

# Getting ready for the age of AI: Developing self-regulated learners

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# 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**



# Developing *adaptive learners* for the age of AI

## Promises and challenges of generative artificial intelligence for human learning

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 Check for updates
Lixiang Yan<sup>1</sup>, Samuel Greiff<sup>2,3,4</sup>✉, Ziwen Teuber<sup>2</sup> & Dragan Gašević<sup>1</sup>✉

Generative artificial intelligence (GenAI) holds the potential to transform the delivery, cultivation and evaluation of human learning. Here the authors examine the integration of GenAI as a tool for human learning, addressing its promises and challenges from a holistic viewpoint that integrates insights from learning sciences, educational technology and human–computer interaction. GenAI promises to enhance learning experiences by scaling personalized support, diversifying learning materials, enabling timely feedback and innovating assessment methods. However, it also presents critical issues such as model imperfections, ethical dilemmas and the disruption of traditional assessments. Thus, cultivating AI literacy and adaptive skills is imperative for facilitating informed engagement with GenAI technologies. Rigorous research across learning contexts is essential to evaluate GenAI's effect on human cognition, metacognition and creativity. Humanity must learn with and about GenAI, ensuring that it becomes a powerful ally in the pursuit of knowledge and innovation, rather than a crutch that undermines our intellectual abilities.

Human learning is a journey that shapes minds, fosters innovation and builds the foundations of society. Beyond merely acquiring knowledge and skills, learning is a path towards fostering critical thinking, creativity, collaboration and social cohesion. By nurturing the ability to question, analyse and innovate, learning empowers individuals to navigate complex challenges and contribute to societal progress. Although education encompasses formalized systems that structure learning processes, learning represents the dynamic and personal process that occurs within this framework (see Box 1 for key definitions of human learning concepts).

The history of human learning presents a narrative of continuous evolution and a adaptation to technological breakthroughs. For example, the printing press democratized access to knowledge and opened the opportunity of learning to many, whereas the Internet and digital technologies transformed information dissemination and collaborative learning across time and space. In this continuum of innovation, recent advancements in artificial intelligence (AI) present

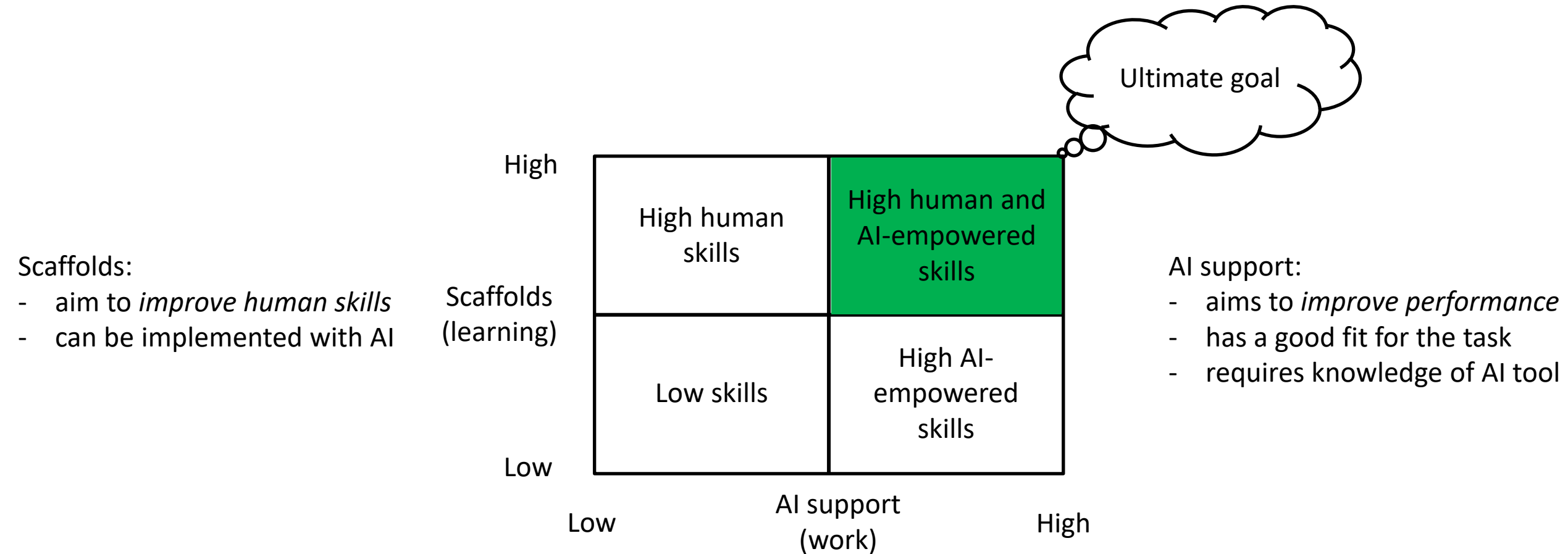
another transformative opportunity to rethink learning processes and educational methodologies<sup>1</sup>.

Generative AI (GenAI) technologies, such as large language models (LLMs) and diffusion models (see Box 2 for key definitions of AI terms), have shown promise in automating various learning tasks<sup>2</sup>, delivering feedback on human efficacy<sup>3</sup>, outperforming average students in reflective writing<sup>4</sup>, innovating conversational assessments<sup>5</sup>, creating dynamic learning resources<sup>6</sup> and supporting multimedia learning<sup>7</sup>. However, these technologies also present challenges and ethical considerations that could outweigh their benefits<sup>2,8</sup>. One major concern is the digital divide, where unequal access to these powerful technologies can exacerbate existing inequalities in learning opportunities<sup>9</sup>. Additionally, over-reliance on GenAI may negatively affect learners' agency, critical thinking and creativity, warranting caution<sup>10</sup>.

Consequently, it is essential to balance technological advancement and human-centred values in learning. The aim of this Perspective

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# Towards high human and AI-empowered skills



Inspired by, but different conceptualization from

Cukurova, M. (2024). The interplay of learning, analytics, and artificial intelligence in education. *British Journal of Educational Technology*, in press.

Shneiderman, B. (2022). *Human-centered artificial intelligence*. Oxford University Press

# Challenge

Learners already have  
profound limitations in SRL abilities

## Today's talk

How do we develop  
self-regulated learners for the age of AI?

## Key takeaway #1

# No free lunch for adaptive learners!

Difficult to develop combined human and AI-empowered skills  
without human skills first



## Key takeaway #2

***Lazy metacognition*** may emerge with  
unscaffolded use of generative AI

## Key takeaway #3

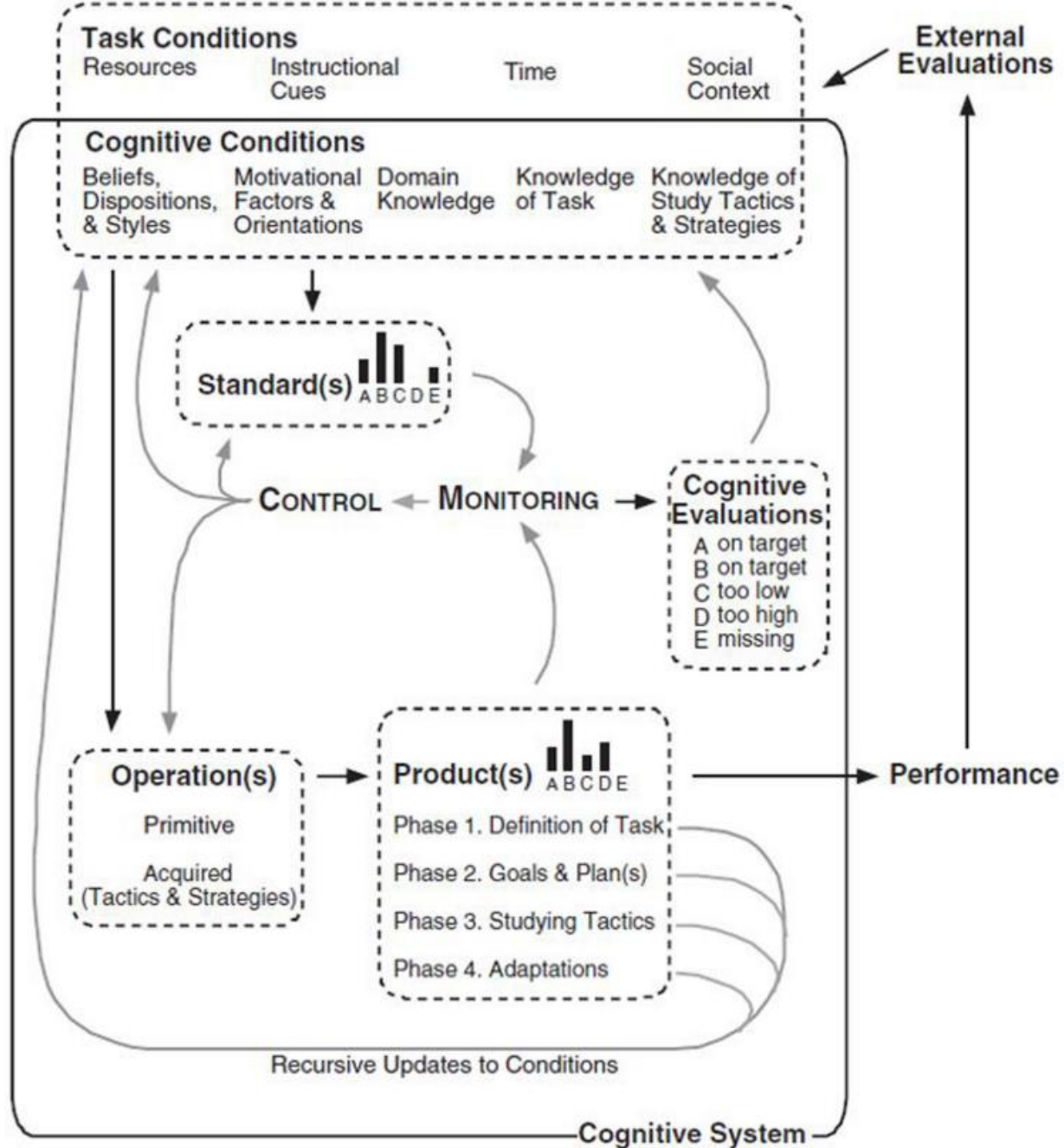
Longitudinal studies are ***urgently*** needed  
in combining scaffolds and AI supports

**FOUNDATIONS** – IMPACT – DIRECTION –  
FINAL REMARKS

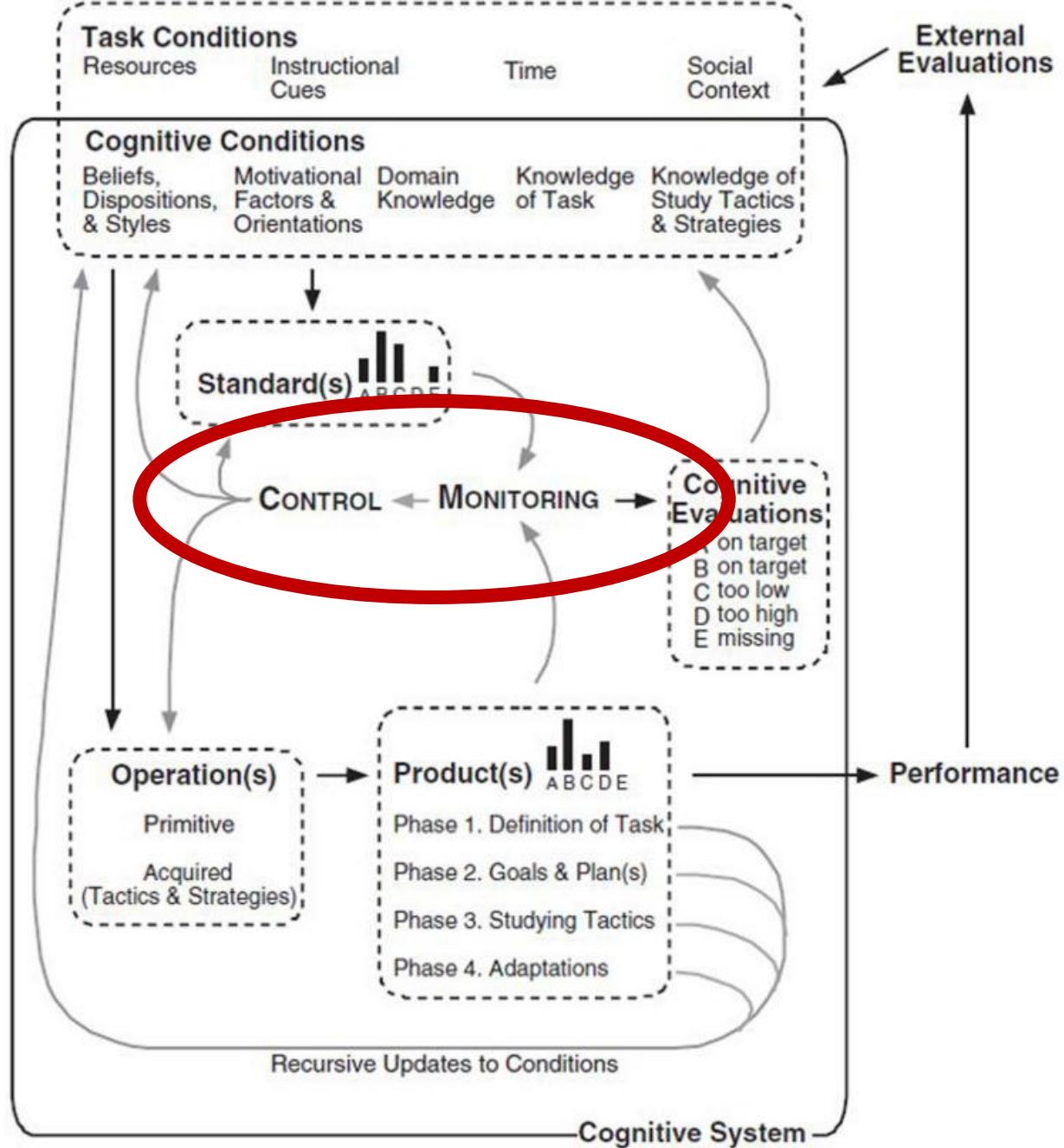


## Towards adaptive learners

How do we currently prepare  
self-regulated learners for the age of AI?



