Deep acknowledgements to the team whose joint work has shaped my thinking…

https://cic.uts.edu.au/about/people
An extraordinary sensor, modelling and prediction infrastructure
“infrastructure”
educational infrastructure we can trust?
ethically and scientifically
People are literally on the streets protesting against AI in education.

We need trust-building conversations for an informed dialogue. A luddite rebellion won’t help anyone…
Proposition for today:
We’re now in a transitional phase — we’re laying foundations for the next educational knowledge infrastructure.
Machines see the world through computational models analysing new forms and volumes of digital data
If we are tracking **learner activity** through the lens of data / analytics / AI we better have a very good idea…

**how those lenses are cut**

**who cut them, for whom**

**how they distort the view**
We need **wholistic (systemic, human-centred)** lenses to design, monitor and evaluate data-intensive educational infrastructure.
Learning Analytics: A Human-Centred Design Discipline
A rapidly changing educational data/analytics ecosystem...

Data Protection Laws
- GDPR etc.
- National privacy laws

Publishers as analytics providers
- Pearson
- McGraw Hill
- Squirrel AI etc.

Adaptive/Learning Analytics Services
- SmartSparrow
- Unizen
- Knewton etc.

Learning Platform Services
- Blackboard
- Canvas
- D2L
- Facebook etc.

Learning Analytics Human Factors
- Adaptive Learning Analytics Services
- Learning Platform Services
- Govnt. & international datasets
- Venture Capitalists...
- Philanthropic Foundations...

Venture Capitalists...
- Philanthropic Foundations...

Govnt. & international datasets
- UK HESA Data Futures
- US Institute for HE Practice
- UNESCO Inst. for Statistics
- OECD PISA etc.
A rapidly changing educational data/analytics ecosystem…

Data Protection Laws

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- OECD PISA
- etc.

GDPR etc.

Learning Analytics Human Factors

Venture Capitalists…
Philanthropic Foundations…
Expand from…

“The Fourth Paradigm”

a Computer Science vision of how research is building on the Empirical, Theoretical and Computational paradigms moving into a Data-Intensive paradigm


To see the wider systems…

“Knowledge Infrastructures”

a critical lens on how human+technical systems in science interoperate to construct, share, contest and sanction knowledge

http://hdl.handle.net/2027.42/97552
e.g. Paul Edwards on…

**climate science**

How do global data, models, visualisations, science and politics combine to produce knowledge about the past, present and future, and how do they handle uncertainty?

https://mitpress.mit.edu/books/vast-machine

That’s what a knowledge infrastructure looks like after nearly 200 years’ evolution

“Computer Models, Climate Data, and the Politics of Global Warming”

“Computer Models, Learning Data, and the Politics of Education” …??
“Knowledge Infrastructures”

“robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds.”

Routine, well-functioning knowledge systems include the world weather forecast infrastructure, the Centers for Disease Control, or the Intergovernmental Panel on Climate Change — individuals, organizations, routines, shared norms, and practices.

“Knowledge Infrastructures”

“Infrastructures are not systems, in the sense of fully coherent, deliberately engineered, end-to-end processes.

...ecologies or complex adaptive systems [...] made to interoperate by means of standards, socket layers, social practices, norms, and individual behaviors.”

“Knowledge Infrastructures”

“Infrastructures are not systems, in the sense of fully coherent, deliberately engineered, end-to-end processes.

...ecologies or complex adaptive systems [...] made to interoperate by means of standards, socket layers, social practices, norms, and individual behaviors.”


I think we can see the educational ecosystem here.
“Knowledge Infrastructures”

“I intend the notion of knowledge infrastructure to signal parallels with other infrastructures [...] Yet this is no mere analogy [...] Get rid of infrastructure and you are left with claims you can’t back up, facts you can’t verify, comprehension you can’t share, and data you can’t trust.” (p.19)
“Knowledge Infrastructures”

...perform 3 key functions...

