UNIVERSITY OF TEXAS ARLINGTON

LINK

Athabasca University

The future of learning: Digital, distributed, and data-driven

George Siemens, PhD

Trondheim, Norway

May 12, 2016

SOLAR
SOCIETY for LEARNING ANALYTICS RESEARCH

The future that I envision

To enable all students to achieve **an education that enables quality of life and meaningful employment** through

a) exceptional quality research and;
b) sophisticated data collection and;
c) advanced machine learning & human learning analysis/support.

What I’ll talk about:

A bit of context
Digital
Data
Distributed
Imagining our future

A bit of context

Digital

Data

Distributed

Imagining our future

What does it mean to be human in a digital age?

LINK Research Areas

NEW KNOWLEDGE PROCESS

THE FUTURE OF WORK

SUCCESS FOR ALL LEARNERS

THE FUTURE OF UNIVERSITIES

linkresearchlab.org/#aboutus

LINK Research Areas

How is knowledge created and shared in a digital age?	How will we work tomorrow?	What is needed for all students to be successful?	How will we learn tomorrow?
NEW KNOWLEDGE PROCESS	THE FUTURE OF WORK	SUCCESS FOR ALL LEARNERS	THE FUTURE OF UNIVERSITIES

linkresearchlab.org/#aboutus

A few LINK Research Lab projects

Projects - dLRN

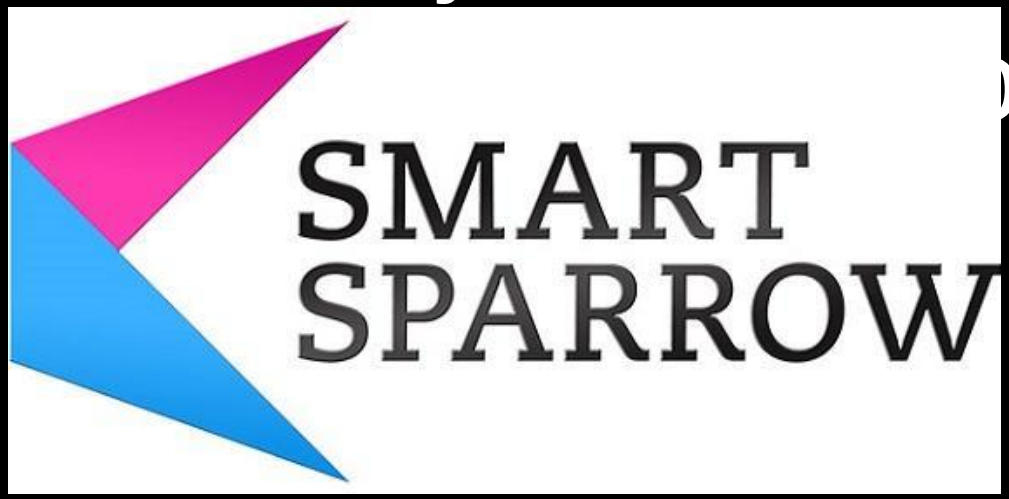
$1.6M Bill and Melinda Gates Foundation (PI)

linkresearchlab.org/dlrn

Projects - Smart Science Network

$5.2M Bill and Melinda Gates Foundation (Co-PI)
linkresearchlab.org/research

Projects - Smart Science ...ork



$5.2M Bill and Melinda Gates Foundation (Co-PI)

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Projects - BCC: Community and Capacity for Educational Discourse Research

$254K NSF (Co-PI)