Metacognition sits  
at the heart of  
self-regulated learning



Metacognition sits  
at the heart of  
self-regulated learning



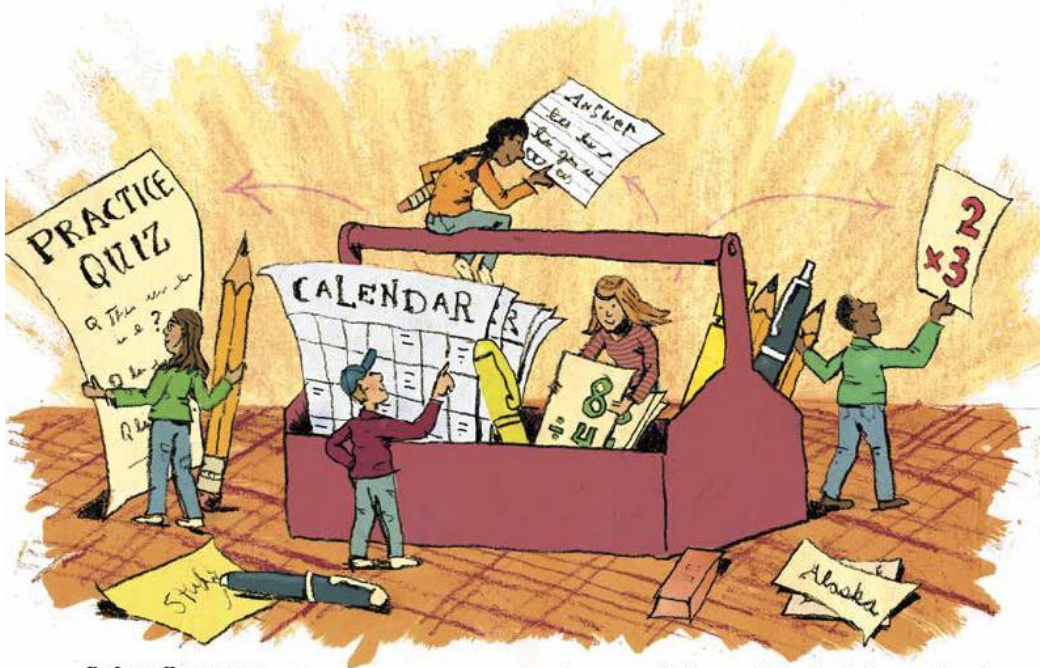


# Self-regulated learning – control

Learners construct knowledge  
through *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 strate-

*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.*

gies are actually the most effective,<sup>1</sup> 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,<sup>2</sup> 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-

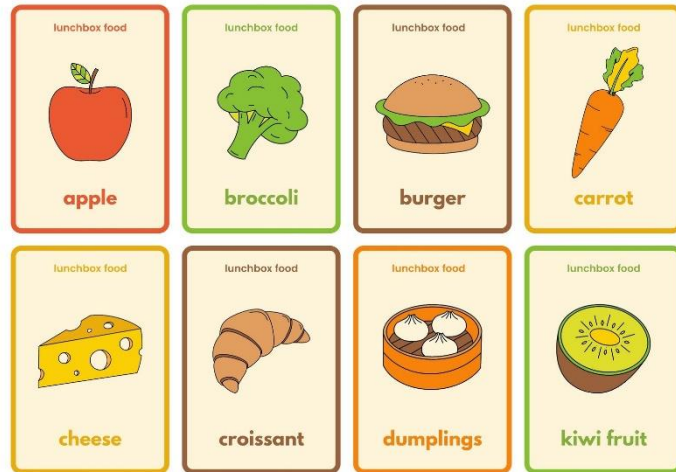
# Learning strategies

**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

# Self-regulated learning – control



<https://bit.ly/canva-flashcards>

Learners have a  
limited repertoire of  
learning strategies



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



## Self-regulated learning – monitoring

Learners are agents who use  
own judgements to make decisions

# Self-regulated learning – monitoring

Learners are *highly inaccurate* about  
their judgements of learning

# Self-regulated learning – monitoring

Processing fluency:  
illusion of truth effect

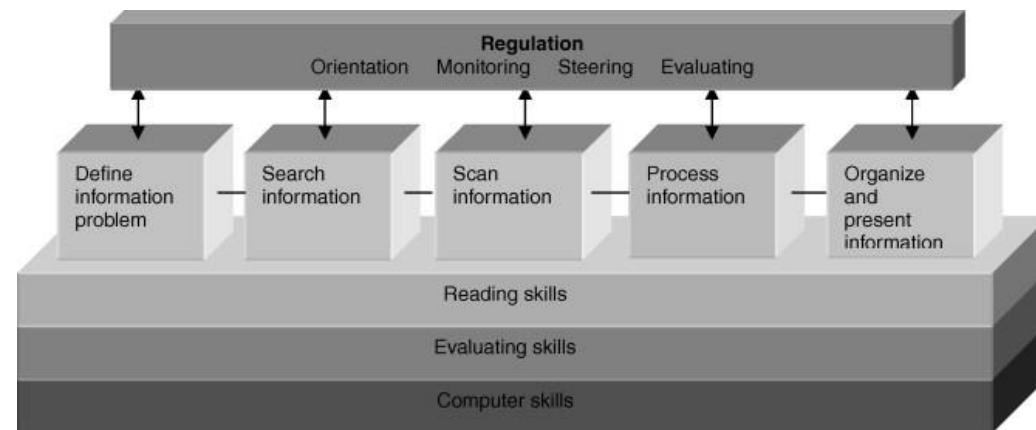


# Self-regulated learning – monitoring

Processing fluency:  
selection of strategy

# Information problem solving

## Metacognition critical for seeking, selecting, and using information



# Information problem solving

Learners use unreliable sources and suboptimal search strategies

# Information problem solving



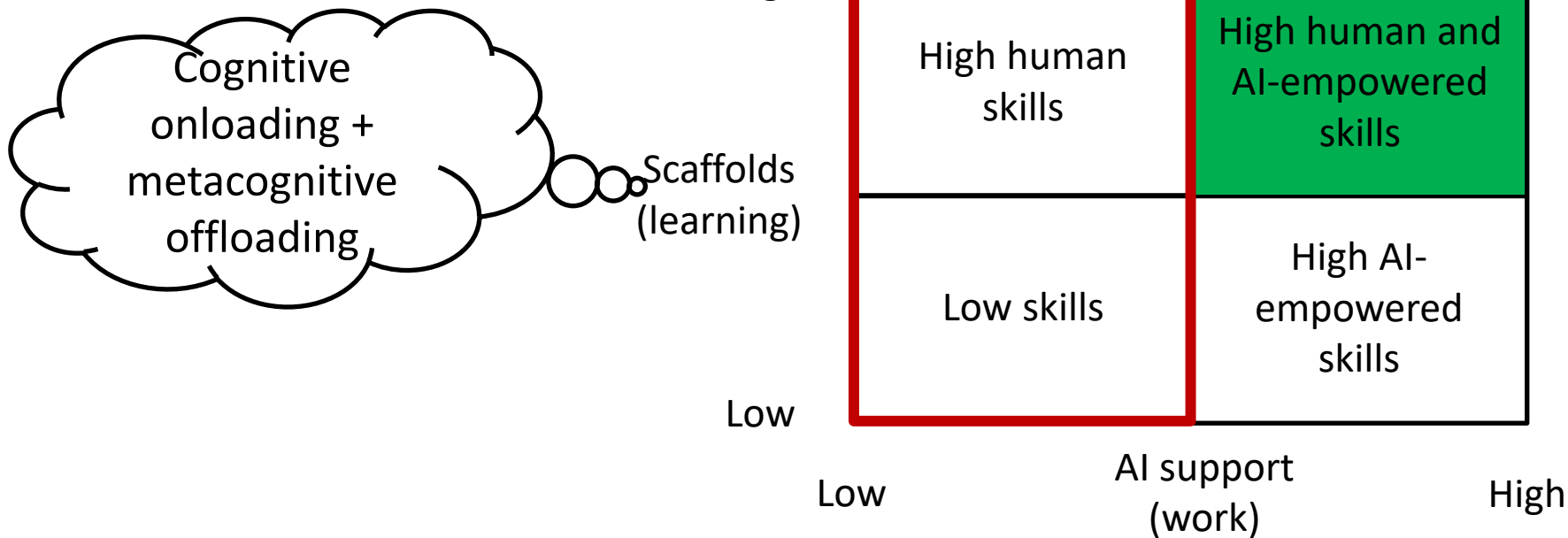
## Sensemaking paradox

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

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

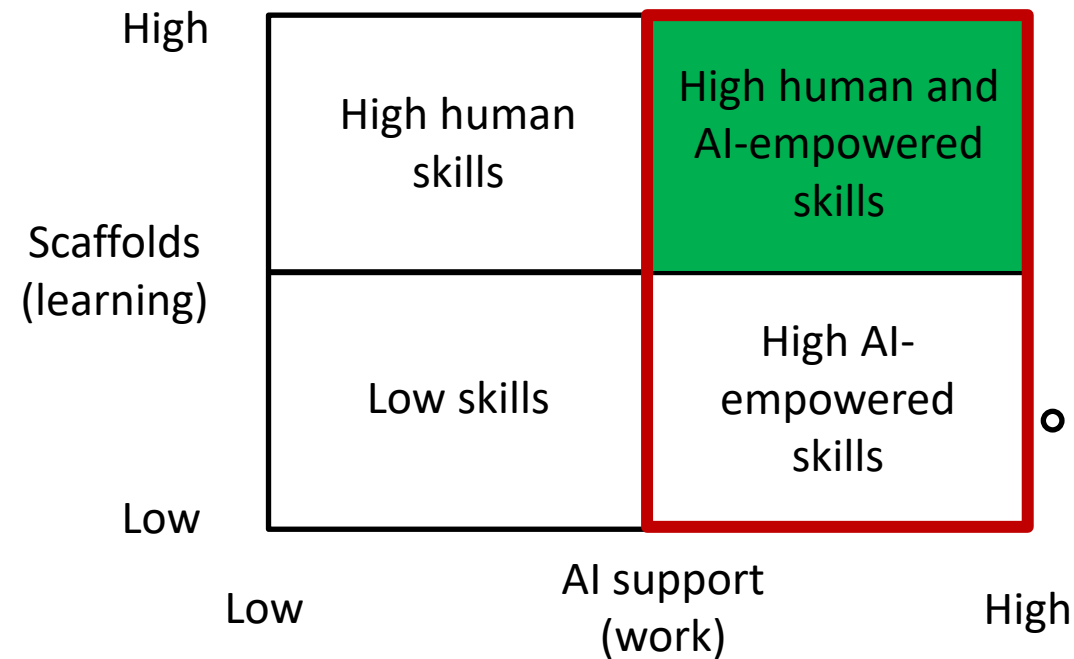
## Risk #1

## Existing adaptive learning systems



## Risk #2

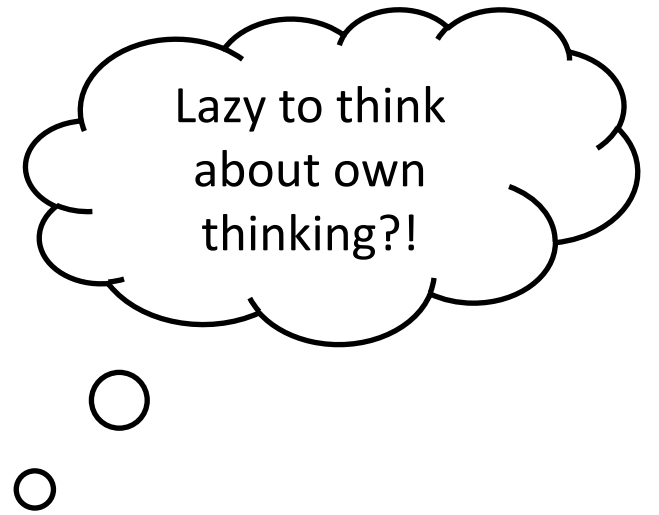
## Cognitive offloading



Cognitive offloading + metacognitive offloading



# Open challenge



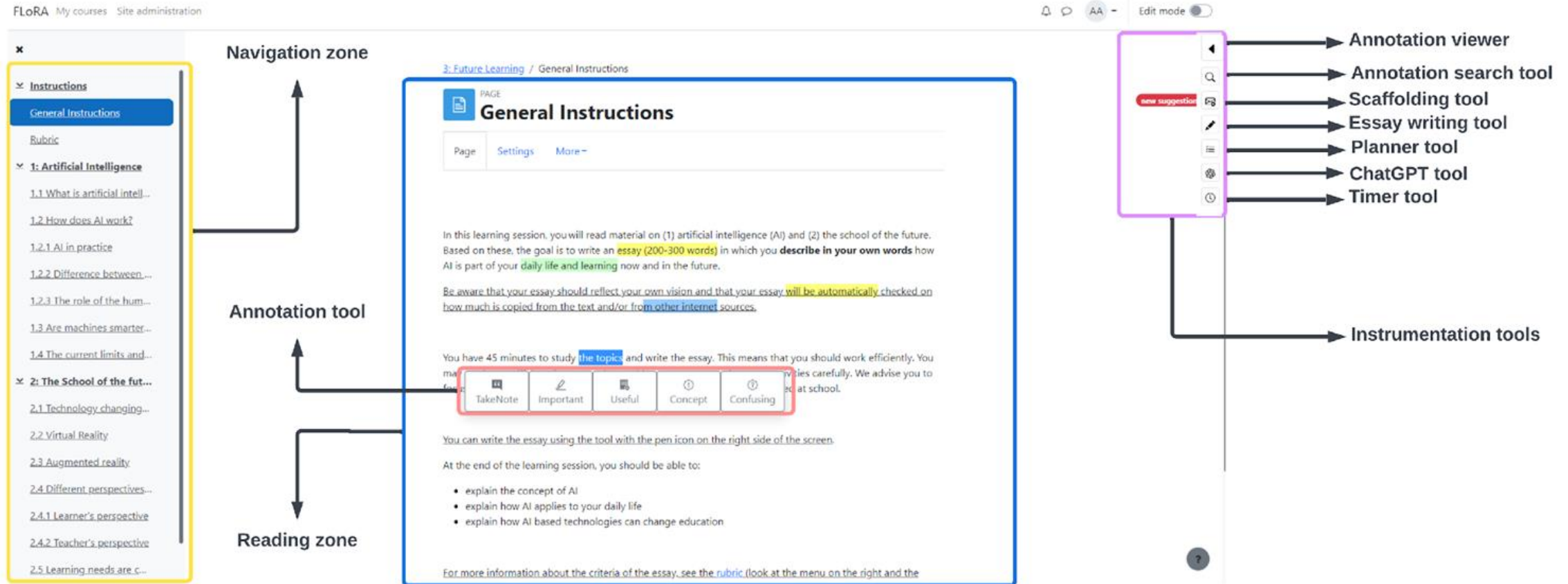
Are we getting metacognitively lazy  
with so much offloading?

