Human-centered design approaches for using Artificial Intelligence to support teaching and learning

Talk Lehre 2025 RWTH Aachen University

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Computational Methods in Modeling and Analysis of Learning Processes (colaps)

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Home Teaching Research Team Blog Impressum

Welcome to the research group "**Computational Methods in Modeling and Analysis of Learning Processes**"
University of Duisburg-Essen

In *colaps* we aim to explore the use of computational data analytics, namely machine-learning and data mining, with the aim to support learning from the perspective of personalization and adaptation and in relation to tutoring feedback and scaffolding.

Our research focuses on data analytics to facilitate learning in formal education and ultimately in modeling, monitoring and guiding complex human activities. Our interests extend to using modern technologies in order to facilitate and promote learning by bridging the gap between theory and modern, data driven, technology-oriented practice: combining top-down, established pedagogical theories with bottom-up, data-driven computational approaches.

Teaching

Research

Team

Blog

The colaps team

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PhD Student

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Research Assistant

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TECH· A.I.

Duolingo CEO says AI is a better teacher than humans—but schools will still exist 'because you still need childcare'

BY IRINA IVANOVA
DEPUTY US NEWS EDITOR

May 20, 2025 at 5:13 AM EDT

Duolingo CEO Luis von Ahn believes there's no subject a computer isn't suited to teaching.
KEVIN DIETSCH/GETTY IMAGES

https://fortune.com/2025/05/20/duolingo-ai-teacher-schools-childcare/

*"**AI**, like any other **tool**, offers many **opportunities** but also carries with it many **threats**, which make it necessary to take human rights principles into account in the early design of its application."*

- Council of Europe's Committee of Ministers, 2019

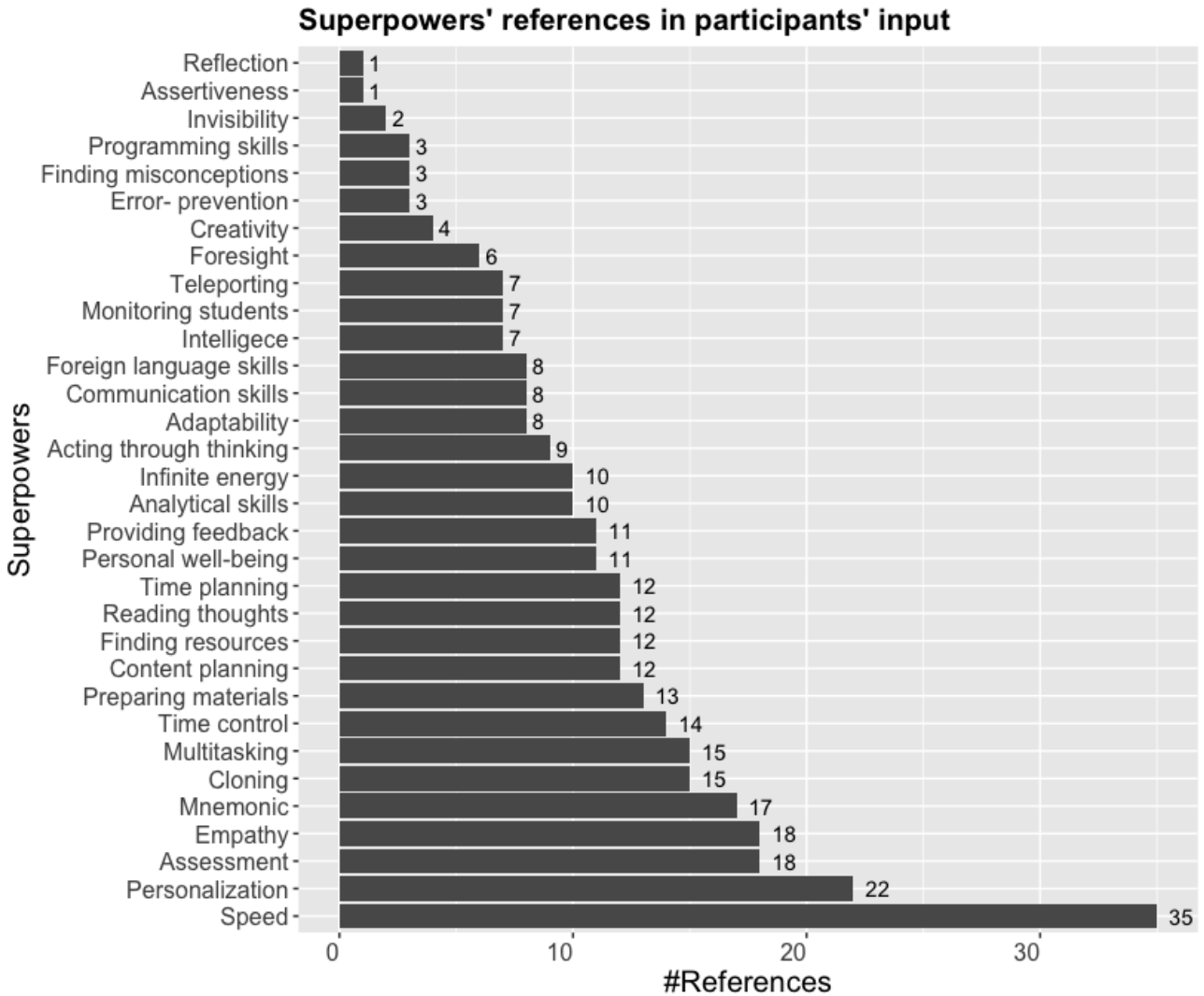
If you could have a superpower to help you in teaching,

what would it be?

