



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)

Faculty of Computer Science, University of Duisburg-Essen, Germany



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Open-Minded



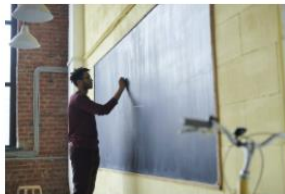
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Welcome to the research group "**Computational Methods in Modeling and Analysis of Learning Processes**"
University of Duisburg-Essen

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



Prof. Dr. Irene-
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Head of the group



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Lisa van der Heyden
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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.”*

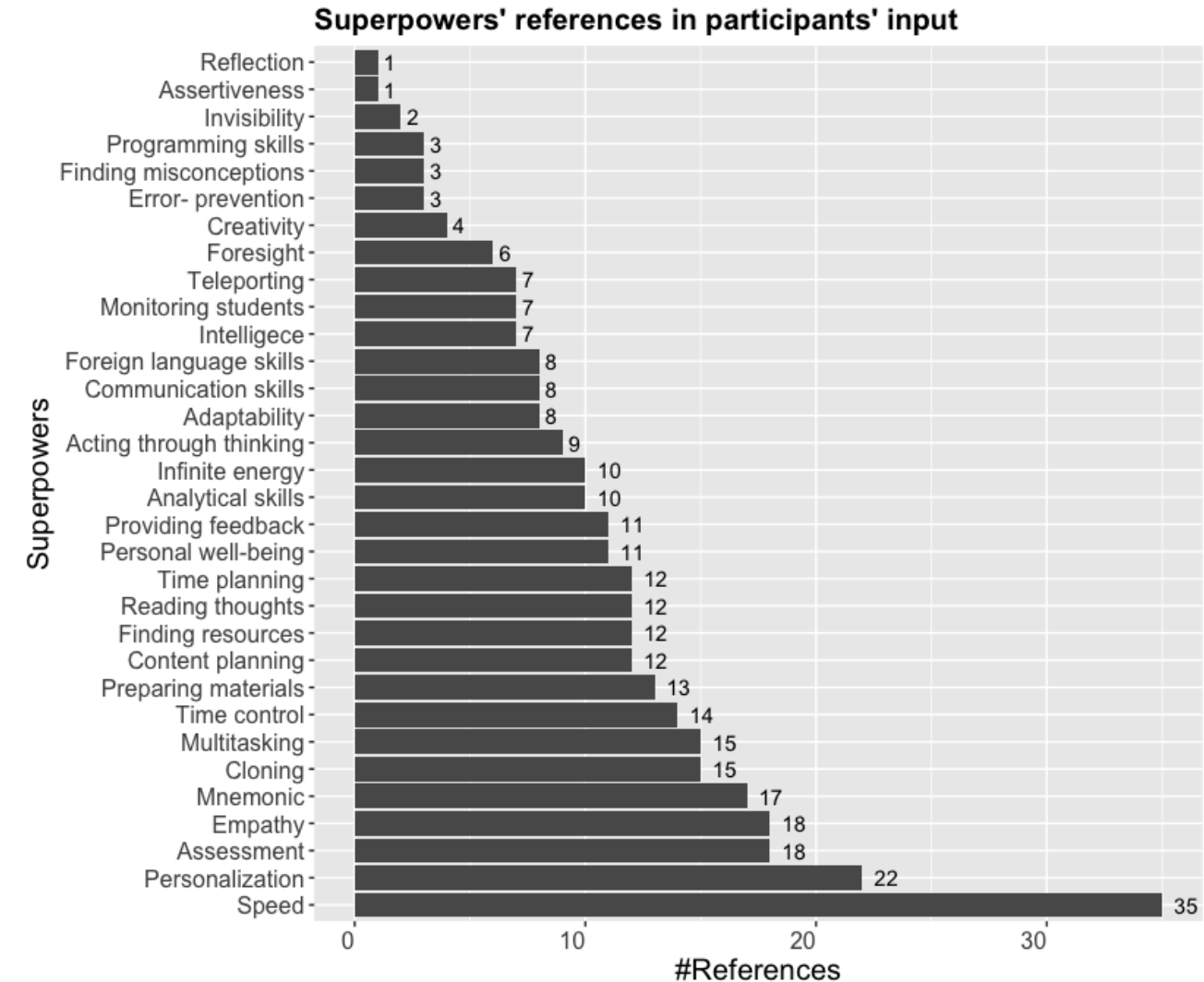
- Council of Europe's Committee of Ministers, 2019