FOUNDATIONS – **IMPACT** – DIRECTION –  
FINAL REMARKS

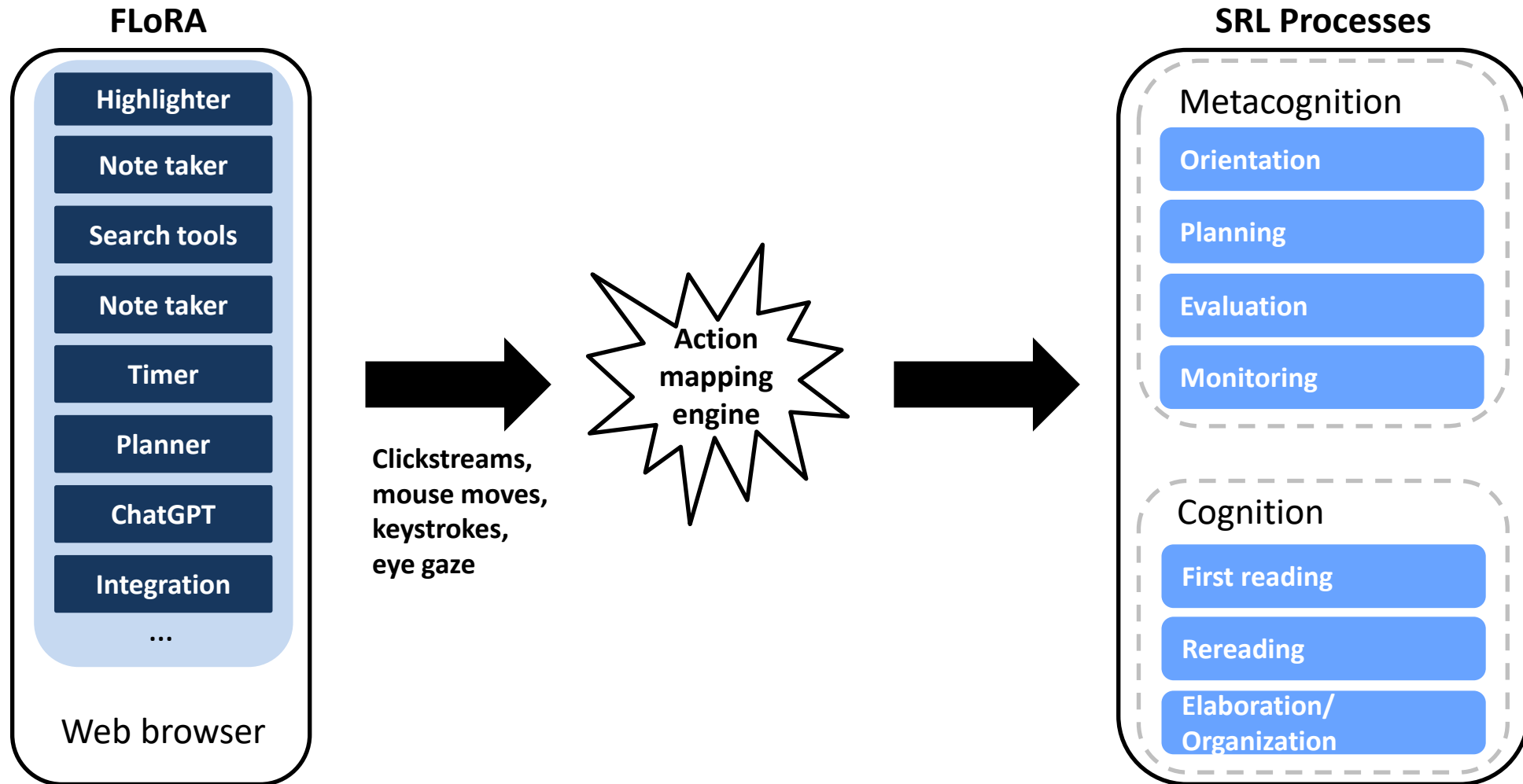
## Direction

Using data to understand and enhance self-regulated learning for the age of AI

# FLoRA



# Mapping trace data to processes



# Framework

## Hybrid human-AI regulation

# 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

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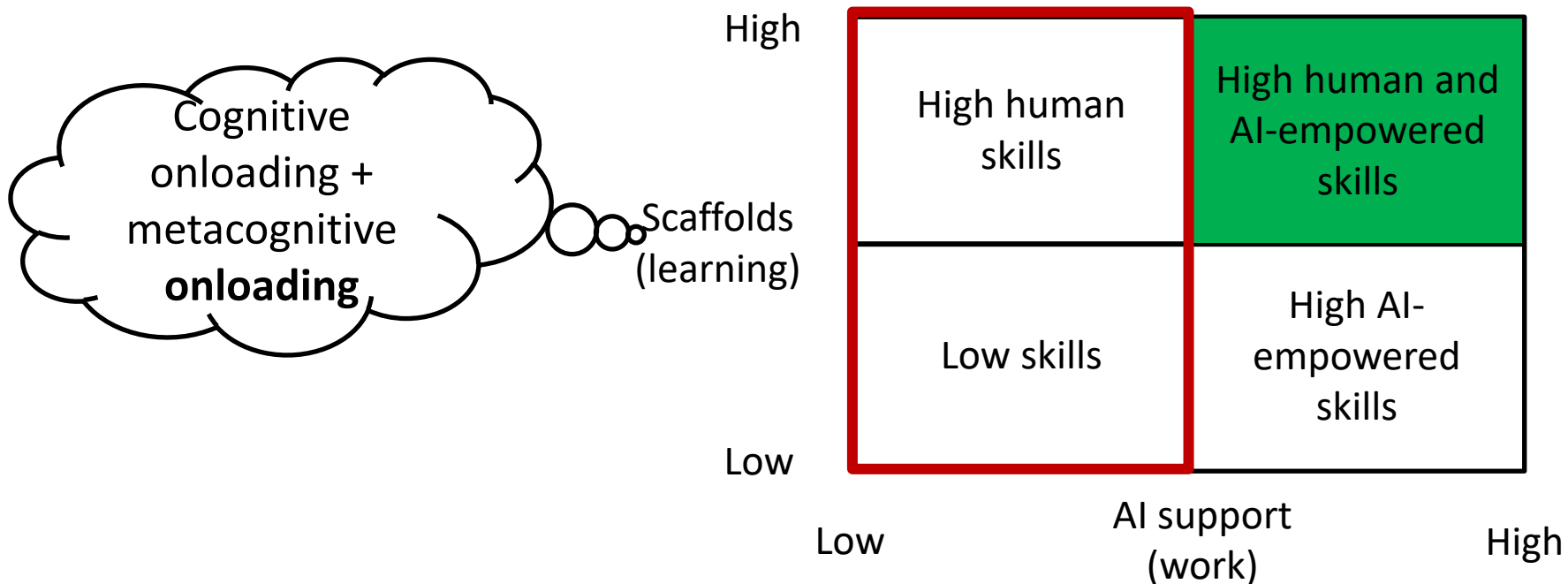


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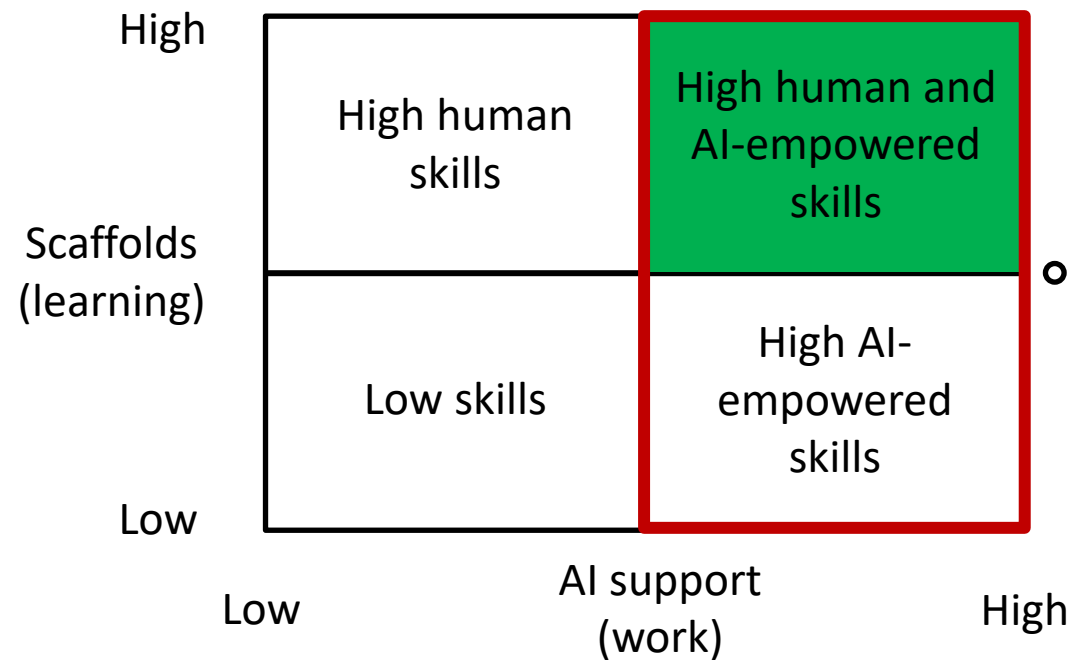
# Framework

## Hybrid human-AI regulation



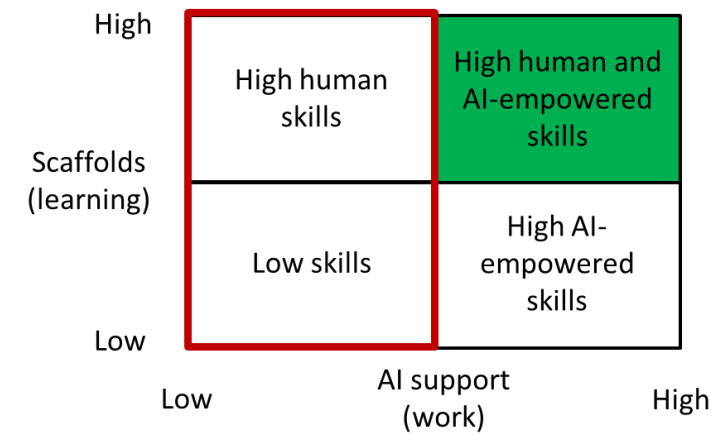
# Framework

## Hybrid human-AI regulation



Can it be used to support this side too?

# Control



How can AI-powered scaffolds influence learning strategies?

# AI-powered scaffolding tool

Instructions

General Instructions

Rubric

1: Artificial Intelligence...

1.1 Definition of Artificial...

1.2 History of Artificial Int...

1.3 How does AI work?

1.4 Ethics and risks of de...

1.5 Supervised machine l...

1.6 Unsupervised machin...

1.7 Reinforcement learning

1.8 Deep Learning

2: Differentiation in Ed...

2.1 What is Differentiation?

2.2 Using differentiation t...

2.3 Standards for teaching

3: Scaffolding in Educa...

3.1 The development of s...

3.2 What is cognitive app...

3: Future Learning / General Instructions

PAGE

## General Instructions

Page Settings More

In this learning session, the goal is to write a vision essay that describes the future of education. Please describe, in 200 to 400 words, how you envision learning in a school in 2035.

Please consult the materials in this learning environment that provide information about three important concepts for envisioning the future of education in 2035.

1. Artificial intelligence and its application
2. What differentiation is and how it is applied in the classroom context
3. The process of scaffolding and how it optimizes students learning

The goal of the learning session is to integrate these topics into a vision essay that describes learning in a school in 2035.

At the end of the learning session, you should be able to:

- explain the concepts of artificial intelligence, scaffolding and differentiation
- explain how they affect learning
- apply them in the context of education
- combine the concepts into a future vision for education

[For more information about the criteria of the essay, see the rubric.](#)

You will have 120 minutes to read the texts, study the concepts and write the essay. Please note that you should work efficiently. We advise you to focus on the three important concepts, their relationships and their combination can form a future vision for education.

### Scaffolding tool

S1 S2 S3 S4 S5

Accurate understanding of the content and requirements of literacy task is critical.

Based on your learning behaviour so far, we recommend the following steps:

- (a) Use table of content to get an overview and skim text
- (b) Check the essay rubric carefully
- (c) Make sure you understand the learning goals and instructions
- (d) Process information by taking notes.

Create Checklist

# AI-powered scaffolds and learning strategies

Scaffolding tool ×

S1 S2 S3 S4 S5

Accurate understanding of the content and requirements of literacy task is critical.

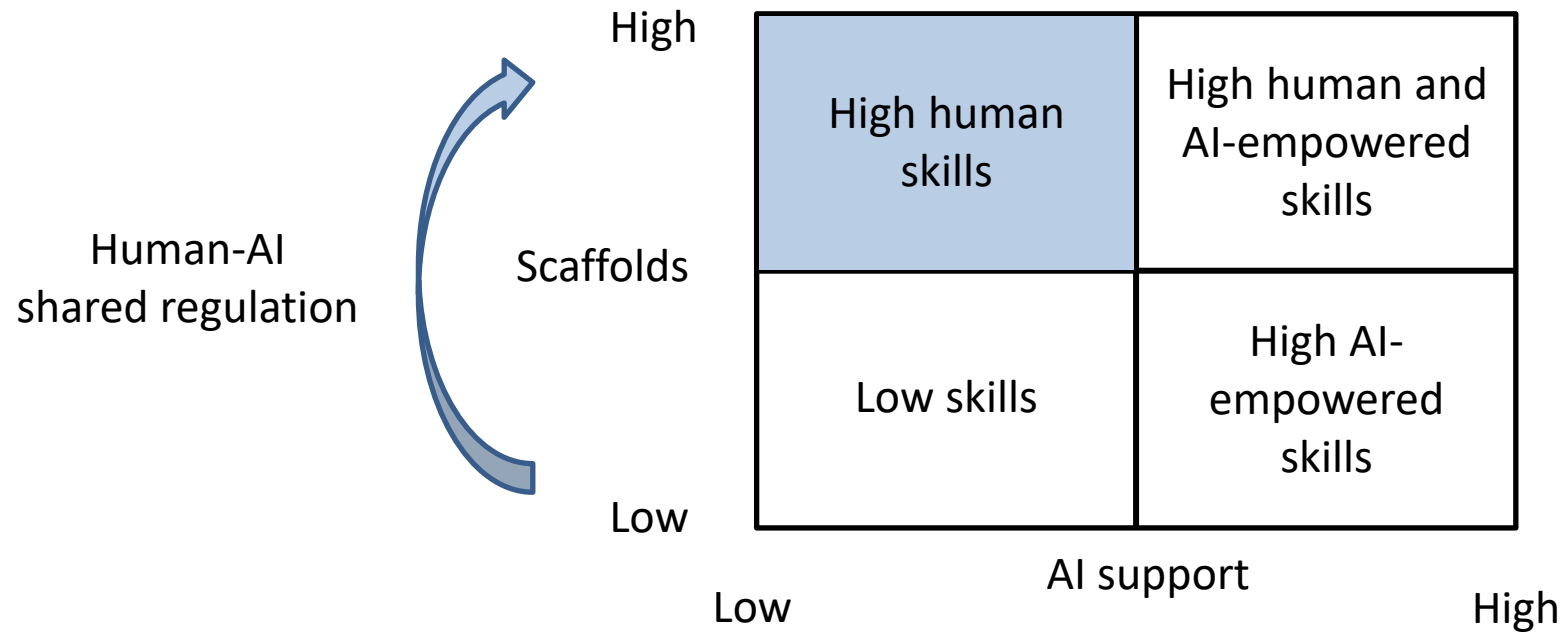
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- (a) Use table of content to get an overview and skim text
- (b) Check the essay rubric carefully
- (c) Make sure you understand the learning goals and instructions
- (d) Process information by taking notes.

