Adaptive learners in the age of AI: Leveraging SRL theory to human-AI collaboration

Prof. Sanna Järvelä, University of Oulu

What are the human strengths in the age of AI?

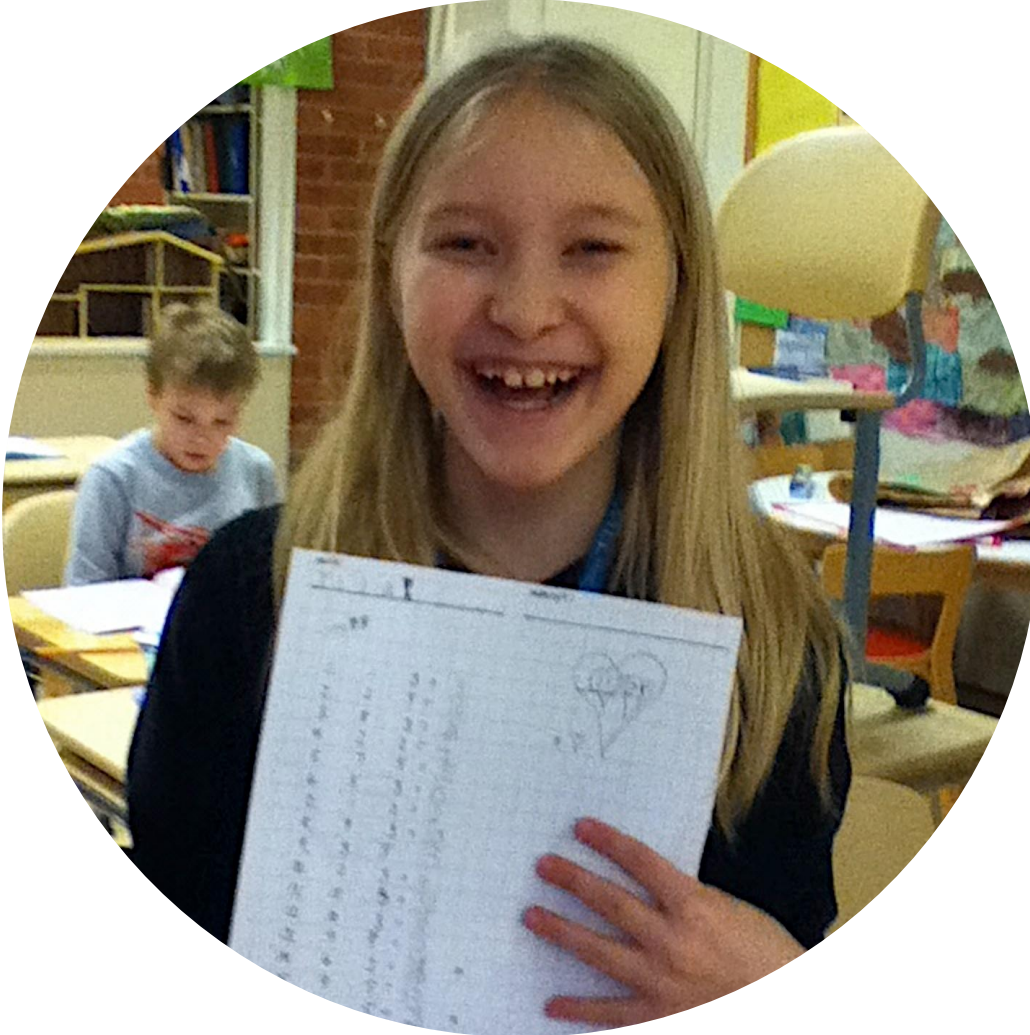How can we help learners to be adaptive?

Why Human-AI collaboration is important?

Hybrid Intelligence augmenting humans

How do we study Hybrid Human-AI regulation?

In the age of AI humans still have something that machines don't have: metacognitive ability

AI does not have agency.

Humans are powerful expressing affect and interpreting emotions.

Human mind is able to operate with cognition, metacognition, motivation and emotion in dynamic way.

"experimenting with your learning"

Learners can monitor and regulate their learning

Self-regulated learning

and transform their mental abilities into skills and competences

Järvelä, S., Hadwin, A.F,. Malmberg, J. & Miller. M. (2018). Contemporary Perspectives of Regulated Learning in Collaboration. In F. Fischer, C.E. Hmelo-Silver, Reimann, P. & S. R. Goldman (Eds.). *Handbook of the Learning Sciences*. Taylor & Francis.

Where is the human power?

(a) ability to adapt to new situations and challenges and engage in complex problem solving

(b) social skills necessary for communicating and collaborating productively and proficiently

(c) socio-emotional skills and empathy necessary for tackling challenging problems, and

(d) ability to take initiative set goals and monitor self and others.

Treasuring uniquely human skills and competencies that machines cannot match or replicate

What is adaptive learning?