*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)



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

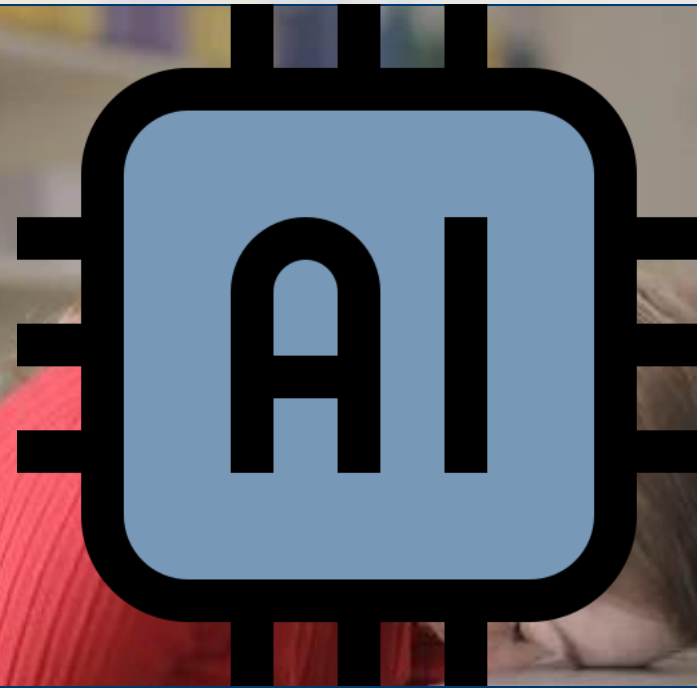




Teachers love to ...teach!

Teachers need support

Teachers love to ...teach!

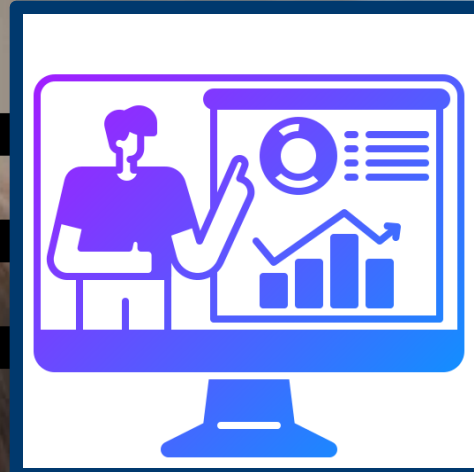


Teachers need support

Teachers love to ...teach!