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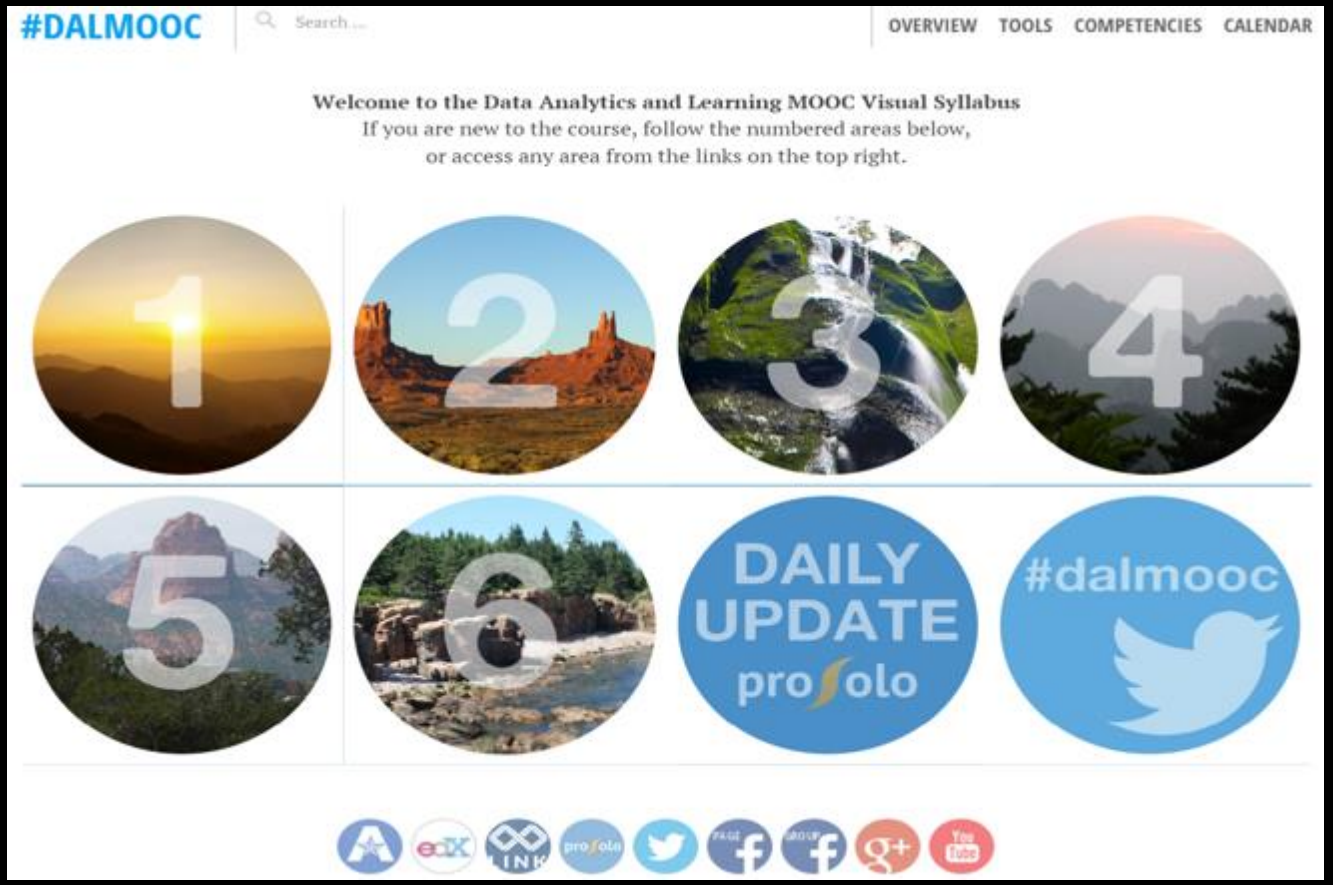
Projects - BIGDATA: Collaborative Research

$1.6M NSF (Co-PI)

linkresearchlab.org/research

DALMOOC: multi-pathway learning



linkresearchlab.org/dalmooc

aWEAR

Expanding data collection to include broadening scope of data collection

Holistic learning

Individual well-being

Preparing learners for the future of work and life

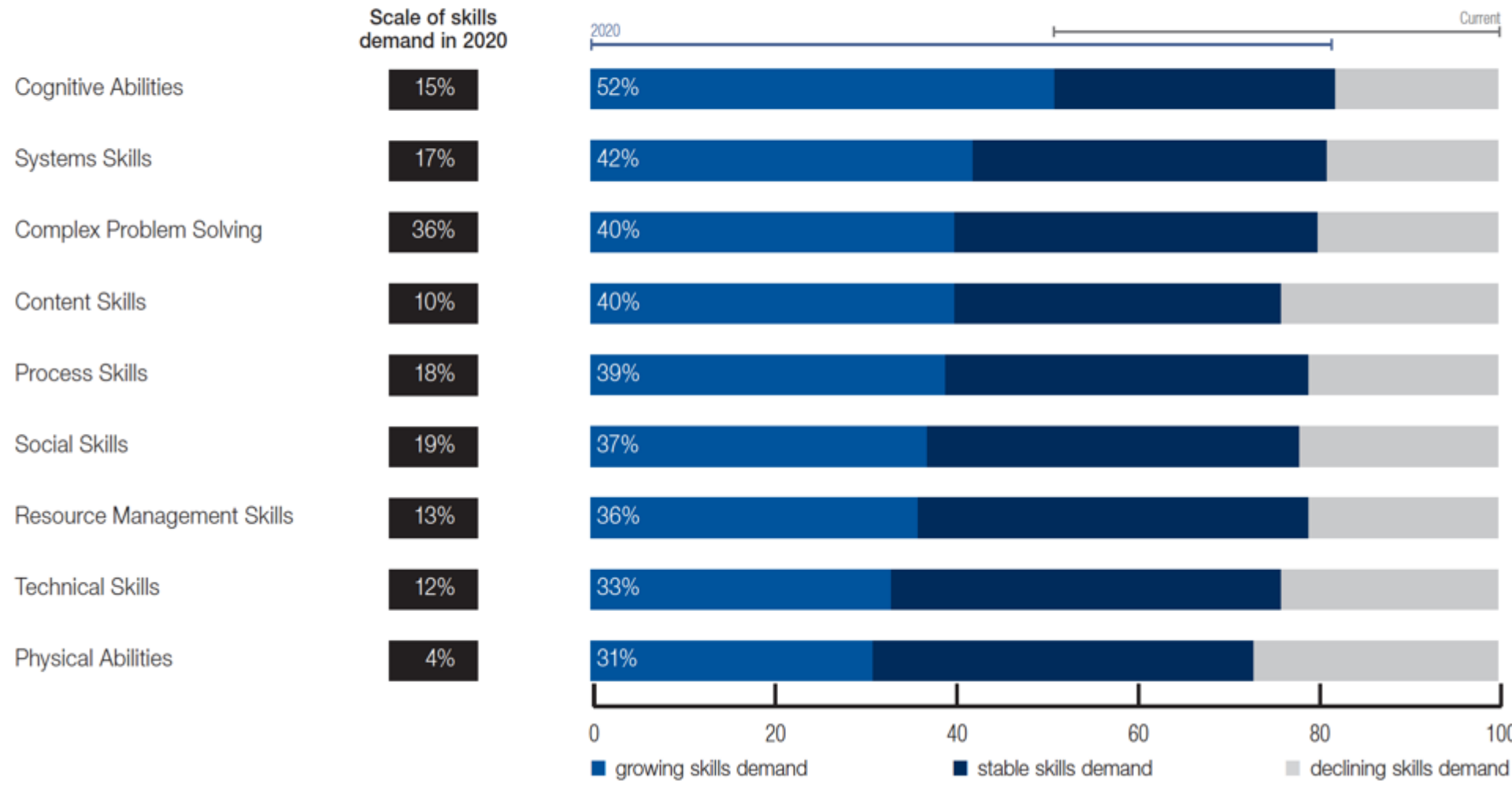
Emerging Technologies and their Practical Applications in K12 Teaching and Learning MOOC

