



Guiding the minds of tomorrow: Conversational Agents to Train Curiosity and Metacognition in Young Learners

Rania Abdelghani

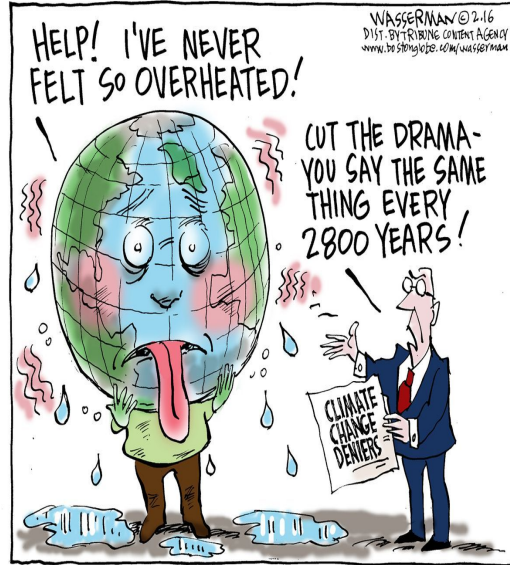
2021-2024

Defended on: September 3rd, 2024

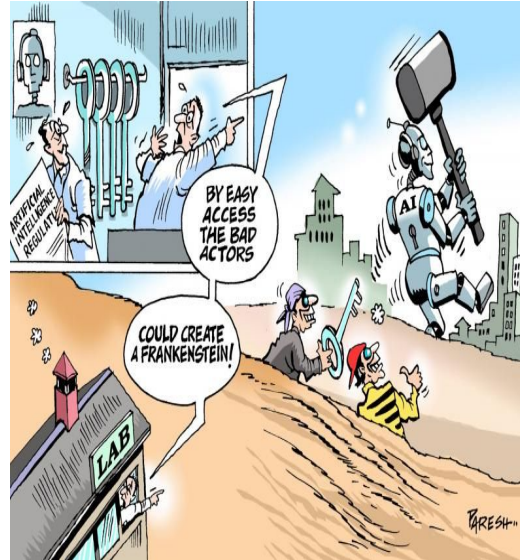
Supervisors: Hélène Sauzéon & Pierre-Yves Oudeyer

Keeping up with a world in transition

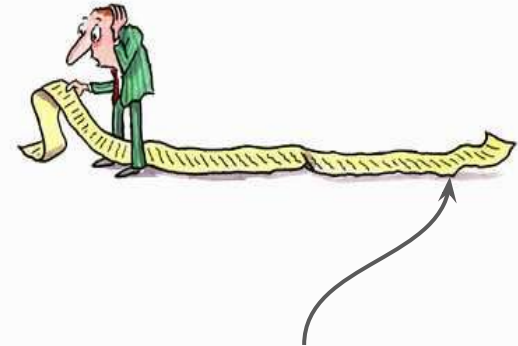
Political & environmental challenges



AI exponential rise in almost all everyday domains



Various staff shortages, economic uncertainty, rise of extremist movements, etc



A very long list of what is challenging in today's world

Keeping up with a world in transition

Strategies needed to face today's world in a transition .. to name a few

Higher-level skills needed to acquire/adopt such strategies

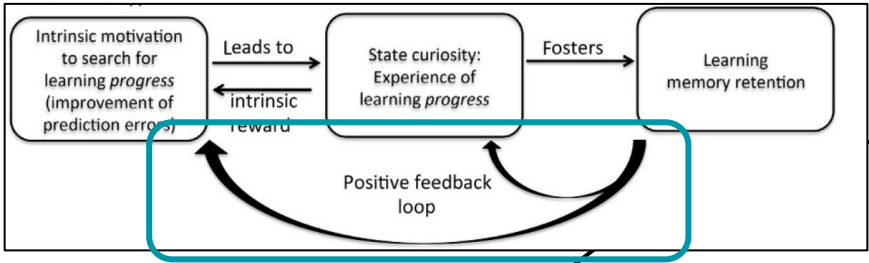


- Learn how to learn independently & face uncertainty
- Learn how to navigate efficiently through large and various knowledge sources
- ...

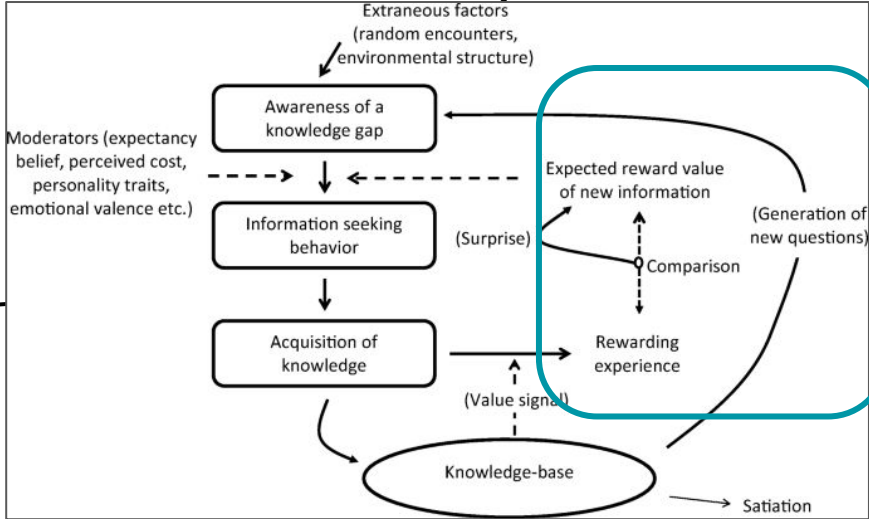
Epistemic curiosity-based skills

Metacognition-based skills

Why this particular focus on curiosity and metacognition?



Oudeyer et al., 2016

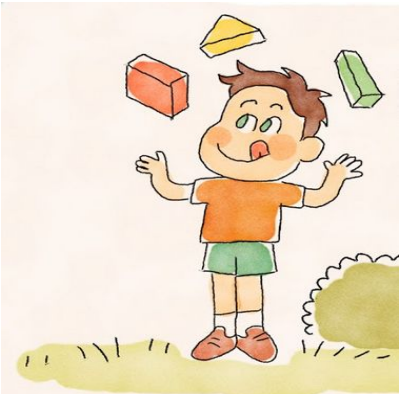


Murayama et al., 2019

Curiosity is an **intrinsic drive** for exploration (Kidd et al., 2015)



Credits: Marie Spénale



It facilitates **independent learning, discovery & academic achievement**

(Gruber et al., 2020; Gottfried et al., 2016)

Why this particular focus on curiosity and metacognition?

Being able to:

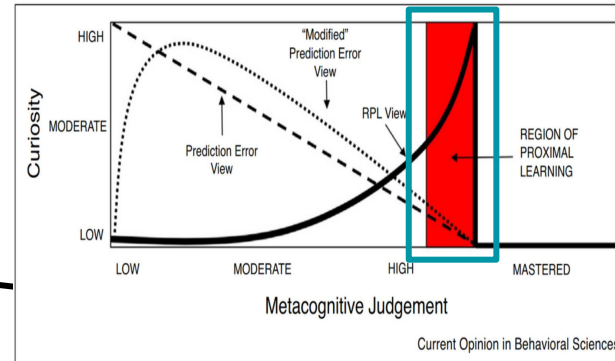
- **Reflect** on current knowledge status
- **Identify** missing information/ desired knowledge gain
- **Adopt** directed information-seeking behavior to reach the learning goal

Metacognition

The ability to:

Know, monitor & control

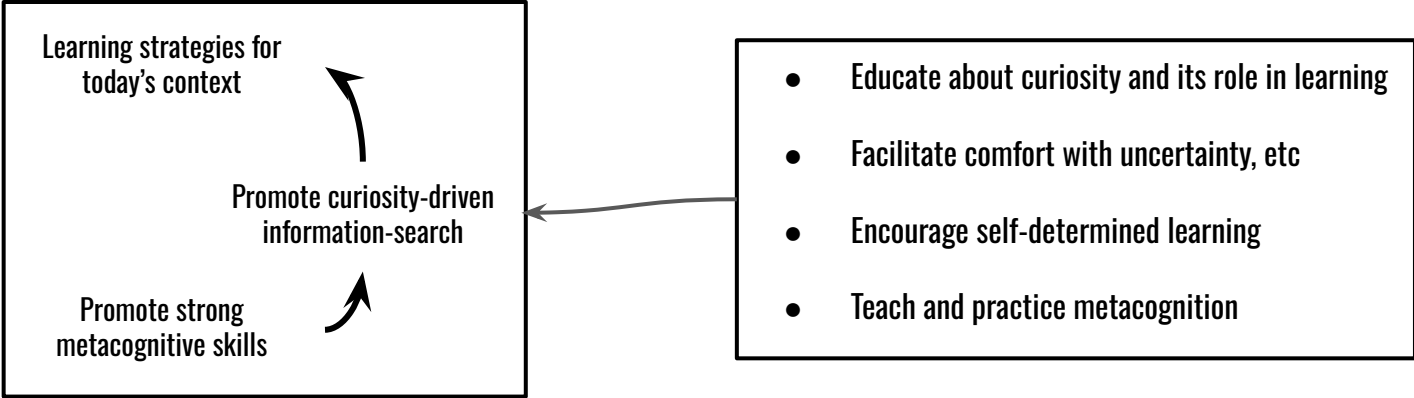
one's own learning to reach better cognition (Kashdan et al., 2018)



Metcalfe et al., 2020

If so important, why are these skills missing in today's classrooms?

