



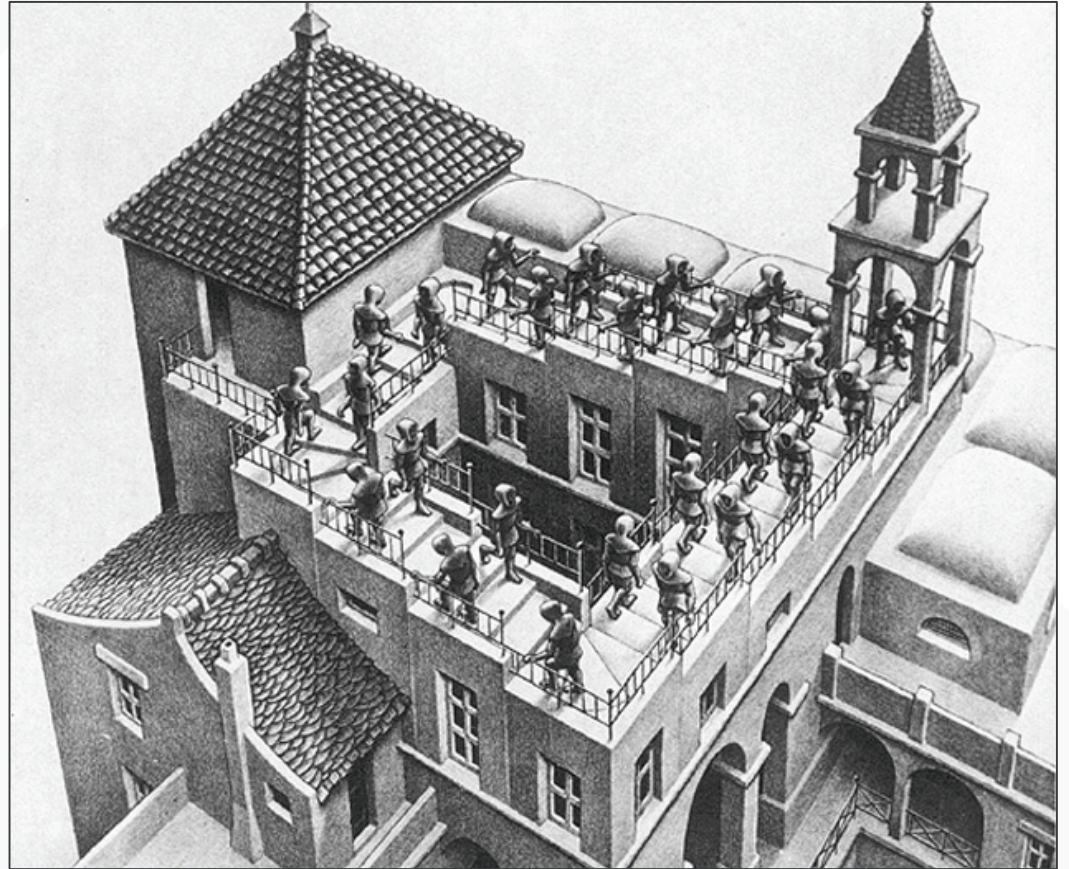
ANGST AND EXPECTATIONS IN LEARNING ANALYTICS

Vince Kellen, PhD
Chief Information Office, UCSD

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DIRECTIONS

- A. Complexity
- B. Dualisms
- C. Singularity
- D. Context
- E. Commandments



COMPLEXITY

BFNs

Neurons in the brain	10^{11}
Synapses in the brain	10^{14}
Minutes in 10 billion years	10^{16}
Combinations of photos in a room of 200 people	10^{60}
Atoms in the universe	10^{80}
Maximum possible subsets of neurons in a brain	10^{2048}

INSTRUCTIONAL COMPLEXITY

- In just one particular paradigm for instructional science, there exist 10^{29} possible combinations
 - 30 instructional techniques
 - 3 intervention/treatment levels
 - 2 timings (early and late)
- But it gets worse
 - We just don't have one paradigm of instruction theory but dozens
 - We just don't have two sets of timings, but many more possibilities as learning unfolds
 - We have oodles of psychological variables
 - And we have multiple outcomes to consider
- We may be many orders of magnitude off. Learning is a moment-by-moment unfolding sequence of events. Complexity might even be as high as 10^{629} !

EDUCATION RESEARCH

Instructional Complexity and the Science to Constrain It

Kenneth R. Koedinger^{1*}, Julie L. Booth², David Klahr¹

Science and technology have had enormous impact on many areas of human endeavor but surprisingly little effect on education. Many large-scale field trials of science-based innovations in education have yielded scant evidence of improvement in student learning (1, 2), although a few have yielded positive outcomes (3, 4). Education involves many important issues, such as cultural questions of values, but we focus on instructional decision-making in the context of determined instructional goals and suggests ways to manage instructional complexity.

This student learn better right now if I give her feedback or if I let her grapple with the material for a while?, the search for general methods that optimize the effectiveness, efficiency, and level of student engagement is more challenging.

Complexity of Instructional Design

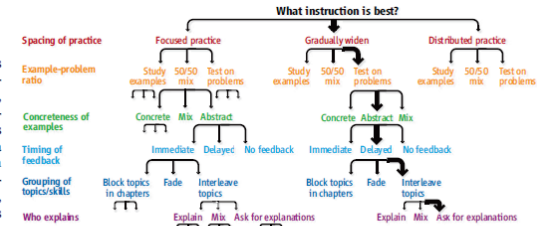
Of the many factors that affect learning in real-world contexts, we describe three of particular importance: instructional technique, dosage, and timing. Independently

School-researcher partnerships and large in vivo experiments help focus on useful, effective, instruction.