goo.gl/w9Bkdx

The new landscape

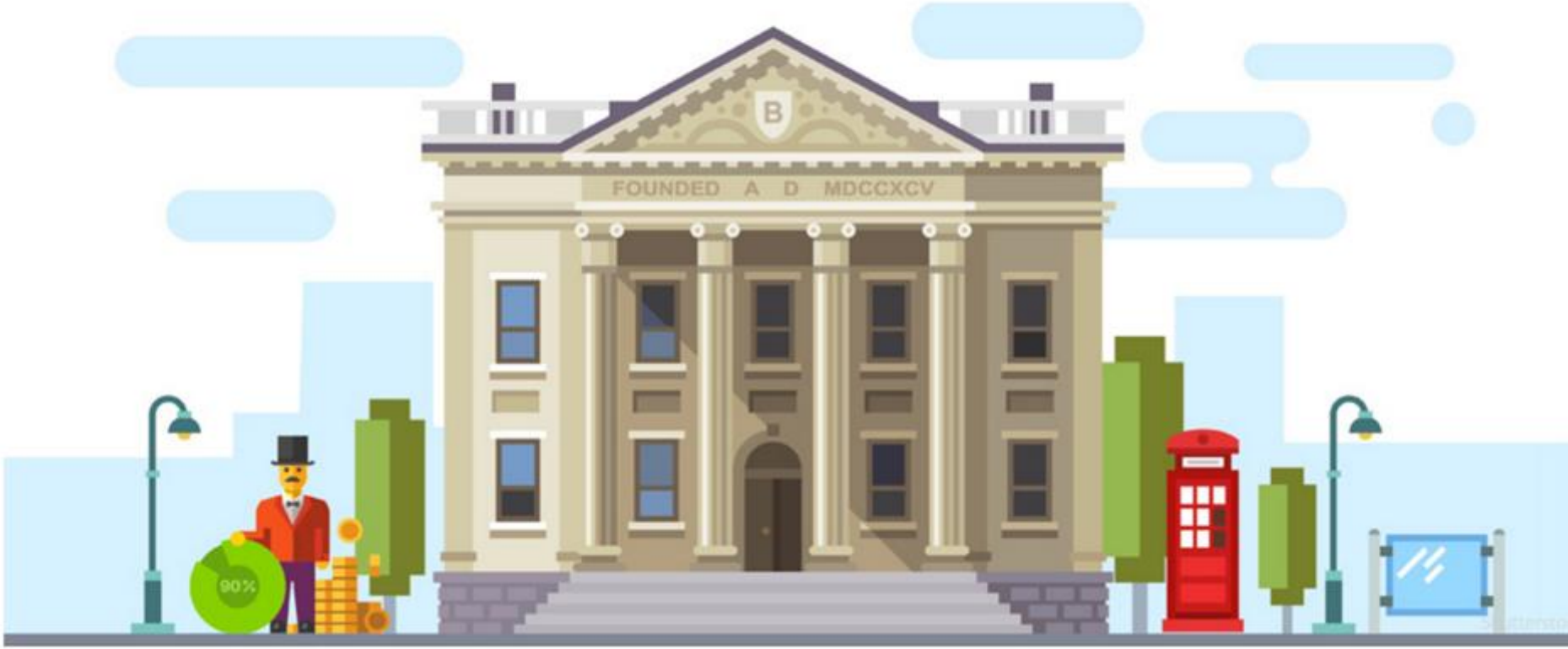
Figure 10: Change in demand for core work-related skills, 2015-2020, all industries

Share of jobs requiring skills family as part of their core skill set, %



World Economic Forum: Future of Jobs, 2016

US Department of Education Opens Financial Aid to Students in 'Bootcamps' and Non-Institutional Programs



Who's Who in Ed Tech? A Look At Prominent VC Board Members

Investor	Firm	Select Ed Tech Board Seats
Amish Jani 	FIRSTMARK CAPITAL	Knewton, Lumosity, Schoology, StraighterLine
E. Novak 	NOVAK BIDDLE VENTURE PARTNERS	Fidelis Education, Parchment, UniversityNow
Frank Bonsal 	New Markets VENTURE PARTNERS	Curiosityville (exited), Moodlerooms (exited), Questar Assessment

John Martinson

Edison PARTNERS

CambridgeSoft (exited), ClearPoint Learning Systems, Presidium Learning (exited)