SSRL

SRL

CoRL

We have been studying SSRL for theory building, methodological development and empirical evidence aiming for adaptive learners and better collaborative learning.
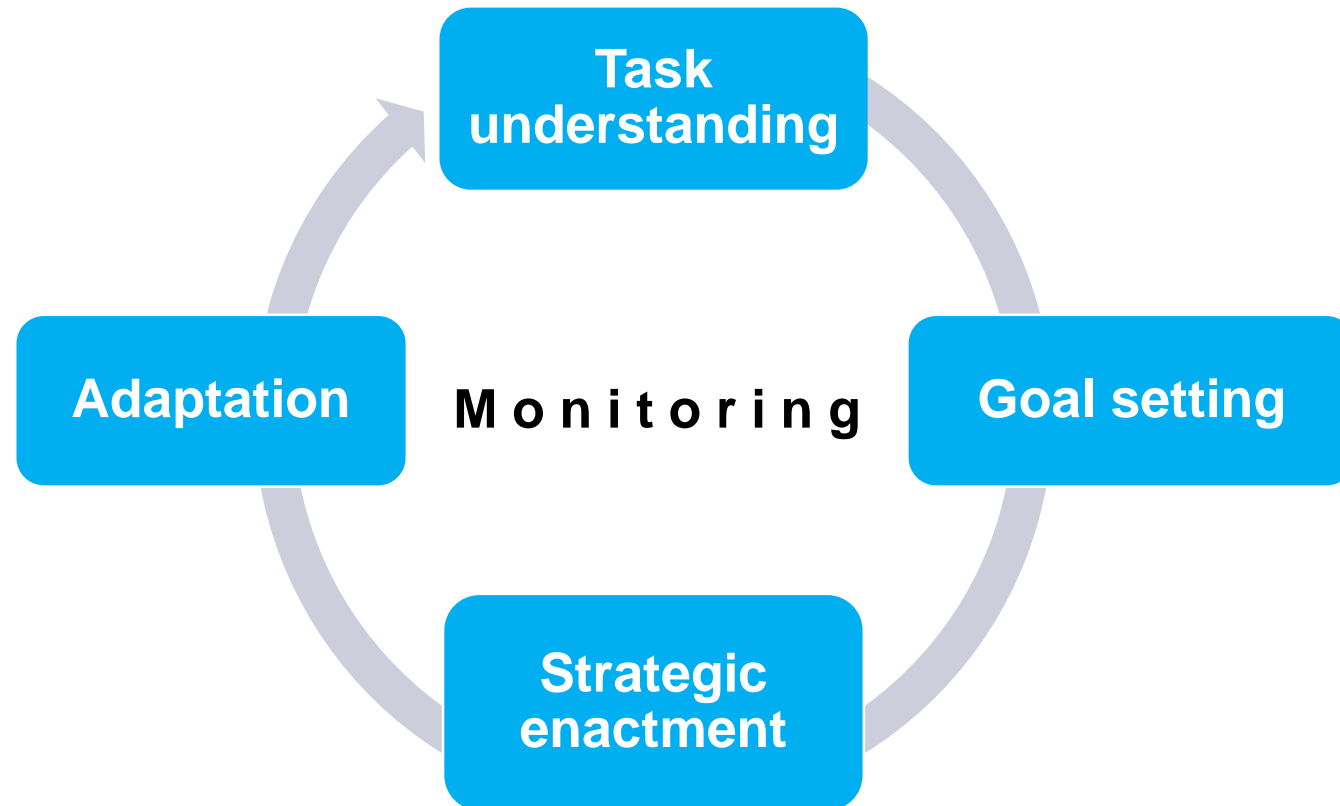
Hadwin, A. F., Järvelä, S., & Miller, M. (2018). Self-regulation, co-regulation and shared regulation in collaborative learning environments. In D. Schunk, & J. Greene (Eds.), *Handbook of Self-Regulation of Learning and Performance*.

What is self-regulated learning?

(e.g. Winne & Hadwin, 1998; Zimmerman 2002)

Task understanding

Goal setting

Monitoring

Strategic enactment

Adaptation

SRL is an ability to be **strategic and make adaptive changes** in terms of your cognition, motivation and emotions

Adaptation is a mark of regulation

(Winne, 1990)

IF ➡ THEN ➡ ELSE

Hadwin, A. F., Järvelä, S., & Miller, M. (2018). Self-regulation, co-regulation and shared regulation in collaborative learning environments (pp. 83-106). In D. Schunk, & J. Greene, (Eds.). *Handbook of Self-Regulation of Learning and Performance* (2nd) Ed. New York, NY: Routledge