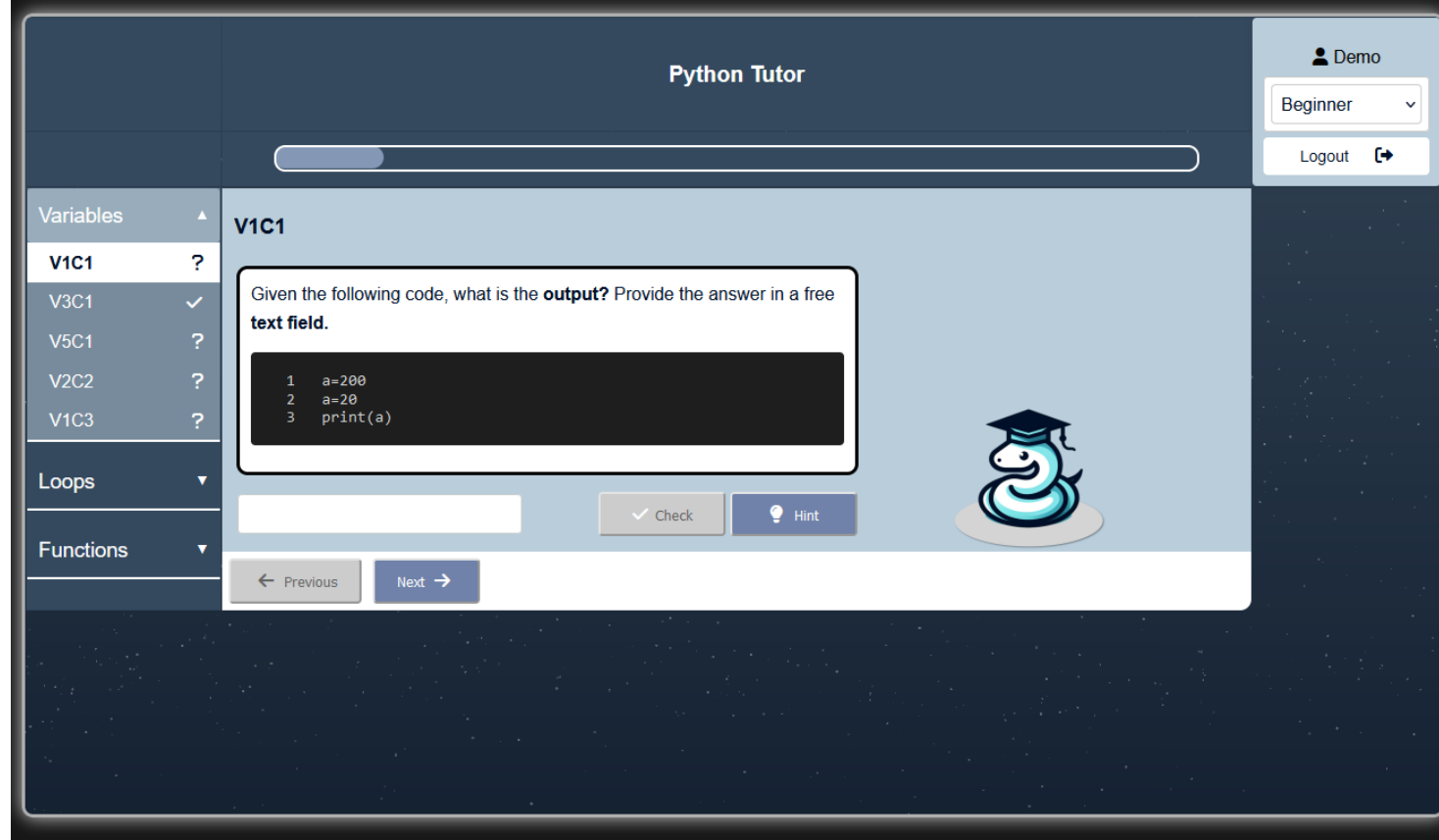


Intelligent Tutoring Systems



Learning Analytics

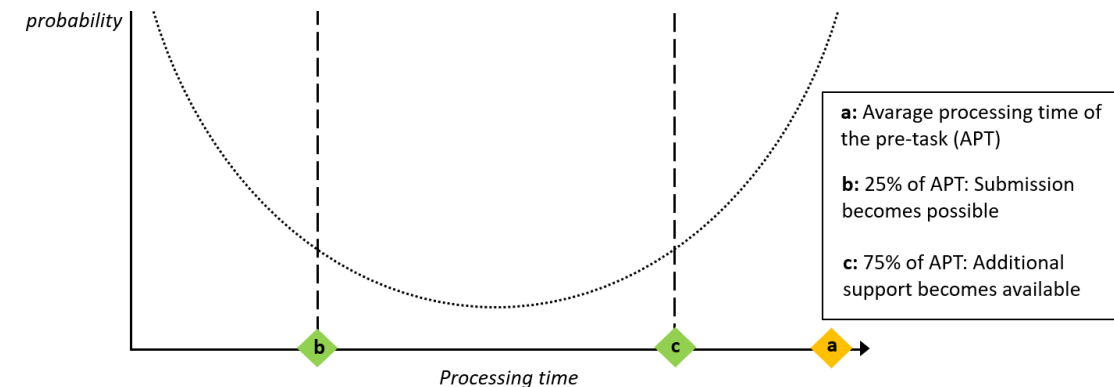
Teachers need support



Instructional Contingency

- No support
- Worked examples
- Explicit instructions

Temporal Contingency





The screenshot displays a Jupyter Notebook environment with three open files: 1_AFM.ipynb, 2_PFM.ipynb, and 3_JFM.ipynb. The left sidebar shows a file explorer with four notebooks listed.

