METIS

Université du Luxembourg

METIS: Future-Proofing Medical Education through Emerging Technologies for Enhanced Social Resilience

An Intelligent Assistant for Student Inquiry Support

Dr. Alfredo Capozucca
Dr. Maria Pavlou

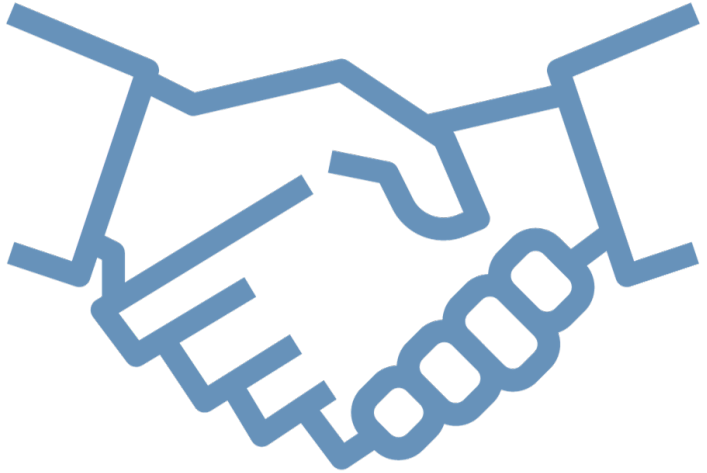
28.05.26

Co-funded by the European Union

METIS

Project partners

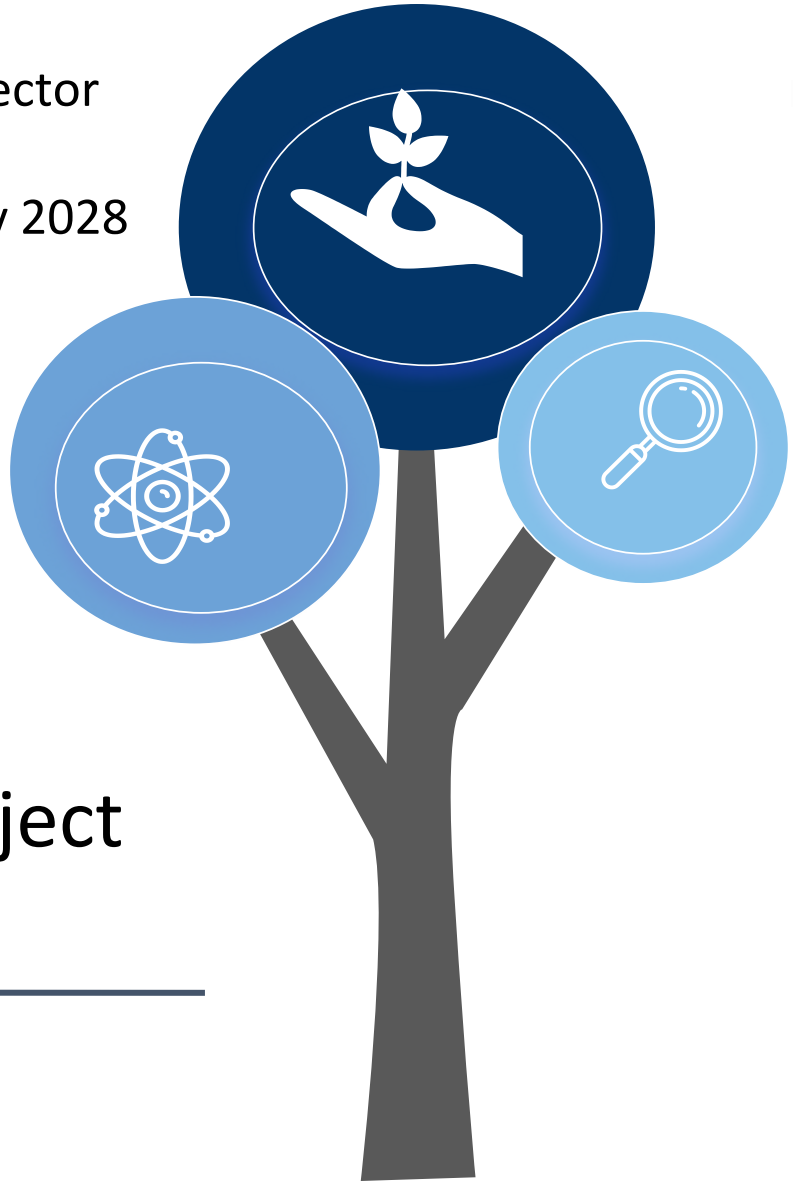
1. University of Luxembourg (coordinator)
2. Web2Learn
3. University of Milano-Bicocca
4. University of Agder
5. Heidelberg University



METIS

Erasmus+ KA2 project
Higher Education (HE) sector

February 2026 – January 2028
(24 months)



Goals of this project

Future-proof medical education: forging competence in Artificial Intelligence (AI) and simulations (VR, AR).

Strengthen digital readiness, ethical awareness, and social resilience among HE students and staff.

Promote technologically-advanced and society-oriented medical education.

Learning Medicine in the Age of Information Overload

Université du Luxembourg

Information Overload in Medical Education

Medical students face an overwhelming volume of rapidly evolving knowledge from multiple digital sources and platforms.

Challenges for First-Year Students

New medical students must grasp foundational science while managing diverse learning tools and complex content simultaneously.

Impact on Learning Quality and Well-being

Excessive information can affect accuracy, coherence, and student well-being, posing risks to effective learning.

Need for Innovative Support Systems

New frameworks are vital to help students navigate complex academic demands effectively.

https://www.magnific.com

The Bachelor in Medicine Challenge

Université du Luxembourg

Interdisciplinary Curriculum

The BMED curriculum integrates biology, chemistry, physics, and anatomy, requiring students to connect ideas across subjects *(like any other medical programme)*.

High Cognitive Load

Students face intense cognitive demands as they develop study strategies to handle integrated complex content.

Competitive Selection Phase

First-year ranking determines continuation in medical studies, creating a high-pressure and competitive environment.

Emotional and Psychological Stress

Students must manage emotional pressure alongside academic challenges, seeking additional support and guidance.

https://www.istockphoto.com

The Support Gap

Limitations of Traditional Support

Traditional academic support like office hours and tutorials are essential but limited in scalability and availability.