- Online survey (2021)
- K-12 teachers in Estonia
- 140 participants (131 valid)

https://tinyurl.com/s6czr98c

- Effectiveness
- Efficiency
- Rapport
- Course planning
- Personal Attributes
- Personal Skills

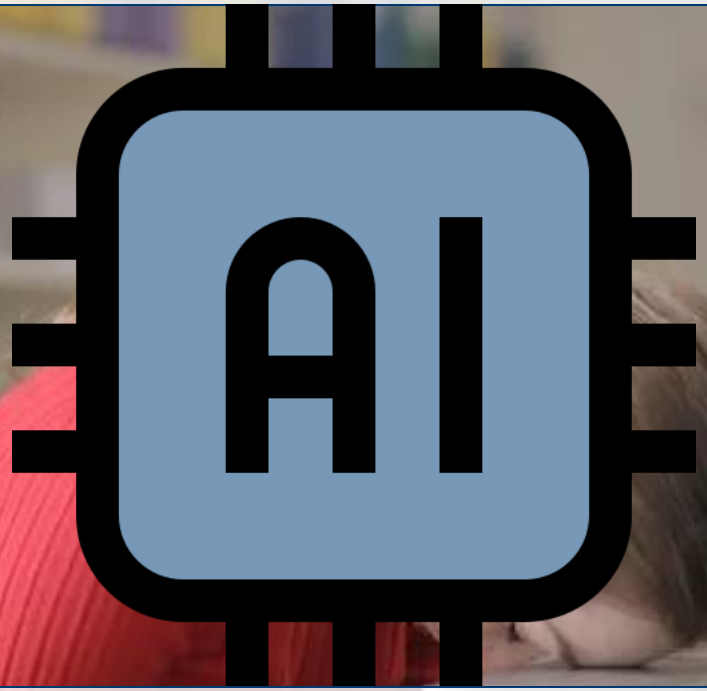


Chounta, Irene-Angelica, Emanuele Bardone, Aet Raudsep, and Margus Pedaste. "Exploring teachers' perceptions of artificial intelligence as a tool to support their practice in Estonian K-12 education." International journal of artificial intelligence in education 32, no. 3 (2022): 725-755.

Teachers love to ….teach!