Bryan Schreier

SEQUOIA CAPITAL
THE ENTREPRENEURS BEHIND THE ENTREPRENEURS

Clever, Inkling Systems, MindSnacks

Rob Stavis

BESSEMER VENTURE PARTNERS

2U (exited), BrightBytes, Knewton

John Martinson

Edison PARTNERS

CambridgeSoft (exited), ClearPoint Learning Systems, Presidium Learning (exited)

Victor Parker

SPECTRUM EQUITY INVESTORS

ExamSoft Worldwide, lynda.com (exited), Teacher Synergy

CB INSIGHTS

Rob Stavis

BESSEMER VENTURE PARTNERS

2U (exited), BrightBytes, Knewton

John Martinson

Edison

PARTNERS

CambridgeSoft (exited), ClearPoint Learning Systems, Presidium Learning (exited)

Who's Investing in Ed-Tech (2010-2016)

Audrey Watters on 03 May 2016

“If the ladder of educational opportunity rises high at the doors of some youth and scarcely rises at the doors of others, while at the same time formal education is made a prerequisite to occupational and social advance, then **education may become the means, not of eliminating race and class distinctions, but of deepening and solidifying them**.”

President Truman, 1947

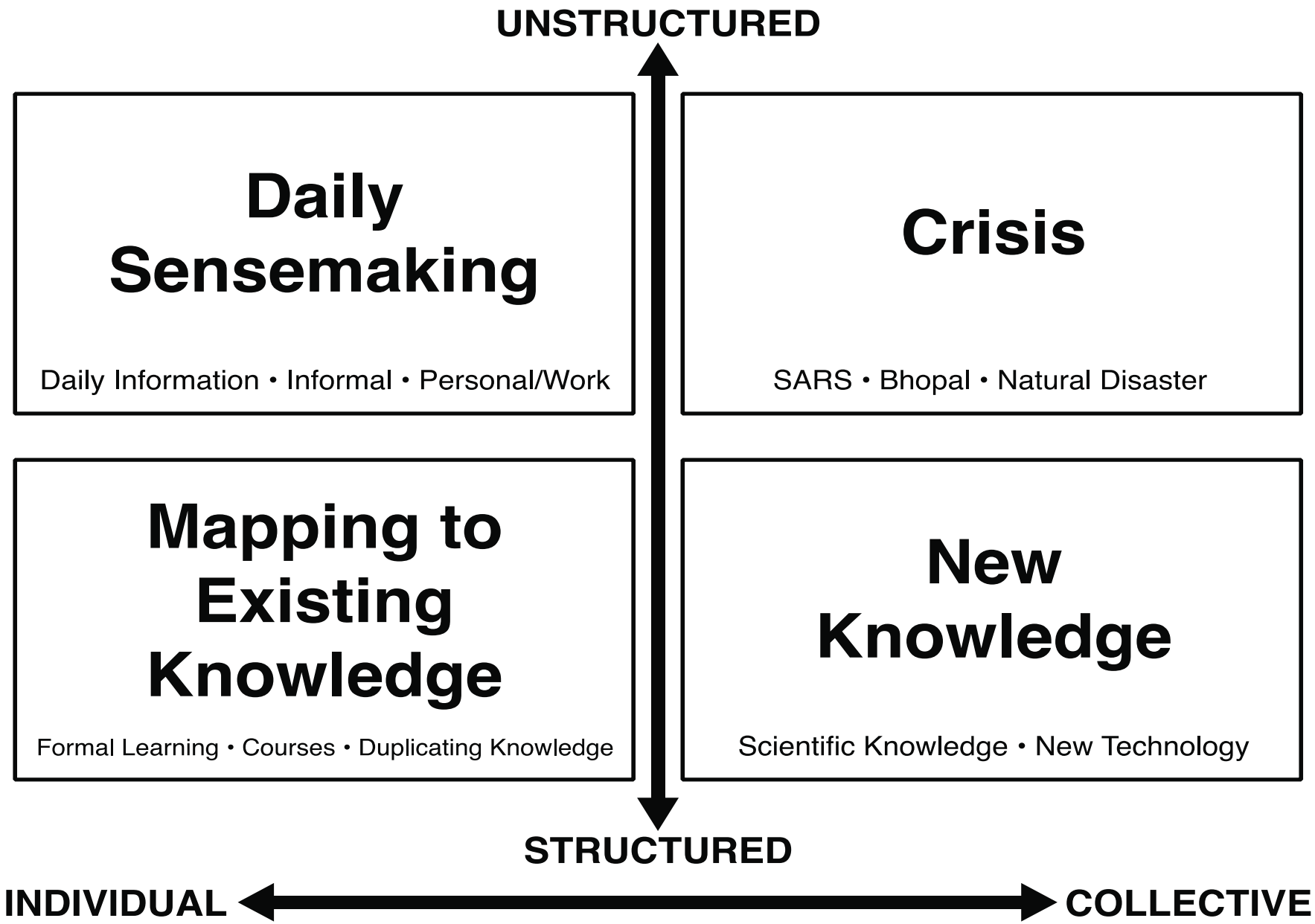
Complexification of learning needs

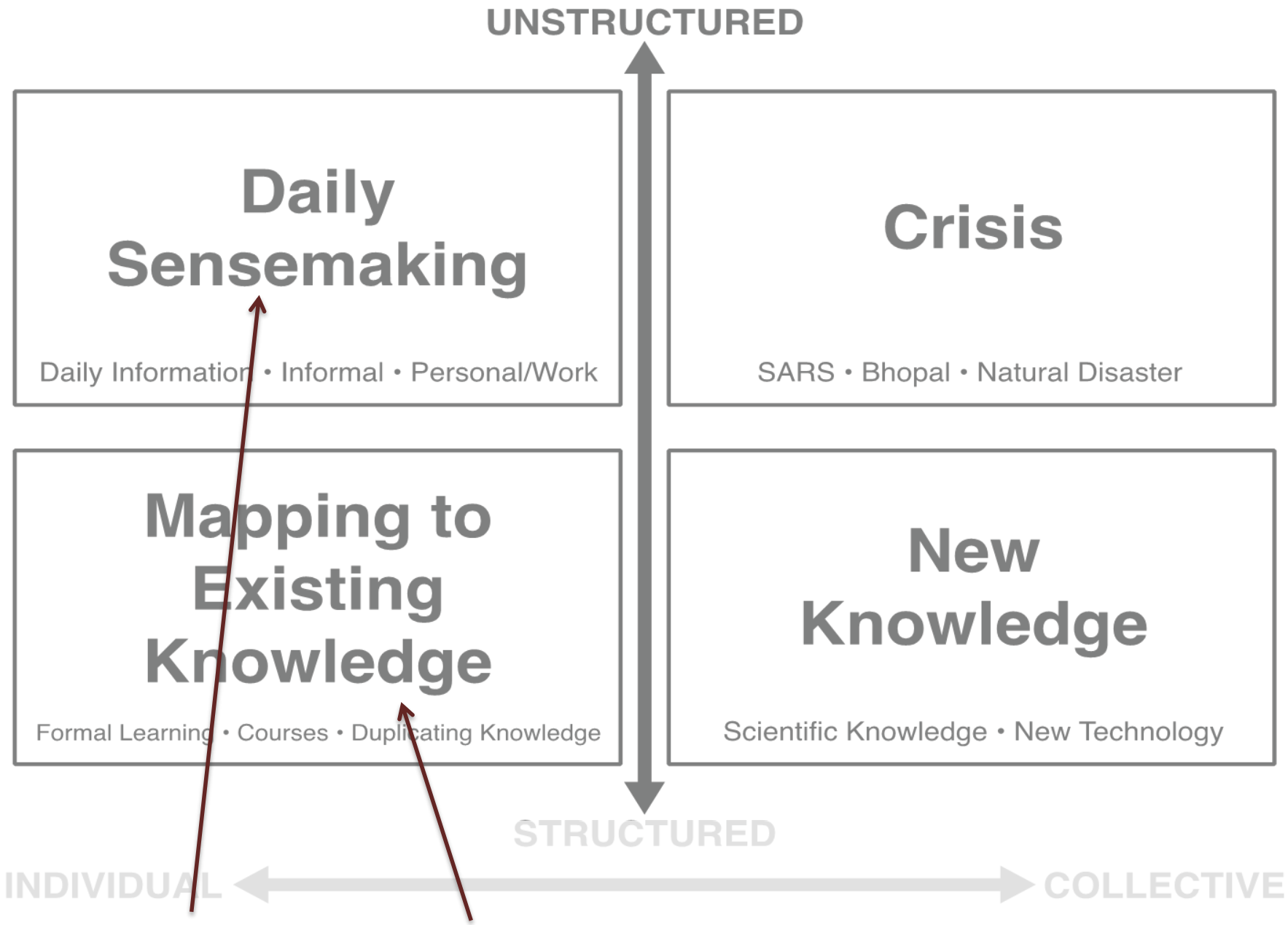
Learning needs are complex, ongoing

Simple singular narrative won't suffice going forward

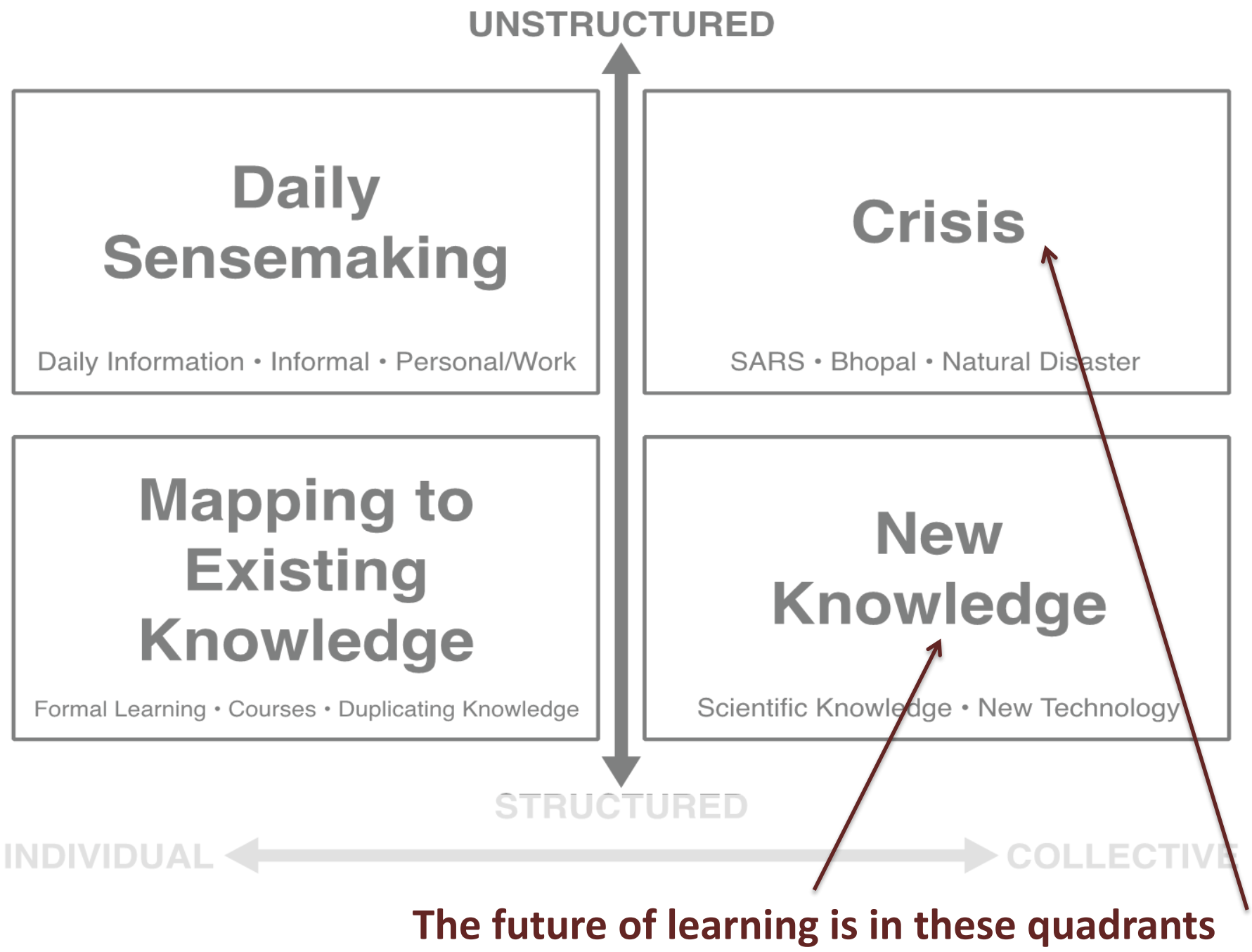
The **idea of learning** is expanding and diversifying

Learning & Knowledge Framework





Existing educational practices addresses these quadrants


UNSTRUCTURED
Daily Sensemaking
Daily Information • Informal • Personal/Work
Crisis
SARS • Bhopal • Natural Disaster
Mapping to Existing Knowledge
Formal Learning • Courses • Duplicating Knowledge
New Knowledge
Scientific Knowledge • New Technology
STRUCTURED
INDIVIDUAL
COLLECTIVE
The future of learning is in these quadrants

The worst idea to happen to education in the past 50 years

