Putting the Philosophy of Modeling to Work for Learning Analytics

Petr Johanes

Bay Area Learning Analytics Network Conference

2019–03–02

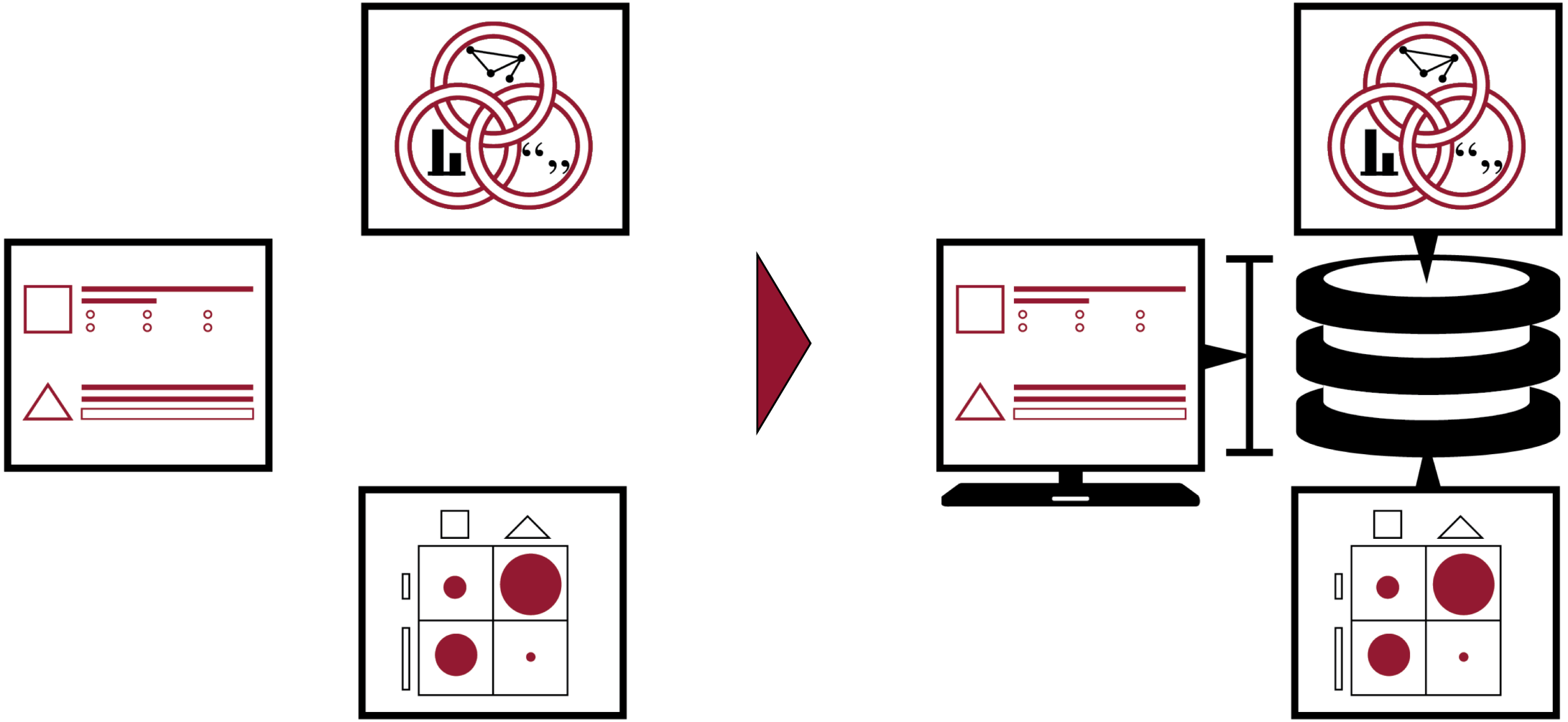
Why Are We Here Today? (1/1)
To build awareness about a scientifically catalytic link.

1. Establish a productive link between learning analytics and philosophy

2. Outline recent questions and developments around the philosophy of modeling and simulation

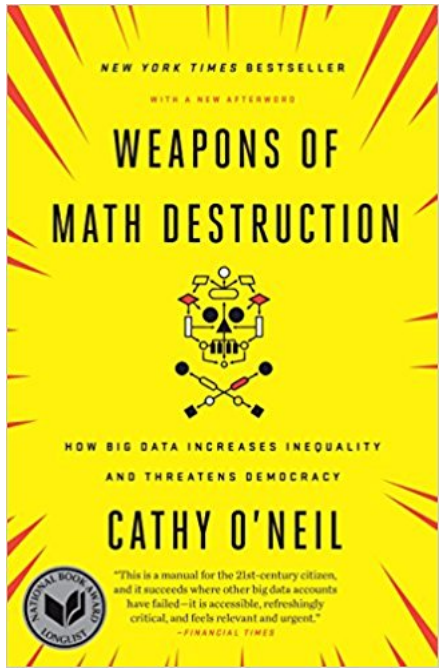
3. Suggest ways that learning analytics research can be enhanced by and also contribute to philosophical debates going forward

Why Now? (1/3)
Because of increased learning datafication & digitization.



Why Now? (2/3)
Because learning analytics are coming under scrutiny.

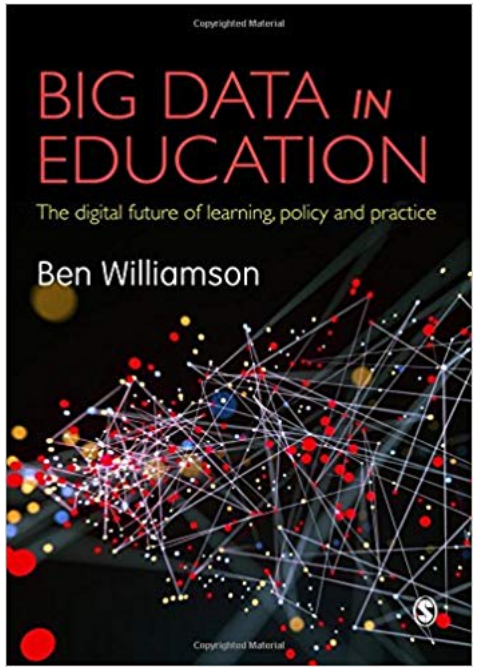
Computer Science



Algorithmic Bias + Scale = Good Society?

