MONASH University | COLAM Centre for Learning Analytics Monash | GRAILE

Empowering Learners in the AI Age

Building Skills for Self-Regulated Learning

Dragan Gašević
@dgasevic

March 25th, 2024
CITE, Faculty of Education
University of Hong Kong

Generative Artificial Intelligence

https://blog.aare.edu.au/why-you-need-to-spot-the-invisible-elephant/

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KDnuggets

Blog ▾ Topics ▾ Datasets Education ▾ Resources ▾

The Effects of ChatGPT in Schools and Why It's Getting Banned

Many schools are banning ChatGPT for plagiarism, accuracy and privacy concerns. However, the chatbot could help students and teachers with the right application.

By **April Miller**, Managing Editor of Consumer Technology at ReHack Magazine on June 13, 2023 in **Artificial Intelligence**

Policy decisions about the use of artificial intelligence in schools

The Guardian
A decade of making a difference

Artificial intelligence (AI)

ChatGPT ban in Australia's public schools likely to be overturned

Government reveals a draft framework has been formulated for how ChatGPT rollout will work in schools

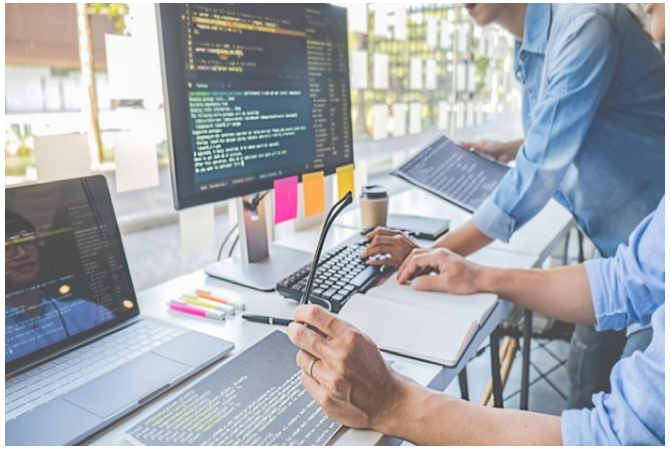
Artificial intelligence

Artificial intelligence will not go away

Source: https://bit.ly/47NbA7D

Over 80% of jobs, especially writing and IT, are predicted have at least 19% exposure to generative AI

Productivity in **problem solving support** increased by 35% for novice, but not for experienced workers



46% productivity increase in software engineers while maintaining code quality by using AI

Generative AI does not have inherent mechanisms to **distinguish facts from falsehoods**

Adaptive learners for the age of AI

The Sydney Morning Herald

National AI

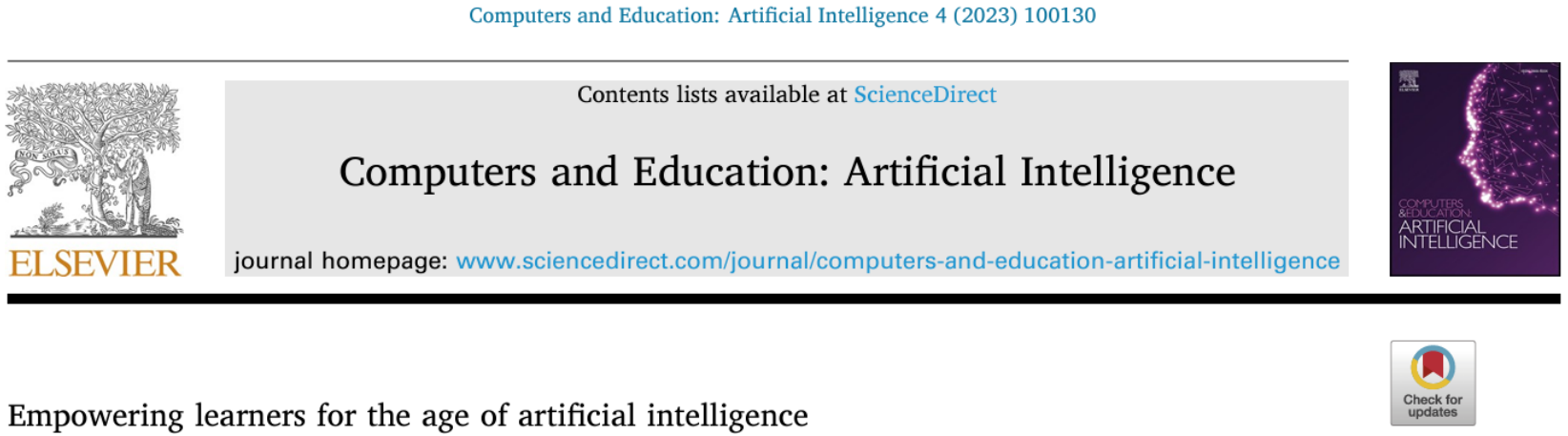
OPINION

Empowering learners for the age of artificial intelligence

Dragan Gasevic and **George Siemens**

December 10, 2020 — 7.30pm

Gašević, D. & Siemens, G. (2020). Empowering learners for the age of artificial intelligence, https://bit.ly/smh-empower-ai



Computers and Education: Artificial Intelligence 4 (2023) 100130

Contents lists available at ScienceDirect

Computers and Education: Artificial Intelligence

journal homepage: www.sciencedirect.com/journal/computers-and-education-artificial-intelligence

Empowering learners for the age of artificial intelligence

Gašević, D., Siemens, G., & Sadiq, S. (2023). Empowering learners for the age of artificial intelligence. *Computers and Education: Artificial Intelligence*, *4*, 100130.

Critical need

Self-regulated learning (SRL) is the key skill for adaptive learners

Learning to learn is central to self-regulated learning

Today's talk

Using AI and learning analytics to enhance self-regulated learning skills

The FLoRA engine

https://floraproject.org

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Key takeaway #1

Learning to learn requires urgent attention

Learners have profound limitations in SRL skills needed in the age of AI

Key takeaway #2

Complex relationship between self-regulated learning skills and AI

Key takeaway #3

Teachers should play a leading role in designing tasks for lasting impact

FOUNDATIONS – CONCERN – IMPACT – FINAL REMARKS

1

What underpins *learning to learn*?

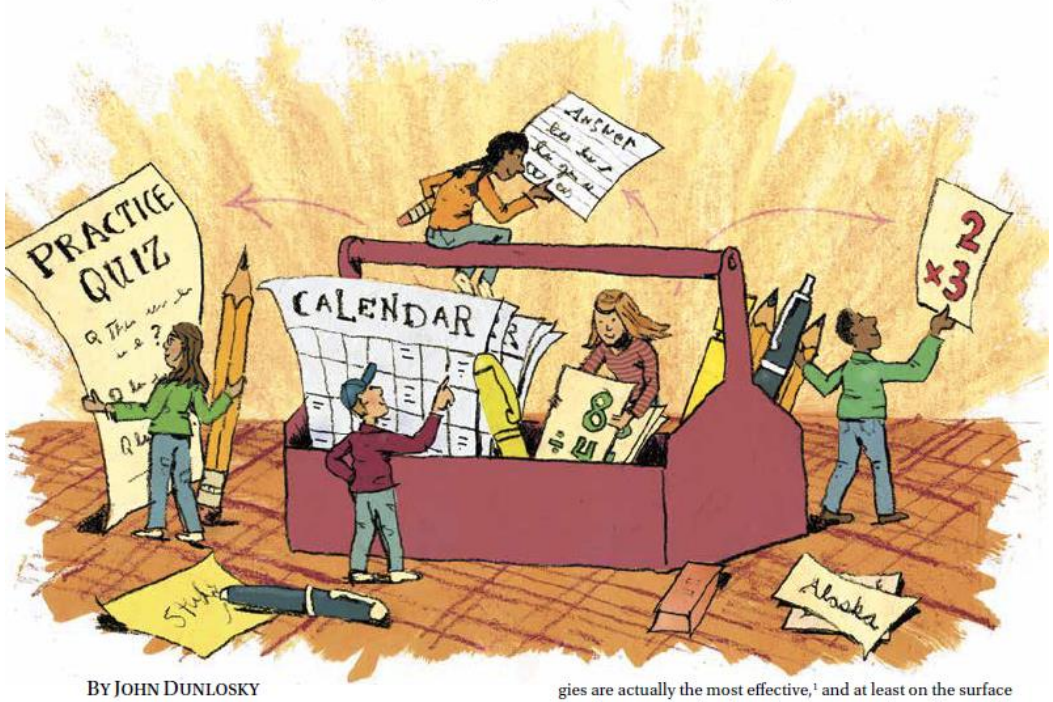
Learners construct knowledge through *learning strategies*

Winne, P. H. (2006). How software technologies can improve research on learning and bolster school reform. *Educational Psychologist*, *41*(1), 5–17.

Learning strategies

Strengthening the Student Toolbox

Study Strategies to Boost Learning



BY JOHN DUNLOSKY

It's the night before her biology exam, and the high school student has just begun to study. She takes out her highlighter and reads her textbook, marking it up as she goes along. She rereads sentences that seem most important and stays up most of the night, just hoping to get a good enough grasp of the material to do well on the exam. These are study strategies that she may have learned from her friends or her teachers or that she simply took to on her own. She is not unusual in this regard; many students rely on strategies such as highlighting, rereading, and cramming the night before an exam.

Quite often, students believe these relatively ineffective strategies are actually the most effective,[1] and at least on the surface they do seem sound, perhaps because, even after pulling an all-nighter, students manage to squeak by on exams. Unfortunately, in a recent review of the research, my colleagues and I found that these strategies are not that effective,[2] especially if students want to retain their learning and understanding of content well after the exam is over—obviously, an important educational goal.

So, why aren't students learning about the best strategies? I can only speculate, but several reasons seem likely. Curricula are developed to highlight the content that teachers should teach, so the focus is on providing content and not on training students how to effectively acquire it. Put differently, the emphasis is on *what* students need to learn, whereas little emphasis—if any—is placed on training students *how* they should go about learning the content and what skills will promote efficient studying to support robust learning. Nevertheless, teaching students *how* to learn is as important as teaching them content, because acquir-

John Dunlosky is a professor of psychology and the director of experimental training at Kent State University. His research focuses on self-regulated learning and how it can be used to improve student achievement across the lifespan.

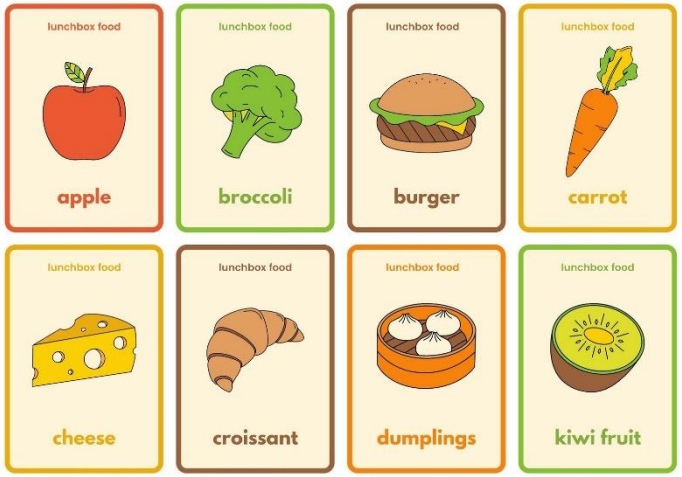
ILLUSTRATIONS BY DANIEL BAXTER

Table 1 Effectiveness of Techniques Reviewed

Technique	Extent and Conditions of Effectiveness
Practice testing	Very effective under a wide array of situations
Distributed practice	Very effective under a wide array of situations
Interleaved practice	Promising for math and concept learning, but needs more research
Elaborative interrogation	Promising, but needs more research
Self-explanation	Promising, but needs more research
Rereading	Distributed rereading can be helpful, but time could be better spent using another strategy
Highlighting and underlining	Not particularly helpful, but can be used as a first step toward further study
Summarization	Helpful only with training on how to summarize
Keyword mnemonic	Somewhat helpful for learning languages, but benefits are short-lived
Imagery for text	Benefits limited to imagery-friendly text, and needs more research

Dunlosky, J. (2013). Strengthening the Student Toolbox: Study Strategies to Boost Learning. *American Educator*, *37*(3), 12-21.

What underpins *learning to learn*?



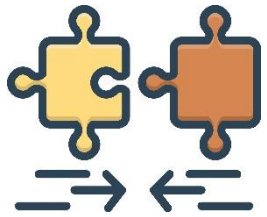
https://bit.ly/canva-flashcards

https://bit.ly/3star-highlight

Learners have a limited repertoire of learning strategies

Bjork, R. A., & Bjork, E. L. (2020). Desirable difficulties in theory and practice. *Journal of Applied research in Memory and Cognition*, *9*(4), 475.

Learning to learn in the age of AI



Select, master, and use most effective learning strategies in collaboration with AI

2

What underpins *learning to learn*?

Learners are agents who use own judgements to make decisions

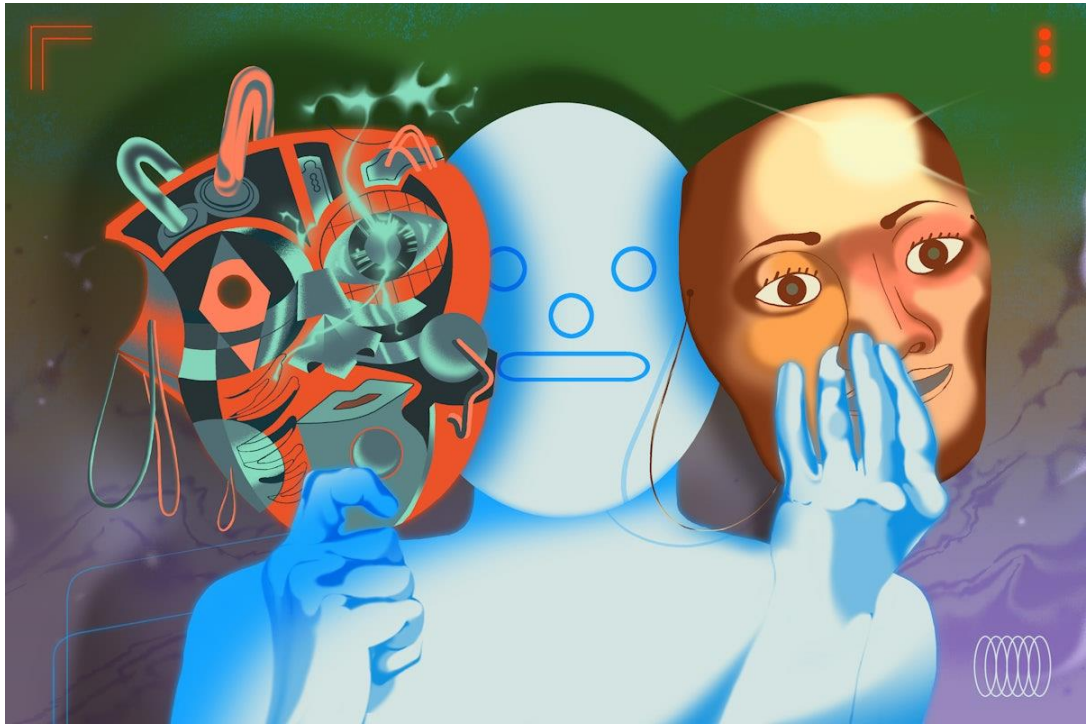
Tauber, S. K. U., Dunlosky, J., & Rawson, K. A. (2015). The influence of retrieval practice versus delayed judgments of learning on memory: Resolving a memory-metamemory paradox. *Experimental psychology*, *62*(4), 254.

What underpins *learning to learn*?

Learners are *highly inaccurate* about their judgements of learning

Prinz, A., Golke, S., & Wittwer, J. (2020). To what extent do situation-model-approach interventions improve relative metacomprehension accuracy? Meta-analytic insights. *Educational Psychology Review*, *32*(4), 917-949.

“Lazy” metacognition



https://bit.ly/nr-genai-hallucinate

Gen AI can worsen judgement of learning

Kabir, S., Udo-Imeh, D. N., Kou, B., & Zhang, T. (2024). *Who Answers It Better? An In-Depth Analysis of ChatGPT and Stack Overflow Answers to Software Engineering Questions* (arXiv:2308.02312). arXiv. https://doi.org/10.48550/arXiv.2308.02312

3

What underpins *learning to learn*?

https://www.lisedunetwork.com/what-information-seeking/

Information seeking skills are key to good self-regulated learning

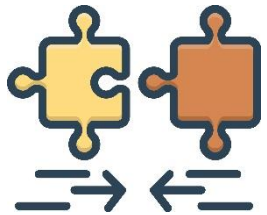
Butcher, K. R., & Sumner, R. (2011). Self-Directed Learning and the Sensemaking Paradox. *Human–Computer Interaction, 26*(1-2), 123-159.

Inadvertent deception of ChatGPT

Inaccurate and verbose, but users prefer ChatGPT responses

Kabir, S., Udo-Imeh, D. N., Kou, B., & Zhang, T. (2024). *Who Answers It Better? An In-Depth Analysis of ChatGPT and Stack Overflow Answers to Software Engineering Questions* (arXiv:2308.02312). arXiv. https://doi.org/10.48550/arXiv.2308.02312

Learning to learn in the age of AI



Seek, learn, verify and apply information in a new context with the use of AI

Potential reasons for the three limitations

Insufficient access to
the necessary learning data and
personalized feedback

FOUNDATIONS – **FLORA** – IMPACT – FINAL REMARKS

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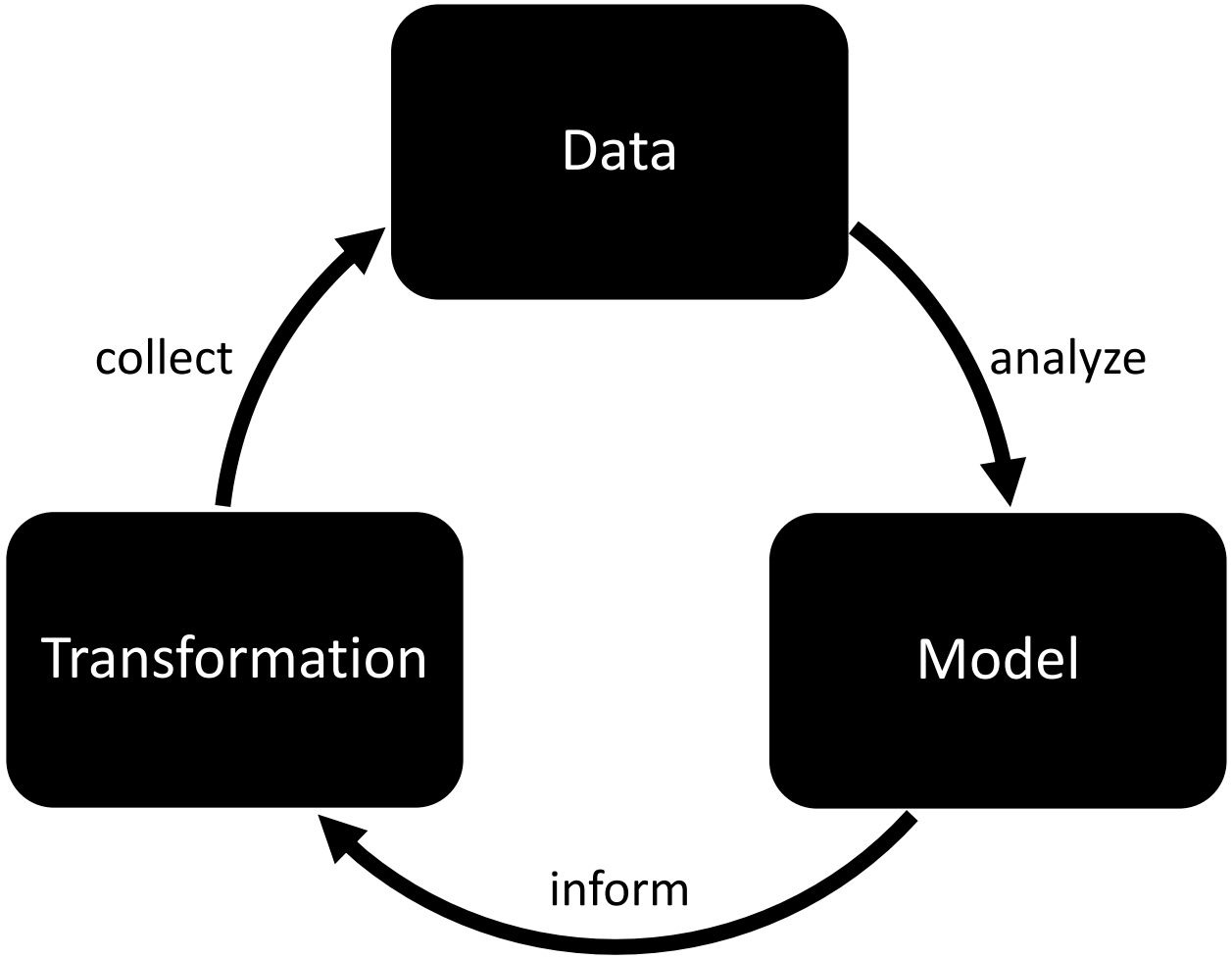
Our approach

Turing data into personalized feedback for learning to learn

http://floraproject.org

Closing the loop of SRL analytics

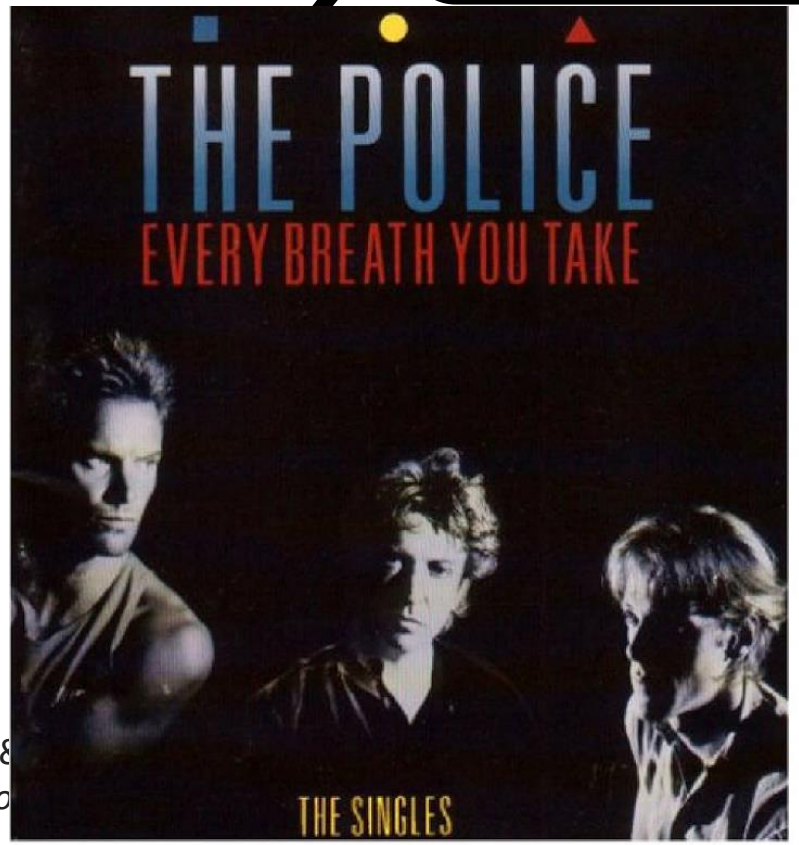


Gašević, D., Tsai, Y-S., Dawson, S., & Pardo, A. (2019). How do we start? An approach to learning analytics adoption in higher education. *International Journal of Information and Learning Technology, 36*(4), 342-353.