Diverse Student Needs

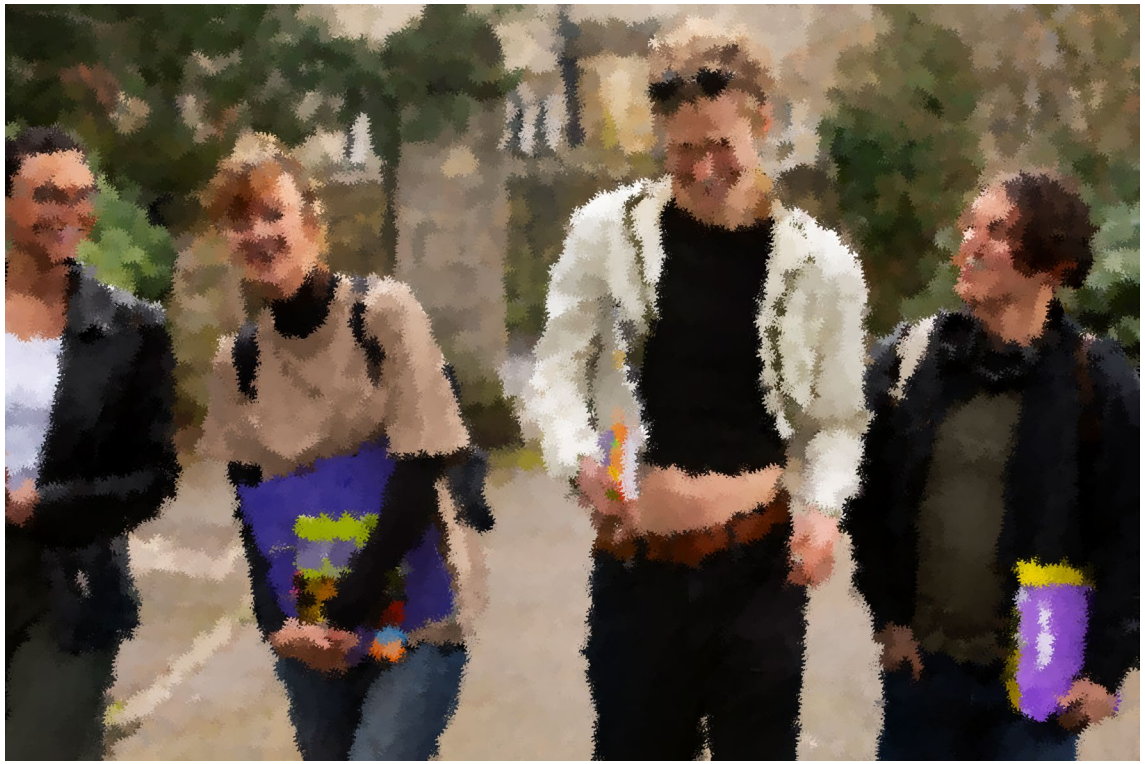
Students have varied challenges including conceptual understanding, exam preparation, time management, and course integration.

Structural Constraints

Support models face structural challenges and weren’t designed for today's complex, high-pressure academic environment.

Need for Rethinking Support

Recognising the support gap highlights why alternative resources and innovative support models are necessary.



https://www.magnific.com

What Students Actually Do ?

Université du Luxembourg

Go to wooclap.com

Enter the event code in the top banner

Event code

FYIXXO

Waiting for participants...

What Students Actually Do

- Students are increasingly turning to general AI tools, to support their learning.
- They use them to explain concepts, summarise material, generate exercises, or clarify doubts.
- This happens regardless of institutional policies or recommendations.
- Most likely, from the student perspective, these tools are fast, accessible, and feel personalised.

https://news.uthm.edu.my/en/2025/06/the-dark-side-of-ai-in-universities-are-we-celebrating-cheating/

Trust vs Risk Tension

Université du Luxembourg

Go to wooclap.com

Enter the event code in the top banner

Event code

QMEYDT

Waiting for participants...

Risks of Uncontrolled AI Use

Data Security and Intellectual Property

Uncontrolled AI use risks violating data protection and intellectual property by sharing proprietary educational content externally.

Accuracy and Reliability Concerns

AI can generate plausible but incorrect medical information, risking misinformation in critical healthcare education.

Impact on Learning Quality

Dependence on AI explanations can reduce critical thinking, cause superficial understanding, and erode confidence in knowledge.

https://www.magnific.com
stock.adobe.com

IASIS

IASIS project is funded by the “Institute for Innovative Teaching and Learning” (I^2TL) of the university of Luxembourg

Technical Sovereignty

In-house & Open-source

By maintaining an independent stack, we foster autonomy from third-party providers.

- Local Data Sovereignty
- Open-source Transparency
- Local expertise
- Experimentation

Image generated with Gemini 3.5 Flash, operating in the Paid tier.

Context-Aware RAG Support

Verified Course Materials

Utilises Retrieval-Augmented Generation (RAG) to provide 24/7 support based strictly on verified library and course resources.

- On-demand student assistance
- Curriculum-aligned accuracy
- Mapping the Curriculum

Image generated with Gemini 3.5 Flash, operating in the Paid tier.

Strategic Usage Monitoring

Feedback Loops

Identifies common queries and assistant usage patterns to help the Software Development team and Teachers refine content.

Benefits:

- Resource optimisation
- Identifying knowledge gaps
- System performance tracking

Image generated with Gemini 3.5 Flash, operating in the Paid tier.

Beneficiary Impact Summary

Feature	Benefit	Primary Beneficiary
In-house Sovereign	Control, Privacy, Independence	Student / Teacher
Context-Aware (RAG)	24/7 Accuracy & Support	Student / Teacher
Curriculum Mapping	Transversal Learning Links	Student / Teacher
Monitoring	Quality Assurance & Insights	Teacher / Dev Team

What we expect to offer

- 24/7 educational access (for students)
- Tailored content (for teachers)
- 100% Data Sovereignty (for the institution)
- Test bed platform (for researchers)