Socially shared regulation (SSRL) involves groups taking metacognitive control of the task together through negotiated, iterative fine-tuning of cognitive, behavioral, motivational, and emotional conditions/states as needed.
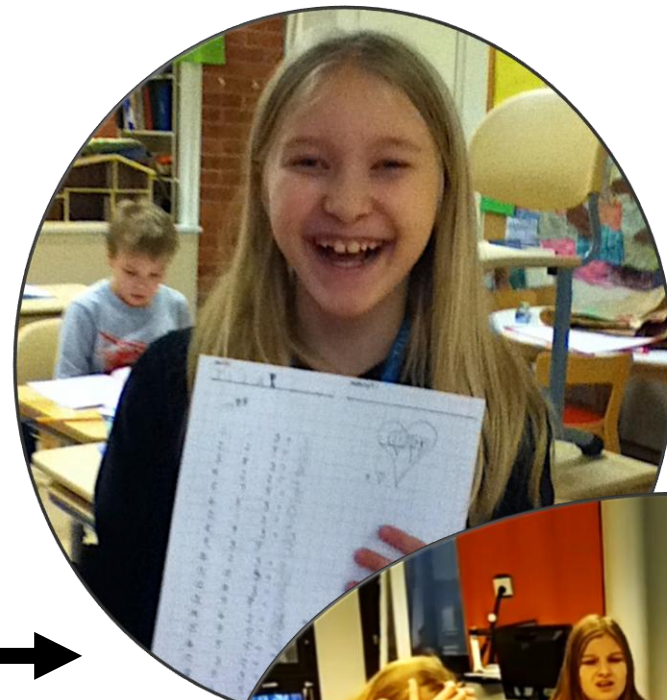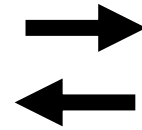
Järvelä, S., Malmberg, J., Sobocinski, M., & Kirschner, P. (2021). Metacognition in collaborative learning. In U. Cress, A. Wise, C. Rosé, & J. Oshima (Eds.), *International handbook of computer supported collaborative learning* (pp. 281–294).
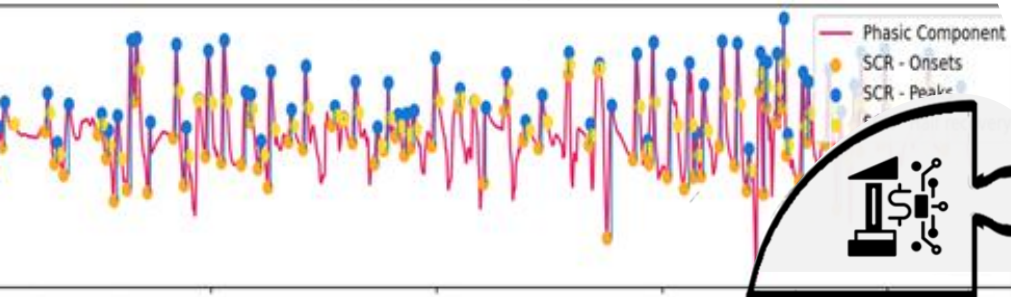
SRL

SSRL

Hybrid human-AI regulation

Järvelä, S., Nguyen, A., & Hadwin, A. (2023). Human and artificial intelligence collaboration for socially shared regulation in learning. *British Journal of Educational Technology, 54,* 5.

Why human-AI collaboration is important?

Advancement in Technology
"Decades happen in weeks in AI development"

Data-driven AI is still **too narrow to help humans**

Human-AI collaboration combines strengths of humans and machines

Timely questions

Jacobs Foundation @Foundation_JF · 3 h · · ·

21%. That's the % of #EdTech companies who have a piece of #evidence to support their programming.

Listen to @libbylhhills & @ionsol, Co-Leads of our Learning Schools portfolio, on @Zanichelli_VC, discussing how we can tackle this issue: bit.ly/42IeAkN #Education

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Global population changes

The global population grows about 200 000 each day.
Enormous pressure to scale education effectively
and sustainability.

E.g. the next decade will see an additional 350 million post-secondary graduates

Crises impact humans

Pandemics

Climate change

Conflicts

e.g. 200 million children worldwide
live in high-intensity conflict zones.

Future work and skills

Uncertainly >< developing human capital in society.

Re-skilling and up-skilling in developed economies.

e.g. 50% of jobs are expected to be significantly affected by automation, 14% of jobs are at high risk of automation

