



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 Yan¹, Samuel Greiff^{2,3,4}✉, Ziwen Teuber³ & Dragan Gašević¹✉

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 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 methodologies¹.

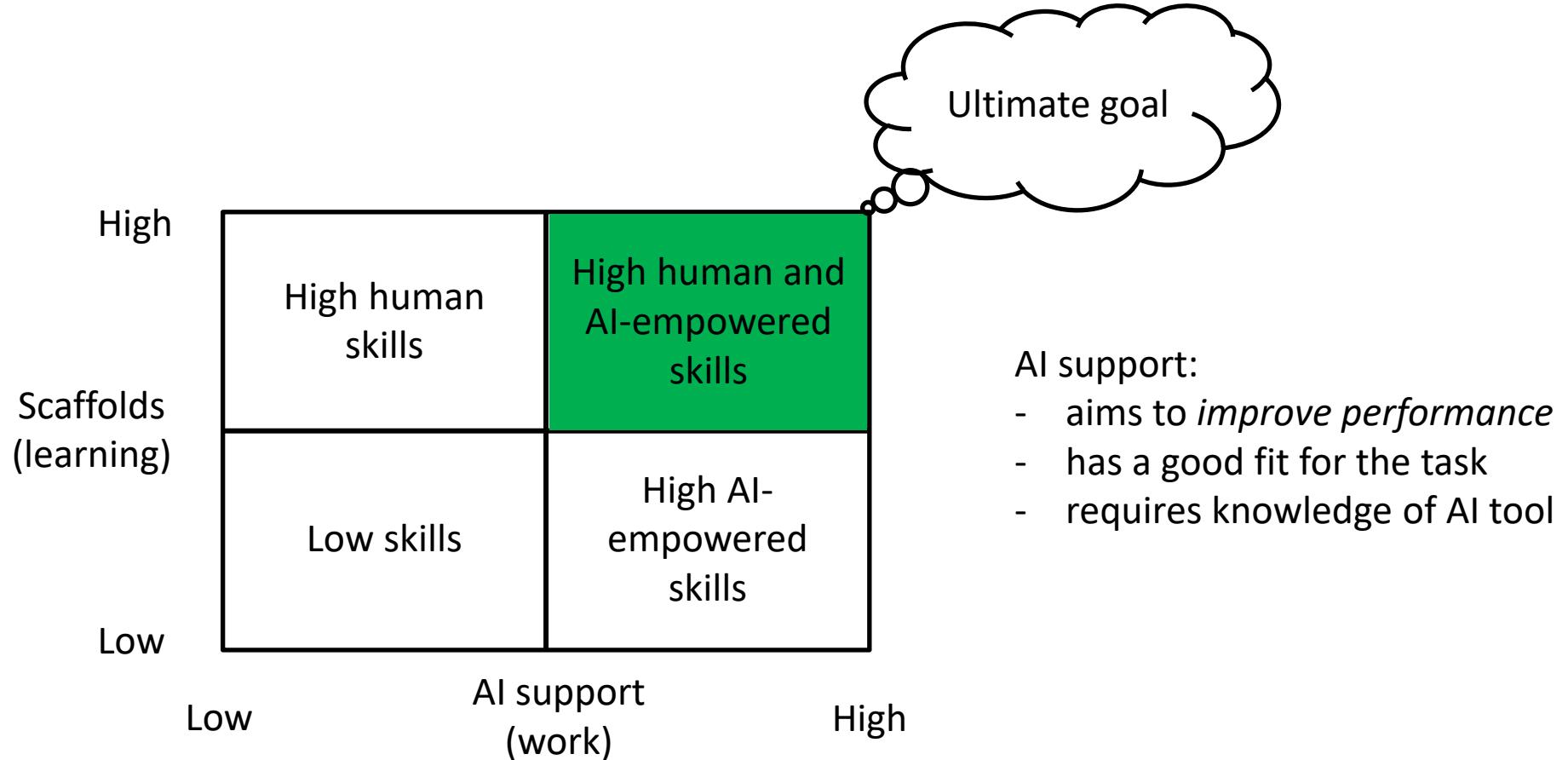
Generative AI (GenAI) technologies, such as large language models (LLMs) and diffusion models (see Box 2 for key definitions of AI terms), have shown promise in automating various learning tasks², delivering feedback on human efficacy³, outperforming average students in reflectively writing⁴, innovating conversational assessments⁵, creating dynamic learning resources⁶ and supporting multimedia learning⁷. However, these technologies also present challenges and ethical considerations that could outweigh their benefits^{2,8}. One major concern is the digital divide, where unequal access to these powerful technologies can exacerbate existing inequalities in learning opportunities⁹. Additionally, over-reliance on GenAI may negatively affect learners' agency, critical thinking and creativity, warranting caution¹⁰.

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

- Scaffolds:**
- aim to *improve human skills*
 - can be implemented with AI



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

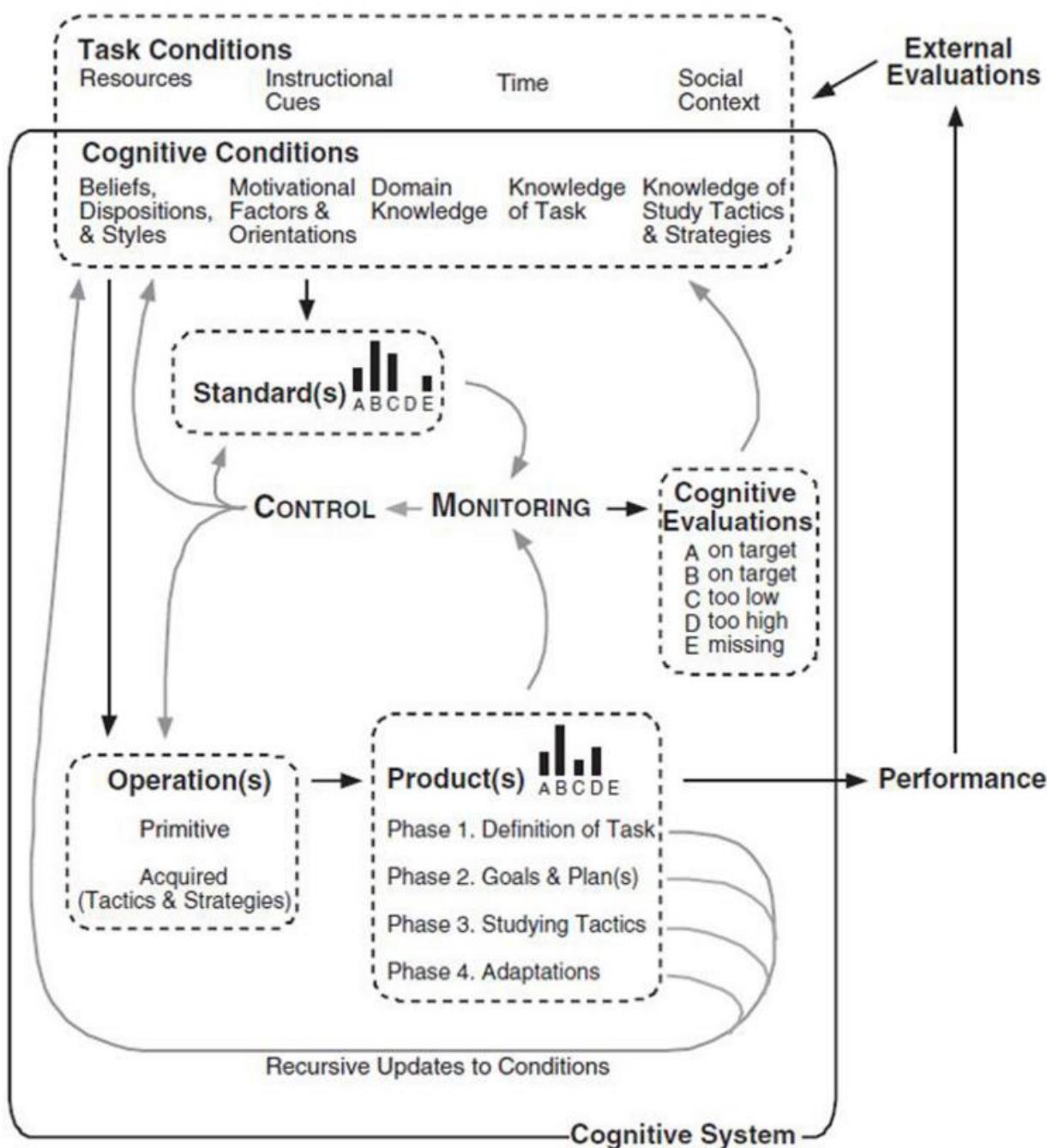
Key takeaway #3

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

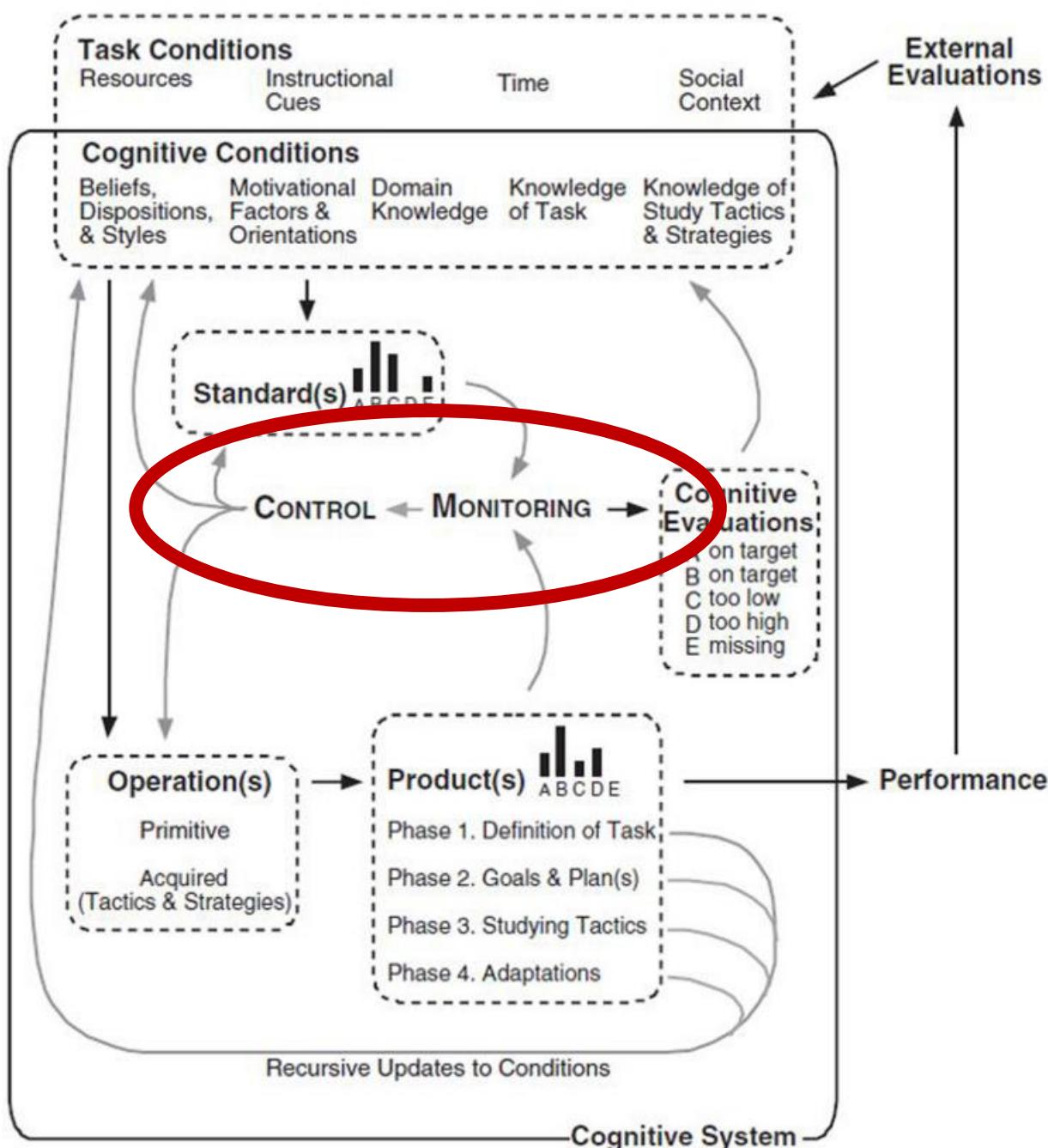
FOUNDATIONS – IMPACT – DIRECTION – FINAL REMARKS

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-

gies 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-

ILLUSTRATION BY DANIEL BAXTER

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.

