THE UNIVERSITY OF SYDNEY

Education in an Age of AI.

New ways to learn, new things to learn

https://tinyurl.com/BB2Feb26

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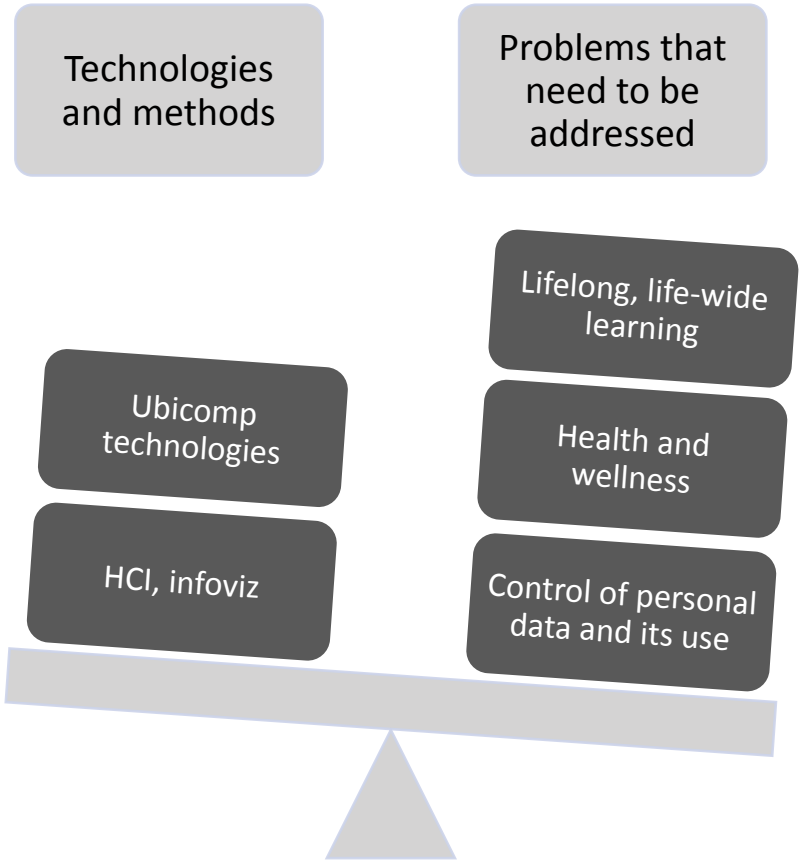
hct:.

Human-Centred Technology

Introductions (1 of 4)

Shared user models

A little about me (1a) :.



International Sustainable Development goals

https://sdgs.un.org/goals

A little more about me

International Journal of Artificial Intelligence in Education

Official Journal of the International AIED Society

User Modeling and User-Adapted Interaction

The Journal of Personalization Research

ACM Transactions on Interactive Intelligent Systems

Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies

A little about you (1b) :.

So I can build a mental model of this audience

A little about you (1b) :.

User model

Open Learner Model (OLM)

XAI (eXplainable AI)

Scrutability

Ontology

Biggs Constructive Alignment

Bloom taxonomy

Metacognition

Epistemic humility

Problem based learning

New ways to learn (2 of 4)

AIED foundations

AIED driving vision

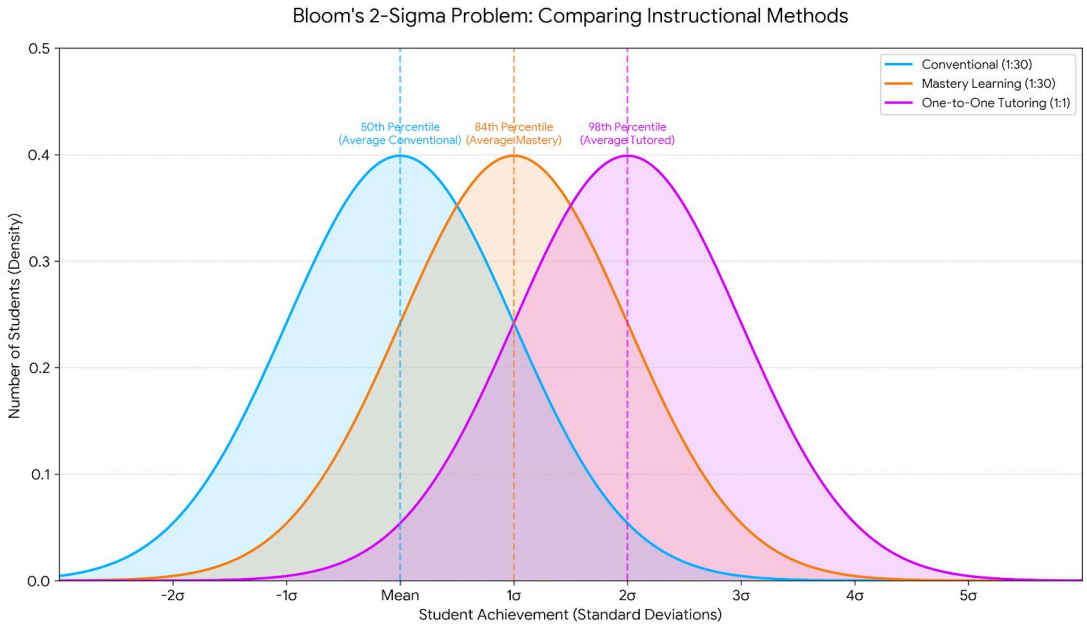
A little history because AIED researchers have established a body of valuable work, theory, methods, architectures … that should be valuable in the future.