Goals



From the teachers' side

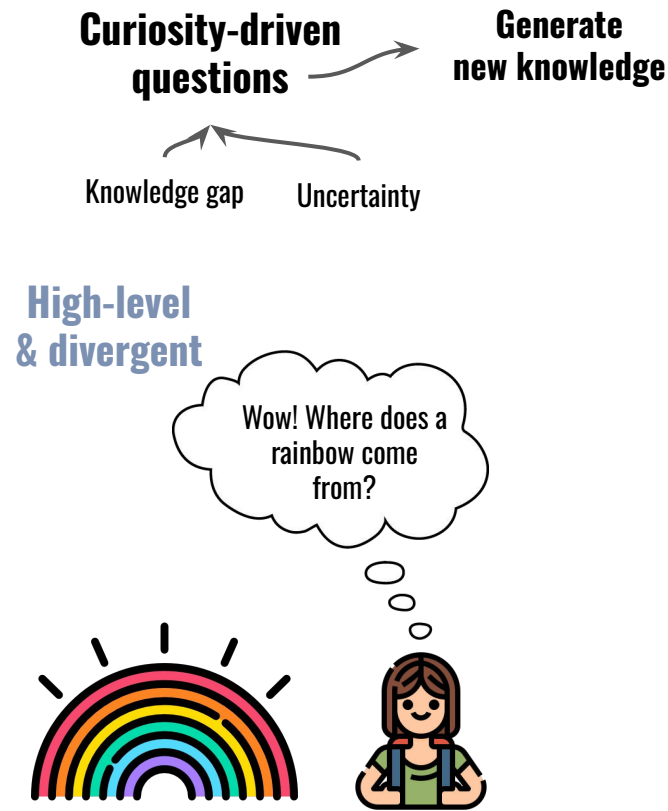
Obstacles

- Lack of time
- Lack of targeted open-access pedagogical resources

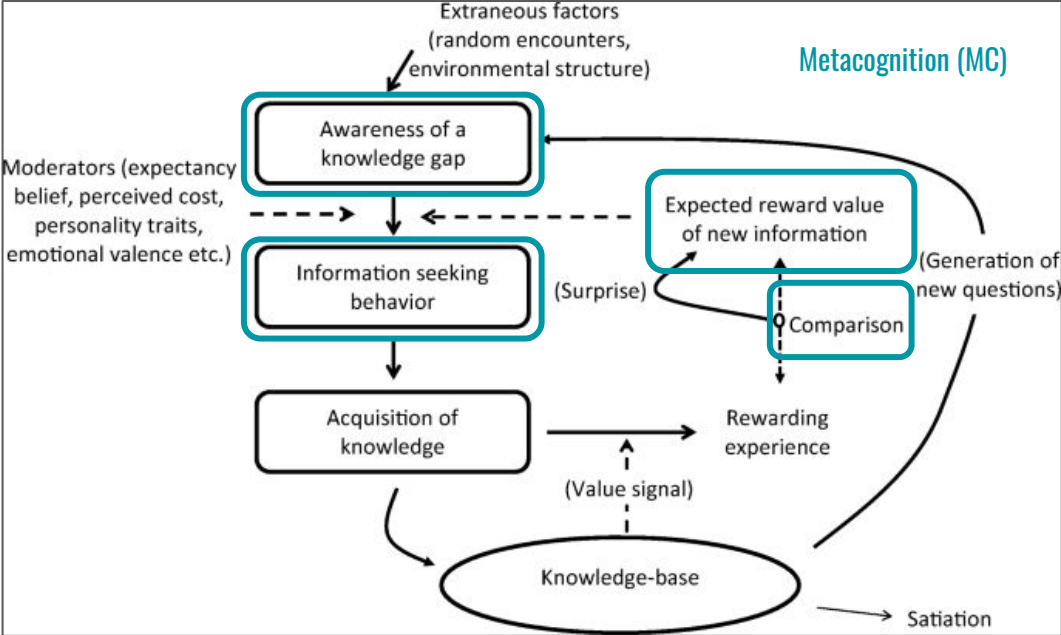
From the students' side

- Tendency to have negative perceptions of curiosity
- Lack of motivation/ engagement
- Metacognitive "immaturity"

How to support teachers promote curiosity-driven learning skills among students?



Example for a curiosity-driven learning cycle through question-asking

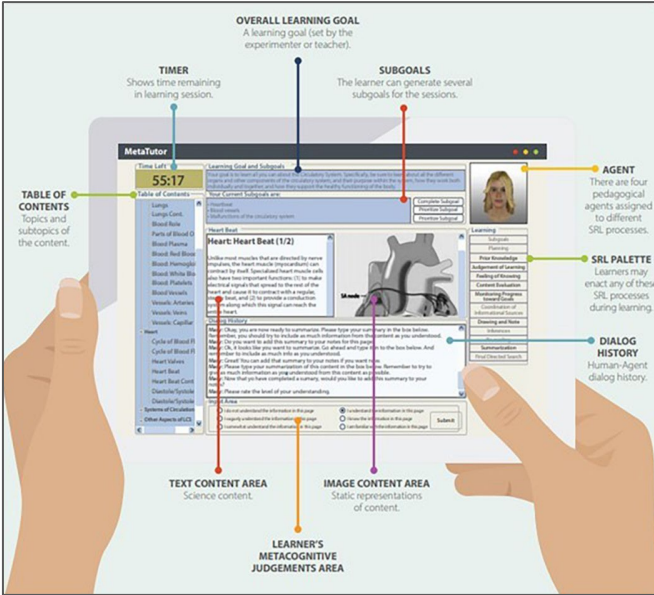


Murayama et al., 2019

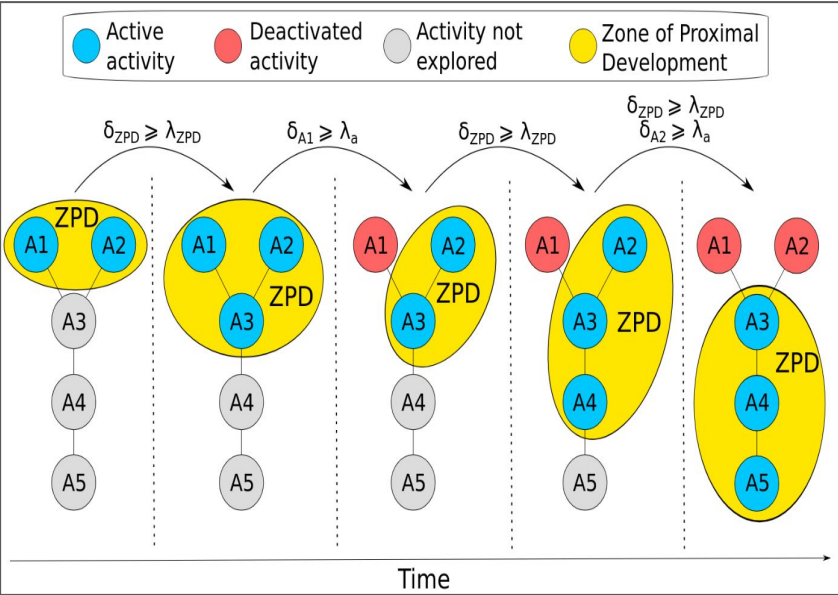
→ Train divergent question-asking as a lever for curiosity, through the promoting of these specific MC skills.

Thesis specific goals, methods and investigations

How to leverage technology to support teachers in promoting divergent QA and related metacognitive skills?



MetaTutor (Azevedo et al., 2020)
to train self-regulated learning



KidLearn (Clément et al., 2018)
to adapt learning sequences and optimize progress

Positive impact on:

- Learning outcomes
- Intrinsic motivation
- Metacognitive efficiency

Thesis specific goals, methods and investigations

How to leverage technology to support teachers in promoting divergent QA and related metacognitive skills?

Potential of Generative Artificial Intelligence (GenAI) in education

- Affordable teaching materials
- Strong personalized learning plans
- Efficient and instant feedback
- Interactive activities
- ...

Generative AI Can Harm Learning

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

The GPT Surprise: Offering Large Language Model Chat in a
Massive Coding Class Reduced Engagement but Increased
Adopters' Exam Performances

Allen Nie^{*1}, Yash Chandak¹, Miroslav Suzara², Ali Malik¹, Juliette Woodrow¹, Matt Peng¹,
Mehran Sahami¹, Emma Brunskill¹, and Chris Piech¹

ChatGPT: Empowering lifelong learning in the digital age
of higher education

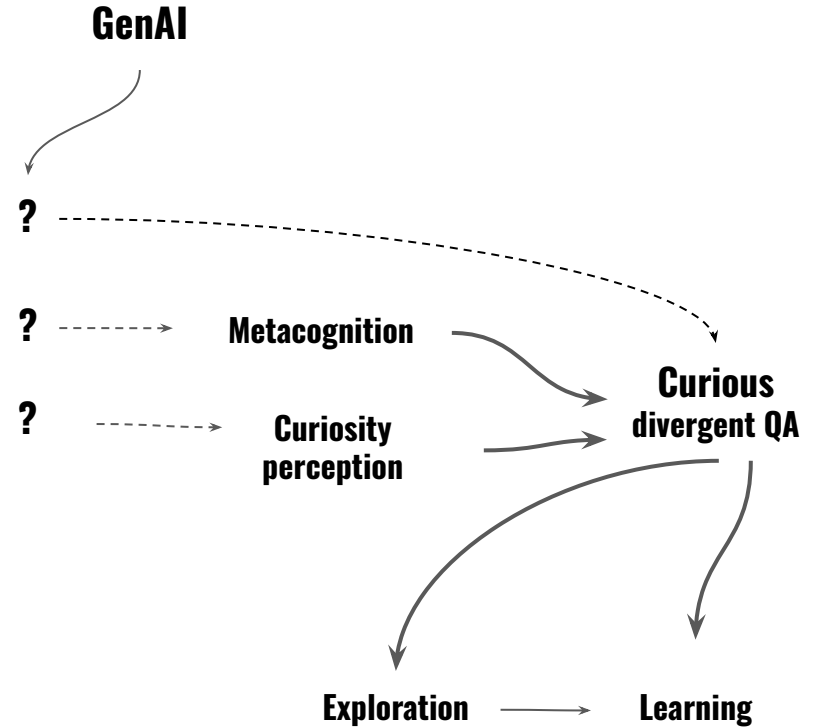
Soha Rawas¹ 



Thesis specific goals, methods and investigations

Research questions

- (How) Can we train curious divergent QA?
- (How) Can we train metacognition and enhance the social perceptions of curiosity? And how can such trainings impact curious divergent QA behaviors in the classroom?
- (How) Are these different trainings impacting students' spontaneous curious divergent QA and exploratory behaviors?
- (How) Are these trainings impacting learning?
- How can we leverage GenAI to facilitate the implementation of curiosity trainings and their use by teachers?



Thesis specific goals, methods and investigations

RATIONALE

Fundamental cognitive science:
(curiosity, question-asking & metacognition models)



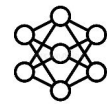
Factors that facilitate curious divergent QA

Instructional design principles to train them

MATERIALS



Teachers



Generative AI



Pedagogical activities
(to train curious divergent QA and metacognition)

INVESTIGATIONS

Empirical test with students aged between 9 and 11. Impact of the tools on:

- Curious divergent QA behaviors
- Curiosity perceptions
- Learning



METHODS

Design of open-access educational tools
(to train curiosity-driven QA and its related metacognitive skills)



Thesis specific goals, methods and investigations

Presentation outline

BACKGROUND & EMPIRICAL CONTRIBUTIONS

Design rationale

Trainings implementation

Exploring GPT-3
as a training lever

SOME RESULTS

Intra-training assessment

Performance outcome
(curiosity-driven behaviors & learning)

GPT-3 pedagogical reliability

DISCUSSION

Results & Takeaways

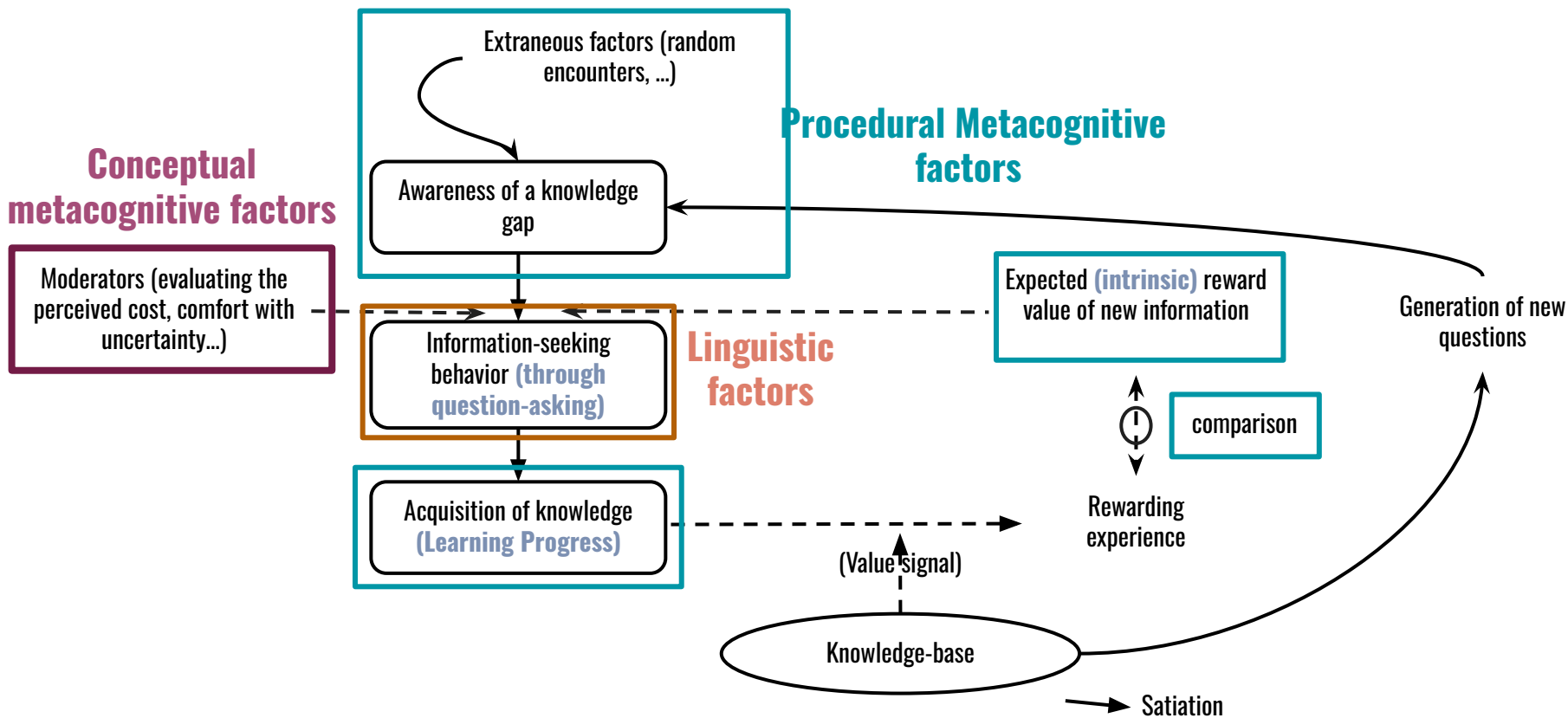
Limitations

Perspectives & future
directions

Background & Empirical contributions

1. Theoretical background
2. “KidsAsk”
3. “KidsReflect”
4. Results summary & takeaways

A curiosity-driven learning framework (Murayama et al., 2019; Oudeyer et al., 2016)