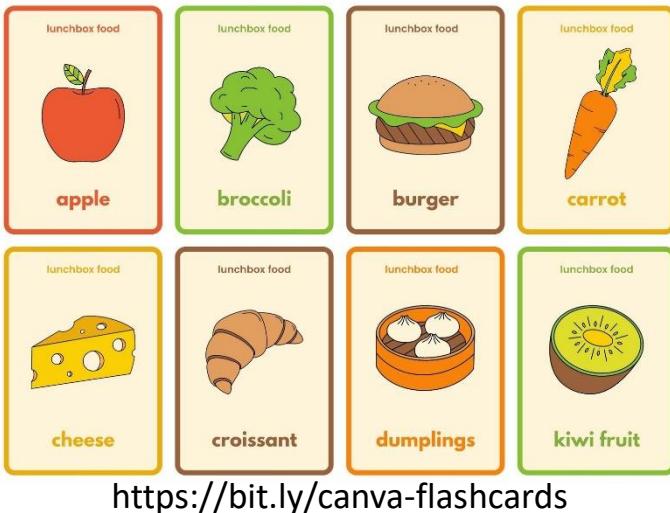
Learning strategies

Table 1

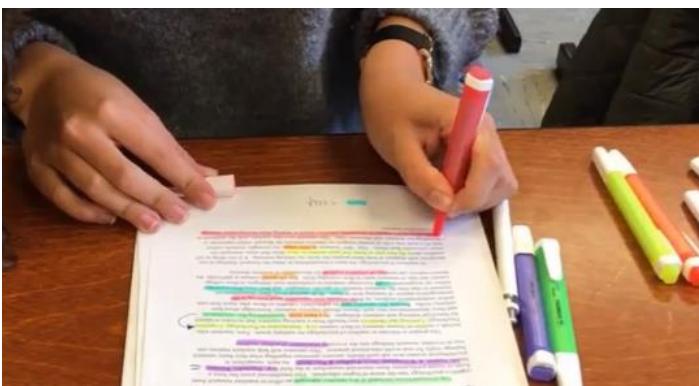
Effectiveness of Techniques Reviewed

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



Learners have a limited repertoire of learning strategies



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

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

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

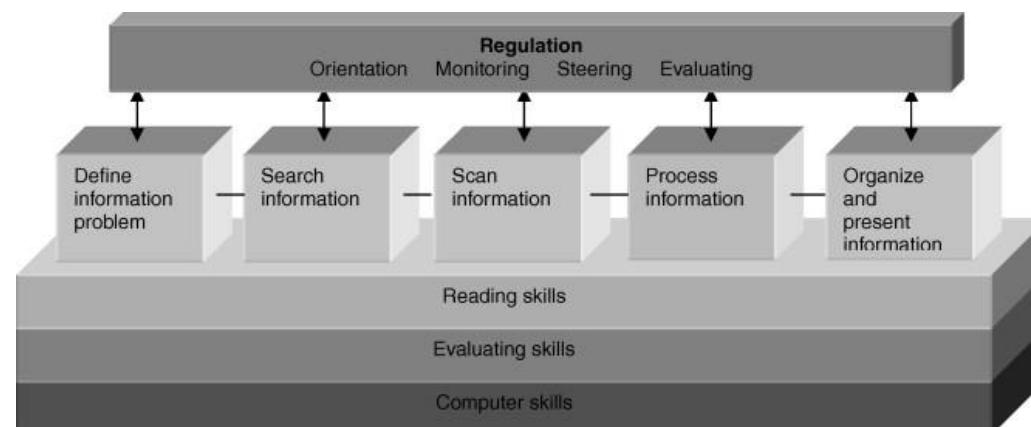
Processing fluency:
illusion of truth effect

Self-regulated learning – monitoring

Processing fluency:
selection of strategy

Information problem solving

Metacognition critical for seeking, selecting, and using information



Brand-Gruwel, S., Wopereis, I., & Walraven, A. (2009). A descriptive model of information problem solving while using internet. *Computers & Education*, 53(4), 1207-1217.

Information problem solving

Learners use unreliable sources and
suboptimal search strategies

Information problem solving



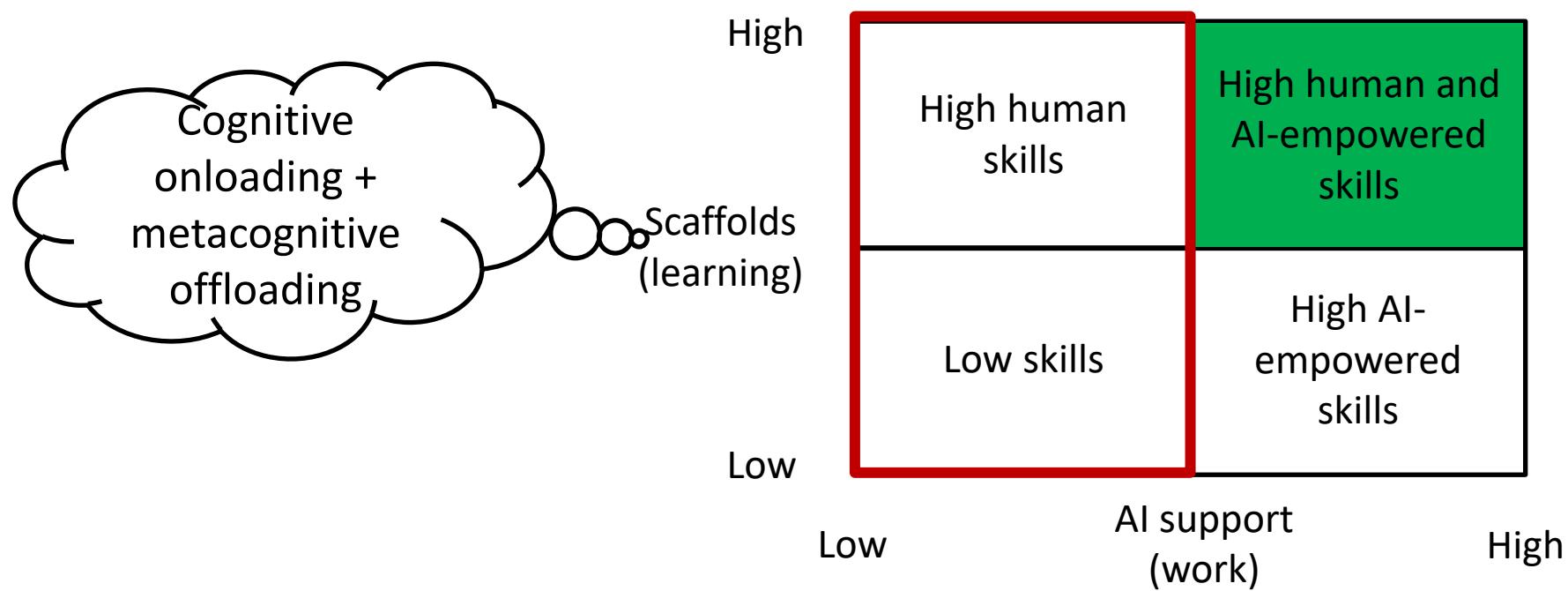
Sensemaking paradox

<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.

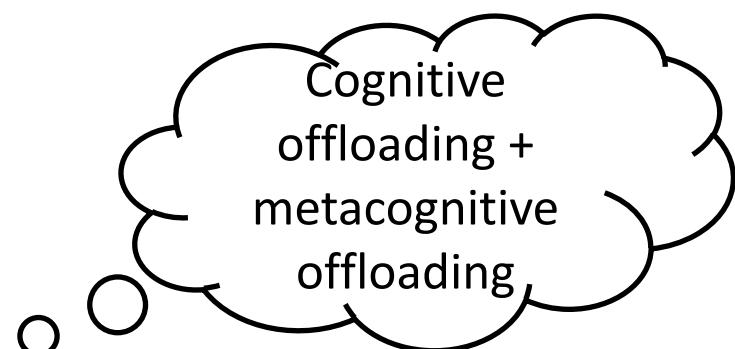
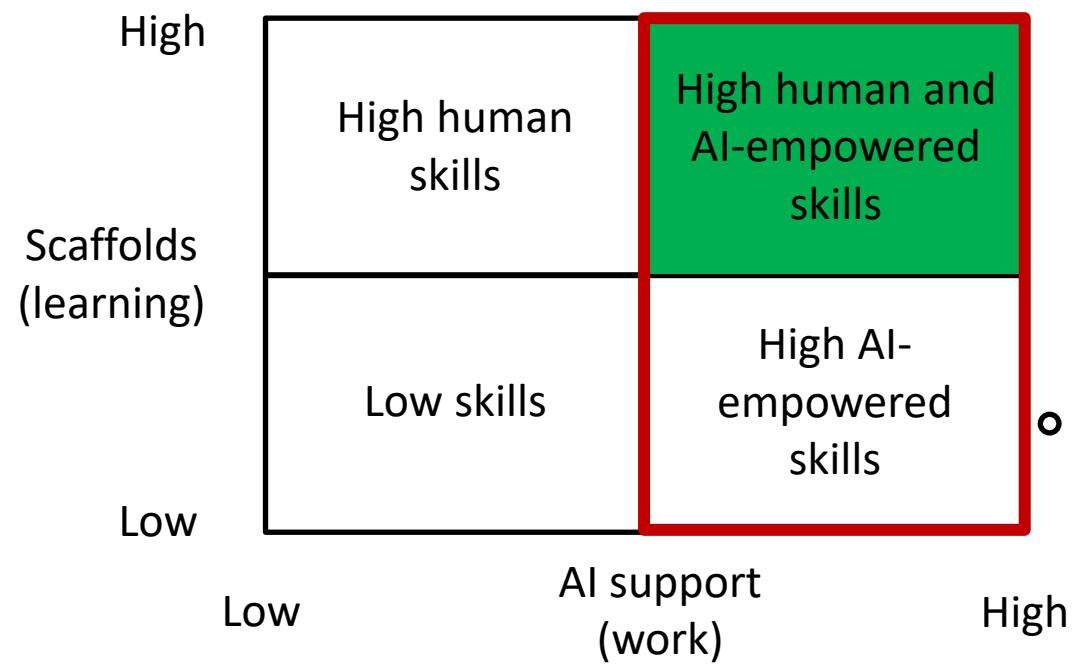
Risk #1

Existing adaptive learning systems



Risk #2

Cognitive offloading



Open challenge

Lazy to think
about own
thinking?!

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

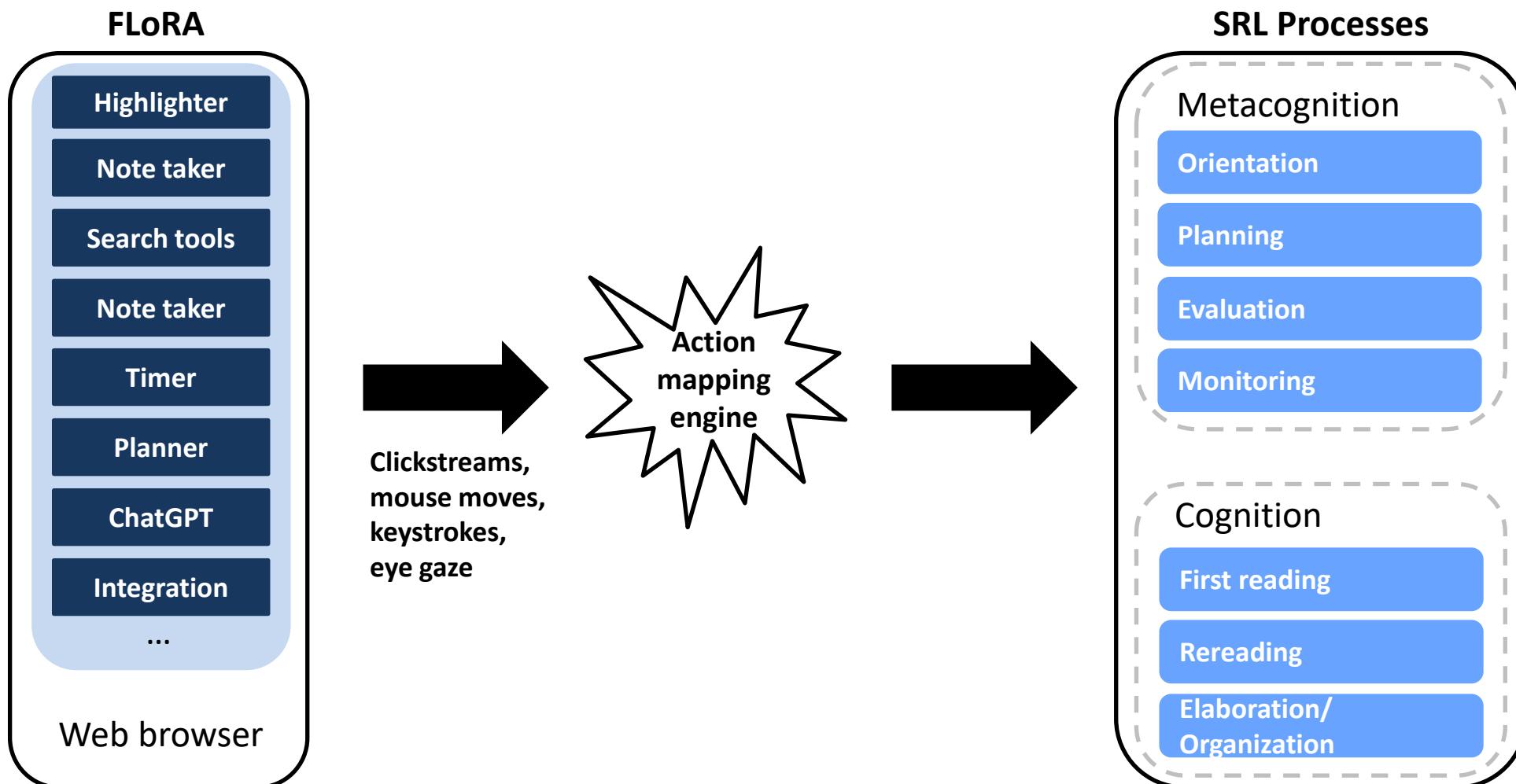
FLoRA

FLoRA My courses Site administration

The diagram illustrates the FLoRA interface structure:

- Navigation zone:** Located on the left, it contains a sidebar menu with sections like "Instructions", "General Instructions", "Rubric", "1: Artificial Intelligence", "2: The School of the future", and "2.5 Learning needs are changing".
- Annotation tool:** A vertical bar on the left side of the main content area.
- Reading zone:** The main content area where learning materials are displayed.
- Annotations in the Reading zone:**
 - A red box highlights a row of five icons: TakeNote, Important, Useful, Concept, and Confusing.
 - A callout arrow points to the "Important" icon.
 - Text below the icons: "You can write the essay using the tool with the pen icon on the right side of the screen."
 - Text at the bottom: "At the end of the learning session, you should be able to:" followed by a bulleted list.
 - Text at the very bottom: "For more information about the criteria of the essay, see the rubric (look at the menu on the right and the
- Instrumentation tools sidebar:** Located on the right, it lists various tools with corresponding icons and arrows pointing to them:
 - Annotation viewer
 - Annotation search tool
 - Scaffolding tool
 - Essay writing tool
 - Planner tool
 - ChatGPT tool
 - Timer tool
- Navigation bar:** At the top right, it includes icons for notifications, user profile, font size, and edit mode.