Intervention timing. The optimal technique may not be the same early in learning as it is later. Consider how novice students benefit from studying many worked examples in place of many problems, whereas shifting to pure problem-solving practice becomes more effective as students develop expertise (17). Many researchers have suggested that effective instruction should provide more structure or support early in learning or for more difficult or complex ideas and fade that assistance as the learner

Ambiguities and Contexts in Instruction

Many debates about instructional methods suffer from a tendency to apply compelling labels to vaguely described procedures, rather than operational definitions of instructional practices (5, 6). Even when practices are reasonably well defined, there is not a consistent evidential base for deciding which approach is optimal for learning. Empirical investigations of instructional methods, including controlled laboratory experiments in cognitive and educational psychology, often fail to yield consensus. For instance, controversy exists regarding benefits of immediate (7) versus delayed feedback (8), or use of concrete (9) versus abstract mate-

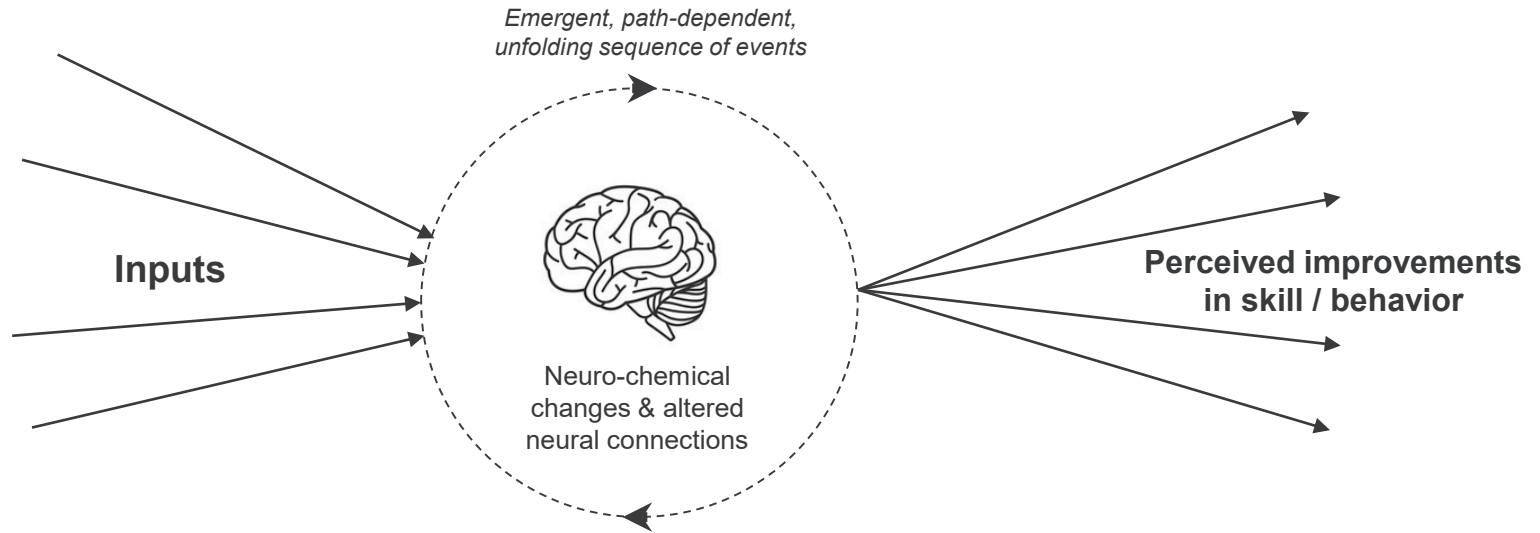


Instructional design choices. Different choices along different instructional dimensions can be combined to produce a vast set of instructional options. The path with thicker arrows illustrates one set of choices within a space of trillions of such options.