An approach to managing reform initiatives, pioneered in the United Kingdom, has had significant impact in a number of other countries around the globe. Three critical components of the approach are the formation of a delivery unit, data collection for setting targets and trajectories, and the establishment of routines.

Michael Barber, Paul Kihn, and Andy Moffit

Now more than ever, governments are under pressure to deliver results in public services while ensuring that citizens' tax dollars are spent

organizations is to find ways to define and execute their highest-priority objectives so that they have the greatest possible impact.

Deliverology: From idea to implementation

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The Avalanche That Hasn't Happened #opened13

David Kernohan

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Bill Gates calls the ed tech bluff

Education, K-12 Schooling

Bill Gates recently shocked a lot of people when he told a room full of educational technology entrepreneurs at the ASU GSV conference in San Diego that educational technology hasn't really improved student learning. This was a blockbuster confession from the man behind Microsoft. While Gates said he still thought technology could be a difference-maker in schooling, his words offered a stark reality check for those hyping technology-infused innovation.

Bill Gates calls the ed tech bluff

Education, K-12 Schooling

educational technology hasn't really improved student learning

School rankings

Need to focus on innovation, not sorting and categorizations of students, schools, and teachers.

Promote wellness, quality of life, happiness index, over routine testing and mechanization of learning.

My research interests in K-12

Questions that we are currently asking:

(We being: Catherine Spann, Dragan Gasevic, Shane Dawson, Danijela Gasevic, Andy Berning)

Australia Study

What are the effects of screen time, physical activity, weight status, and social support on school performance?

Are there observed gender and ethnic differences in the association of barriers to physical activity with physical activity, screen time, weight status and overall health?

What is the relationship between neighbourhood walkability (determined by walk score based on child's postal code) and safety and their association with physical activity, screen time, weight status and overall health?

What is the between neighbourhood walkability (determined by walk score based on child's postal code) and safety and overall academic performance?

What is the association between screen time (e.g., use of computer for games) and wellbeing and is there a mediation effect of social supports and extracurricular activities in that association

UTA/LINK and School Districts

What are the associations between academic catastrophes and attendance, well-being, achievement, student behavior?

Can these associations be used to predict learner drop out, increase academic performance and reduce related challenges for both individuals and the school systems?

UTA and institutional learner wellness

What is the relationship between mind (stress, negative emotions), body (physical activity and health), and academic performance among nursing students?

Can real-time data signals, big learning data, and machine learning models uncover these interrelationships at a deeper level?

How can interventions that challenge physical, cognitive, and emotional dimensions of individuals improve the health, well-being, and academic performance of learners?
What is the feasibility of such an intervention on a university campus?
Can students adhere to the protocol and does the intervention produce measurable change in health and academic performance?