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

Hybrid human-AI regulation

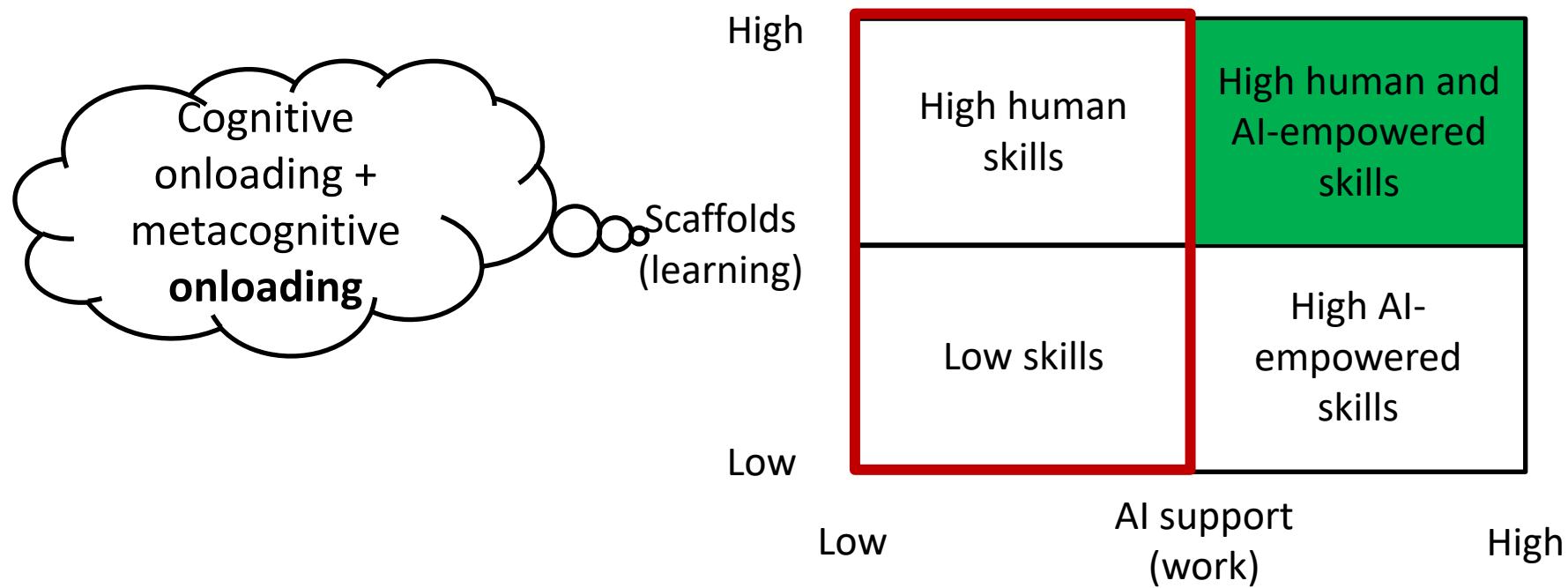
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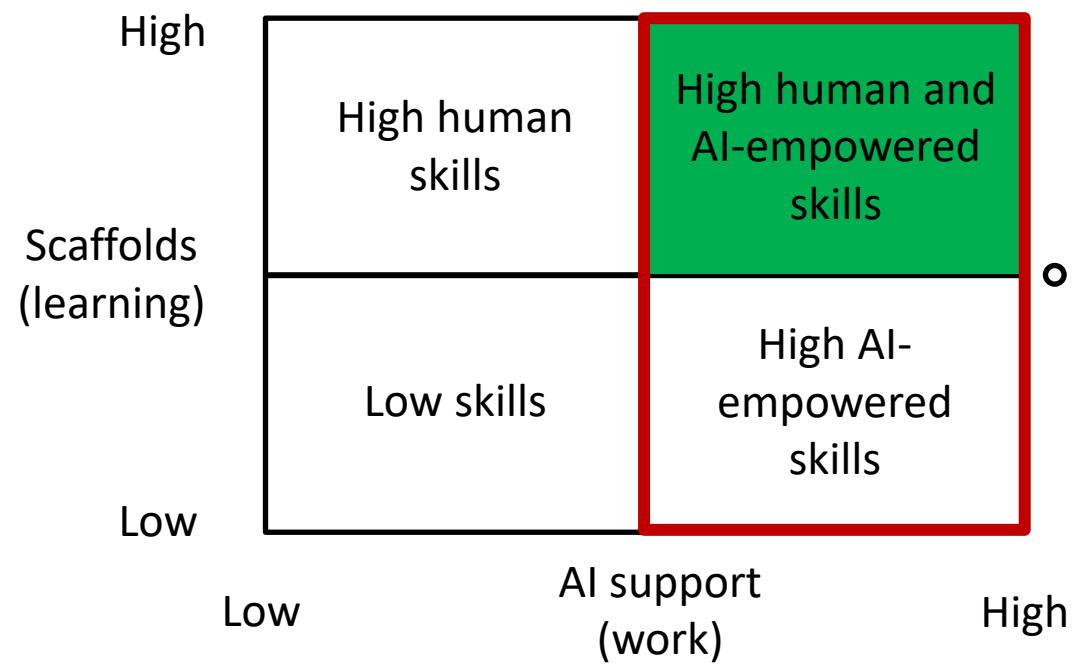
Framework

Hybrid human-AI regulation



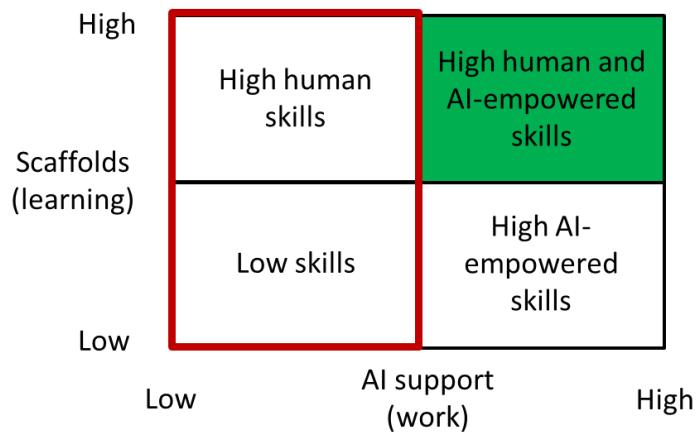
Framework

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

FLoRA My courses Site administration

AU - Edit mode

General Instructions

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 how 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 X

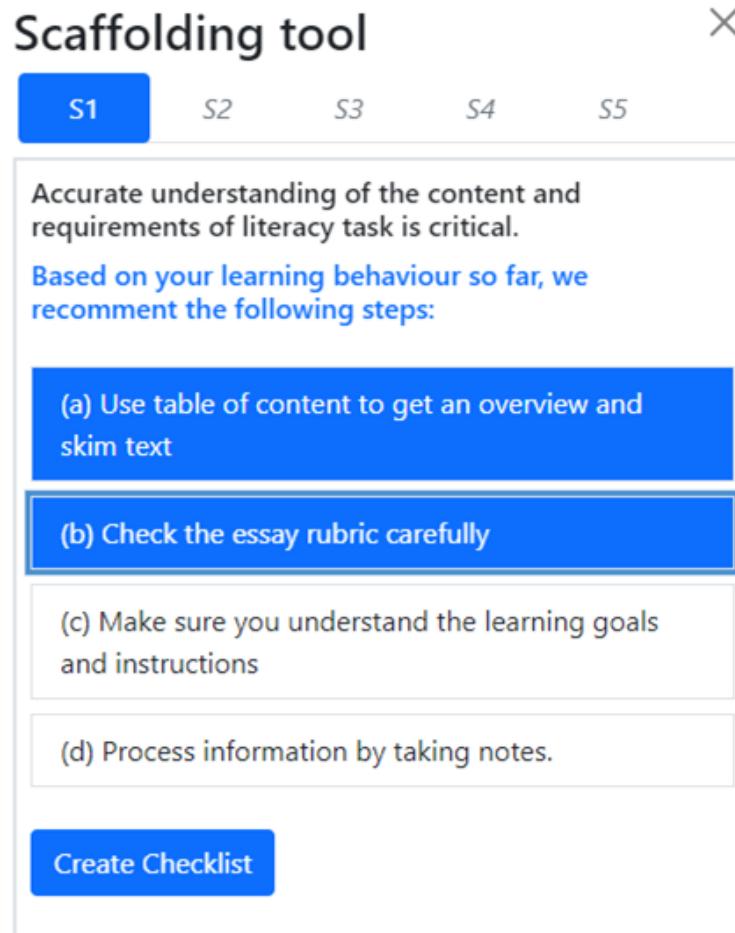
S1 S2 S3 S4 S5

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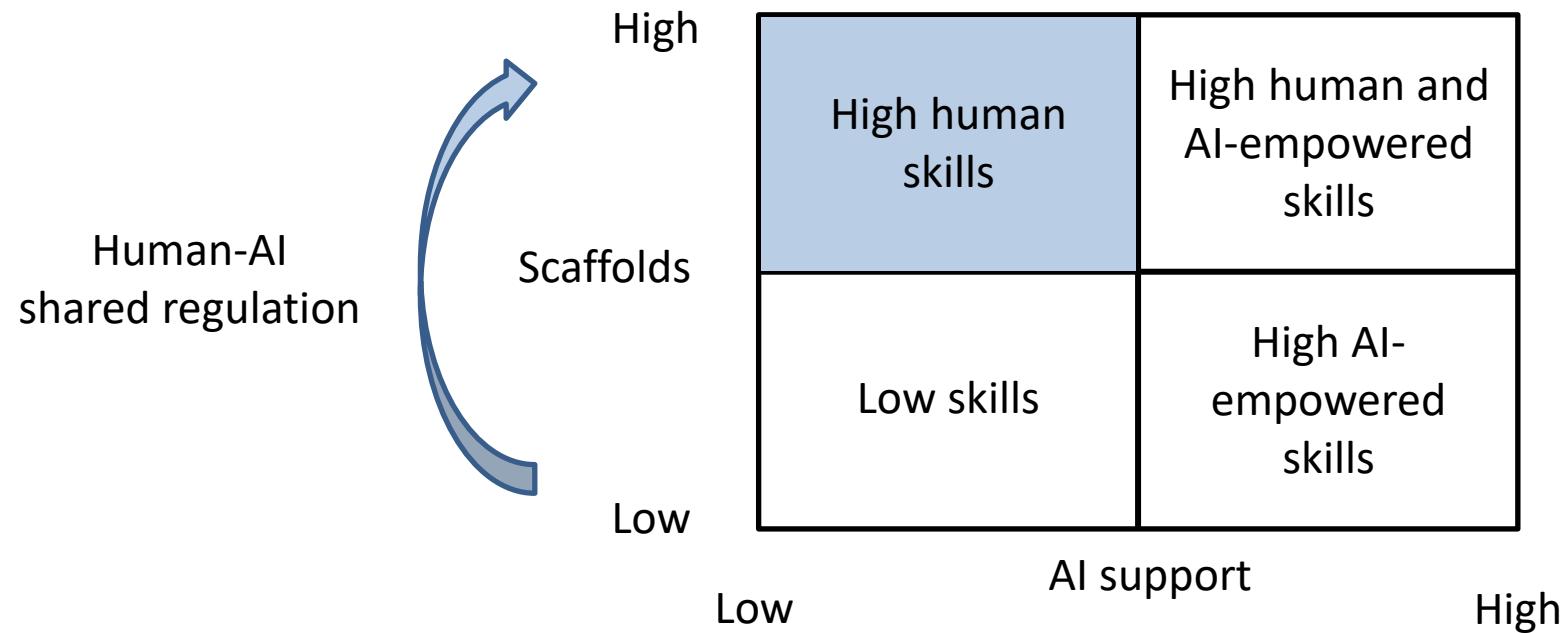
- (a) Use table of content to get an overview and skim text
- (b) Check the essay rubric carefully**
- (c) Make sure you understand the learning goals and instructions
- (d) Process information by taking notes.