(O'Neill, 2016)

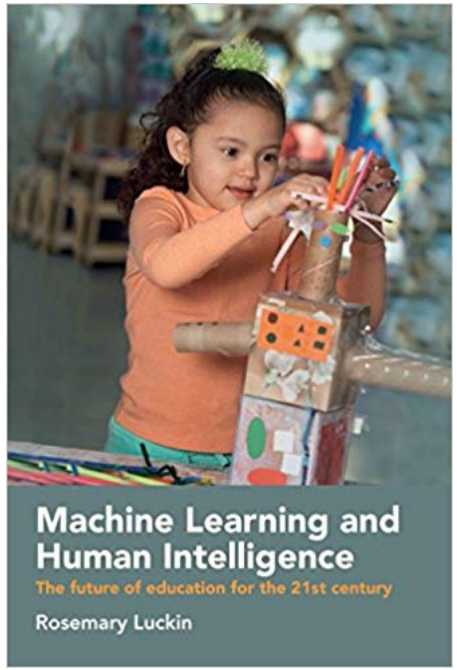
Social Science



Datafication + Digitization = Good Governance?

(Williamson, 2017)

Educational Science



Machines + Complexity = Good Science?

(Luckin, 2018)

Why Now? (3/3)
Because learning scientists are actively reflecting.

Why Theory Matters More than Ever in the Age of Big Data

Alyssa Friend Wise
Simon Fraser University, Canada
alyssa.wise@sfu.ca

David Williamson Shaffer
University of Wisconsin, Madison, USA

(Wise & Shaffer, 2015)

Envisioning a Learning Analytics for the Learning Sciences

Alyssa Friend Wise, New York University, alyssa.wise@nyu.edu
Yi Cui, New York University, yc65@nyu.edu

(Wise & Cui, 2018)

Does "learning" exist?

Ray McDermott*

(McDermott, 2015)

Complex Systems in Education: Scientific and Educational Importance and Implications for the Learning Sciences

Michael J. Jacobson & Uri Wilensky

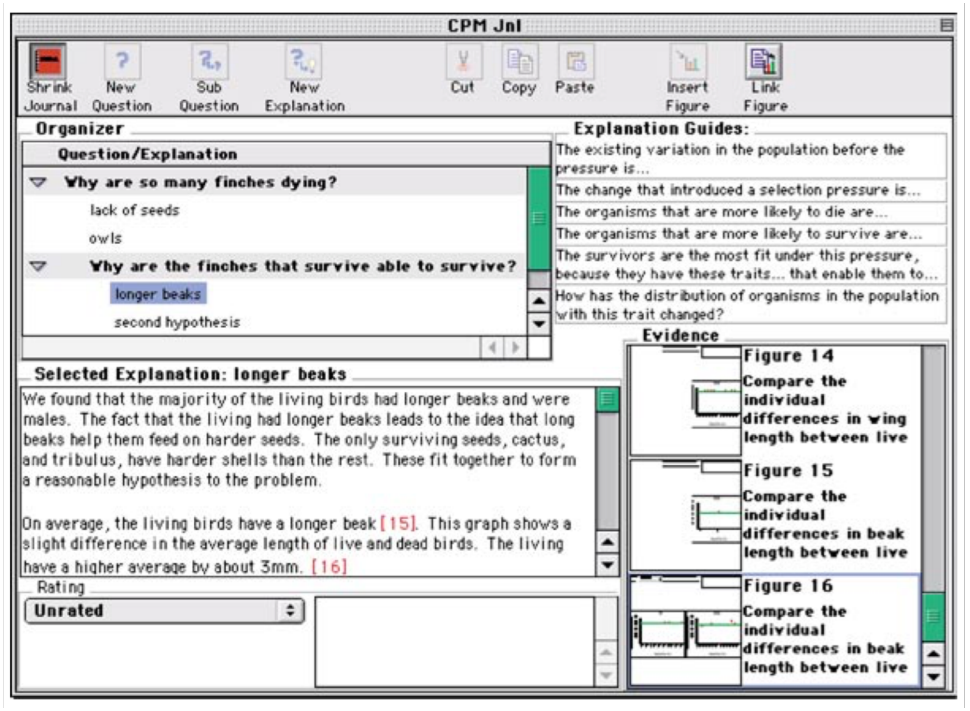
(Jacobson & Wilensky, 2006)