1. Monitoring
2. Modelling
3. Memory

Knowledge Infrastructure concepts

metadata friction

“People long ago observed climate and weather for their own reasons, within the knowledge frameworks of their times. You would like to use what they observed — not as they used it, but in new ways, with more precise, more powerful tools. […] So you dig into the history of data. You fight metadata friction, the difficulty of recovering contextual knowledge about old records.” (p.xvii)

Knowledge Infrastructure concepts

**metadata friction**

“People long ago observed climate and weather for their own reasons — within the knowledge frameworks of their times. You would like to use what they observed — not as they used it, but in new ways, with more precise, more powerful tools. […] So you dig into the history of data. **You fight metadata friction, the difficulty of recovering contextual knowledge about old records.**”

(p.xvii)

Knowledge Infrastructure concepts

Models, models, models…

“Everything we know about the world’s climate — past, present, and future — we know through models.” (p.xiv)

“I’m not talking about the difference between “raw” and “cooked” data. I mean this literally. Today, no collection of signals or observations […] becomes global in time and space without first passing through a series of data models.” (p.xiii)

Knowledge Infrastructure concepts

Models, models, models...

“Everything we know about the world’s climate — past, present, and future — we know through models.” (p.xiv)

Today, no collection of signals or observations [...] becomes global in time and space without first passing through a series of data models.” (p.xiii)

“Raw data is an oxymoron” (Geof Bowker)

Knowledge Infrastructure concepts

infrastructural inversion

“The climate knowledge infrastructure never disappears from view, because it functions by infrastructural inversion: continual self-interrogation, examining and reexamining its own past. The black box of climate history is never closed.”

Knowledge Infrastructure concepts

infrastructural inversion

“The climate knowledge infrastructure never disappears from view, because it functions by infrastructural inversion: continual self-interrogation, examining and reexamining its own past. The black box of climate history is never closed.”

We must keep lifting the lid on learning analytics infrastructures

We must equip learners and educators to engage critically with such tools

**Epistemic Infrastructure** taxonomy for professional knowledge
Partic contributions at the “Micro-KI” level: how professionals construct their EI

In what senses might Learning Analytics constitute, or at least contribute to, an emerging knowledge infrastructure?
In what senses might Learning Analytics constitute, or at least contribute to, an emerging KI?

1. KI concepts seem to apply to critical perspectives on LA

2. LA is starting to display KI properties at different levels of the system

LA is only 10 years old, and there’s much to do. But knowing what functioning KIs look like could help us prioritise.
Macro/Meso/Micro Learning Analytics

Aggregation of user traces enriches meso + macro analytics with finer-grained process data

Breadth + depth from macro + meso levels add power to micro analytics

Macro
state/national/international comparisons/league tables

Meso
institution-wide demographics and formal outcomes

Micro
student activity traces during learning

PISA School Rankings
Uni Rankings
School/Uni Information Systems
Analytics from individual student activity

Macro/Meso/Micro Educational KI

**Macro**
state/national/international networks sharing data, models, scholarship
→ debate but emerging consensus on optimising learning

**Meso**
institution-wide networks [...] optimising learning in the institution

**Micro**
assignment/course specific networks [...] optimising learning in a course
If Learning Analytics were Climate Science...

- Trusted data sources *
- Validated models *
- Interoperable data flows and models *
- Established research methodologies *
- Government policy held accountable to international scientific consensus *

* all under rigorous scholarly review and debate
If the challenge is to build education’s KI, what are the practical implications for LA?

**Macro**
- state/national/international networks sharing data, models, scholarship
  - debate but emerging consensus on optimising learning

**Meso**
- institution-wide networks [...] optimising learning in the institution

**Micro**
- assignment/course specific networks [...] optimising learning in a course
Accountability: ground models in educ. research + learning sciences

Impact policy + practice: make the evidence base accessible

Share models (and data?) Climate data ≠ Learner data

Macro
state/national/international networks sharing data, models, scholarship
→ debate but emerging consensus on optimising learning
Ground models in learning sciences + educ. research