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

FLoRA My courses Site administration

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 ...](#)

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

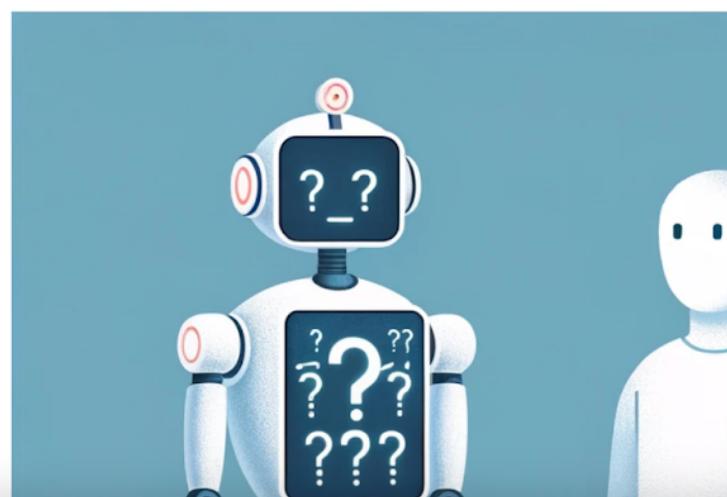


PAGE

2.4 Patient's perspectives

Page Settings More ▾

Researchers at a US university found that many patients do not trust AI systems for various reasons. For example, an AI doctor (robot) may sometimes ask the patient to do things that 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

FLoRA My courses Site administration

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...](#)

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[2.8 How does hospitals in ...](#)

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



PAGE

2.4 Patient's perspectives

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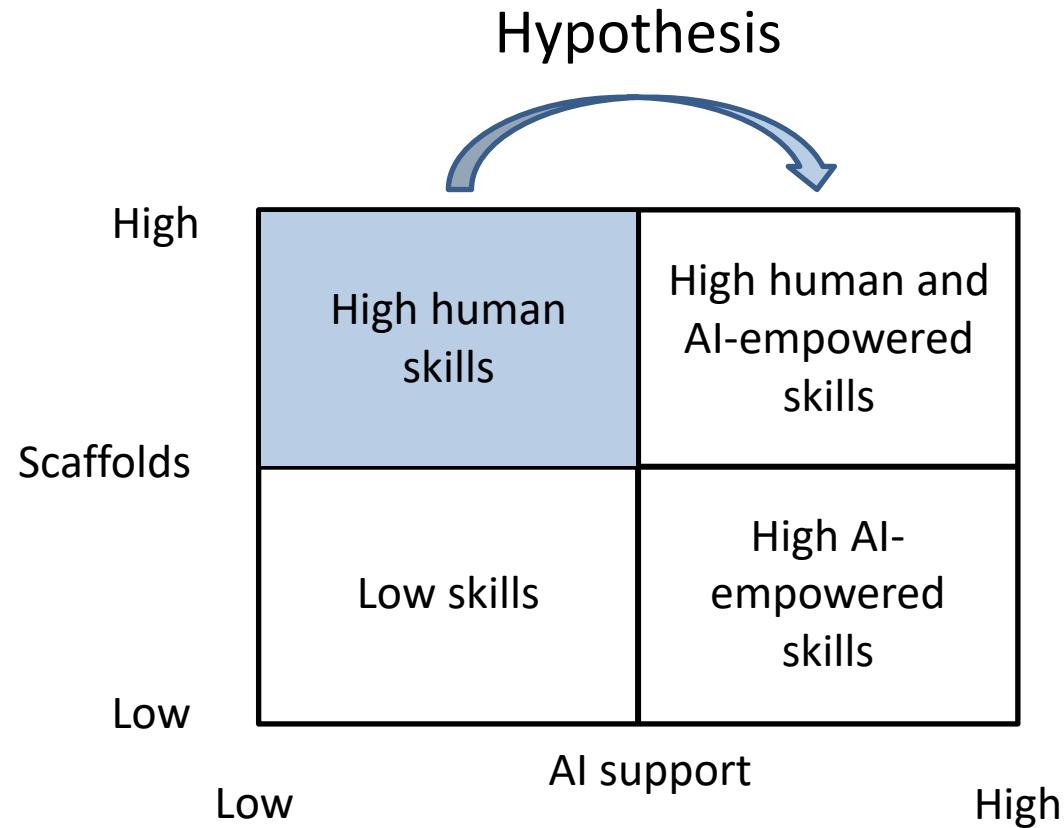
Researchers at a US university have found that AI can help patients with depression. For example, a patient might be asked to wear a device that tracks their heart rate and breathing. This information can be used to make her or him unconscious.



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

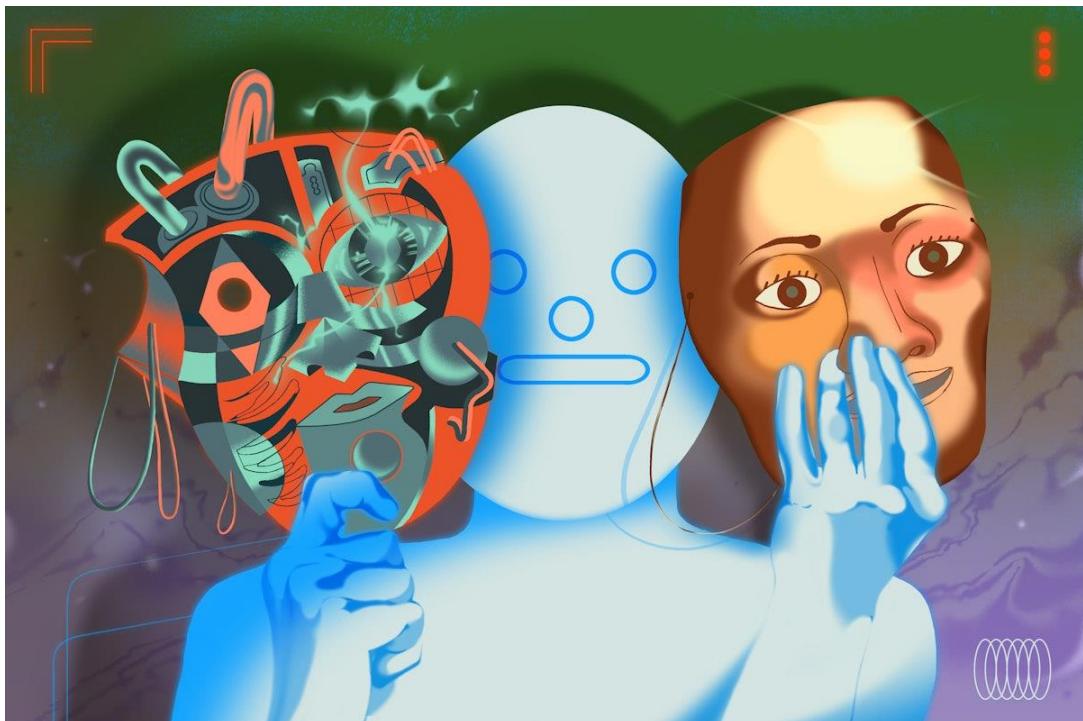
Towards high human and AI-empowered skills



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

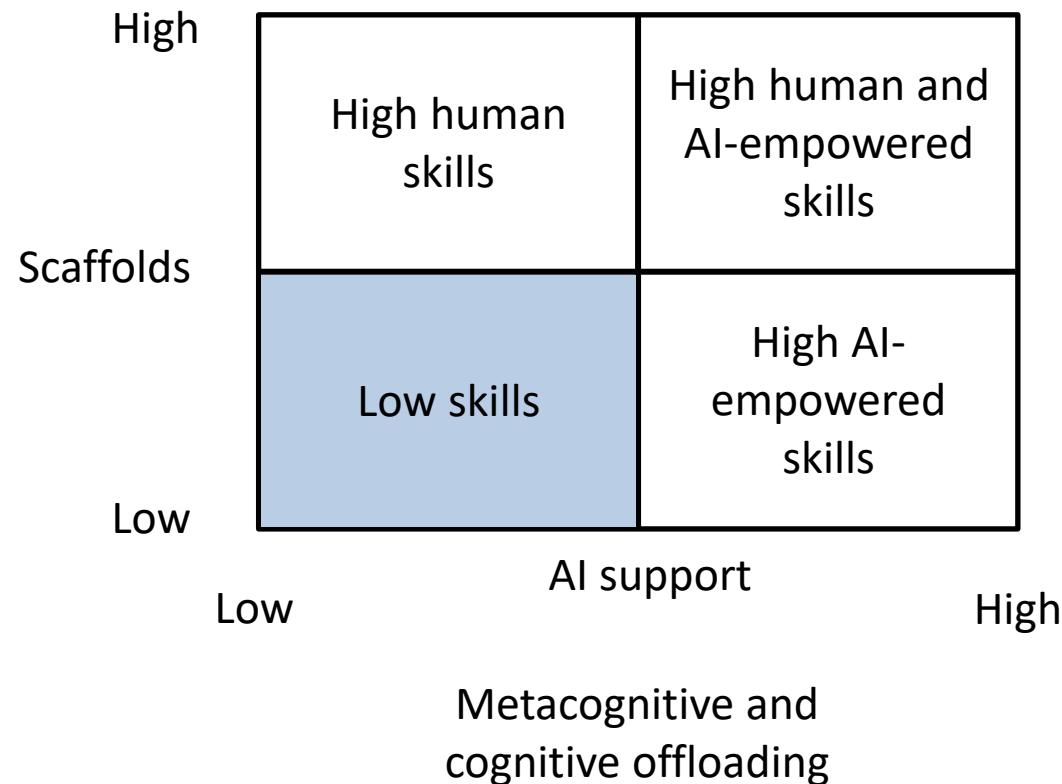
Metacognitive offloading

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

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Edit mode

Instructions

General Instructions

Rubric

1: Artificial Intelligence in Education

- [1.1 Definition of Artificial Intelligence](#)
- [1.2 History of Artificial Intelligence](#)
- [1.3 How does AI work?](#)
- [1.4 Ethics and risks of developing AI](#)
- [1.5 Supervised machine learning](#)
- [1.6 Unsupervised machine learning](#)
- [1.7 Reinforcement learning](#)
- [1.8 Deep Learning](#)

2: Differentiation in Education

- [2.1 What is Differentiation?](#)
- [2.2 Using differentiation to support all learners](#)
- [2.3 Standards for teaching](#)

3: Scaffolding in Education

- [3.1 The development of scaffolding](#)
- [3.2 What is cognitive apprenticeship?](#)
- [3.3 What is scaffolding?](#)
- [3.4 Applications of scaffolding](#)
- [3.5 Applications of cognitive apprenticeship](#)

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 topics for envisioning the future of education in 2035.

Essay Writing

222 words

Normal **B** I x_1 x^2 Σ \equiv \approx \neq \subseteq \supseteq

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

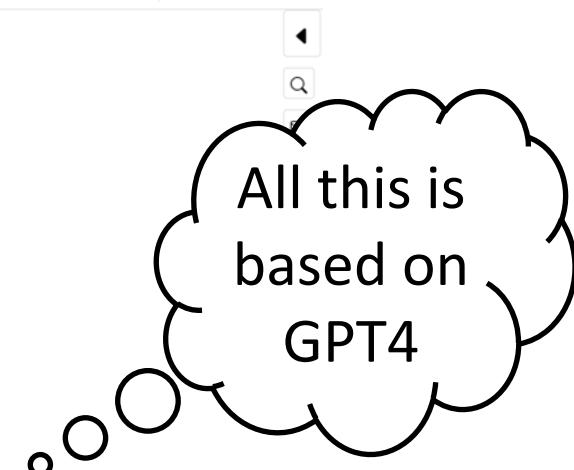
Essay Sentence: And the scaffolding is that the work is shared alone between the learner and some more knowledgeable other or agent.
Integration Level: Evaluate and create

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

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AU Edit mode

General Instructions

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 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.

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Checklist Tool

- Basic**: Essay Sentence: Nowadays, the role of AI in education is limited in some educational products. Integration Level: Remember and understanding
- Academic**: Essay Sentence: More and more data are needed to make AI work better. Integration Level: Evaluate and create
- Originality**: 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
- Integration and Reuse**: 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 minutes.

Learning content

- Instructions**
 - General Instructions
 - Rubric
- 1: Artificial Intelligence**
 - 1.1 Definition of Artificial Intelligence
 - 1.2 History of Artificial Intelligence
 - 1.3 How does AI work?
 - 1.4 Ethics and risks of AI
 - 1.5 Supervised machine learning
 - 1.6 Unsupervised machine learning
 - 1.7 Reinforcement learning
 - 1.8 Deep Learning
- 2: Differentiation in Education**
 - 2.1 What is Differentiation in Education?
 - 2.2 Using differentiation in the classroom
 - 2.3 Standards for teaching differentiation

Navigation menu

3: Future Learning_1 / General Instructions

PAGE General Instructions

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:

1. Artificial intelligence and its applications

2. What differentiation is and how it can be used

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- combine the concepts into a cohesive vision essay

For more information about the assignment, please refer to the rubric.

Save Essay

(Stage 1)

Notes Panel

Search Tool

Essay tool

Planner Tool

Dictionary Tool

Timer

Checklist Tool

ChatGPT Tool

Ask Teacher Tool

(Stage 2)

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

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Ask a question...

