

University of Georgia
AI4STEM Education Speaker Series
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Intellectual Stewardship:

*How Should Human Minds Re-adapt for
Creative Knowledge Work in the Age of AI?*

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Educational Change for the AI Age

- **Fix/optimize the old:**

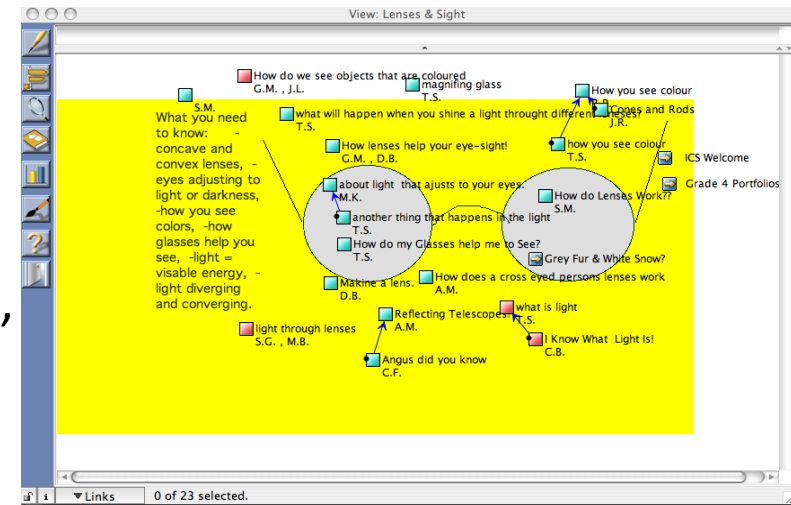
- Improving student mastery of predefined knowledge and skills

- **Envision new future learning:**

- More creative, dynamic, authentic, sustainable (Linn et al., 2025; Penuel et al., 2025; Resnick, 2024; Zhai & Krajcik, 2024)

Collaborative Knowledge-Building

- Build collective knowledge, which leverages personal learning and growth
- Use authentic processes for knowledge creation
 - Questioning, theorizing/explaining, evidence, designing, improving...;
 - Knowledge-building discourse
- Epistemic agency for co-structuring ever-deeper inquiry

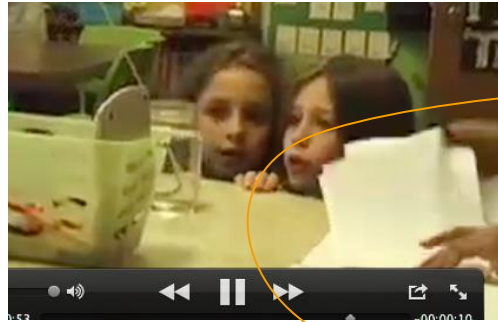
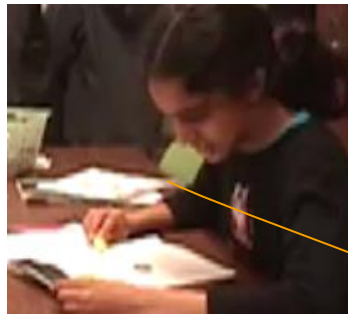


Shared knowledge space

(Scardamalia & Bereiter, 2006, 2014; Paavola & Hakkarainen, 2005; Penuel et al., 2025; Resnick, 2024; Chen & Hong, 2016; Ko & Krist, 2019; Miller et al., 2018; Zhang et al., 2009, 2011, 2018, 2022)