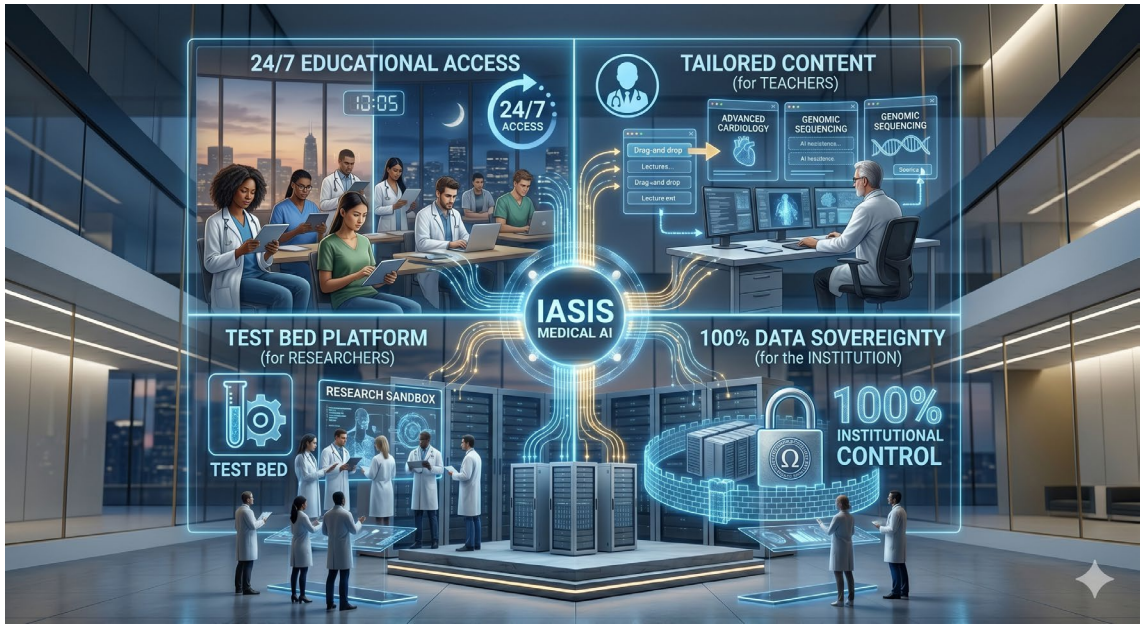


Image generated with Gemini 3.5 Flash, operating in the Paid tier.

The experimental framework

Objectives

- **RQ1: Performance.**
- Does IASIS help students answer complex biological mechanism questions correctly?

- **RQ2: The Trust Paradox.**
- How does student trust in AI affect the accuracy of their performance (i.e. final submissions)?

- **RQ3: Interaction Patterns.**
- What prompting behaviours lead to the best explanations?

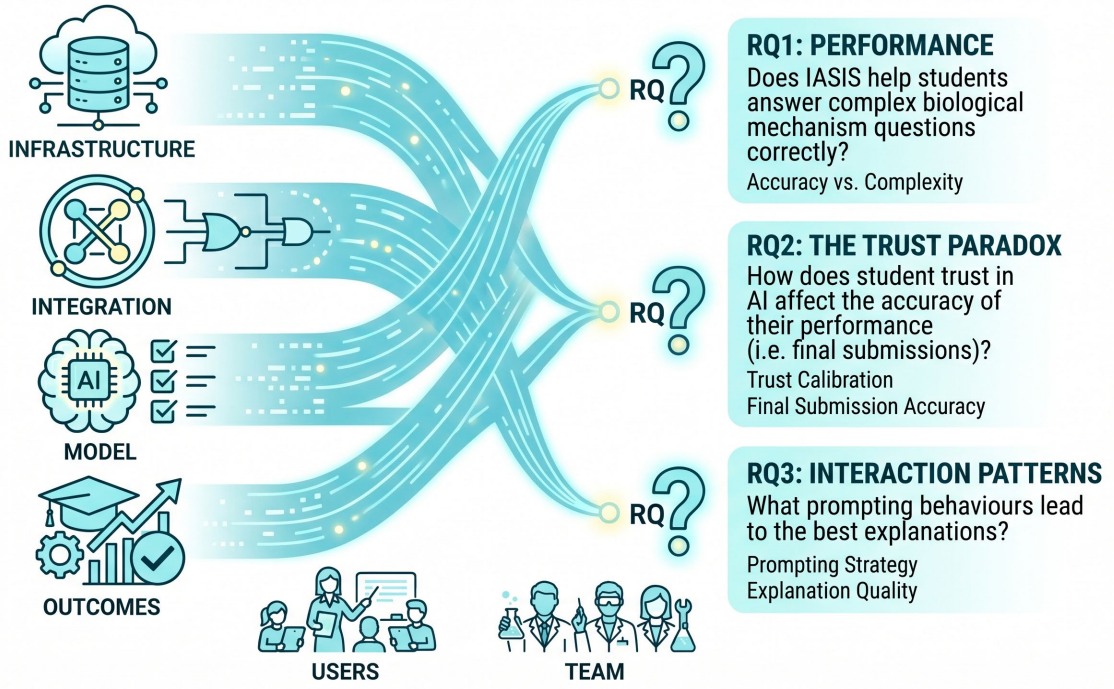


Image generated with Gemini 3.5 Flash, operating in the Paid tier.

The CS strategy

- **Fact**: early studies show that AI can help with coding tasks.
- **Gap**: No prior research on AI's impact on writing formal B-like specifications.
- **Goal**: Understanding this is crucial for educators in designing courses and assessments.