(The many people inspired by LLMs are reinventing, needlessly wasting effort.)

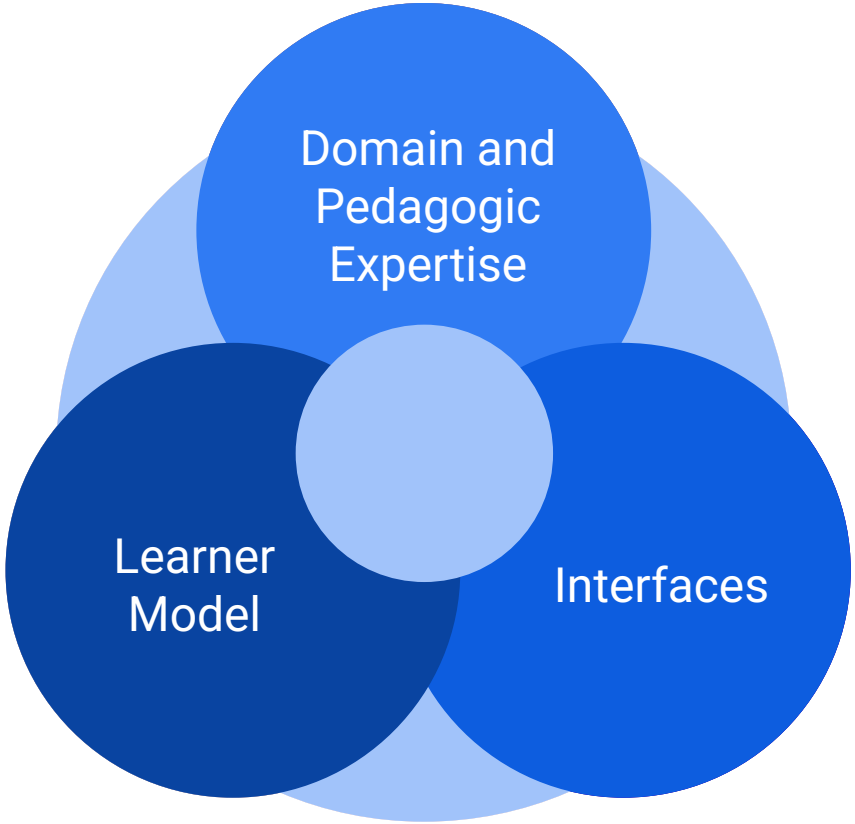
AIED driving vision

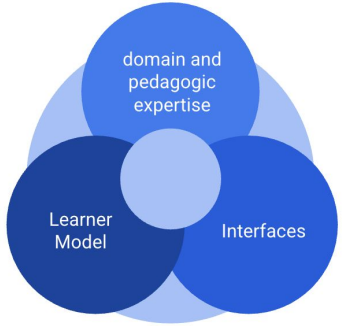
Bloom, Benjamin S. "The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring." Educational researcher 13, no. 6 (1984): 4-16.

For scale … personalised teaching systems.



Classic AIED





Key feature of AIED teaching systems

Personalisation based on a **learner model**

… AIED systems care about the learner, precisely

What is a learner model?

a.k.a a user model

(where the user is a learner using a teaching system)

Four meanings of learner model

#1: The the model of the learner in the mind(s) of the teacher(s).

#2: An implicit user model frozen within the code.