Let student ideas drive the classroom flow

Individual



Experiment



Co-read



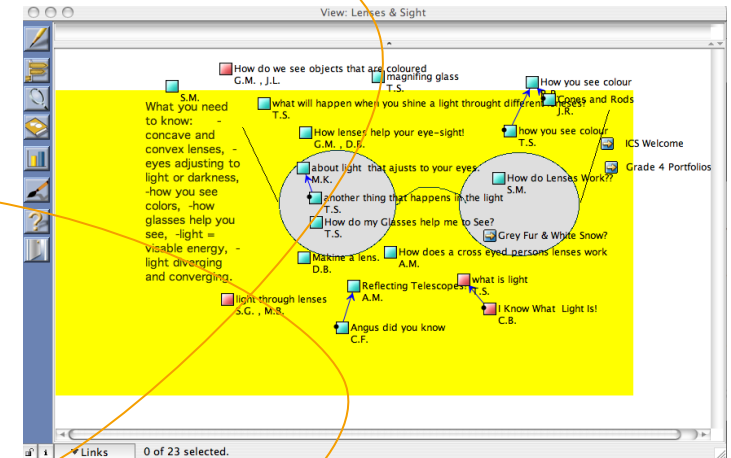
~~Reflect~~



Whole class conversations



Go online



Sustained discourse

Life and learning in the larger world

Rise Above to the Meta-Space: Cross-Classroom Collaboration

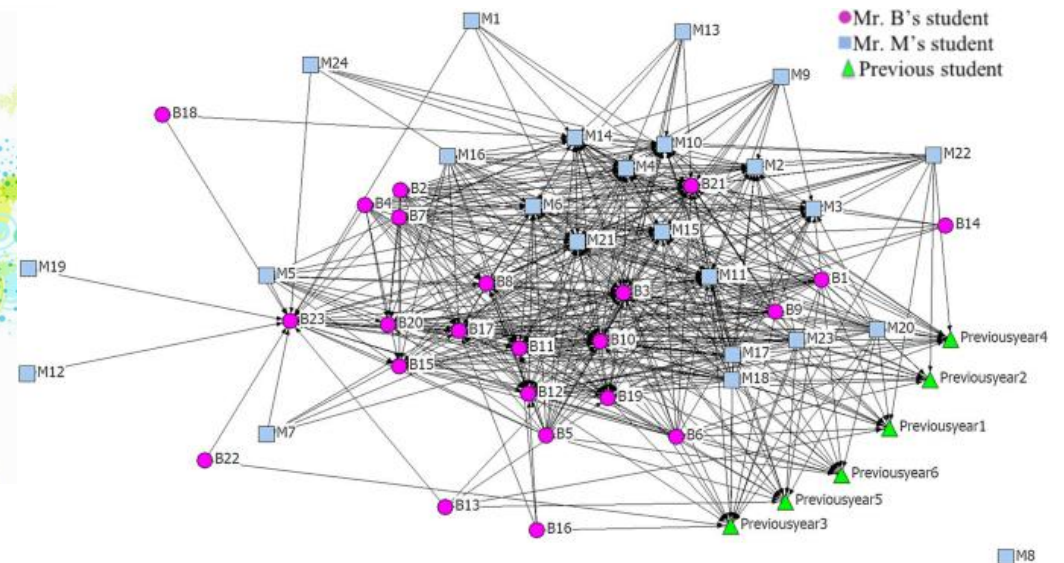
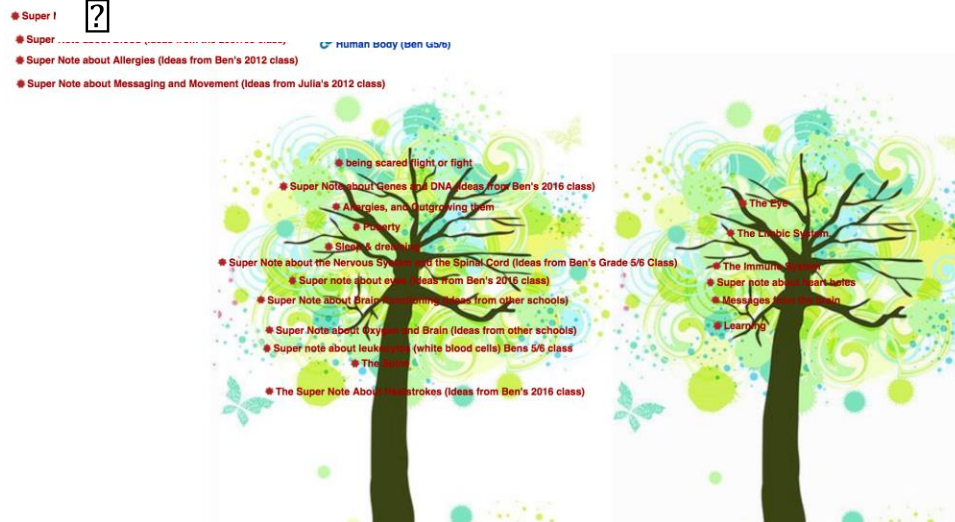
Super note about heart holes

Our topic and problems Why do hearts get holes in it? And how does it heal?

We used to think that it would heal by itself overtime. We also thought that the hole(s) was on the outside of the heart

Now we understand The hole is on the septum which is between the two chambers of the heart. One chamber sends lots of oxygen rich blood to the body and the other chamber sends not oxygen rich blood to the lungs. It can be dangerous when the blood mixes because it's like breathing carbon dioxide instead of oxygen.

Now we understand that some people who are born with heart holes in their septum will heal overtime. Whereas some people will have to get an open heart surgery to close the holes where a machine takes over the heart's pumping action and moves blood away from the heart.



(Yuan et al., 2019, 2022; Zhang et al., 2020)

New Opportunities for Creative Knowledge Work with AI

- Student-AI interaction to
 - define problem
 - generate and improve ideas
 - compare and synthesize sources
 - expand discourse moves

(Bereiter & Scardamalia, 2016, 2025; Chen, Zhu, and Díaz del Castillo, 2023; Feng, 2025; Lee et al., 2023; Yi, Yin, & Zhang, 2025).

Risks and Challenges

- **Cognitive debt (offloading)** (Deng et al., 2025 ; Kosmyna et al., 2025; Shen & Tamkin, 2026)
- **Gap of agency:** Weakening of student agency and responsibility (Choi et al., 2025; Fan et al., 2025; Gerlich, 2025; Habib et al., 2024 ; Wu et al, 2025)
- **Ethical and civic risks:** misinformation, bias, erosion of knowledge integrity, social trust, and student well-being (Burns et al., 2026).