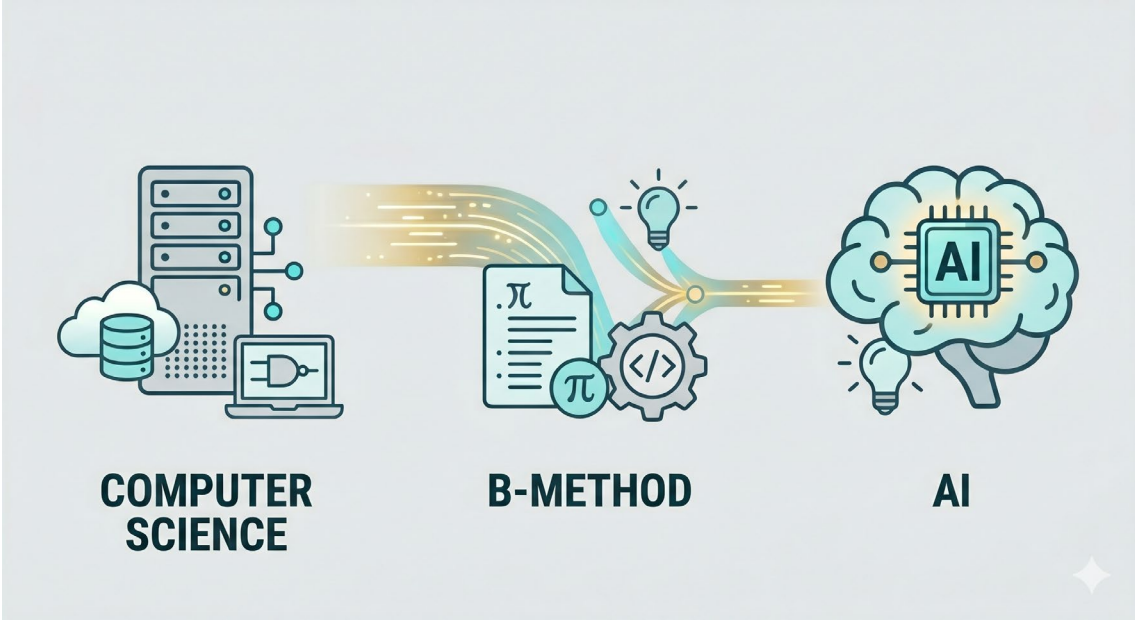


Image generated with Gemini 3.5 Flash, operating in the Paid tier.

A. Capozucca, D. Yampolskyi, A. Goldberg and M. Cristiá, "*Do AI Assistants Help Students Write Formal Specifications? A Study with ChatGPT and the B-Method*", 2025 IEEE/ACM 37th International Conference on Software Engineering Education and Training (CSEE&T), Ottawa, ON, Canada, 2025, pp. 19-29, https://ieeexplore.ieee.org/document/11024458

Research approach

- Single-group pretest-posttest experiment.
- Measured **correctness** of B specifications before and after ChatGPT use.
- Participants: Undergraduate Computer Science students in an introductory course on formal specifications.

- Two iterations

➢ April-May 2023 & 2024 (6 and 10 participants*, respectively).

- All participants had prior experience using ChatGPT

➢ (mainly for programming and writing).

➢ Some of them (17% and 30%) used premium version

How we measured and collected data

- **Correctness Assessment**

➢ Two instructors assessed B-specifications based on weighted rubric.

- **Data Collection**

➢ B-specifications from two guided activities (pre / post-test) => RQ1

➢ Post-activity questionnaire (perceptions of AI help, trust) => RQ2

➢ Logs of student interactions with AIA => RQ3

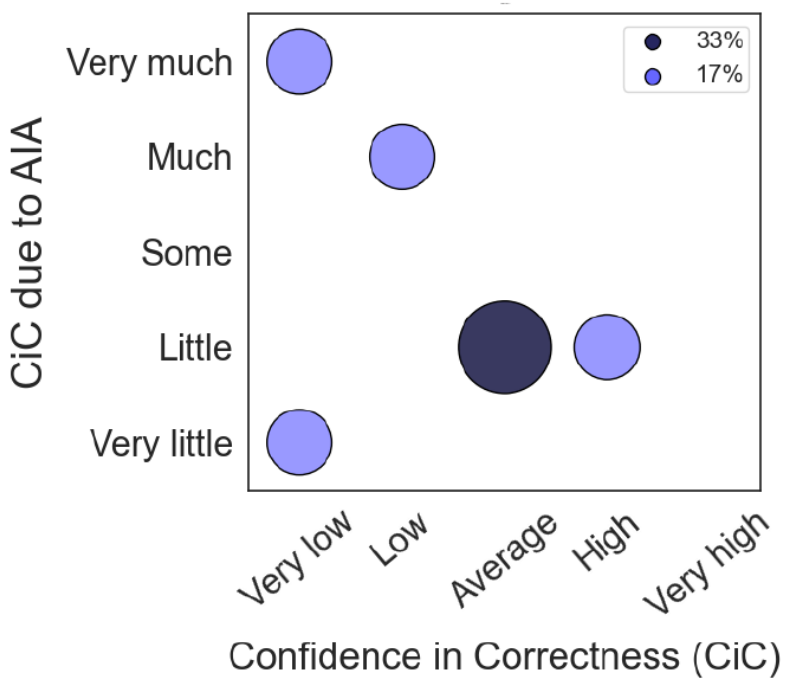
Key Findings – RQ1

Does the AIA (ChatGPT) help students write B-specifications?

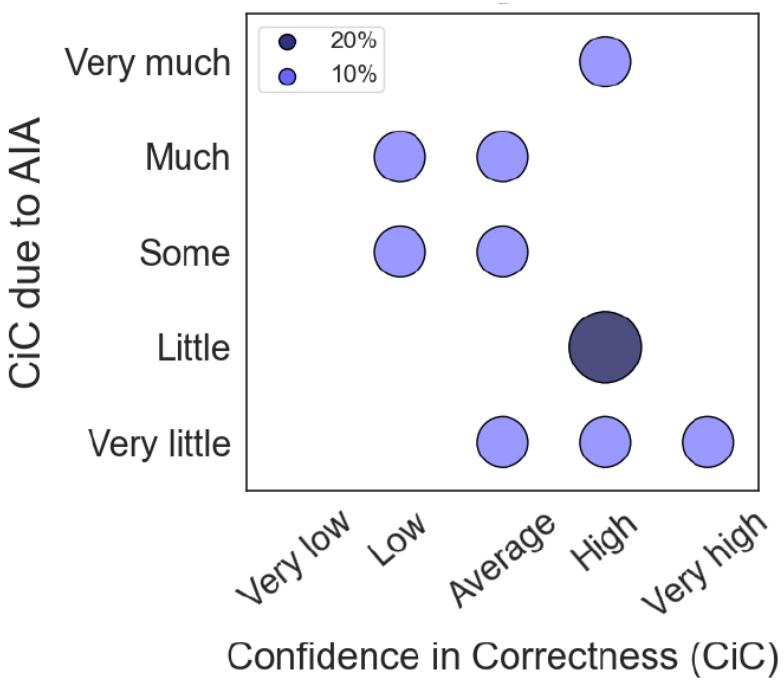
Guided Activity	Correctness		
	Average	Min	Max
Iteration 1			
First (pretest)	77,92%	45,00%	100,00%
Second (posttest)	59,78%	34,78%	93,48%
Iteration 2			
First (pretest)	73,33%	40,00%	100,00%
Second (posttest)	70,88%	35,29%	100,00%

Key Findings – RQ2 (1)

Do students trust the AIA (ChatGPT) to write B-specifications?