Aging and care

Utilizing AI and other realities for wellbeing, care and training professionals

e.g. WHO predicts international shortages mounting up to 9.9 million healthcare workers by 2030.
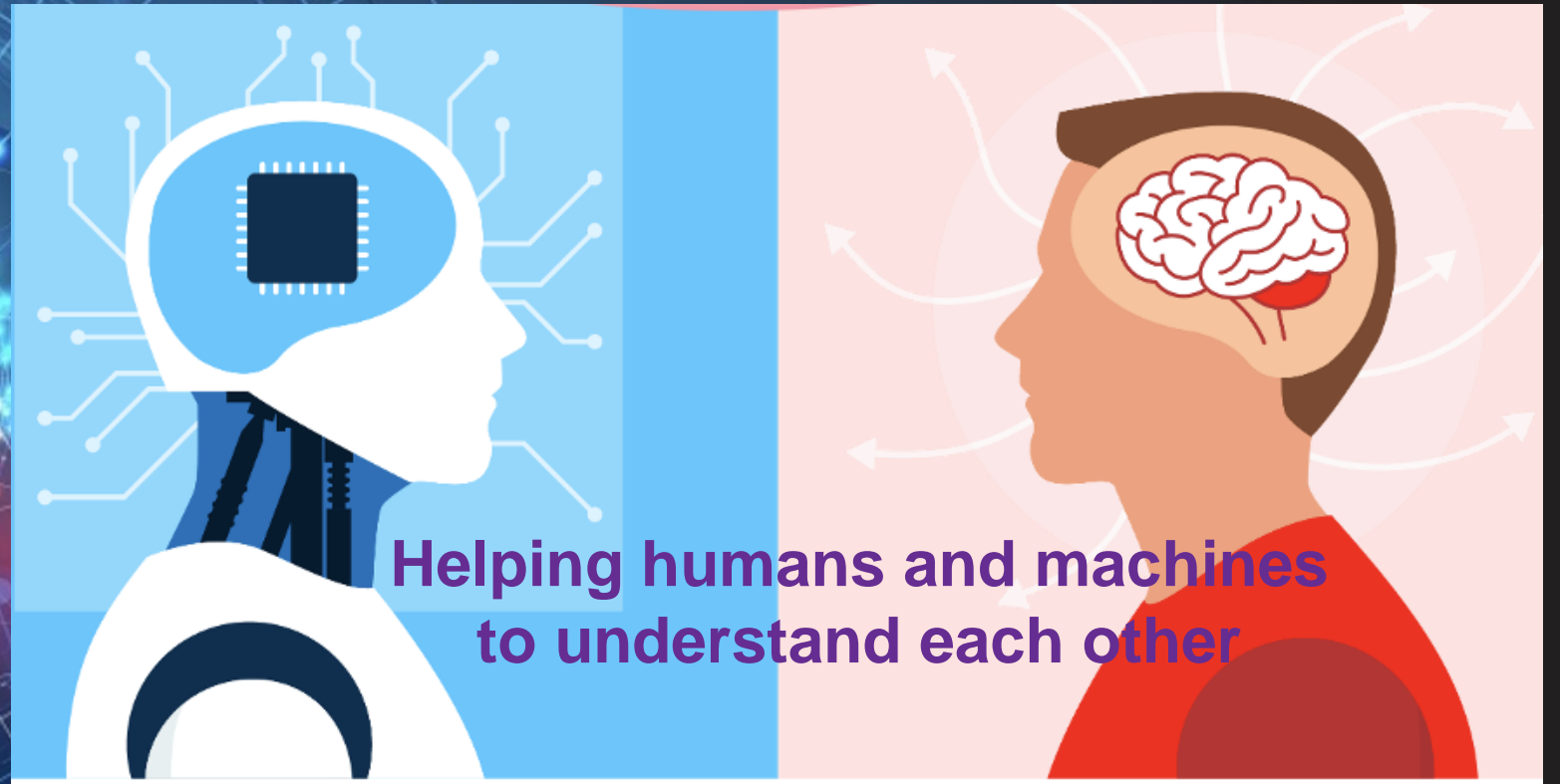
HYBRID INTELLIGENCE

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What is HYBRID INTELLIGENCE?

Helping humans and machines to understand each other

to replace or complement human intelligence.

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Why HYBRID INTELLIGENCE?

Current data-driven AI is still too narrow to help humans, as it is lacking in social and emotional intelligence being restricted by reality.

By placing the emphasis on mutual understanding and learning from each other, we combine the strengths of both humans and machines in their co-evolutionary processes.
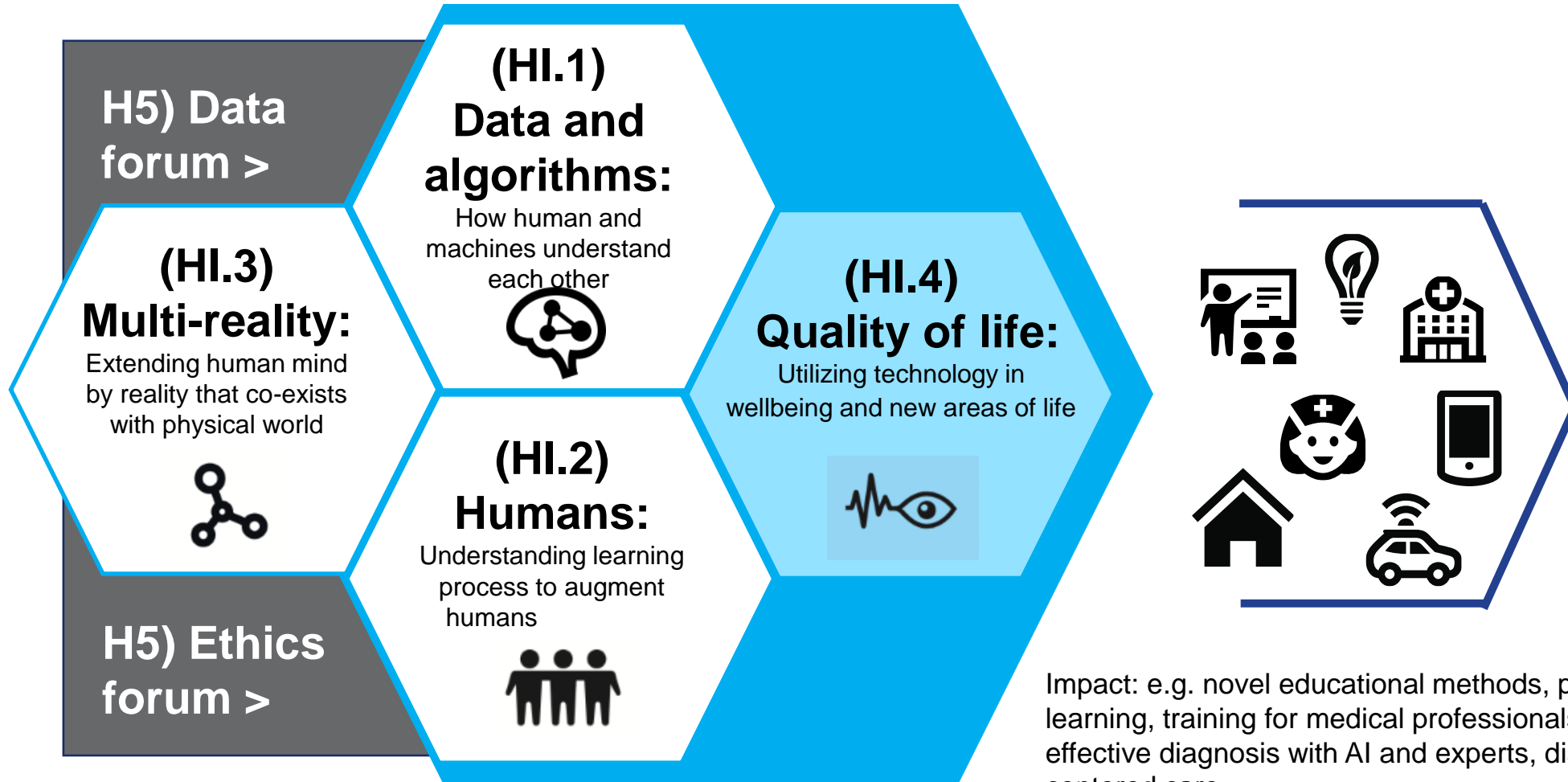
HYBRID INTELLIGENCE