Closing the loop of SRL

Granular and reliable measurements

Data



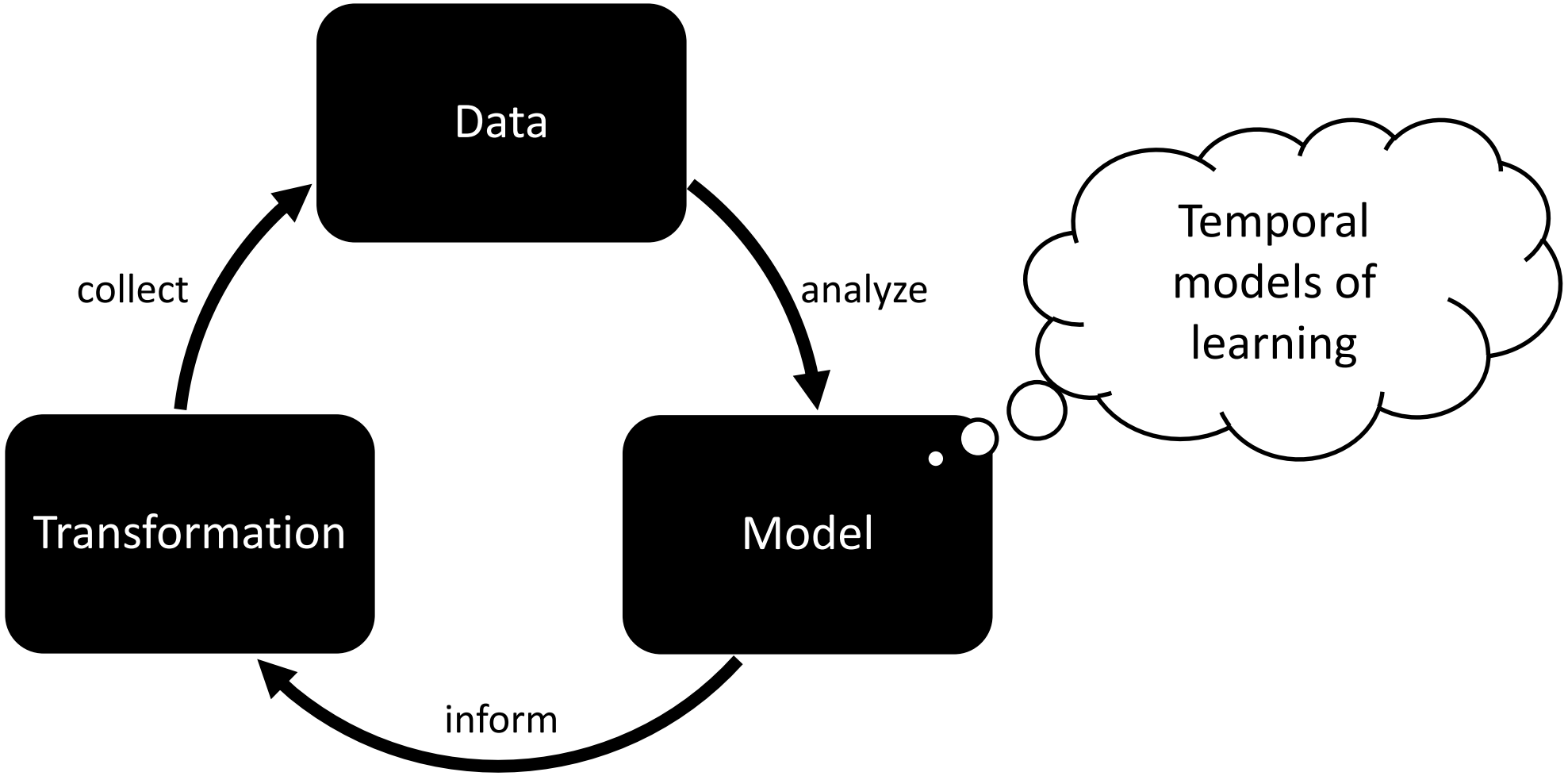
Every breath you take
And every move you make
Every bond you break
Every step you take
I'll be watching you

Every single day
And every word you say
Every game you play
Every night you stay
I'll be watching you

Gašević, D., Tsai, Y-S., Dawson, S., &

higher education. *International Journal of Information and Learning Technolo*

Closing the loop of SRL analytics



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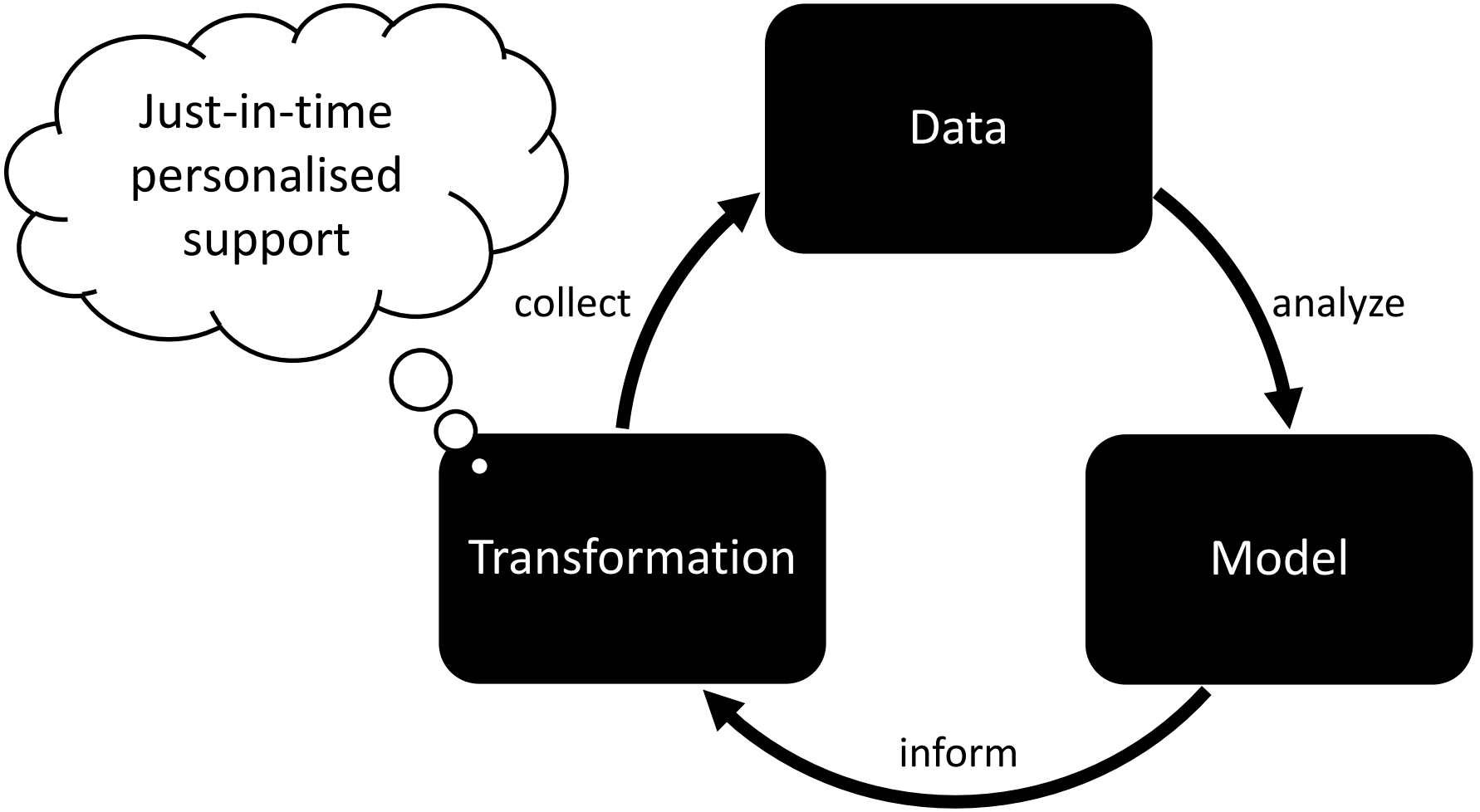

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FLoRA

Supporting learning to learn in comprehension and writing tasks

http://floraproject.org

Hybrid human-AI regulation

Degrees of hybrid regulation	AI regulation	Human regulation	Function of dashboard
AI regulation	AI monitors and adjusts extensively	Aware of AI regulation	Raising awareness of AI regulation
Co-regulation	AI monitors and adjusts in small steps	Understanding how AI monitors and controls	Showing AI monitoring and modelling AI control
Shared-regulation	AI monitors and proposes control actions to the learner	Understanding monitoring and executing control	Showing monitoring and scaffolding learners' control
Self-regulation	Observing regulation	Monitoring and self-initiation of control	Showing learners' regulation to support their understanding

Molenaar, I. (2022). The concept of hybrid human-AI regulation: Exemplifying how to support young learners' self-regulated learning. *Computers and Education: Artificial Intelligence*, *3*, 100070.

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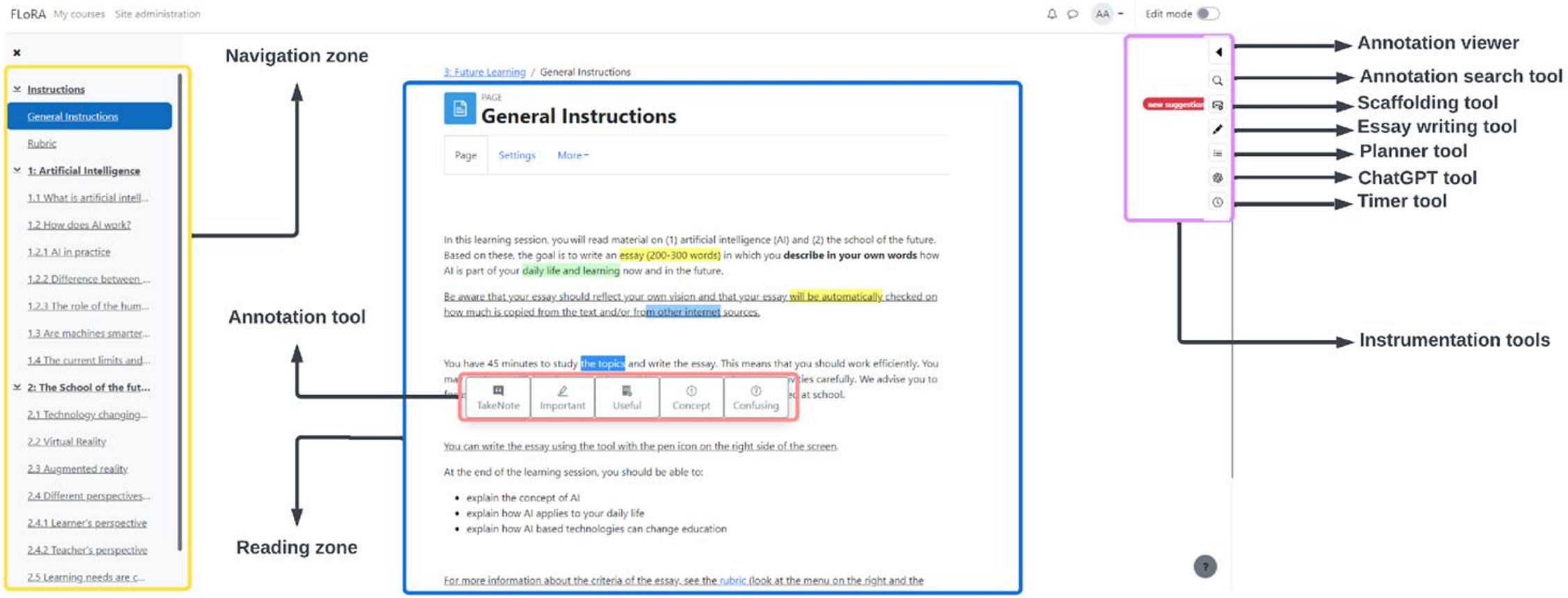
FLoRA



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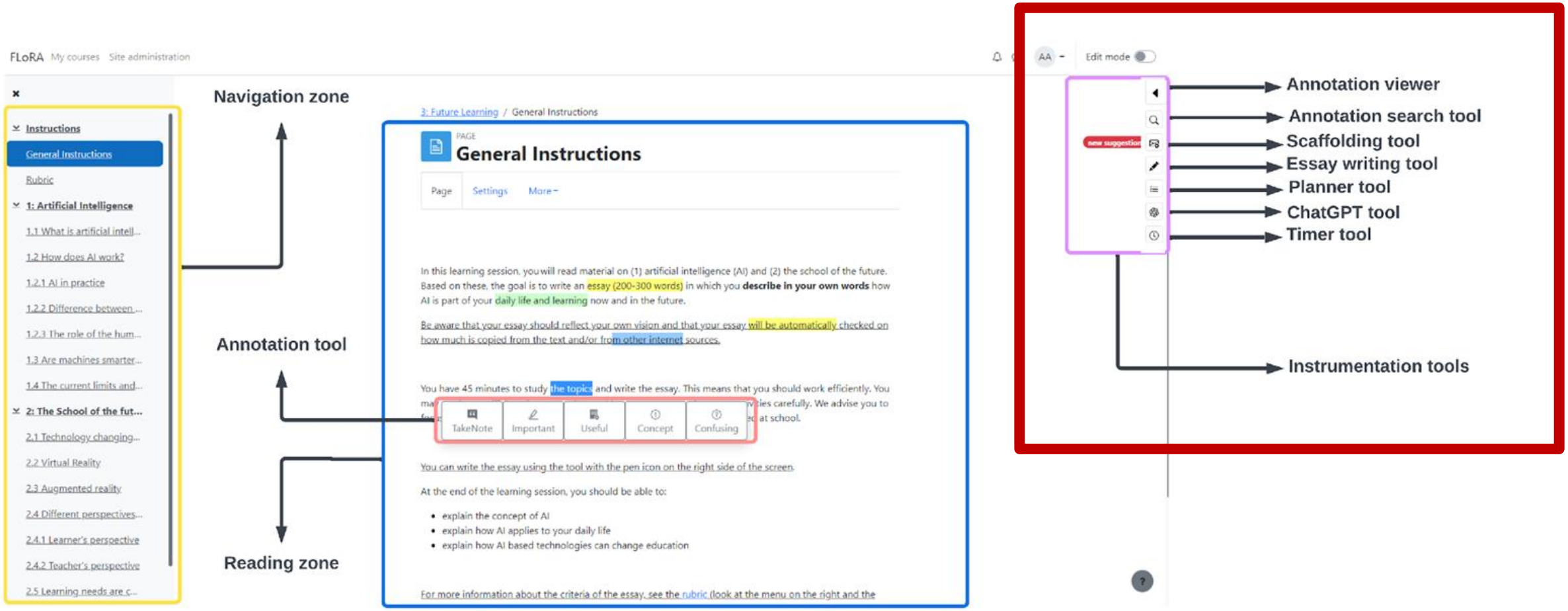
FLoRA tools



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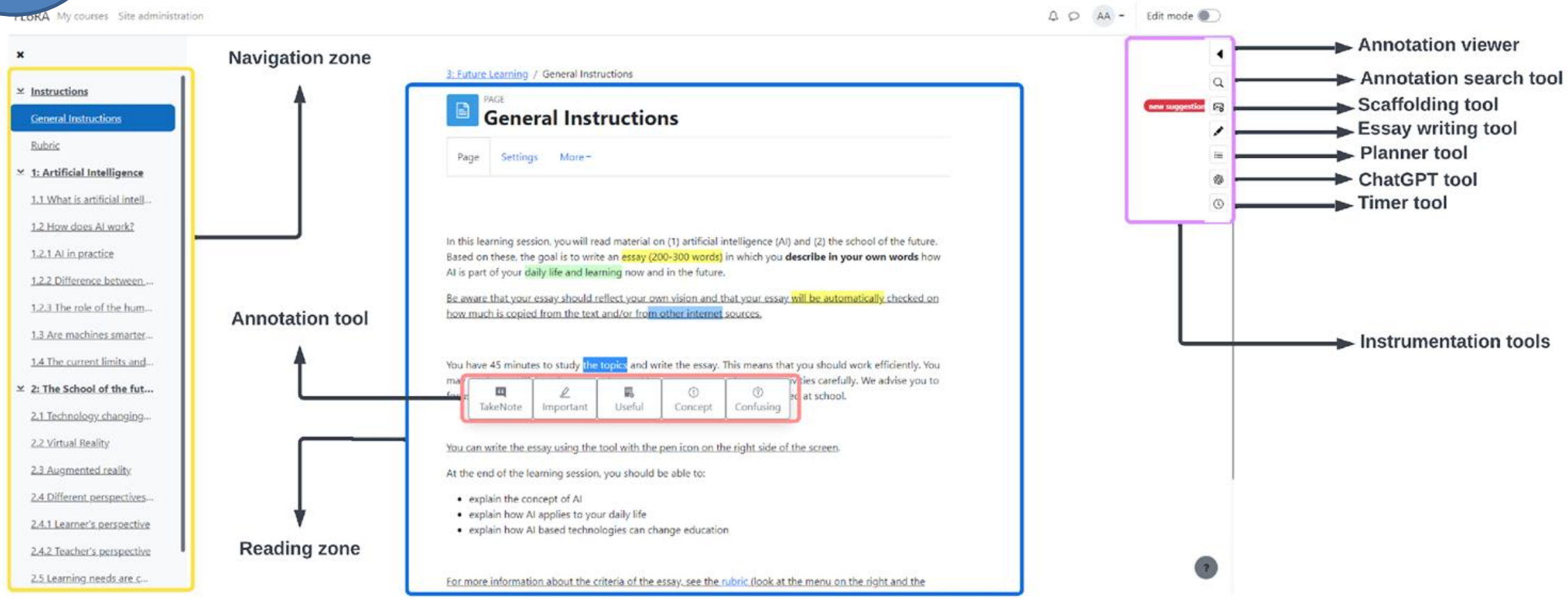
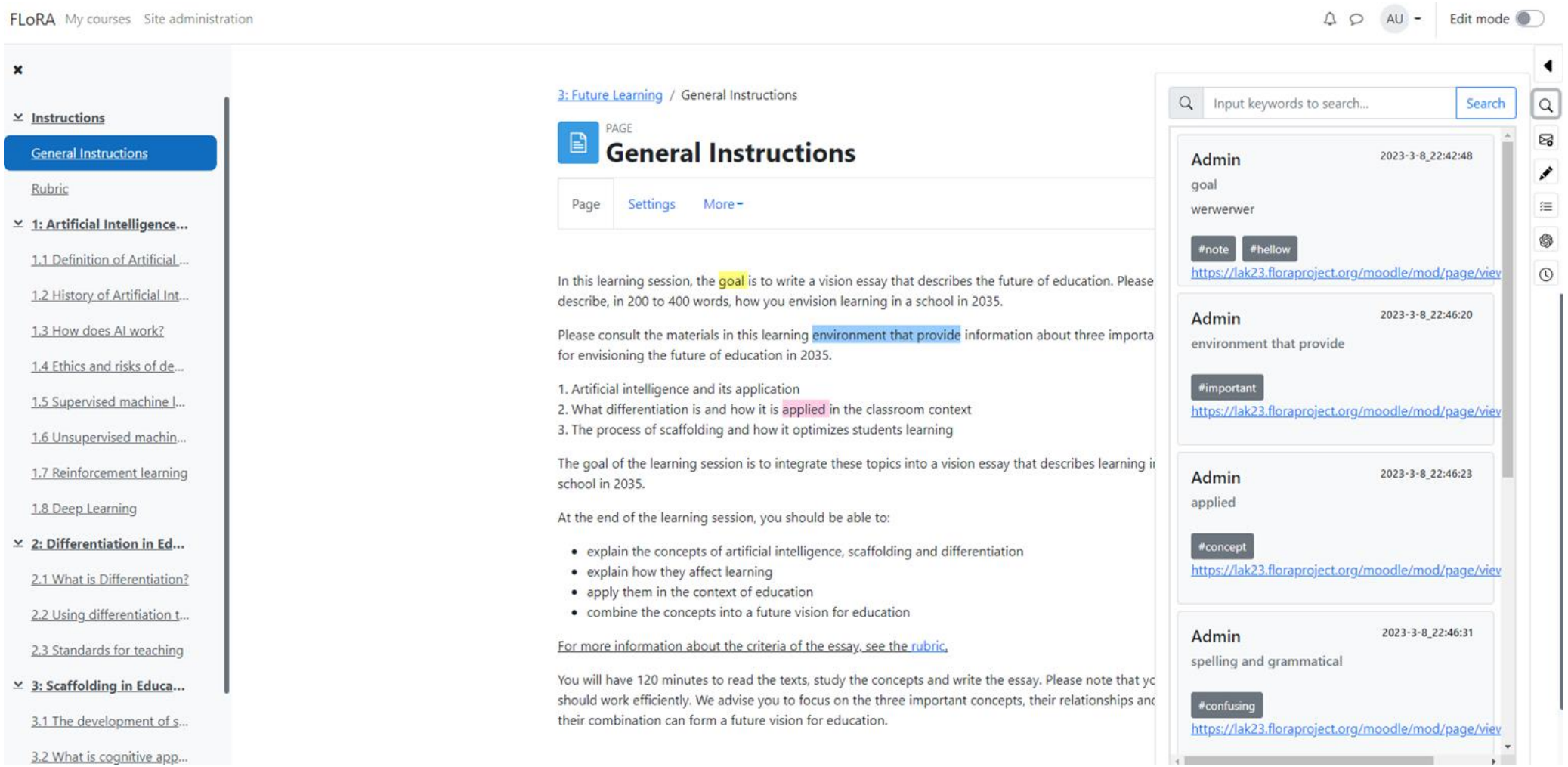
1

Reading tools – annotations



http://floraproject.org

Reading tools – annotation search



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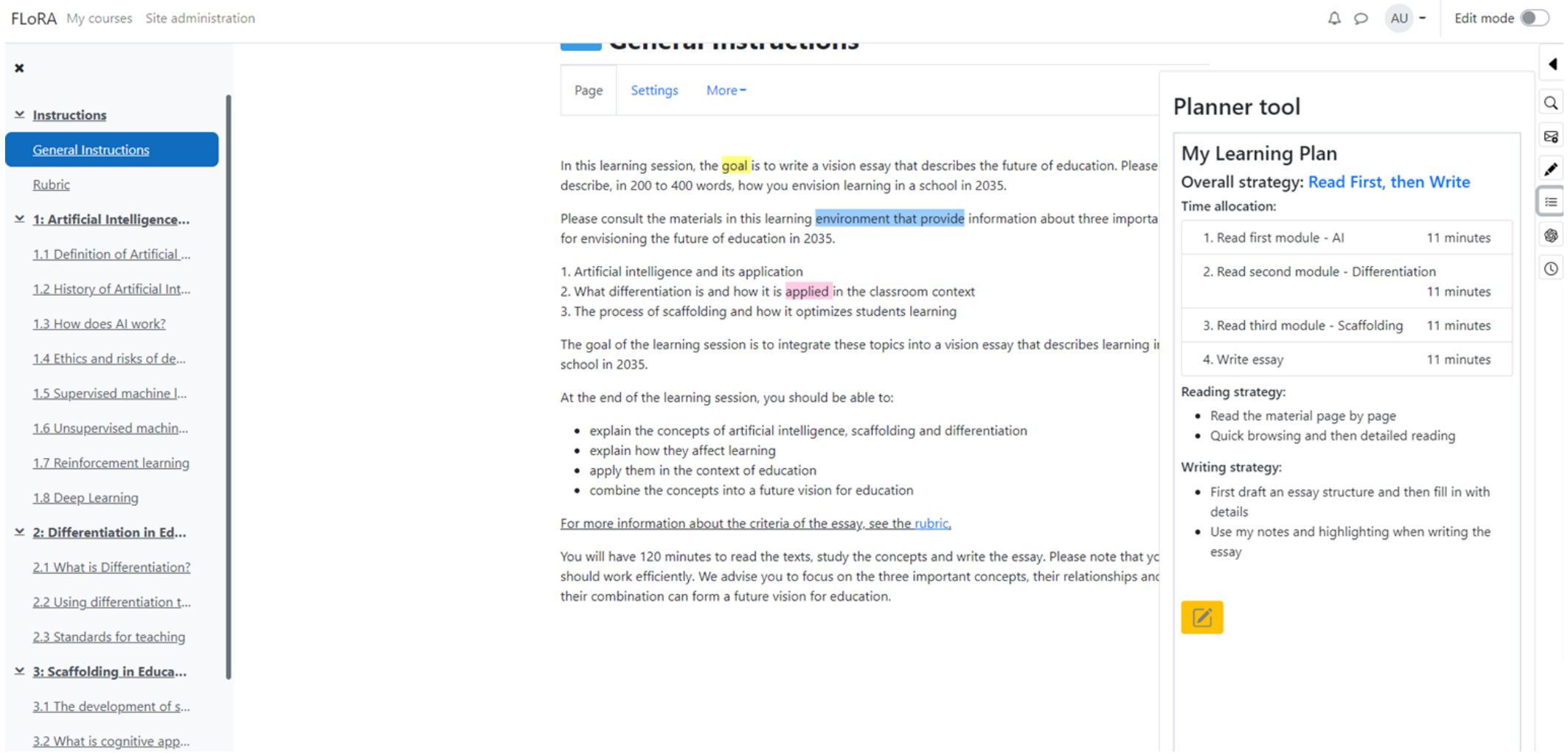
Supporting planning