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='dataframe')

[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

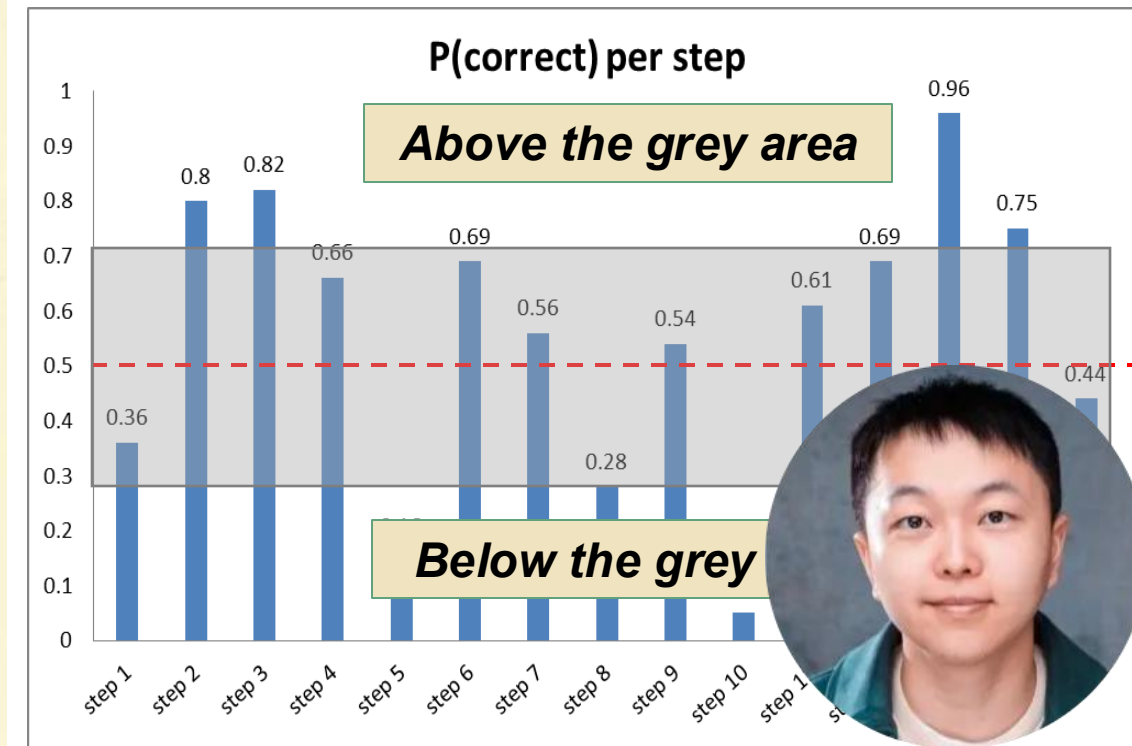
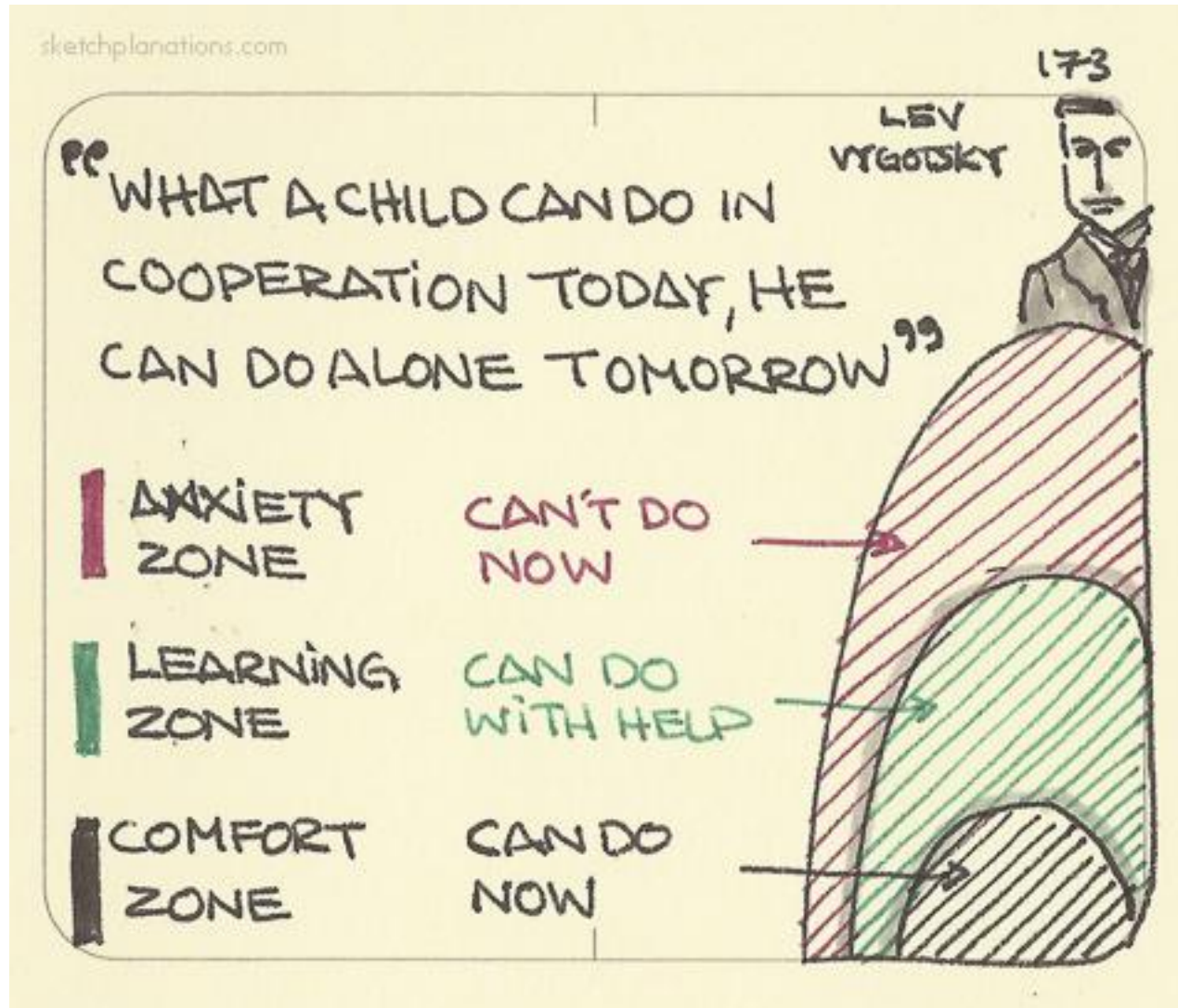
LLM Help