Ontological Innovation and the Role of Theory in Design Experiments

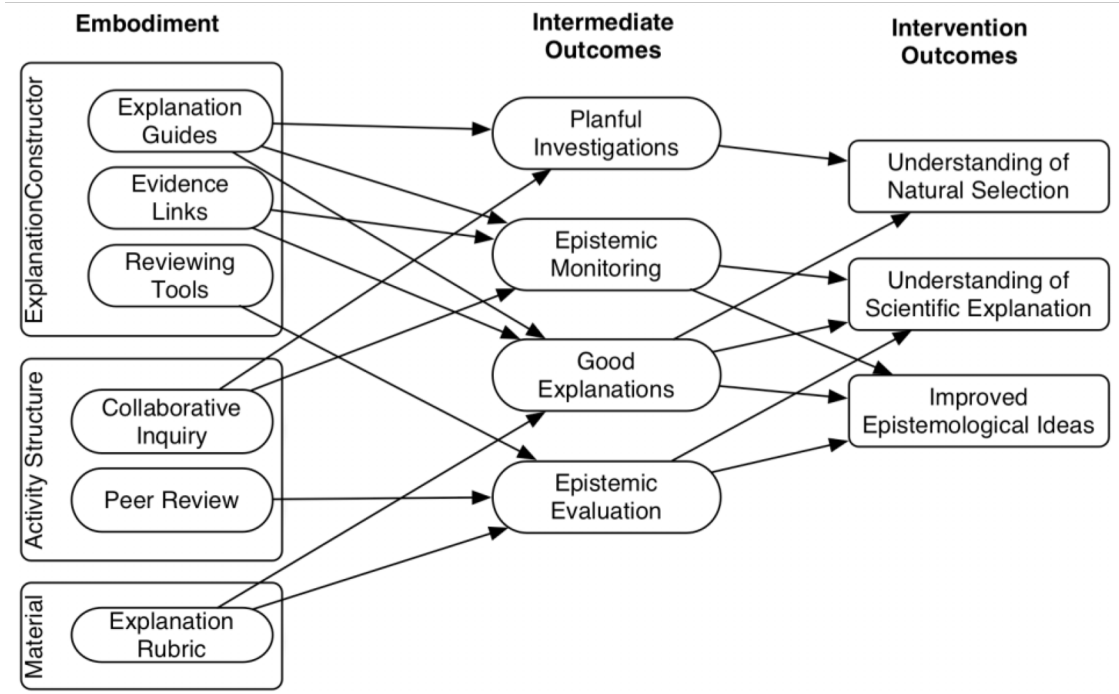
Andrea A. diSessa & Paul Cobb

(disessa & Cobb, 2004)

Why Look To Philosophy? (1/3)
Because learning technologies embody philosophies.

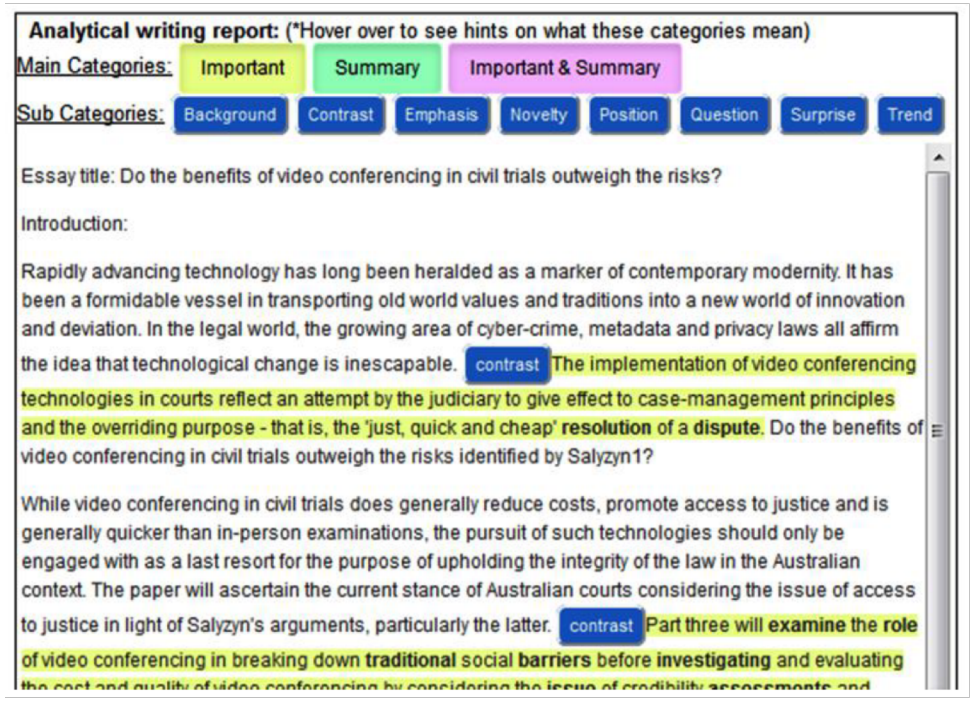


(Sandoval & Reiser, 2004)

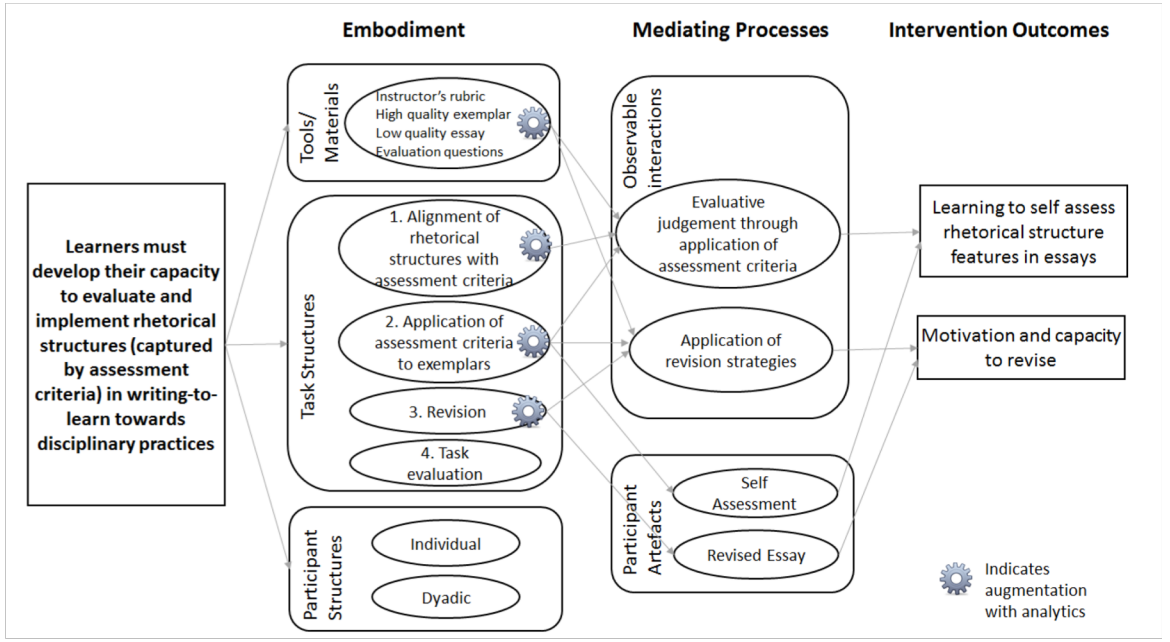


(Sandoval, 2004)

Why Look To Philosophy? (2/3)
Because learning analytics embody philosophies.