Educational Response

- Existing response: focus on how to *use* AI well and mitigate risks
- Moving forward: situate AI use in a broader framework of learning in the age of AI
- How should human minds and responsibilities re-adapt?
 - Type in Chat: What kinds of mindset are needed for working productively with GenAI to learn/research?

Search for a New Metaphor

- Yes, **human–AI *partnerships***

(Hutchins, 1995; Pea, 1993; Perkins et al., 2000; Siemens et al., 2022; Markauskaite et al., 2022)

- **Human centered, agency**

(Woodruff & Hewitt, 2026; Wu et al., 2005; Zhang et al., 2022).

We need a detailed account for the high-order, reflective functions that define human agency

The Stewardship Metaphor

The motif of stewards across cultures: Joseph, Guang Zhong (管仲, 725?–645 BC)

- Faithful/responsible action
 - Wisdom in context/time
 - Fruitfulness
-
- **Stewardship mindset:** Reflective judgment *above and beyond* task, for meaningful growth well-being & flourishing

Intellectual stewardship

- Human practice and responsibility of wisely governing intellectual activity—human, artificial, and hybrid—in a dynamic context
 - by judging what knowledge work should be undertaken,
 - how it should be pursued,
 - using what tools and resources, and
 - toward what personal and social purposes.



See pre-print on arXiv

<https://arxiv.org/abs/2603.18117>

A lens for analyzing human agency and responsibility

- What assets and practices fall under one's stewardship?
- Stances and choices: What critical judgments/choices to make, about AI use and the knowledge work as a whole?
- Tools and processes: How are intellectual tools and processes orchestrated?
- In what contexts, for what purposes?
- What principles?

Intellectual stewardship: Five areas of judgment

KNOWLEDGE-WISE

Understanding the status of knowledge & taking fruitful actions

ETHICS-WISE
*Exercising moral
judgment, accountability,
and care*



INTELLIGENCE-WISE
*Orchestrating distributed
intellectual processes and
resources*

CONTEXT-WISE
*Recognizing opportunities and risks for creative
contribution in a changing environment*

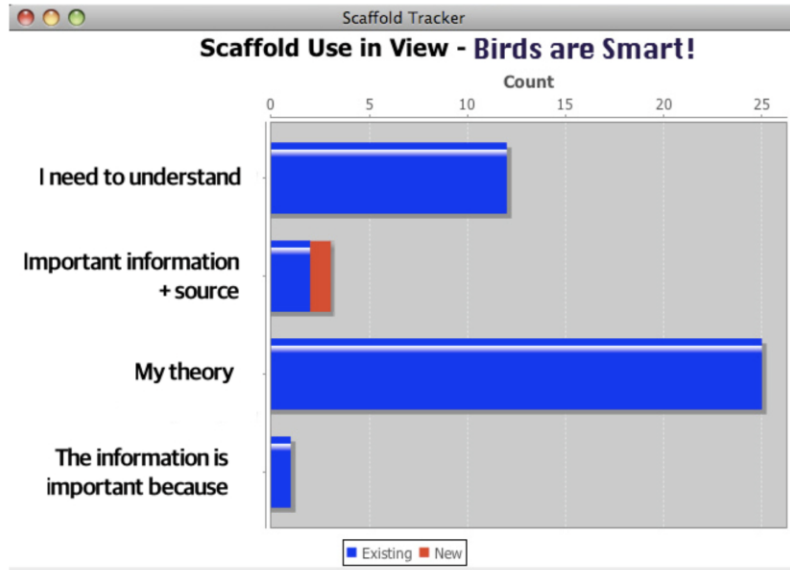
Knowledge-wise above & beyond “*knowledgeable*”

- Understanding the evolving state of knowledge —personal & collective-- and taking purposeful actions to advance or apply it
 - Epistemic, meta-knowledge (Bereiter & 2025): epistemic status, explanatory power, limitations, gaps, and future potentials
 - Knowledge-advancing choices (Chen & Zhang, 2016)

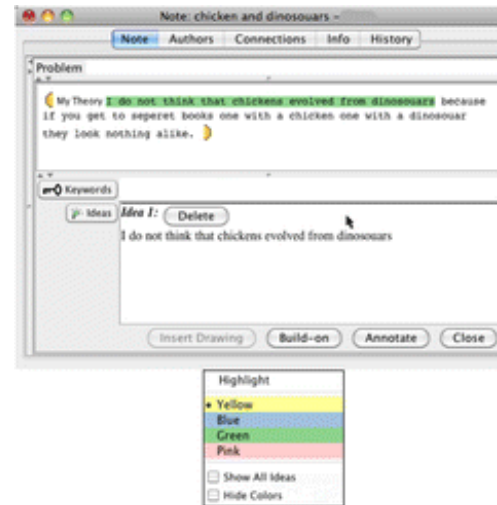
Decision points

- which problems are worth pursuing,
- what information/expertise is relevant,
- which ideas are promising to develop (or dead-ends to avoid),
- whether AI output advances understanding,
- what remains unclear, and how to move forward.