We propose to build the idea of a *metaverse* by combining our physical and virtual realities in a movement towards a multi-reality.

HYBRID INTELLIGENCE 2023-2028
Human-AI co-evolution and learning in multi-realities (HI)

H5) Data forum >

H5) Ethics forum >

(HI.1) Data and algorithms: How human and machines understand each other

(HI.3) Multi-reality: Extending human mind by reality that co-exists with physical world

(HI.2) Humans: Understanding learning process to augment humans

(HI.4) Quality of life: Utilizing technology in wellbeing and new areas of life

Impact: e.g. novel educational methods, personalized learning, training for medical professionals, more effective diagnosis with AI and experts, distant human-centered care

AI and Human reinforce each other in **ethical, responsible** and **productive** ways

Industry: FrostBit Software Lab, R&D Partner and Learning Environment in XR, YLE, Varjo, Kone, and Dispelix

Policy makers: OECD, Ministry of Education and Culture, Finnish Transport and Communications Agency and International Telecommunication Union.

HI video

How do we study
Hybrid human – AI regulation?

What are we doing @

1. Use data to understand SSRL.
2. Use AI to make data meaningful for us.
3. Help learners and AI to collaborate.
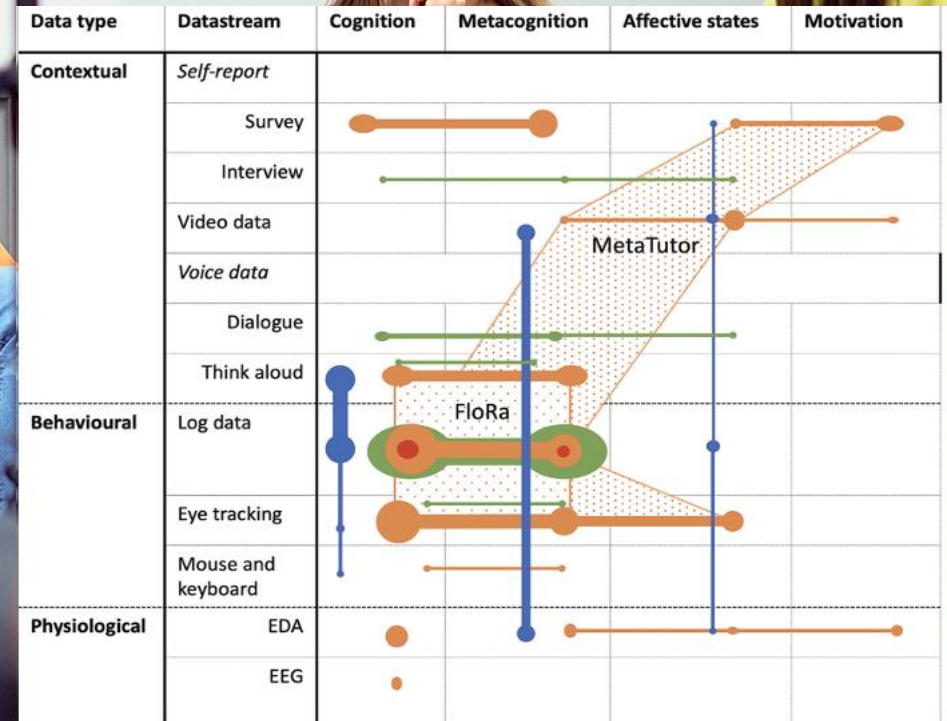4. Augment learners to be more adaptive self-regulated learners