Create Checklist

Moderate association  
between scaffolding  
and learning strategy

# Towards metacognitive onloading



Towards human and AI-empowered skills

Integrating scaffolds with AI support



# AI-powered scaffolds and learning strategies

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Ag - Edit mode

x

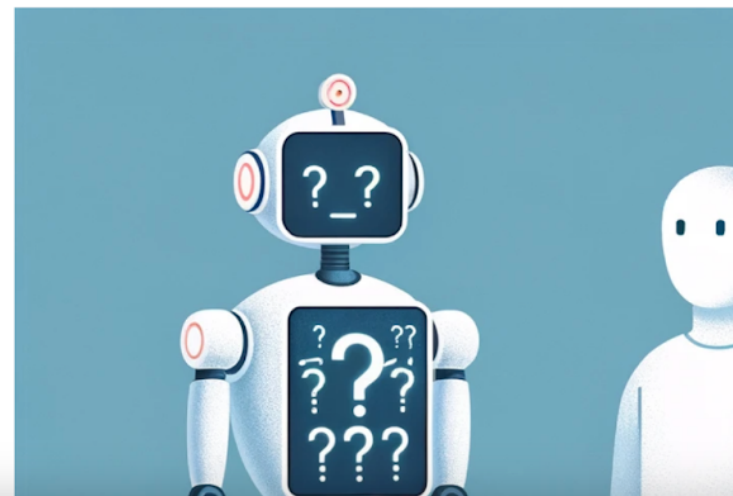
[1.1 What is artificial intellig...](#)[1.2 How does AI work?](#)[1.3 AI in practice](#)[1.4 Difference between AI ...](#)[1.5 The role of the human ...](#)[1.6 Are AI machines smart...](#)[1.7 The current limits and ...](#)v **2: The medicine in the f...**[2.1 Technology changing...](#)[2.2 AI and disease detecti...](#)[2.3 AI and mental illness](#)**[2.4 Patient's perspectives](#)**[2.5 Doctor's perspectives](#)[2.6 AI accuracy in medicine](#)[2.7 AI and data security in...](#)[2.8 How does hospitals in ...](#)<https://www.floraengine.org/moodle/my/courses.php>

3: AI in Medicine C / 2.4 Patient's perspectives

## 2.4 Patient's perspectives

Page Settings More

Researchers at a US university found that many patients do not trust AI systems for several reasons. For example, an AI doctor (robot) may sometimes ask the patient to make her or him uncomfortable. Also, some patients may feel that AI systems



### Instruction Panel

This will help you structure your essay effectively and cover all necessary points. Remember, planning your approach and being mindful of the time can enhance your performance. You're in control of your learning, and these strategies will empower you to produce a high-quality essay. Keep up the good work!

10:49:46

I see that you're aware of the time and tools available, which is great! However, it's important to also understand the task instructions and rubric. Your essay should discuss AI's concept, current use, and future integration in daily life and medicine. Use the reading material to gather information and examples. Start by defining AI, then discuss its current and potential future applications in medicine. Remember to write in your own words and include your own thoughts. You're doing well, just focus on incorporating the reading material into your essay. You've got this!

10:56:51

# AI-powered scaffolds and learning strategies

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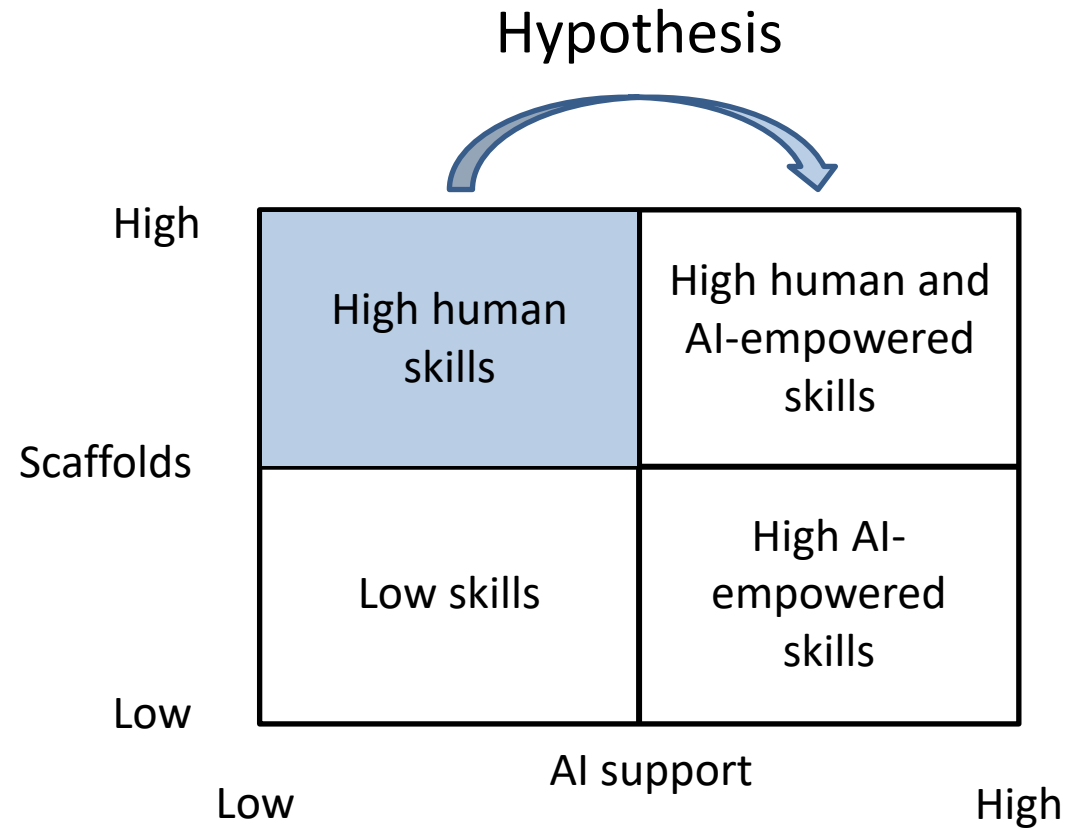
The screenshot shows a Moodle course page for '3: AI in Medicine C / 2.4 Patient's perspectives'. The left sidebar contains a table of contents with '2.4 Patient's perspectives' highlighted. The main content area shows a page titled '2.4 Patient's perspectives' with a 'Page' button and 'Settings' and 'More' options. Below the title, there is a paragraph of text starting with 'Researchers at a US university...'. A magnifying glass is positioned over a text box that contains the following AI-generated scaffold text:

I see that you're aware of the time and tools available, which is great! However, it's important to also understand the task instructions and rubric. Your essay should discuss AI's concept, current use, and future integration in daily life and medicine. Use the reading material to gather information and examples. Start by defining AI, then discuss its current and potential future applications in medicine. Remember to write in your own words and include your own thoughts. You're doing well, just focus on incorporating the reading material into your essay. You've got this!

10:56:51

The background of the page features a blue robot character holding a sign with question marks.

# Towards high human and AI-empowered skills

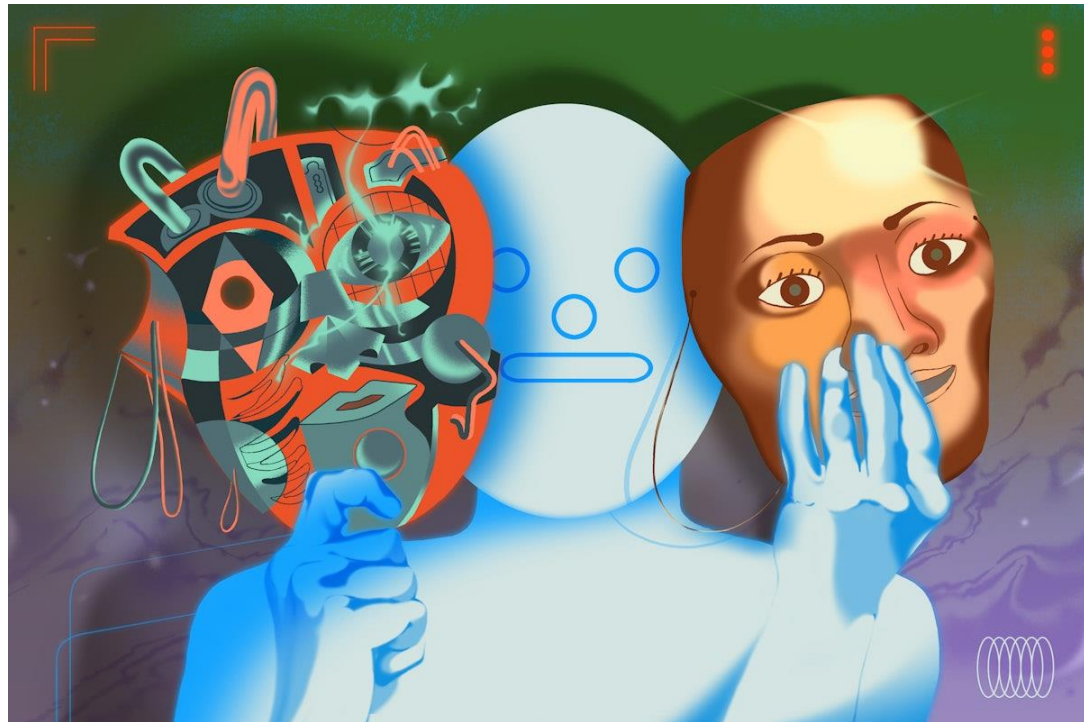




# Monitoring

What are effects of gen AI on monitoring?

# Effects of gen AI on processing fluency



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

Gen AI can worsen  
monitoring

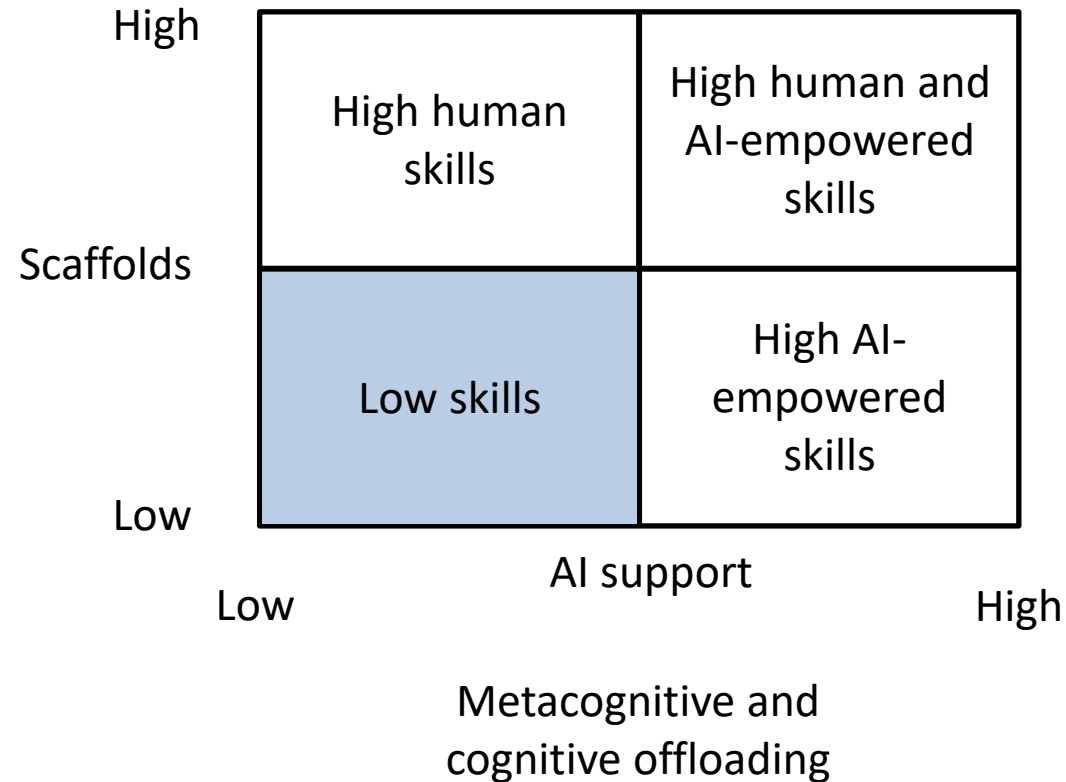
Metacognitive offloading

# Inadvertent deception of ChatGPT

Inaccurate and verbose, but  
users prefer ChatGPT responses

Processing fluency – illusion of truth effect

# Towards high human and AI-empowered skills



AI support:

- aims to improve performance
- ~~has a fit for the task~~
- knowledge of AI tool

# AI-powered scaffolds

- ✕
- ✕ Instructions
  - General Instructions
  - Rubric
- ✕ 1: Artificial Intelligence i...
  - 1.1 Definition of Artificial I...
  - 1.2 History of Artificial Intel...
  - 1.3 How does AI work?
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  - 1.5 Supervised machine lea...
  - 1.6 Unsupervised machine ...
  - 1.7 Reinforcement learning
  - 1.8 Deep Learning
- ✕ 2: Differentiation in Educ...
  - 2.1 What is Differentiation?
  - 2.2 Using differentiation to...
  - 2.3 Standards for teaching
- ✕ 3: Scaffolding in Education
  - 3.1 The development of sc...
  - 3.2 What is cognitive appr...
  - 3.3 What is scaffolding
  - 3.4 Applications of scaffold...
  - 3.5 Applications of coactiv...

3: Future Learning / General Instructions

## General Instructions

Page Settings More-

In this learning session, the goal is to write a vision essay that describes the future of education. Please describe, in 200 to 400 words, how you envision learning in a school in 2035.

Please consult the materials in this [learning](#) environment that provide information about three important topics for envisioning the future of education in 2035.

### Essay Writing 222 words

Normal B I U

Nowadays, the role of AI in education is limited in some tangible educational products. More and more data are needed to make AI work better. And the scaffolding is that the work is shared alone between the learner and some more knowledgeable other or agent. In addition, it also enables learning from the experience. Scaffolding to optimize learning needs to acquire more knowledge. Besides, as we all know, differentiation is a combination of careful progress monitoring and adapting instruction in response. By this, students or learners could be divided into different groups by their teacher according to their competence degree. In these groups, students can learn knowledge that they don't understand and make progress belonging to themselves. Differentiation practices in the classroom will help students in their group process.

Integration of three topics is very essential and all three are indispensable. In the future education, the three should complement each other. Respectively, there are great expectations for AI in education to help students and teachers work better. To facilitate our independent and appropriate use in education in the future, we should learn more on how the scaffolding component skills work and so on. Furthermore, differentiation should be paid more attention in education. Beyond that, the three should continue to innovate, so as to better serve the education and other industries in the future.

Save Essay

### Checklist Tool

Basic Academic Originality Integration and elaboration

Essay Sentence: Nowadays, the role of AI in education is limited in some tangible educational products.  
Integration Level: Remember and understanding

Essay Sentence: More and more data are needed to make AI work better.  
Integration Level: Evaluate and create

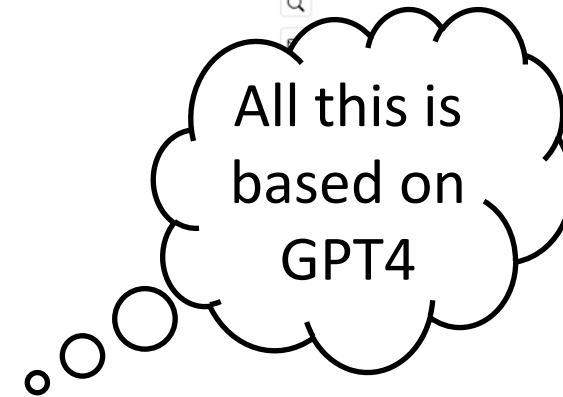
Essay Sentence: And the scaffolding is that the work is shared alone between the learner and some more knowledgeable other or agent.  
Integration Level: Evaluate and create

Essay Sentence: In addition, it also enables learning from the experience.  
Integration Level: Apply and analyse

Essay Sentence: Scaffolding to optimize learning needs to acquire more knowledge.