- Not directly observable
  - Educationally meaningful construct
    - Sub-Construct
      - Behaviour
        - Digitally Captured Event
      - Behaviour
        - Digitally Captured Event
      - Behaviour
        - Digitally Captured Event
    - Sub-Construct
      - Behaviour
        - Digitally Captured Event
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  - Sub-Construct
    - Behaviour
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    - Behaviour
      - Digitally Captured Event
    - Behaviour
      - Digitally Captured Event

- Human Observable
- Computationally Detectable

Derived Feature
Metrics
Derived Feature
Digitally Captured Event

Educationally meaningful construct

Not directly observable

Sub-Construct

Behaviour

Derived Feature

Digitally Captured Event

Human Observable

Sub-Construct

Behaviour

Derived Feature

Digitally Captured Event

Computationally Detectable

Behaviour

Derived Feature

Digitally Captured Event

Ground models in learning sciences + educ. research

Derived Feature

Metrics

Constructs

infrastructural inversion?


Impact policy + practice: make the evidence base accessible

http://evidence.laceproject.eu
In principle, as variation reduces (e.g. timescale, geography, methodology), so do the KI challenges. So MACRO to MESO should help simplify the KI.

But institutions still have long histories

Institutional data and knowledge are still notoriously slippery to curate

And institutionalized teaching practices slow to change

“data management”
“knowledge management”
“progressive pedagogy”
“authentic assessment”

Meso
institution-wide networks [...] optimising learning in the institution
Nonetheless, it’s at the MESO + MICRO layers where LA can really add to KI

Enable data flows
Tune analytics for the institution’s specific needs
Co-design with stakeholders

Meso
institution-wide networks [...] optimising learning in the institution

Micro
assignment/course specific networks [...] optimising learning in a course
Envisioning the learning ecosystem beyond the LMS, in the wild

“How are we going to deliver LA over that type of complexity?”

Kirsty Kitto: Designing Learning Analytics Ecosystems (LASI 2019)
https://www.beyondlms.org/blog/LASIworkshop

Towards LA data flows over an emergent ecosystem:
LA-API infrastructure designed for huge diversity in data + analytics

Figure 5: The data flows being implemented in the LA-API being designed at UTS.

generalisable models without sacrificing context-sensitivity

Meso
institution-wide networks [...] optimising learning in the institution

Micro
assignment/course specific networks [...] optimising learning in a course
Framework @UTS for educators to co-design Analytics/AI → augment teaching practice

AcaWriter feedback tuned for Civil Law

Feedback & User Interface

NOTE: Computers don’t understand writing like humans. So, AcaWriter may highlight rhetorically good sentences that actually make no sense, or leave un-highlighted a sentence that you feel is really good. It’s fine to disagree with the feedback — but it’s also your job to check your facts!

Analytical Report

The analytical report highlights salient rhetorical moves AcaWriter identified in your essay for reflection. For more specific feedback, go to the Feedback tab.

Rhetorical Moves

- 5 Summarises or signals the authors goals
- P Perspective or stance
- E Emphasis to highlight key ideas
- N Novel improvements in ideas
- C Contrasting idea, tension or critical insight
- B Background information and previous work
- S Surprising or unexpected finding
- Q Question or gap in previous knowledge
- T Trend or tendency related to ideas

Technology is an enabler in providing greater access to justice through its ability to connect people with legal needs to legal assistance, information, and advice. With the increasing popularity of internet-enabled hand held devices and laptop computers, there is a tendency to assume that even the socio-economically vulnerable in our society have access to technology and the skills to use online services with confidence. This is not necessarily the case. Examples of the application of technology to provide legal information and assistance include case studies, guides and virtual legal advice clinics. The 2012 Review does not address the role of courts in serving the legal needs of the community. The court system is not regarded as a part of the wider legal assistance services. This omission questions the role of the court in facilitating access to its services, including dispute resolution and trials. It also identified uses of technology to expand the delivery of services, many of which are transferable to an online court. These services include e-access for remote communities, availability outside of business hours, interactive processes and virtual appearances. This essay will discuss uses of technology to expand the delivery of services, many of which are transferable to an online court.
Building UTS trust with an “AcaWriter micro-KI”

- A pedagogically robust writing exercise was rated significantly more useful with the addition of AcaWriter.
- Students who used AcaWriter made significantly more academic rhetorical moves in their revised essays.
- A significantly higher proportion of AcaWriter users improved their drafts (many students degraded them across drafts).
- Students who used AcaWriter produced higher graded submissions if they engaged deeply with AcaWriter’s feedback.