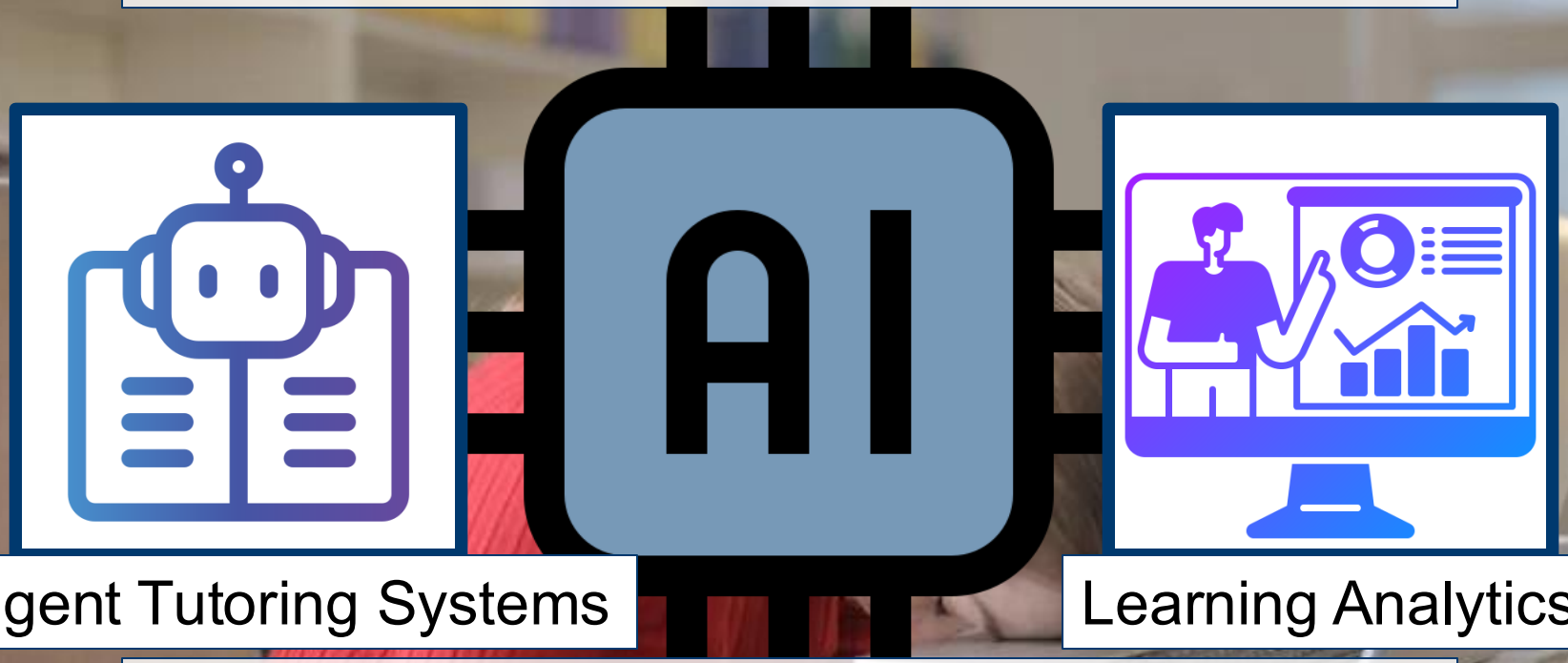
Teachers need support

Teachers love to ….teach!



Teachers need support

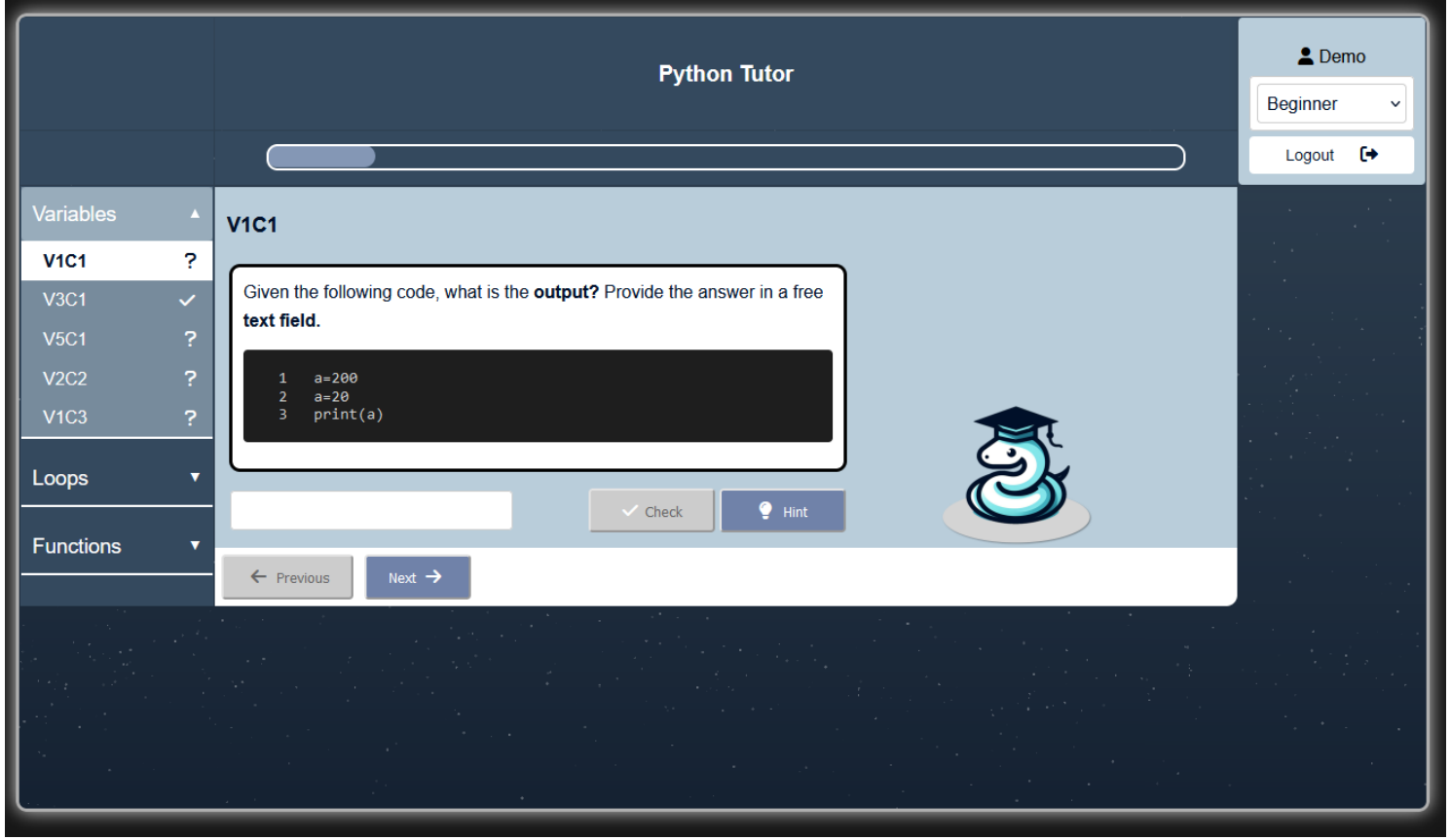
Teachers love to ….teach!