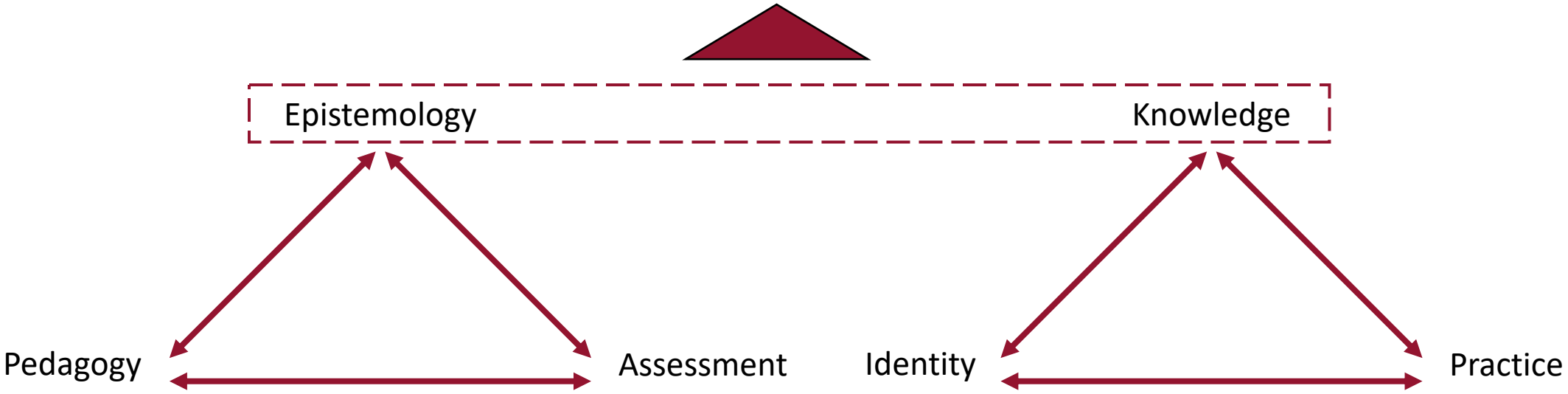
(Knight, Shibani, & Buckingham Shum, 2018)



(Knight, Shibani, & Buckingham Shum, 2018)

Why Look To Philosophy? (3/3)
Because learning research/studies embody philosophies.

researching, facilitating, capturing learning
inherently requires philosophical stances



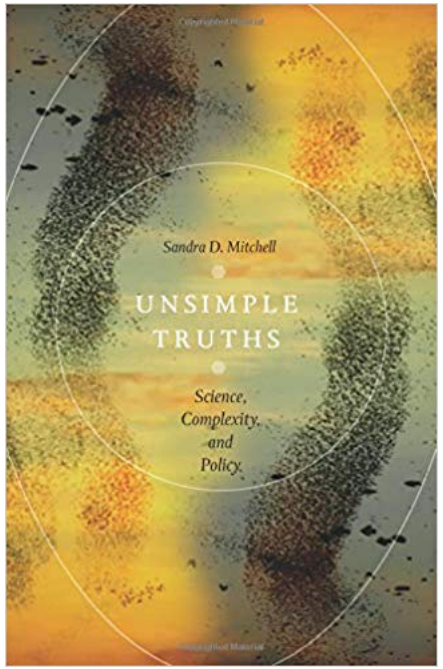
(Knight, Buckingham Shum, & Littleton, 2014)

(Boaler, 2002)

What Are The Philosophical Conversations? (1/1)

They scrutinize language & practice, at times for scientists.

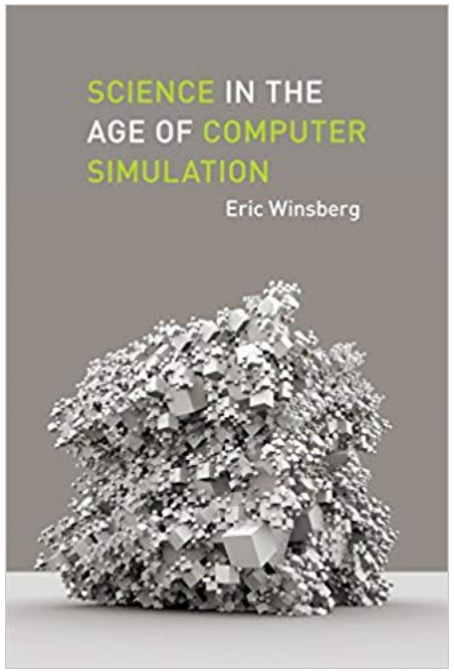
Complex Phenomena



How do we model and build science with them?

(Mitchell, 2009)

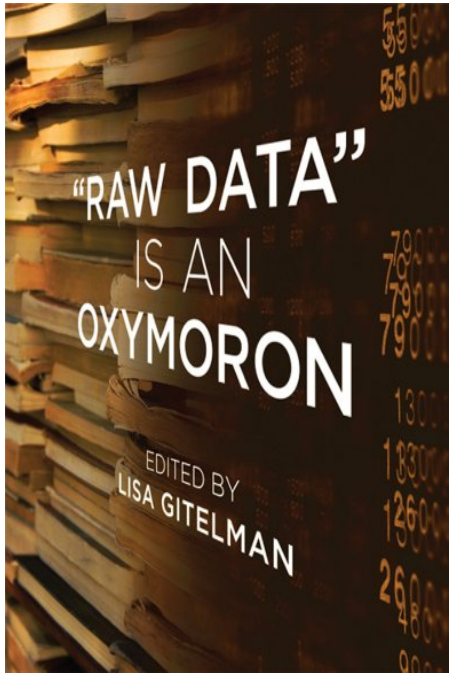
Computer Simulations



What is their epistemic nature and import?