This analysis may take around 5-10 min to process.

Analyse





# AI-powered scaffolds

FLoRA Home My courses Site administration

AU - Edit mode

**General Instructions**

3: Future Learning / General Instructions

Page Settings

Integration of three topics is very essential and all three are indispensable. In the future education, the three should complement each other. Respectively, there are great expectations for AI in education to help students and teachers work better. To facilitate our independent and appropriate use in education in the future, we should learn more on how the scaffolding component skills work and so on. Furthermore, differentiation should be paid more attention in education. Beyond that, the three should continue to innovate, so as to better serve the education and other industries in the future.

**Checklist Tool**

- Basic Academic Originality Integration and...
- Essay Sentence: Nowadays, the role of AI in education is limited in some educational products.  
Integration Level: Remember and understanding
- Essay Sentence: More and more data are needed to make AI work better.  
Integration Level: Evaluate and create
- Essay Sentence: And the scaffolding is that the work is shared alone between the learner and some more knowledgeable other or agent.  
Integration Level: Evaluate and create
- Essay Sentence: In addition, it also enables learning from the experience.  
Integration Level: Apply and analyse
- Essay Sentence: Scaffolding to optimize learning needs to acquire more knowledge.

This analysis may take around 5...

Save Essay

Learning content

Navigation menu

3: Future Learning\_1 / General Instructions

PAGE

## General Instructions

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Please consult the materials in this learning environment that provide information about three important topics for envisioning the future:

1. Artificial intelligence and its applications
2. What differentiation is and how it affects learning
3. The process of scaffolding a learning experience

The goal of the learning session is to write a vision essay about learning in a school in 2035.

At the end of the learning session, you will be asked to:

- explain the concepts of artificial intelligence and its applications
- explain how they affect learning
- apply them in the context of a school in 2035
- combine the concepts into a vision of learning in a school in 2035

For more information about the topics, please refer to the materials provided in this learning environment.

### Essay Writing

0 words

Normal B I U X<sub>2</sub> X<sup>2</sup> [List icons]

Write essay here...

Save Essay

- Notes Panel
  - Search Tool
  - Essay tool
  - Planner Tool
  - Dictionary Tool
  - Timer
  - Checklist Tool
  - ChatGPT Tool
  - Ask Teacher Tool
- (Stage 2)

(Stage 1)

### Checklist Tool

Basic Academic Originality Integration and elaboration

Sentence Text: Artificial intelligence has been rapidly developing for years, leading to the emergence of a wide variety of products.  
 Error Position: variety  
 Error Correction: variety  
 Error Explanation: The correct spelling of the word is "variety."  
 Error Type: Spelling

Sentence Text: However, limited extent in tangible AI-based educational products can be seen.  
 Error Position: limited extent  
 Error Correction: a limited extent  
 Error Explanation: The phrase should include an article "a" to make it grammatically correct.

This analysis may take around 5-10 min to process. **Analyse**

### ChatGPT Tool

could you give me some advice on the academic writing skills of my essay?  
16:12:08

Certainly! Here are some suggestions to improve the academic writing skills in your essay:

1. Use clear and concise language: Aim for clarity in your writing by choosing precise words and avoiding unnecessary jargon or overly complex language. Make sure each sentence contributes to your overall argument.

Ask a question... **Send**

### Ask Teacher Tool

Connected to server: ● Teacher is typing...  
 Teacher online status: ●

Hello  
16:42:38

hi  
16:42:41

could you give me some advice on the structure of my essay?  
16:43:04

Ask a question... **Send**

Learning content

Navigation menu

3: Future Learning\_1 / General Instructions

PAGE  
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For more information about the topics, please refer to the materials in this learning environment.

**Essay Writing** 0 words

Normal B I U X<sub>2</sub> X<sup>2</sup> [List icons]

Write essay here...

Save Essay

- Notes Panel
  - Search Tool
  - Essay tool
  - Planner Tool
  - Dictionary Tool
  - Timer
  - Checklist Tool
  - ChatGPT Tool
  - Ask Teacher Tool
- (Stage 2)

(Stage 1)

CN

Revise essay by themselves

AI



HE



CL

**Checklist Tool**

Basic Academic Originality Integration and elaboration

Sentence Text: Artificial intelligence has been rapidly developing for years, leading to the emergence of a wide variety of products.  
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Learning content

Navigation menu

3: Future Learning\_1 / General Instructions

General Instructions

Rubric

1: Artificial Intelligenc...

1.1 Definition of Artificial...

1.2 History of Artificial In...

1.3 How does AI work?

1.4 Ethics and risks of d...

1.5 Supervised machine...

1.6 Unsupervised machi...

1.7 Reinforcement learni...

1.8 Deep Learning

2: Differentiation in Ed...

2.1 What is Differentiatio...

2.2 Using differentiation ...

2.3 Standards for teachi...

General Instructions

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- apply them in the context of your own school
- combine the concepts into a vision for the future of learning in a school in 2035

For more information about the topics, please refer to the materials in this learning environment.

Essay Writing 0 words

Normal B I U X<sub>2</sub> X<sup>2</sup> [List icons]

Write essay here...

Save Essay

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AI



HE

(Stage 1)

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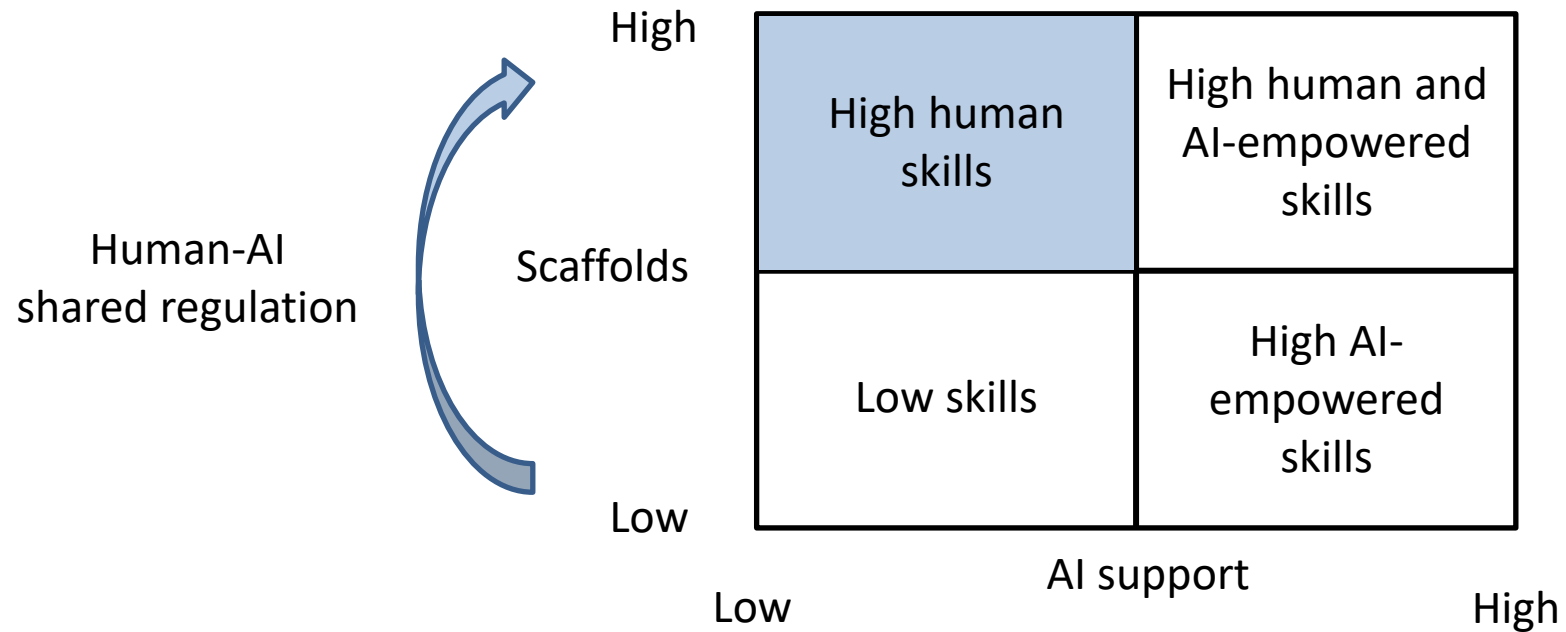
This analysis may take around 5-10 min to process. **Analyse**

CL

# Towards metacognitive onloading

## Increased monitoring accuracy with AI scaffolds for writing

# Towards metacognitive onloading



# Challenge

AI-powered scaffolds may have  
inadvertent side effects on learning

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



# AI scaffolds and monitoring

What is long-term effect of *AI scaffolds* as shared regulation on monitoring?



# AI support and monitoring

← RETURN REPORT [HOW DO I MODERATE?](#) [SKIP RESOURCE](#)

I don't want to moderate this resource

### Resource Feedback

Please evaluate the resource based on the following criteria:

Alignment with course content & objectives:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Correctness, clarity & ease of understanding:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Appropriateness of difficulty:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Encouragement of critical thinking and reasoning:	Poor	Needs Improvement	Satisfactory	Great	Outstanding

### Justify your responses & provide feedback

Please provide constructive feedback & justify your responses to the author so they can improve the resource.

A) It's unclear what this means, so I initially didn't mark it as false - maybe reword? also, are street number and name partial keys? Should they be marked as such? C) I think for this one you need the double line connecting the restaurant to the manage relationship, rather than a double line around the manage relationship itself (which represents that the relationship can have more than one value) E) since you can't say, it's not necessarily false it's just also not necessarily true. Maybe switch to "a restaurant needs at least one chef" or something that can be proven false by the diagram - something with "must" in it rather than just "has"

### Decision

Please rate the overall quality of this resource based on the criteria above.

The overall quality of this resource is:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Rate your confidence in assessing this resource:	Very low	Low	Medium	High	Very High

SUBMIT

Moderator	Decision	Weight	Comment	👍	👎
1	2	16%	A) It's unclear what this means, so I initially didn't mark it as false - maybe reword? also, are street number and name partial keys? Should they be marked as such? C) I think for this one you need the double line connecting the restaurant to the manage relationship, rather than a double line around the manage relationship itself (which represents that the relationship can have more than one value) E) since you can't say, it's not necessarily false it's just also not necessarily true. Maybe switch to "a restaurant needs at least one chef" or something that can be proven false by the diagram - something with "must" in it rather than just "has"	2	0
2	3	13%	Most of the answers which you say are false are right but I am unsure if the second answer is entirely false. That might just be me.	0	0
3	5	20%	good question with complex attributes	0	1
4	4	16%	great question	0	0
5	2	13%	1. Making "A restaurant" a weak entity is entirely incorrect here as it is not dependent on a key of another owner entity as it has its own unique key. Thus, both "a restaurant" and "manage" should not be double lined. 2. Remove F. It's just a weird option to have. For all we know, the restaurant does have 2 chefs and they just didn't want it recorded in the ER diagram.	1	0
6	5	22%	This question is very useful for students to understand the details of ER-model, and reduce mistakes they make when painting their own ER diagram. But there is a problem in this ER diagram, the line between "A restaurant" and "manage" needs to be two lines, because the weak entity set must necessarily participate totally in their identifying relationship.	0	0
<b>Result: Approved (3.7)</b>					

# AI support and monitoring

Our algorithms have flagged that this comment may not be helpful.

- Please ensure that the comment:
  - Is specific to this resource
  - Suggests meaningful improvements for the author
  - Aligns with the grades assigned in the rubric

Our algorithms have flagged that this comment may not be helpful.

- Your moderation comment is too similar to your previous comments

Previous Comment	Date
Interesting question with well explanation. I could not add more to it. Well done.	Sep 01, 2021

[I don't want to moderate this resource](#)

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Encouragement of critical thinking and reasoning:	Poor	Needs Improvement	Satisfactory	Great	Outstanding

### Justify your responses & provide feedback

Please provide constructive feedback & justify your responses to the author so they can improve the resource. ?

Align feedback with rubric
  Be detailed & specific
  Suggest improvements
  Use constructive language

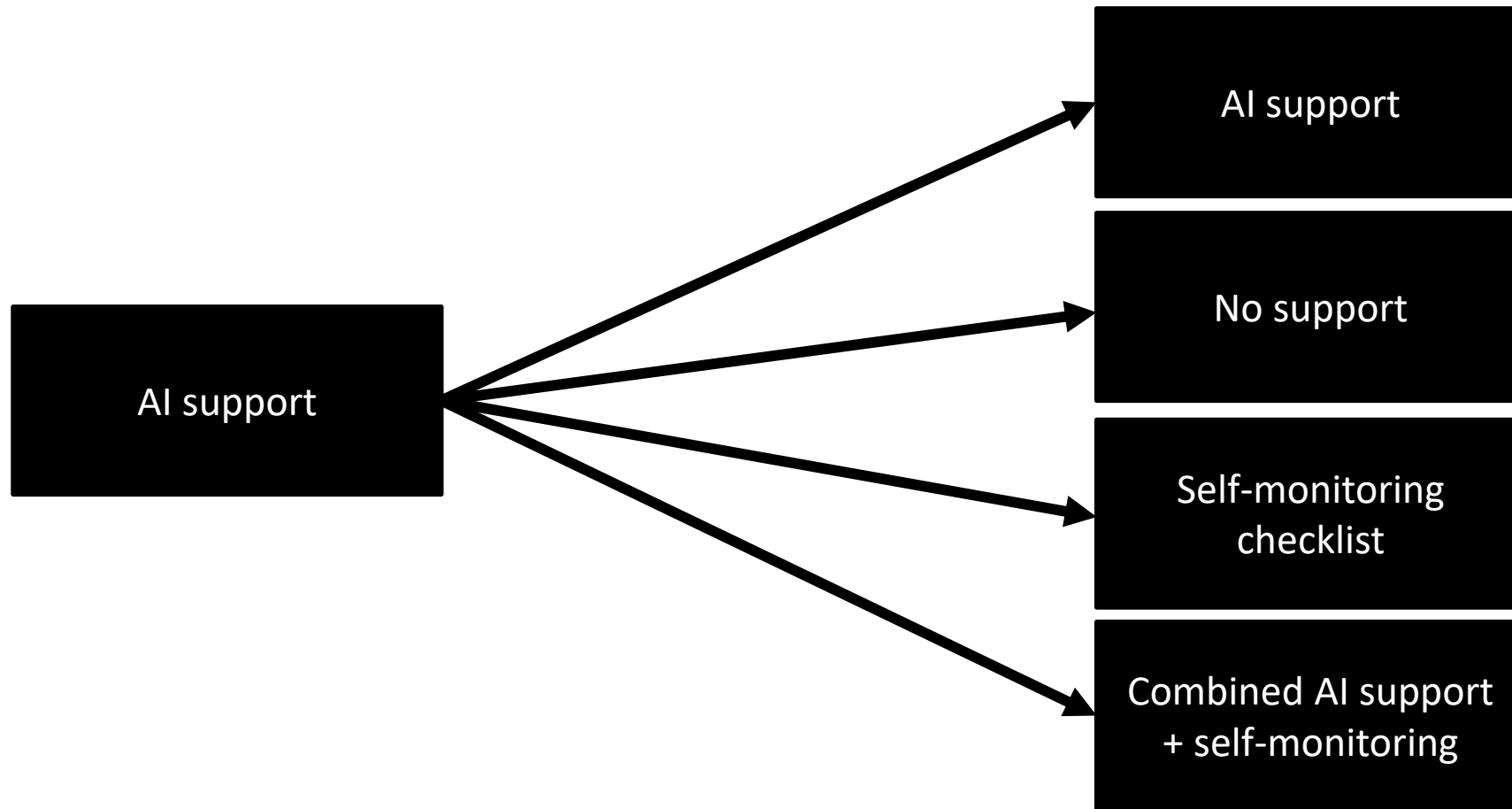
The content of the question is good. However, please revise the answer. Distractor C is also correct in addition to the option A that has been selected. It would be better to change the question either by making it a multiple-answer or negating option C.