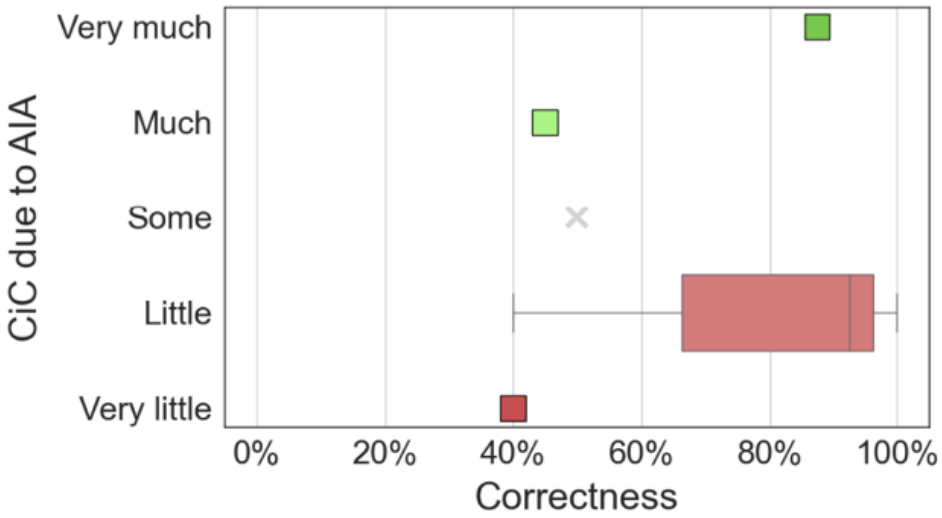
(a) Iteration 1



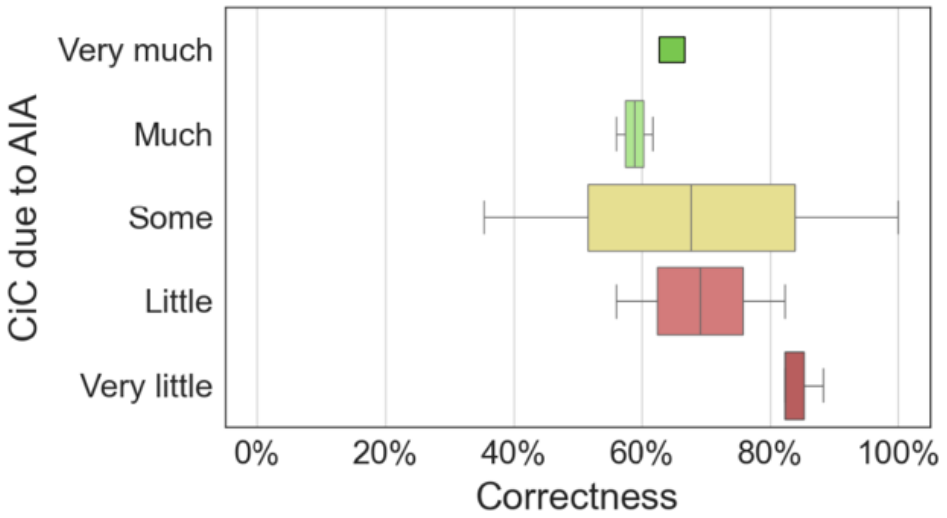
(b) Iteration 2

Key Findings – RQ2 (2)

Do students trust the AIA (ChatGPT) to write B-specifications?



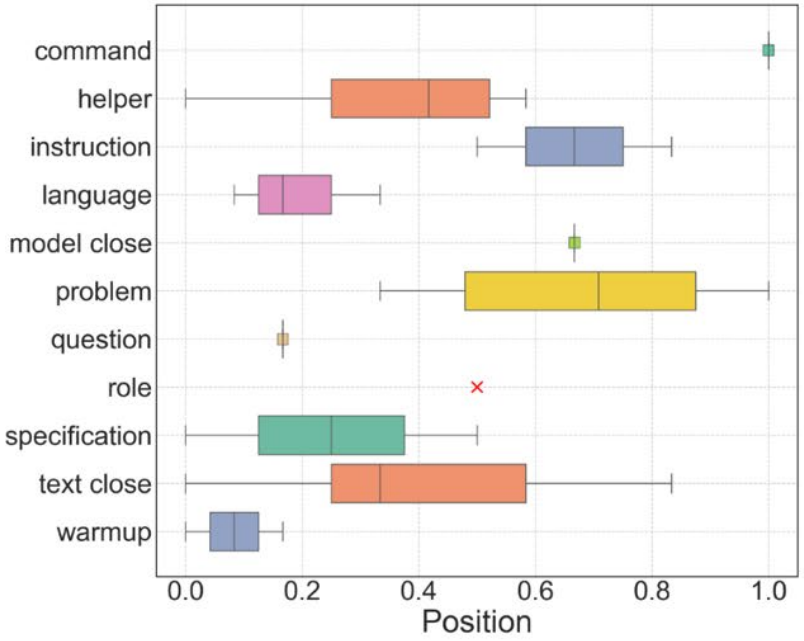
(a) Iteration 1



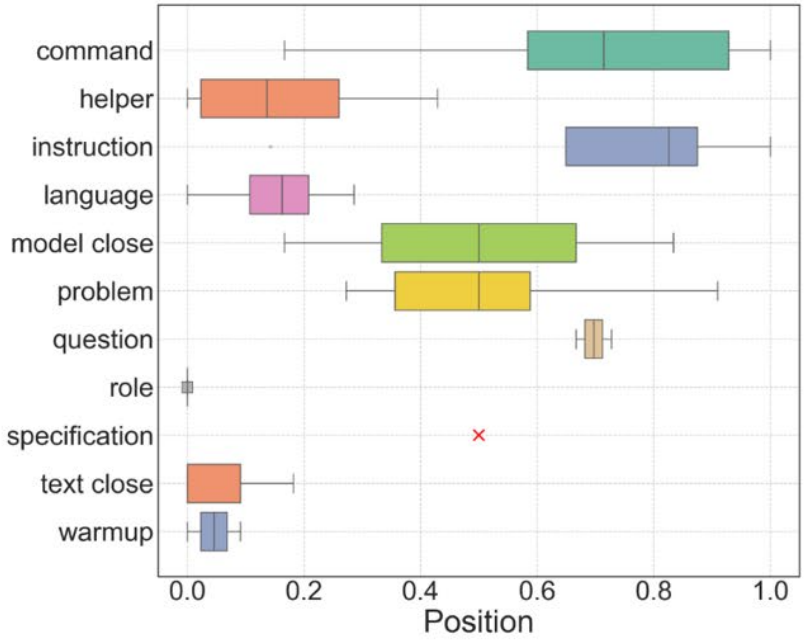
(b) Iteration 2

Key Findings – RQ3

How do students' behaviour when interacting with the AIA (ChatGPT) affect the correctness?