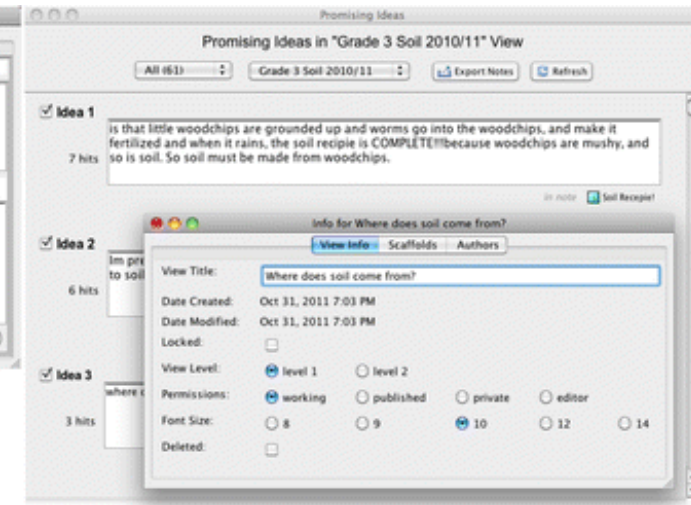
Meta-knowledge analytics



New contribution tracking



Promising ideas



(Chen et al., 2015; Chen & Zhang, 2016)

Intelligence-wise

beyond skillset and toolbox

- Meta-level thinking about **how diverse thinking forms should be organized and distributed (personal, team, AI)** to achieve meaningful goals.
- **Meta-intelligence:** a distinctly human capacity (Sternberg et al., 2023) of governing different intellectual processes and resources for specific purposes and contexts

Decision points

- what kind of intellectual work (analytical, creative, practical thinking) is needed in a context, for what purposes,
- how should it be carried out, by/with whom,
- using what intellectual resources and tools,
- what counts as success?

AI partners for diverse modes thinking

Reflective planning | Ideation | Synthesizing



- **G-Ideas:** What challenge or problem are you trying to solve?

- G-Ideas: What do you know about this challenge already, and what do you need to know (e.g., questions, problems):

- G-Ideas: What may be your first steps to work on this problem?

- How do you want me to help?

- **[Send request to GPT with prior conversation as context]**

- **User response:** We are working with P (a new energy company) to help people understand hydrogen as a clean energy source.
- User response: We know hydrogen is a clean energy that does not produce CO2. We need to know how this energy is used to power things and how it compares with other energy sources.
- User response: We may find some basic information about hydrogen energy, and may be also find good examples
- Can you help find a few companies and organizations?



Think first
before
open AI
chat

Meta-intelligence dispositions

- Inquisitive and persistent:
 - identifying valuable problems and sustaining effort to achieve deep understanding that goes beyond AI-generated first responses.
- Open-minded yet disciplined
 - carry out imaginative exploration with AI while maintaining standards of evidence, coherence, and logical reasoning.
- Collaborative
 - engage in productive dialogue with both human peers and AI partners (Bereiter & Scardamalia, 2025; Chen et al., 2023; Lee et al., 2023).

(Lucas, 2016; Perkins et al., 1993; Woodruff & Hewitt, 2026; Wu et al., 2025).