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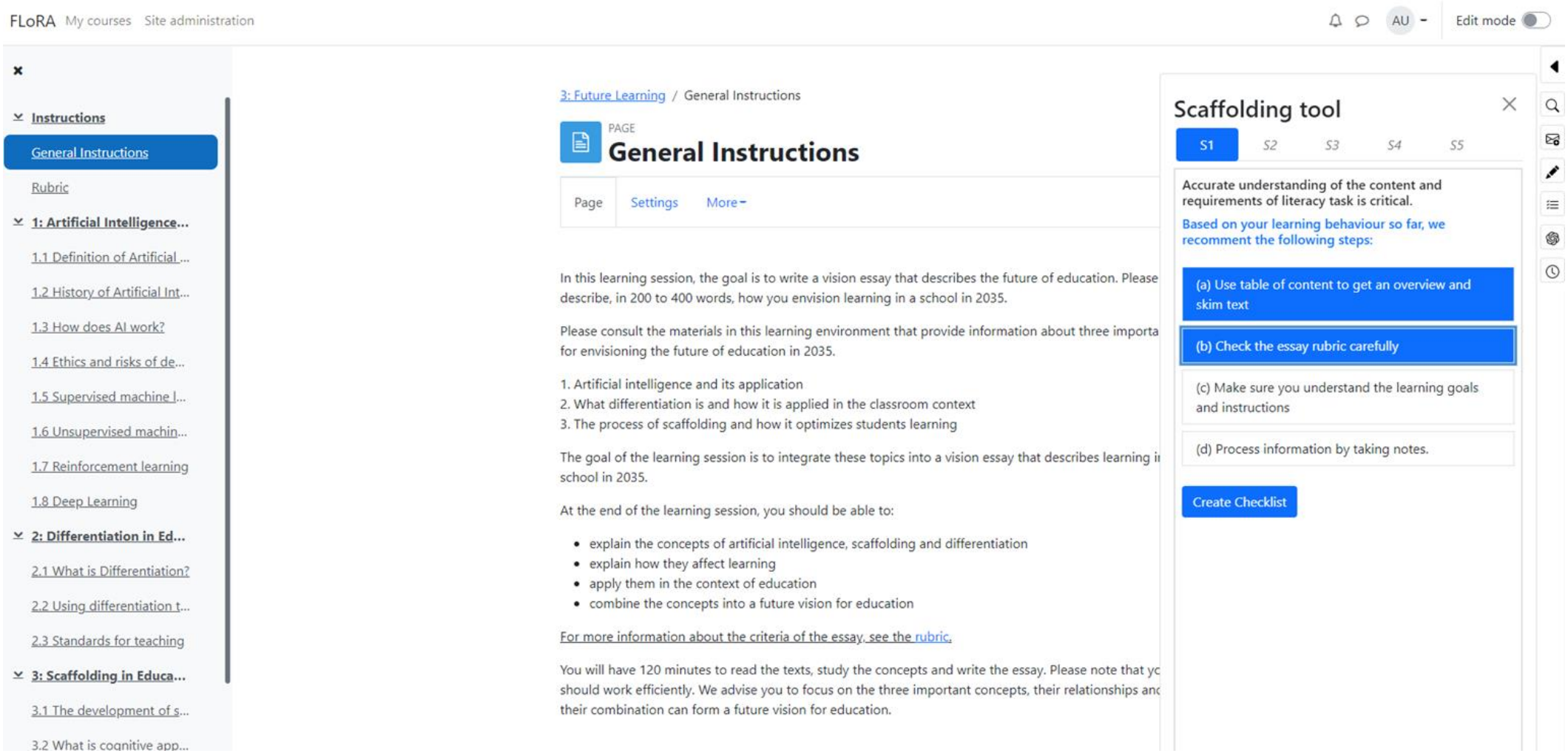
Scaffolding tool



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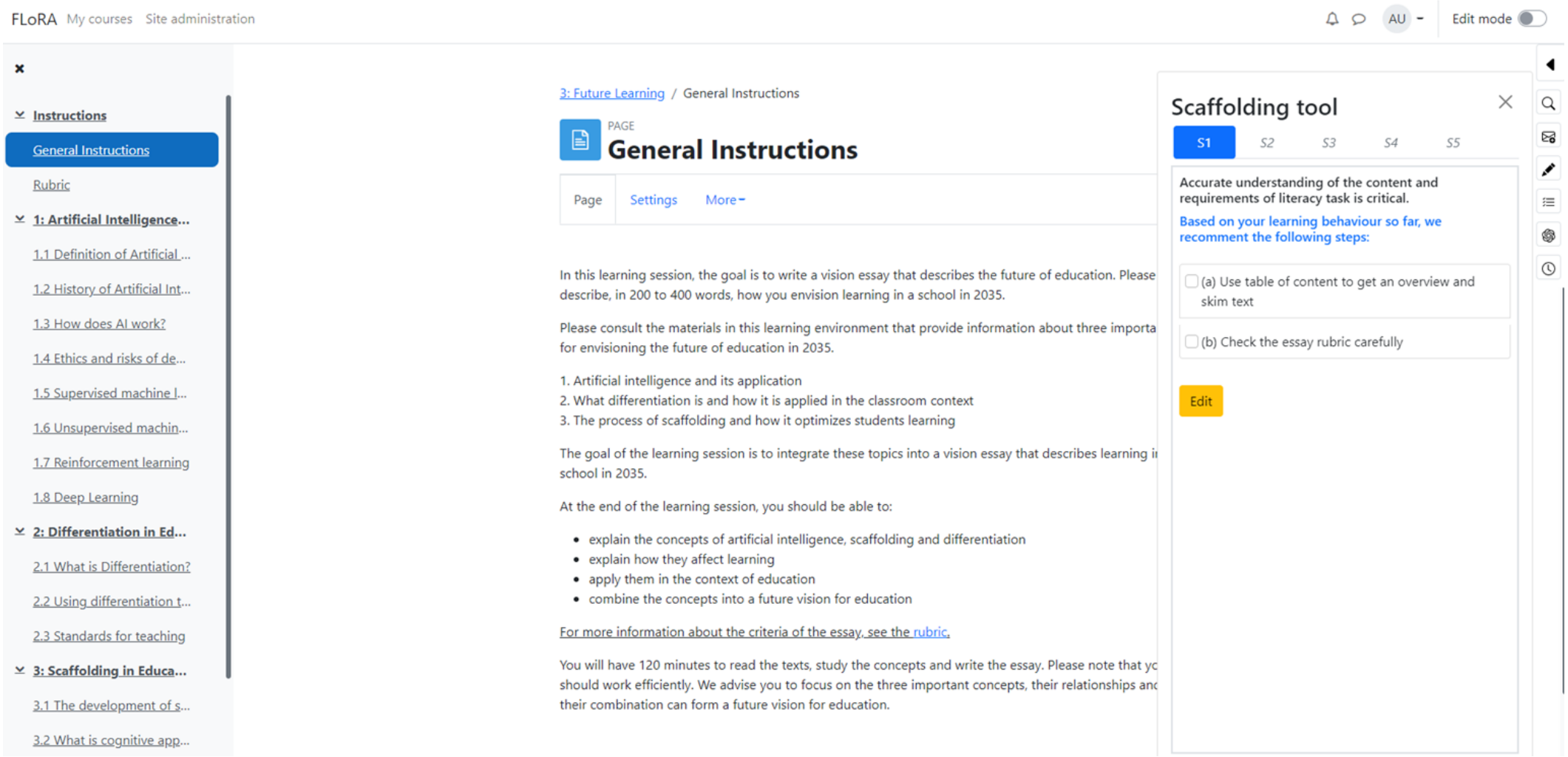
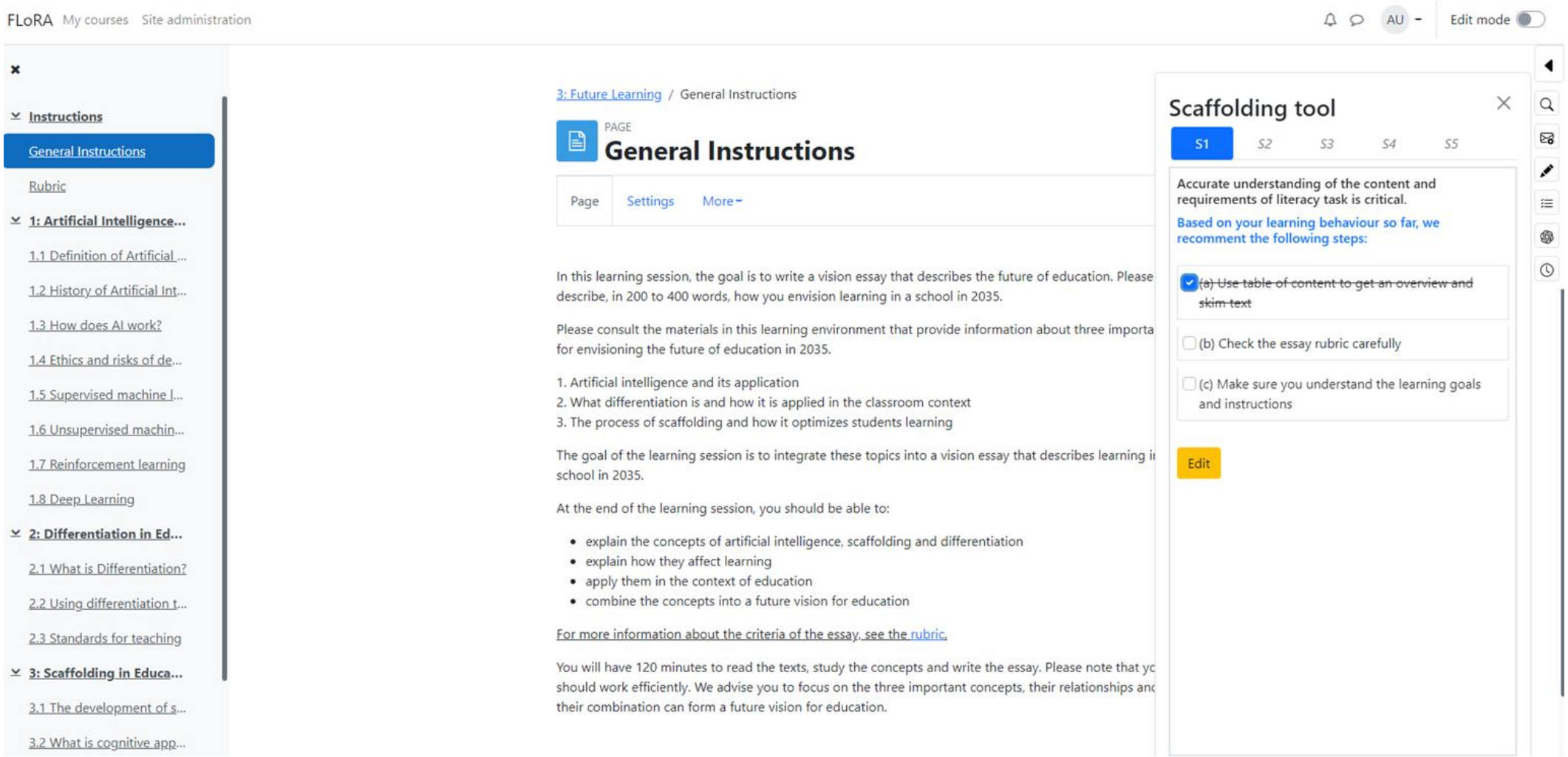
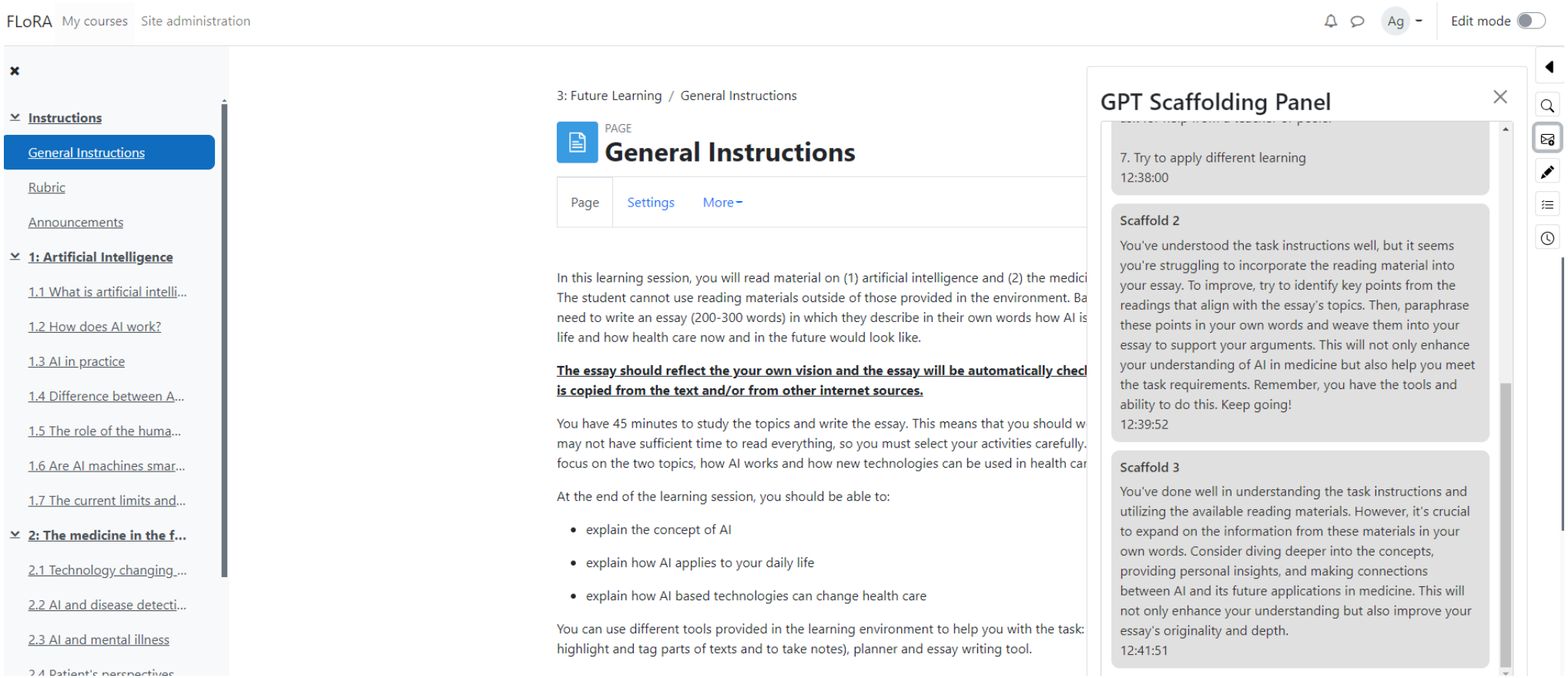


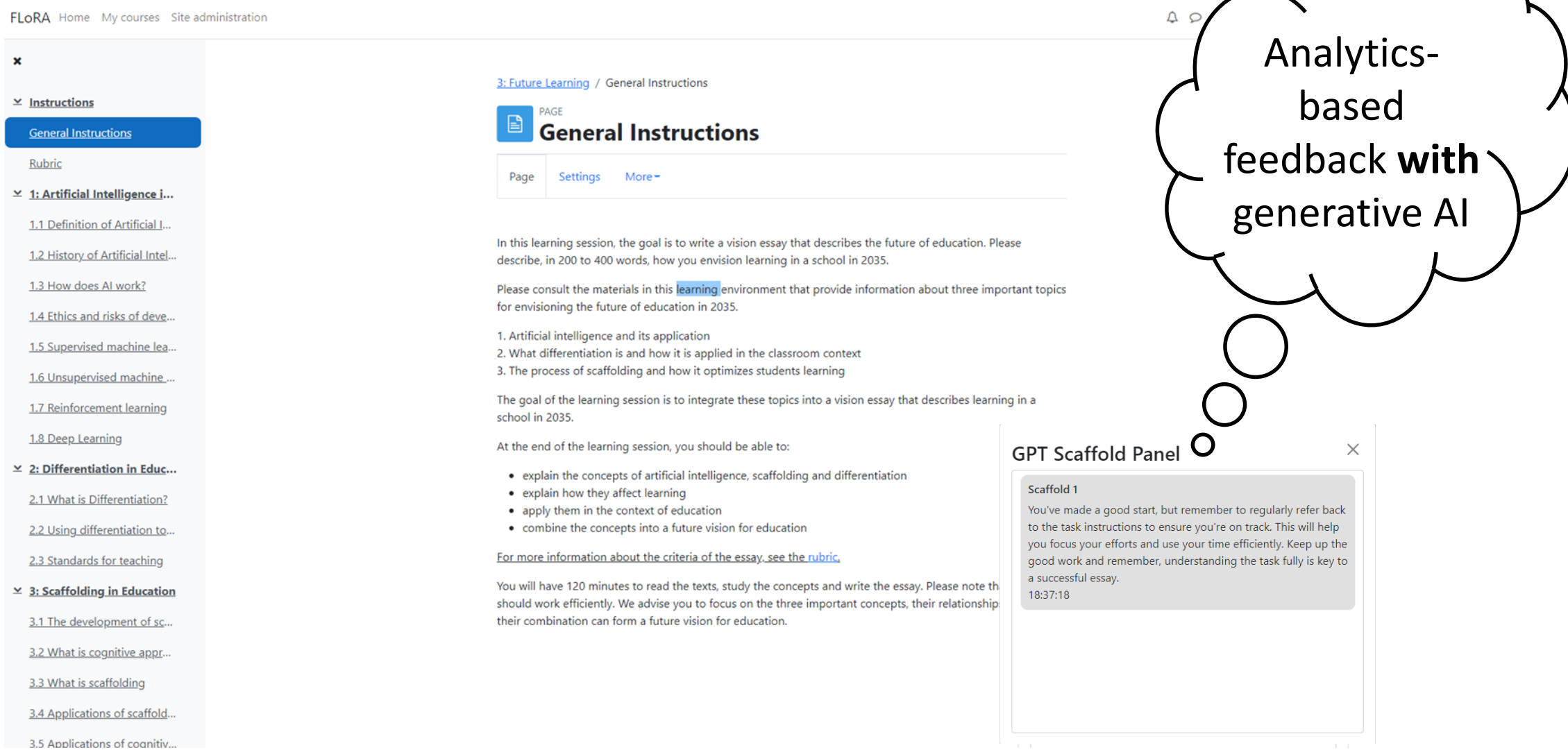
Scaffolding tool



GPT Scaffolding Tool



Closing the personalized feedback loop



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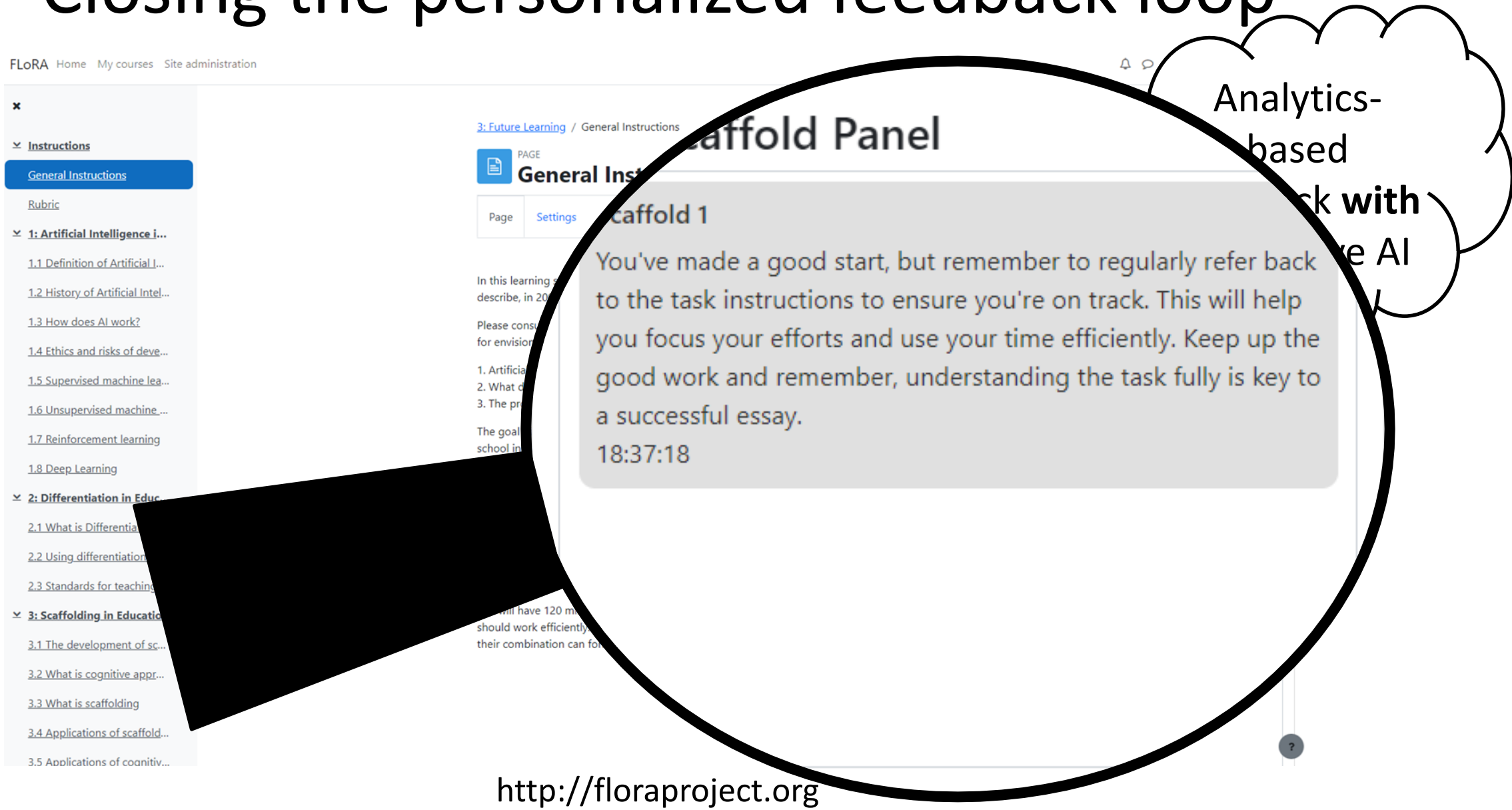
Closing the personalized feedback loop