(a) Iteration 1



(b) Iteration 2

Timing pattern detected: *warmup -> language -> helper ->* interleaved *instruction* and *command.*

Main takeaways

- **For the study**
  - ➢ Participation rates
  - ➢ Reconciliation with the course
  - ➢ Ethics
- **For the teacher**
  - ➢ Continuous monitoring
- **For IASIS**
  - ➢ Data privacy
  - ➢ Prompt analysis
  - ➢ Monitoring

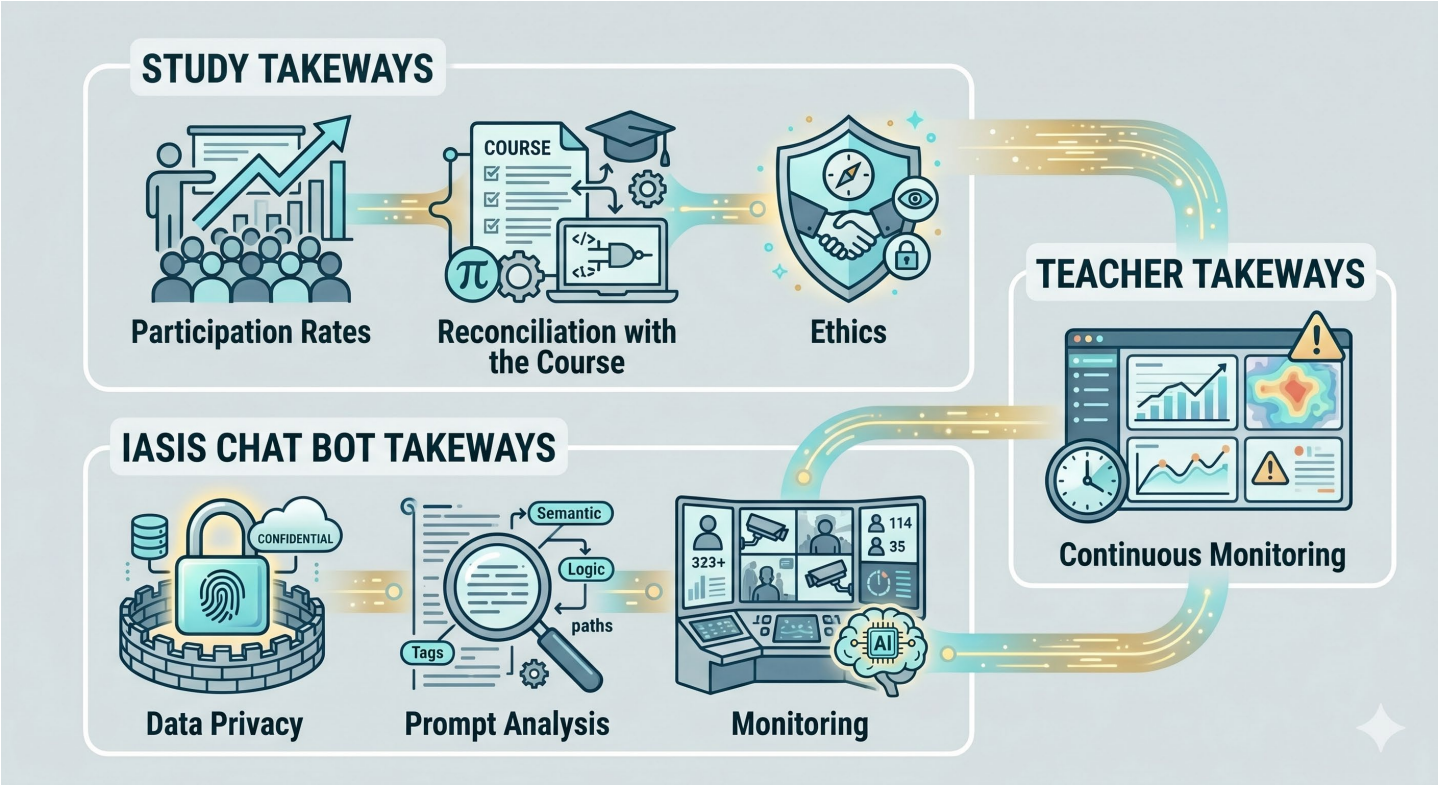


Image generated with Gemini 3.5 Flash, operating in the Paid tier.