Context-wise

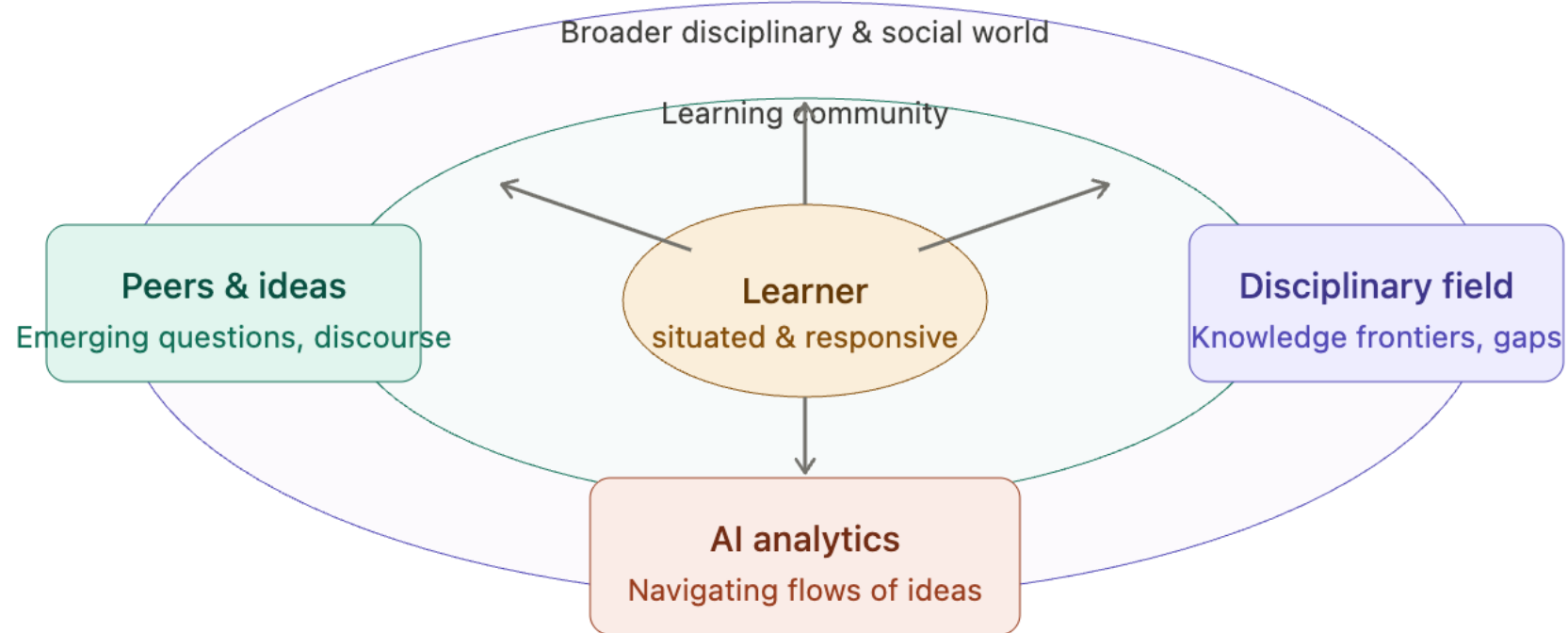
read the context & respond

- Recognizing **emerging needs and opportunities** to take initiatives
 - in connection with the ideas and works of other people as well as information generated by AI systems.
- **Sensitivity in context**
 - a core component of intelligent action in the AI age (Pendleton-Jullian & Brown, 2018; Perkins et al., 1993, 2000).



Context-wise stewardship

Recognizing opportunities and risks in a changing environment — and taking responsive action



Key judgment points for context-wise learners

What is happening here
that calls for intellectual
engagement?

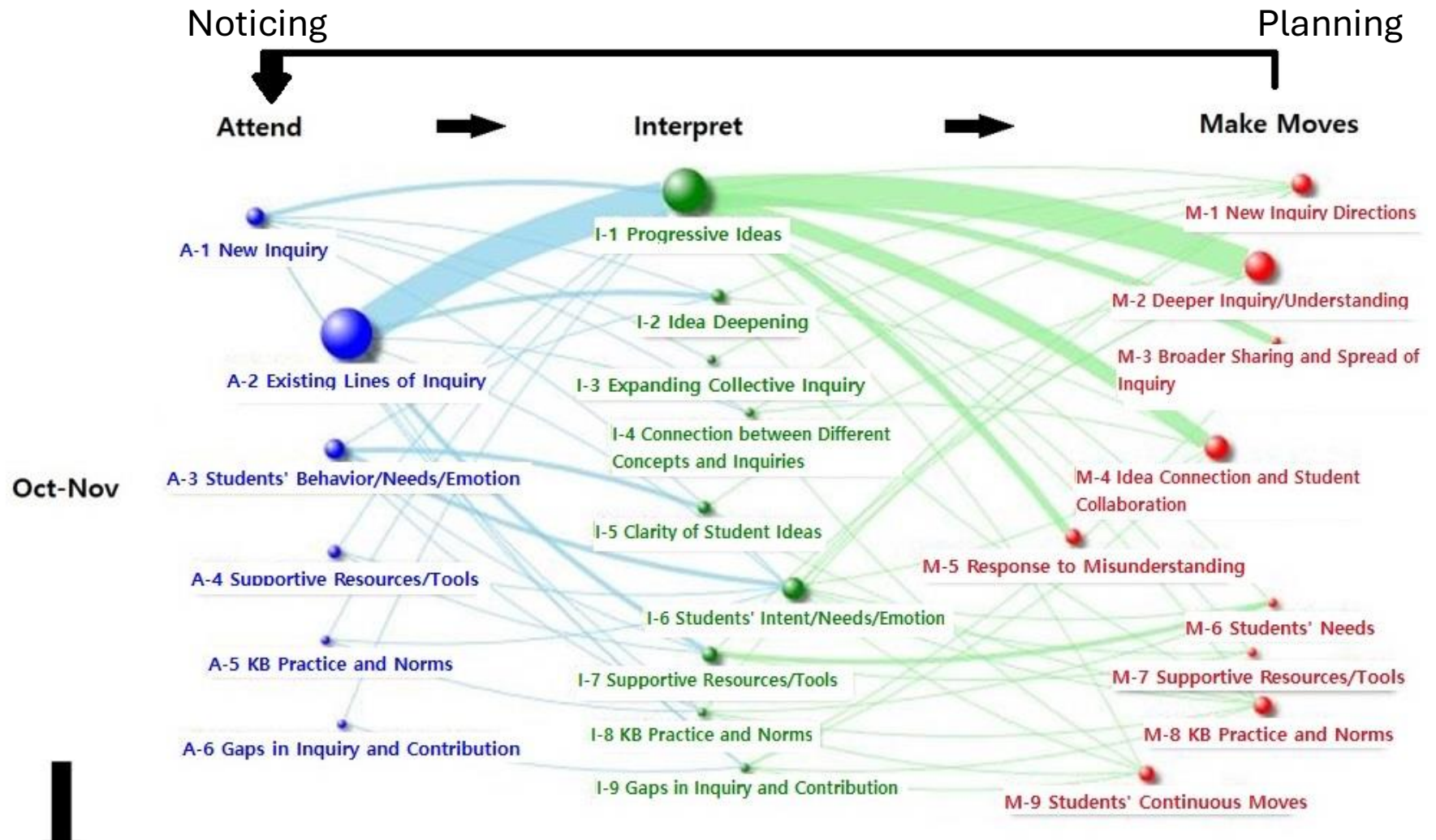
How should I position
my work in relation to
others' ideas?