A bit of context
Digital
Data
Distributed
Imagining our future

Self-regulated, self-selected, self-directed learning

Social media, MOOCs, community knowledge spaces

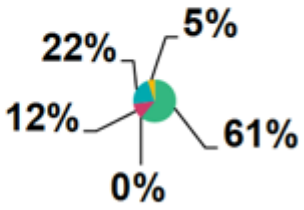
Wearables, Ambient, VR, IoT

Internet Users – 1995 → 2014…
<1% to 39% Population Penetration

1995

35MM+ Internet Users

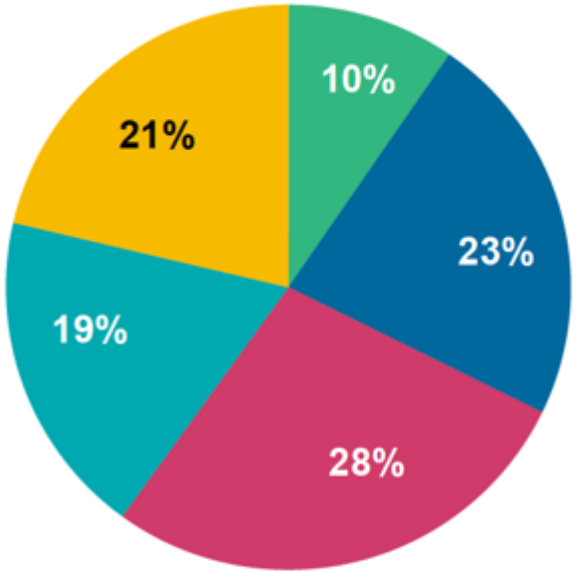
0.6% Population Penetration



2014

2.8B Internet Users

39% Population Penetration



USA China Asia (ex. China) Europe Rest of World

@KPCB Source: Euromonitor, ITU, US Census.

Source: Mary Meeker, 2015, Internet Trends

Mobile Phone Users – 1995 → 2014...
1% to 73% Population Penetration

1995

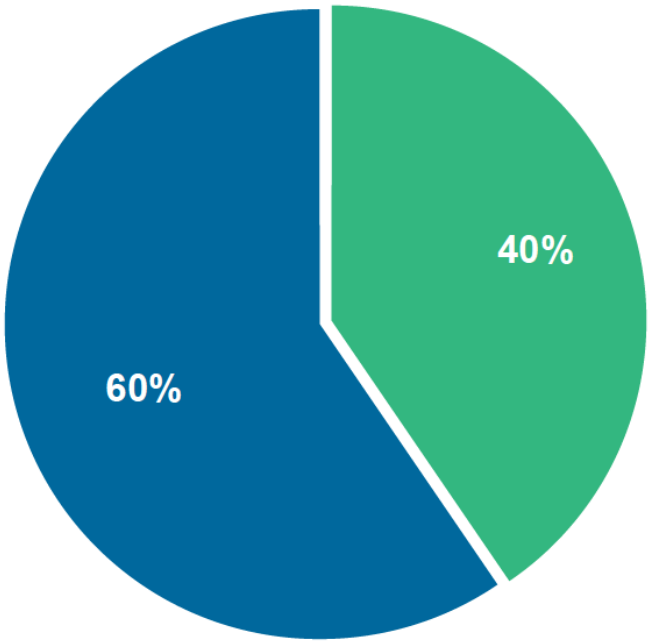
80MM+ Mobile Phone Users

1% Population Penetration

2014

5.2B Mobile Phone Users

73% Population Penetration



Source: Mary Meeker, 2015, Internet Trends

Smartphone Feature Phone

@KPCB

Source: Informa, World Cellular Information Service (WCIS). Assumes in 1995, one mobile phone subscription per unique user (no duplication).
Note: In 2014, user base per KPCB estimates based on Morgan Stanley Research and ITU data. Smartphone users & mobile phone users represent unique individuals owning mobile devices; mobile subscribers based on number of connections & may therefore overstate number of mobile users.

A bit of context
Digital
Data
Distributed
Imagining our future

Data and Analytics

Big, sloppy, fuzzy data
Inference
The benefit of scale
“so, follow the data”

Halevy, A., Norvig, P., & Pereira, F. (2009). The unreasonable effectiveness of data. *Intelligent Systems, IEEE*, *24*(2), 8-12.

Meet The Mind-Reading Robo Tutor In The Sky

Updated October 15, 2015 · 2:24 PM ET
Published October 13, 2015 · 5:14 AM ET

ERIC WESTERVELT

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Morning Edition
4:36

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Meet The Mind-Reading Robo Tutor In The Sky

Updated October 15, 2015 · 2:24 PM ET
Published October 13, 2015 · 5:14 AM ET

"I would go so far as to say that he is selling snake oil."

Listen to the Story
Morning Edition

+ Playlist

SHARE

Comment

Lack of data-informed decision making culture

Macfadyen, L., & Dawson, S. (2012). Numbers Are Not Enough. Why e-Learning Analytics Failed to Inform an Institutional Strategic Plan. *Educational Technology & Society, 15*(3), 149-163.

Once size fits all does not work in learning analytics

Gašević, D., Dawson, S., Rogers, T., Gašević, D. (2016). Learning analytics should not promote one size fits all: The effects of course-specific technology use in predicting academic success. *The Internet and Higher Education*, 26, 68–84.