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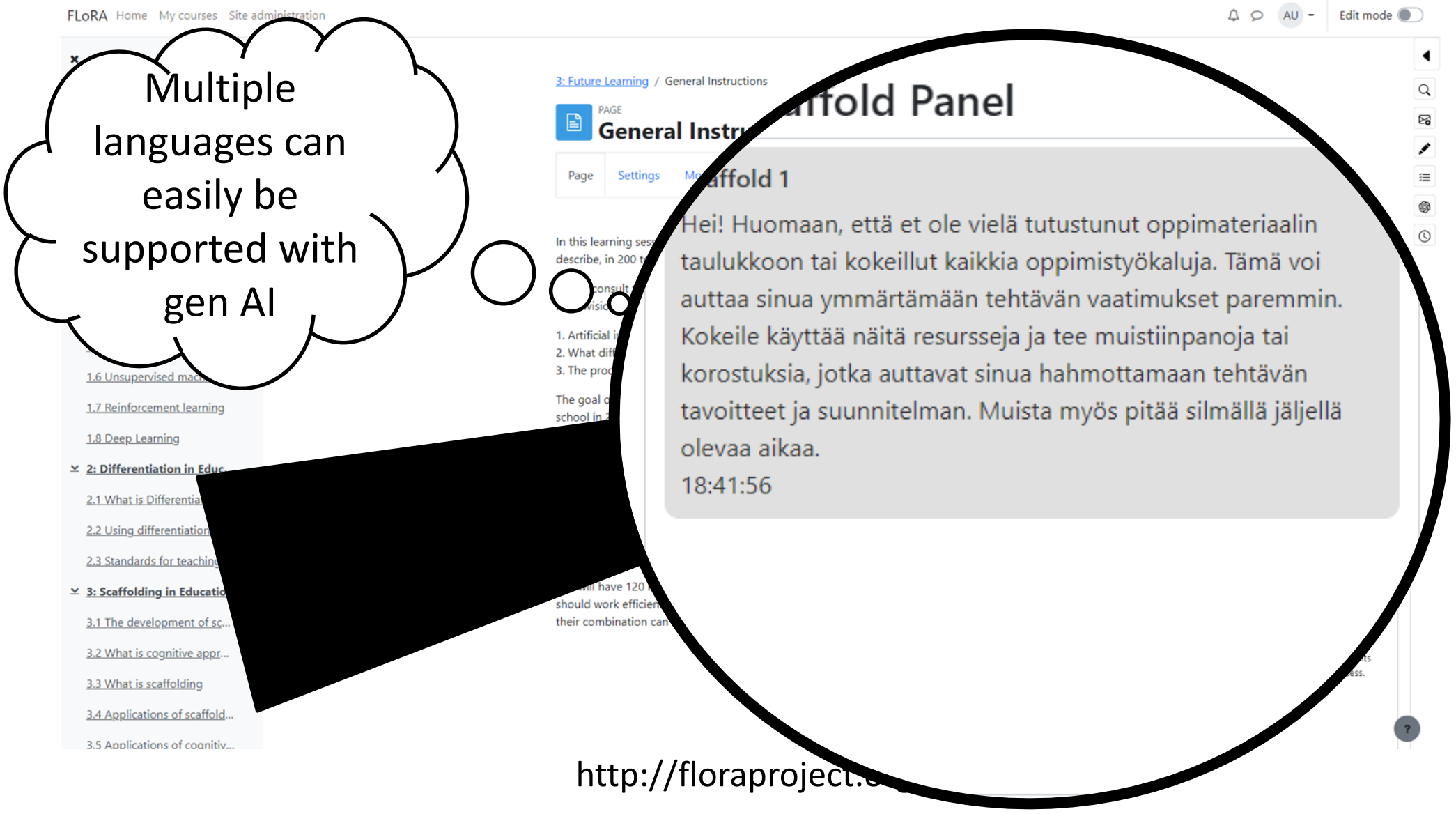
Closing the personalized feedback loop



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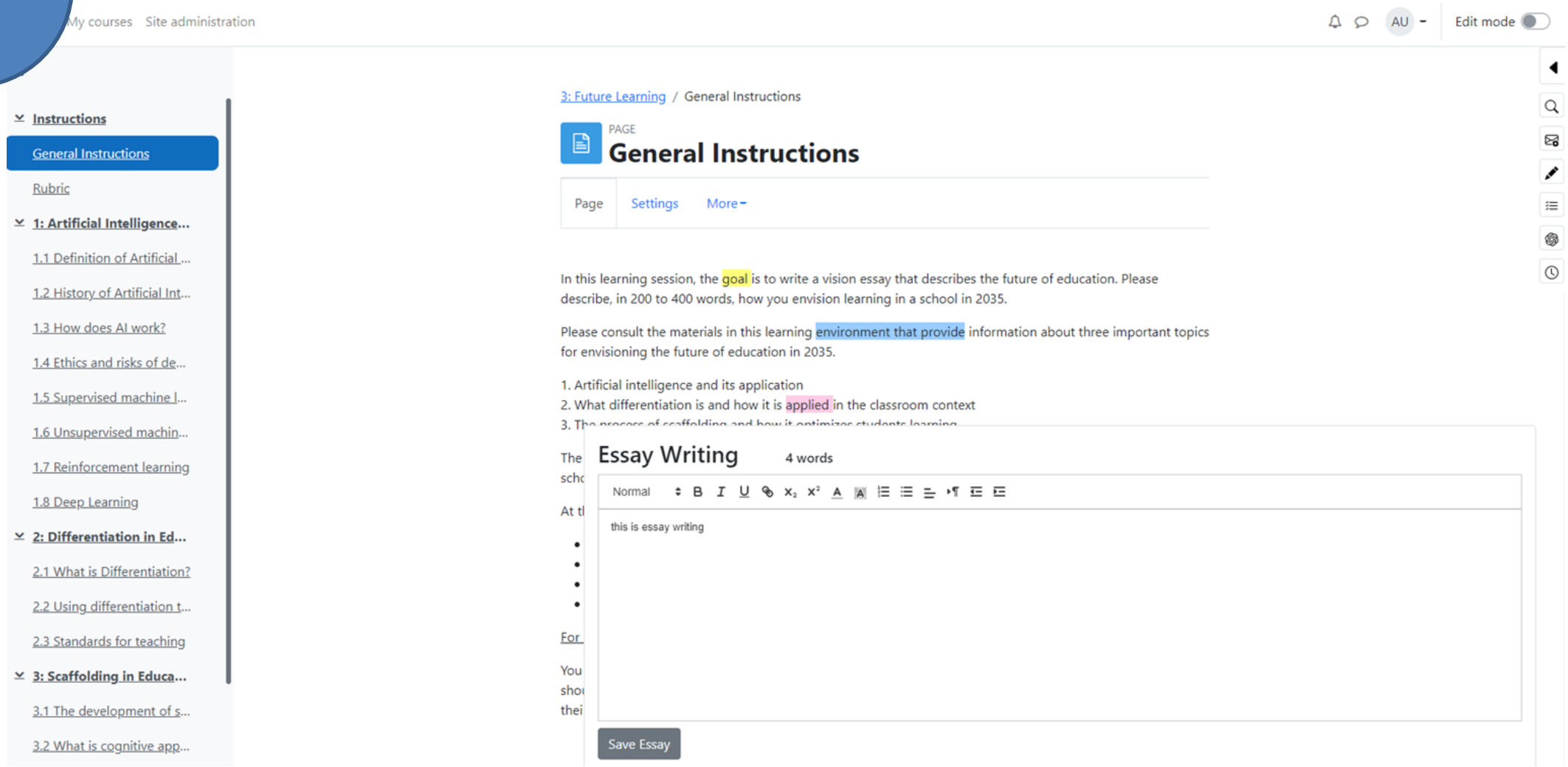
2

Writing Tools in FLoRA



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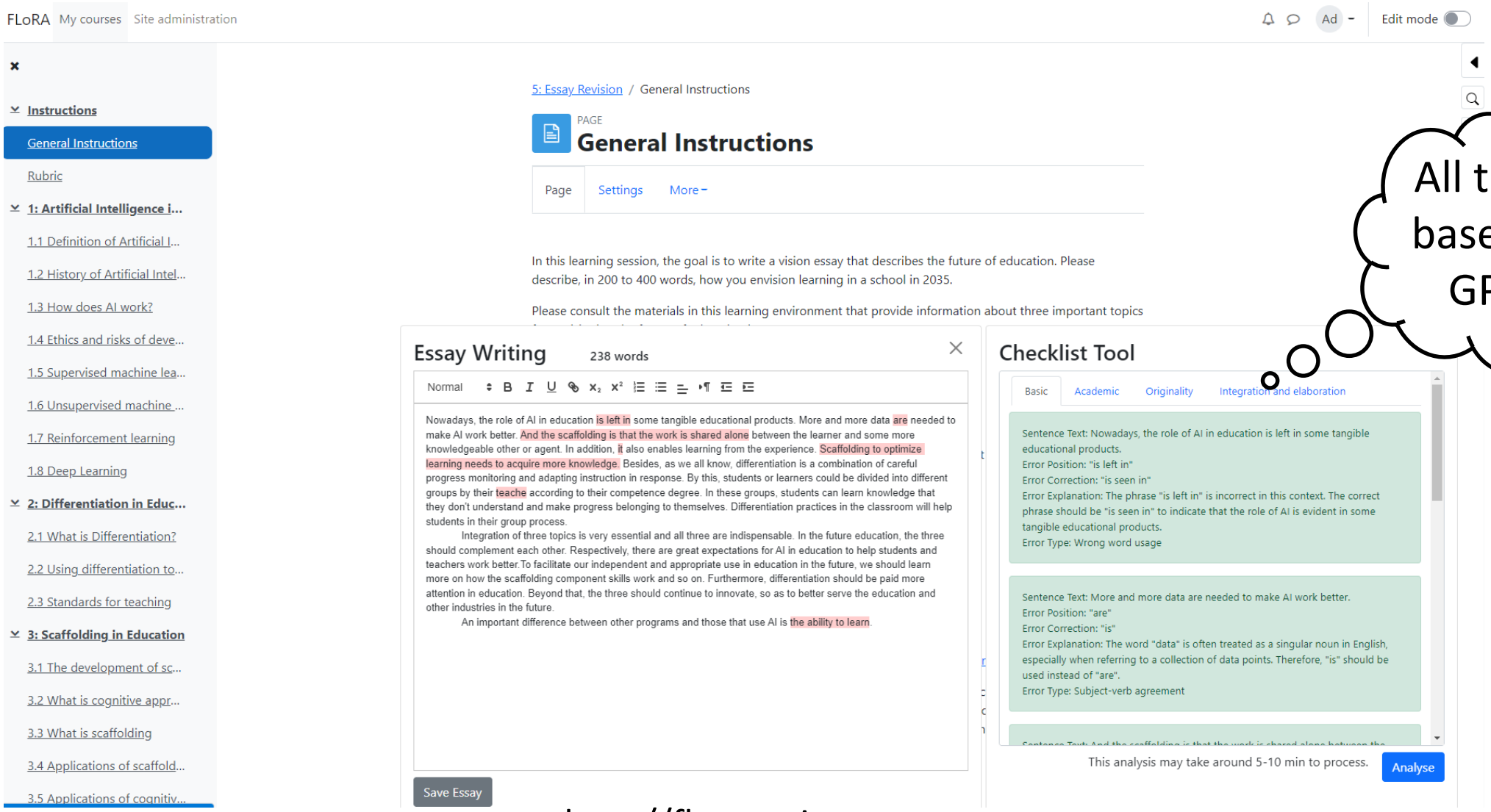
Grammar support



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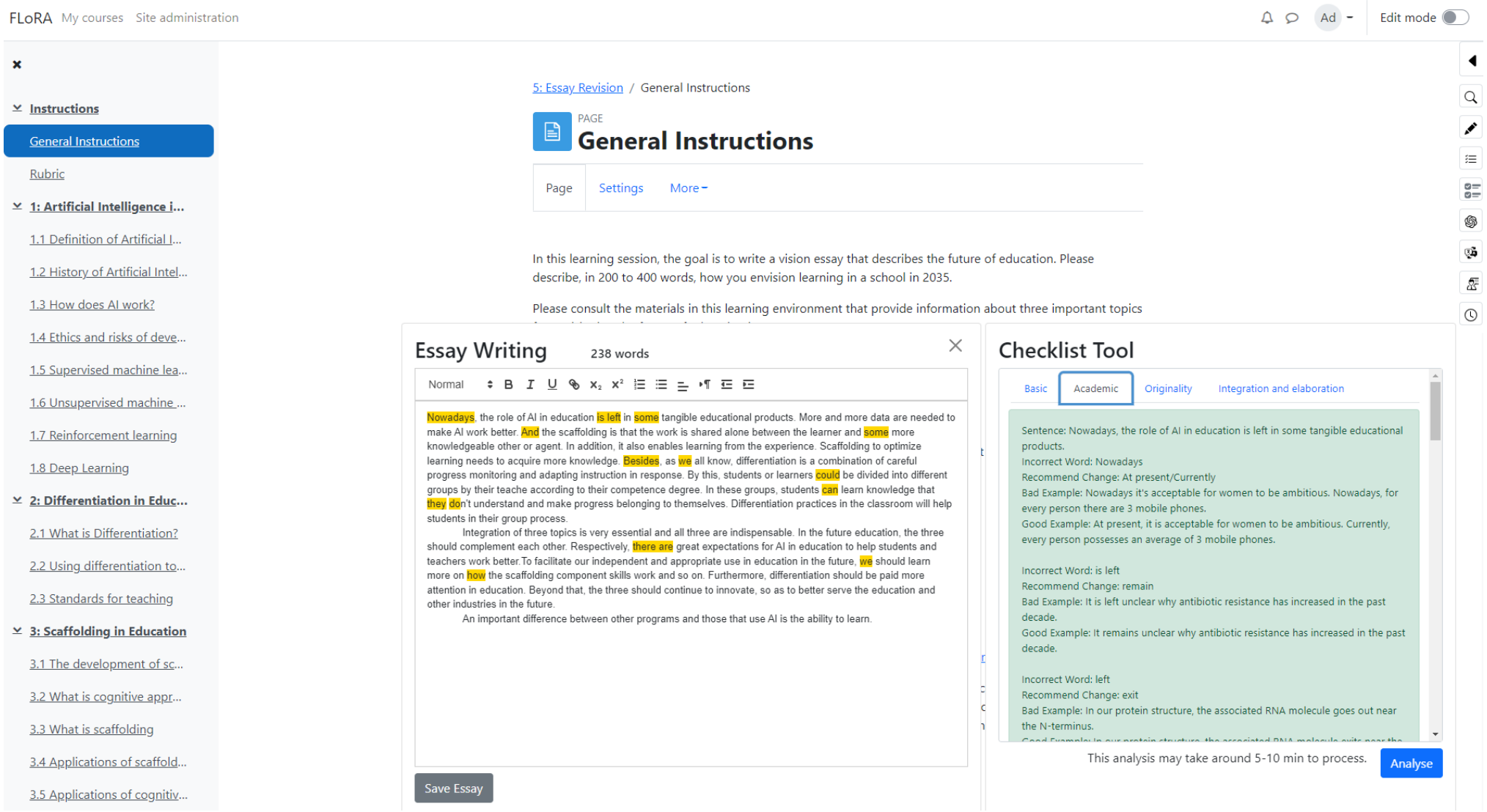
Formal academic writing support



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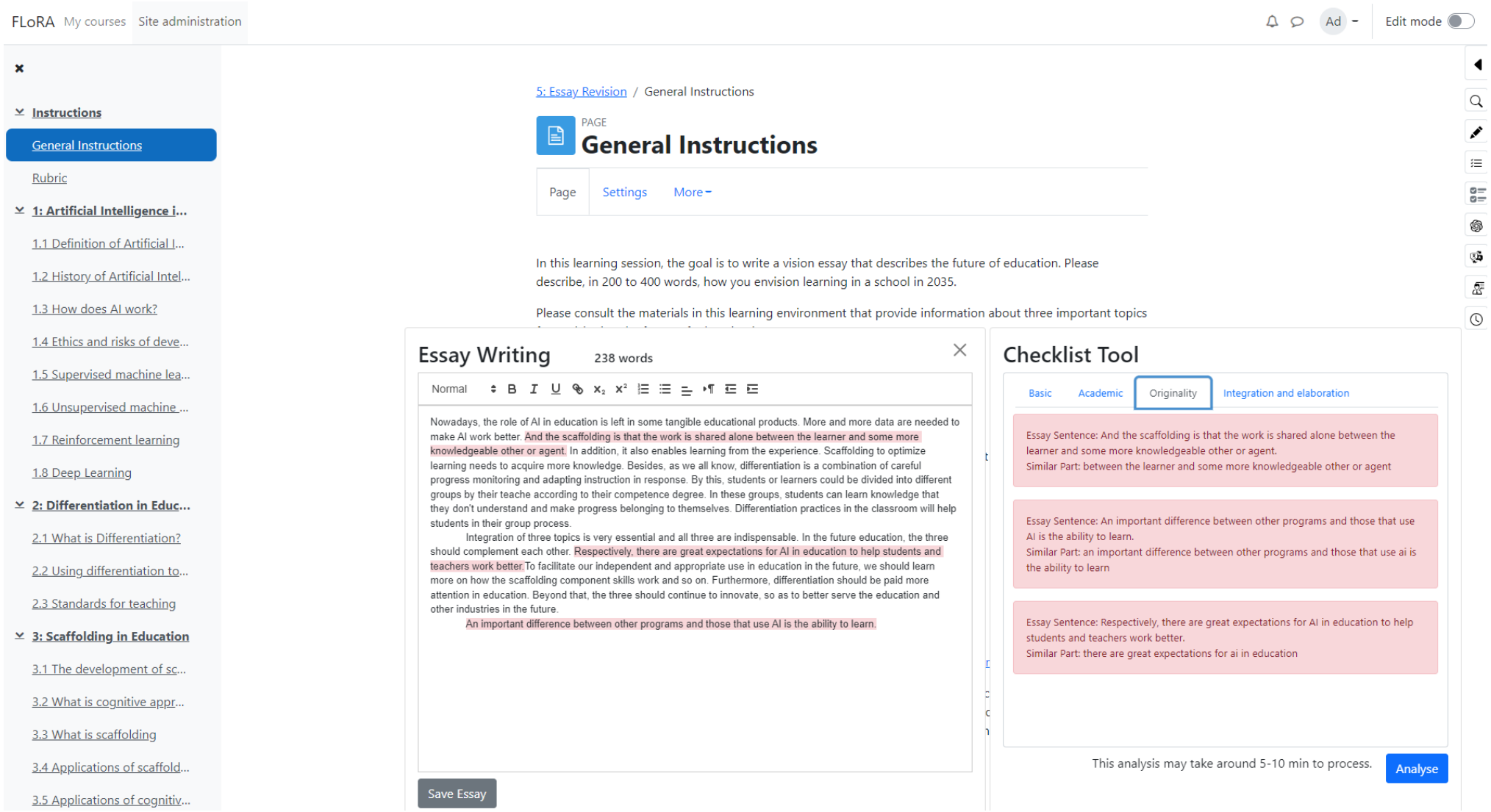
Originality testing



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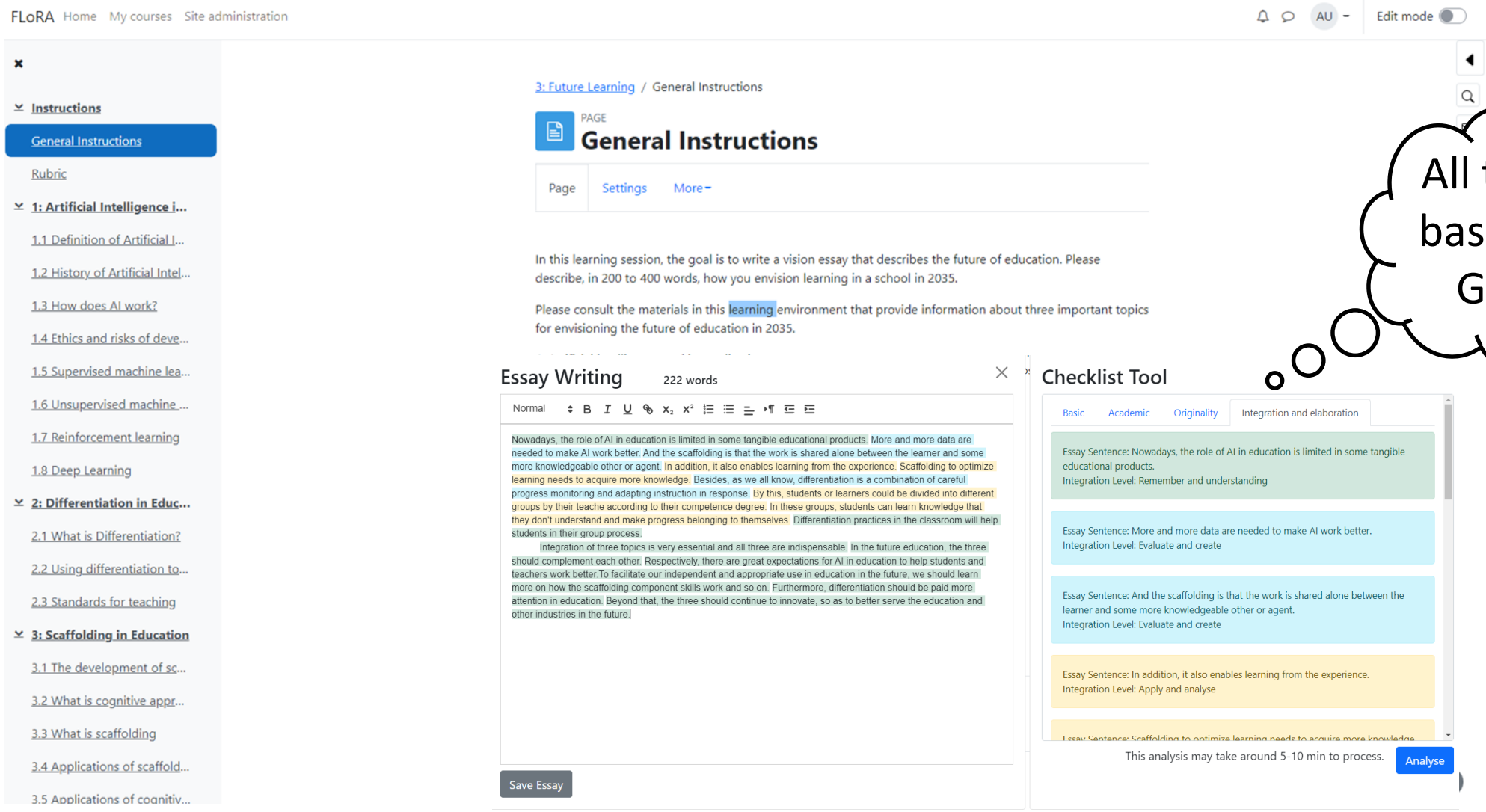
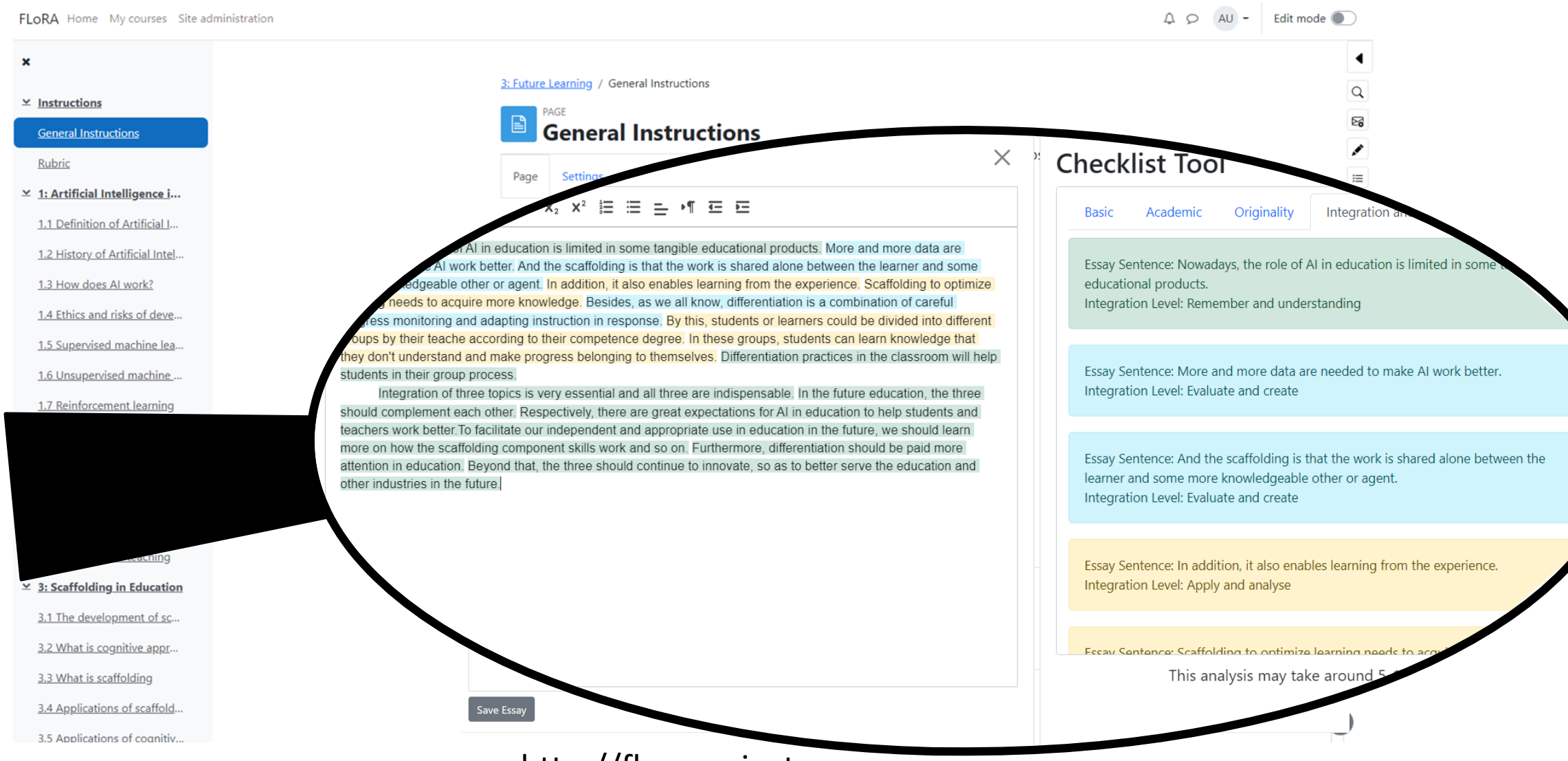
Rhetorical structures – integration