(Winsberg, 2010)

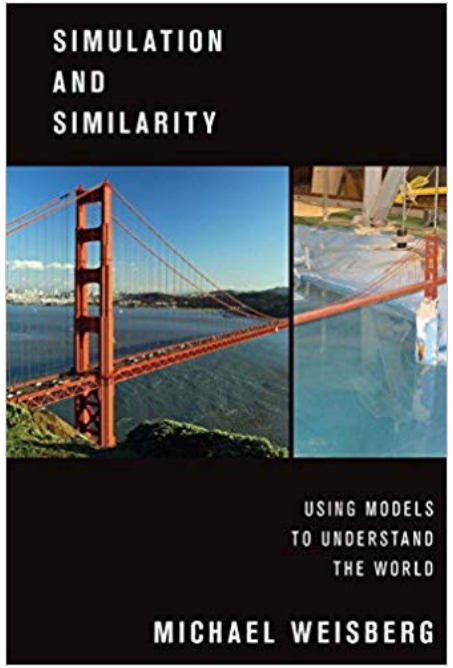
Non-Epistemic Values



How do they inform the modeling process?

(Gitelman, 2013)

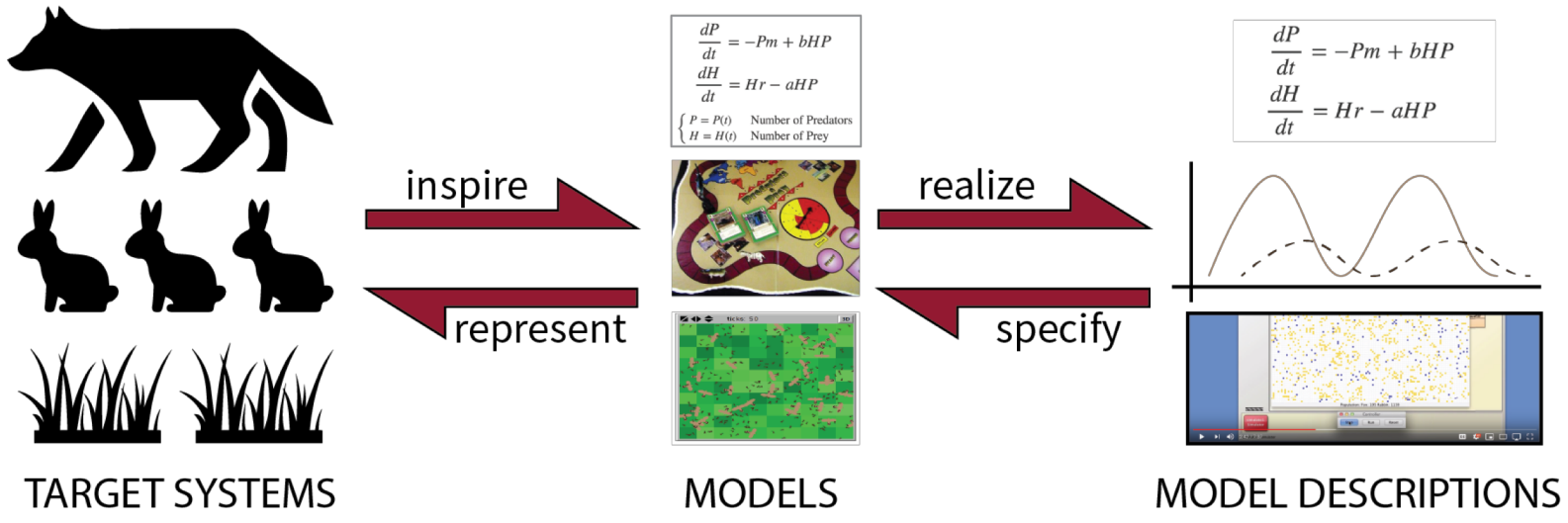
Model-Based Simulations



How do scientists build and use them?

(Weisberg, 2013)

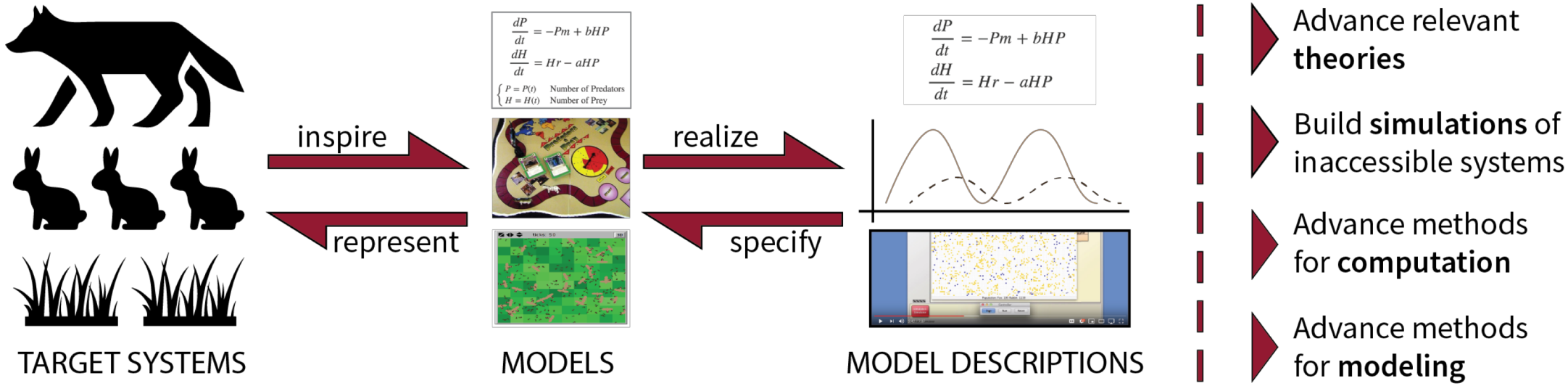
What Is A Model? (1/2)
Model = (representational) structure + interpretation