In AIED research:

A machine representation of the user – a (dynamic) set of beliefs about:

– #3: many learners e.g. to predict user behaviour

– #4: an individual learner. e.g. personalise based on learner's knowledge

Kay, Judy, and Bob Kummerfeld. "From data to personal user models for life-long, life-wide learners." British ournal of Educational Technology 50, no. 6 (2019): 2871-2884

Typical definition of learner models

Machine representations of the learner's

- **knowledge**
- skills and other attributes

… may include cognitive, metacognitive, affective, personality, social and perceptual aspects

Zapata-Rivera, Diego, and Burcu Arslan. "Enhancing personalization by integrating top-down and bottom-up approaches to learner modeling." In International Conference on Human-Computer Interaction, pp. 234-246. Cham: Springer International Publishing, 2021.

Why create learner models

Answer 1: **Personalisation** such as:

- Selection of assessments,
- Personalising the form of assessments
- Recommending next learning step options
- …

Answer 2: "**Useful in their own right**" and designed for use by learners and teachers (via an OLM interface) supporting **metacognitive activities** such as:

- self-reflection,
- self-monitoring,
- planning.

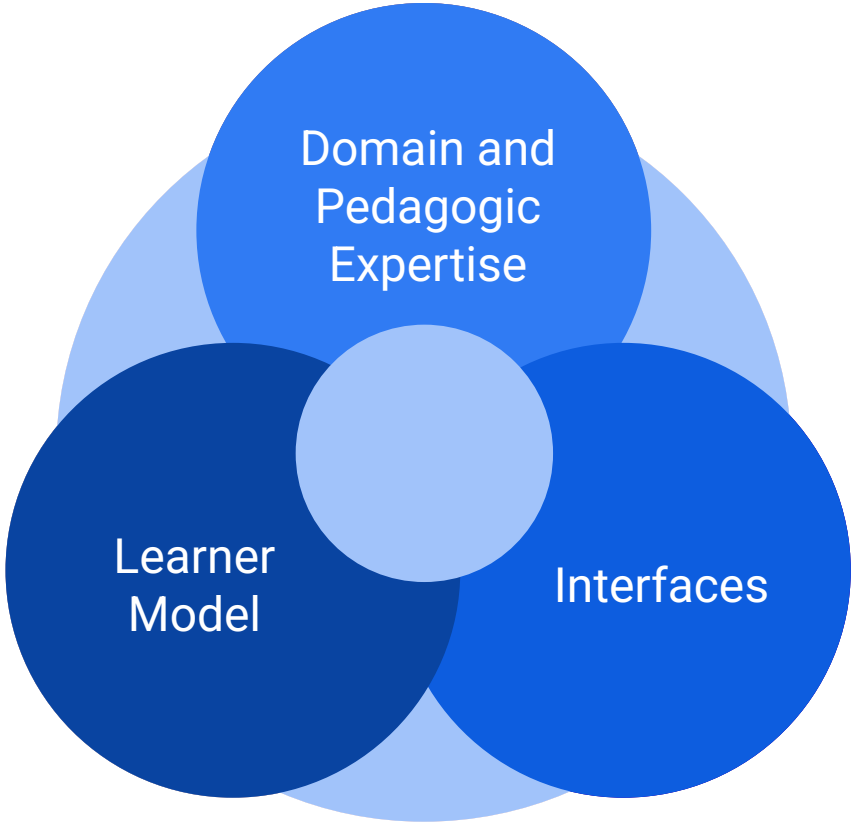
Scrutability is a key enabler for human learning