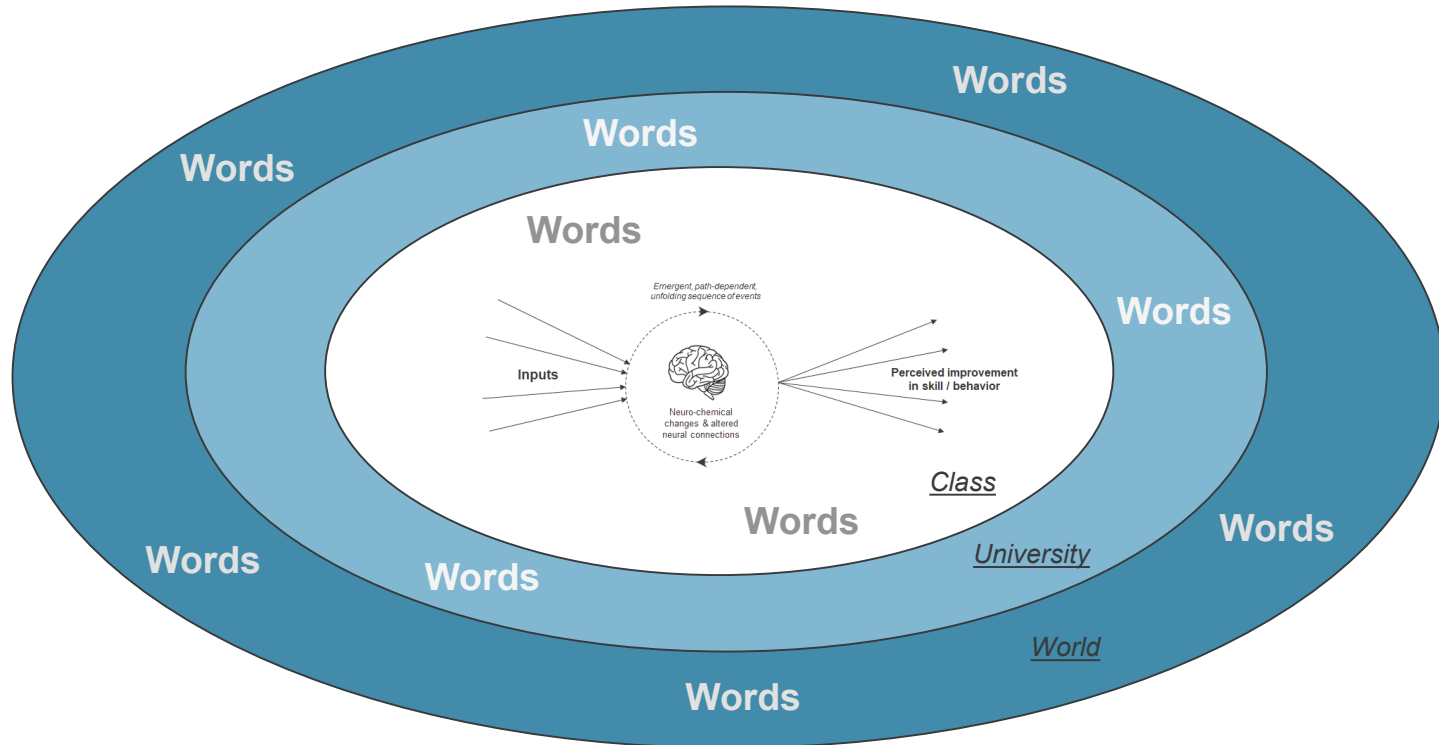
We don't have

- Any common theory of the mind or a common meta-structure to the problem
- Any good means for simulating

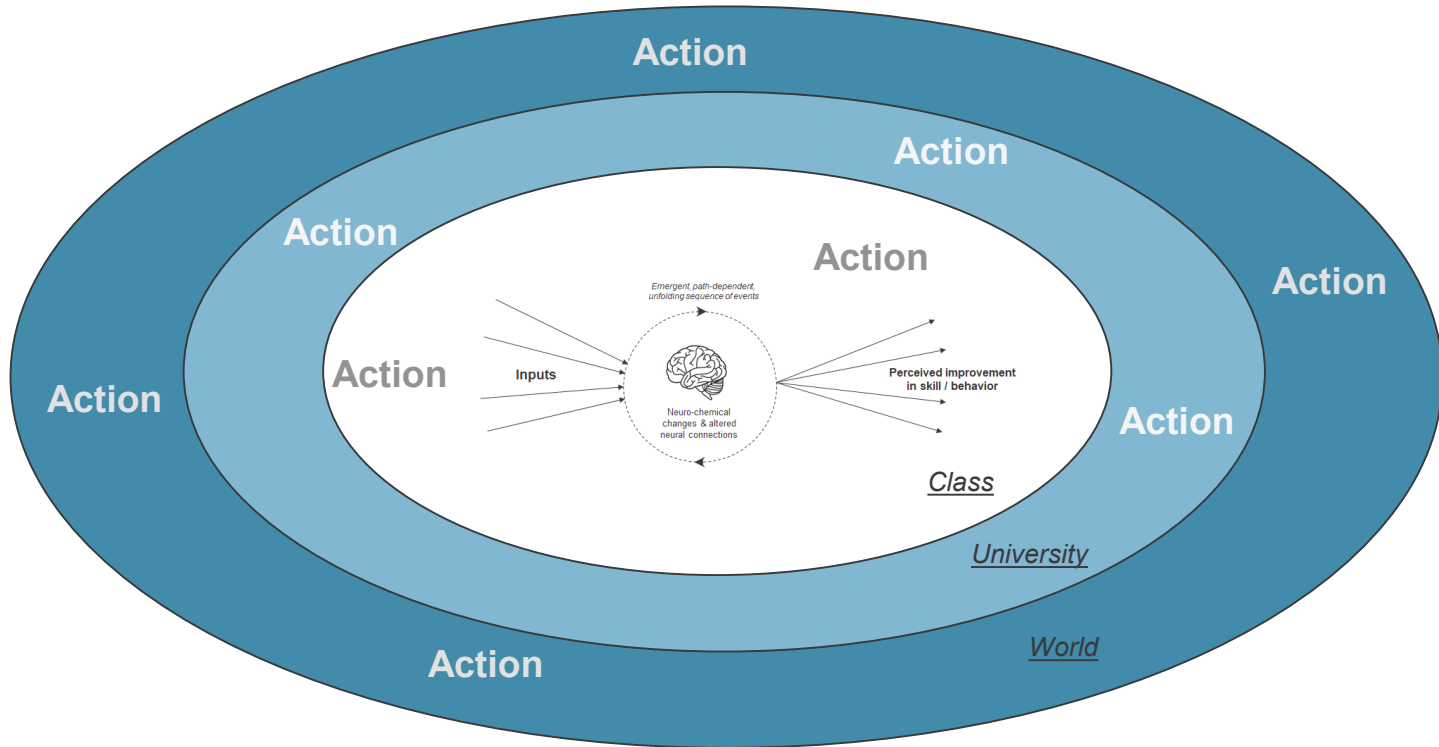
A POSITIVIST / REDUCTIONIST VIEW ON LEARNING