When to reframe
or redirect inquiry
as conditions shift?

Opportunistic collaboration

Forming and reforming inquiry groups · reading emerging currents · improvising as conditions shift

(Park & Zhang, 2025)



Ethics-Wise

- It's wise to be moral/ethical!
 - An ethical mind: beyond compliance
 - System-level stewardship
- What responsibilities accompany my learning and work?
 - What is right or good to do, and what is not?
 - Should this work be done with AI, and under what conditions?
 - Who might be affected by these ideas or outputs?
 - How do I ensure integrity, fairness, and accountability?

Human-Centered Purpose (1/2):

Self-Growing

It is a fundamental human responsibility to ensure that AI serves meaningful ends.

- **Performing vs. learning/growing:**

- Use AI to produce better work → knowledge product, but become better knowledge builders, writers, thinkers, learners

- **Self-knowledge:**

- Know yourself: values, experiences, strengths, limitations, and long-term purposes

- **Self-surpassing:**

- As AI helps reduce the time and effort required for routine cognitive tasks, students may reinvest their resources in addressing greater complexity (Bereiter & Scardamalia, 1993):
 - working with richer representations
 - revisiting enduring problems at higher levels
 - identifying new or deeper issues, and
 - launching new directions of learning

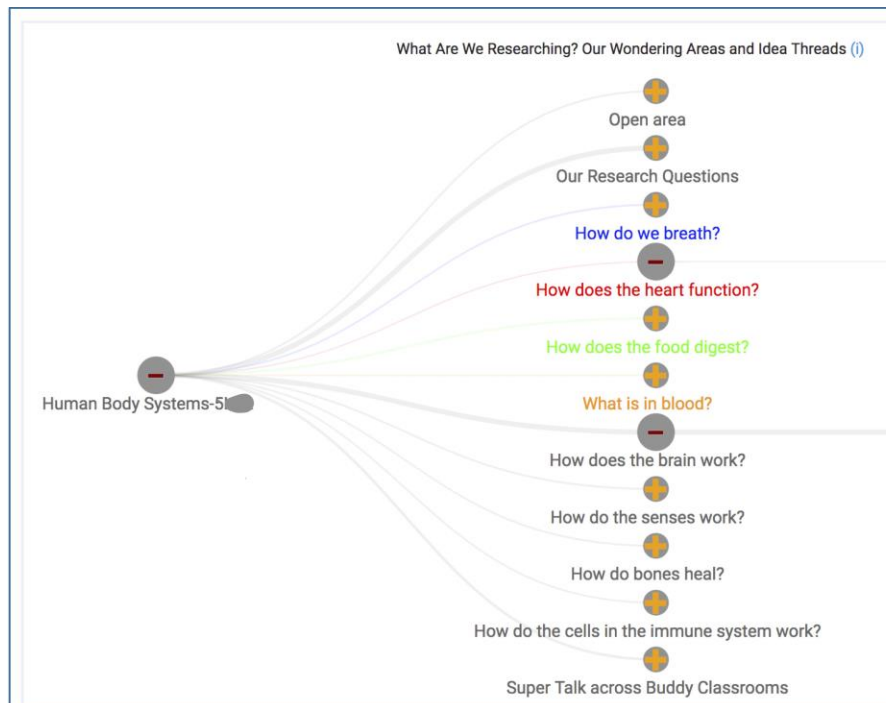
Human-Centered Purpose (2/2):

Community-Growing

- **Within a classroom community**
 - advance collective understanding, discourse, inquiry practices, and socio-emotional well-being.
- **Boundary-crossing across communities and fields**
 - Knowledge flow across classrooms
 - Real-world research: Work with real-world partners to solve authentic challenges (Ding et al., 2025; Underwood et al., 2025).