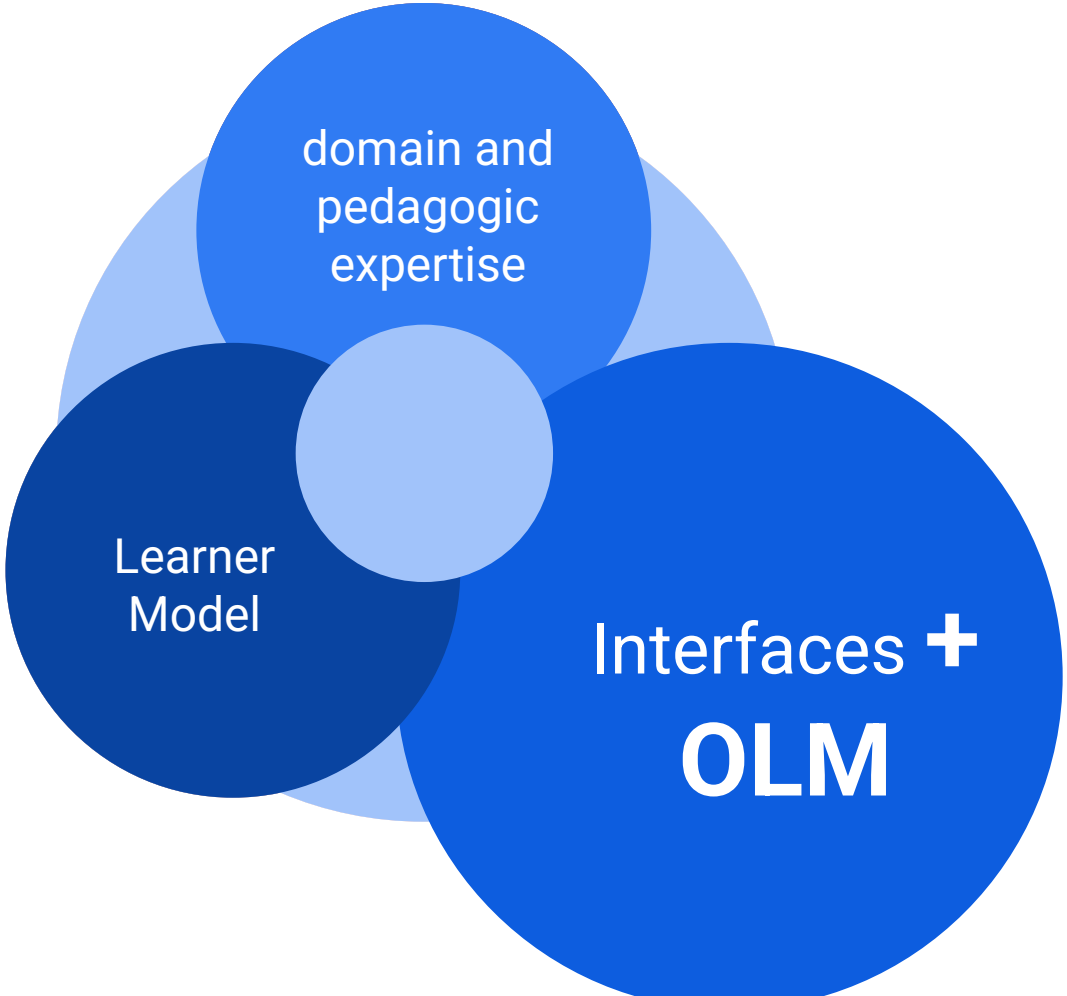
(because it can scaffold **metacognitive** skills).

Learner models, Open learner models (3 of 4)

One valuable AIED idea for creating new ways to learn

Classic AIED




domain and pedagogic expertise
Learner Model
Interfaces +
OLM

What is an OLM?

Start with some examples at various levels of communication with learner.

Brusilovsky lab
OLM for Java

Barria-Pineda, Jordan, Julio Guerra-Hollstein, and Peter Brusilovsky. 2018.
"A Fine-Grained Open Learner Model for an Introductory Programming Course." In *Proceedings of the 26th Conference on User Modeling, Adaptation and Personalization*, 53–61.

Figure 1: Mastery Grids interface for Java programming

OLM for public speaking

VR Game: VirtualSpeech, available on STEAM, VIVEPORT APPS, and Oculus, players practice giving a speech, building skills like eye-contact

Khan Academy
Nice OLM – opportunities for better

Each cell in the display maps to a discrete maths skill.

Lost opportunity for student to see the actual “subtracting decimals” sub-skills mastered.

Math Pretest

Don't worry if you don't know some answers. Everything you get right is a bonus!

Your Pre-Test Results Are In!

Your 104 Skills, Grouped by Estimated Familiarity.

less familiar → more familiar → most familiar

Practiced | Level One | Level Two | Mastered

104 Skills Earned

Yay! Based on your assessment, we've filled some skills in your progress bar that we think you're familiar with.