From Concept to Practice: IASIS in BMED

Courses: Cellular and Molecular Biology *(semesters 1 and 2)*

Programmes: Bachelors in Medicine and in Life Sciences

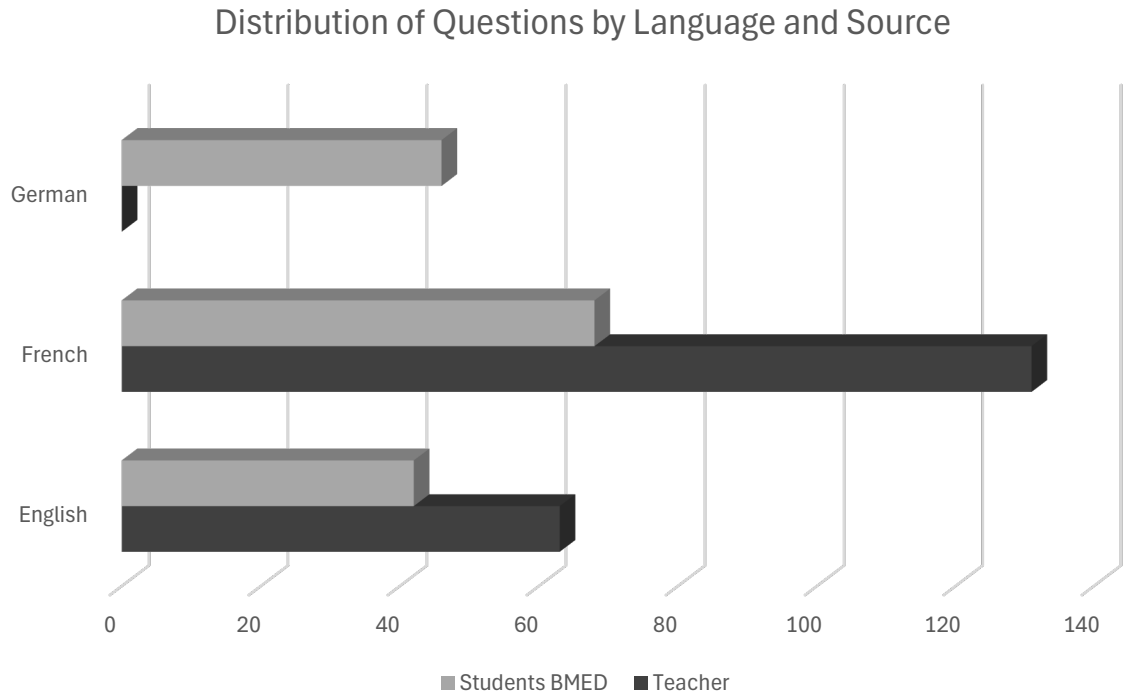
Testing Phase:
4 students + instructor
(Students: 3 from 3rd year and 1 from 2nd year of BMED)

4-week testing period

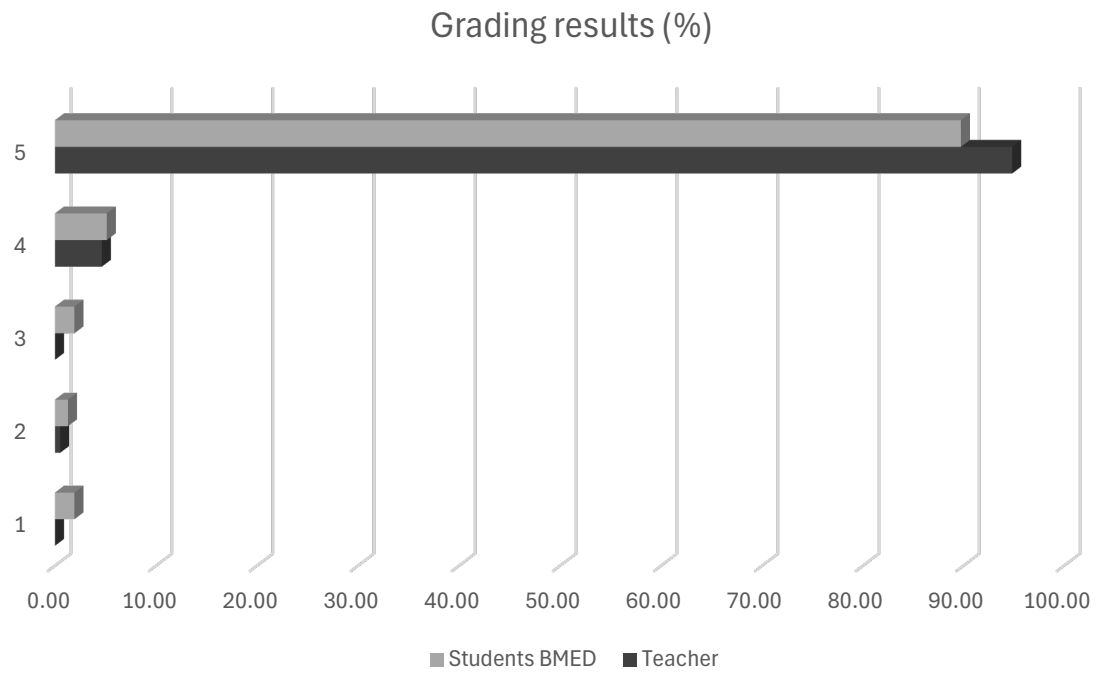
Components tested:
1) The efficacy of IASIS in answering students' questions;
2) The comparison of IASIS responses with those provided by Copilot, *(available to university staff and students)*;
3) The effectiveness of IASIS responses in the three main languages used in the university: English, French and German.

Dataset Overview

	Students BMED	Educator
Language:		
English	46	63
French	68	131
German	46	0
Total:	156	194



Dataset Overview



	Students BMED	Educator
Score:		
1	3	0
2	2	1
3	3	0
4	8	9
5	140	184
Total:	156	194

1 = Poor – Totally incorrect

2 = Insufficient – Not good enough; room for improvement

3 = Neutral – Acceptable but lacking precision

4 = Good – Quite good, though not entirely correct

5 = Excellent – Fully correct and satisfactory

Pilot Design in BMED

IASIS embedded into course activities

Students received structured tasks:
1 Scenario
2 Groups
Swap and Repeat

AI as inquiry assistant ≠ answer machine ?

Engagement
Perception
Usage of the tool

©Rémi Grizard/Université du Luxembourg

Overall Feedback

“Overall, the AI is excellent and answers questions very accurately. I think it’s a great tool for revision and even for understanding, because the answers are not too long but still accurate and complete”.

“Copilot tends to give too much additional information that isn’t always relevant for the student. In contrast, IASIS provides clearer and more concise answers. They are often better because they focus on the most important points for the student”.

“IASIS gave clear answers that weren't too long or hard to follow or understand”.

“The tool explains things in a way that is easy to understand yet also detailed and using scientific terminology”.

“The resources in the cell biology courses are limited, so that I can focus on learning only what is necessary”.