Meta-discourse with analytics support

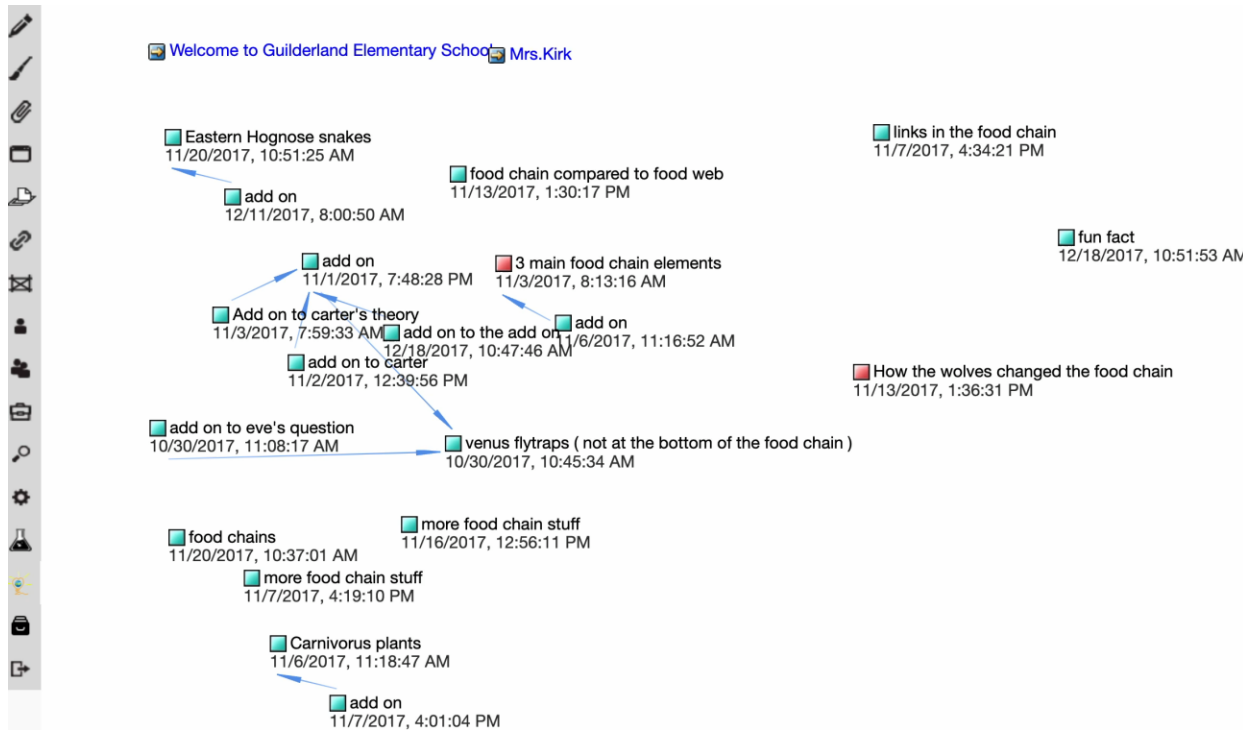
- What are the juicy topics or questions?
- Who are the experts?
- What are the key ideas we have developed? What are gaps?
- What are the insights from other communities?
- How do we move forward?



Idea Thread Mapper (ITM)

AI for meta-discourse

Meta-discourse with AI



Student discourse

Pinned Notes

KB GPT

Select Notes	Import All Notes	Import My Notes	Selected Notes	Chat History
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Welcome to KB-GPT. I am a chatbot representative for KB to help you with your queries. To help me better understand your requests, give me some information about the inquiry work you are doing

KB

Student grade and background: Grade 5 students in New York State
Learning Topic: Ecosystems
Curriculum Expectations: Based on the NGSS science standards, students in grade 5 are expected to develop an understanding of the idea that plants get the materials they need for growth chiefly from air and water. Using models, students can describe the movement of matter among plants, animals, decomposers, and the environment and that energy in animals' food was once energy from the sun.

Thank you for providing the context for student

Chat History

Student grade and background: Grade 5 students in

Put Together...

How should human minds and responsibilities re-adapt?