Subtracting decimals 0.5

You Earned LEVEL ONE

BADGES EARNED

Math Pretest Champion

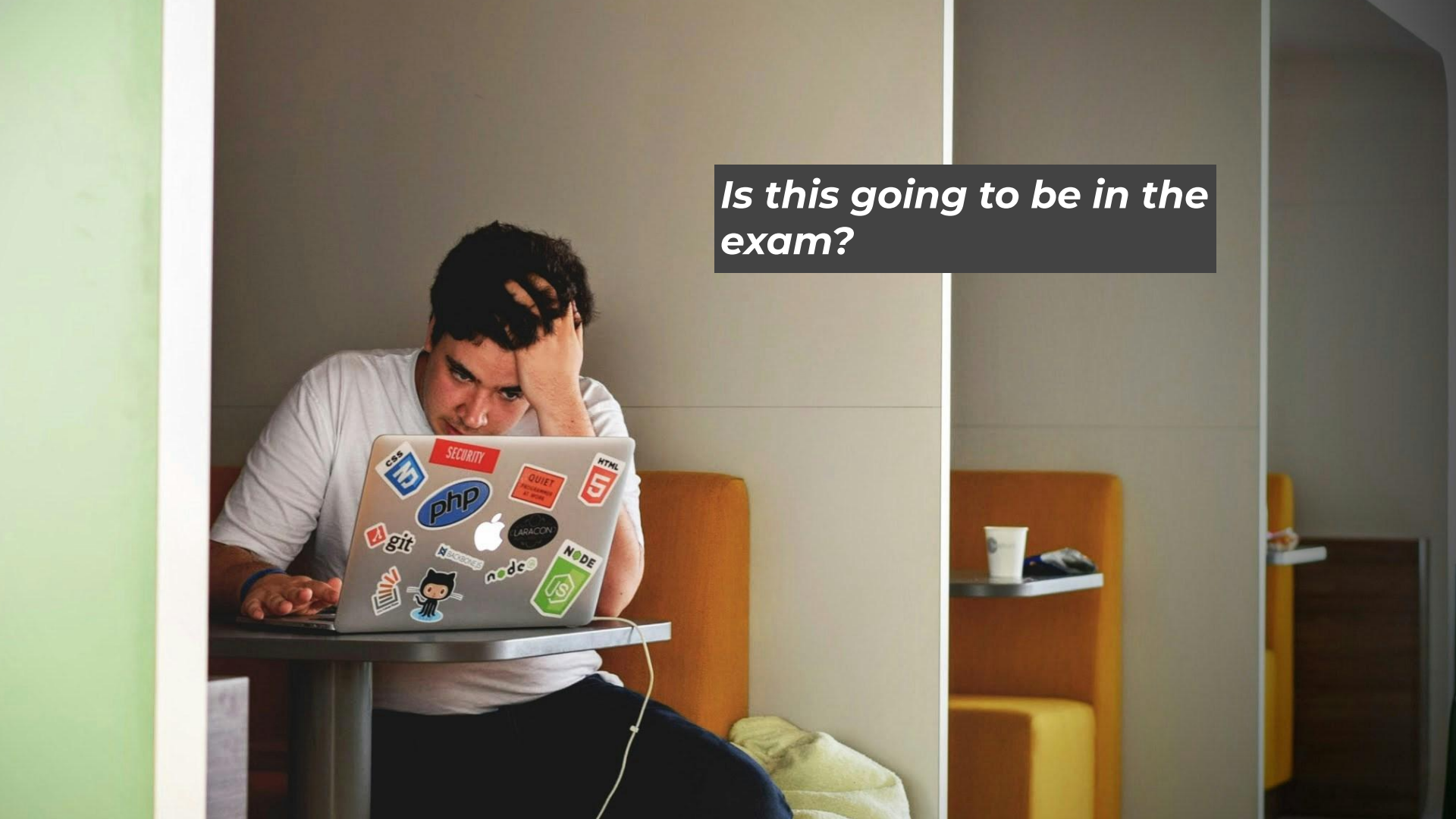
You finished the math pretest in the learning dashboard. Good work!

Kay, Judy, Kathryn Bartimote, Kirsty Kitto, Bob Kummerfeld, Danny Liu, and Peter Reimann. "Enhancing learning by Open Learner Model (OLM) driven data design." Computers and Education: Artificial Intelligence 3 (2022): 100069.

Yuan, Annie, Andrew Fang, Danny Liu, and Judy Kay. "OLiMent: Conversations About Open Learner Modelling to Help Learners Understand and Self-assess Learning Goals." In International Conference on Artificial Intelligence in Education, pp. 132-145. Cham: Springer Nature Switzerland, 2025.

Recent case study of OLM with LLM

Radically simple OLM with LLM chatbot guide for learner self-assessment (Annie Yuan and Danny Liu)