Ask Teacher Tool

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

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

x

Instructions

General Instructions

Rubric

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- [1.1 Definition of Artificial Intelligence](#)
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- [1.8 Deep Learning](#)

2: Differentiation in Education

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3: Future Learning_1 / General Instructions

PAGE

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CL

AI

HE



Revise essay by themselves

Learning content

x

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General Instructions

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AI



HE

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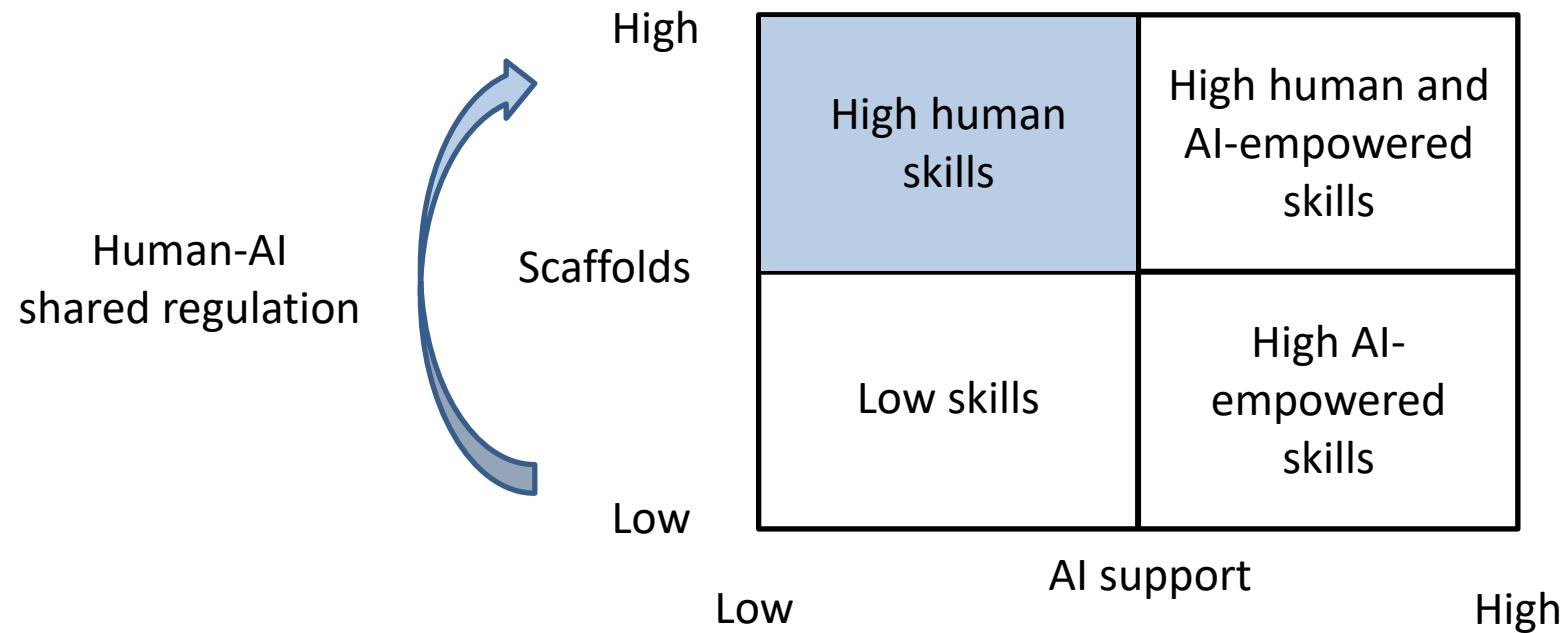
This analysis may take around 5-10 min to process.

Analyse

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

Resource Feedback
Please evaluate the resource based on the following criteria.

I don't want to moderate this resource

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 mistake they make when painting their own ER diagram. But there is a problem in this ER diagram, the line between "A restaurant" and "manage" need to be two lines, because the weak entity set must necessarily participate totally in their identifying relationship. 0 0

Result: Approved (3.7)

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

MY FEEDBACK IS APPROPRIATE - SUBMIT ANYWAY
EDIT COMMENT

Resource Feedback
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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

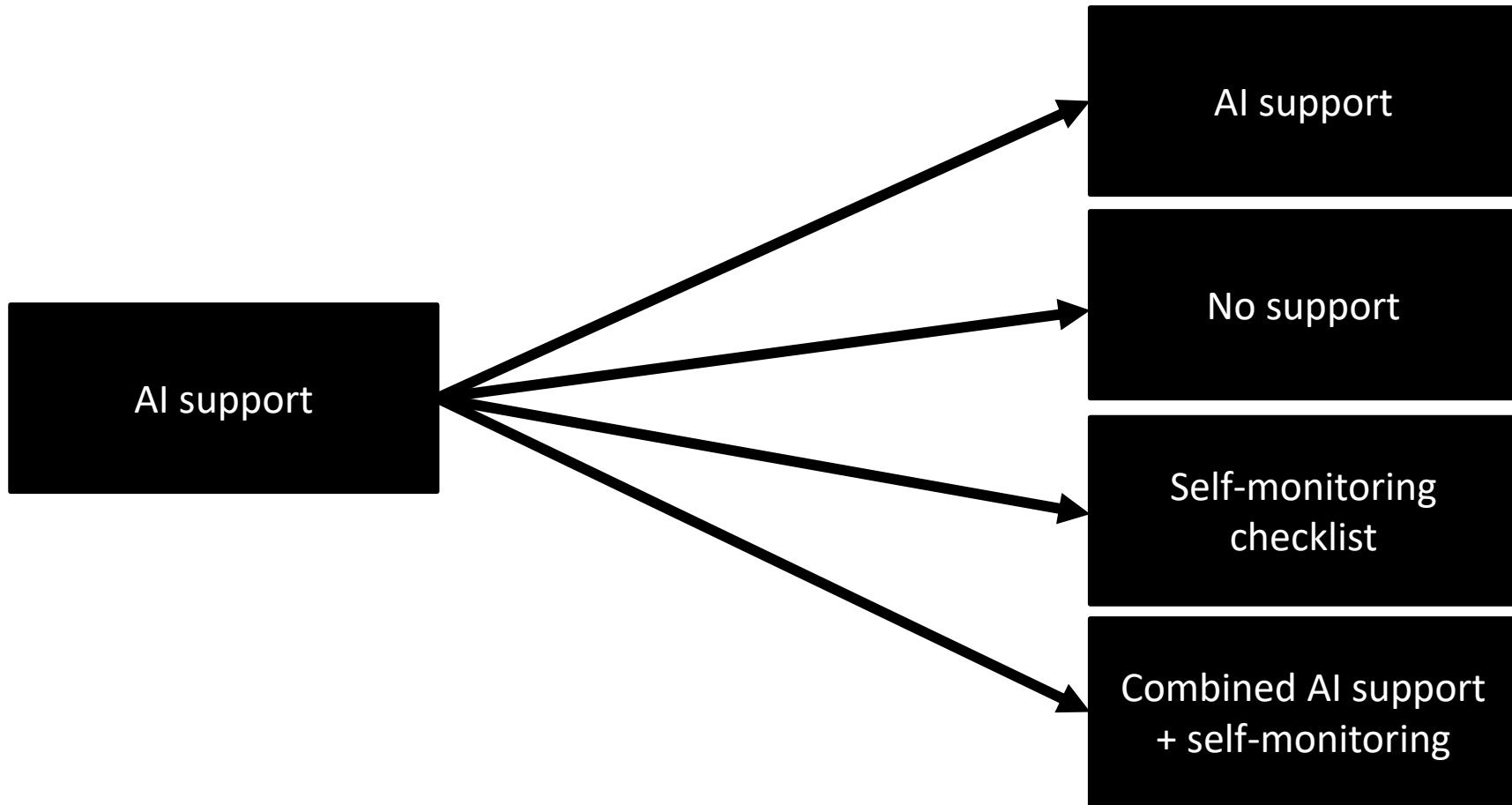
The content of the question is good. However, please revise the answer. Distractor C is also correct in addition to the option A that has been selected. It would be better to change the question either by making it a multiple-answer or negating option C.

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

SUBMIT

Longitudinal impact on monitoring



AI support and monitoring

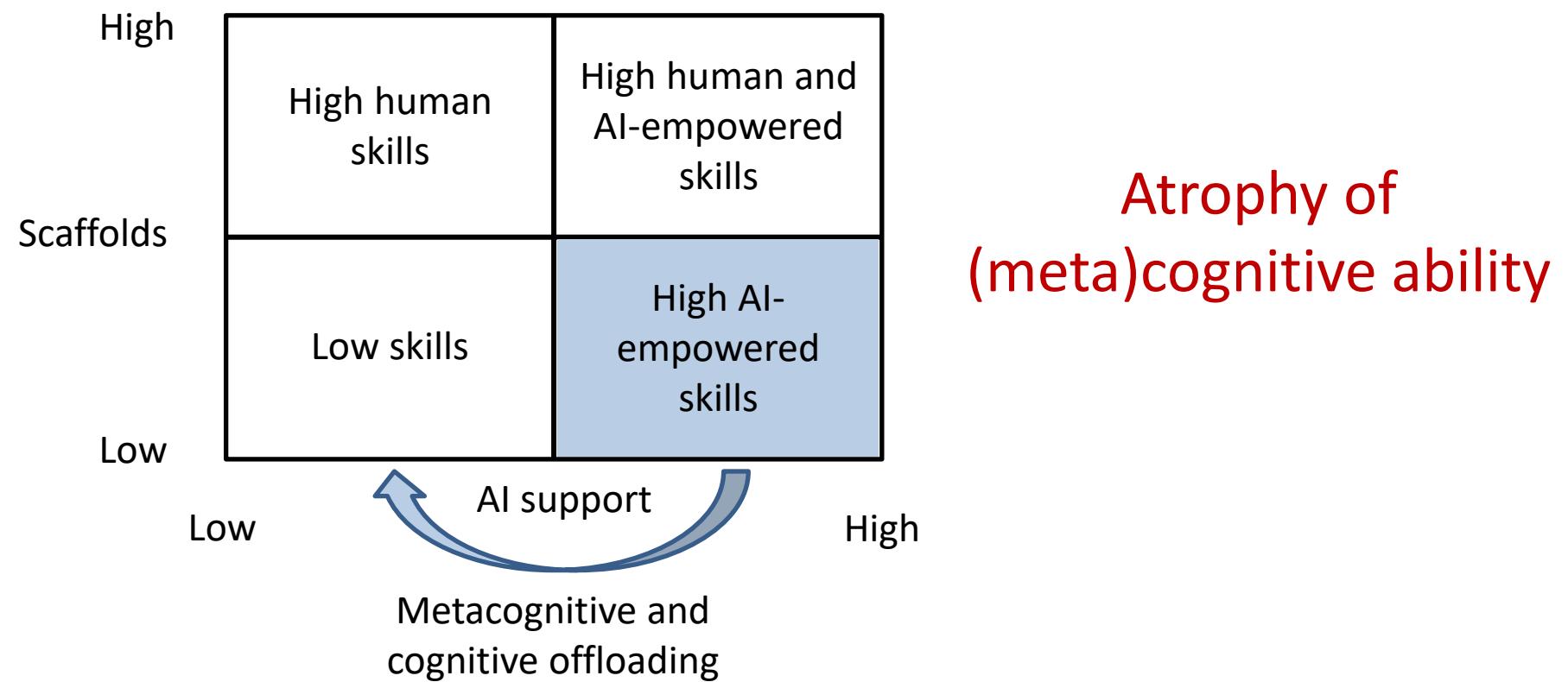
Benefits deteriorate when
AI support is removed

AI support and monitoring

Benefits deteriorate when
AI support is removed

“Generative AI can harm learning”