### Decision

Please rate the overall quality of this resource based on the criteria above.

The overall quality of this resource is:	Poor	Needs Improvement	Satisfactory	Great	Outstanding
Rate your confidence in assessing this resource:	Very low	Low	Medium	High	Very High

# Longitudinal impact on monitoring



AI support and monitoring

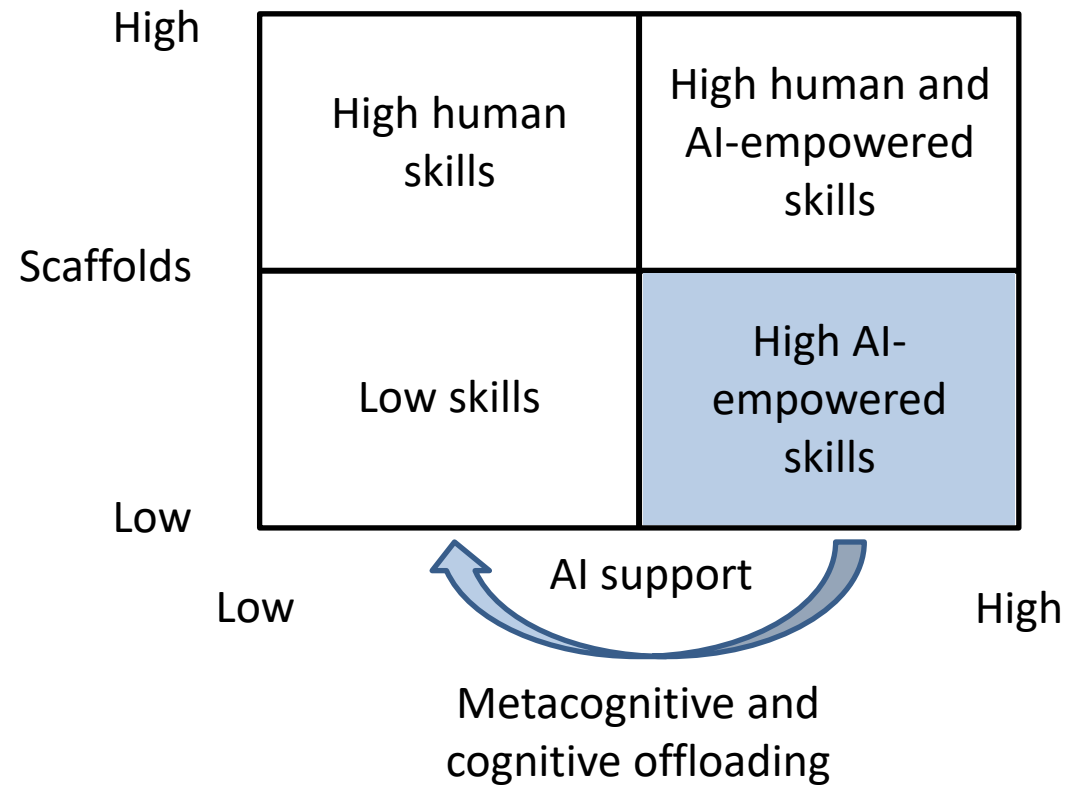
Benefits deteriorate when  
AI support is removed

AI support and monitoring

Benefits deteriorate when  
AI support is removed

“Generative AI can harm learning”

# Long term effects of unscaffolded AI-support



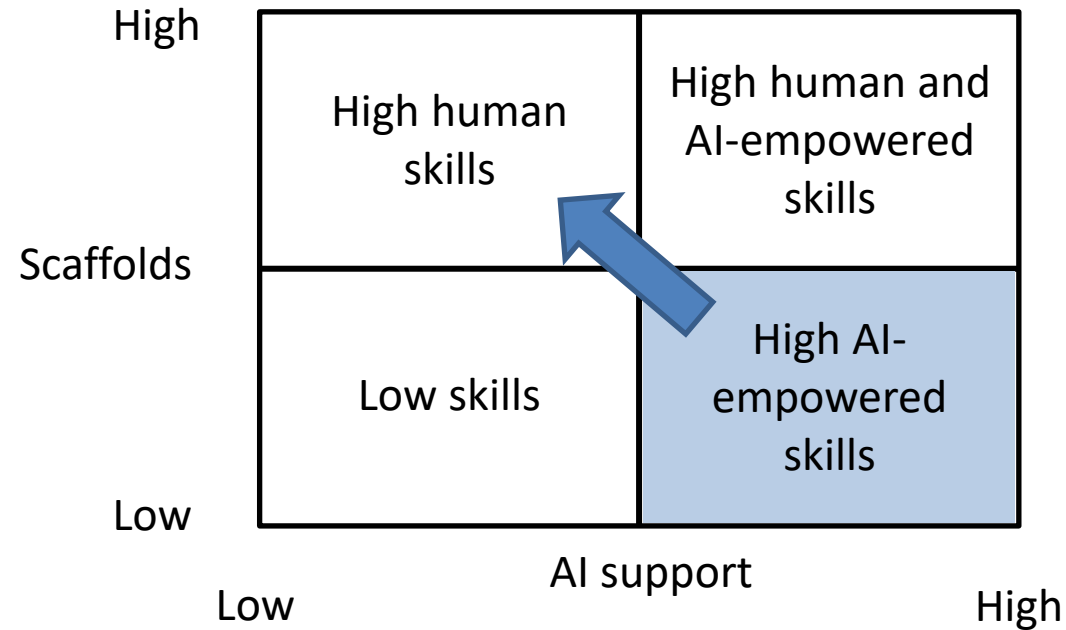
Atrophy of  
(meta)cognitive ability

# AI support and judgment of learning

Benefits present\* when  
AI support replaced by scaffolds

\*But not as high as they are with AI support

# AI-support after replaced with scaffolds



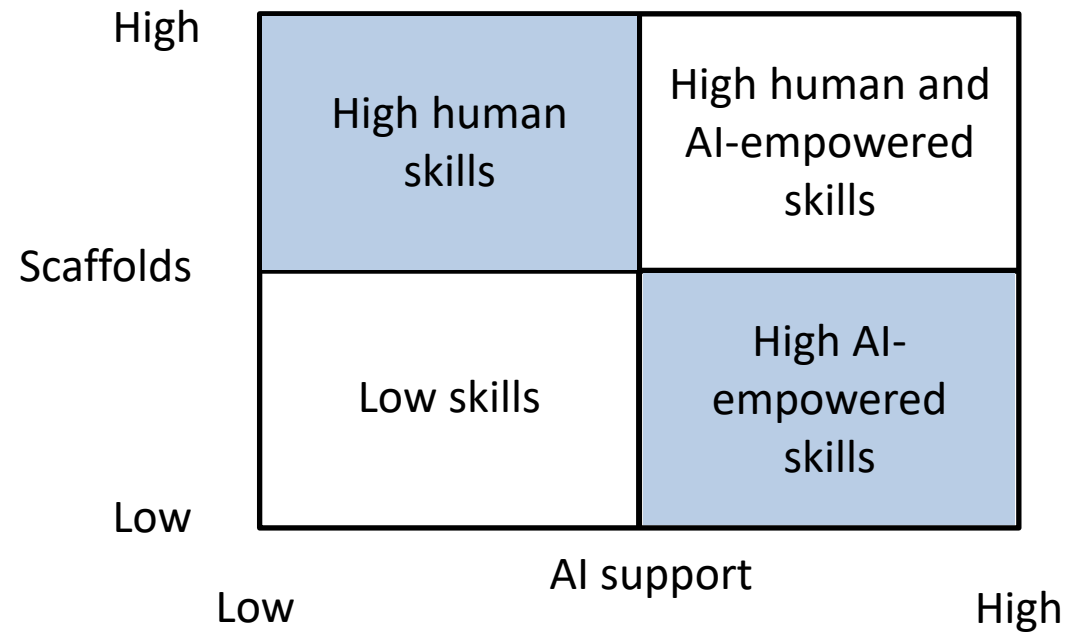
Positive, but not novel



# AI support and judgment of learning

Combining scaffolds and AI support  
does not produce additive effects

# Towards high human and AI-empowered skills



No additive effect of scaffolds and AI support

# Open challenge

How do we develop  
high human and AI-empowered skills?



# Information problem solving

What effect does generative AI have on information problem solving?

# ChatGPT in FLoRA

3: Future Learning / General Instructions

PAGE

## General Instructions

Page Settings More

### Essay Writing

236 words

Normal B I U x<sub>2</sub> x<sup>2</sup> [List Icons]

AI in Education. AI plays an important role in Education. Nowadays, the role of AI in education is limited in some tangible educational products. More and more data are needed to make AI work better. And the scaffolding is that the work is shared alone between the learner and some more knowledgeable other or agent. In addition, it also enables learning from the experience. Scaffolding to optimize learning needs to acquire more knowledge. Besides, as we all know, differentiation is a combination of careful progress monitoring and adapting instruction in response. By this, students or learners could be divided into different groups by their teacher according to their competence degree. In these groups, students can learn knowledge that they don't understand and make progress belonging to themselves. Differentiation practices in the classroom will help students in their group process.

Integration of three topics is very essential and all three are indispensable. In the future education, the three should complement each other. Respectively, there are great expectations for AI in education to help students and teachers work better. To facilitate our independent and appropriate use in education in the future, we should learn more on how the scaffolding component skills work and so on. Furthermore, differentiation should be paid more attention in education. Beyond that, the three should continue to innovate, so as to better serve the education and other industries in the future. AI is good now.

Save Essay

### ChatGPT Tool

Can you give more advice on how to improve the essay?  
18:20:01

Certainly! Here are some additional suggestions to improve your essay:

1. Expand on the role of AI in education: Discuss specific examples of how AI can be applied to learning, such as personalized learning, adaptive assessments, and intelligent tutoring systems. Explain how these applications can contribute to an innovative vision of education in 2035.
2. Elaborate on scaffolding to optimize learning: Provide examples of how scaffolding techniques can be used to support learners in acquiring new

Ask a question... Send

Learning content

Navigation menu

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- (Stage 2)

(Stage 1)

CN

Revise essay by themselves

AI



HE



CL

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CN Revise essay by themselves



(Stage 1)