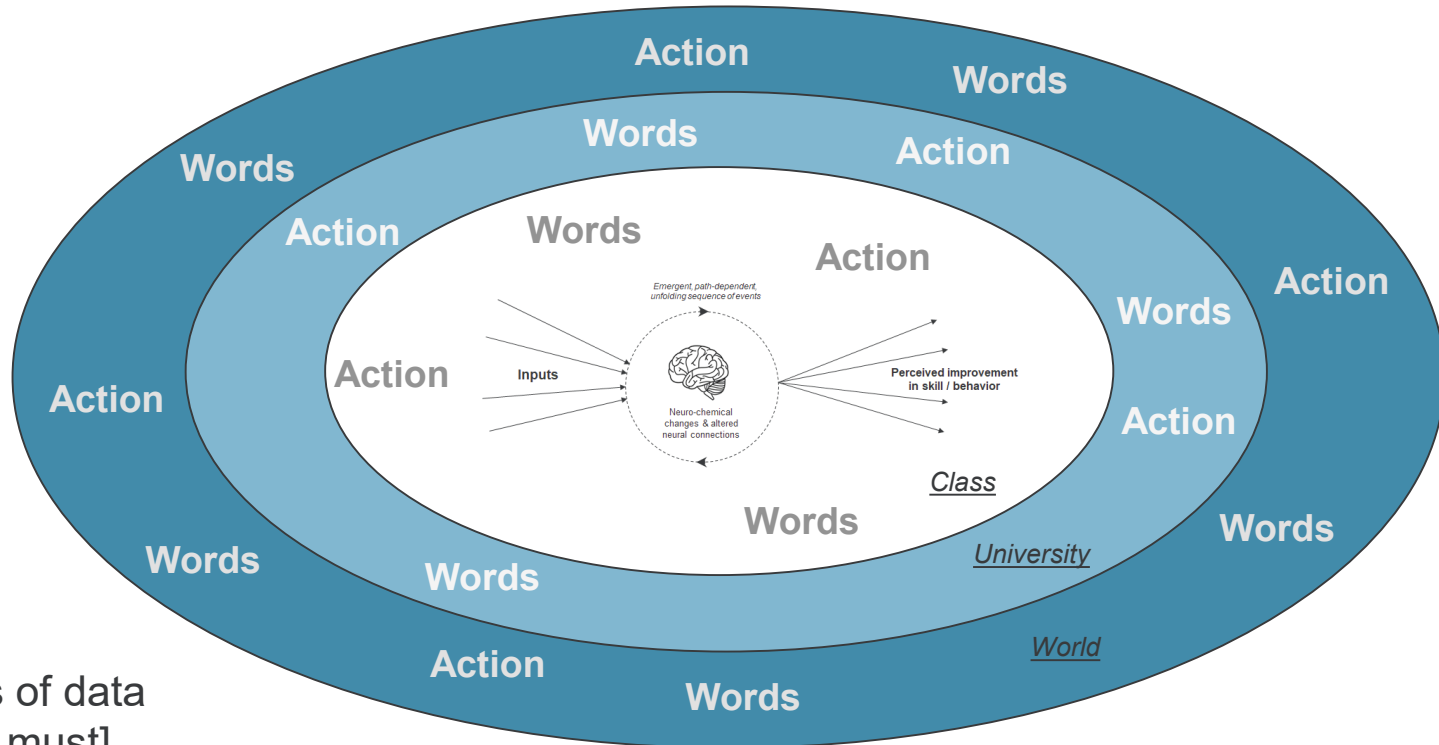
LANGUAGE IS FUNDAMENTAL FOR LEARNING



SOCIAL INTERACTION IS FUNDAMENTAL FOR LEARNING

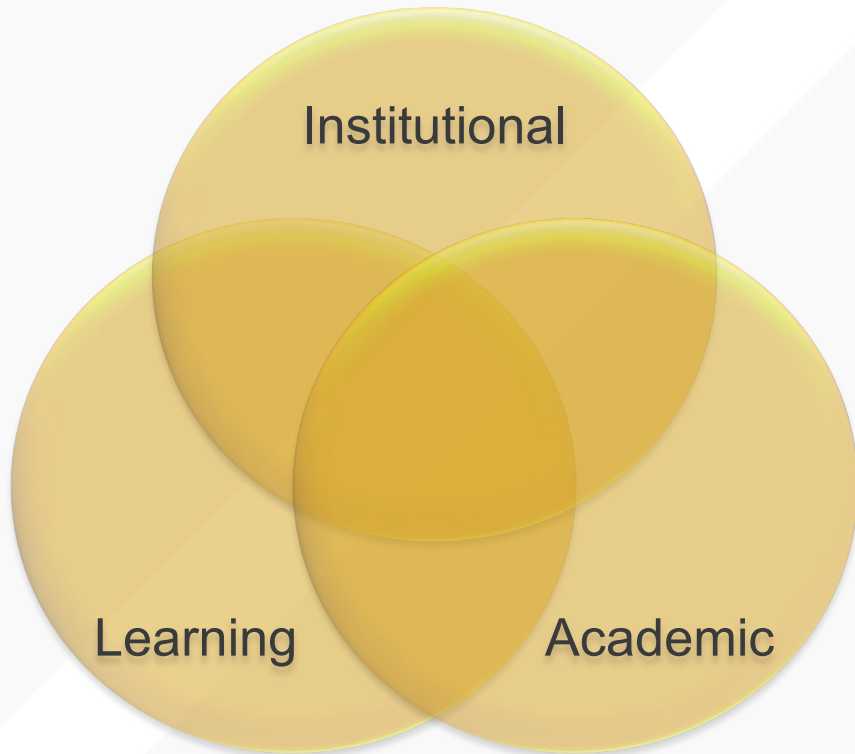


LANGUAGE AND INTERACTIONS ARE FUNDAMENTAL FOR LEARNING



Analysis of data
[should, must]
accommodate behavioral and semantic analysis

THREE REALMS OF STUDENT ANALYTICS



Institutional

Graduation and retention rates; time-to-degree; student success by socio-economic, geographic, ethnicity categories; academic unit assessment; support program assessment; institutional surveys