Long term effects of unscaffolded AI-support

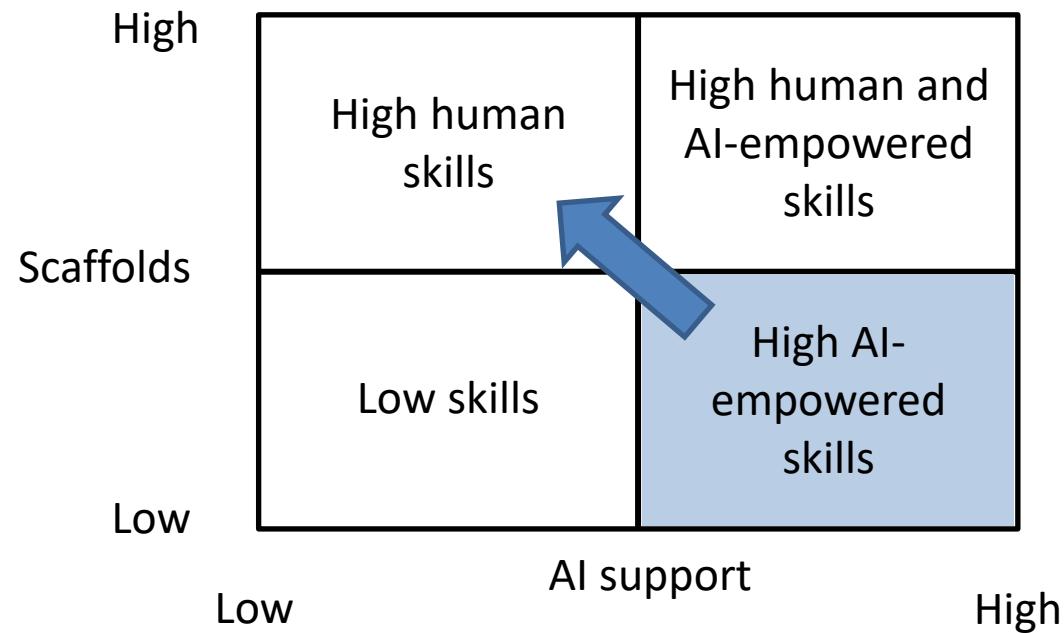


AI support and judgment of learning

Benefits present* when
AI support replaced by scaffolds

*But not as high as they are with AI support

AI-support after replaced with scaffolds

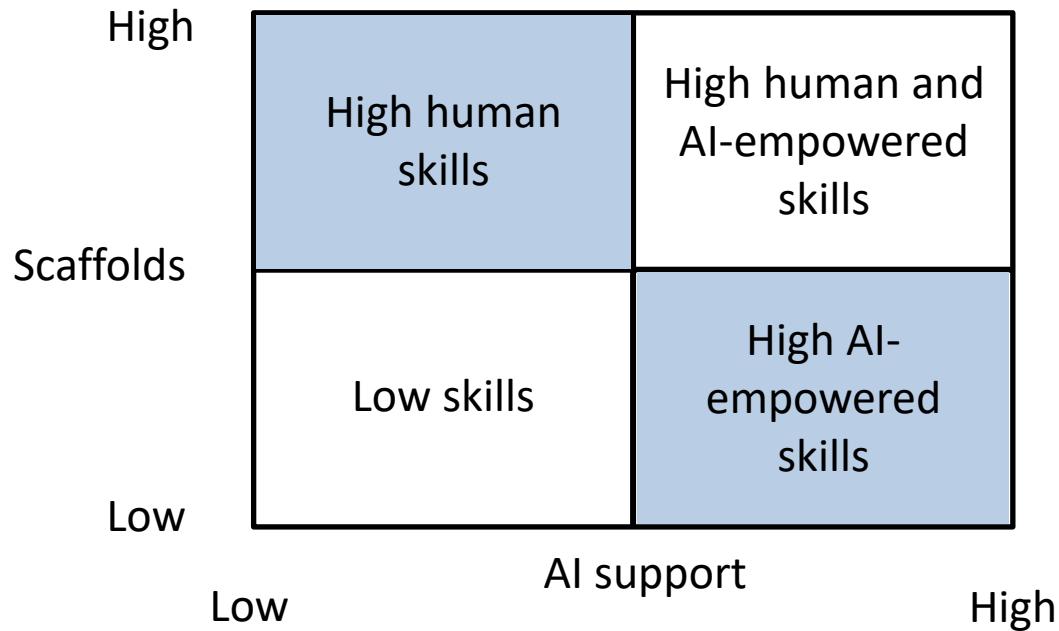


Positive, but
not novel

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

FLoRA My courses Site administration

AU Edit mode

General Instructions

3: Future Learning / General Instructions

General Instructions

Page Settings More

Essay Writing 236 words

Normal B I U Σ x_1 x^2 \equiv \equiv \equiv \equiv

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.

ChatGPT Tool

Can you give more advice on how to improve the essay?

18:00:1

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

x

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AI



HE

Revise essay by themselves

Learning content

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Writing performance

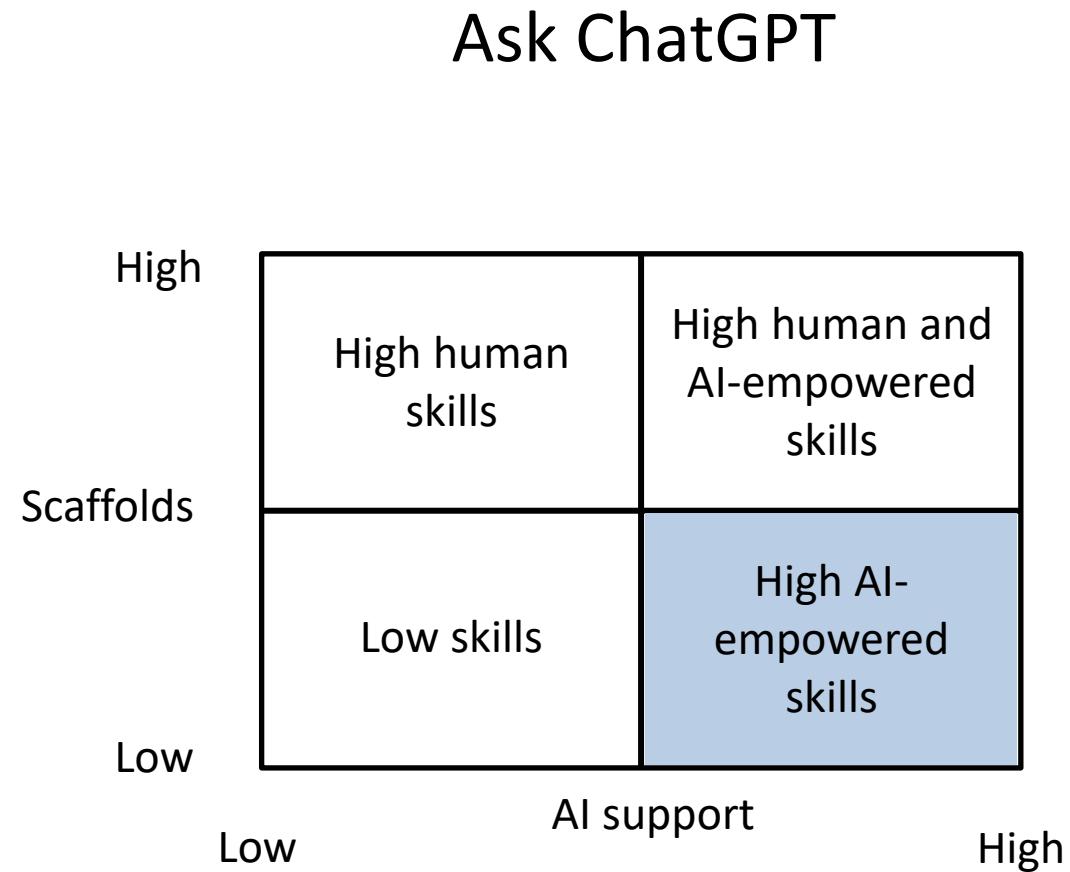
Unsurprisingly writing performance is improved when using ChatGPT

ChatGPT significantly higher essay scores than the other three

Metacognition in information problem solving

Limited monitoring when information provided by generative AI

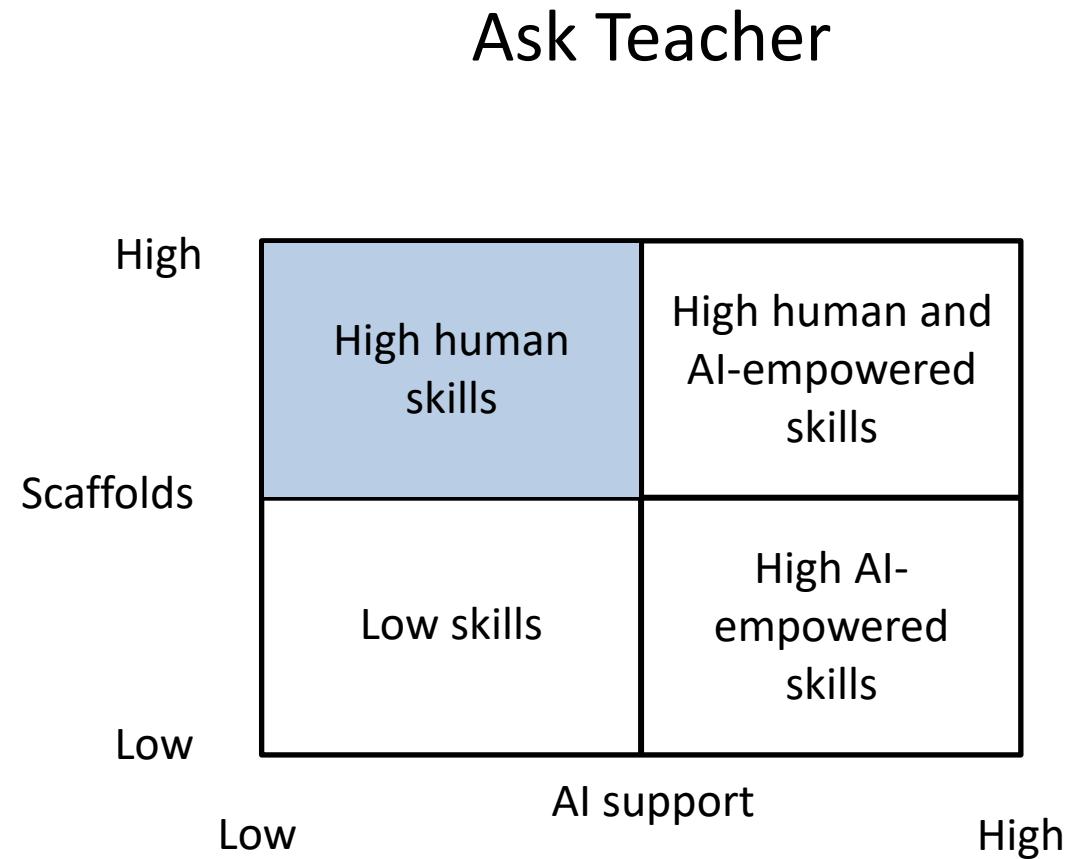
Towards high human and AI-empowered skills



Metacognition in information problem solving

Always observed evidence of monitoring
of human provided information

Towards high human and AI-empowered skills

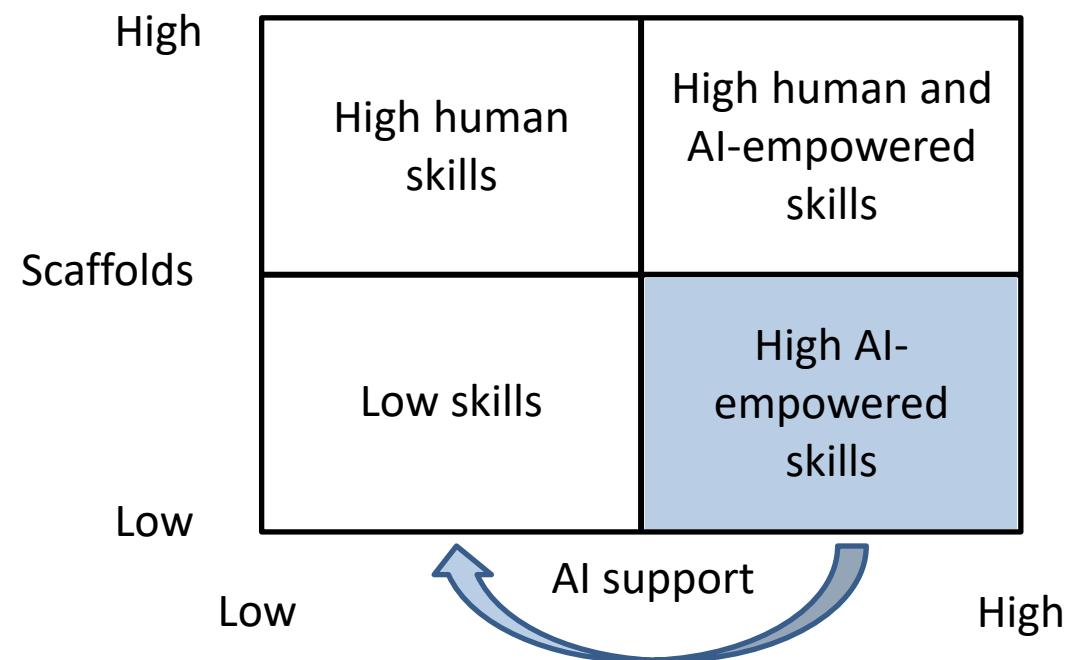


Metacognitive engagement

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,^{1*} Osbert Bastani,^{2*} Alp Sungu,^{1*†}
Haosen Ge,³ Özge Kabakçı,⁴ Rei Mariman

¹Operations, Information and Decisions, University of Pennsylvania

²Computer and Information Science, University of Pennsylvania

³Wharton AI & Analytics, University of Pennsylvania

⁴Budapest British International School

Metacognitive laziness



Computers in Human Behavior 160 (2024) 108386



Contents lists available at [ScienceDirect](#)

Computers in Human Behavior

journal homepage: www.elsevier.com/locate/comphumbeh



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

Matthias Stadler ^{a,*}, Maria Bannert ^b, Michael Sailer ^c

^a Institute of Medical Education, LMU University Hospital, LMU Munich, Germany

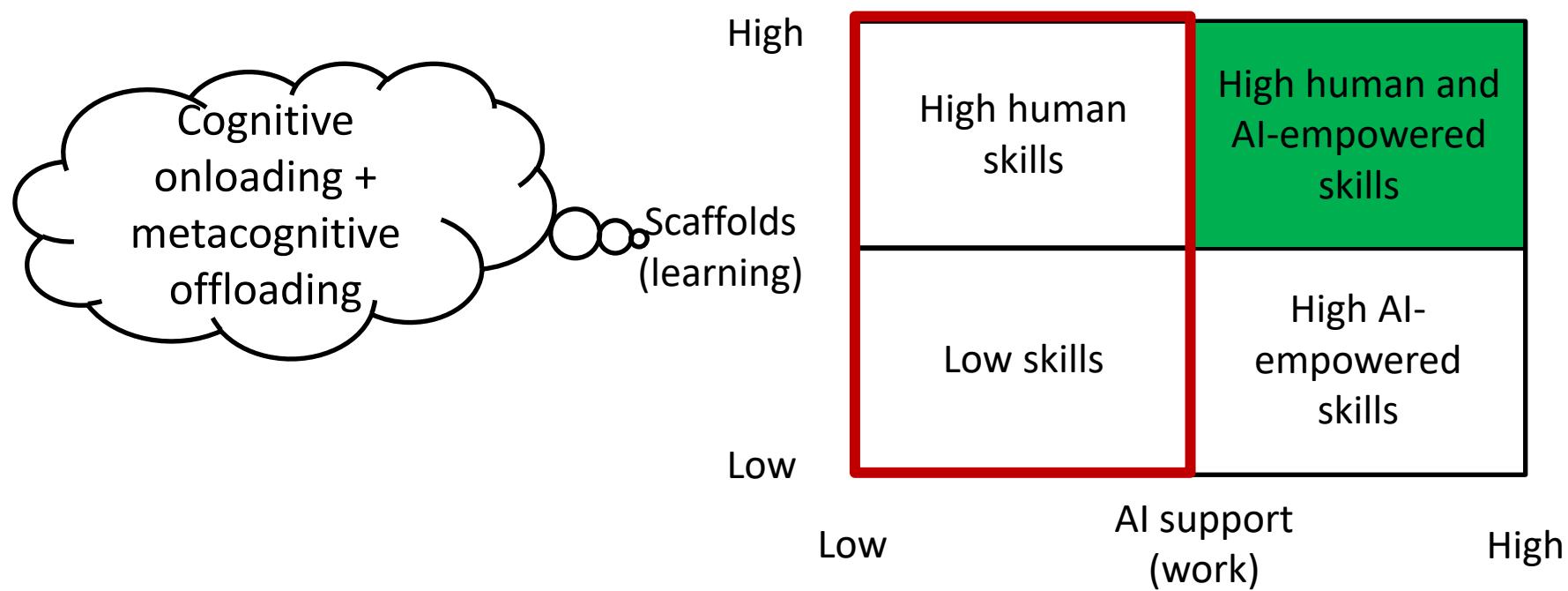
^b Chair for Teaching and Learning with Digital Media, Technical University of Munich, Germany