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# Writing performance

Unsurprisingly writing performance is improved when using ChatGPT

ChatGPT significantly higher essay scores than the other three

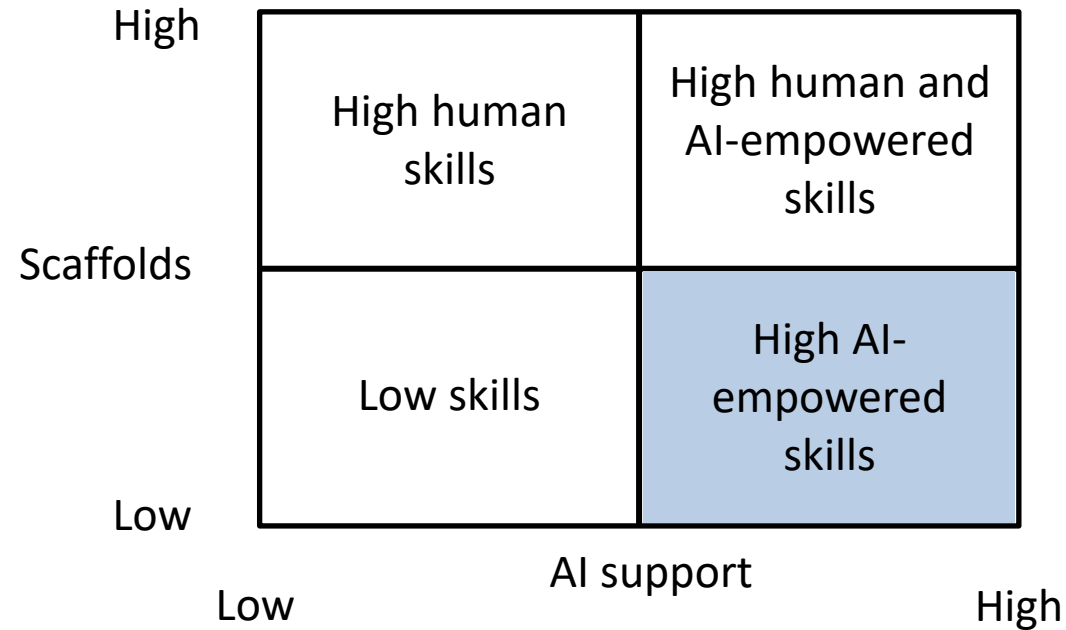


# Metacognition in information problem solving

## Limited monitoring when information provided by generative AI

# Towards high human and AI-empowered skills

Ask ChatGPT

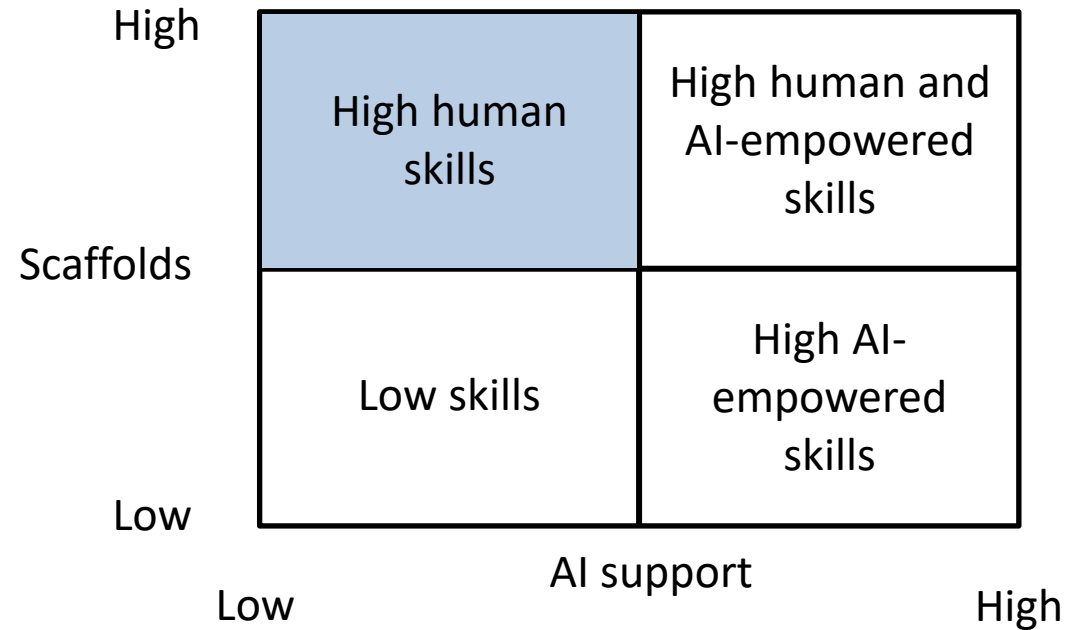


# Metacognition in information problem solving

Always observed evidence of monitoring  
of human provided information

# Towards high human and AI-empowered skills

Ask Teacher

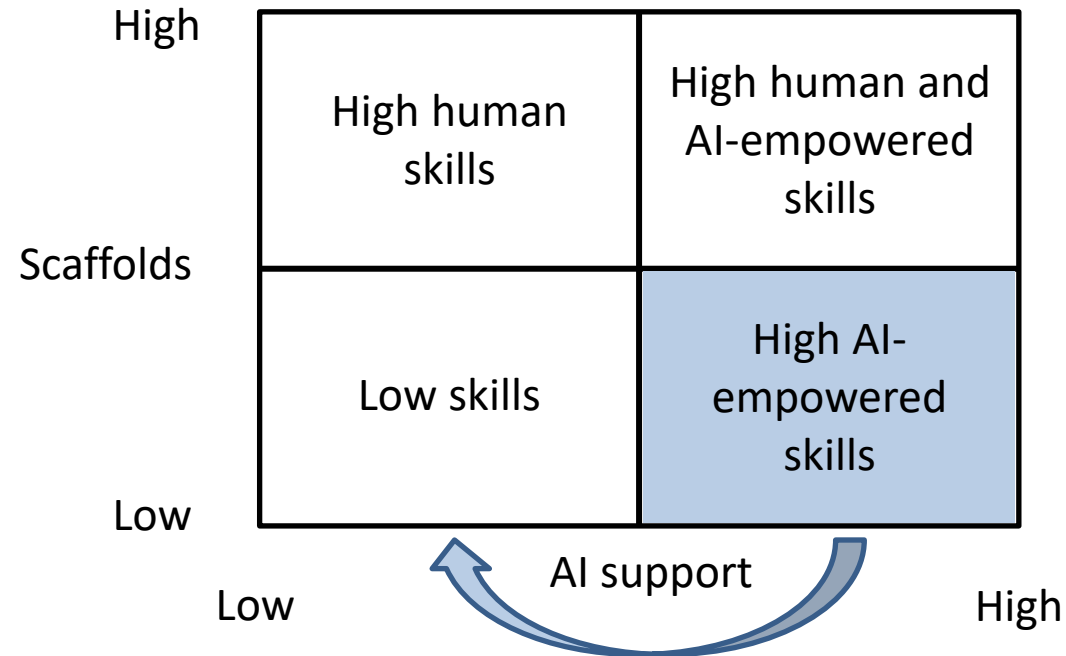


# Metacognitive engagement

What are long term implications of  
limited monitoring?

Unreliable information produced by GenAI

# Long term effects of unscaffolded AI-support



Atrophy of  
(meta)cognitive ability

Cognitive offloading coupled with  
high processing fluency

# Metacognitive laziness



## Generative AI Can Harm Learning

Hamsa Bastani,<sup>1\*</sup> Osbert Bastani,<sup>2\*</sup> Alp Sungu,<sup>1\*†</sup>  
Haosen Ge,<sup>3</sup> Özge Kabakçı,<sup>4</sup> Rei Mariman

<sup>1</sup>Operations, Information and Decisions, University of Pennsylvania

<sup>2</sup>Computer and Information Science, University of Pennsylvania

<sup>3</sup>Wharton AI & Analytics, University of Pennsylvania

<sup>4</sup>Budapest British International School

# Metacognitive laziness

Computers in Human Behavior 160 (2024) 108386

BEWARE

METACOGNITIVE  
LAZINESS



ELSEVIER

Contents lists available at [ScienceDirect](#)

Computers in Human Behavior

journal homepage: [www.elsevier.com/locate/comphumbeh](http://www.elsevier.com/locate/comphumbeh)



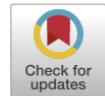
Cognitive ease at a cost: LLMs reduce mental effort but compromise depth in student scientific inquiry

Matthias Stadler<sup>a,\*</sup>, Maria Bannert<sup>b</sup>, Michael Sailer<sup>c</sup>

<sup>a</sup> Institute of Medical Education, LMU University Hospital, LMU Munich, Germany

<sup>b</sup> Chair for Teaching and Learning with Digital Media, Technical University of Munich, Germany

<sup>c</sup> Learning Analytics and Educational Data Mining, University of Augsburg, Augsburg, Germany

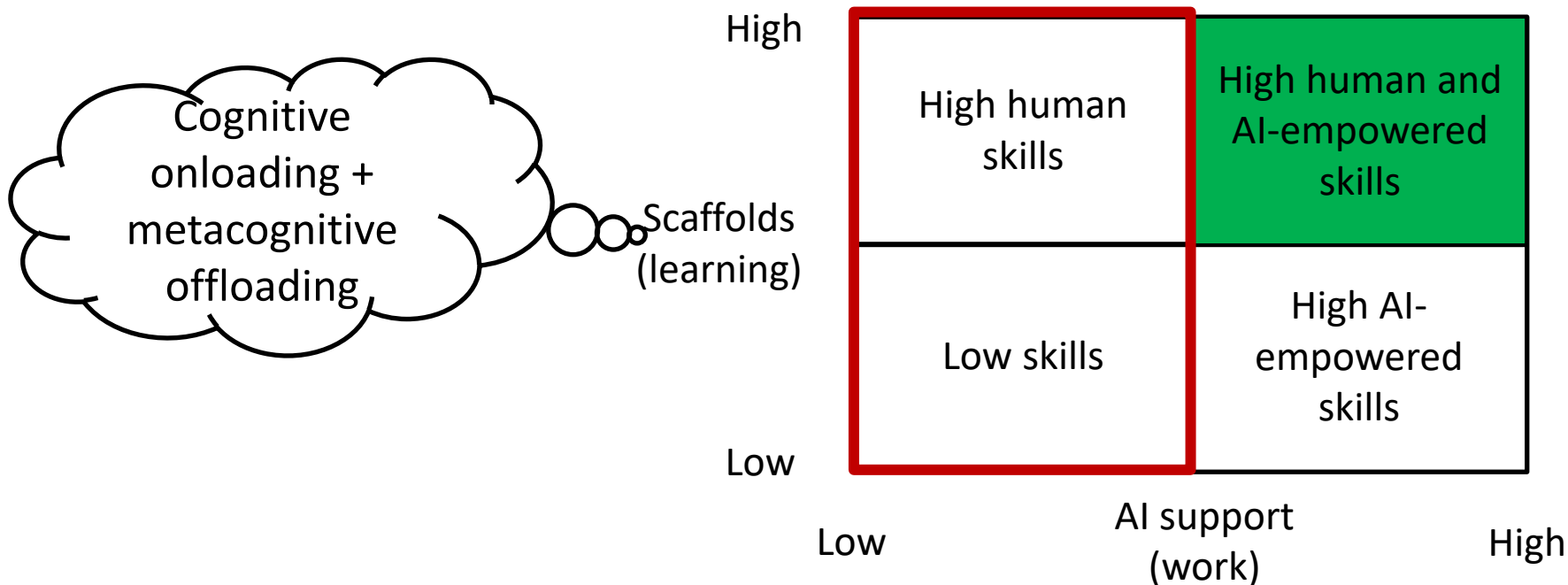




FOUNDATIONS – IMPACT – **DIRECTION** –  
FINAL REMARKS

## Risk #1

## Existing adaptive learning systems



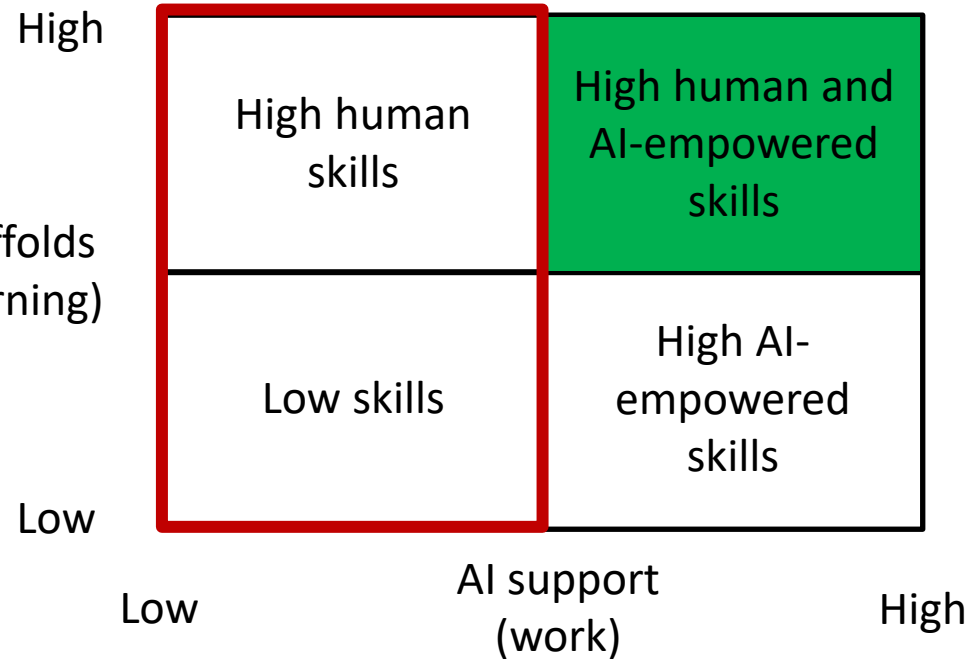
# Opportunity #1

AI-powered  
personalized  
scaffolds

## Hybrid human-AI regulation

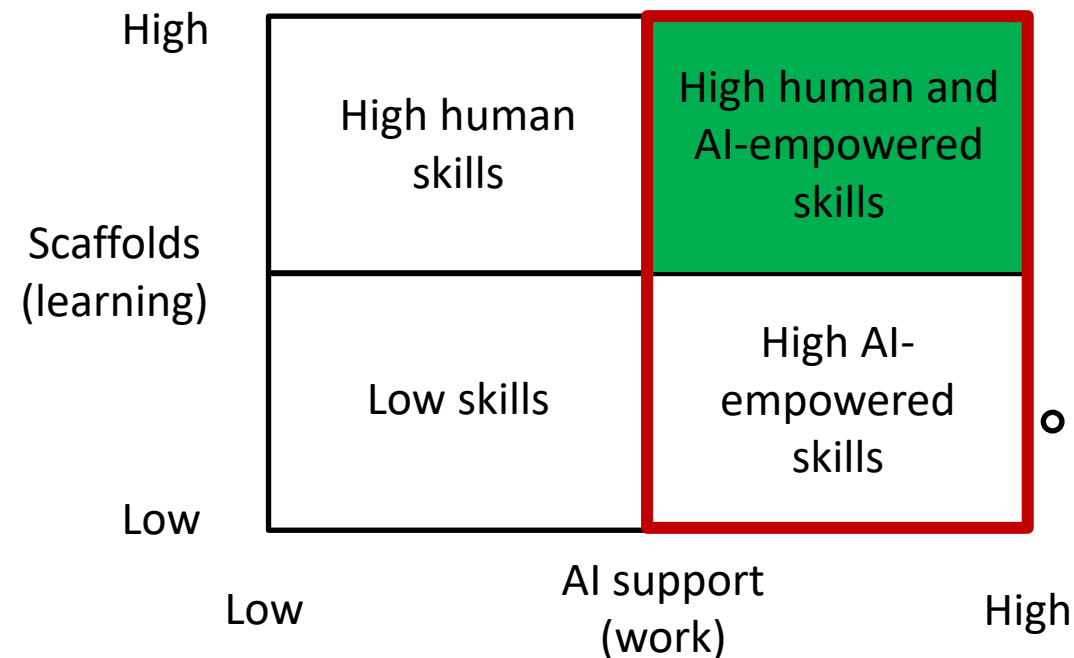
Cognitive  
onloading +  
metacognitive  
**onloading**

Scaffolds  
(learning)