All this is based on GPT4

http://floraproject.org

Rhetorical structures – integration



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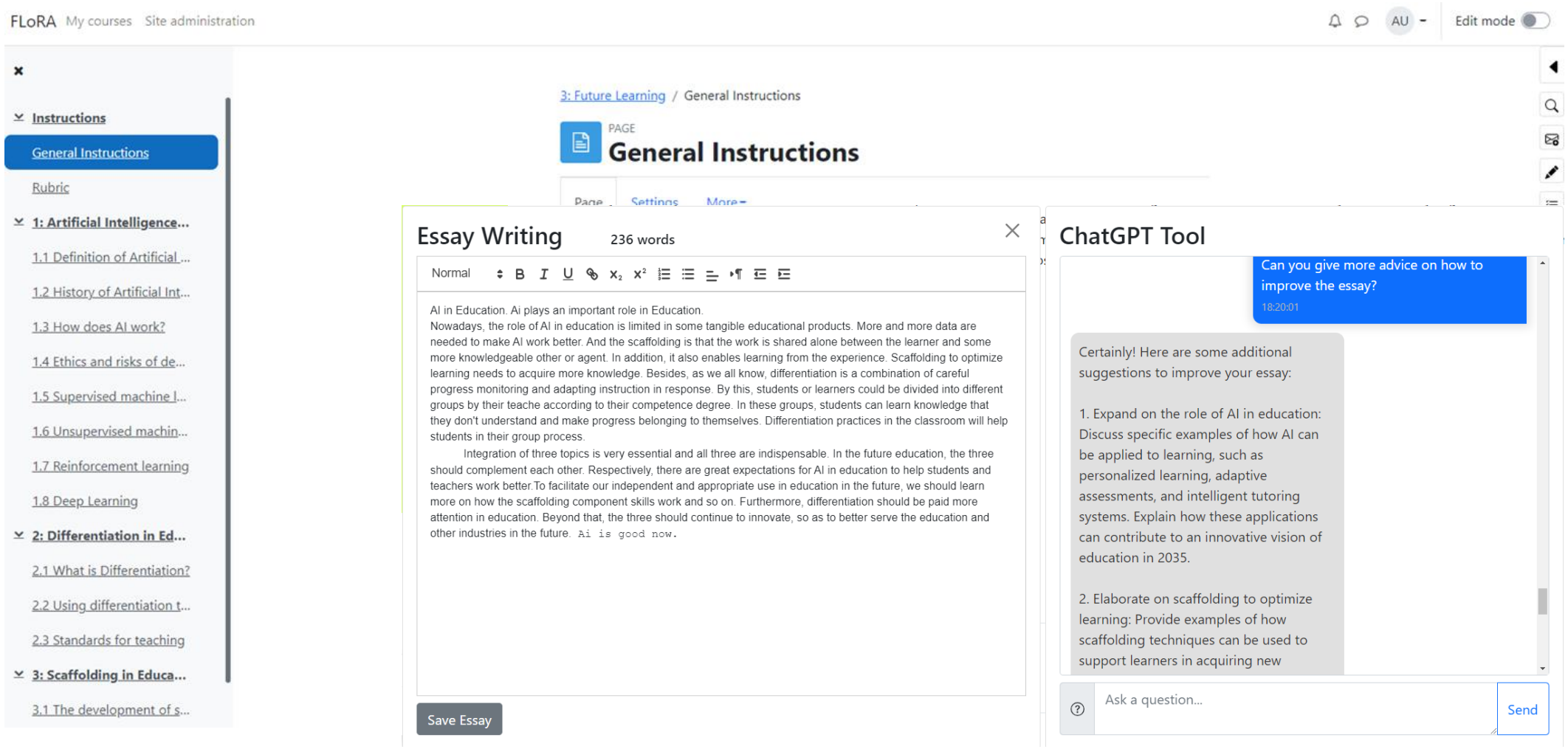
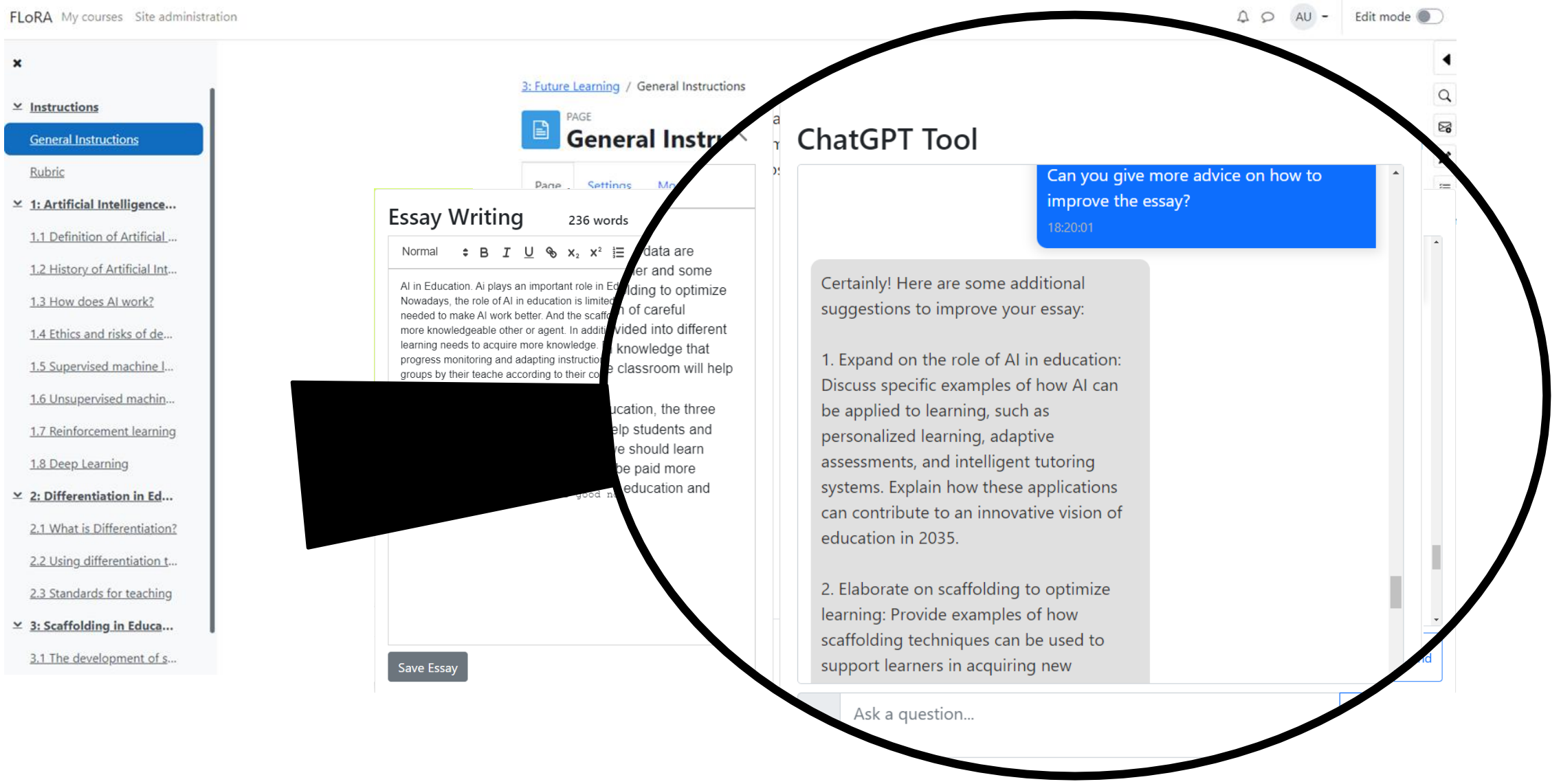
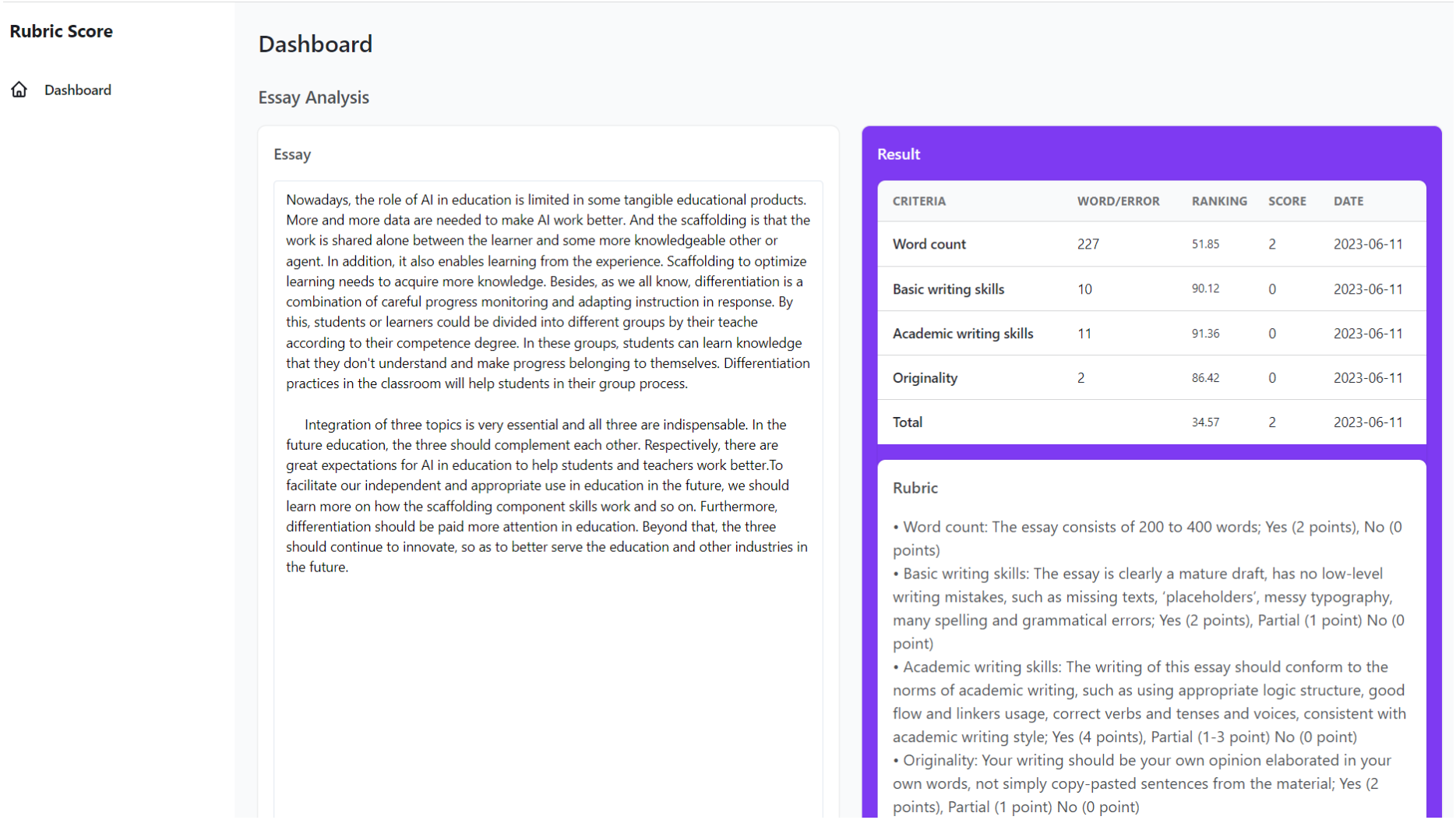
ChatGPT in FLoRA



ChatGPT in FLoRA



Essay marking tool



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FOUNDATIONS – FLORA – **IMPACT** – FINAL REMARKS

Present uses of FLoRA

FLoRA goes to primary,
secondary and higher education

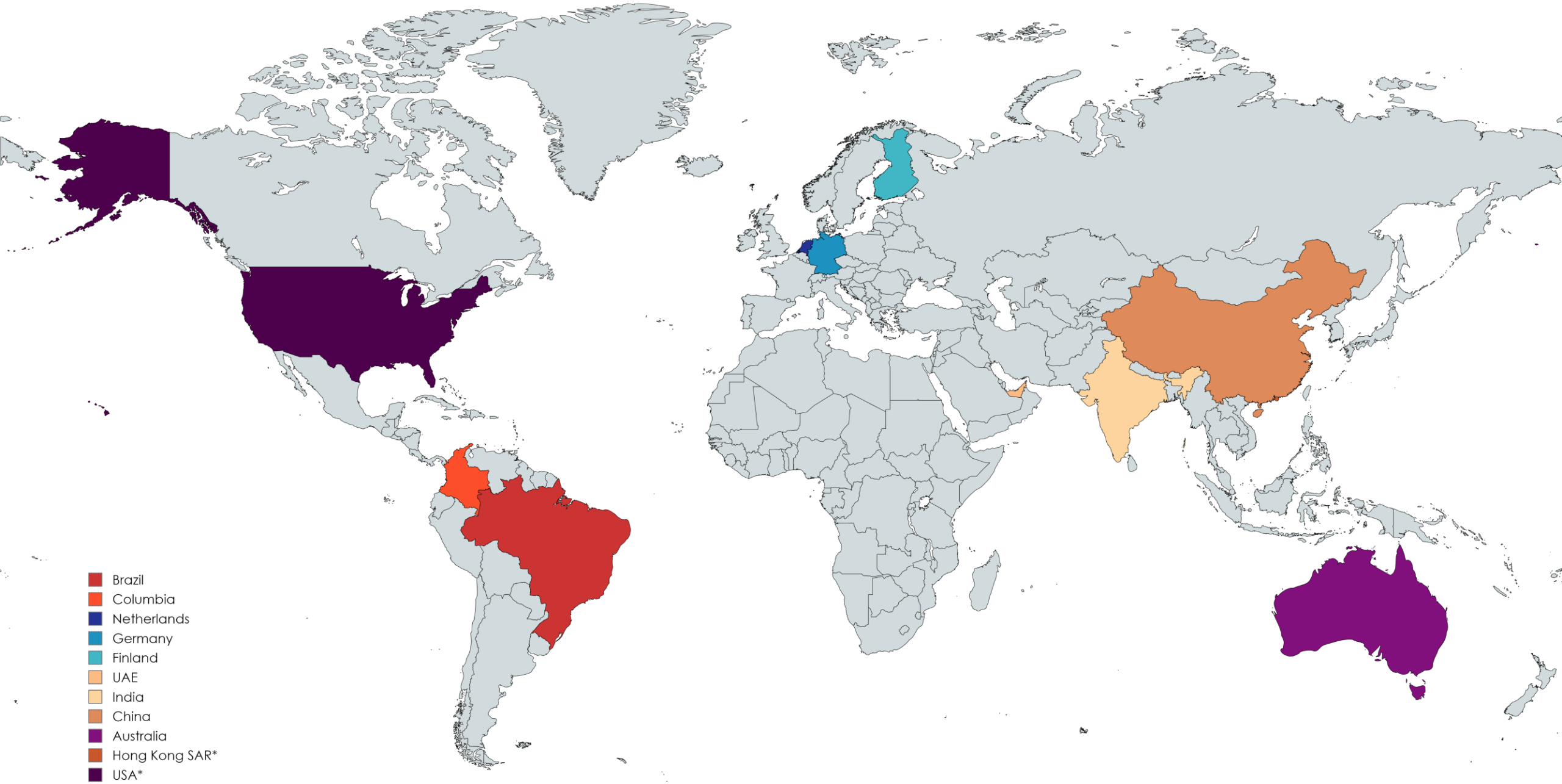
Present uses of FLoRA

FLoRA can be used in multiple languages

Dutch, English, Finnish, German, Mandarin, Spanish, and Portuguese already supported

Arabic in preparation

COLAM



Created with mapchart.net

Present uses of FLoRA

Comprehension and writing tasks in language, communications, biology, IT, and data science