- Advance relevant **theories**
- Build **simulations** of inaccessible systems
- Advance methods for **computation**
- Advance methods for **modeling**

(Weisberg, 2013)

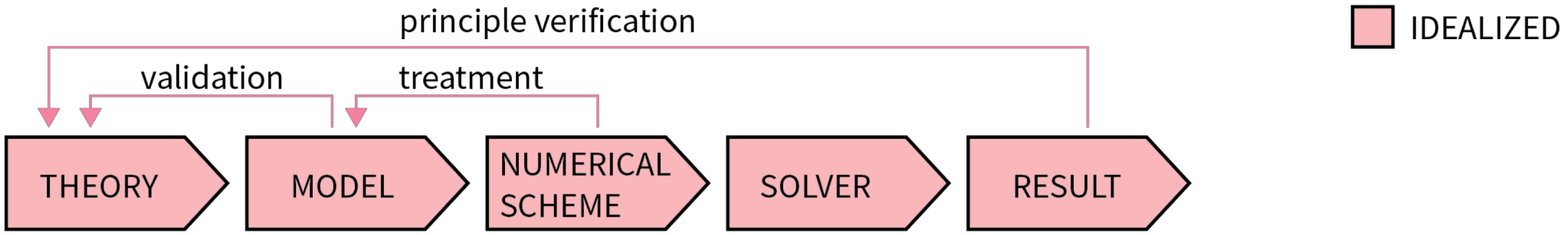
What Is A Model? (2/2)
Model = Learning? Behavior? Neurons? Mind?



(Weisberg, 2013)

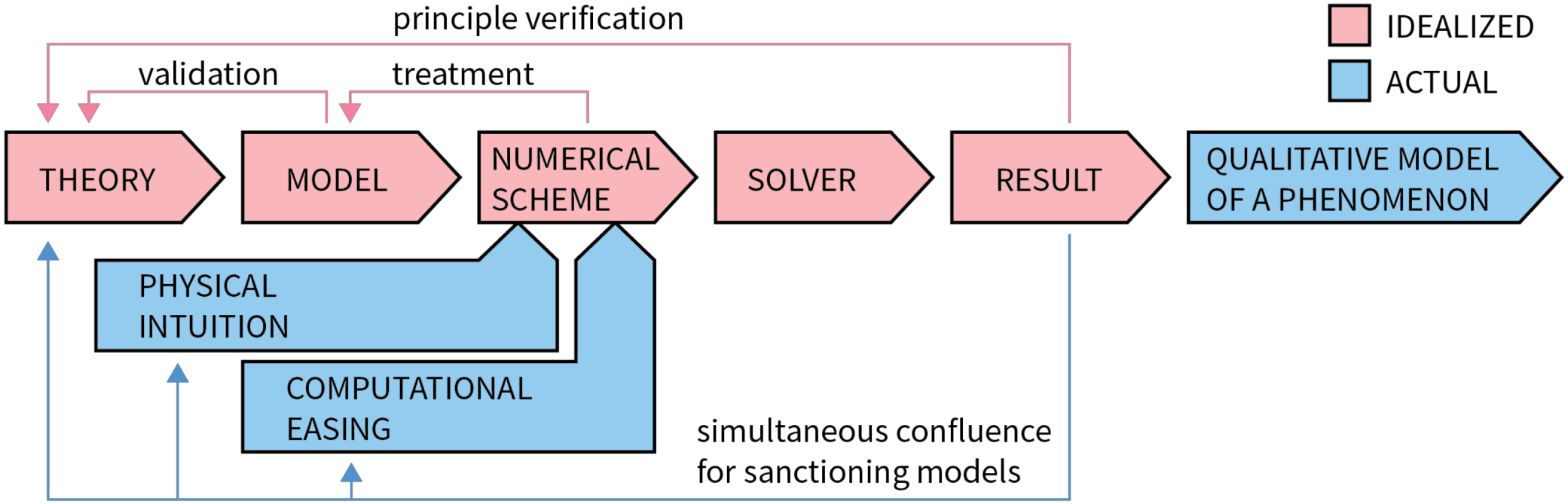
How do we proceed when our target system is unobservable?
How do we proceed without consensus about the nature of our target system?
How do we proceed when we do not have a minimal viable simulation system?

How Do Scientists Build Models? (1/3)
Ideally, in a linear, proceed-and-check manner.



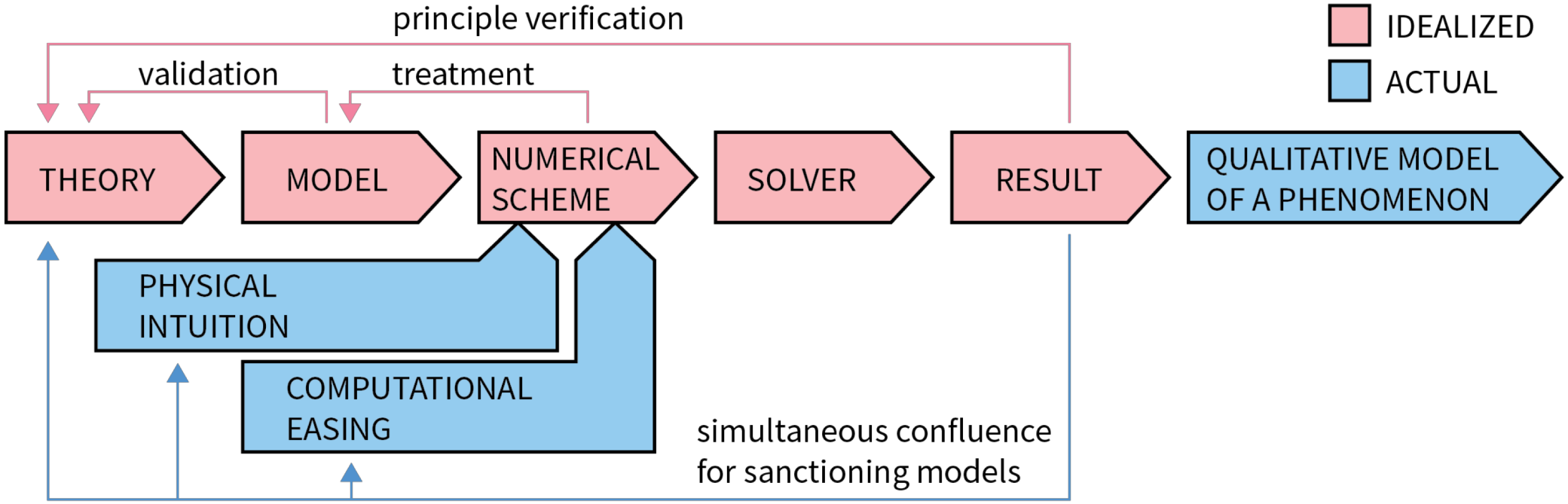
(Winsberg, 2010)