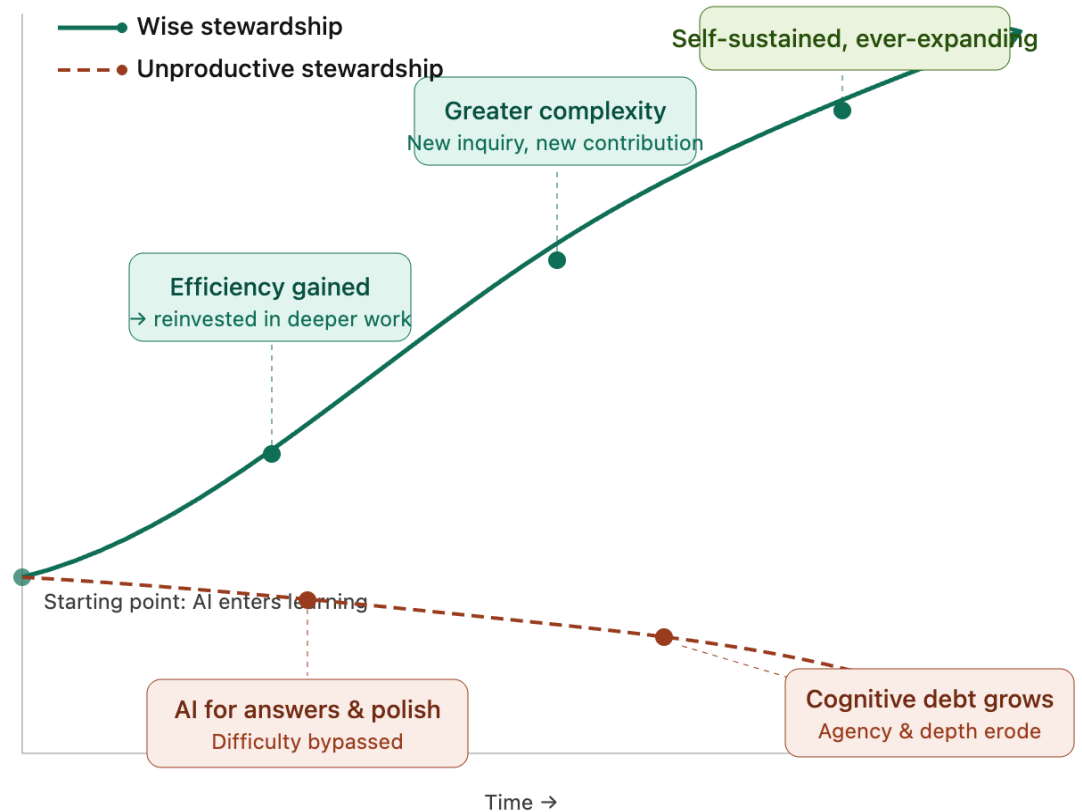
- As AI takes on various cognitive operations and amplifies potential risks, human minds need to increase their capacity for meta-level judgments and governance of thinking, learning, and knowledge work.

- Epistemic, meta-knowledge
- Meta-intelligence
- Sensitivity in context
- Ethical mind for "good work" with knowledge
- Continual growth of self and communities/societies



Core conjectures

- Different stances and choices do not merely affect student performance in tasks, but put them on different participatory pathways and developmental trajectories in the long term.



Beyond AI literacy, we need an AI-ready mindset

- Above: Staying metacognitively above one's work with agency and intentionality
- Beyond: Making sense of dynamic changes in the larger context, and approaching every task as an opportunity for future learning
- For personal growth & community flourishing

*A year grows grain; a decade grows timber;
a century grows a people. (Guan Zhong)*

Future research

- How do the reflective stances and choices interact to shape learners' engagement with human and AI systems over time?
- What are their impacts on knowledge building, epistemic agency, identity development, and adaptive expertise?
- How should we design human-centered AI systems that scaffold principle-based judgment and reflection? And
- Assess student epistemic choices and judgements?

Questions & Comments

See full paper on arXiv

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<https://arxiv.org/abs/2603.18117>

Smart people stumble at their own smartness “聪明反被聪明误”

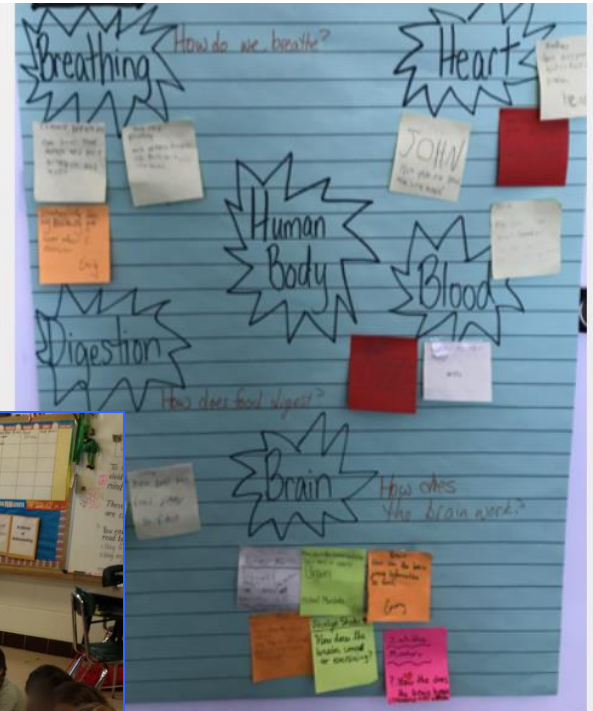
- Efficiency over depth (essence) of engagement
- Good performance in task w/o lasting & fruitful learning
- Get work done w/o purpose/meaning (why)

The risks are heightened by traditional school cultures that value efficiency and superficial learning.

Metacognitive Meeting: Co-organize pathways of inquiry

Breathing. Why does
my Breathing get
faster when I
exercise

I wonder...



Our wondering



Metacognitive
meeting

(Tao & Zhang, 2018,
2021; Zhang et al.,
2022)

Opportunistic Collaboration

- From fixed groups to opportunistic collaboration (Zhang et al., 2009, 2022).