"Translate" AI to SSRL for evidence based educational technology

Multimodal data

	Cognition	Metacognition	Affect/Emotions	Motivation
Log files				
Eye tracking				
Physiological sensors				
360° video+audio				
Facial recognition				
Situated self-reports				

Järvelä, S., Malmberg, J., Haataja, E., Sobosincki, M. & Kirschner, P. (2021). What multimodal data can tell us about the self-regulated learning process? *Learning and Instruction, 72,*

Data type	Datastream	Cognition	Metacognition	Affective states	Motivation
Contextual	*Self-report*				
	Survey				
	Interview				
	Video data				
	Voice data				
	Dialogue				
	Think aloud				
Behavioural	Log data				
	Eye tracking				
	Mouse and keyboard				
Physiological	EDA				
	EEG				

Molenaar, I., de Mooij, S., Azevedo, R., Bannert, M., Järvelä, S., & Gašević, D. (2023). Measuring SRL and the role of AI: Five years of research using multimodal multichannel data. *Computers in Human Behavior*, 107540.
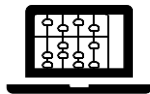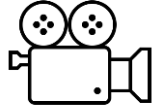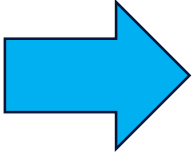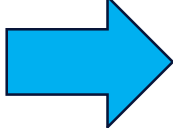
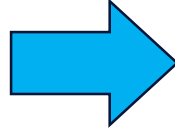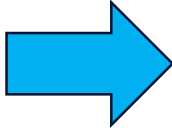Hybrid Intelligence | University of Oulu

Our research progress to understand (S)SRL

Data collection

Evidence about social and emotional factors in CL

Human-AI collaboration

Evidencing SSRL
Järvelä et al., 2013

MC monitoring & physiologal syncrony
(Haataja et al. 2020)

Physiological activation and emotions
(Törmänen et al. 2022)

Gazes and visual cues
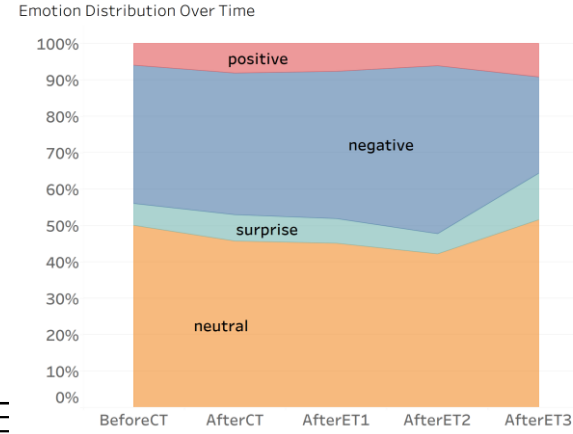(Cini et al., 2023; Whitehead et al., 2023)

HR as change point detection
(Sobocinski et al., 2020)

Patterns of social interactions
(Vuorenmaa et al. 2022)

AI-based methods for automating, modeling and predicting regulatory triggers
(Nguyen et al., 2023)

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Understanding learning process

Human Learning
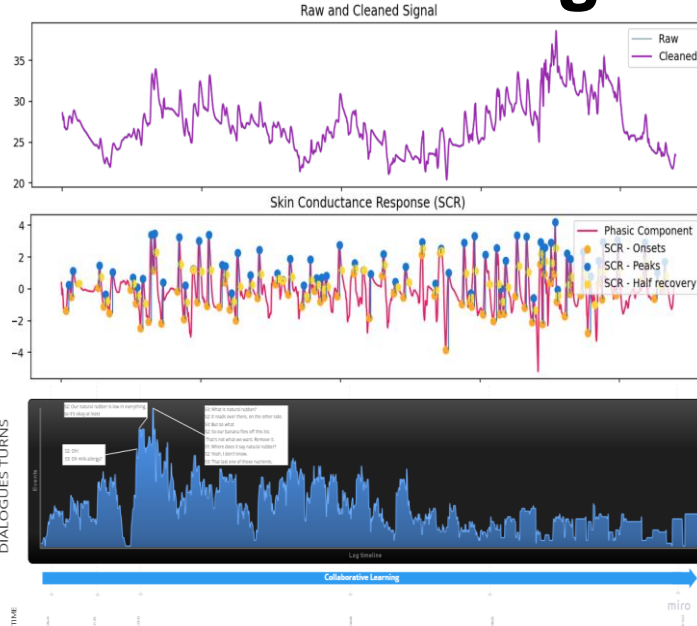
Teach machines

Human agent

AI agent

Järvelä, S., Nguyen, A., & Hadwin, A. (2023). Human and artificial intelligence collaboration for socially shared regulation in learning. *British Journal of Educational Technology, 54,* 5.