Academic

Advising; GPA; SAT, major performance; course selection; prior course performance; engagement; student progression; course scheduling and planning

Learning

Course engagement; formative and summative assessments; assignment grades; content interaction; learning system, clickers, active learning tools, etc. click stream; program of study engagement

Thanks Jenn Stringer, Chief Academic Technology Officer, UC Berkeley for the Venn diagram!

DUALISMS

BINARY THINKING

VERSUS

Either/Or



Both/And

Most participants in a debate slip into simpler 'either-or' frames. While expressing concepts across a continuum and focusing on the extreme ends of the continuum may help clarify reasoning, over-reliance on simplistic frames will lead to shoddy reasoning. It's a both-and world!

STUDENT AFFAIRS VERSUS ACADEMIC DEPARTMENTS!

VERSUS

Curricular



Co-curricular

Organizationally and technically, these two areas are usually distinct and not integrated. However, at the intersection and interplay between these realms lies our reason for being. A fuzzy operational and analytic line may be better than a crisp line. This is a very rich area!

HOW MUCH SHOULD STUDENTS DO BY THEMSELVES?

VERSUS

Agency



Scaffolding

When I was in school... We help these kids too much... They need to do this themselves... The right amount of difficulty at the right time is efficacious. Teams need to learn how the levels of scaffolding in each context should be altered to foster student agency

FROM 2 TO N

VERSUS

Linear



Network

Connectivist approaches are growing. ANNs are being used. Social network analysis is here. The simple dyad of instructor and learner needs to give way to how a network of time-dependent factors 'vibrate' to influence a student. Growth, as we know, isn't monotonic or linear. Linear analytic techniques need to co-exist with non-linear methods

CULTURE WARS

VERSUS

Individual



Community

Education, especially higher education, has people running it who are excellent individual, if not solitary, contributors. Cultures vary on the relationship between the individual, their immediate communities and the responsibility for their education. One does not teach a student. One teaches a family! Should students share their learning analytics with family and friends? Should family members closely monitor them?

ARE STUDENTS LIKE PATIENTS? ARE FACULTY LIKE DOCTORS?

VERSUS

Objective



Subjective

The medical community, due to its scientific richness, can be highly objective. In teaching, the mind is still considered too [special, taboo] to inspect. Some instructors and administrators are fearful of bias. In healthcare, the assumption of objectivity requires data from patients. In education, the assumption of subjectivity makes [some, all] data optional

“PATHS TO THE TRUTH” CAGE MATCH!

Deduction vs Induction vs No-duction

Theoretical



Atheoretical

Winner fights Abduction!

Deductive, abductive and inductive reasoning each have their worthy proponents! The coming ML & AI revolution may render deduction irrelevant! But no-duction isn't going away either!