Oudeyer, P.-Y., Jacqueline Gottlieb, and Manuel Lopes. "Intrinsic motivation, curiosity, and learning: Theory and applications in educational technologies." *Progress in brain research* 229 (2016): 257-284.

Murayama, K., FitzGibbon, L., & Sakaki, M. (2019). Process account of curiosity and interest: A reward-learning perspective. *Educational Psychology Review*, 31, 875-895.

Facilitating curiosity-driven learning through helping the different factors

FACTORS

INSTRUCTIONAL DESIGN PRINCIPLES (IDPs)

TRAINING

Linguistic factors

- Provide **linguistic assistance** to formulate KGs into divergent questions
- Provide cues to make knowledge gaps (KGs) explicit

“KidsAsk”

Conceptual metacognitive factors

- Provide **declarative knowledge** about **curiosity** and benefits for learning
- Positivise **social perceptions of QA**

“KidsReflect” - Part I

Procedural metacognitive factors

- Support **identifying KGs** autonomously
- Support **formulating guesses** about them
- Support **pursuing the KG**
- Support **evaluating new information** & comparing it to an initial KG

“KidsReflect” - Part II

Presenting the “KidsAsk” training (Abdelghani et al., 2022)

Theme: History of science



Louis Pasteur was born in 1822. In 1865, he discovered a way to preserve food longer: this is called pasteurization. In the 1880s, while fighting cholera in animals, a brilliant idea occurred to him: to introduce the disease in small quantities so that the body strengthens its ability to defend itself. This is the principle of vaccination! He tested this principle with a little boy with rage. In 1888, Pasteur opened an institute dedicated to vaccination and research.

0:00 / 0:39

Agent space



I could think of a question that starts with 'How' about this text. Would you like to guess it?



You can see the answer to this question in the box below. If you would like to guess it, click on the box.

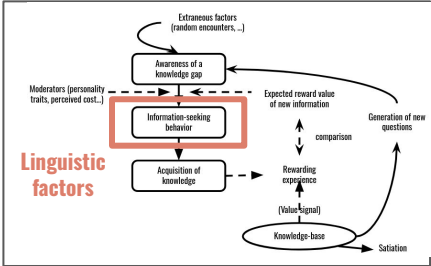
☒ Our body contains special cells to protect it



Great! You can now write your question below. Take your time to formulate! .

Write your question here

Submit



The Pedagogical agent (PA) facilitates curious divergent QA by giving 2 cues:

- To propose a possible knowledge gap
- To transform it into a clear divergent question

Training duration: 18 questions to be generated

Presenting the “KidsAsk” training (Abdelghani et al., 2022)

Theme: History of science



Louis Pasteur was born in 1822. In 1865, he discovered a way to preserve food longer: this is called pasteurization. In the 1880s, while fighting cholera in animals, a brilliant idea occurred to him: to introduce the disease in small quantities so that the body strengthens its ability to defend itself. This is the principle of vaccination! He tested this principle with a little boy with rage. In 1888, Pasteur opened an institute dedicated to vaccination and research.

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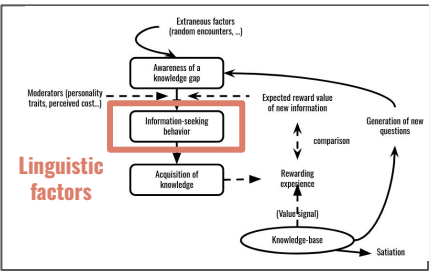
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Presenting the “KidsAsk” training (Abdelghani et al., 2022)

You still have 2 hidden videos you can open

Content table for sports

Football in the world



Football popularity in the world



American Football



Rugby

Sports that are not so common



Curling



The rallye Dakar



E-sports

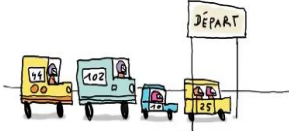
Sports inventors



The invention of volley-ball

Content

The rallye Dakar



I finished viewing

End the exploration

I Hope you enjoyed this video. If you wish, you can request another one from the following list that I have for you:

Theme: Sports inventors

- The invention of ski
- The invention of basket-ball

But to do so, you need to ask me a divergent question about the one you just saw.

Write your question here

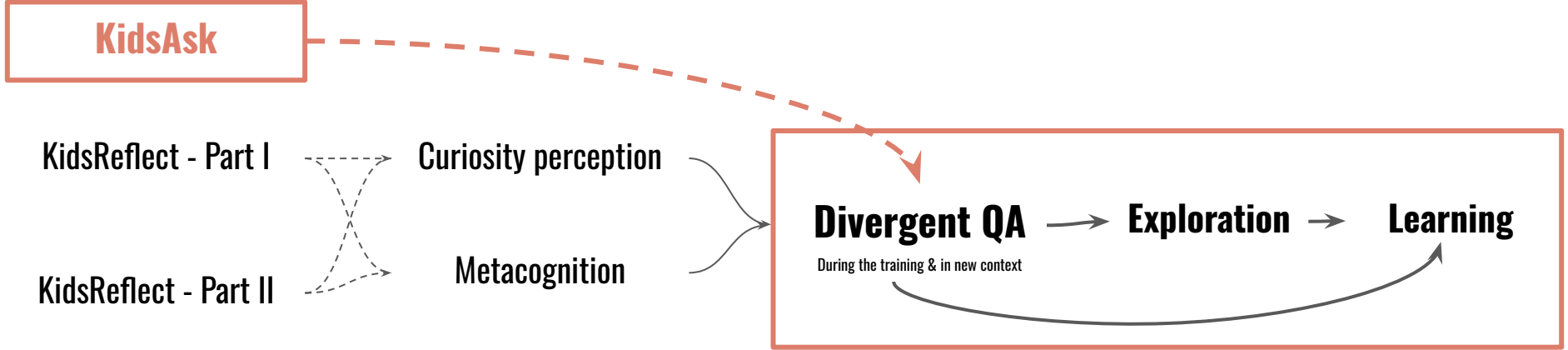
Submit my question

I don't have any questions

A maximum of 9 videos to be explored in total



Links examined with “KidsAsk”



Study design

Theme: History of science



Louis Pasteur was born in 1822. In 1865, he discovered a way to preserve food longer: this is called pasteurization. In the 1880s, while fighting cholera in animals, a brilliant idea occurred to him: to introduce the disease in small quantities so that the body strengthens its ability to defend itself. This is the principle of vaccination! He tested this principle with a little boy with rage. In 1888, Pasteur opened an institute dedicated to vaccination and research.



Espace agent



Hum, I could think of a question that starts with 'How' about this text, try to guess it!



Remember, the answer to my question is not in the text. Take your time to formulate!

Write your question here

Submit

KidsAsk -----> Divergent QA

Manual annotations of the questions generated :

- Divergence
- Syntactic quality

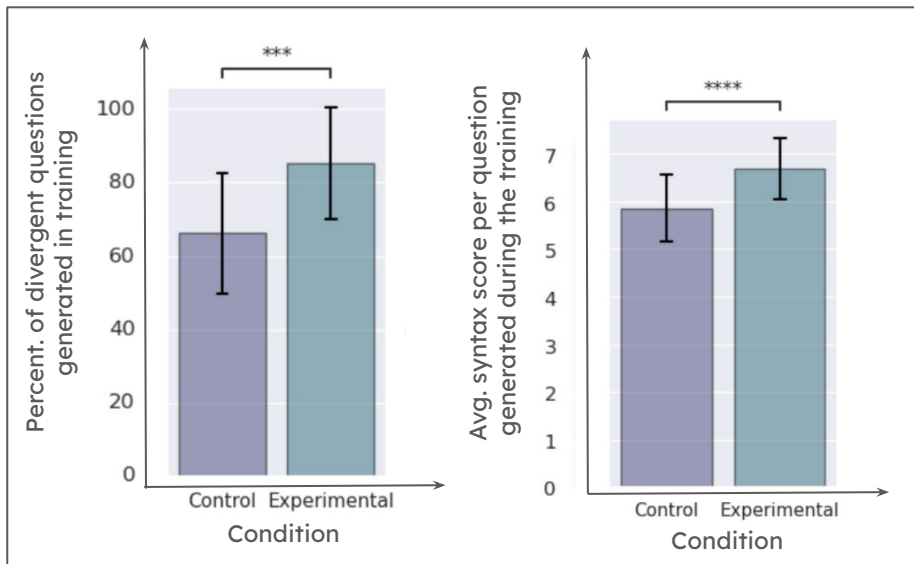
- 51 students 9 -10 YO
- Pseudo-randomized assignment (2 conditions: **KG propositions vs. no KG propositions**)
- A total of 18 questions (3 texts of their topic with linguistic assistance)