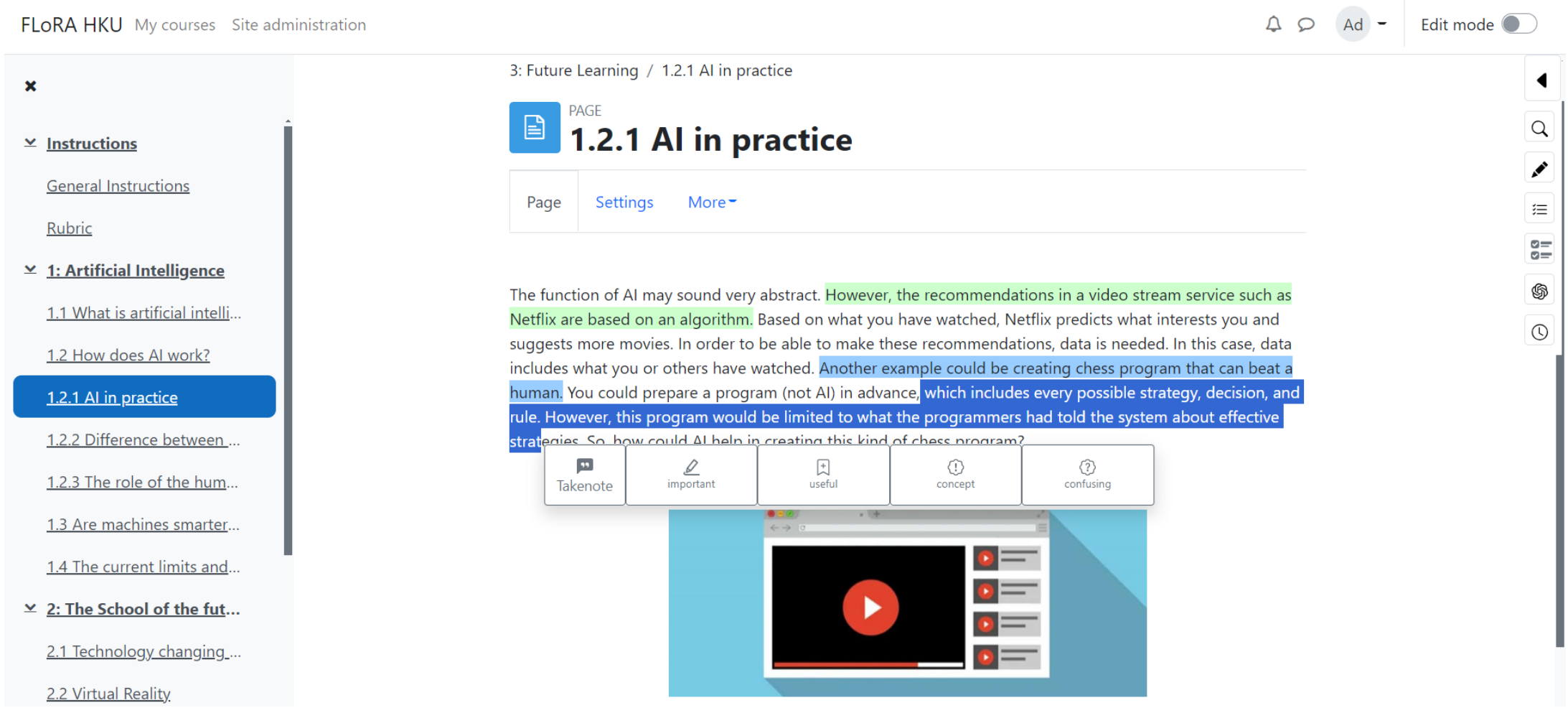
COLAM

1

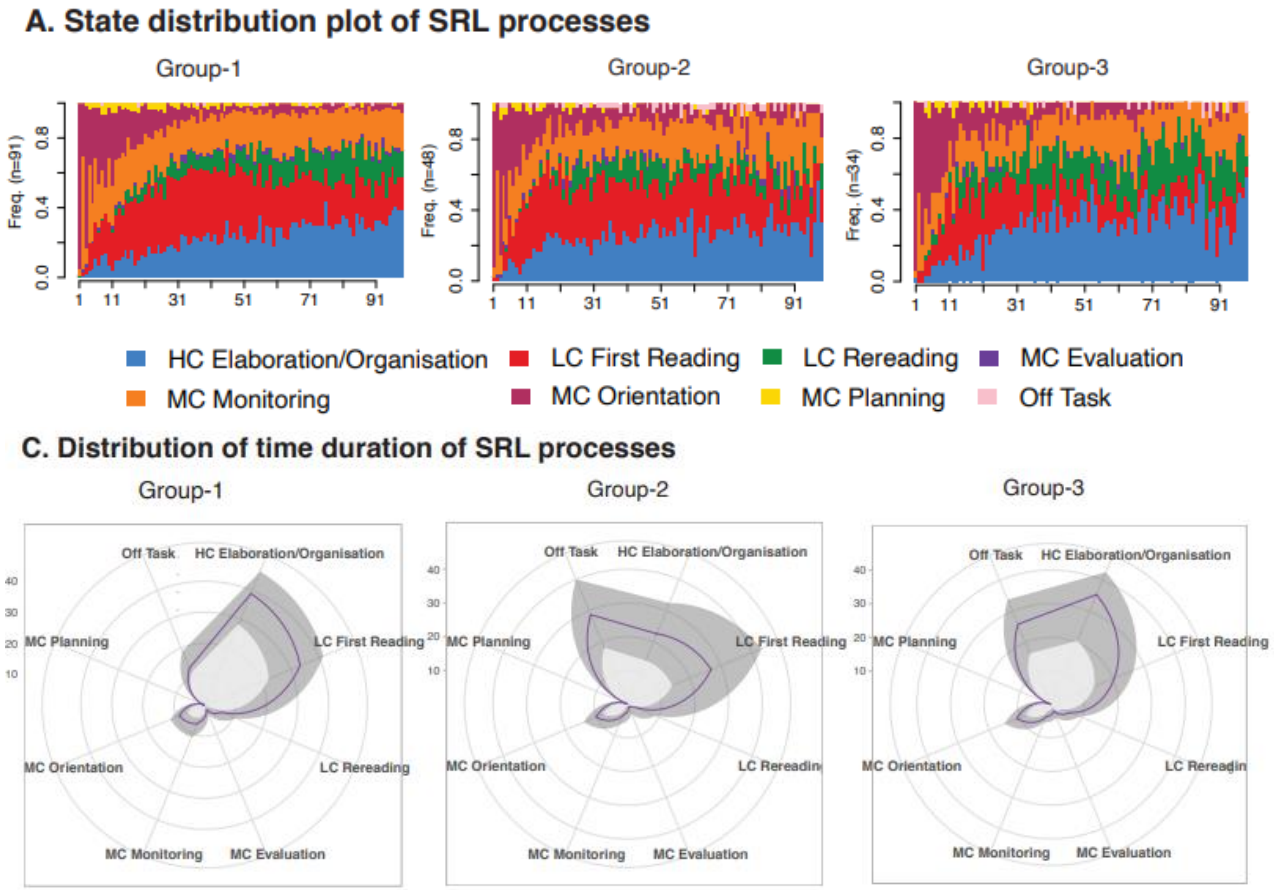
Learning strategies

Effective ways to track and influence learning strategies with FLoRA

Track and influence learning strategies



Learning strategies



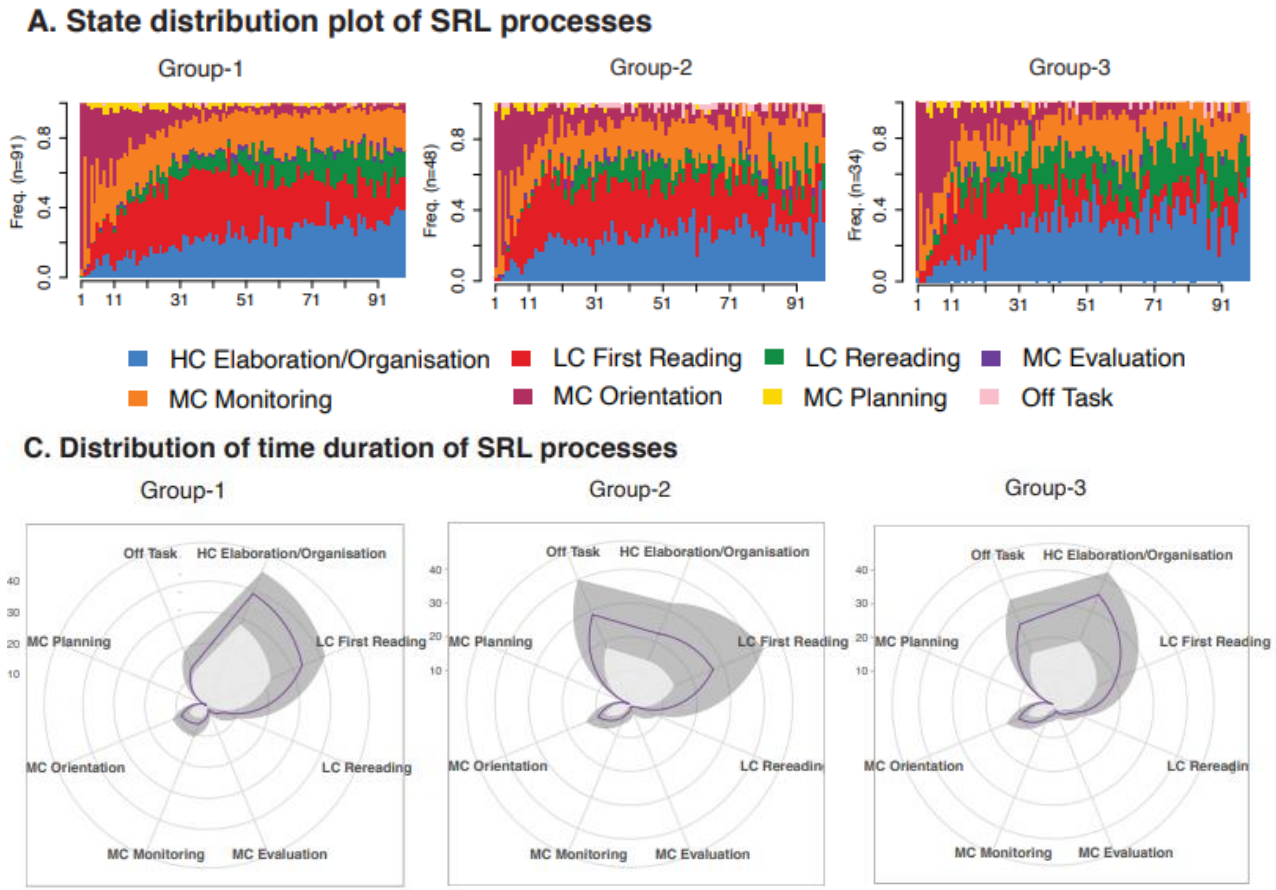
Task: AI application futures

Secondary and higher education

Group 1 - Read First, Write Next
Group 2 - Read and Write Simultaneously
Group 3 - Write Intensively, Read Selectively

Srivastava, N., Fan, Y., Rakovic, M., Singh, S., Jovanovic, J., Van Der Graaf, J., ... & Gasevic, D. (2022). Effects of Internal and External Conditions on Strategies of Self-regulated Learning: A Learning Analytics Study. In *Proceedings of the 12th International Learning Analytics and Knowledge Conference* (pp. 392-403).

Learning strategies



Task: AI application futures

Secondary and higher education

Group 1 - Read First, Write Next*
Group 2 - Read and Write Simultaneously
Group 3 - Write Intensively, Read Selectively

***moderate to large effect sizes on essays**

Srivastava, N., Fan, Y., Rakovic, M., Singh, S., Jovanovic, J., Van Der Graaf, J., ... & Gasevic, D. (2022). Effects of Internal and External Conditions on Strategies of Self-regulated Learning: A Learning Analytics Study. In *Proceedings of the 12th International Learning Analytics and Knowledge Conference* (pp. 392-403).

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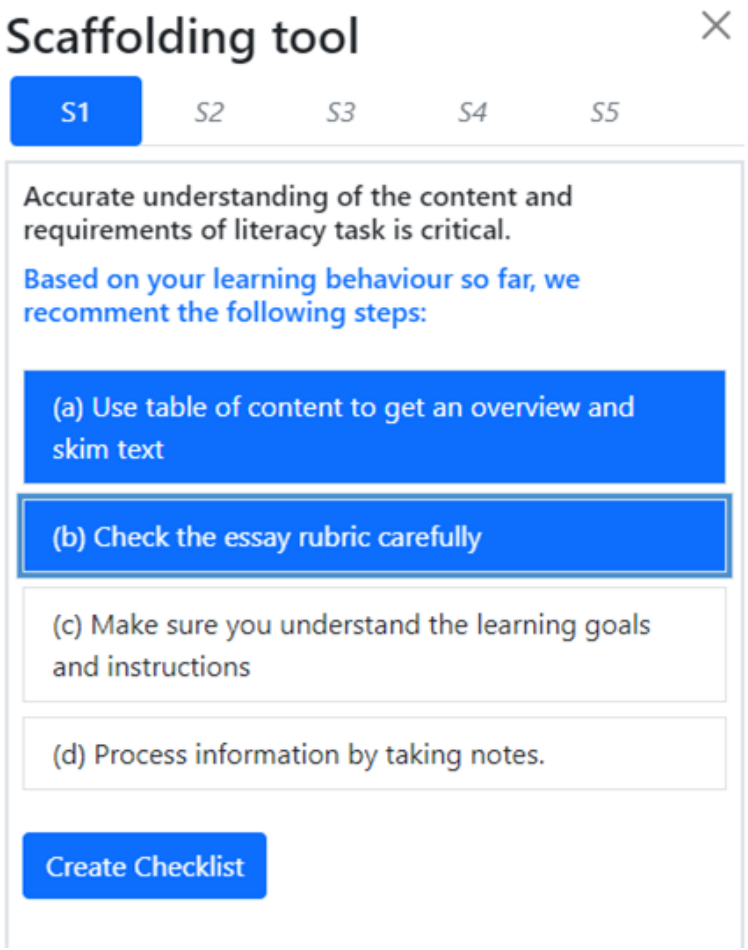


Moderate association between scaffolding and learning strategy

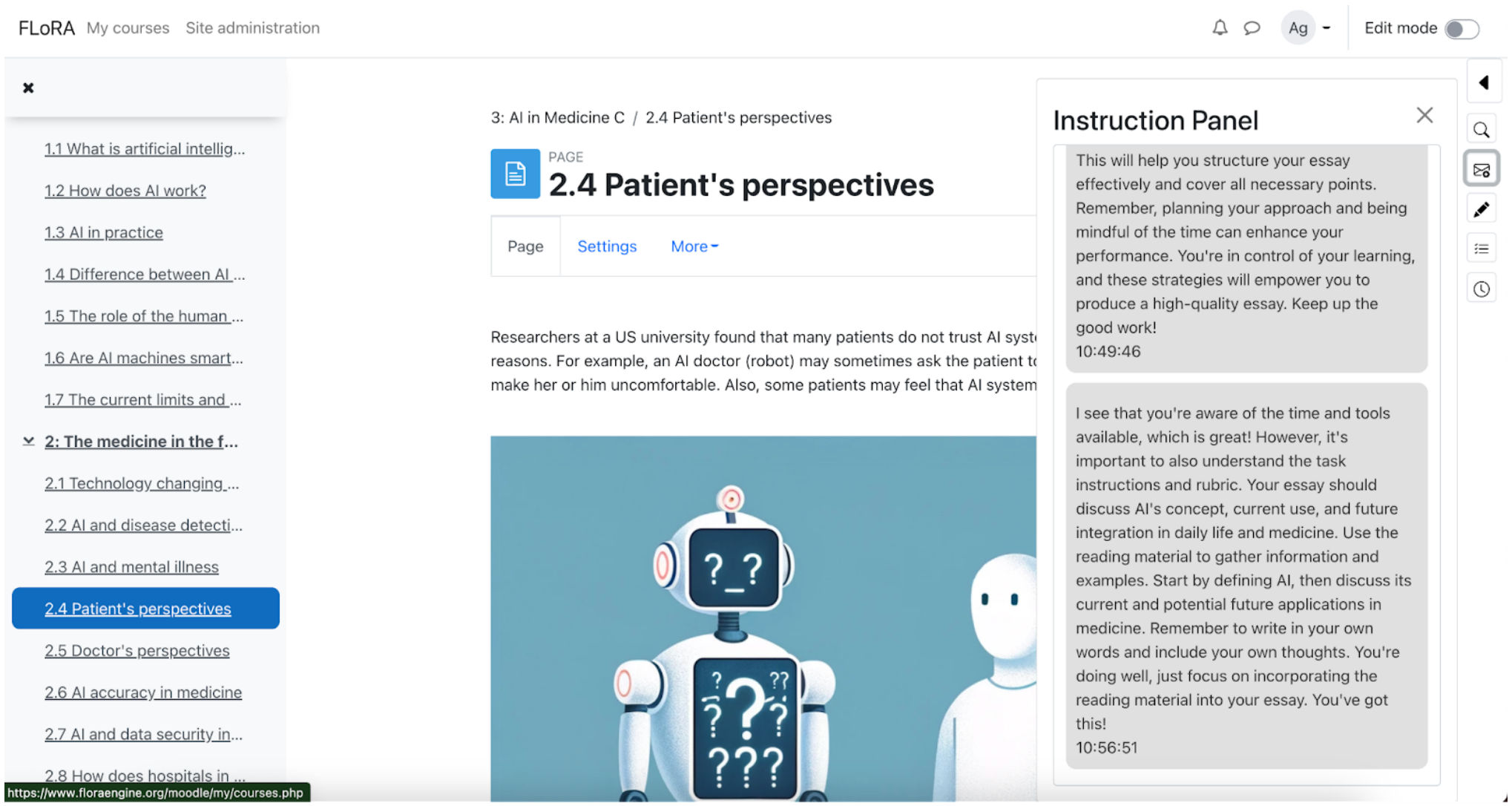
Learning strategies

GPT scaffolds go to schools

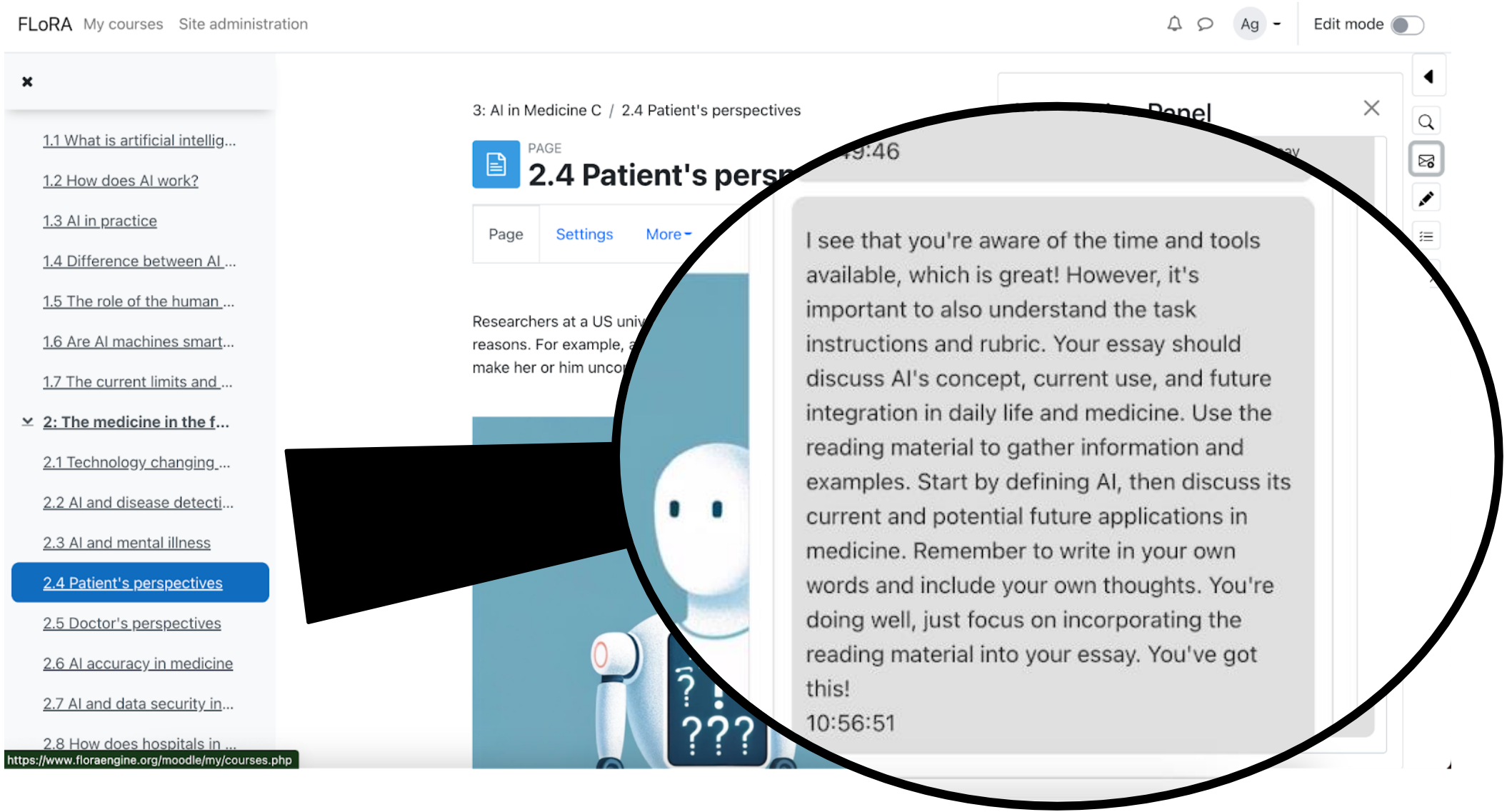
Biology, writing, and IT classes

Australia, Brazil, China, Colombia, Finland, India, and UAE

Learning strategies

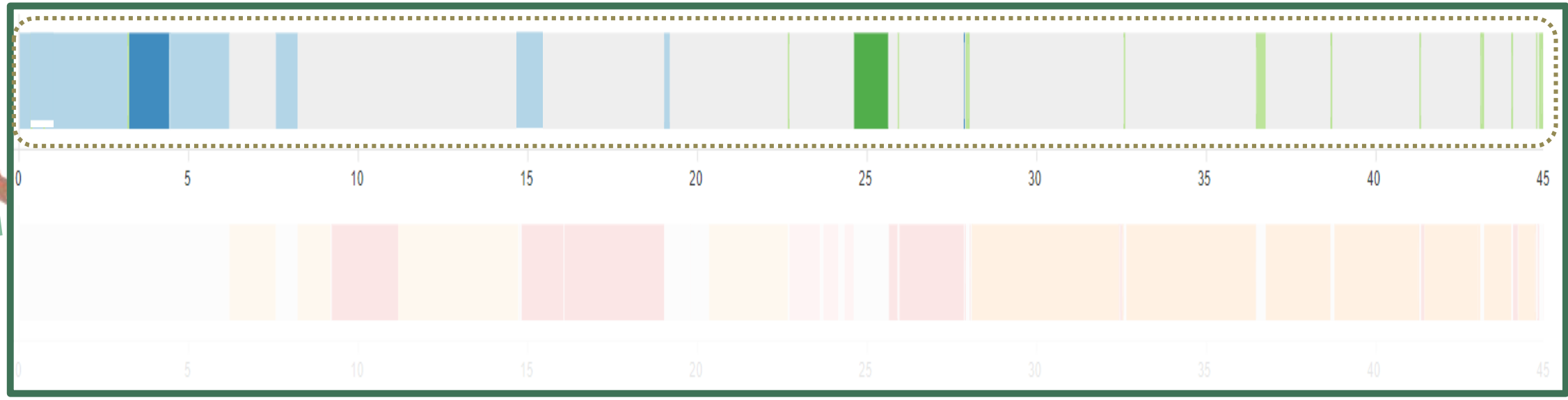


Learning strategies



Eden

"Starting with reading the instructions and careful planning is the key to success"



Metacognition		Cognition	
17%	*Orientation*	1%	*Reading*
0%	*Planning*	19%	*Rereading*
2%	*Monitoring*	55%	*Writing*
1%	*Evaluation*	0%	*Note-taking*

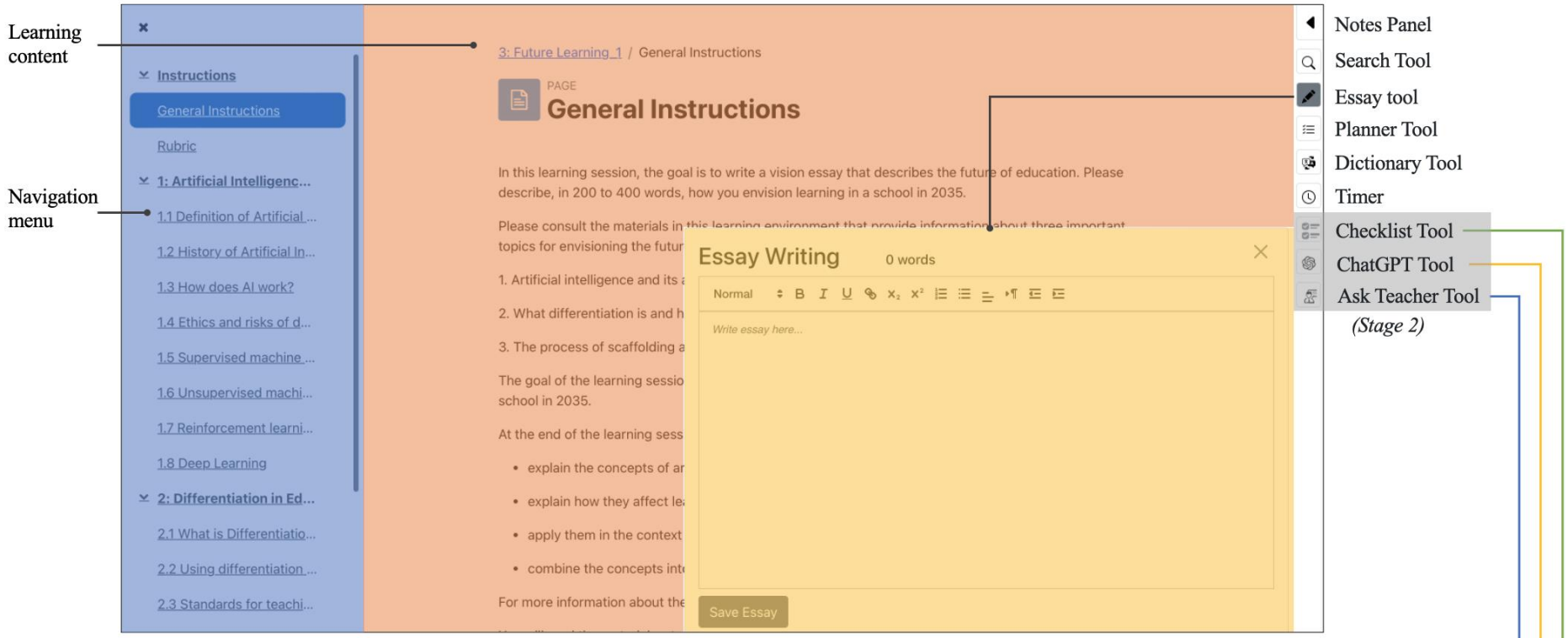
SRL Cycle

- Eden learns in one cycle, which starts by **checking the essay instructions to see what the task is about** and **planning.**
- Eden continues with the **evaluation** of their learning progress by **rechecking the instructions and the rubric,** Eden regularly **takes notes** and **checks the remaining time.**

2

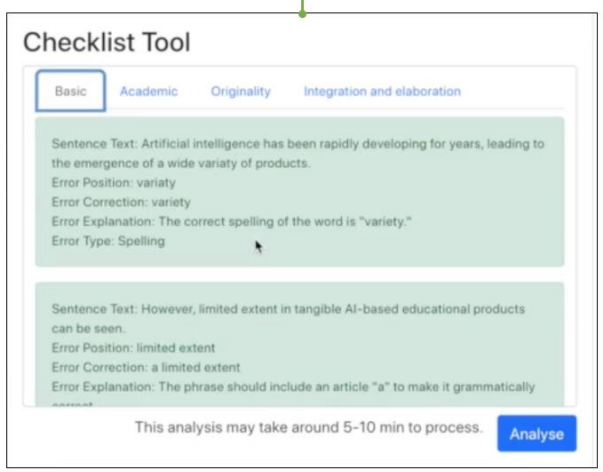
Judgment of learning

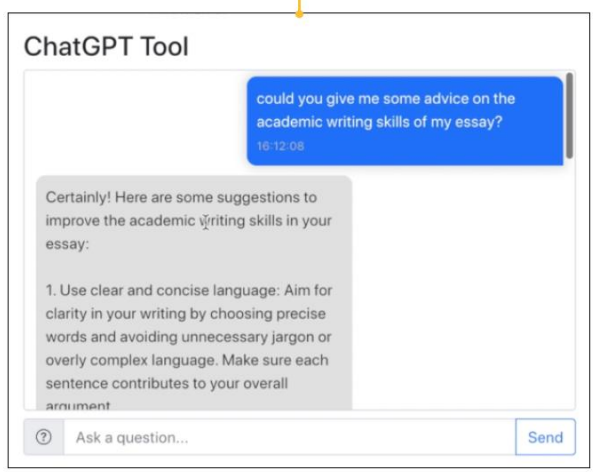
Can AI help improve learners' judgement of learning?