WARFARE IS OFTEN MERELY ONTOLOGICAL

VERSUS

Data



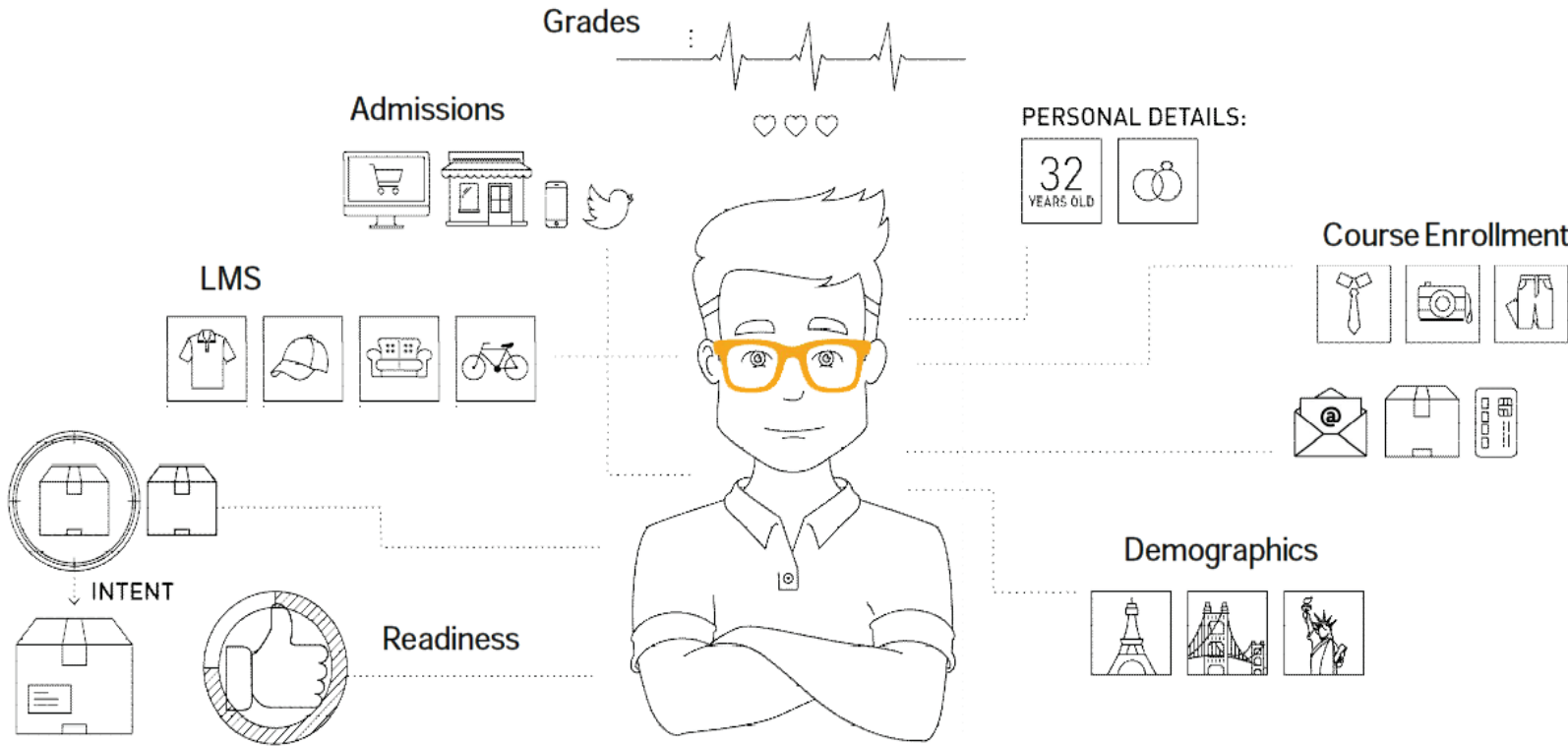
Culture

Owing to our genetic heritage with animals, humans compete on information. This leads to many organizational dysfunctions that are hard to root out. Information isn't power. Information sharing is! Can members of the community dedicate their efforts to their neighbor's success? Can evidence-based decision making replace powerful anecdotes?

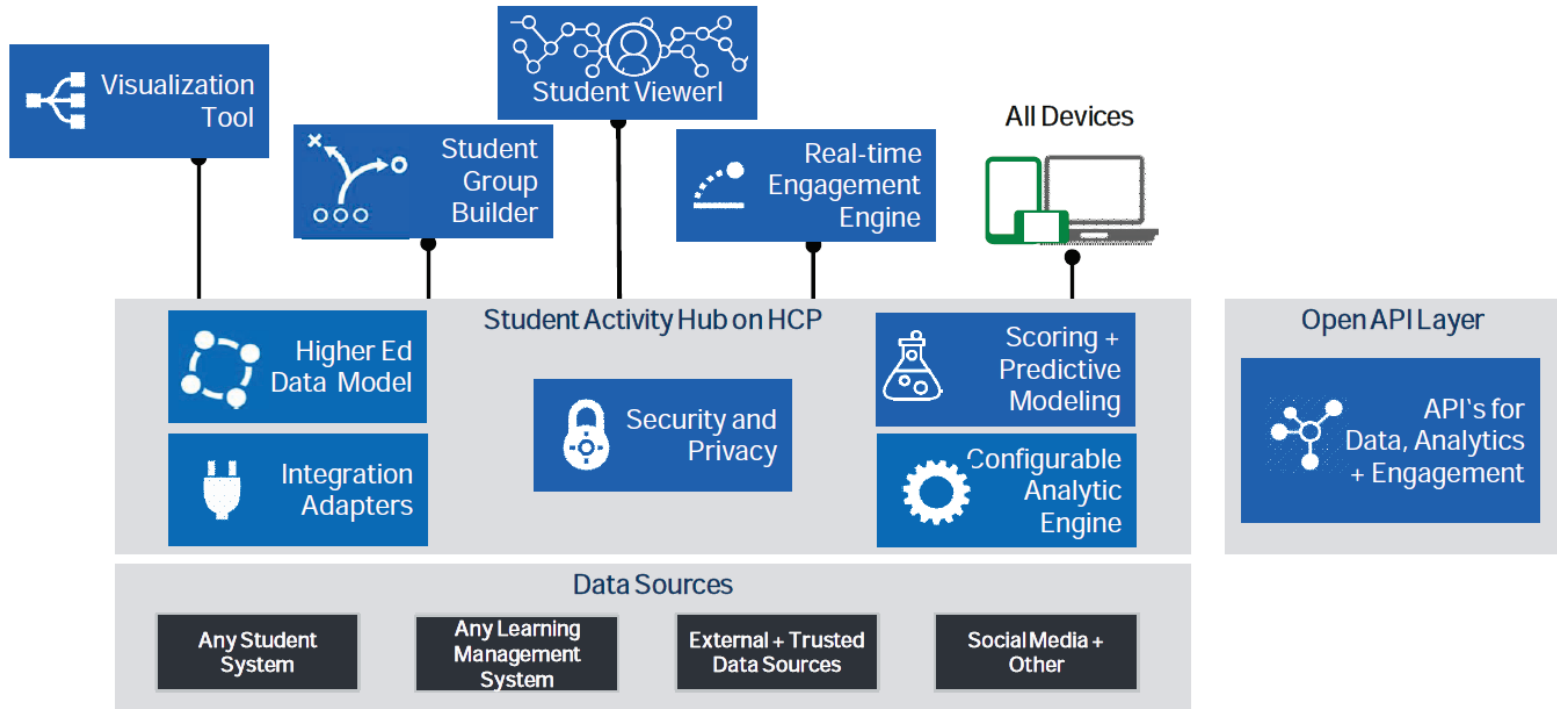
**There is perhaps nothing more
vexing than a powerful person
with a strong need for an heroic
narrative to come true**