Some highlight results

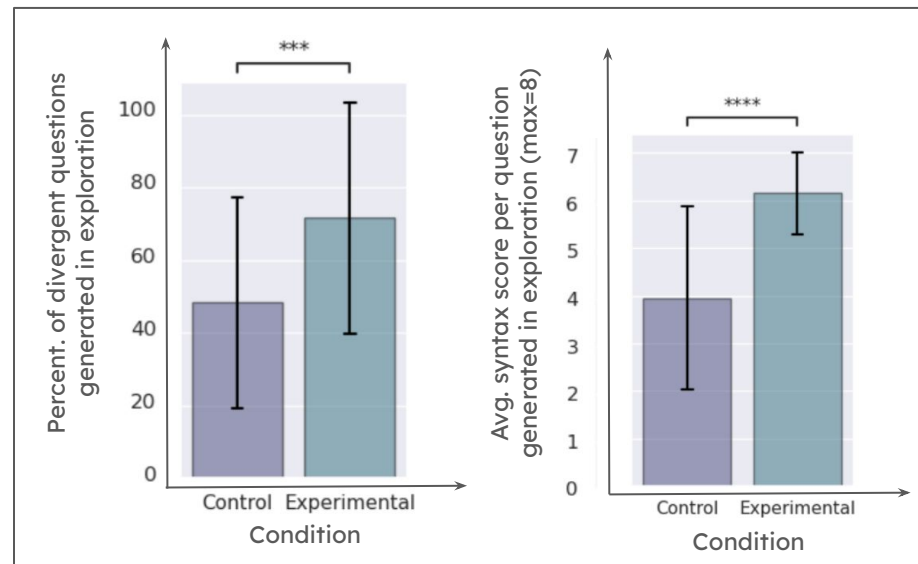
KidsAsk -----> Divergent QA

Experimental: *With KG propositions*
Control: *No KG propositions*

QA performance during the training



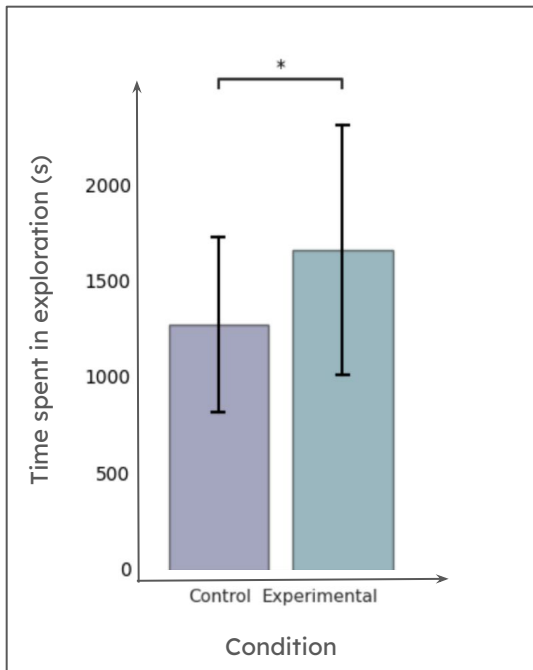
QA performance during the free question-guided exploration



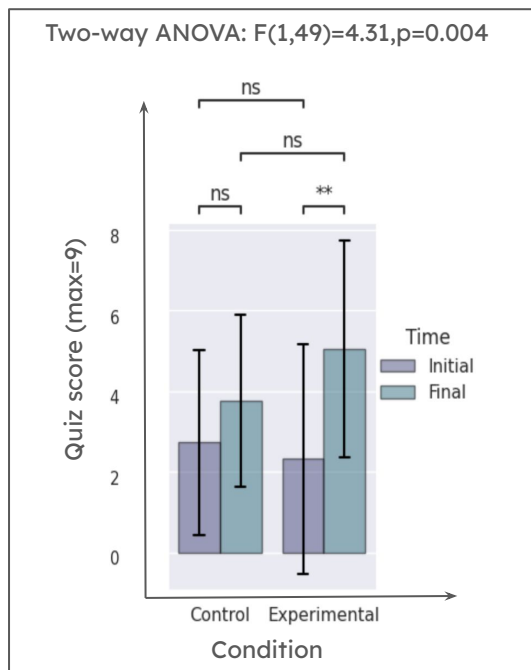
→ A better training of divergent QA and a stronger transfer of the skill in different learning contexts

Some highlight results

Time spent in exploration



Pre-post intervention learning progress



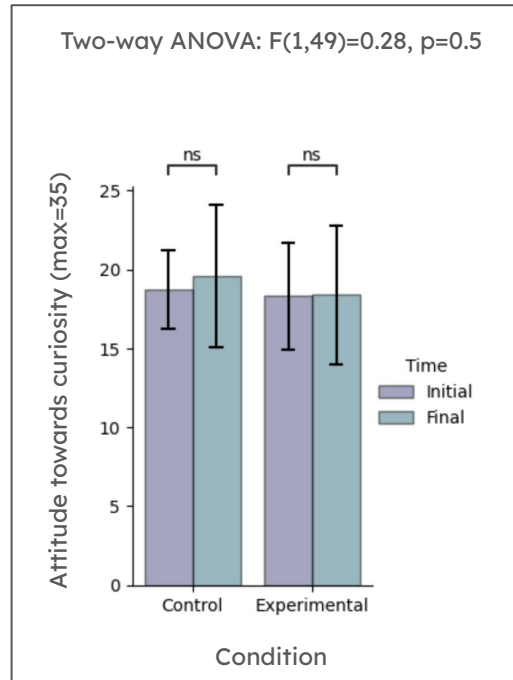
Experimental: With KG propositions
Control: No KG propositions

- Time spent in exploration was correlated to the QA performance in the training (ANCOVA: $F=4.1, p=0.04$)
- Learning progress was correlated to the QA performance in the exploration (ANCOVA: $F=3.67, p=0.05$)

→ Longer exploration and stronger domain-knowledge learning progress

Some highlight results

Pre-post intervention curiosity perception



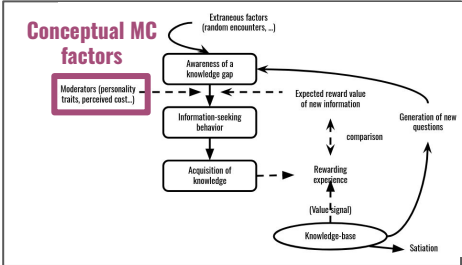
Experimental: *With KG propositions*

Control: *No KG propositions*

→ Initial attitude is rather low & no change in curiosity perception for the two groups

Conceptual metacognitive factors

Presenting part I of the “KidsReflect” training (Abdelghani et al., 2023)



Videos content

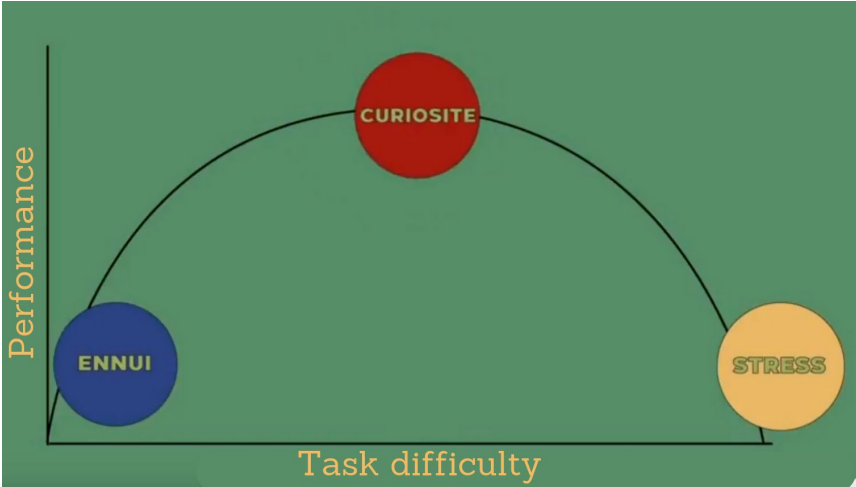
Video 1: Motivation types & curiosity

Video 2: Importance of curiosity in learning

- * Intrinsic (IM) vs. extrinsic (EM) motivation
- * Curiosity as an IM
- * Benefits of IM

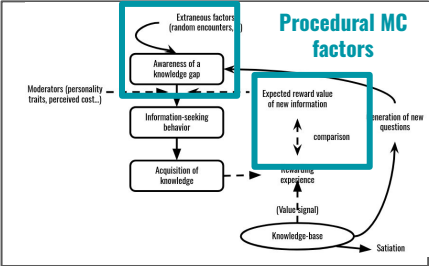
- * Learning and Memory
- * Attention
- * Autonomy & self-competence

Extract example from video 1 storyboard:
Motivation types & curiosity



Procedural metacognitive factors

Presenting the declarative component of part II of the “KidsReflect” training



Videos content

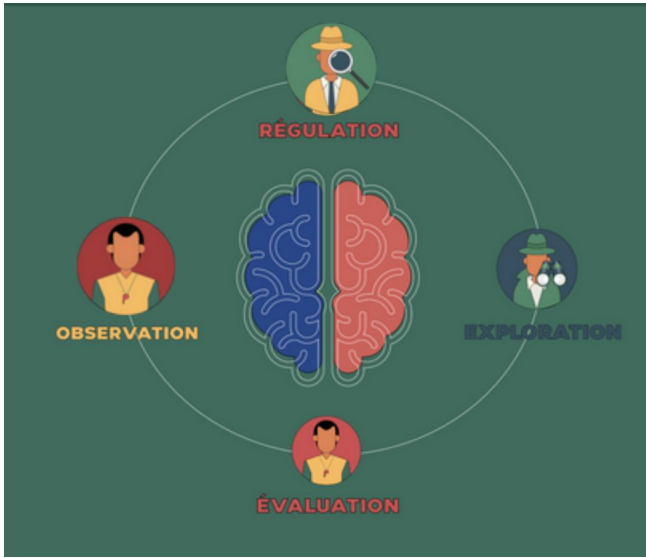
Video 1: Metacognition & its basic skills

Video 2: Linking metacognition & curiosity

- * Metacognition (MC)
- * The four MC skills for learning: IDENTIFY, GUESS, SEEK, ASSESS
- * Embodiment of 4 MC skills with 2D characters

- * Links each of the 4 MC skills to curiosity.
- * Procedures to use the 4 MC skills to trigger and regulate curiosity

Extract example from video 1 storyboard: Metacognition & its basic skills



Procedural metacognitive factors

Presenting the procedural component of part II of the “KidsReflect” training (Abdelghani et al., 2023)

MC steps for curiosity-driven learning

The “KIDSREFLECT” training platform



Procedural metacognitive factors

Presenting part II of the “KidsReflect” training (Abdelghani et al., 2023)

Step 1 for identifying a knowledge gap

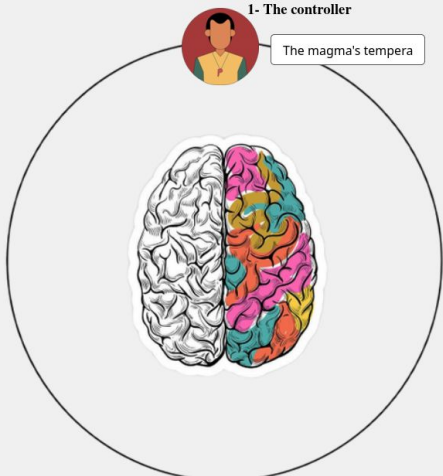
Text 1:

Tens of kilometers below our feet, the earth contains a layer called the mantle. It is so hot in this layer that the rocks become liquid: this is called magma. Magma is responsible for the explosion of volcanoes: this is what scientists also call an eruption of a volcano. A volcano is said to be dormant if there has been no eruption in the last 10,000 years. After 10,000 years, the volcano can be said to be extinct.

0:00 / 0:33

1- The controller

The magma's tempera



1- The controller identifies the uncertainty we want to pursue

I am the controller, my role is to help you use your metacognition to decide what new information is useful for you to learn.

To do this, I suggest you start by reading/listening to the text and trying to connect it to your previous knowledge. Is there a part or a sentence that is not very clear to you and that makes you curious?

Here are some examples of sentences that I have identified that I don't understand very well and that make me curious:

- The layers of the Earth
- The magma's temperature
- Eruption of volcanoes

You can choose the one that makes you most curious by writing it in the box, or write another one of your own choice. You will then try to discover this information with our other metacognitive friends.

Submit

Metacognitive factors

Presenting part II of the “KidsReflect” training (Abdelghani et al., 2023)

Step 2 for formulating an educated guess

Text 1:

Tens of kilometers below our feet, the earth contains a layer called the mantle. It is so hot in this layer that the rocks become liquid: this is called magma. Magma is responsible for the explosion of volcanoes: this is what scientists also call an eruption of a volcano. A volcano is said to be dormant if there has been no eruption in the last 10,000 years. After 10,000 years, the volcano can be said to be extinct.