Intelligent Tutoring Systems

Learning Analytics

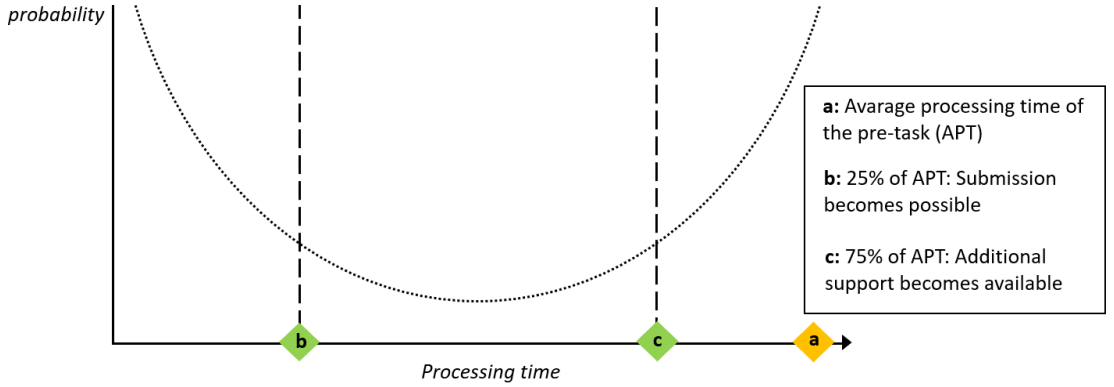
Teachers need support



Instructional Contingency

- No support
- Worked examples
- Explicit instructions

Temporal Contingency



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Name	Modified
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2_PFM.ipynb	12 days ago
3_IFM.ipynb	20 days ago
4_BKT.ipynb	13 days ago

1_AFM.ipynb | 2_PFM.ipynb | 3_IFM.ipynb

Markdown | Open in... | Python 3 (ipykernel)

10	11	Stu_1	0	KC14	3	5	1	12.0	0

Define the model's function

Here we define the logistic regression function for the AFM model. Remember, the AFM model calculates the probability of correctness based on the student's prior opportunities in the respective Knowledge Components (KCs). The function **dmatrices()** prepares the X(input) and y(output) data that we will use for training and testing the model.

[24]:
```
#specify the model type
modeltype="AFM"
#specify the model function
y, X = dmatrices('Outcome ~ AnonStudentId + KCModel+ KCModel:OpportunityModel', data,return_type="datafr
```

[25]:
```
(RMSE, f1, precision, recall)=trainModel(data,modeltype,X)
print(RMSE, f1, precision, recall)
```

```
0.5462613119736263 0.47688155391354364 0.5348621553884711 0.510954135954136
```

QUESTION When splitting the dataset into train and test subsets, we followed an 80/20 split. If we change the split to 50/50, how does this affect the performance of the model? Please change the code below accordingly and calculate again the values for RMSE, f1, precision and recall.

[27]:
```
# TODO: Set test_size to 0.5 for 50/50 split
def trainModel5050(df,modeltype,X):

    y = df['Outcome']
    y= y.astype('int')

    X_train,X_test,y_train,y_test=train_test_split(X, y, test_size=half, random_state=0)
    TrainTestSplitModel=LogisticRegression(max_iter=1000,penalty='l2')
    TrainTestSplitModel.fit(X_train,y_train)

    y_pred=TrainTestSplitModel.predict(X_test)
    RMSE=np.sqrt(np.mean((y_test-y_pred)**2))
    f1=f1_score(y_test, y_pred, average="macro")
    precision=precision_score(y_test, y_pred, average="macro")
    recall=recall_score(y_test, y_pred, average="macro")

    return (RMSE, f1, precision, recall)

(RMSE, f1, precision, recall)=trainModel5050(data,modeltype,X)
print(RMSE, f1, precision, recall)
```

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
Cell In[27], line 19
     15     recall=recall_score(y_test, y_pred, average="macro")
     17     return (RMSE, f1, precision, recall)
---> 19 (RMSE, f1, precision, recall)=trainModel5050(data,modeltype,X)
     20 print(RMSE, f1, precision, recall)

Cell In[27], line 7, in trainModel5050(df, modeltype, X)
      4 y = df['Outcome']
      5 y= y.astype('int')
----> 7 X_train,X_test,y_train,y_test=train_test_split(X, y, test_size=half, random_state=0)
      8 TrainTestSplitModel=LogisticRegression(max_iter=1000,penalty='l2')
      9 TrainTestSplitModel.fit(X_train,y_train)

NameError: name 'half' is not defined
```

LLM Help

Cell [27] NameError

```
A `NameError` in Python occurs when you try to use a variable
or function that has not been defined or is not in the current
scope. Here are some common ways to solve a `NameError` error:

1. Check the spelling and casing of the variable or function
name to ensure it matches the definition.
2. Make sure the variable or function is defined before it is
used. Check for typos or missing assignments.
3. Check the scope of the variable or function. Variables
defined inside a function are not accessible outside of it.
4. Ensure that the variable or function is imported if it is
defined in another module or file.
5. Check for any missing or incorrect imports that may cause
the NameError.
6. If you are using Jupyter notebooks or interactive shells,
make sure you have executed the cell that defines the variable
or function.

