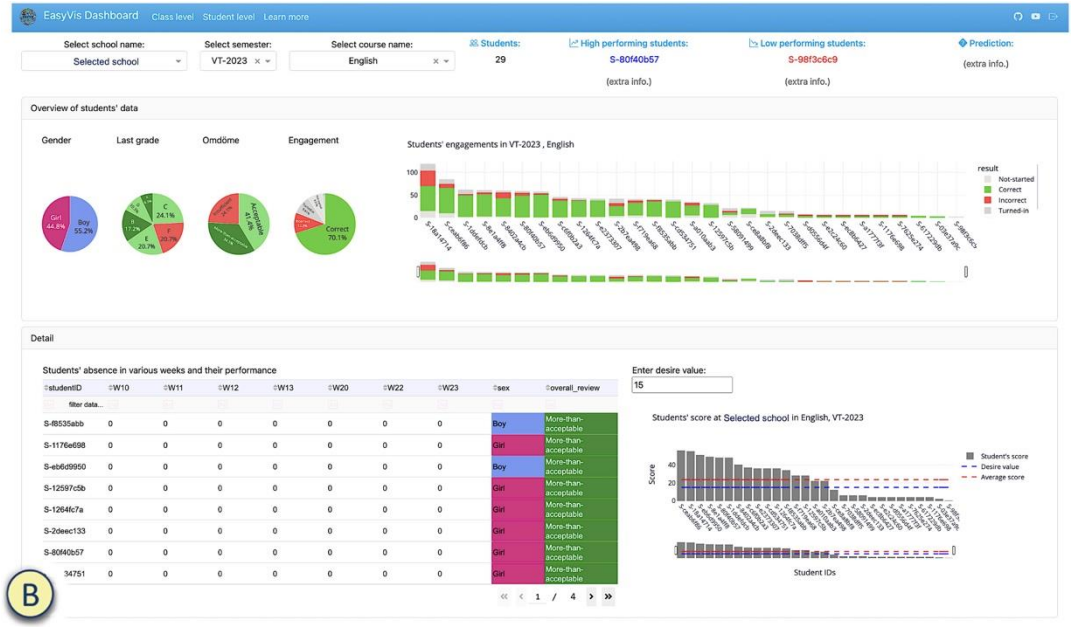

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Ref. [7]

Limitations, Challenges and Contribution

Limitations

- Teachers used purchased DLMs without clear understanding.
- Apprehension among IT and educational managers regarding data sharing.

Challenges

- Teachers' feedback on the DLMs was not promptly attended by providers
- Obtaining student data took around three years due to GDPR regulations.
- Accessing data on a weekly basis was challenging.
- Conducting empirical studies progressed slowly due to busy schedules.

Overall Contribution

Improves educational technology by enhancing data visualization that can be used for pedagogical decision-making to possibly aid academic results and engagement.

What is Next?

A simple MLADs targeting various stakeholders...

Publications

1. Mohseni, Z., Martins, R.M., Masiello, I. (2021). SAVis : a Learning Analytics Dashboard with Interactive Visualization and Machine Learning. *Nordic Learning Analytics (Summer) Institute 2021, Stockholm*.
2. Mohseni, Z., Martins, R.M., Masiello, I. (2021). SBGTool : Similarity-Based Grouping Tool for Students' Learning Outcomes. *Proceedings of the 2021 Swedish Workshop on Data Science (SweDS), IEEE*.
3. Mohseni, Z., Martins, R.M., Masiello, I. (2022). SBGTool v2.0: An Empirical Study on a Similarity-Based Grouping Tool for Students' Learning Outcomes. *Data*. 7 (7).
4. Mohseni, Z., Masiello, I., Martins, R.M. (2023). Co-Developing an Easy-to-Use Learning Analytics Dashboard for Teachers in Primary/Secondary Education : A Human-Centered Design Approach. *Education Sciences*. 13 (12).
5. Mohseni, Z., Masiello, I., Martins, R.M. (2023). Towards a Teacher-Oriented Framework of Visual Learning Analytics by Scenario-Based Development. *DCECTEL 2023 Doctoral Consortium of ECTEL, Aveiro, Portugal, 4-8 September 2023*.12-17.
6. Mohseni, Z., and Masiello, I. (2025) Towards a Scenario-Based Framework for Developing Multiple Learning Analytics Dashboards. *Under review*.
7. Mohseni, Z., and Masiello, I. (2025) Co-designing, Developing, and Implementing Multiple Learning Analytics Dashboards for Data-Driven Decision-Making in Education: A Design-Based Research Approach. *Accepted*.

Thank you for your attention!!!

Please find me at:

- Email: zmohseni@uva.es
- LinkedIn: https://www.linkedin.com/in/artemis-mohseni
- Webpage: https://gsic.uva.es/members/artemismh

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