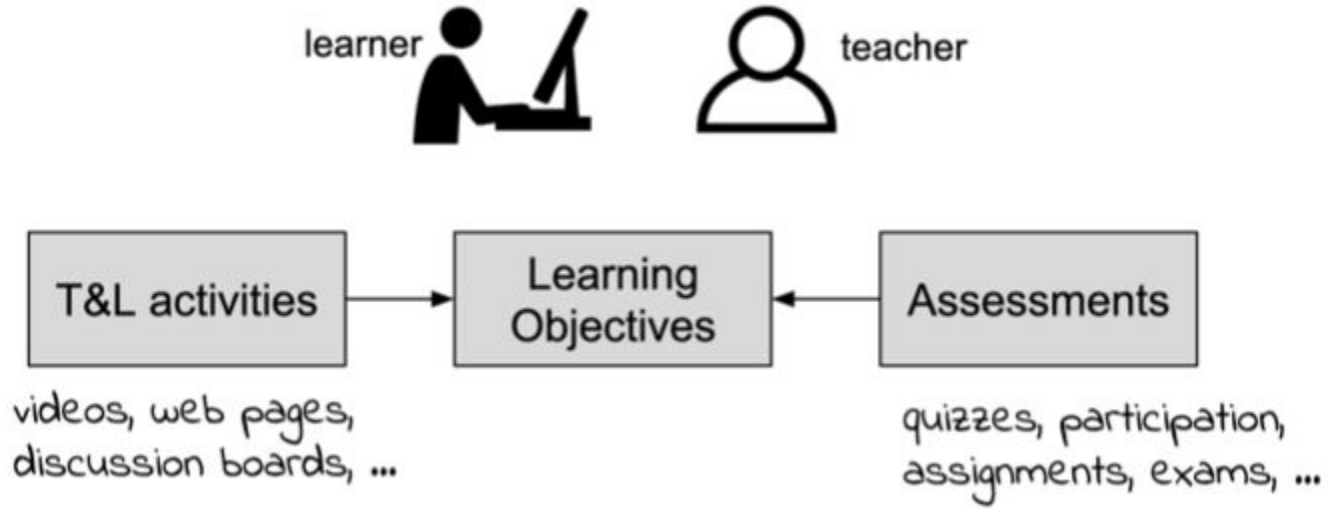

Is this going to be in the exam?
SECURITY
QUIET
HTML
CSS
php
git
LARACON
NODE
nodc