0:00 / 0:33

The diagram shows a central brain with the left hemisphere colored grey and the right hemisphere colored with various colors (pink, yellow, blue, green). A large circle surrounds the brain. At the top of the circle is a red circle containing a person icon, labeled "1- The controller". A speech bubble from this icon says "The magma's tempera". At the bottom of the circle is a green circle containing a detective icon, labeled "2- The detective". A speech bubble from this icon says "It exceeds 500°C".

2- The detective thinks about the possible answers to our uncertainties

Now it's time to become a detective of your learning. It's exciting to be able to go and discover new things, isn't it?

To be a good detective of your learning, you must first think of possible answers that can solve the uncertainty you identified with my friend the controller. This is a good exercise for your memory, remember ?

Here are some proposed hypotheses that I have formulated to answer my uncertainties :

- The Earth has other layers besides the 'mantle'
- The temperature of the magma exceeds 500°C
- During the eruption, the volcano makes magma come out

You can choose a proposition from this list or write your own hypothesis. Your hypothesis must be related to what you wrote in the first step.

Submit

Metacognitive factors

Presenting part II of the “KidsReflect” training (Abdelghani et al., 2023)

Step 3 for formulating a divergent question

Text 1:

Tens of kilometers below our feet, the earth contains a layer called the mantle. It is so hot in this layer that the rocks become liquid: this is called magma. Magma is responsible for the explosion of volcanoes: this is what scientists also call an eruption of a volcano. A volcano is said to be dormant if there has been no eruption in the last 10,000 years. After 10,000 years, the volcano can be said to be extinct.

0:00 / 0:33

1- The controller

magma's temperature

2- The detective

It exceeds 500°C

3- The explorer

What is the temperatu

Submit

3- The explorer seeks answers to our uncertainties

You have already finished two steps, congratulations! Now you can concentrate on how to find your answer, you are a little explorer, like me!

Now we're going to try to turn the uncertainty you identified into a question. It is important to do this exercise because it allows you to find the answers you are looking for and that make you curious.

Here are some questions that I find important:

- What are the other layers of the earth ?
- What is the temperature of the magma ?
- What happens during the eruption of a volcano ?

Choose the question that is related to the information you are looking for and that you described in the two previous steps and write it in the box. You can also formulate your own question if you want.

Metacognitive factors

Presenting part II of the “KidsReflect” training (Abdelghani et al., 2023)

Step 4 for evaluating newly-acquired information

Text 1:

Tens of kilometers below our feet, the earth contains a layer called the mantle. It is so hot in this layer that the rocks become liquid: this is called magma. Magma is responsible for the explosion of volcanoes: this is what scientists also call an eruption of a volcano. A volcano is said to be dormant if there has been no eruption in the last 10,000 years. After 10,000 years, the volcano can be said to be extinct.

0:00 / 0:33

1- The controller

The magma's tempera

2- The detective

It exceeds 500°C

3- The explorer

What is the temperatu

4- The second controller

Answer found:1000 °C

Save my work and move to the next text

4- The second controller verifies if we have found the answer we were looking for

Here I am again, your controller! You have now finished your exploration. You are with me again because I want to know if you think you have made any learning progress using your curiosity.

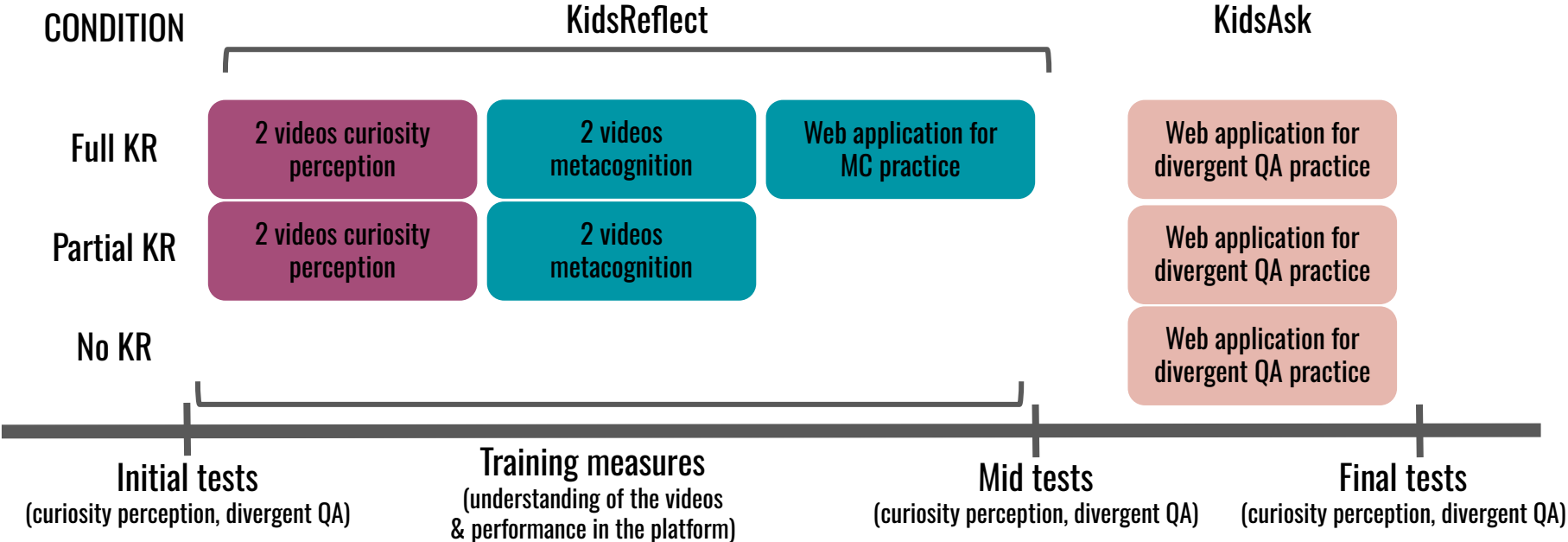
For this, here are three different pieces of information. Do you think the answer you were looking for is in this list ?

- The earth contains 7 layers including the core
- The temperature of magma reaches 1000°C
- A volcano in eruption emits dangerous gases

If you find information that answers your question, write it in the box. If not, you can write "I could not find the answer to my question".

Don't worry, you'll have plenty of other opportunities to find your answers.

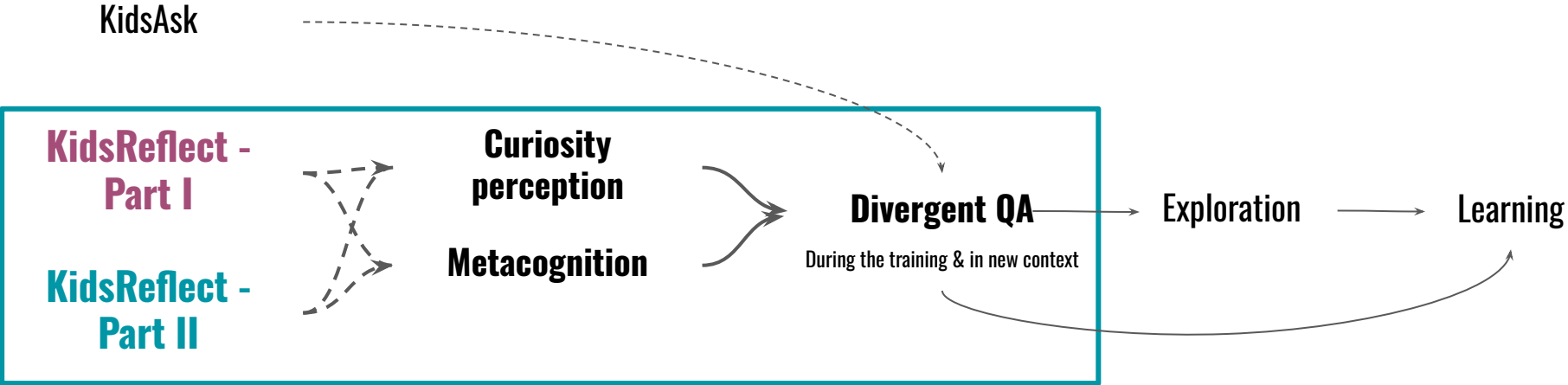
Study design



* 86 students 9 -11 YO

* Pseudo-randomized assignment (3 conditions: **Full KR vs. Partial KR vs. No KR**)

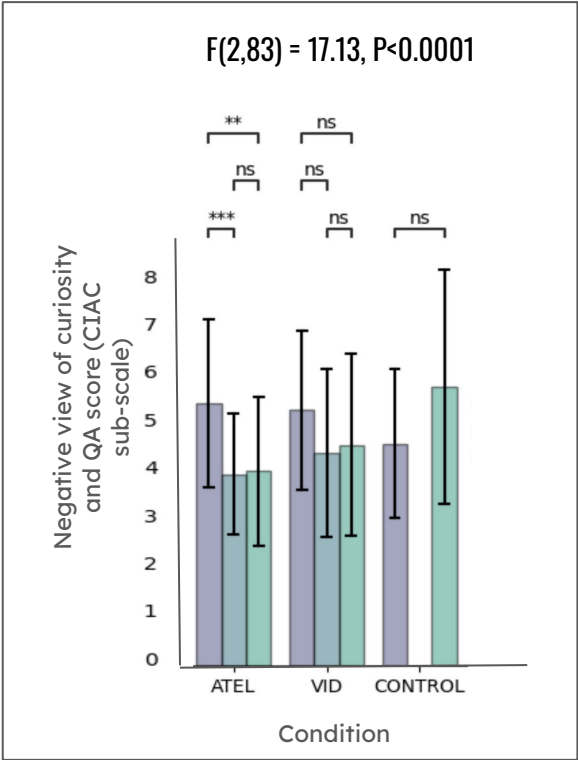
Links examined with “KidsReflect”



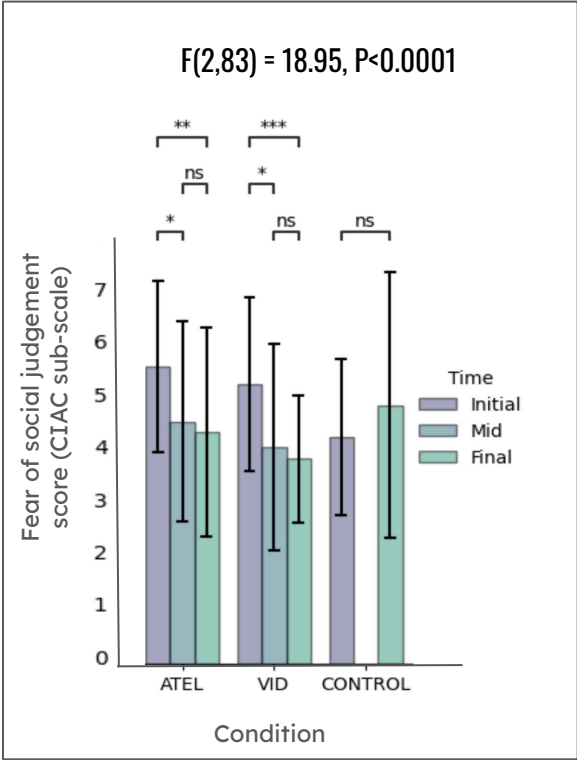
Some highlight results

KidsReflect + KidsAsk → Curiosity perception

Pre-Post negative view of curiosity



Pre-Post fear of judgement when asking questions



ATEL: Full KR
VID: Partial KR
CONTROL: No KR

Initial: Pre-KR
Mid: Post-KR
Final: Post-KA

Enhancement in CIAC score was correlated to the understanding scores of the 4 videos:

ANCOVA: $F=19.62, p < 0.0001$

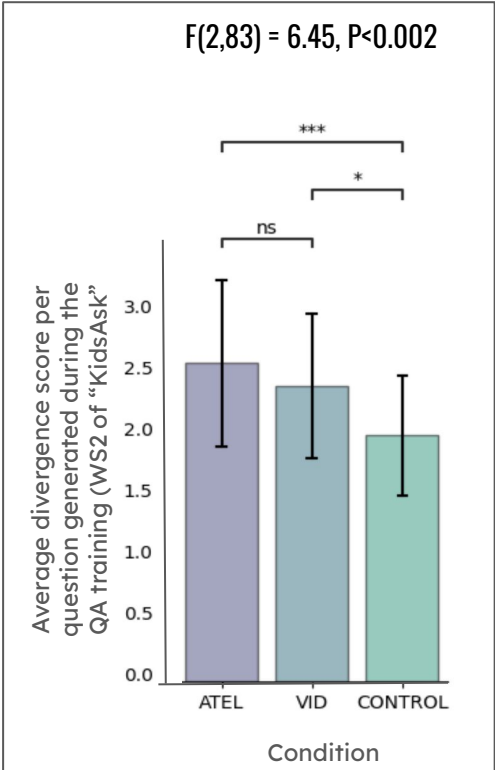
→ Significant decrease in the negative view of curiosity and QA in the classroom with KR, especially in its full form.