Human-AI collaboration

Järvelä, S., Nguyen, A., Lämsä, J., Edwards, J., Sobocinski, M., Dang, B & Whitehead, R. (2024). *Learning regulation with AI – promoting adaptive K-12 learners* (in prep.)
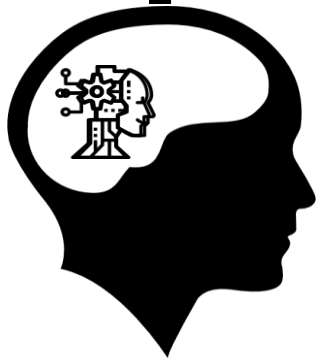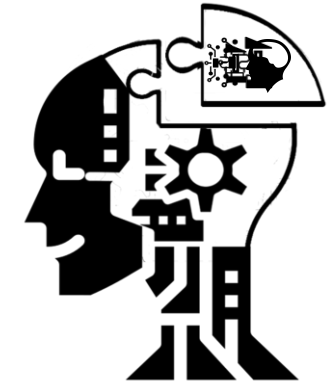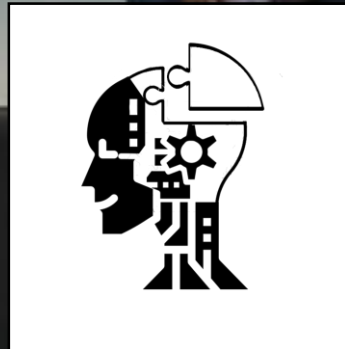
Human (- AI) collaboration in metaverse

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MAI Metacognitive AI agent

Intervene

I noticed that you might be confused....Can you explain what are you trying to understand now?

I noticed that you are facing a difficulty...How is your current approach helping you achieve your goals?

I noticed that you are thinking of your individual perspectives... How can you progress as a group?

Detect

Lack of shared perspective

Negative valence monitoring cognition

Lack of conceptual understanding

Increase metacognitive awareness

Edwards, J., Nguyen, A., Lämsä, J., Sobocinski, M., Whitehead, R., Dang, B., Roberts, A.S., & Järvelä, S (2024, submitted). *How artificial agents influence socially shared regulation among learners*

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Radboud Universiteit

TUM
TUM Educational Media Lab
TUM School of Education
Technical University of Munich

MONASH University

UNIVERSITY OF CENTRAL FLORIDA ★1963★

To equip especially younger learners to learn, live, and work in the age of AI

JACOBS FOUNDATION
Our Promise to Youth

CELLA aims

Design and implement AI-driven systems for supporting learners to improve their SRL skills

Develop practices that boost agency of learners while working with AI

To equip K-12 learners to learn, live, and work in the age of AI

Inform policy making about the application of AI in education

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Centre for Learning and Living with AI
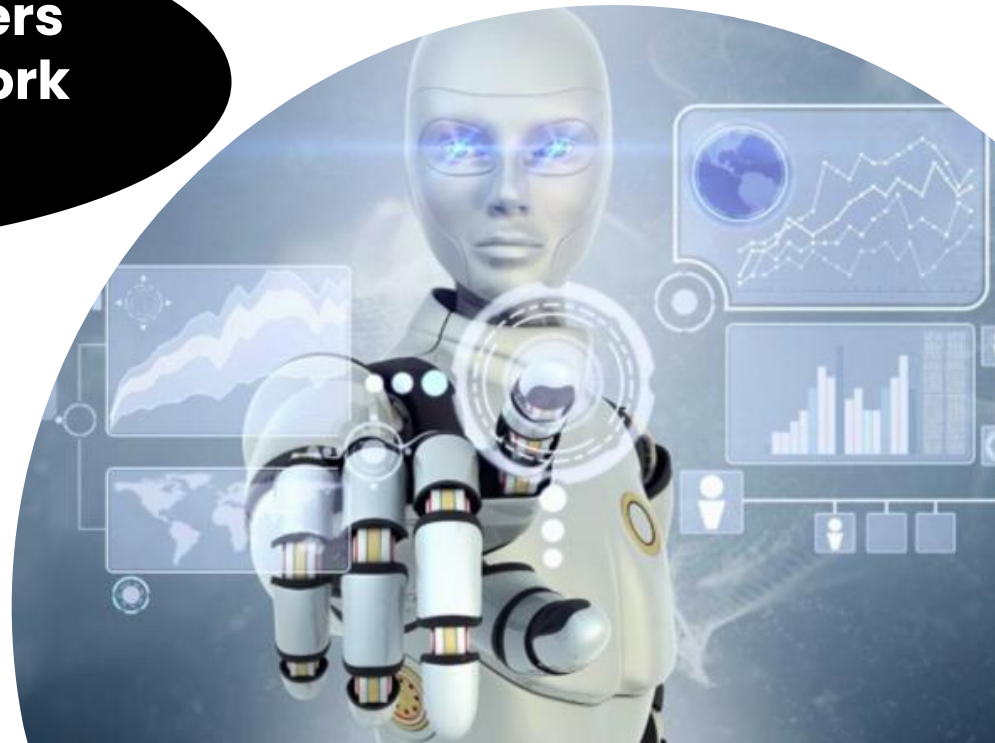
SRL when writing from multiple source texts

Going through instructions

Searching

Checking available time

Reflecting

Making notes on source texts

Highlighting

Drafting essay

Editing essay

Orienting   **Monitoring**   **Writing**

Planning   **Reading**   **Re-reading**   **Evaluating**

(e.g., Rakovic & Winne, 2022; Winne & Hadwin, 2013; Fan et al., 2022)