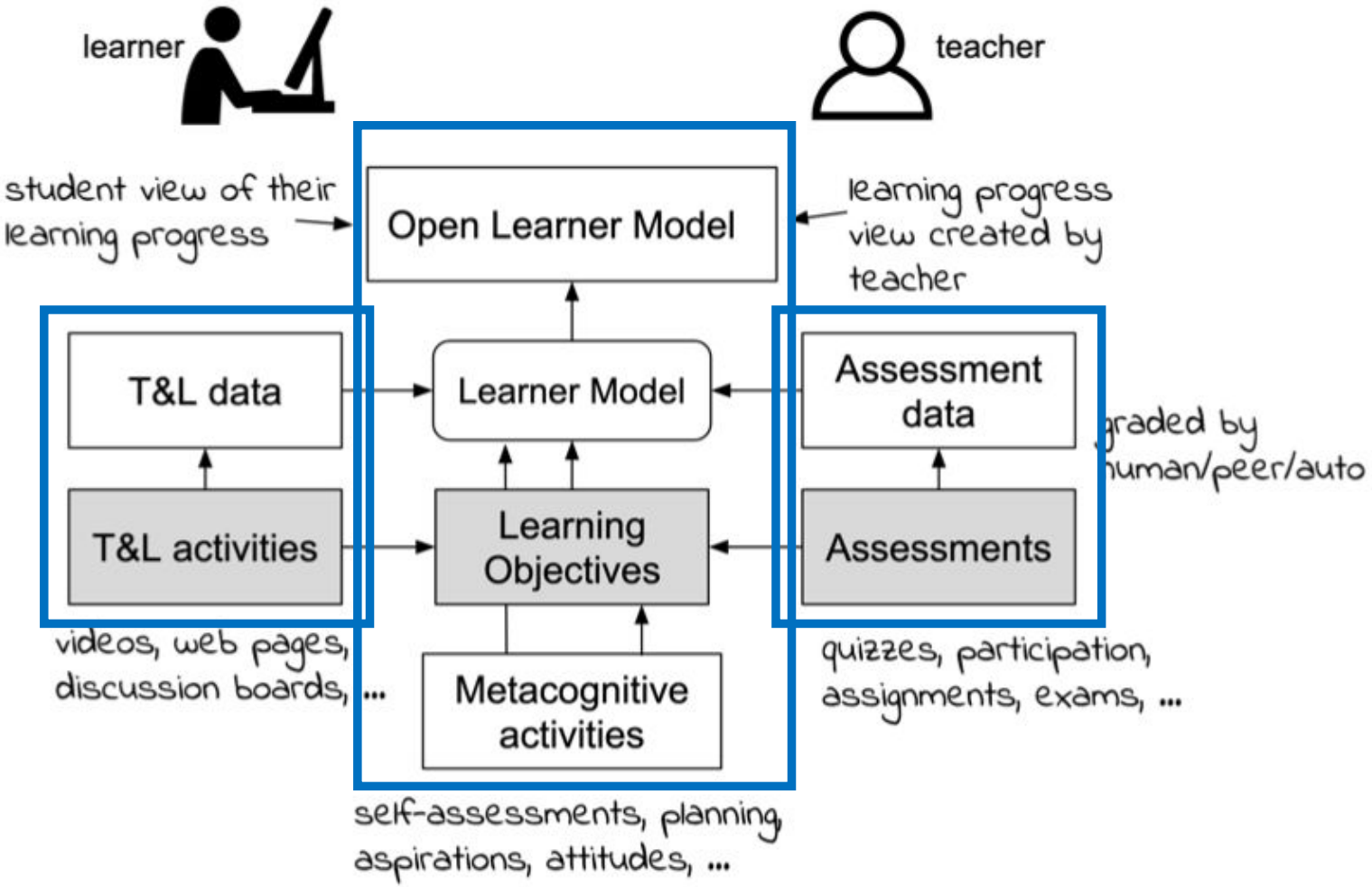
About the Light-Weight OLM

- Absolute student control
- All data provided by student
- Ontology provided by teacher
- Scaffolding provided in each lecture, including explaining role of the lecture and the assessments at that time

Biggs' Constructive Alignment

aligns learning activities and assessments with Learning Objectives.



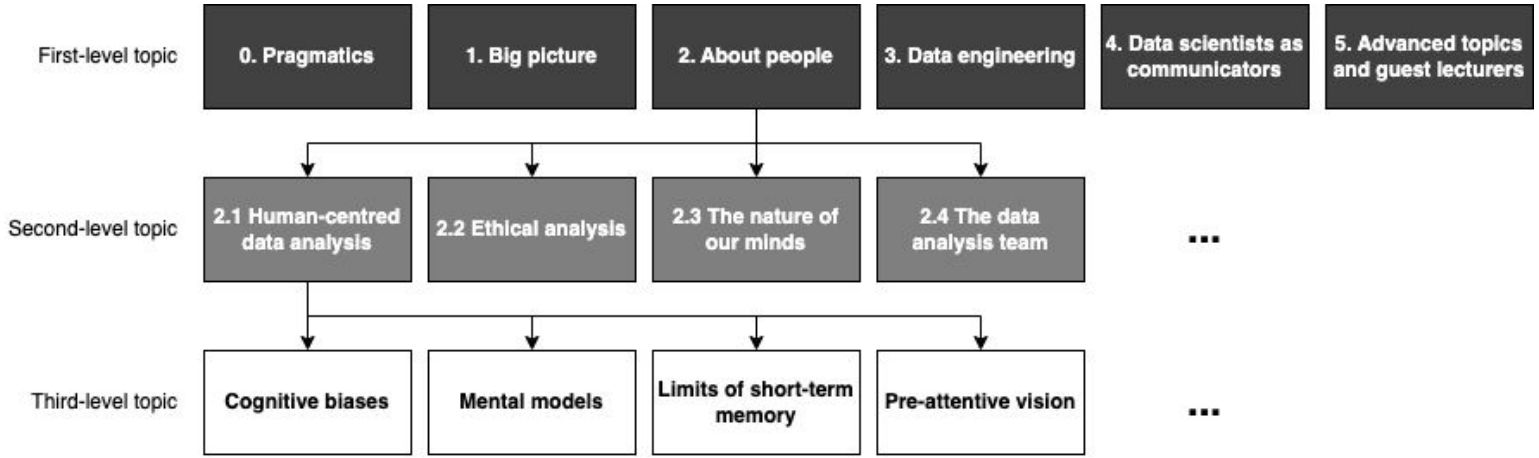

learner
teacher
student view of their learning progress
Open Learner Model
learning progress view created by teacher
T&L data
Learner Model
Assessment data
graded by human/peer/auto
T&L activities
Learning Objectives
Assessments
videos, web pages, discussion boards, ...
Metacognitive activities
quizzes, participation, assignments, exams, ...
self-assessments, planning, aspirations, attitudes, ...

Low tech OLM

Data creation and collection by the learner in classroom activities

All stored in their copy of OLM ontology spreadsheet

Lightweight Open Learner Model (OLM) Ontology



Research question: Did students find it useful?