“Overall, since we’ve been working with CIC around written communication over the course of the last four of five semesters, we have seen marked improvement in students’ written communication. Overall their individual assignment pass-rate is going up... We are seeing improvements in the number of students who are either meeting or exceeding the expectations around written communication”

Building the AcaWriter micro-KI → student trust

“It's like having a tutor or another person check and give constructive feedback on your work.”

“When you’re editing your own writing, you automatically think that your work sounds good and that all your ideas and views have been clearly conveyed. This exercise was useful in the sense that it indicated areas where I needed to be more explicit, which on my own I would not have noticed.”

Building the AcaWriter micro-KI → student trust

“I think what is being taught is something I was already aware of. However, by being forced to actually identify ways of arguing, along with the types of words used to do so, it has broadened my perspective. I think I will be more aware of the way I am writing now.”

co-design techniques

educators trust analytics when they can see that they’re really shaping the design
Learning Analytics Deck for co-design

http://ladeck.utscic.edu.au

Carlos Prieto’s PhD: ‘Playing cards’ to help stakeholder communication as they design a new kind of analytics tool
Co-design with educators to tune writing analytics

Goal: calibrate the parser detecting affect in reflective writing, working through sample texts

Rapid prototyping with a Jupyter notebook to agree on thresholds

More on LA + KI...
(in particular on LA's relationship to the learning sciences)

http://simon.buckinghamshum.net/2018/06/icls2018-keynote
More on Human-Centred AIED & Learning Analytics…

Collections of insider accounts from teams who are building these infrastructures: how do they engage with issues of epistemology, pedagogy, politics, ethics…?

Human-Centred Learning Analytics. *Journal of Learning Analytics*, 6(2), pp. 1–94 (Eds.) Simon Buckingham Shum, Rebecca Ferguson, & Roberto Martínez-Maldonado

Learning Analytics and AI: Politics, Pedagogy and Practices. *British Journal of Educational Technology* (50th Anniversary Special Issue), (Eds.) Simon Buckingham Shum & Rose Luckin. (late 2019)

What’s the Problem with Learning Analytics? *Journal of Learning Analytics*. Invited Commentaries on Neil Selwyn’s LAK18 Keynote Talk, from Carolyn Rosé, Rebecca Ferguson, Paul Prinsloo & Alfred Essa (late 2019)

Human-Centred Analytics/Al in Education
By sbs on May 4th, 2019 | Edit

A heads-up that three collections will hit the streets this year focused on how we can design so that human needs and values are well and truly centre-stage in educational tools powered by data, analytics and AI. It will be good to have detailed ‘insider accounts’ from researcher/developers who are reflecting deeply on how values are baked into their design practices and the infrastructures they are building, and how different stakeholders can engage meaningfully in shaping design. I’m excited about the papers shaping up for these volumes, so watch out for their releases mid-and end-2019…

http://simon.buckinghamshum.net/2019/05/human-centred-analyticsai-in-education
Reflections on the future educational KI

Are we aspiring for an “Intergovernmental Panel on Learning?”

Is part of this already in place?...


A conventional form of educational KI
Reflections on the future educational KI

Commercial platforms and their R&D programs are ‘vertical Knowledge Infrastructures’ at national and increasingly international scales

Knowledge about learners from proprietary platforms, primarily ITS (but expanding beyond no doubt)

All the usual questions and concerns around multinational platforms, data ownership, commercial products in education…
Conclusion

We know how a mature, functioning Knowledge Infrastructure operates, and the influence it can have on science, policy and practice (not that this is straightforward)

Insights into KI structure and dynamics should help the LA community focus its efforts to invent an educational KI that can be sustained, and trusted

Your feedback welcomed!
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