Some highlight results

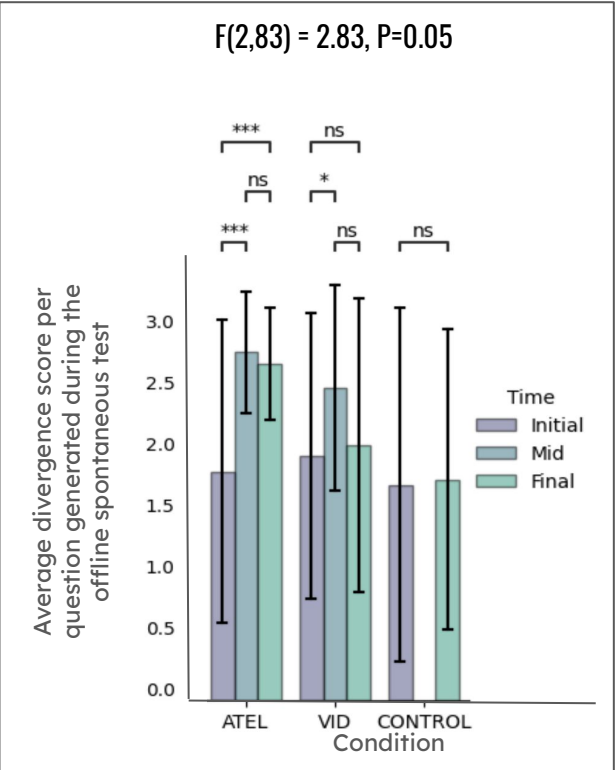
Divergent QA performance in “KidsAsk”

ATEL: Full KR
VID: Partial KR
CONTROL: No KR

Initial: Pre-KR
Mid: Post-KR
Final: Post-KA



Pre-Post divergent QA performance



Divergent QA performance during “KidsAsk” was correlated to the understanding scores of the 4 videos:

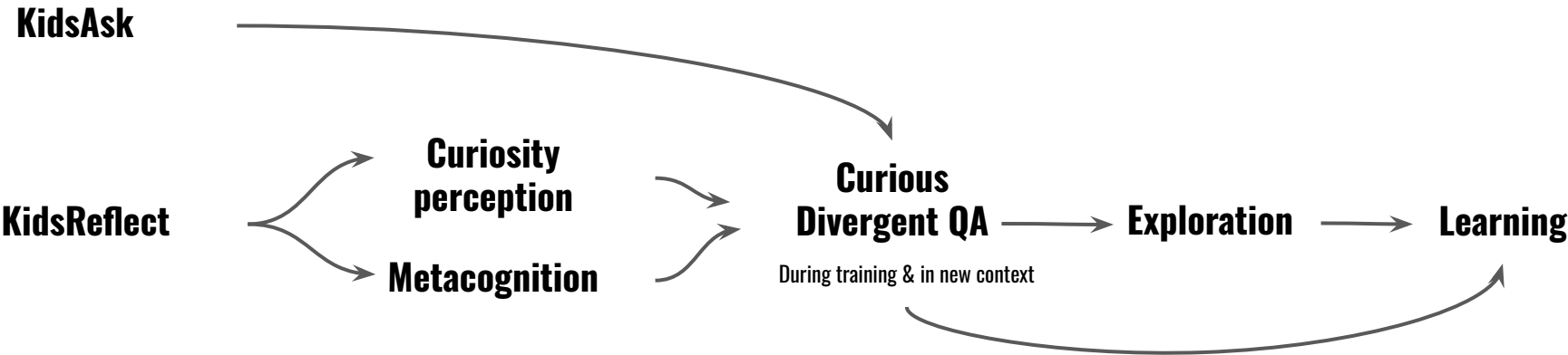
ANCOVA: $F=19.93, p<0.0001$

And to the performance during the KR platform:

ANCOVA: $F=33.31, P<0.0001$

→ Stronger training and transfer of the divergent QA skill with KR, especially in its full form.

Intermediate summary



Exploring the potential of GenAI as lever for curiosity training

1. Background
2. A GPT-3-driven “KidsAsk”
3. Results summary & takeaways
4. Limitations & perspectives

Background

THE TRAININGS ARE STILL HARD TO USE

- Time-costly & effortful
- Not easily transferable

→ It is still difficult for teachers to adopt as a method

WHAT IF WE AUTOMATE THE PROCESS ?

Large Language Models (LLMs) can be a part of the solution But:

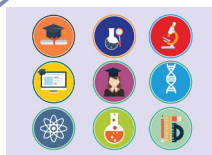
- Still not validated pedagogically
- Need for good prompting strategies for **efficient input**

END GOAL

- Design and validate expert-inspired prompting approaches

→ Provide easy-to-use guidelines **for teachers** to create divergent QA trainings with LLMs

METHODS



Educational tasks

GPT-3

Design and test different prompt structures



Divergent QA-eliciting cues

Structure for the help proposed by the agent

The “closed” structure (same as “KidsAsk”)

Proposition of the KG	A specific piece of information related but not stated in the educational resource
Linguistic help	A questioning word to formulate the question that seeks this information

- Too stringent
- May not be convenient to all learners
- Expert-guided rather than student-guided

The “open” structure

Hints to think of a KG	A list of important words related to the text that could lead to think of a several KGs
Linguistic help	A list of questioning words that could be used to formulate divergent questions

- Supports agentivity
- May correspond more to the learners’ ZPD
- Student-guided

Structure for the help proposed by the agent

Cues generated using GPT-3, using a step-by-step prompting approach in a zero-shot setting (after exploration)

The “closed” structure

Example



Cue 1: **“The vaccine prevents the disease, the medicine treats it”**

Cue 2: **“what is the difference”**

→ Leads to one question: **“what is the difference between vaccines and medicine?”**

The “open” structure

Example



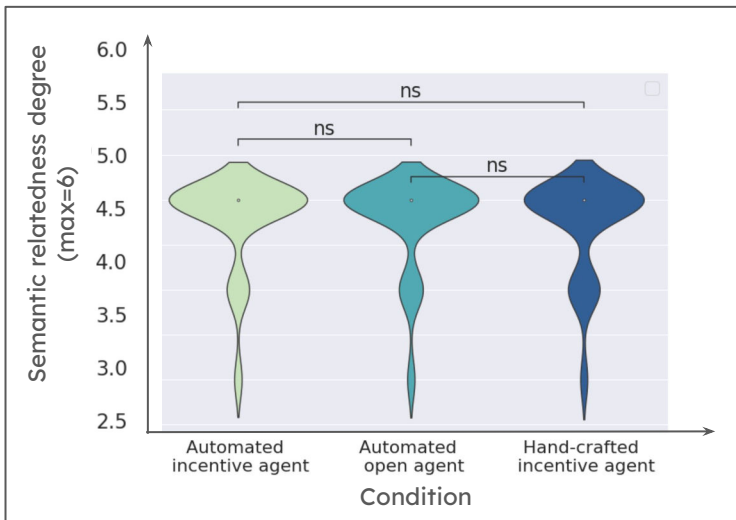
Cu1: **“vaccine, medicine, role”**

Cue 2: **“what, how, why”**

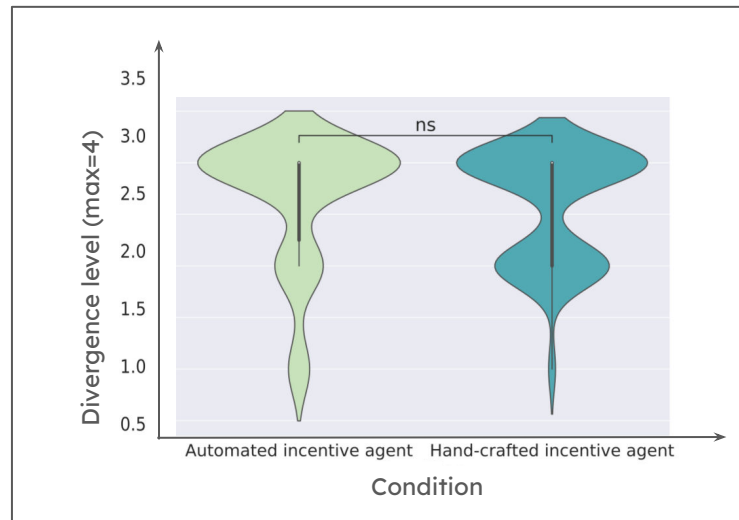
Can lead to several questions: **“what is the role of vaccine?”**, **“what is the role of medicine?”** **“Why is vaccine different from medicine?”**, etc.

Examining the cues quality

Semantic relatedness of the cues



Divergence level of the cues



→ Using manual annotations by experts, GPT-3-generated curiosity-eliciting cues had similar semantic quality to hand-generated ones.

- * 108 cues of each type were evaluated
- * They relate to 6 different topics

Hand-crafted incentive (control): “closed” KGs generated by hand
Automated incentive (GPT-3 analog): “closed” KGs, generated by GPT-3
Automated open (new structure): “open” KGs, generated by GPT-3

Implementing WS2 of “KidsAsk” using GPT-3: a prompt-based approach

KidsAsk” with “closed” cues

Theme: The universe



After several experiments, we think we understand the first moments of our universe. It was microscopic in size and extremely hot. There were no galaxies, no stars, no planets, nothing. In the beginning, all of a sudden, it is believed that there was a very large burst of energy. It gave birth to our universe in an explosion-like phenomenon. We call this the Big Bang. This energy was so great that it created all the matter in the universe. The elements merged little by little to create new ones: we speak of an 'expansion of the universe'.

0:00 / 0:41

Agent space

You can explore this text more by asking curious questions.

Here, I can help you think of one: An interesting question can start with 'What'

The answer to this question brings the following new information, can you guess it ?

☒ At its start, the temperature of the universe was about 10 billion degrees.

Super! You can now ask your question, take your time to formulate.

Mets ta question ici

Implementing WS2 of “KidsAsk” using GPT-3: a prompt-based approach

“KidsAsk” with “open” cues

Theme: The universe



After several experiments, we think we understand the first moments of our universe. It was microscopic in size and extremely hot. There were no galaxies, no stars, no planets, nothing. In the beginning, all of a sudden, it is believed that there was a very large burst of energy. It gave birth to our universe in an explosion-like phenomenon. We call this the Big Bang. This energy was so great that it created all the matter in the universe. The elements merged little by little to create new ones: we speak of an 'expansion of the universe'.



Agent space

 Here are some important key words I could find about this text. You can choose one or several of them to help you think of a curious question.

☒ Big Bang
☐ Explosion

 I propose you start your question with 'What'. But you can choose to use another questioning word if you want.