## Risk #2

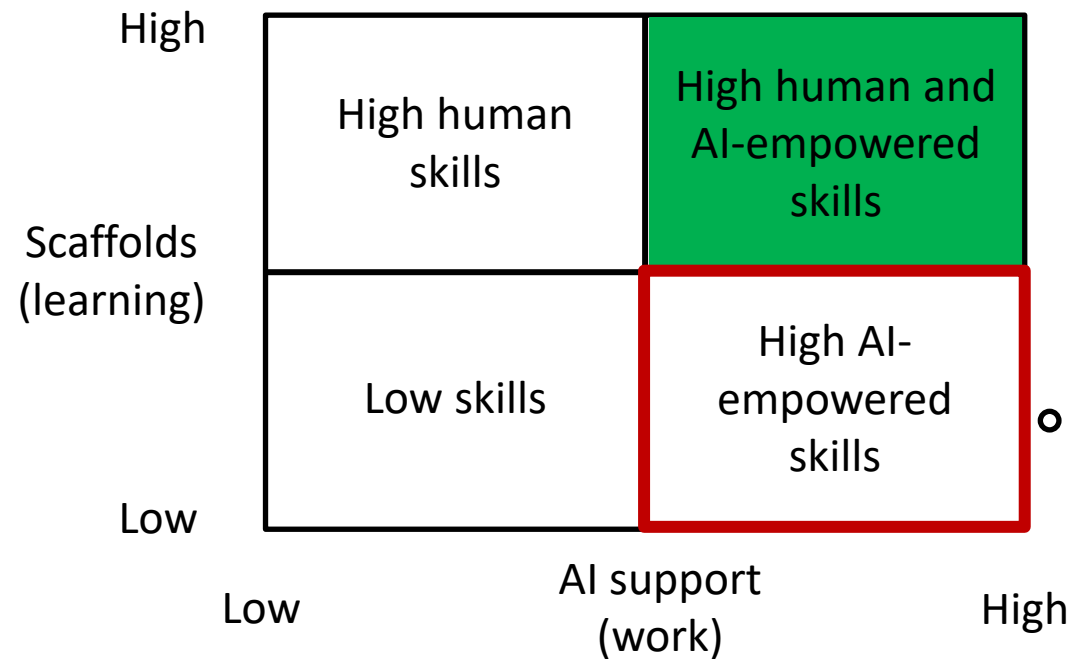
## Cognitive offloading



Cognitive offloading + metacognitive offloading

## Risk #2

## Cognitive offloading



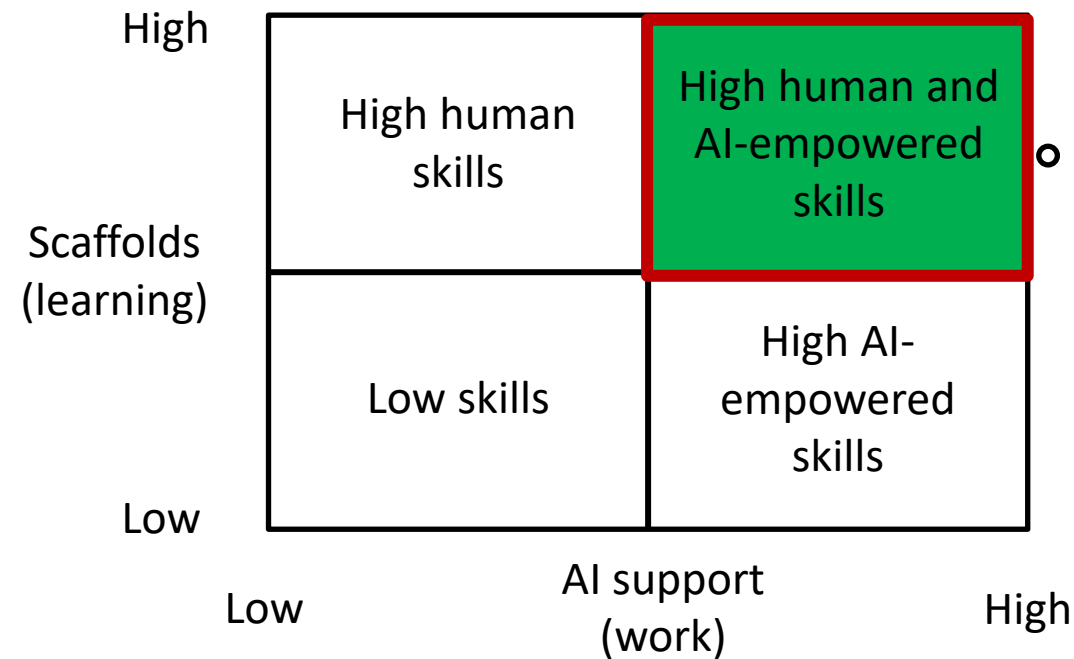
# Metacognitive engagement

## How to minimize risks of AI-empowered skills?

Makes developing human skills worse

# Opportunity #2

## Metacognitive onloading



Cognitive offloading + metacognitive **onloading**

# Proposition

High	High human skills	High human and AI-empowered skills
Scaffolds (learning)	Low skills	High AI-empowered skills
Low	Low	High
	Low	High
	AI support (work)	

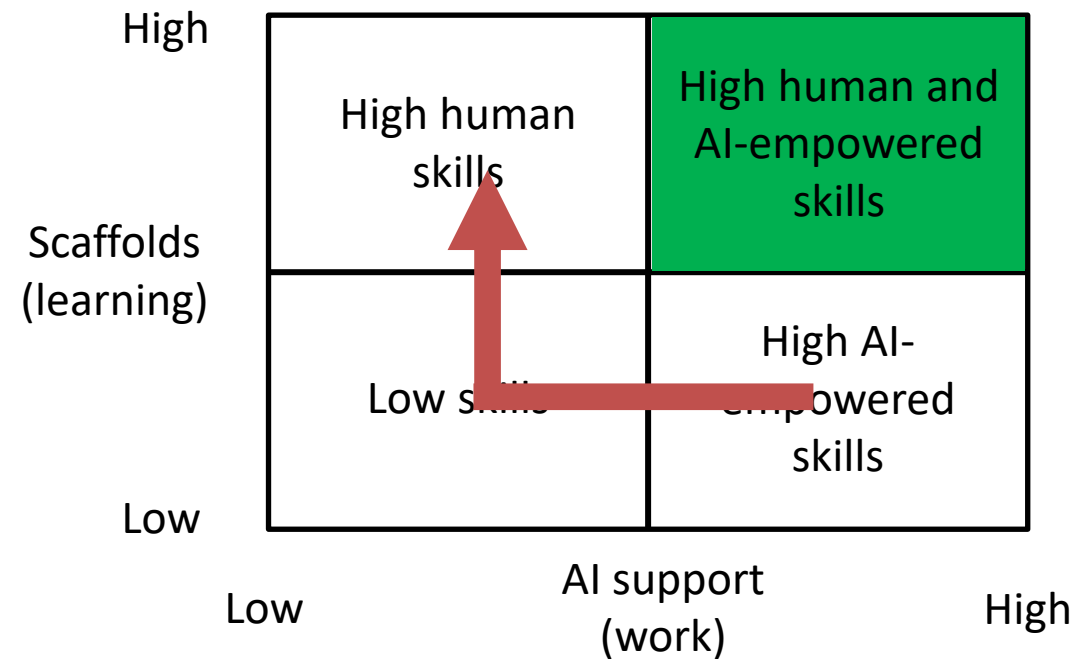
Combined human and AI-empowered  
only at high expertise levels

Regulation needed in complex authentic tasks



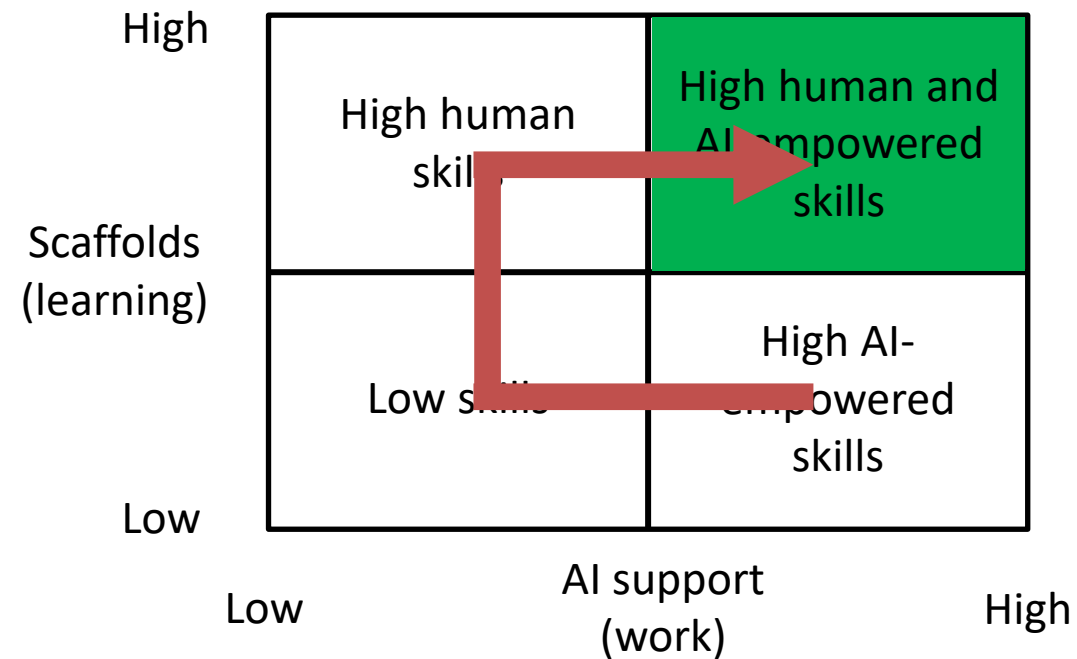
# Opportunity #2

## Metacognitive onloading

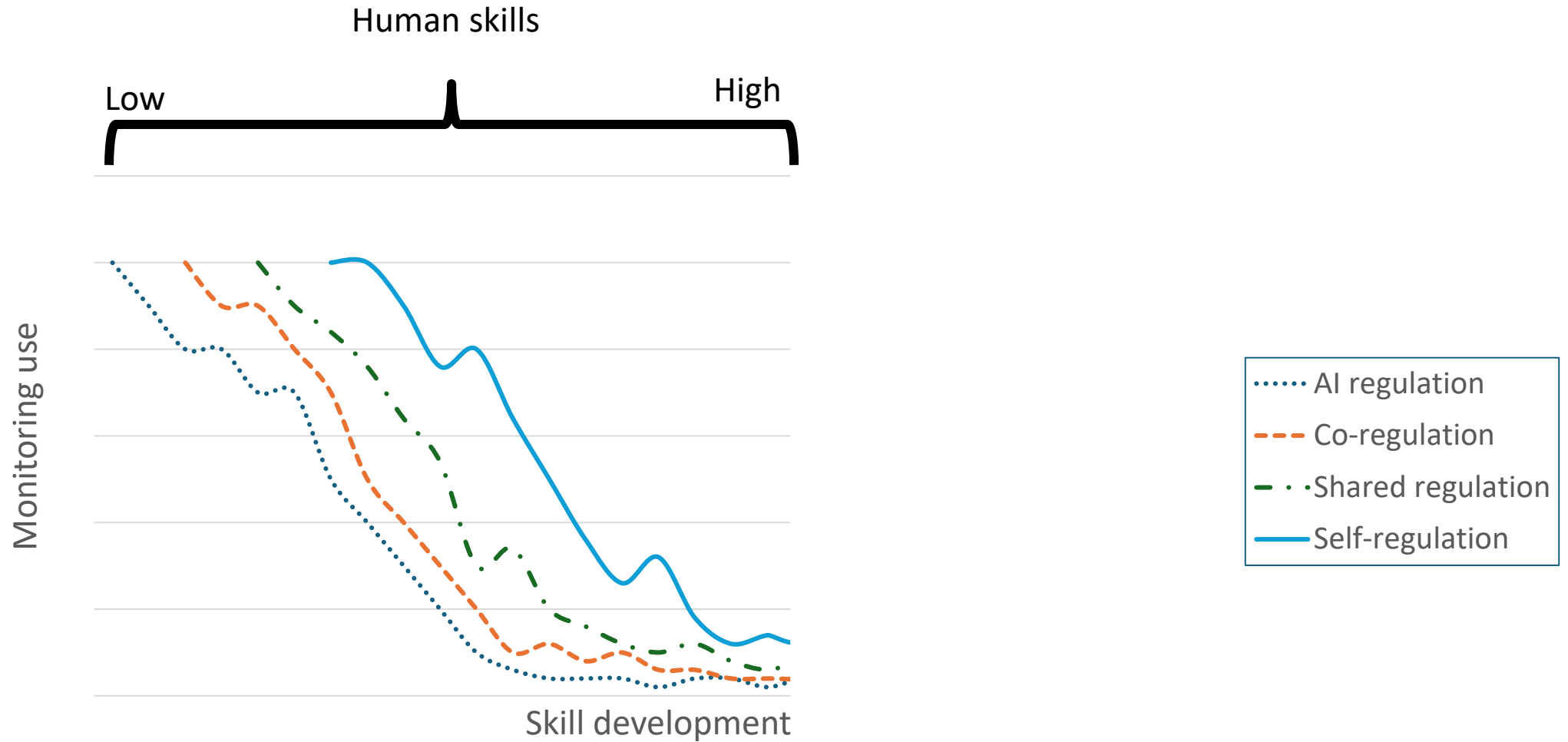


# Opportunity #2

## Metacognitive onloading

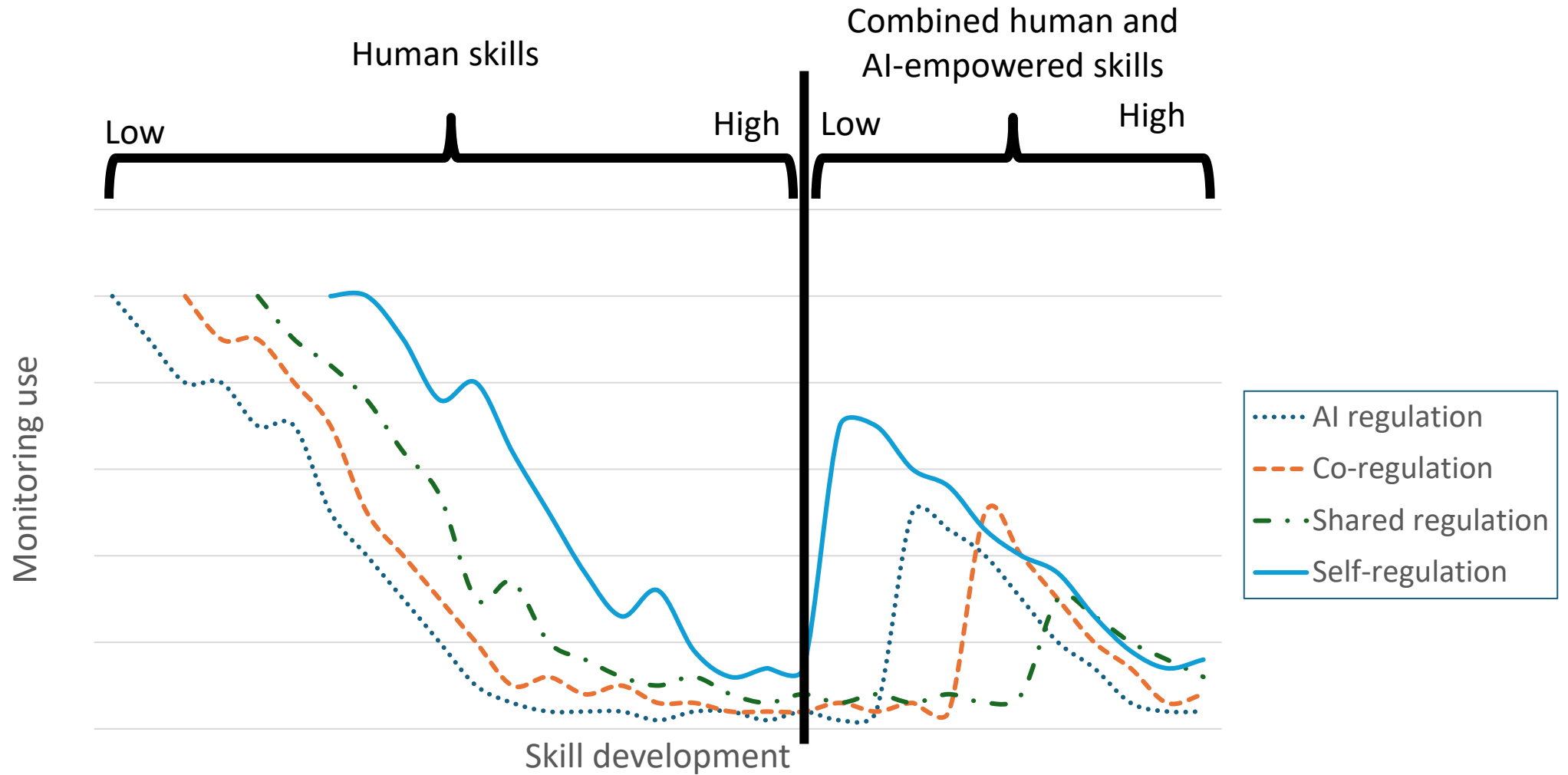


# Proposition



This image is not based on actual data. It is fully hypothesized based on existing research on hybrid human-AI regulation and cognitive offloading.

# Proposition



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FOUNDATIONS – IMPACT – DIRECTION –  
**FINAL REMARKS**

# Tackling open challenges

AI can help enhance SRL, but  
it can also inhibit it if used carelessly

# Tackling open challenges

Effective AI-empowered skills  
require strong human skills

# Opportunity

Human and AI

to learn together and from each other



# Getting ready for the age of AI: Developing self-regulated learners

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ICCE'24  
Manila, Philippines