Early Insights from the Pilot Study

Student engagement

Faster clarification of complex concepts

Variability in critical thinking

→ Need for pedagogical guidance

stock.adobe.com

What We Learn Across Disciplines

Bachelor in Medicine vs Bachelor in Computer Science

Commonalities
Students already use AI tools
High engagement with AI support
AI supports process, not final correctness
Strong need for guidance / prompting
Learning outcome still depends on student knowledge

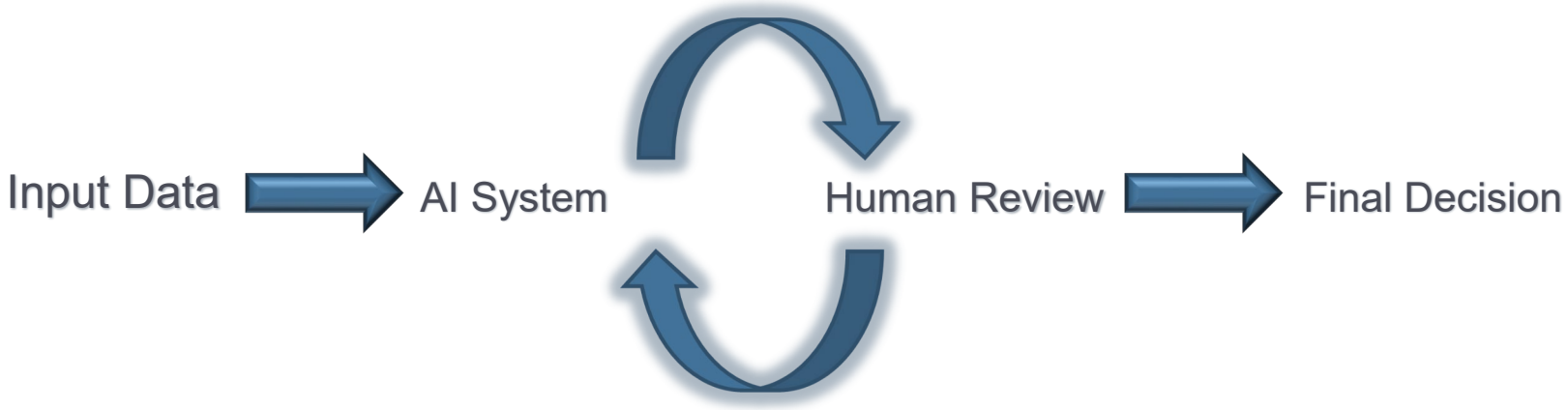
Key Differences	
AI performs very well for factual explanations	AI does not improve correctness of outputs
Focus: conceptual understanding & explanation	Can help identify components, but not produce correct solutions
Supports understanding & revision	Low student trust → better performance
Risk: over-trust due to high perceived accuracy	Strong validation possible (syntax, execution)
Multilingual usage (FR/EN/DE)	Focus: formal correctness & structure

Implications for Scaling

- Framework is transferable but not one-size-fits-all
- Discipline-specific pedagogical design needed
- Governance and safeguards are critical
- Scalability is pedagogical and institutional

stock.adobe.com

Human-in-the-Loop



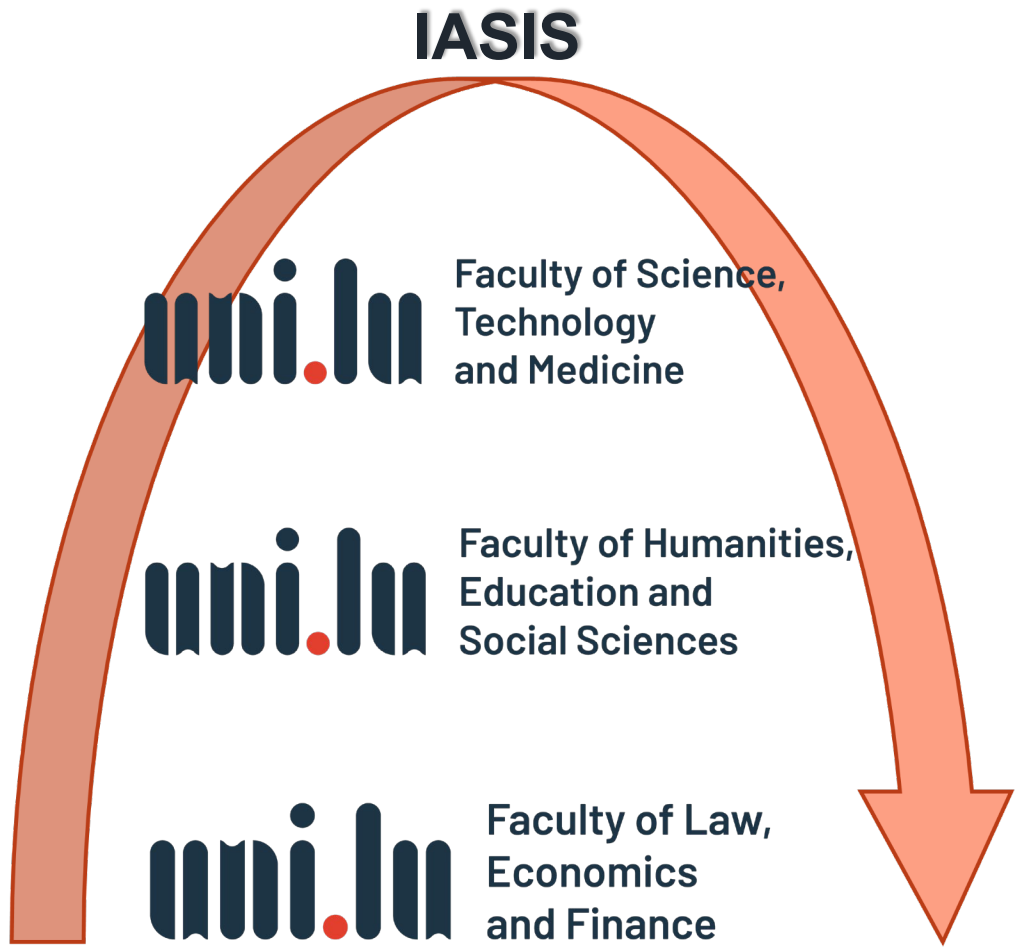
- AI supports learning, does not replace reasoning
- Students remain responsible for correctness
  (Student = final decision maker)
- Students' knowledge
- Critical thinking is essential

Sustainability and Scalability

Designed for cross-programme adoption

Potential across faculties

Requires institutional alignment



Join our Pilot Studies!

Students and colleagues invited

Participate in pilots and focus groups

Help shape the future of AI in education

stock.adobe.com

Acknowledgments

IASIS received financial support from the Education Innovation Fund (EIF) of the Institute for Innovative Teaching and Learning (I²TL) at the University of Luxembourg.

Our students

Prof. Paul Heuschling

Christian Meyers

Alexandre Adrian Tinouert

Fabio Silva Rodriques

IT Innovation Team: Dimitri Efremov, Alexandr Davydov

Cédric Rochet

METIS

Thank you

https://metis-project.eu/

LinkedIn: @METIS Erasmus+ project

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

Satisfaction survey

https://metis-project.eu/