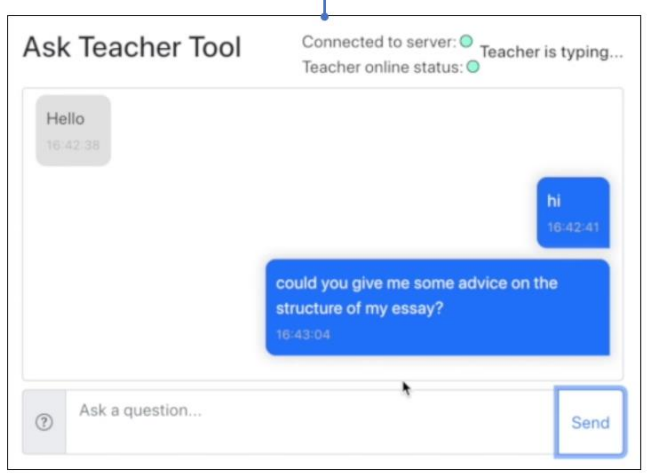


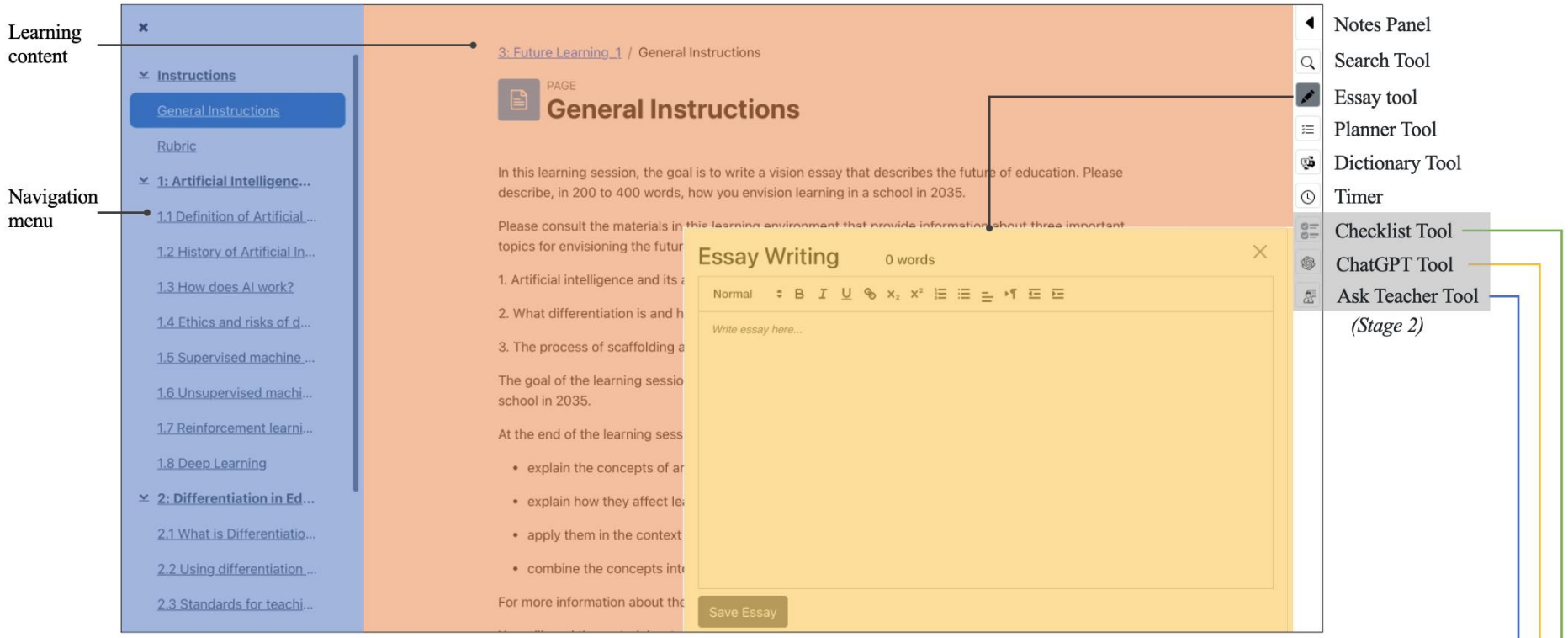
(Stage 1)

(Stage 2)









(Stage 1)

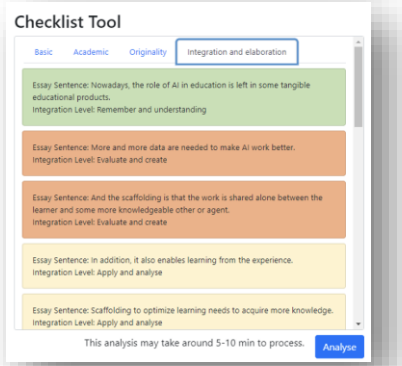
CN

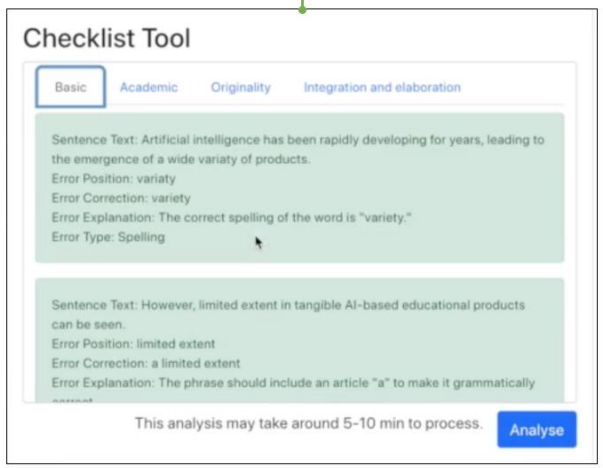
Revise essay by themselves

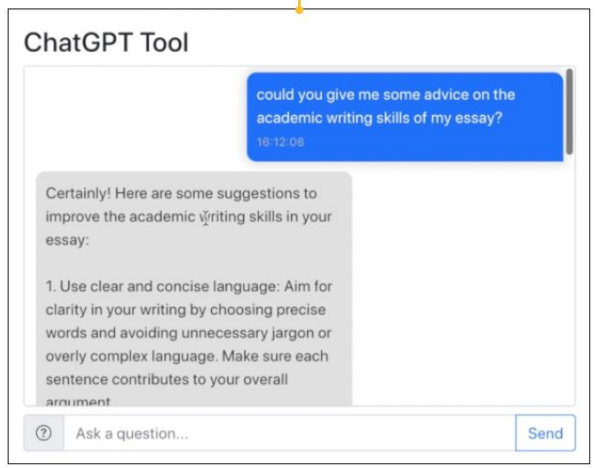
AI

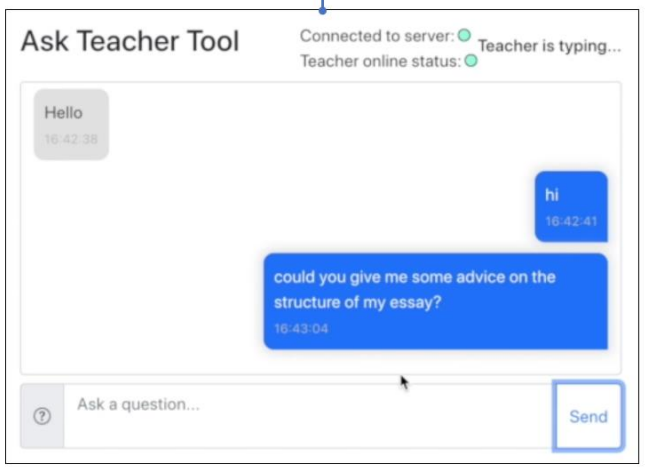
HE

CL









Challenge

Increased judgement of learning with AI-powered tools for writing

Tang, L., Shen, K., Le, H., Shen, Y., Tan, S., Zhao, S., Juelich, T., Li, X., Gašević, D., Fan, Y. (2024). Facilitating learners' self-assessment during formative writing tasks using writing analytics toolkit. *Journal of Computer Assisted Learning*, submitted.

Challenge

AI-powered tools have inadvertent side effects on learning

External locus of control is increased
(i.e., learners blame AI-powered assessment for any issues)

Tang, L., Shen, K., Le, H., Shen, Y., Tan, S., Zhao, S., Juelich, T., Li, X., Gašević, D., Fan, Y. (2024). Facilitating learners' self-assessment during formative writing tasks using writing analytics toolkit. *Journal of Computer Assisted Learning*, submitted.

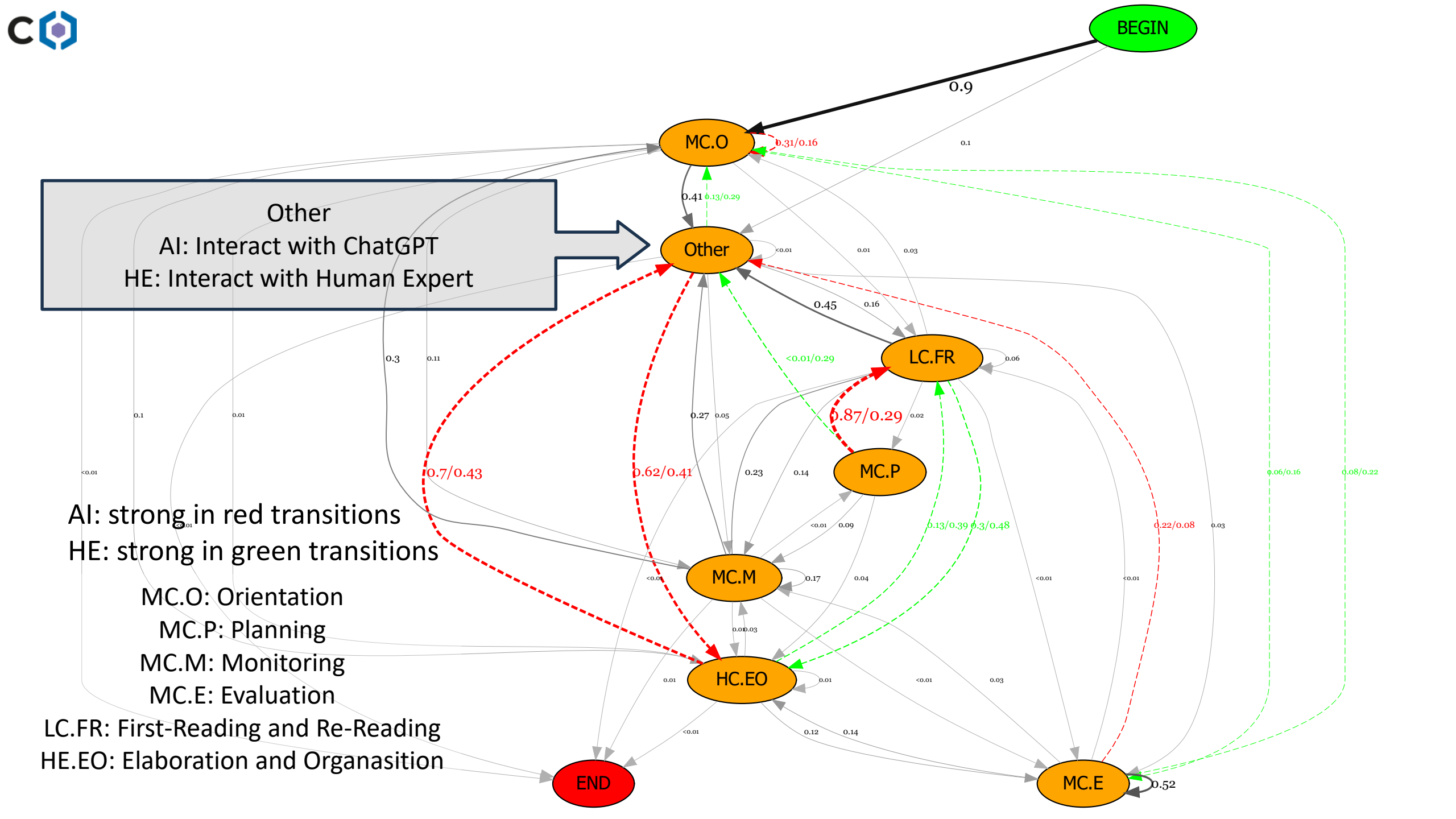
Writing performance

Unsurprisingly writing performance is improved when using ChatGPT

ChatGPT significantly higher essay scores than the other three

Metacognitive engagement

But, deeper engagement with content when chatting with human teacher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HE: Interact with Human Expert
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AI: strong in red transitions
HE: strong in green transitions
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MC.M: Monitoring
MC.E: Evaluation
LC.FR: First-Reading and Re-Reading
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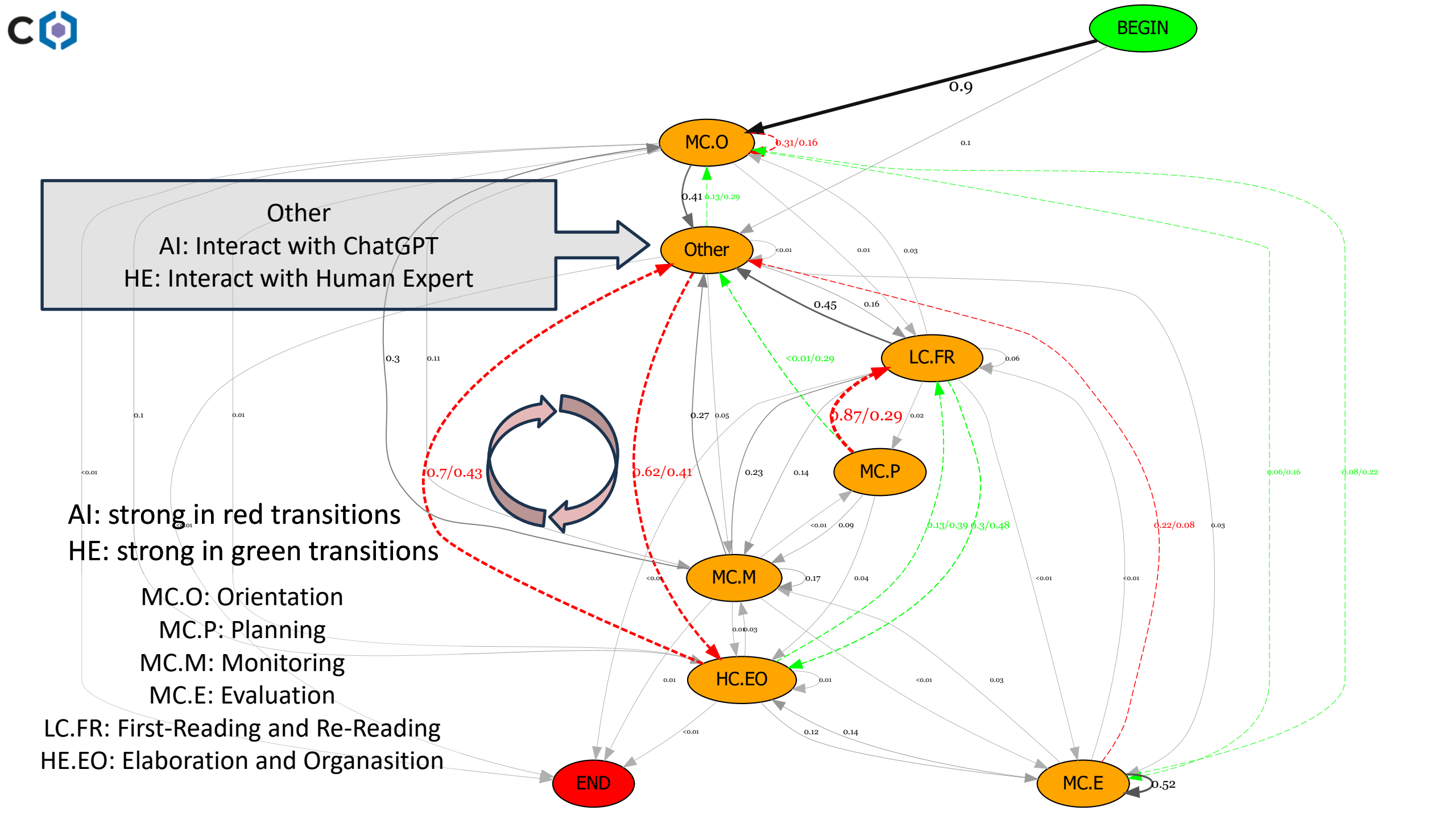
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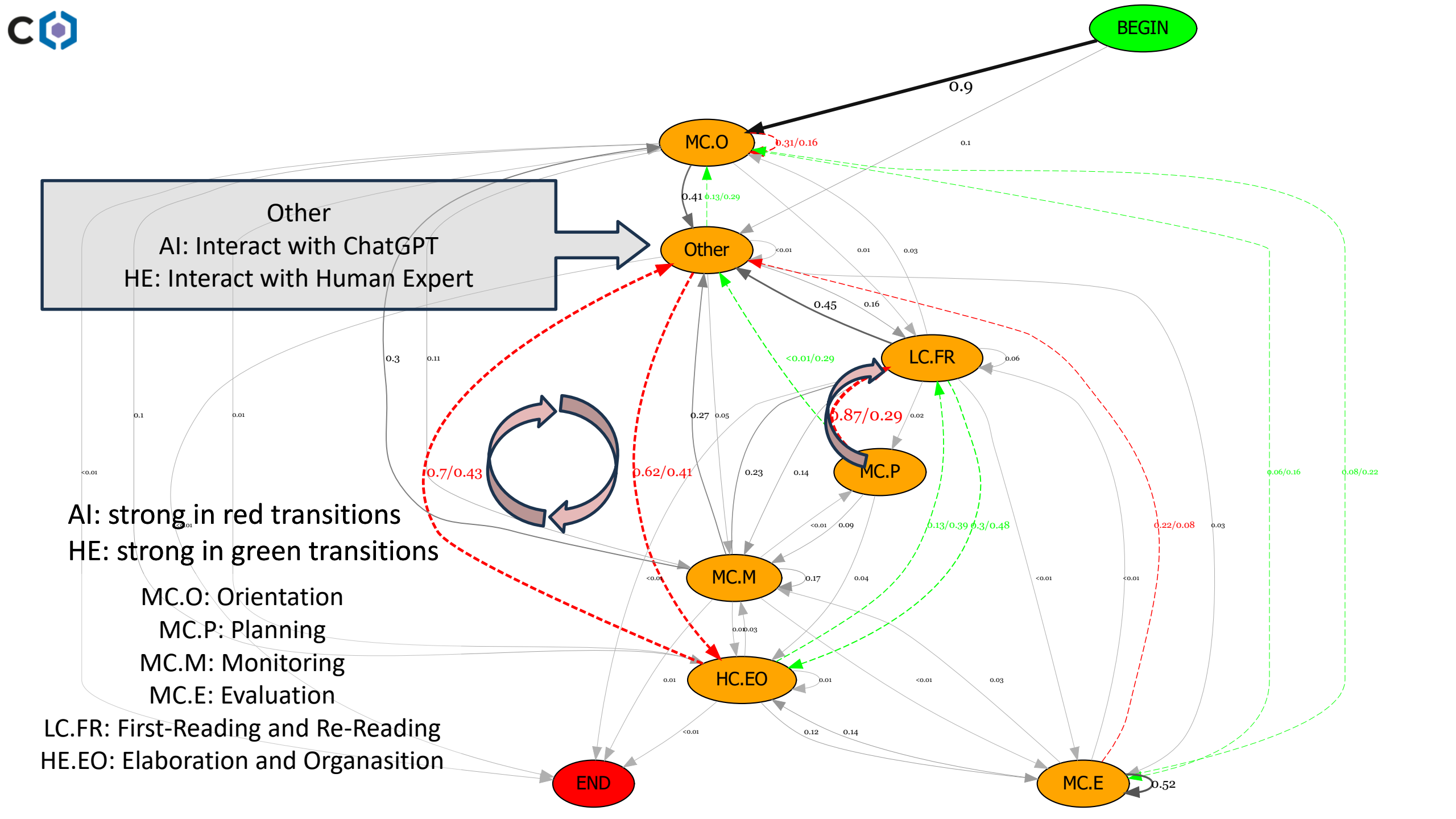
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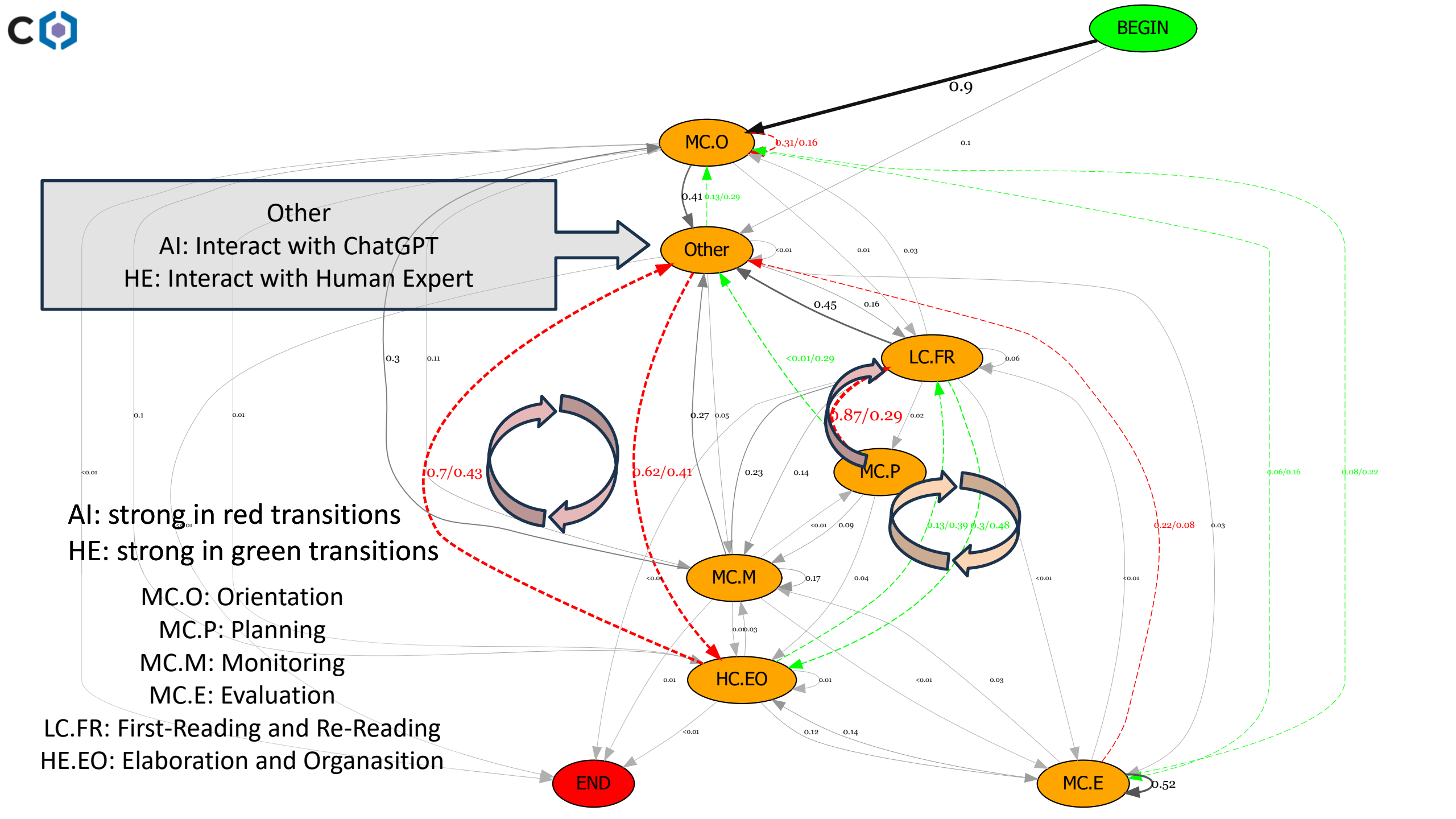
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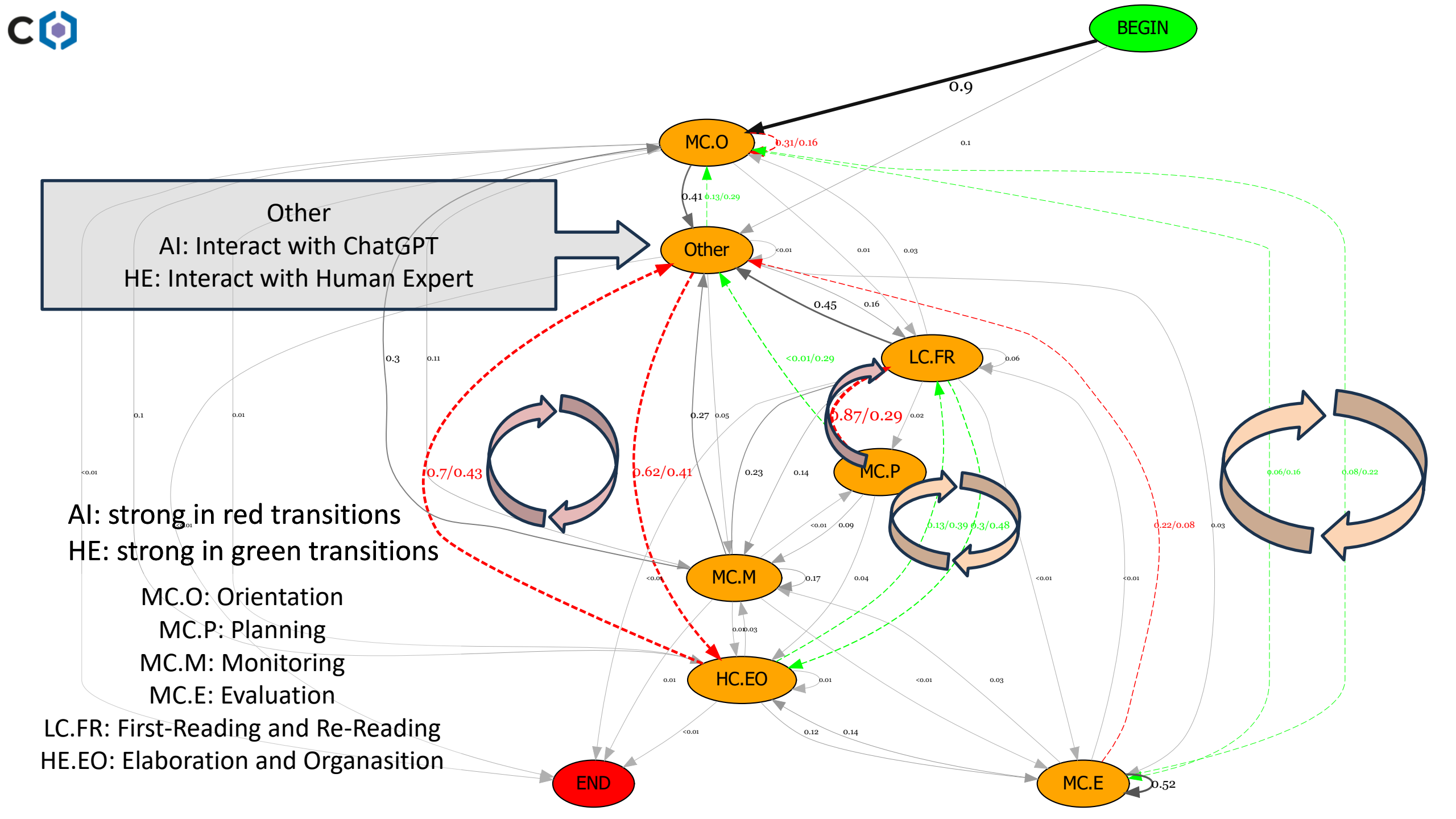
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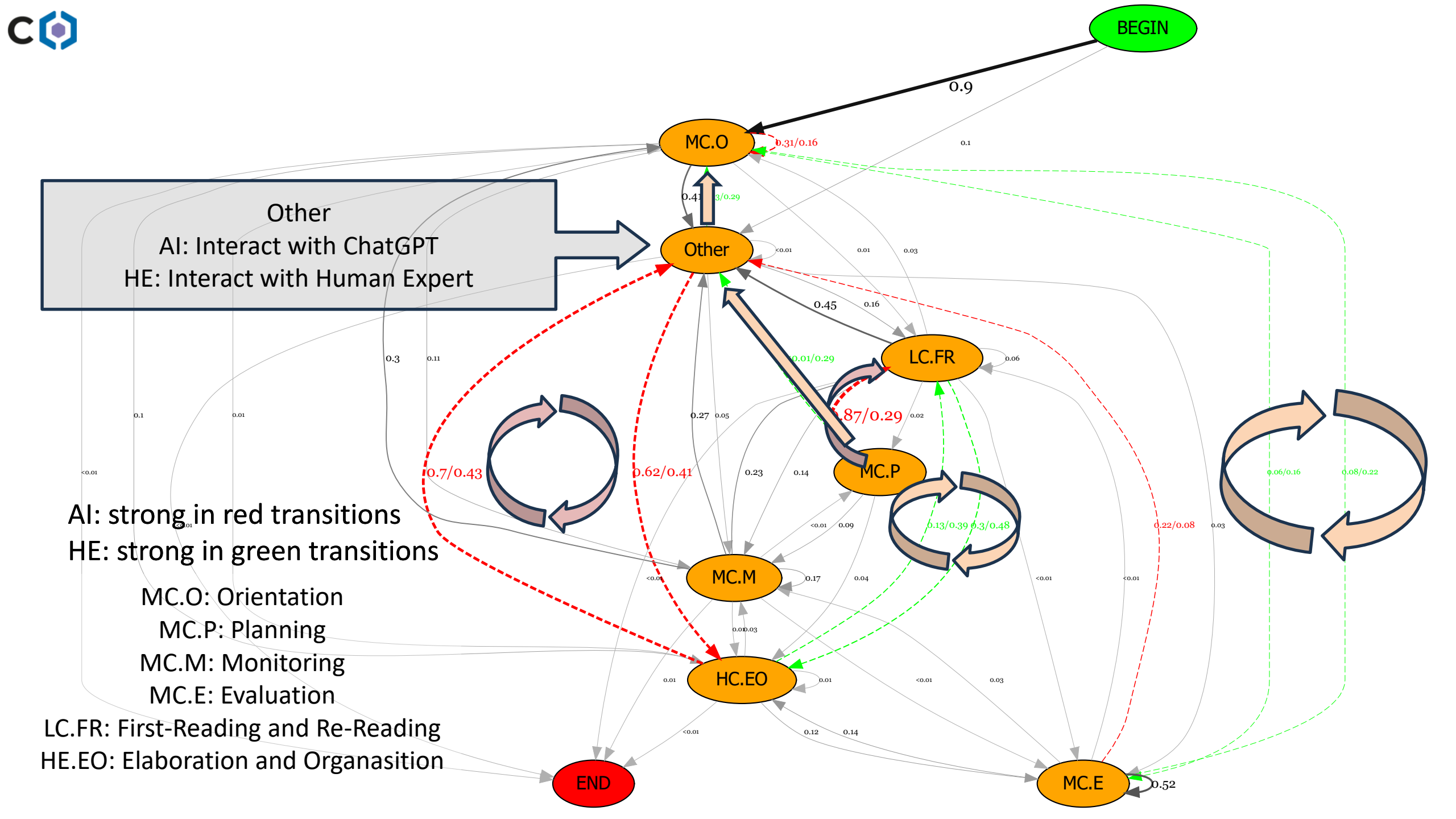
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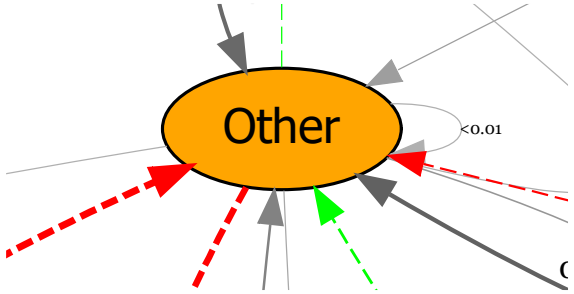
Metacognitive engagement