UCSD CONTEXT

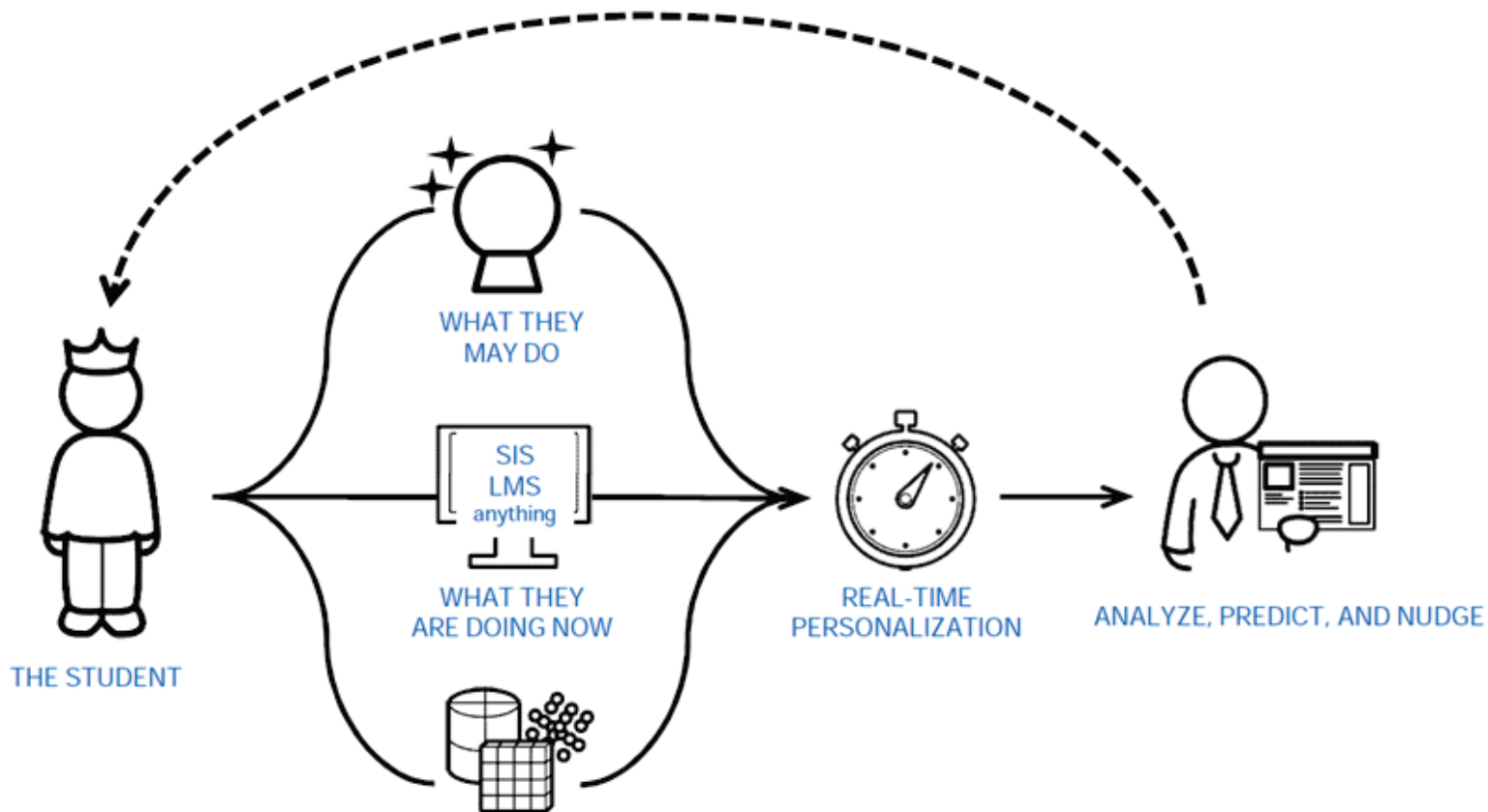
WE HAVE THE DATA. ITS JUST SPREAD OUT



SAP STUDENT ACTIVITY HUB PLATFORM



GOAL: GIVE ANALYSTS ACCESS TO ANONYMIZED VIEWS



GROUP AND MESSAGE BUILDER



Student group builder

Analyze student and learning activities to uncover trends
Filter and group students according to different attributes
Explore (and save) results in graphs and list format



Group management

Store groups – including static and dynamic groups
Track group membership over time
Compare and analyze groups
Use groups as “attributes” in BI tools