As a reminder, here is a list of other questioning words that you can use:

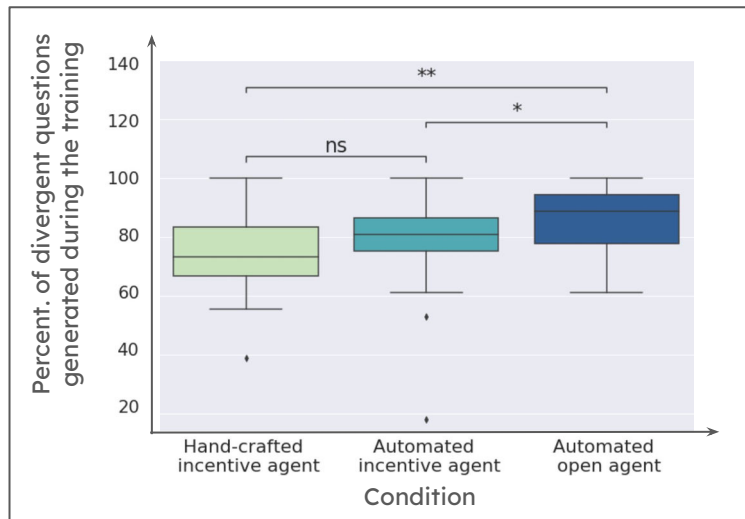
- How
- Why
- Who
- ...

 Super! You can now ask your question, take your time to formulate.

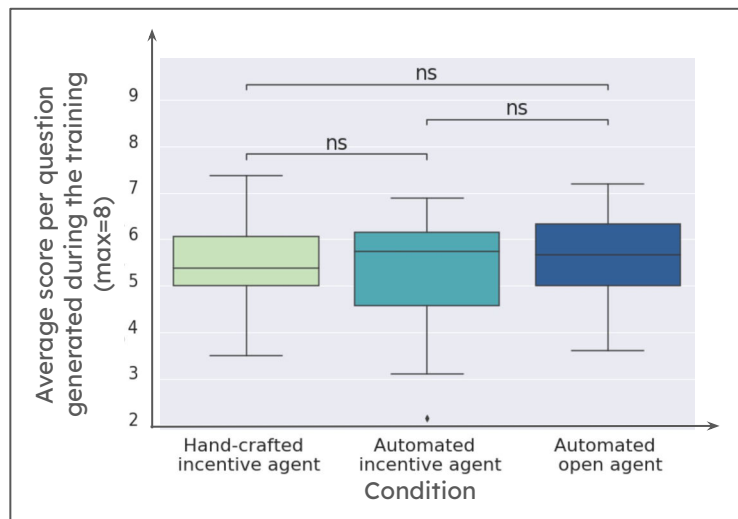
Mets ta question ici

Some highlight results

Percent. of divergent QA questions generated



Syntactic quality of the questions generated



→ Using manual annotations by experts, “closed” GPT-3-generated curiosity-eliciting cues had similar impact on students’ divergent QA. The “open” structure seems to have a stronger impact.

Hand-crafted incentive (control): “closed” KGs generated by hand

Automated incentive (GPT-3 analog): “closed” KGs, generated by GPT-3

Automated open (new structure): “open” KGs, generated by GPT-3

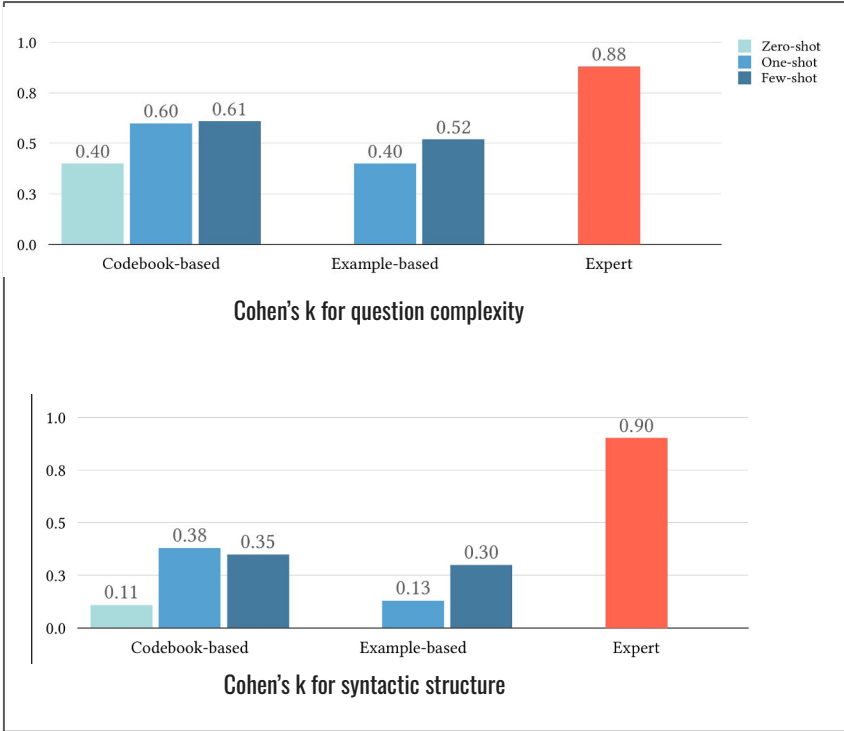
- * 75 students 9 -11 YO
- * Pseudo-randomized assignment (3 conditions: control vs GPT-3 analog vs new structure)
- * A total of 18 questions were generated during the training (3 texts of the chosen topic)

Intermediate summary

If used with the appropriate strategies, GenAI can be an efficient tool to help train curiosity-driven question-asking.

However:

- What about more recent models ?
- What about reproducibility?
- We are lacking real-time feedback for the questions' type and quality entered by the students.



Discussion, perspectives & future directions

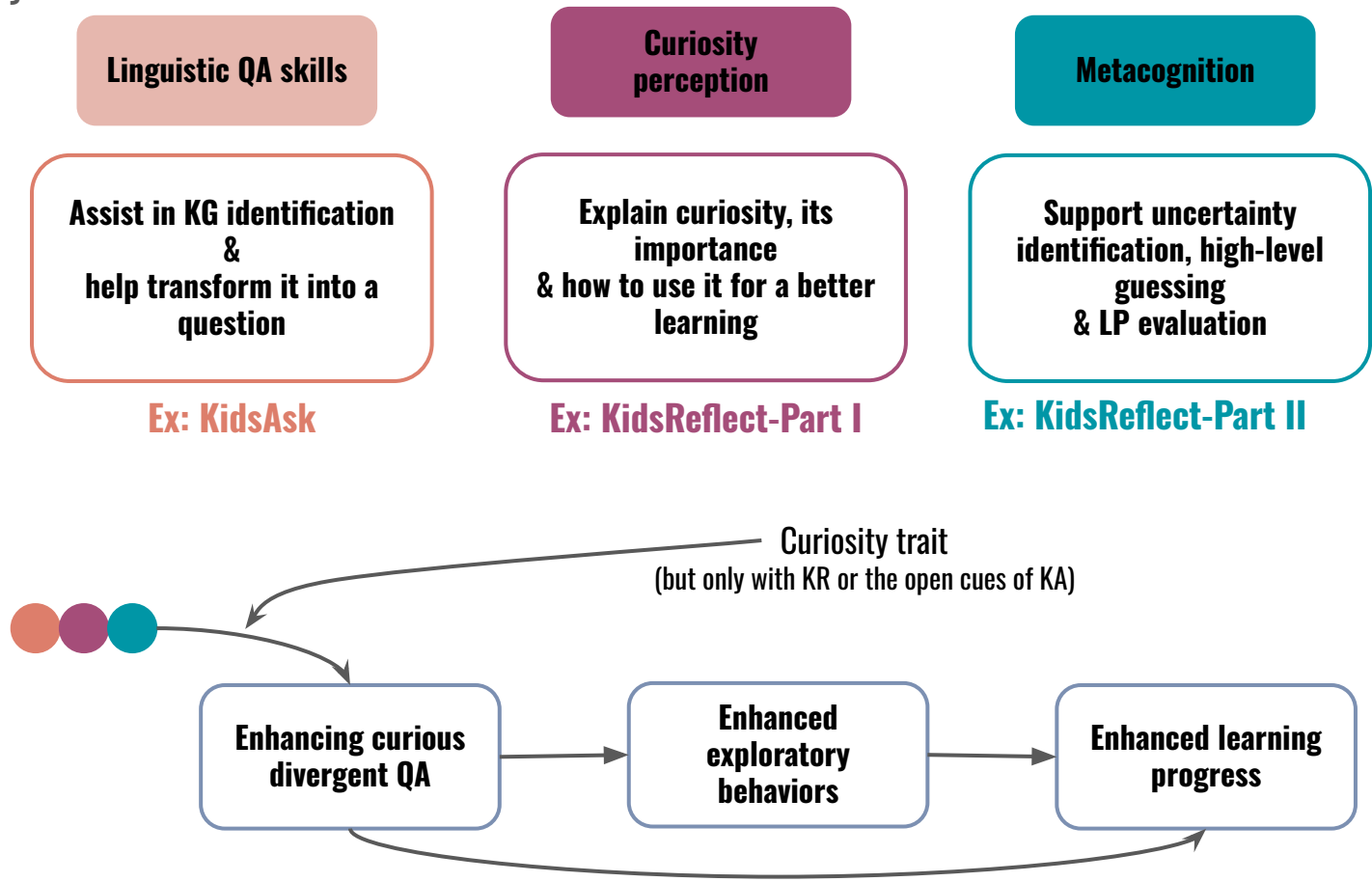
1. **Summary of important results**
2. **Major limitations**
3. **Future limitations**
4. **Conclusion**

Results summary

Skills trained

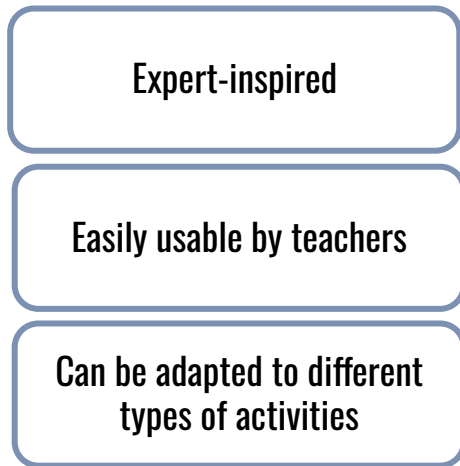
Validated training ideas

Observed effects

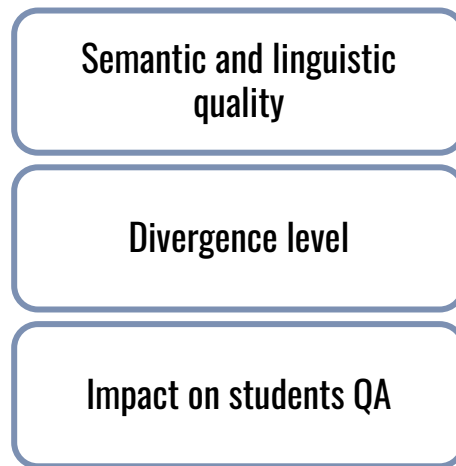


Results summary

Validated GenAI prompting approaches



Pedagogical content for curiosity-eliciting activities



Limitations & Future directions

Short duration & lack of long-term testing

- All effects are measured immediately after training (1 day)
- Very limited in time