Are there any differences in frequency of judgement of learning?

Help seeking behaviors

Opening this black box



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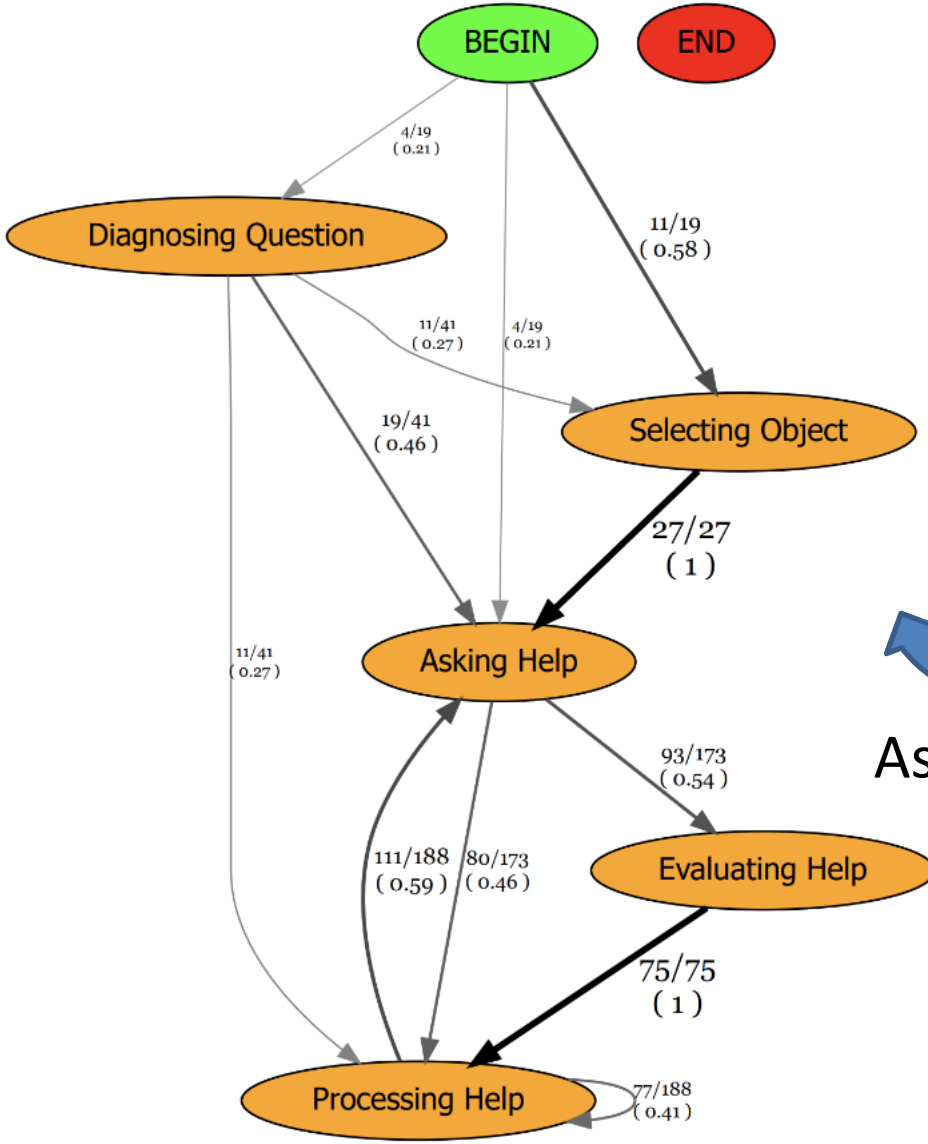

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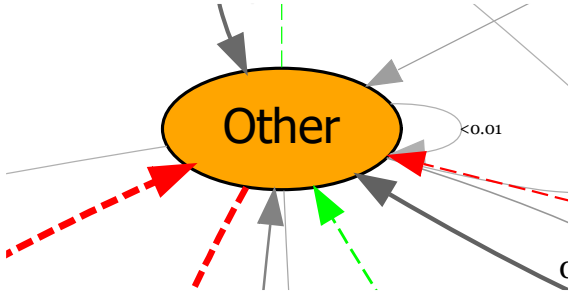
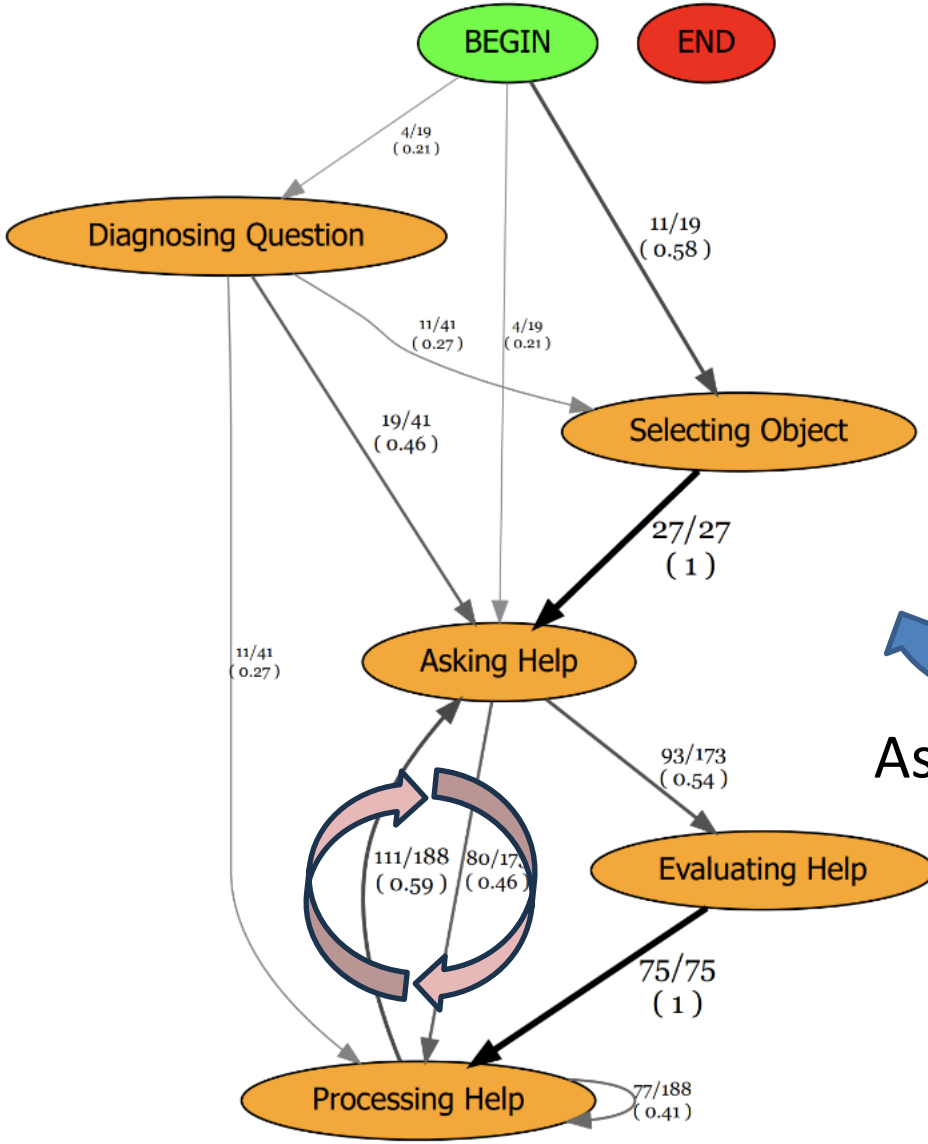


Ask ChatGPT

Help seeking behaviors



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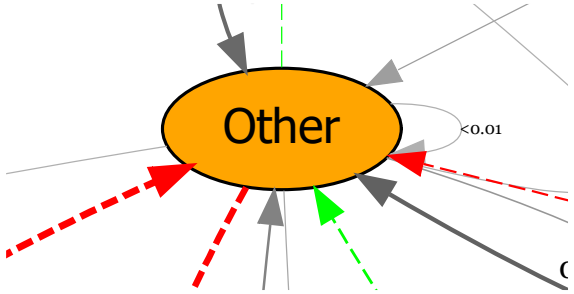
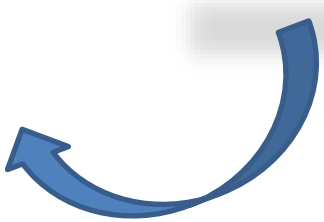
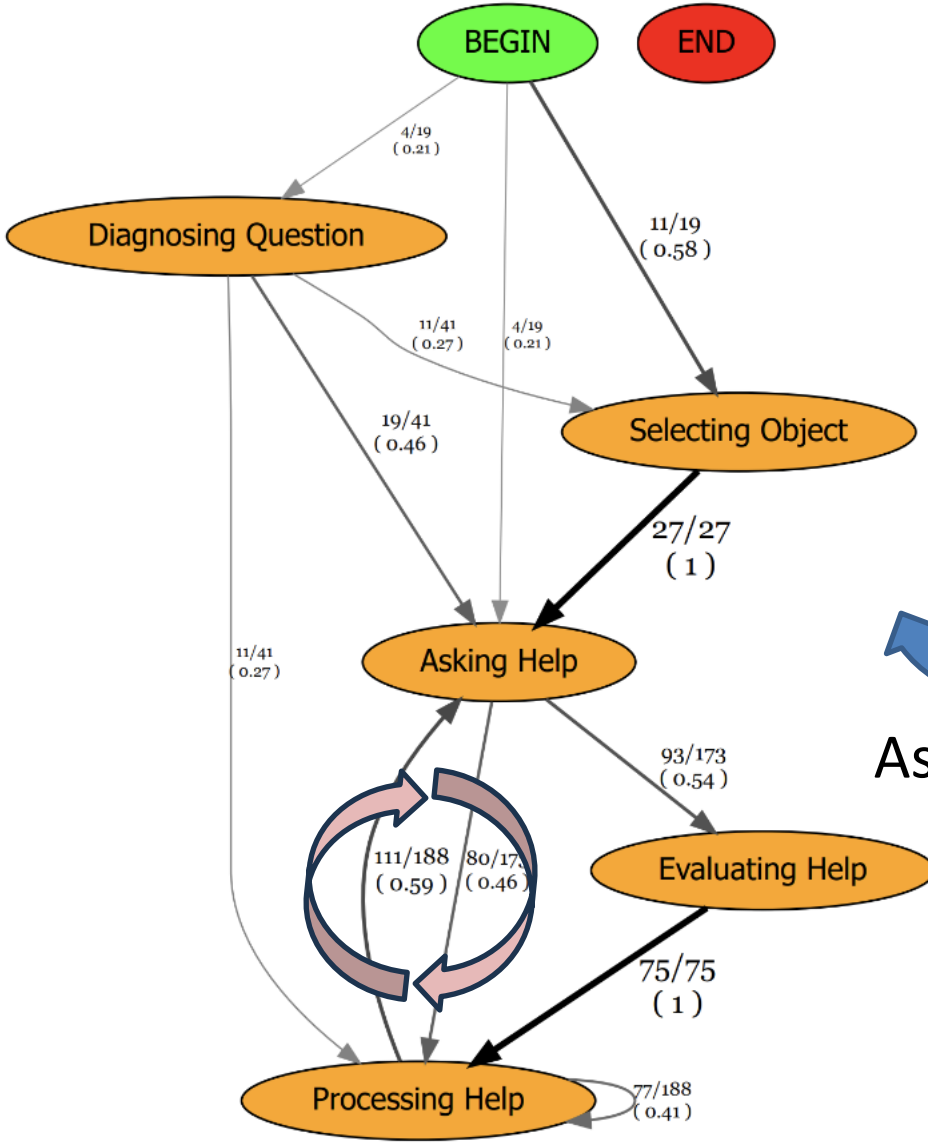




Ask ChatGPT

Help seeking behaviors



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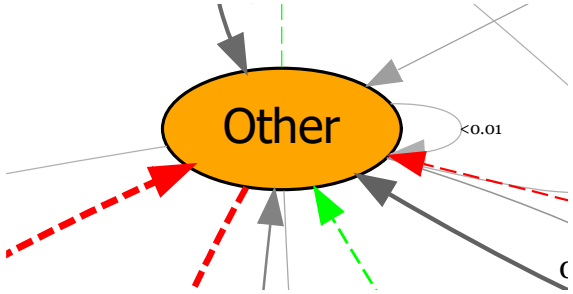
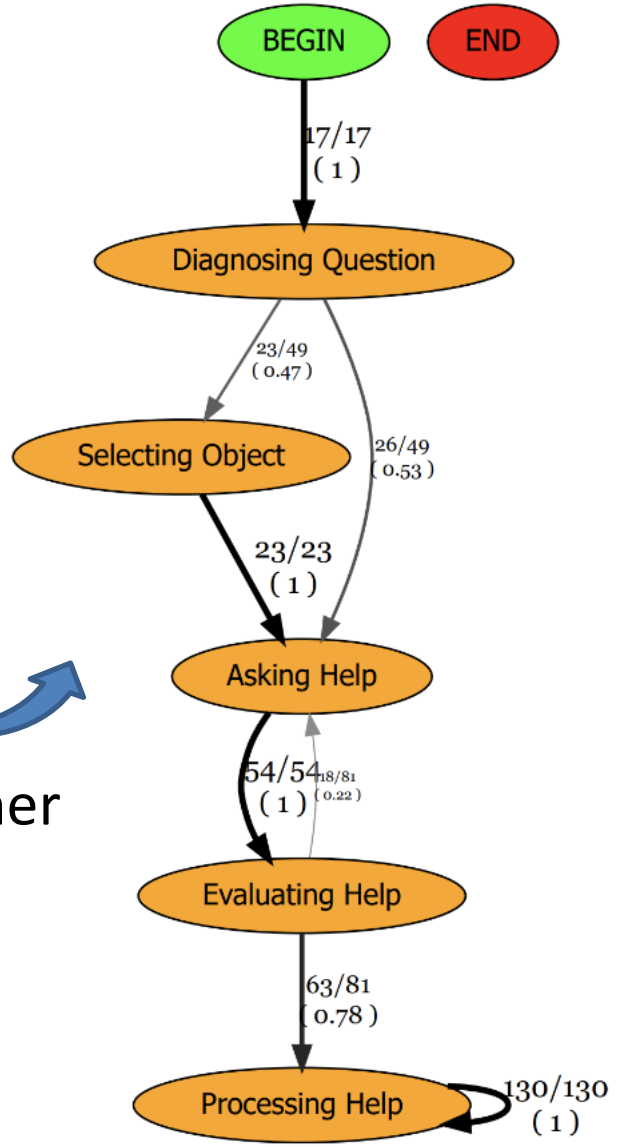


Ask ChatGPT

Ask Teacher



Metacognitive engagement

What are long term implications of limited judgement of learning?

Unreliable information produced by GenAI

Challenge

AI-powered tools may have inadvertent side effects on learning

Benefits deteriorate when AI-powered tools are removed

Darvishi, A., Khosravi, H., Sadiq, S., Gašević, D., Siemens, G. (2024). Impact of AI Assistance on Student Agency. *Computers & Education, 210*,104967.

FINAL REMARKS

AI can have profound implications on learning to learn skills

Learning strategies and judgement of learning

AI is unlikely to go away and we need to lead the change

Teachers play the central role in designing tasks for using AI tools

Scaffolding AI scaffolds

Longitudinal effects of AI on learning to learn skills require future research

MONASH University | COLAM Centre for Learning Analytics Monash | GRAILE

Empowering Learners in the AI Age

Building Skills for Self-Regulated Learning

Dragan Gašević
@dgasevic

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CITE, Faculty of Education
University of Hong Kong