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:

- Check the spelling and casing of the variable or function name to ensure it matches the definition.
- Make sure the variable or function is defined before it is used. Check for typos or missing assignments.
- Check the scope of the variable or function. Variables defined inside a function are not accessible outside of it.
- Ensure that the variable or function is imported if it is defined in another module or file.
- Check for any missing or incorrect imports that may cause the NameError.
- 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.



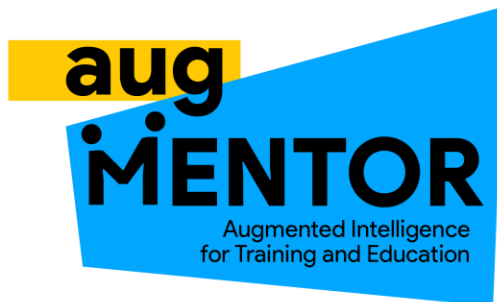
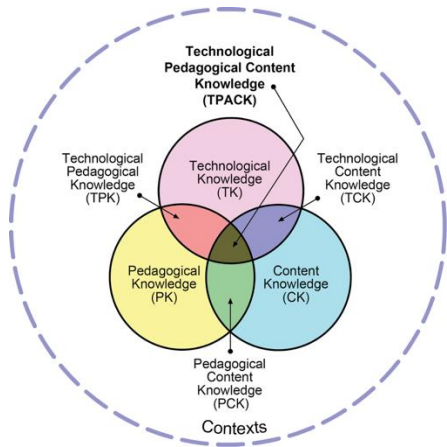
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Katz, S., Albacete, P., Chounta, I.A., Jordan, P., McLaren, B.M., Zapata-Rivera, D.: Linking dialogue with student modelling to create an adaptive tutoring system for conceptual physics. International Journal of Artificial Intelligence in Education 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



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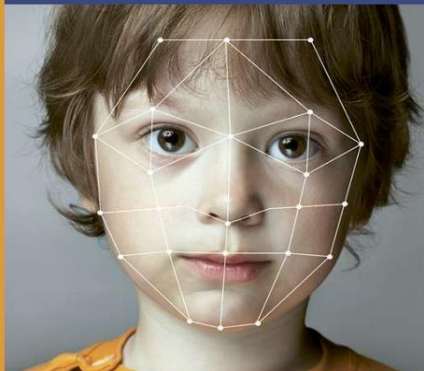
missionX



Artificial Intelligence and Education

ARTIFICIAL INTELLIGENCE AND EDUCATION

A critical view through the lens of human rights, democracy and the rule of law



THE STATE OF ARTIFICIAL INTELLIGENCE AND EDUCATION ACROSS EUROPE



Key take aways from the Council of Europe Survey

The Council of Europe has been examining the impact of Artificial Intelligence (AI) on human rights, democracy, and the rule of law. As part of the "AI and Education" project, Council of Europe carried out a survey in September-October 2022. This survey aimed to gather data from its member states to enable a better understanding of the connections between AI and education, and existing strategies on AI and education.

Key take aways: In the education sector, more specifically, it is necessary for member states to establish AI policies and strategies dedicated to educational aspects to ensure respect for the fundamental values of the Council of Europe, rather than relying solely on general AI frameworks to regulate the use of AI systems in education.

Members of the Council of Europe Expert Group on Artificial Intelligence and Education
Irene-Angelica Chounta, Vania Dimitrova, Paulo Nuno Vicente, Malgorzata Cyndacka, Wayne Holmes, Lidija Kralj, Jen Persson, Barbara Wasson



SURVEY OBJECTIVES

- Identify promising policies and/or strategies on AI and education
- Identify promising practices in relation to learning with AI, learning about AI, and preparing for use of AI
- Facilitate the Council of Europe work in developing appropriate policy and legal instruments to ensure responsible, fair, accountable, ethical, and transparent use of AI in education.

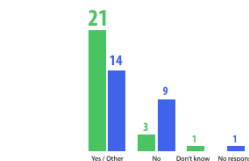


SURVEY STRUCTURE

Profile	Policies/Strategies	Current Practices	Regulation
Information about the respondents	<ul style="list-style-type: none"> General AI Learning with AI Learning about AI Preparing for AI 	<ul style="list-style-type: none"> Learning with AI Learning about AI Preparing for AI 	<ul style="list-style-type: none"> Regulation Monitoring Evaluation



ARE WE READY FOR AI?



- Does your country have a general AI policy and/or strategy?
 - Is your country working on the development of a general AI policy and/or strategy?
- Most of the respondent member states have a general AI policy/strategy or are working on one.



USE OF AI IN EDUCATION



AI Literacy (Technical skills)
National policies emphasise enhancing teachers' digital skills and AI competence across education levels, stressing the need for ongoing teacher training.



AI Literacy (Human aspects)
Curricula should encompass not only AI technology but also the ethical, social, and societal dimensions. Preparation for parents and teachers about children's rights/risks posed by AI is acknowledged, as well as the importance of discussing ethical considerations in AI education.



Using AI to learn about learning
There's a call for research on adopting learning progress assessments in self-directed learning and considering ethical and data protection concerns. Data analysis systems are recommended for educational administrators to make informed decisions.