By following these steps, you should be able to identify and
resolve the `NameError` in your Python code.
```

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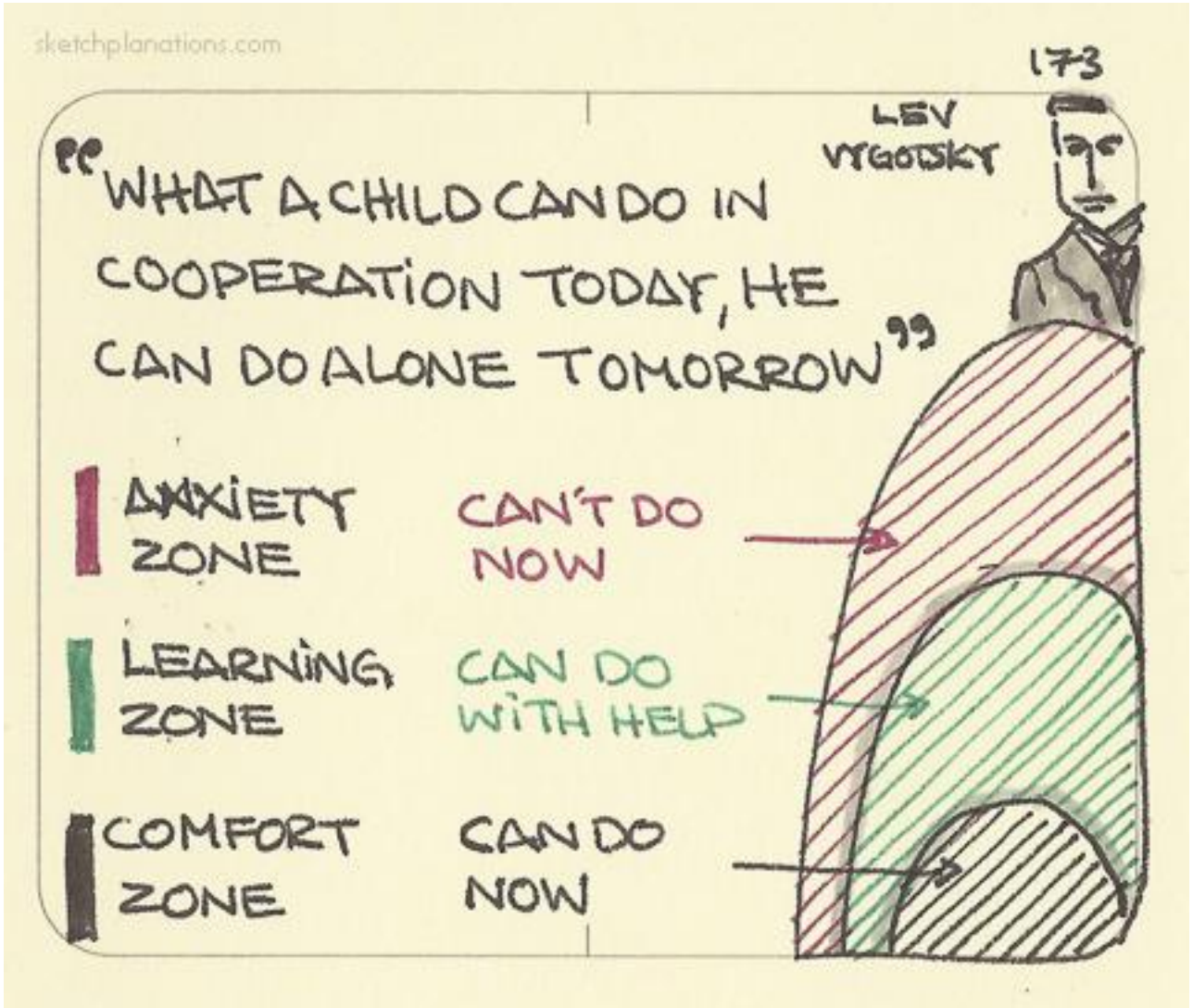
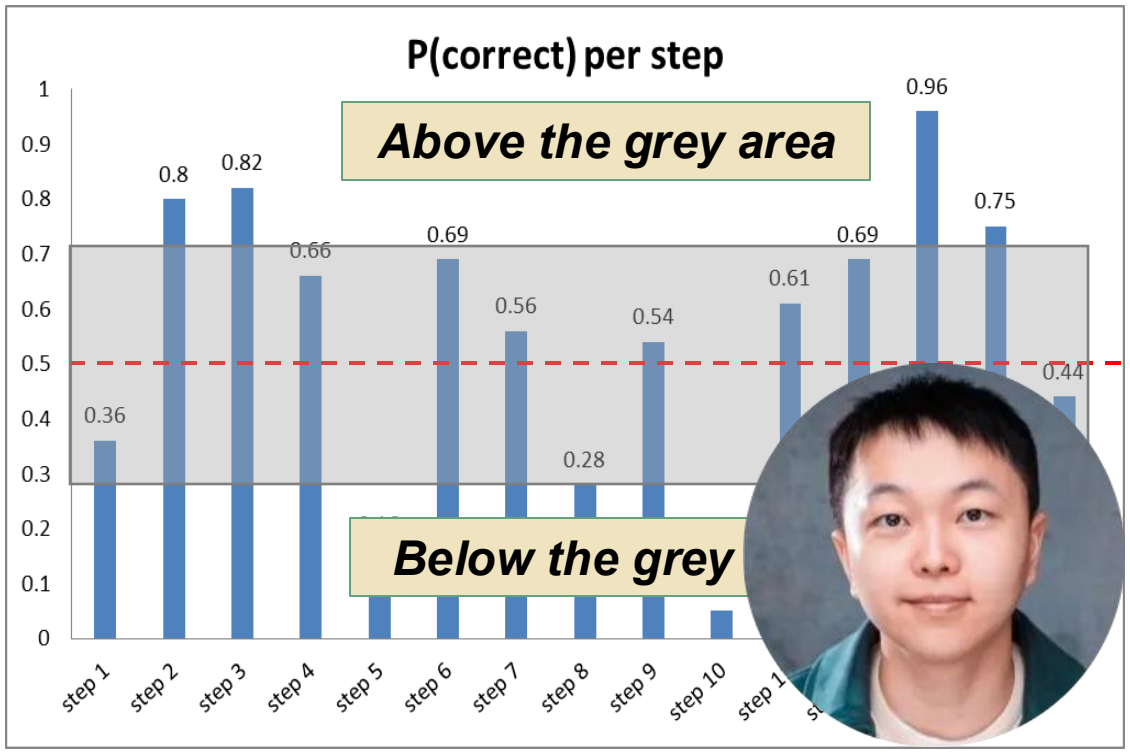
ADAPTIVE FEEDBACK FOR PYTHON PROGRAMMING



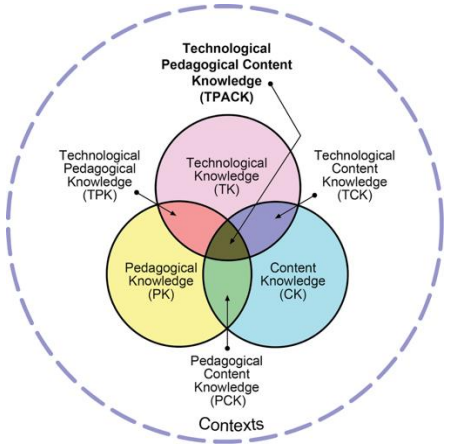


Schulze Bernd, N., & Chounta, I. A. (2024, July). Beyond the Grey Area: Exploring the Effectiveness of Scaffolding as a Learning Measure. In International Conference on Artificial Intelligence in Education (pp. 365-378). Cham: Springer Nature Switzerland.

Chounta, I.A., Albacete, P., Jordan, P., Katz, S., McLaren, B.M.: The grey area: A computational approach to model the zone of proximal development. In: Lavou´e, E., Drachsler, H., Verbert, K., Broisin, J., P´erez-Sanagust´ın, M. (eds.) Data driven ´ approaches in digital education, Lecture notes in computer science Information systems and applications, incl. internet/web, and HCI, vol. 10474, pp. 3–16. Springer, Cham (2017)

Katz, S., Albacete, P., Chounta, I.A., Jordan, P., McLaren, B.M., Zapata-Rivera, D.: Linking dialogue with student modelling to create an adaptive tutoring system for conceptual physics. International Journal of Artificial Intelligence in Education 31(3), 397–445 (2021). https://doi.org/10.1007/s40593-020-00226-y