^c Learning Analytics and Educational Data Mining, University of Augsburg, Augsburg, Germany

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

Risk #1

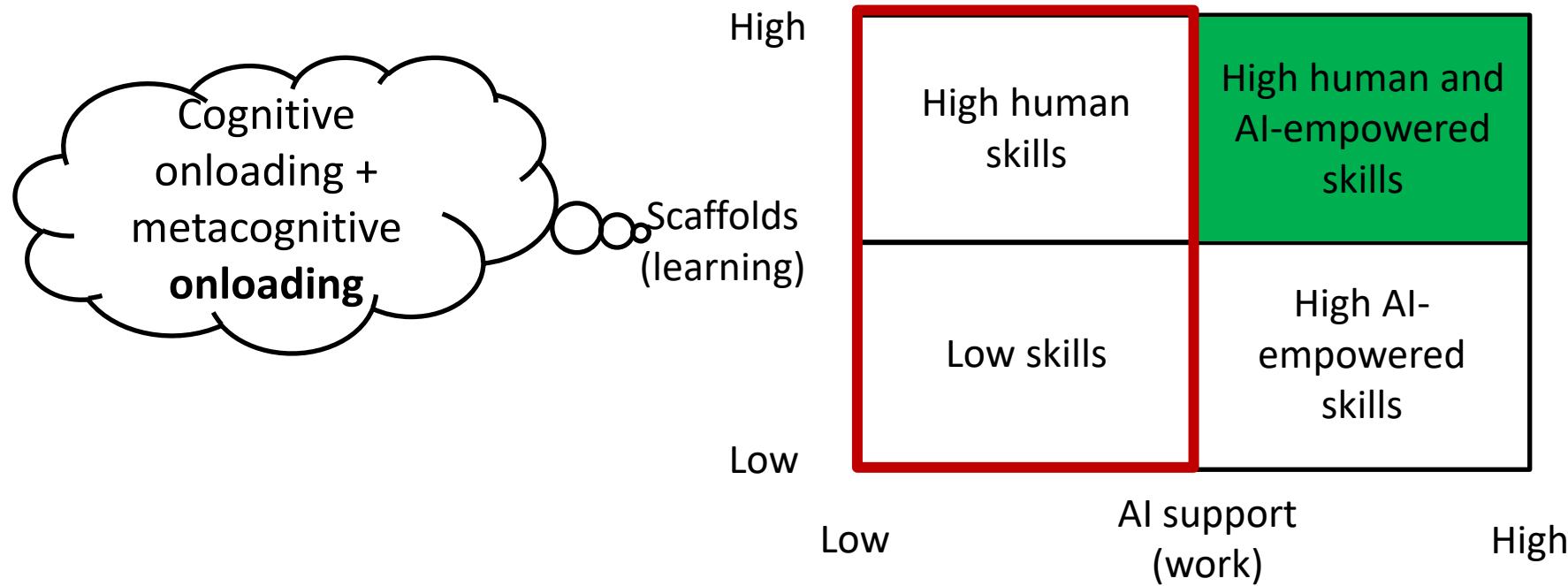
Existing adaptive learning systems



Opportunity #1

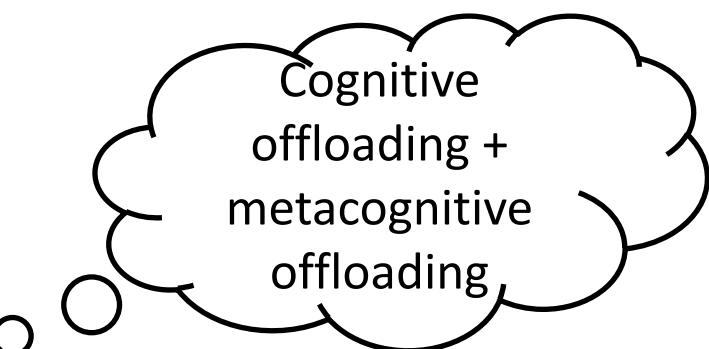
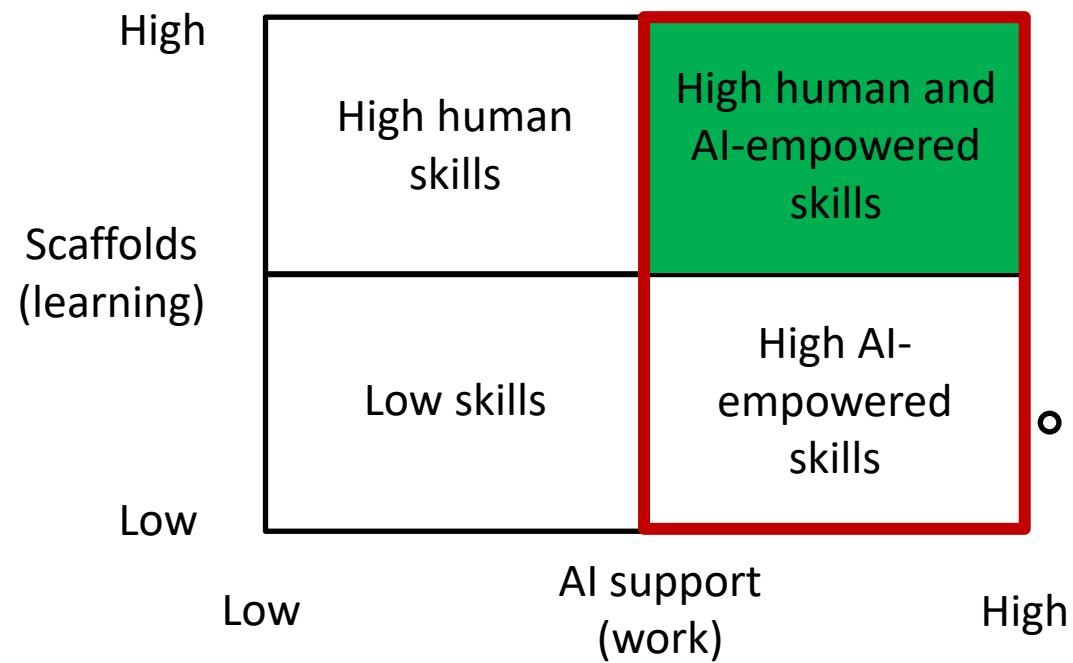
AI-powered
personalized
scaffolds

Hybrid human-AI regulation



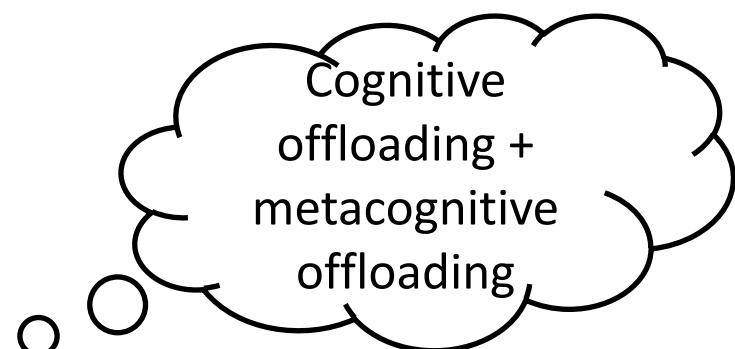
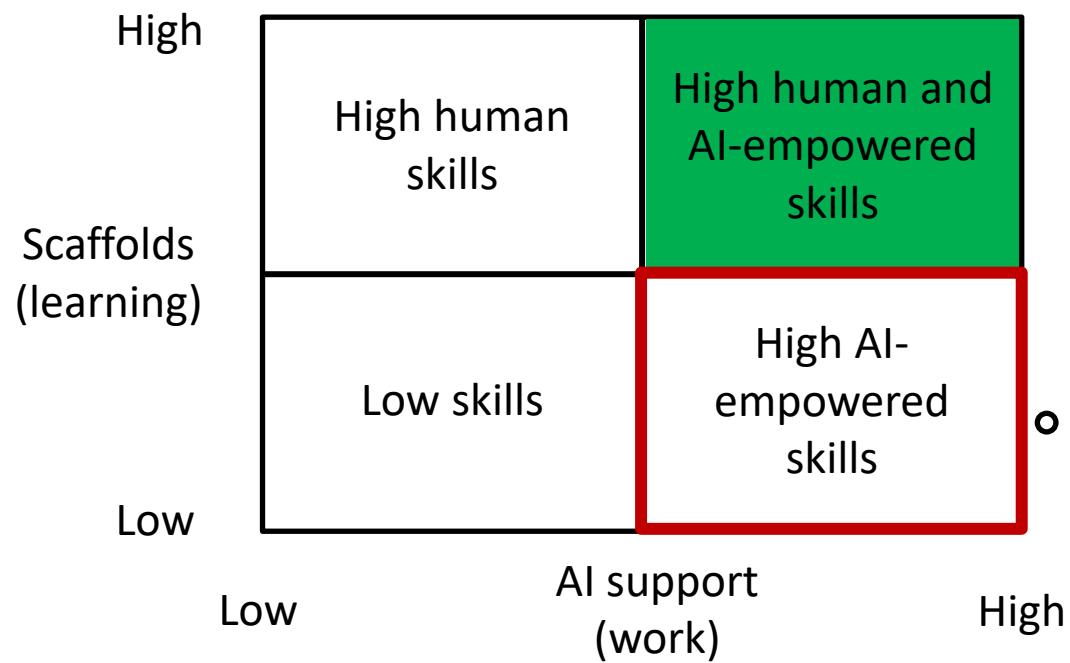
Risk #2

Cognitive offloading



Risk #2

Cognitive offloading



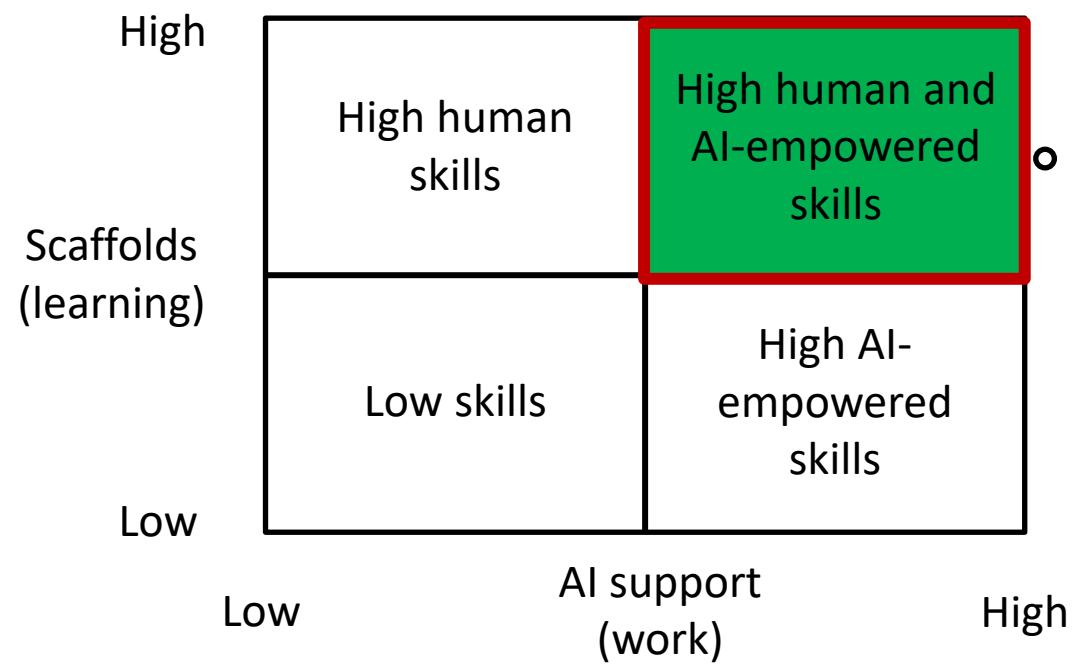
Metacognitive engagement

How to minimize risks of
AI-empowered skills?