Learning with AI
Personalised learning is a common theme in national policies, often involving collaboration with private sector experts. There's an emphasis on AI-supported education for individualised learning paths, and some countries encourage awards for AI-innovative teachers.

Only five member states reported that AI and education (including learning with AI, using AI to learn about learning, learning about AI and preparing for AI) is regulated.

Newsroom

2ND WORKING CONFERENCE "REGULATING THE USE OF ARTIFICIAL INTELLIGENCE SYSTEMS IN EDUCATION"

Key stakeholders across Europe will explore the regulatory dimensions of AI in education at the 2nd Working Conference in October

STRASBOURG | 4 JULY 2024



The Education Department of the Council of Europe is organising the 2nd Working Conference on 24-25 October 2024 to address regulation of the use of Artificial Intelligence (AI) systems in education. The conference will provide an opportunity for key stakeholders from different backgrounds across Europe to work together in a series of engaging, informative and interactive formats to explore the regulatory dimensions of AI in education.

The conference will also discuss other relevant issues, such as AI governance in education, teaching and learning with and about AI, future-proofing education systems, and the idea of a European evaluation framework to assess educational technologies.

Read more >>

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

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

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[Discussion](#)

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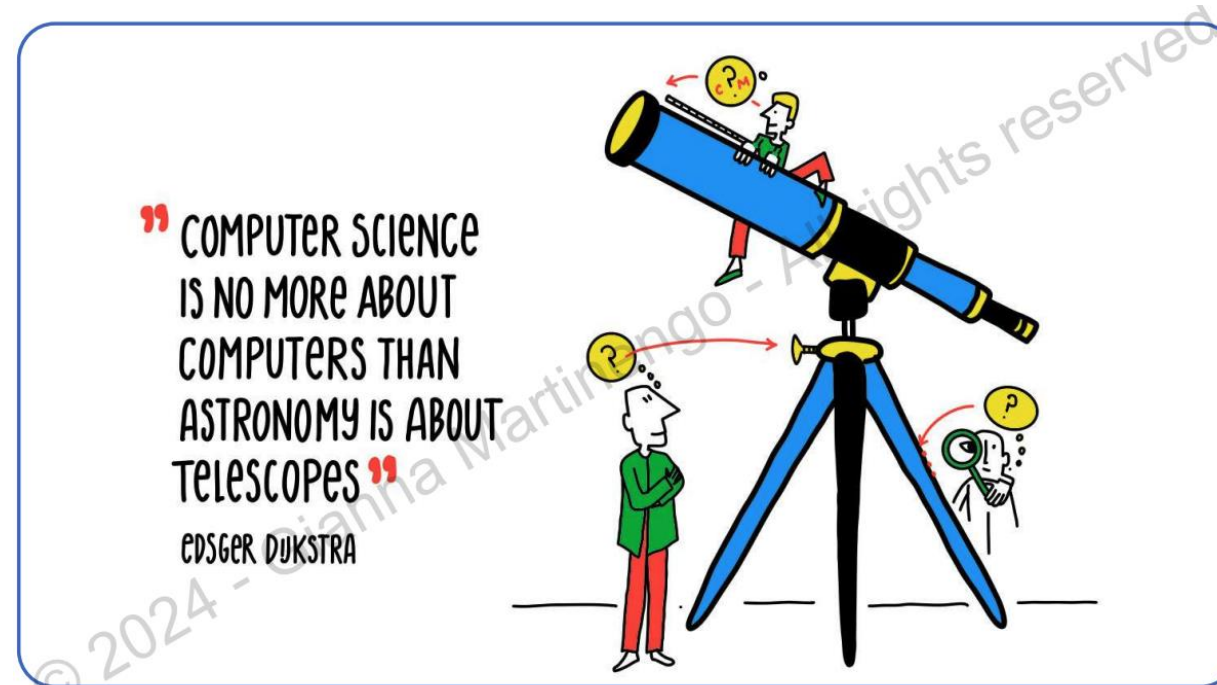
2019 - 2023

All Education Levels

Research Study(ies)



AI and Education



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

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>