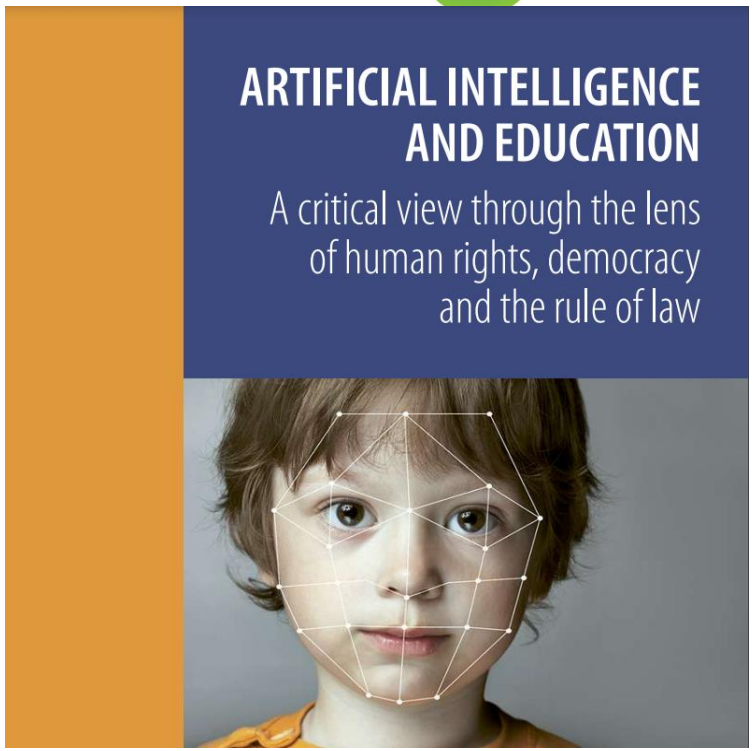
Augmented Intelligence for Training and Education

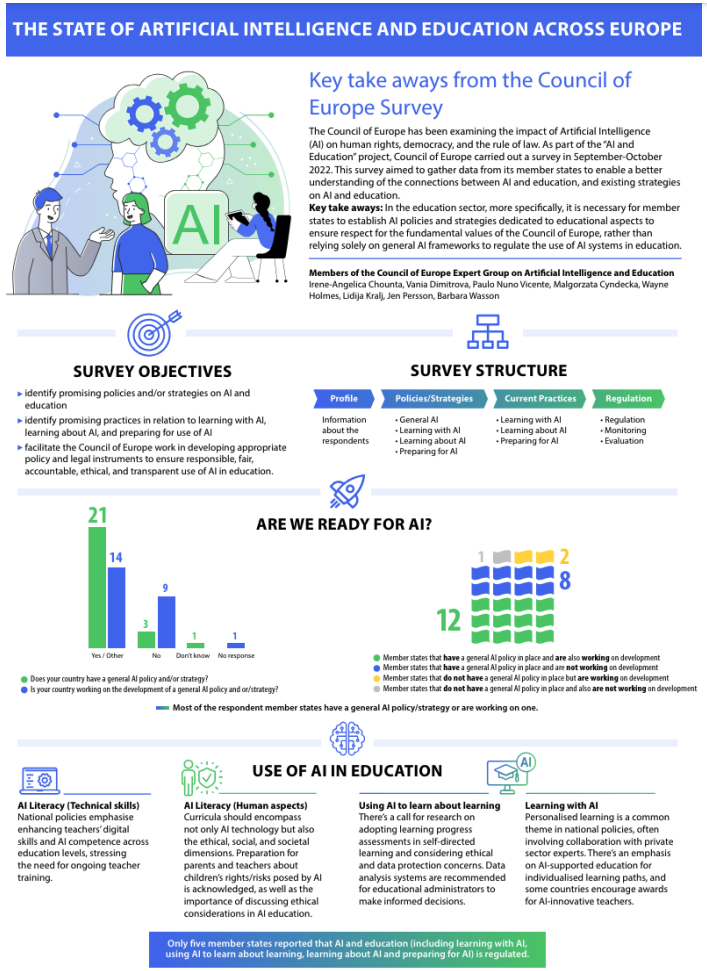


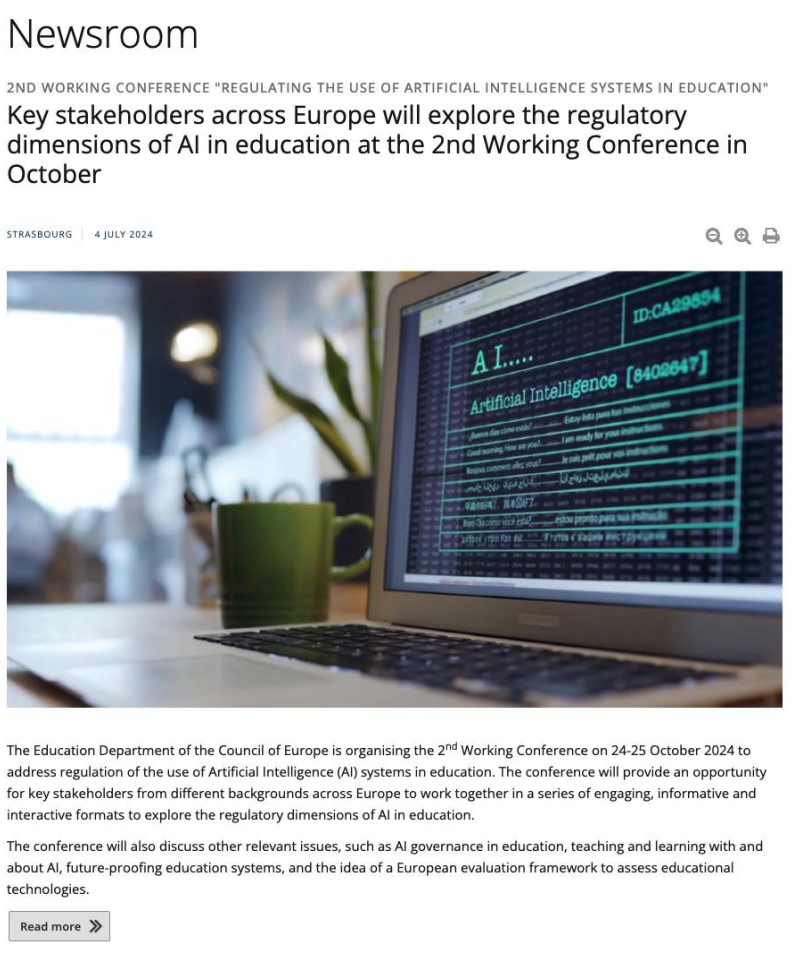
- Jan. 2023 – Dec. 2025, Horizon Research & Innovation
- Pedagogical framework for basic skills + 21st century competencies
- AI-boosted toolkit for recommendations & personalization

https://augmentor-project.eu/

Artificial Intelligence and Education







https://www.coe.int/en/web/education/artificial-intelligence

Research methods in AIED

Home > Generative Intelligence and Intelligent Tutoring Systems > Conference paper

Exploring the Methodological Contexts and Constraints of Research in Artificial Intelligence in Education

Conference paper | First Online: 01 June 2024

pp 162–173 | Cite this conference paper

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Generative Intelligence and Intelligent Tutoring Systems

(ITS 2024)

Irene-Angelica Chounta, Bibeg Limbu & Lisa van der Heyden

Part of the book series: Lecture Notes in Computer Science ((LNCS,volume 14798))

Included in the following conference series: International Conference on Intelligent Tutoring Systems

535 Accesses

Sections | Figures | References

Abstract