Makes developing human skills worse

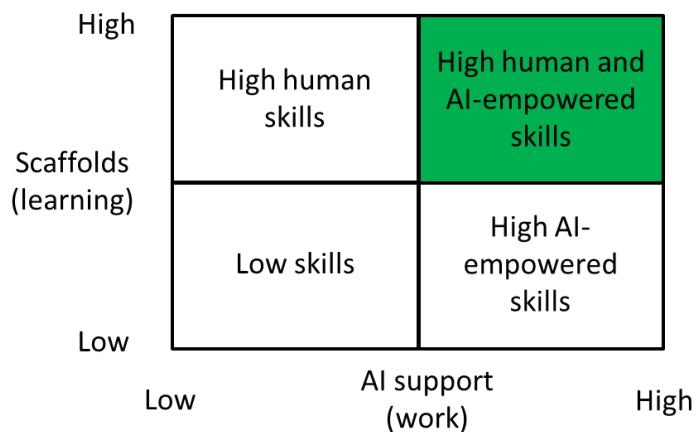
Opportunity #2

Metacognitive onloading



Cognitive offloading +
metacognitive
onloading

Proposition

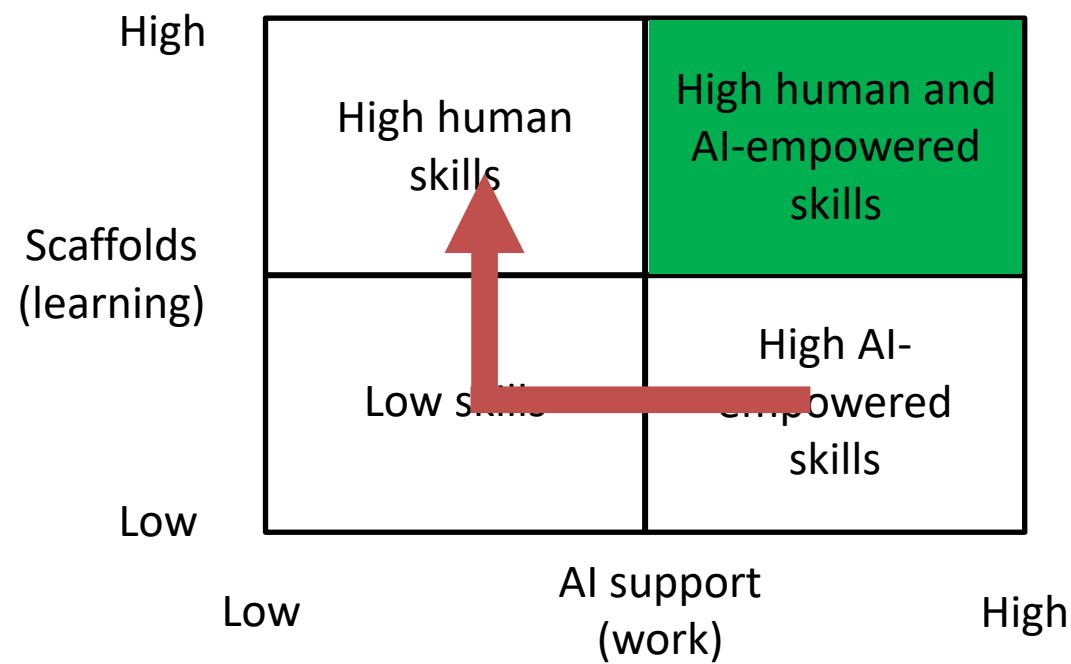


Combined human and AI-empowered
only at high expertise levels

Regulation needed in complex authentic tasks

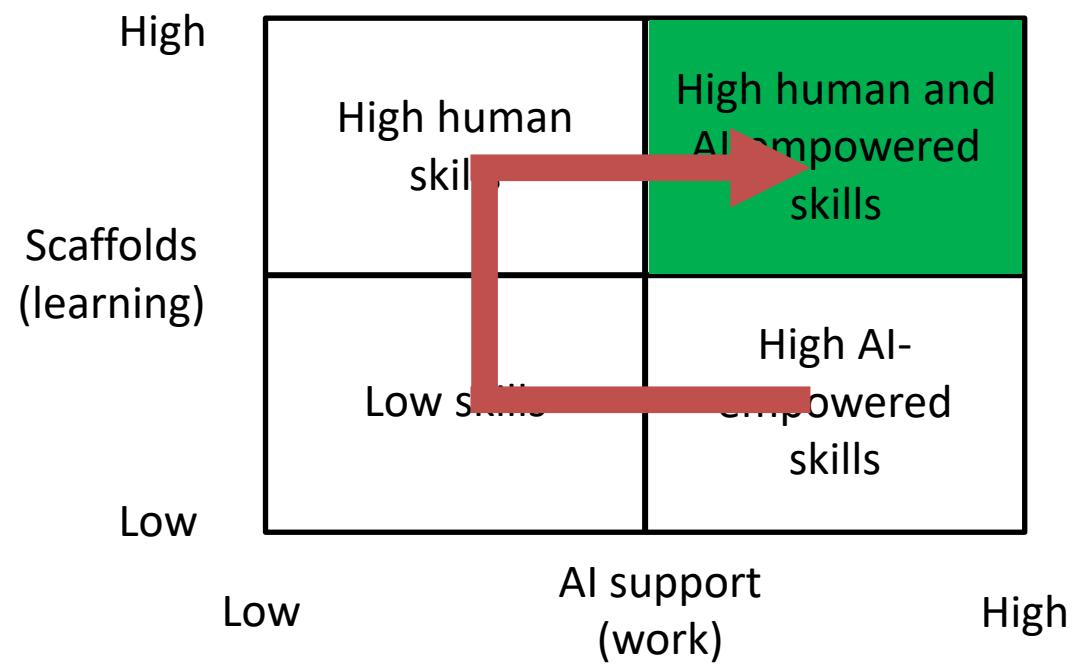
Opportunity #2

Metacognitive onloading

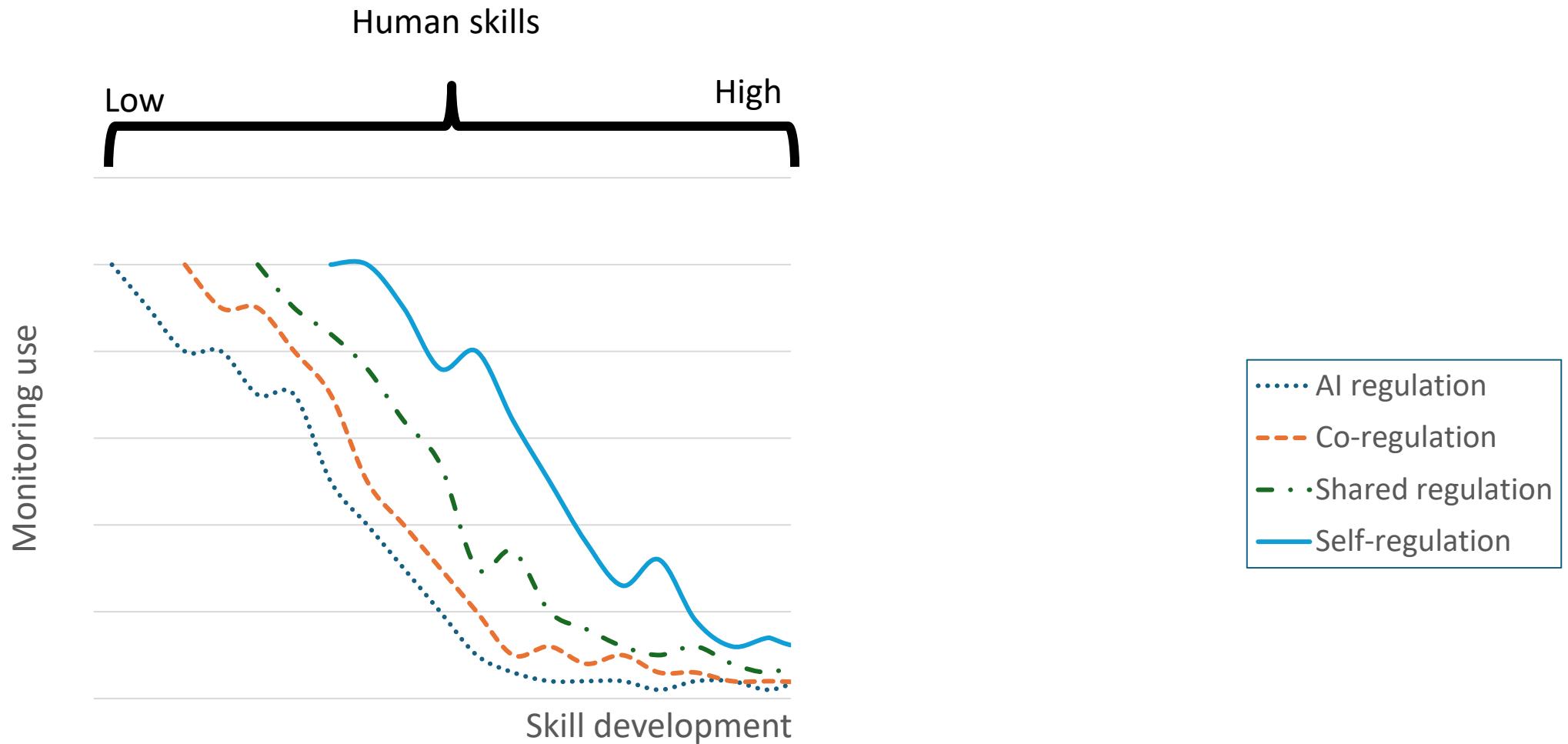


Opportunity #2

Metacognitive onloading

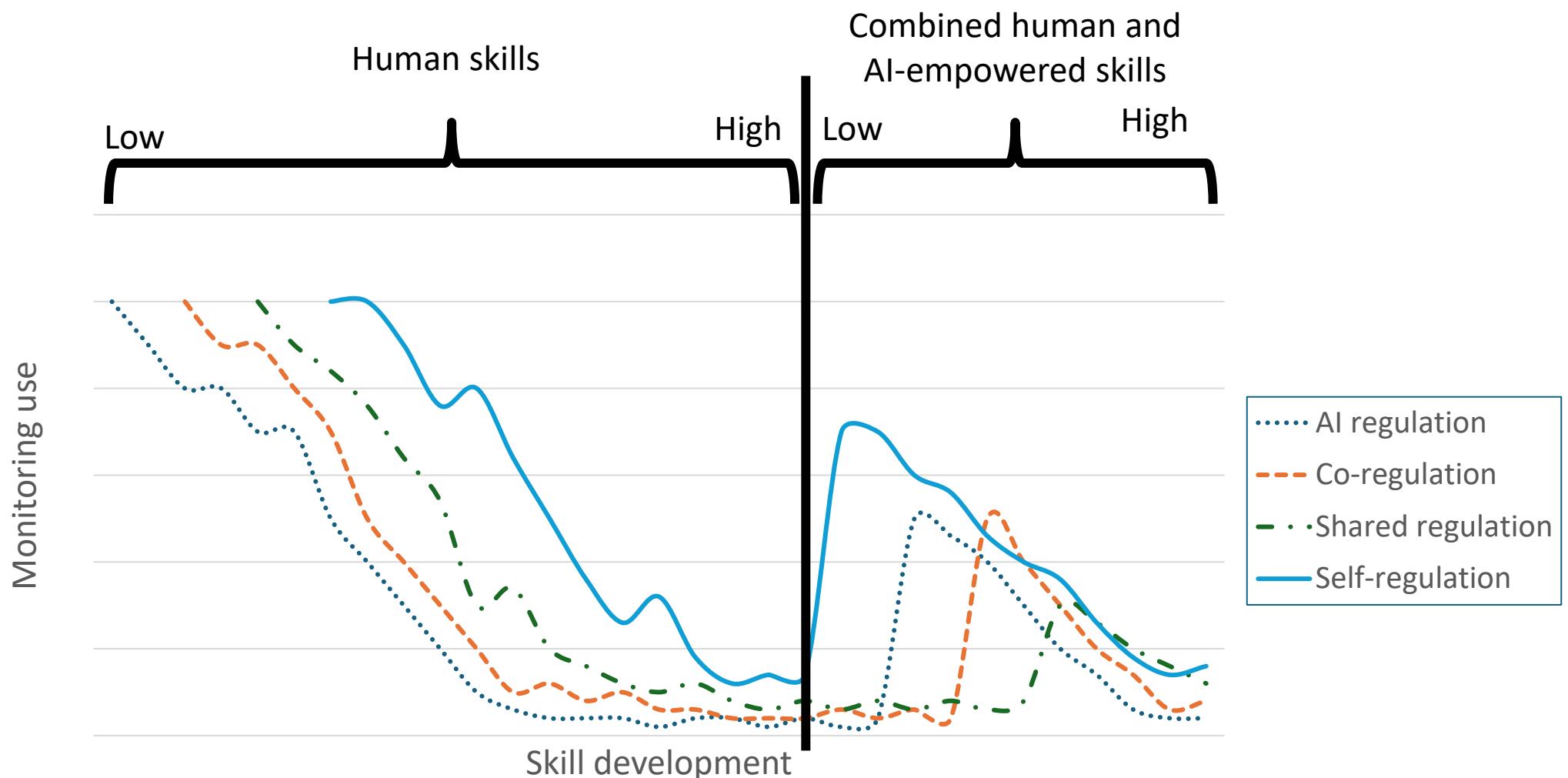


Proposition



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

Tacking open challenges

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

Tacking 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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