How Do Scientists Build Models? (2/3)
Actually, in an iterative, multi-dimensional manner.



(Winsberg, 2010)

How Do Scientists Build Models? (3/3)
Actually, in an iterative, multi-dimensional manner.



(Winsberg, 2010)

What is the equivalent of “physical intuition” for learning analytics?

Does this process match the modeling in current learning analytics?

What Kind of Future Do We Want To Build? (1/3)
Because this is not new.

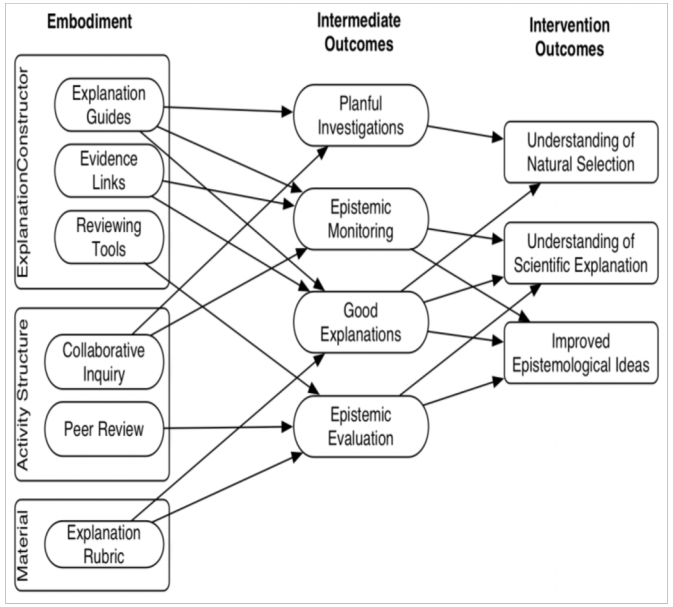
"The philosophy of education is a source of the science of education, but one less often recognized as such. We are, I think, habituated to thinking of the sciences as feeders of philosophy rather than of philosophy as a source of science."

(Dewey, 1929, p. 51)

What Kind of Future Do We Want To Build? (2/3)

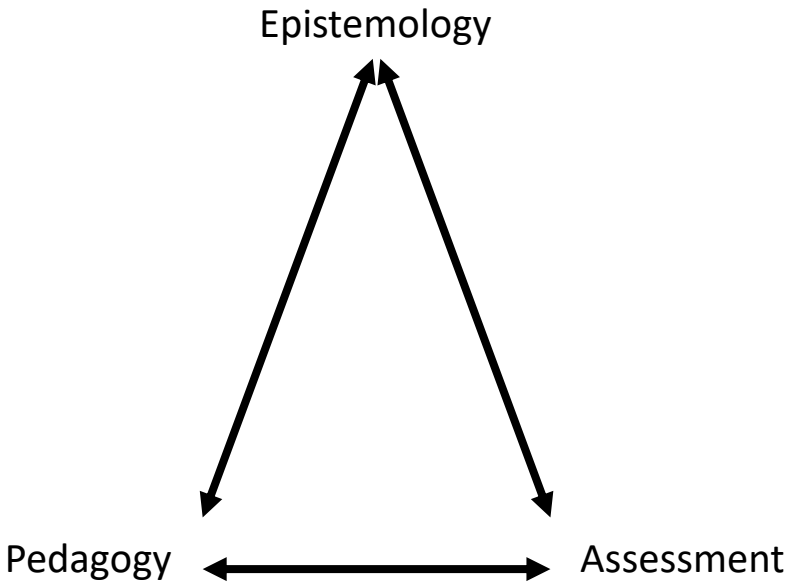
Because we are all working with & within philosophy.

We Embody It



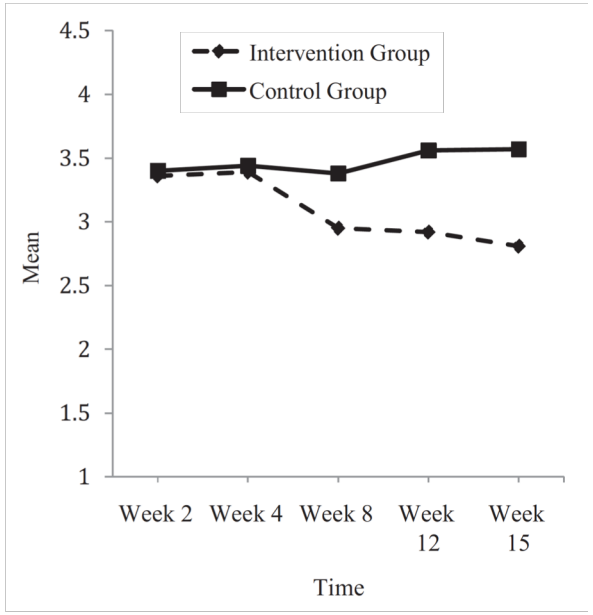
(Sandoval, 2004)