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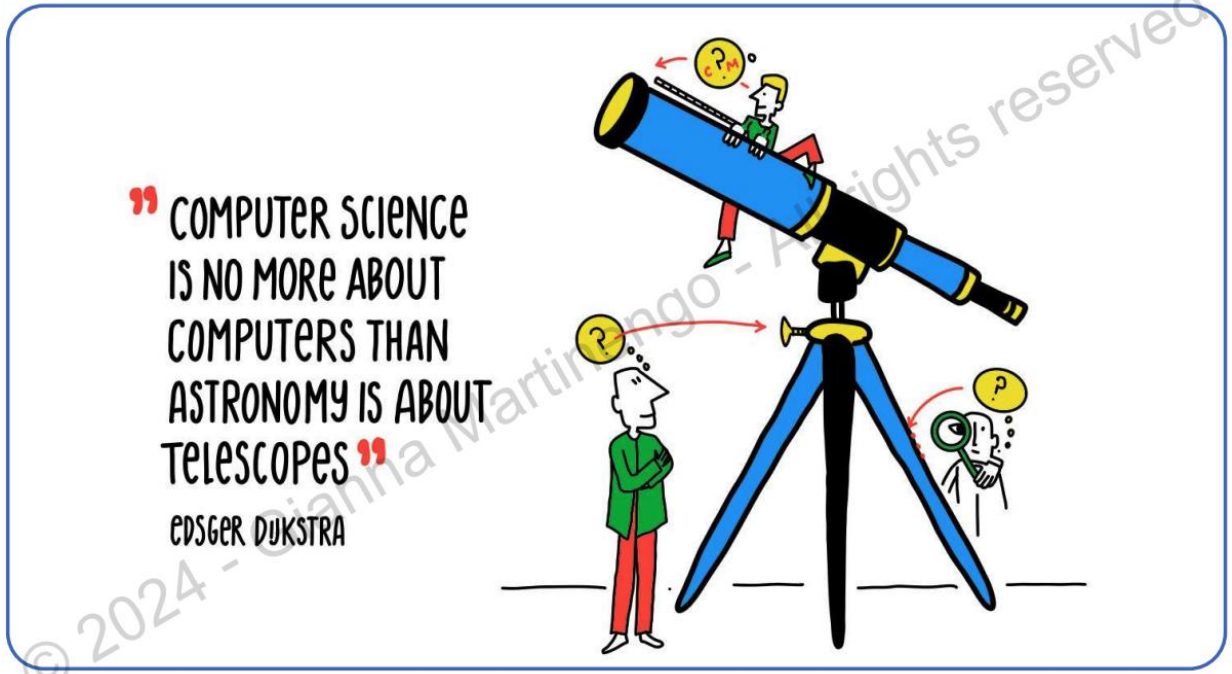
Abstract

In this paper, we present a Systematic Literature Review (SLR) on the state-of-the-art in Artificial Intelligence in Education (AIED) focusing on methodological contexts and constraints of the research landscape. To do so, we built on existing works and extended them to cover the latest research advancements in the field over the past five years. We aimed at covering all educational levels and retrieving important data regarding the planning and execution of research studies and the robustness of results. In total, we reviewed 181 papers and answered three research questions, relating to the educational context of AI use, the methodology and study design utilized in AIED research, and the type of AI algorithms and technologies used in education. Our findings suggest that research in AIED primarily focuses on formal, higher education and that there is a demand for robust and rigorous scientific evidence of the effectiveness and impact of AIED. Furthermore, the findings indicate that the most popular AI technologies currently studied are traditional AI algorithms, usually used for prediction, classification, or clustering. Based on our analysis, we discuss practical implications that can serve as inspiration and guidance for future research initiatives.

Chounta, I.-A., Limbu, B., & van der Heyden, L. (2024). Exploring the Methodological Contexts and Constraints of Research in Artificial Intelligence in Education. Generative Intelligence and Intelligent Tutoring Systems, 162–173. https://doi.org/10.1007/978-3-031-63028-6_13

- 2019 - 2023
- All Education Levels
- Research Study(ies)

AI and Education



Gianna Martinengo. Sharing from experience: competencies for “intelligent dialogues” with emerging technologies (ITS, 2024)

https://iis-international.org/wp-content/uploads/2024/10/2024-vers-SHARE-ITS-THESSALONIKI-GM-TALK-V6_compressed.pdf

Thank you

Happy to answer your questions ☺

You may want to check here:

- **[October 1-2 2025] Council of Europe 3rd AIED Working Conference**: (more information to be announced) https://www.coe.int/en/web/education/artificial-intelligence
- **[October 31 – November 2 2025] ETPE 2025** "14th Panhellenic Conference with International Participation", https://etpe2025.aegean.gr/en/14-ict/
- **[November 4-7 2025] Collabtech 2025**: "The 31st International Conference on Collaboration Technologies and Social Computing" http://www.collabtech.org

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