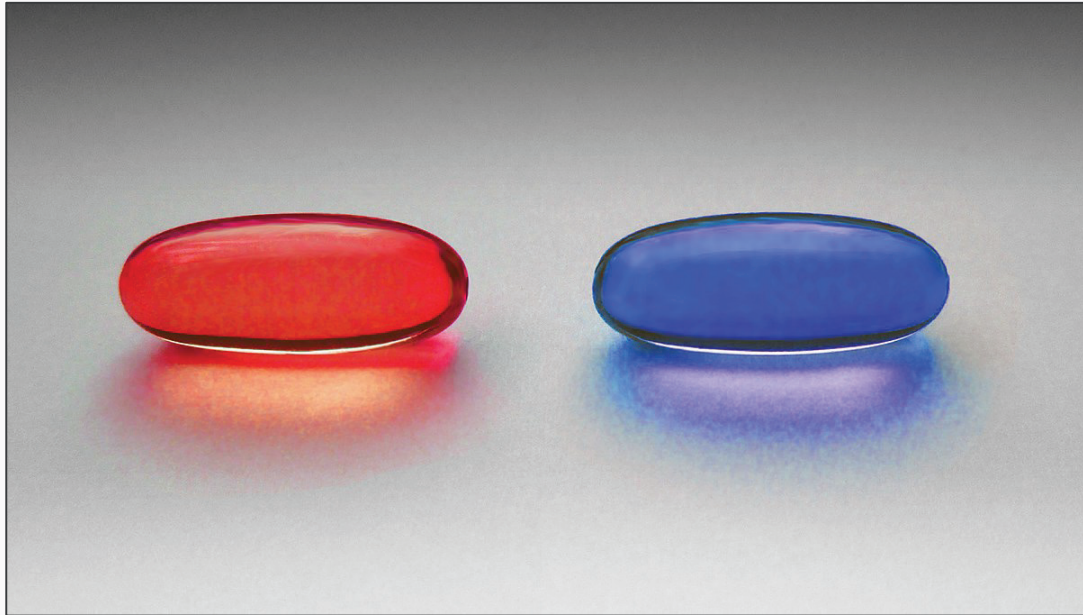


Personalized messaging

Automatically generate user-defined messages
Use message templates and embed variables
Tie message recipients to student groups

SINGULARITY & COMMANDMENTS

I HAD AN EPIPHANY WHILE I WAS AT A DISTANCE LEARNING CONFERENCE IN FLORIDA...



What if an online AI instruction method could teach *better* than humans and at five times (5X) the productivity in 85% of all our courses? What would happen next?

Or better, still, what has already happened?

QUESTIONS

What learning data will never be useful to capture?

Would you like to see an AI-powered Socrates?

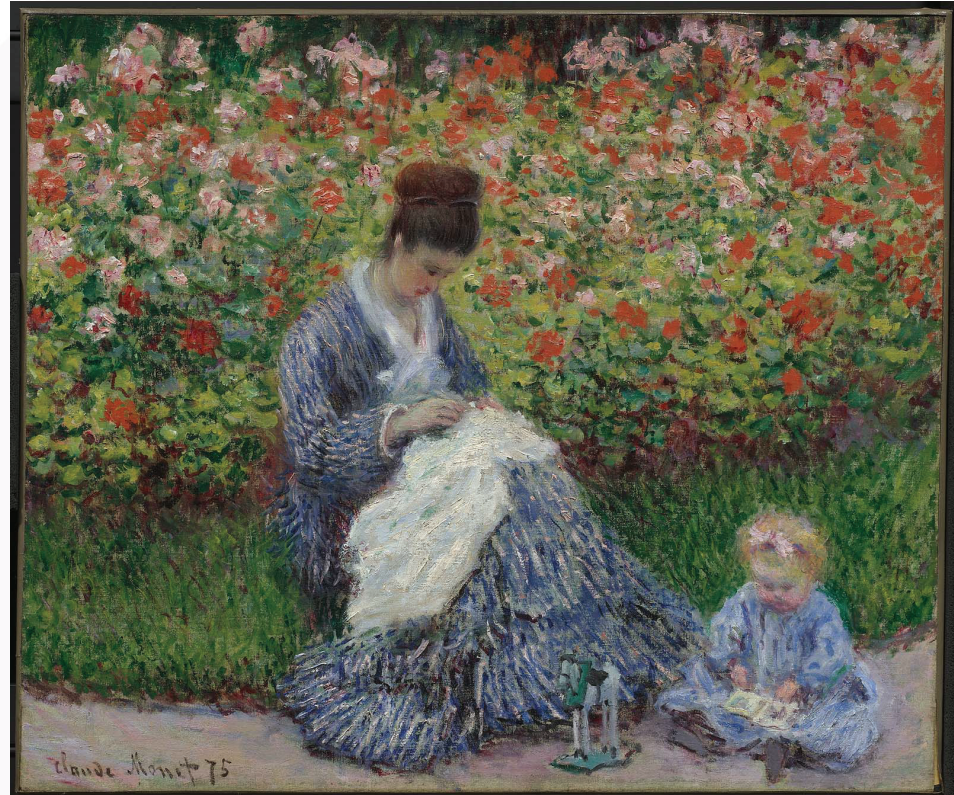
What would happen if students strongly prefer AI-driven learning analytics even if it didn't provide major productivity improvements?

How will we know the technology has advanced too far?

When should we start using consumer technology in real-time learning analytics?

What should [Google, Amazon, IBM, etc.] do in this area?

Would you want to see your kid's library search terms? Real-time?



THE 7 COMMANDMENTS OF LEARNING ANALYTICS

1. The teaching and learning research space is much more complex than we realize. Large jumps in teaching productivity akin to 20th century technology is not likely. ***Cultivate humility when pursuing LA***
2. The lack of a robust, fundamental theory makes this even more difficult as the shroud of subjectivity still is large. ***Help a community of researchers to build theories over time***
3. A top challenge is data integration. This is like building roads between cities. Not terribly sophisticated, but hard work. ***Build a great platform for data and analysis***
4. Respect for privacy for all parties is a given. How to do this and more importantly, how far to extend a positivist, reductionist approach is, for now, a local matter. ***Develop an institutional point of view based on institutional values***
5. Data and technology are now outrunning human abilities to manage them. This requires technical talent and the higher organizational IQ/EQ. ***Treat individual and group information dysfunctions***
6. How organizations build capacity in learning analytics might be emergent and path dependent. This can create unique advantages. Take 'best practices' with a large grain of salt. ***Seek your own path***
7. If AI takes over education as some think it will, don't fret about the classroom. Much of culture will be different. Instead, ***find your family and hope your DNA hasn't been rewired***

IF YOU AREN'T CONFUSED, YOU HAVEN'T BEEN PAYING ATTENTION