Not very ecological settings

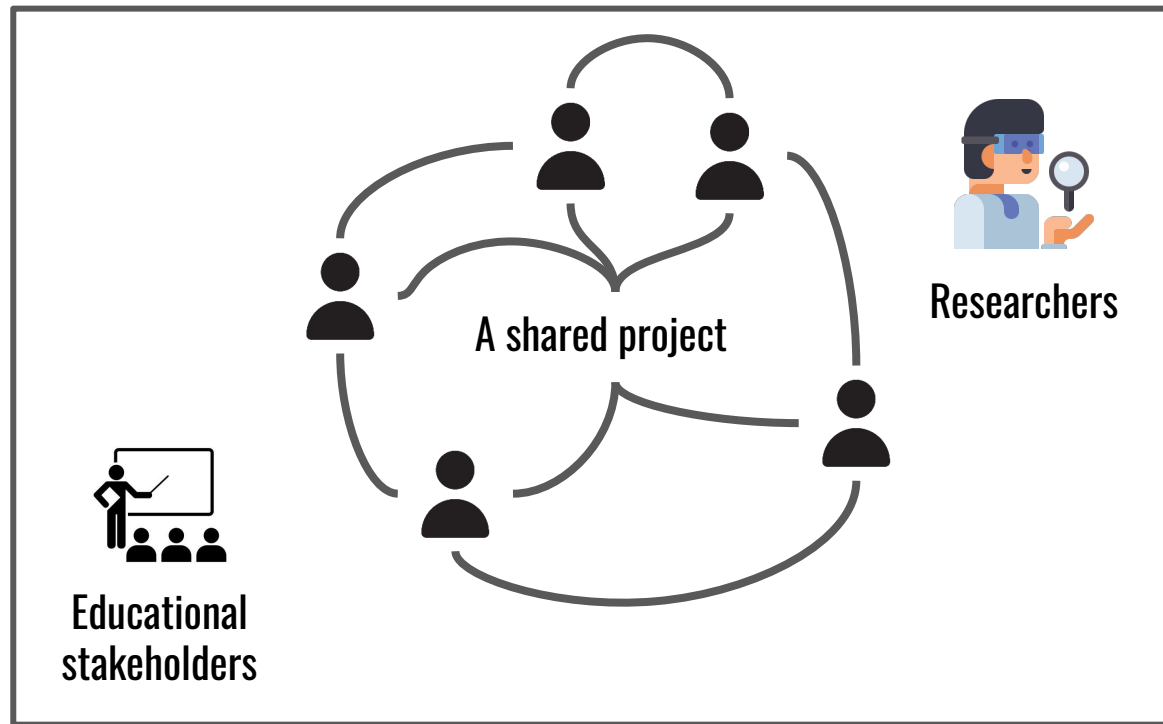
- The training is conducted by the research team
- We did not test the transfer in “standard” educational activities

2 *complementary* possibilities :

- Work on transfer of our Instructional Design Principles (IDPs) in pedagogical policies
- Work on transfer of our IDPs in industrial learning technologies

Implement the methods in low-tech/ offline solutions

1. Familiarize teachers with concepts of curiosity & metacognition
2. Co-design teaching strategies that incorporate these concepts
3. Feedback & iteration
4. Create general guidelines with example activities for teachers to use



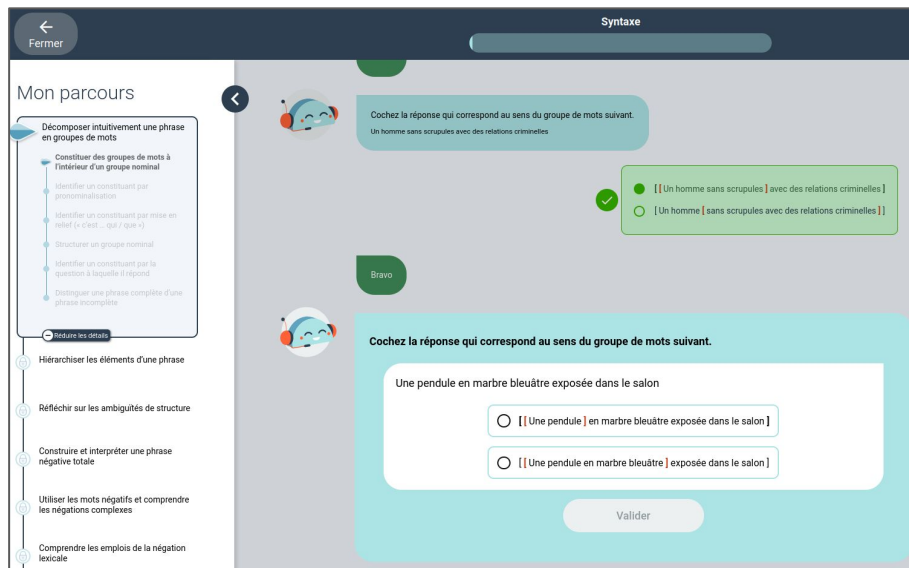
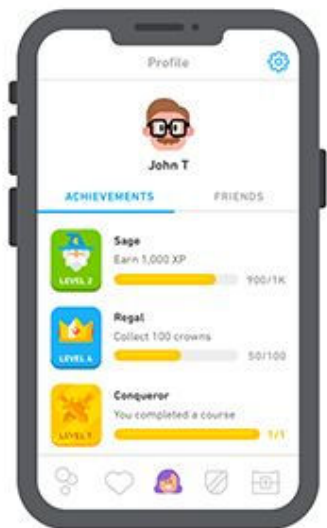
E.g.: LéA-IFÉ projects

Track 2: transfer in educational technologies

Enhance engagement in learning technologies through curiosity-eliciting mechanisms

GOAL: Avoid extensive gamification that can hinder learning

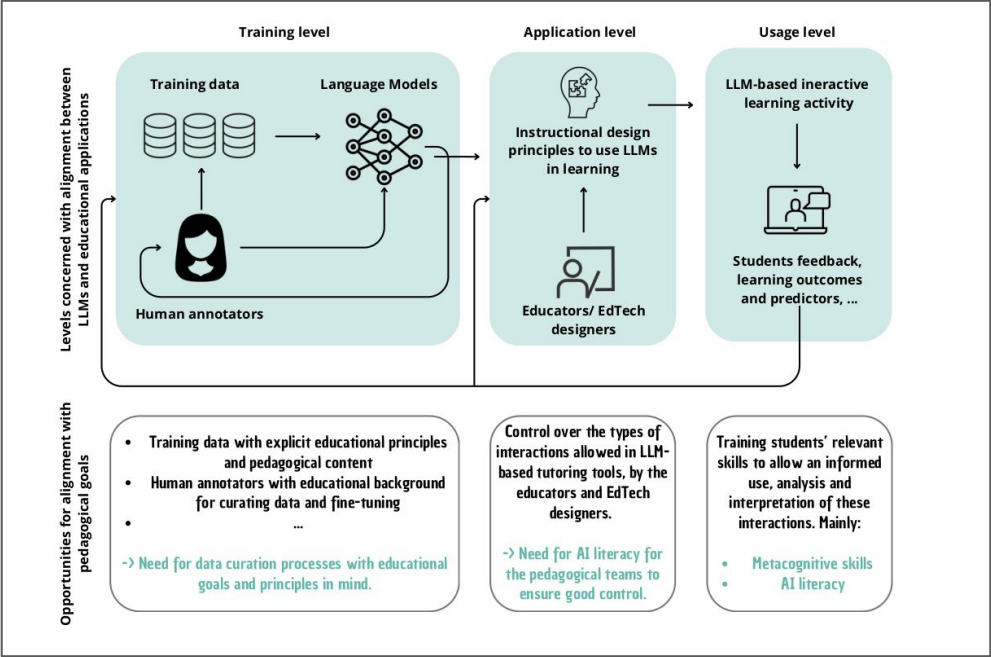
By replacing it with intrinsic motivation factors



Future directions

How can GenAI can be adapted to support curiosity-driven learning behaviors & Metacognition in educational settings?

→ Need for the alignment with targeted educational practices



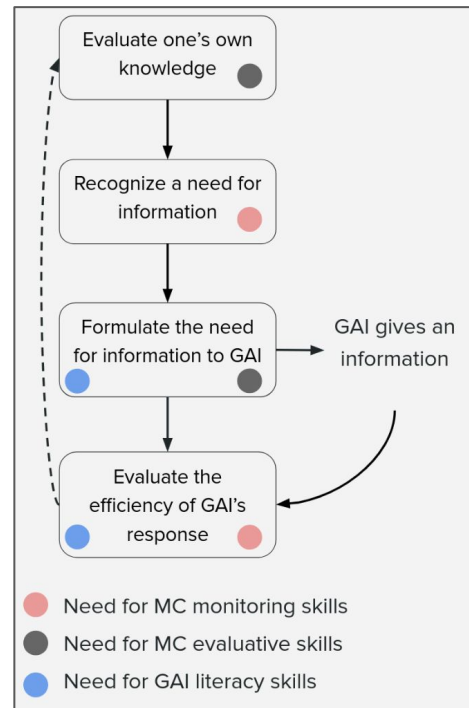
Future directions

**Are our trainings useful in GenAI-enhanced learning environments?
How to adapt them to?**

A lot of similarities between QA skills and prompting skills

Using GenAI to acquire new knowledge efficiently requires strong metacognitive skills

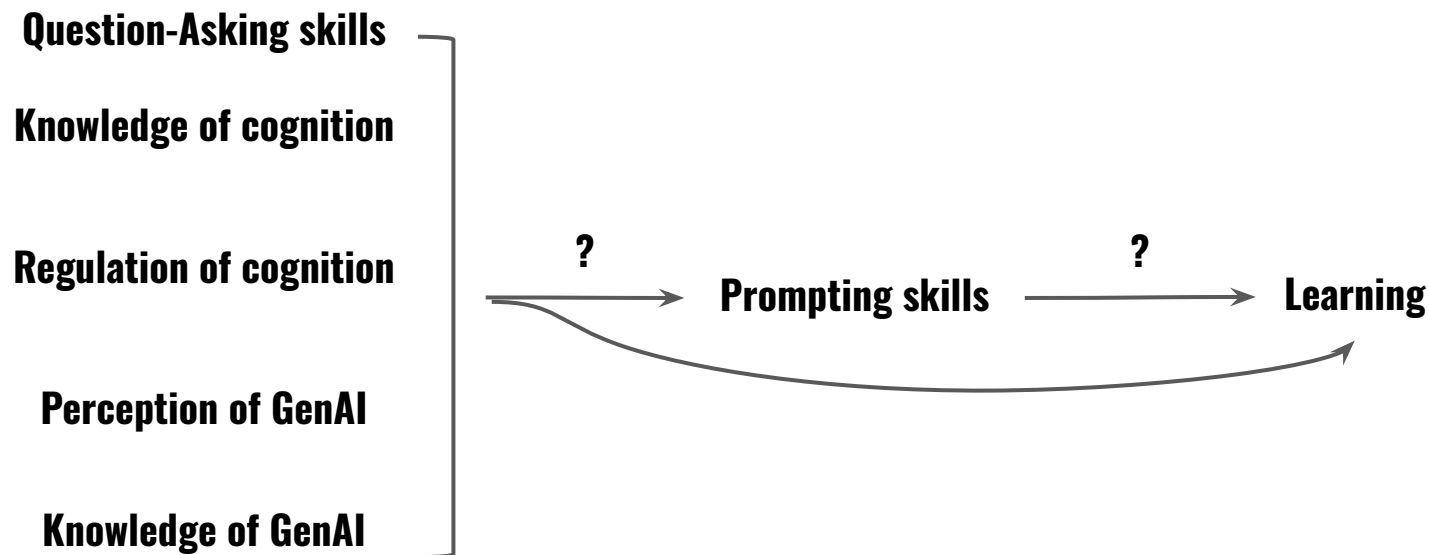
Active knowledge-acquisition with GenAI



Takeaways, limitations & perspectives

Work-in-progress

GOAL: Find empirical evidence for the role of metacognition, QA skills in facilitating an efficient use of GenAI during learning



THANK YOU !

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