Discretionary use

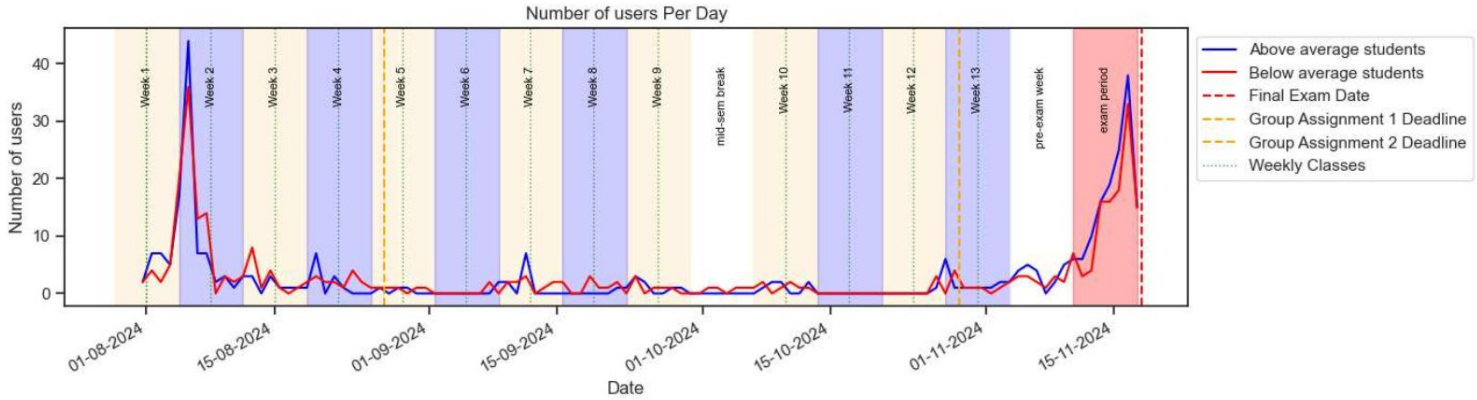


Figure shows when students used it out of set class activities – *look at the peak leading up to the exam – at the right, highlighted in pink*

How did students use it?

- Self-ratings: *“I think I’m a 3, maybe 3.5?”*
- Uncertainty and confidence reflection: *“I’m confused by this topic…” or “I feel pretty confident.”*
- Explicit references to the ontology, with students choosing specific topics to assess.

“I know that cognitive biases may result in bias in the results of data analysis, but I’m not sure how to relate it to short term memory and I don’t know what pre-attentive vision is.” (P316670)

Differences across the class in tutorial and homework activities

Broadly the top half of the class used it more, with longer responses to the Chatbot and more genuine interactions (versus play etc)

Student comments about usefulness

Survey responses

Does OLiMent meet your learning needs?

- Week 6 survey: 70%
- Week 12 survey: 77%

Post-semester survey (anonymous):

- “OLiMent is AMAZING! I wish every unit had it. It helped with concepts we rushed in lectures.”

Where next?
Four Grand Challenges
(4 of 4)

Potential collaborations, conversations …

Creating effective ***curriculum*** for ***use of AI tools*** (a.k.a AI partner):

Will beginners be able to learn faster? Slower? Very little?

How to teach for current AI tools ***and future ones***?

How to validate the curriculum?

Curriculum for learners who can take ***responsibility*** for "their" products.

Ultimately people are ***responsible*** for their products.

How can we build deep ***awareness*** of limitations of

(1) the tools (including ethical, accessibility …)
(2) human minds (building epistemic humility).

How can we teach the ways to address these?

***Support time-poor educators*?**

How to help educators teach the above?

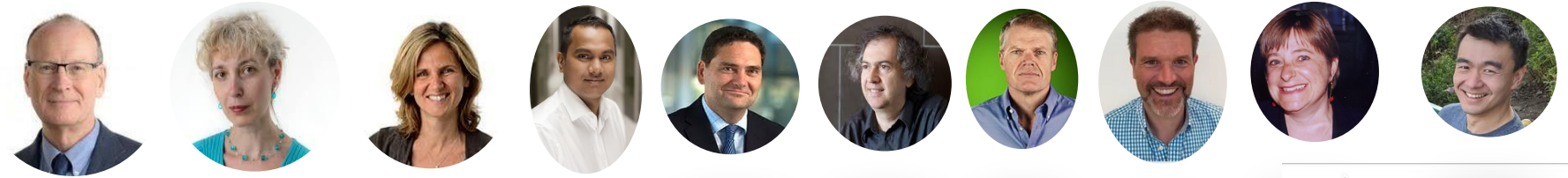
To build their competence in the above.

To find and learn AI tools to manage teaching more effectively.

Assessment of student knowledge, skills, attitudes for Age of AI

Going beyond lower Bloom levels of assessment.

These still matter but how do we manage to go well beyond them to higher Bloom levels.



Australian Government
Australian Research Council

Australian Government
National Health and Medical Research Council

Cooperative Research Australia

DARE
ARC Training Centre in Data Analytics for Resources & Environments

NVIDIA

UNIVERSITY OF HAIFA

Collaborators and Funding

Questions??

Learner models
Open Learner models
Grand Challenges:
Curriculum on AI as partner + responsibility,
Teacher support,
Assessments