We Use It



(Knight, Buckingham Shum, & Littleton, 2014)

We Change It

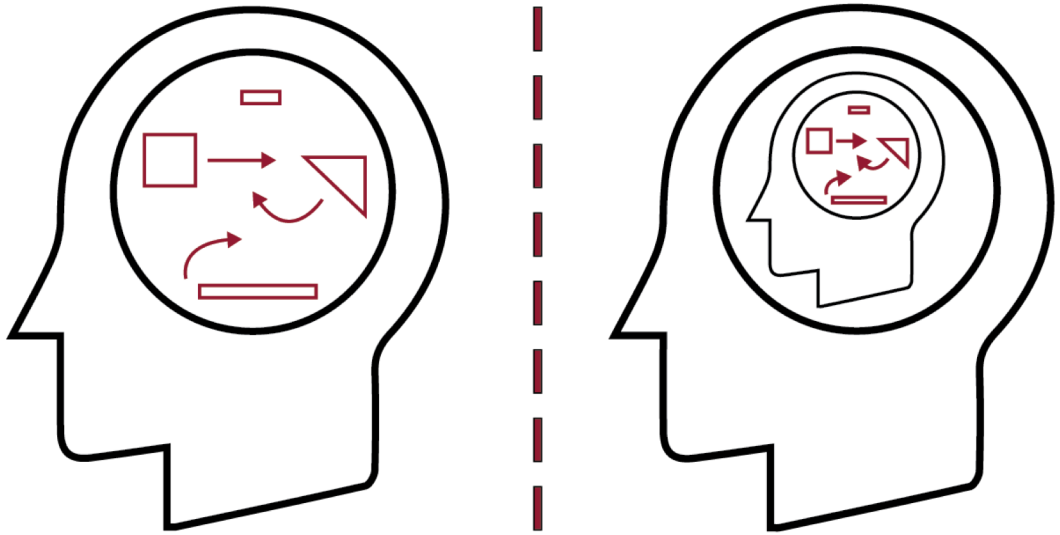


(Muis & Duffy, 2013

What Kind of Future Do We Want To Build? (3/3)

Because it is our choice to engage with philosophy.

- Invent **means to capture** learning
- Build **technologies** for research / learning
- Conduct studies to find **constructs**
- Suggest new ideas for **practice**



- Precisify entangled **terminology**
- Relate to questions of **philosophy**
- Dis-entangle and create **concepts**
- Suggest new ideas for **practice**

1. Meet a philosopher of science or an epistemologist.
   You might be pleasantly surprised!

2. Converse with the philosophical critical analyses of computational modeling.
   You might be productively inspired!

Productive Science = Practice + Philosophy

Thank You

Petr Johanes

pjohanes@stanford.edu

References (1/1)
All those we are grateful for.

Boaler, J. (2002). The Development of Disciplinary Relationships: Knowledge, Practice and Identity in Mathematics Classrooms. *For the Learning of Mathematics*, *22*(1), 42–47.

Dewey, J. (1929). *The sources of a science of education*. Read Books Ltd.

diSessa, A. A., & Cobb, P. (2004). Ontological Innovation and the Role of Theory in Design Experiments. *Journal of the Learning Sciences*, *13*(1), 77–103. https://doi.org/10.1207/s15327809jls1301_4

Gitelman, L. (Ed.). (2013). *"Raw data" is an oxymoron*. MIT Press.

Jacobson, M. J., & Wilensky, U. (2006). Complex Systems in Education: Scientific and Educational Importance and Implications for the Learning Sciences. *Journal of the Learning Sciences*, *15*(1), 11–34. https://doi.org/10.1207/s15327809jls1501_4

Knight, S., Buckingham Shum, S., & Littleton, K. (2014). Epistemology, assessment, pedagogy: where learning meets analytics in the middle space. *Journal of Learning Analytics*, *1*(2), 23–47.

Knight, S., Shibani, A., & Shum, S. B. (2018). Augmenting Formative Writing Assessment with Learning Analytics: A Design Abstraction Approach, 8.

Luckin, R. (2018). *Machine learning and human intelligence: The future of education for the 21st century*. London: UCL Institute of Education Press.

McDermott, R. (2015). Does "learning" exist? WORD, *61*(4), 335–349. https://doi.org/10.1080/00437956.2015.1112956

Mitchell, S. D. (2009). *Unsimple truths: Science, complexity, and policy*. University of Chicago Press.

Muis, K. R., & Duffy, M. C. (2013). Epistemic climate and epistemic change: Instruction designed to change students' beliefs and learning strategies and improve achievement. *Journal of Educational Psychology*, *105*(1), 213–225. https://doi.org/10.1037/a0029690

O'Neil, C. (2016). *Weapons of Math Destruction: How big data increases inequality and threatens democracy*. New York, NY: Crown Publishing Group.

Sandoval, W. A. (2004). Developing Learning Theory by Refining Conjectures Embodied in Educational Designs. *Educational Psychologist*, *39*(4), 213–223. https://doi.org/10.1207/s15326985ep3904_3

Sandoval, W. A., & Reiser, B. J. (2004). Explanation-driven inquiry: Integrating conceptual and epistemic scaffolds for scientific inquiry. *Science Education*, *88*(3), 345–372. https://doi.org/10.1002/sce.10130

Weisberg, M. (2013). *Simulation and Similarity: Using Models to Understand the World*. Oxford University Press.

Williamson, B. (2017). *Big Data in Education: The digital future of learning, policy and practice*. SAGE Publications, Inc.

Winsberg, E. (2010). *Science in the age of computer simulation*. Chicago: The University of Chicago Press.

Wise, A. F., & Cui, Y. (2018). Envisioning a Learning Analytics for the Learning Sciences, 8.

Wise, A. F., & Schaffer, D. W. (2015). Why theory matters more than ever in the age of big data. *Journal of Learning Analytics*, *2*(2), 5–13. https://doi.org/10.18608/jla.2015.22.2