Lämsä, J., Mooij, S., Aksela, O., Athavale, S., Bistolfi,S., Azevedo, R., Bannert, M., Gašević, D., Molenaar, I & Järvelä, S. (2024, submitted). *Measuring secondary education students' self-regulated learning processes with digital trace data*

University of Oulu
Oulu, Finland

Research reach

200+ students,
2 schools, 6 teachers

Research areas

Eye tracking

Self reports

Qualitative and quantatitive insights on self-regulated learning

Interviews

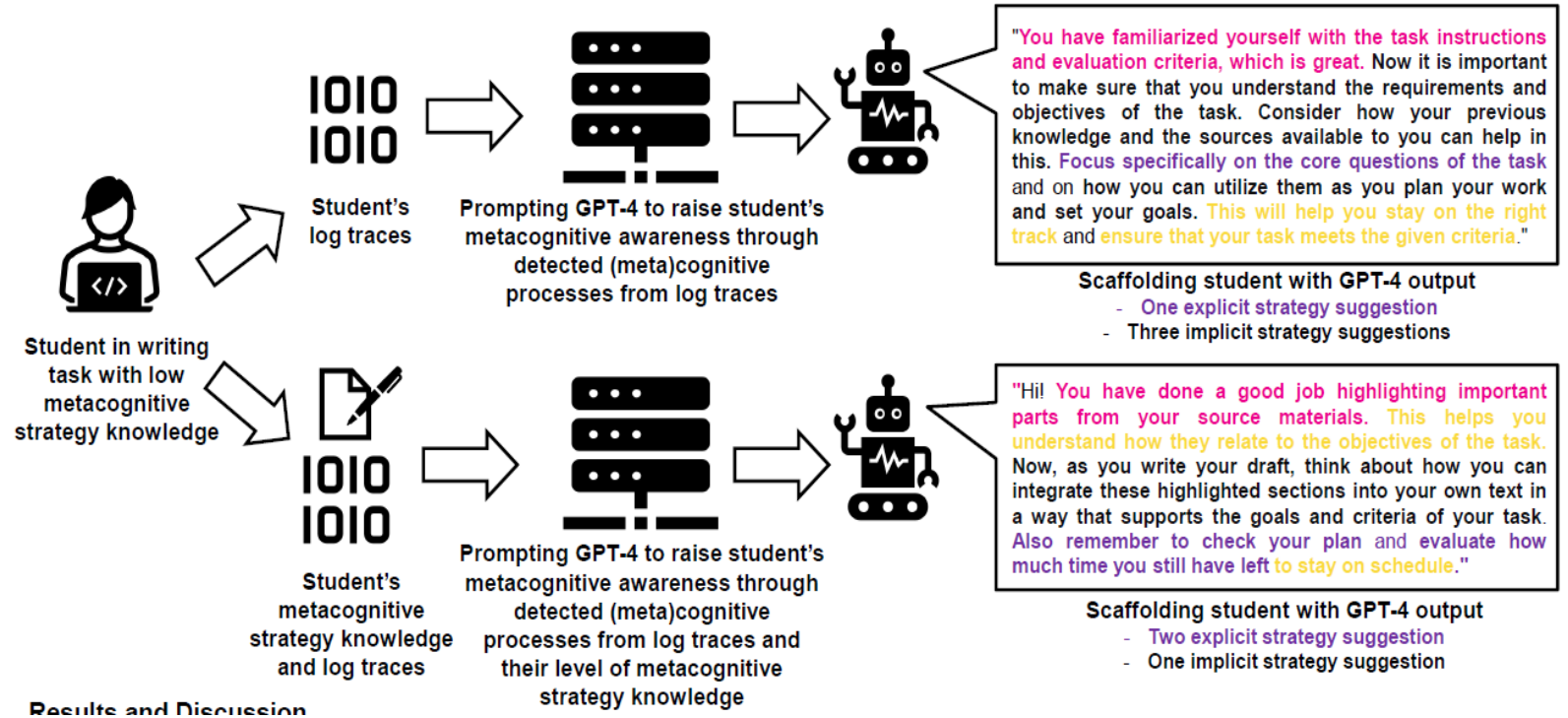Trace data

GenAI for supporting metacognitive awareness

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How much GenAI can revolutionize learning?

SRL is laborous

Too much or too little help for learners metacognition?

Lämsä, J. Li, X., Aksela, O, Kaarlela, M:, Rakovic, M., Gasevic, D. & Järvelä, S. (2024). Using generative artificial intelligence to scaffold students' metacognitive awareness. *14th International Conference on Learning Analytics & Knowledge (LAK24)*

cognitive residues rather t[...]damalia,
Bereiter, McLean, Swallo[...]

It is not the computer that shoul[...]g, and the
planning. It is the student. The [...]viding the
knowledge and intelligence to g[...]acilitating
structure and tools that enable s[...]wn intelli-
gence and knowledge. (p. 54)

In Salomon, G. (1993). Distributed cognitions. New York: Cambridge University Press.

Thank you

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