Important to know what works where

Ineffective to

- Scale through humans what should be scaled through technology
  - Inferring and detecting knowledge and other key aspects of learner
- Trying to scale through technology what should be scaled by humans
  - Intervening on deep misconceptions or in the face of disengagement

Important to know what works where

Ineffective to

- Scale through humans what should be scaled through technology
  - Inferring and detecting knowledge and other key aspects of learner
- Trying to scale through technology what should be done by humans
  - Intervening on deep misconceptions or in the face of disengagement

Machine learning for human learning

Emerging methods

Physiological and physical sensors

- Webcam
- Skin Conductance Sensor
- Environmental observation (Kinect)
- Emotion detection
- Social sensors
- Photoplethysmography Sensor
- Heart Rate Sensor
- Skin temperature
- Posture Sensor
- EEG
- FMRI


LEARNING
COGNITIVE
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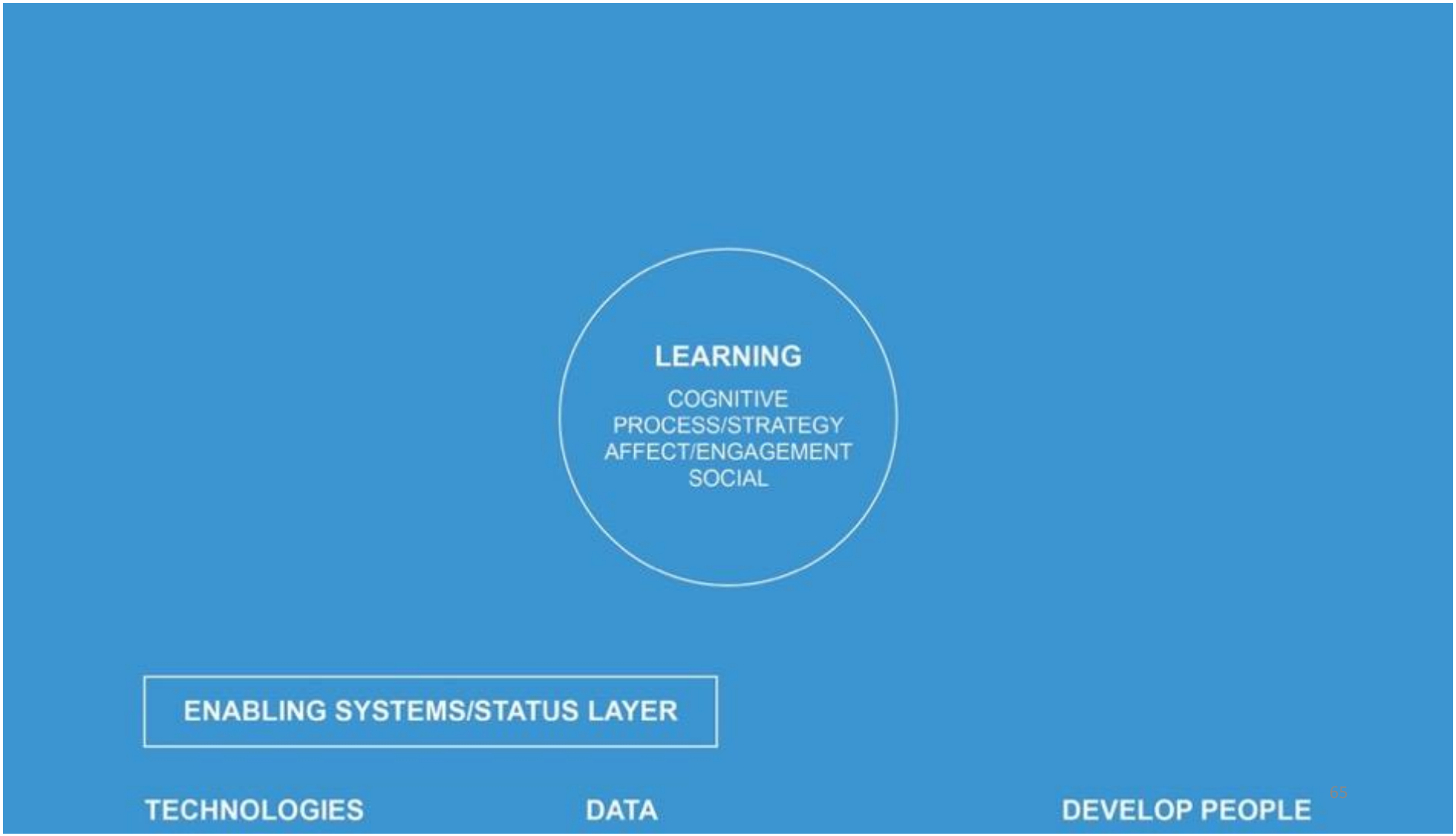
AFFECT/ENGAGEMENT
SOCIAL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ENABLING SYSTEMS/STATUS LAYER
TECHNOLOGIES
DATA
DEVELOP PEOPLE

ENABLING SYSTEMS/STATUS LAYER

TECHNOLOGIES

- Next generation
- Machine/Human Adaptation

DATA

- Enabling standards
- Data sources (Wearables)
- Interoperability

DEVELOP PEOPLE

- Leadership
- Faculty
- Support Staff


LEARNING
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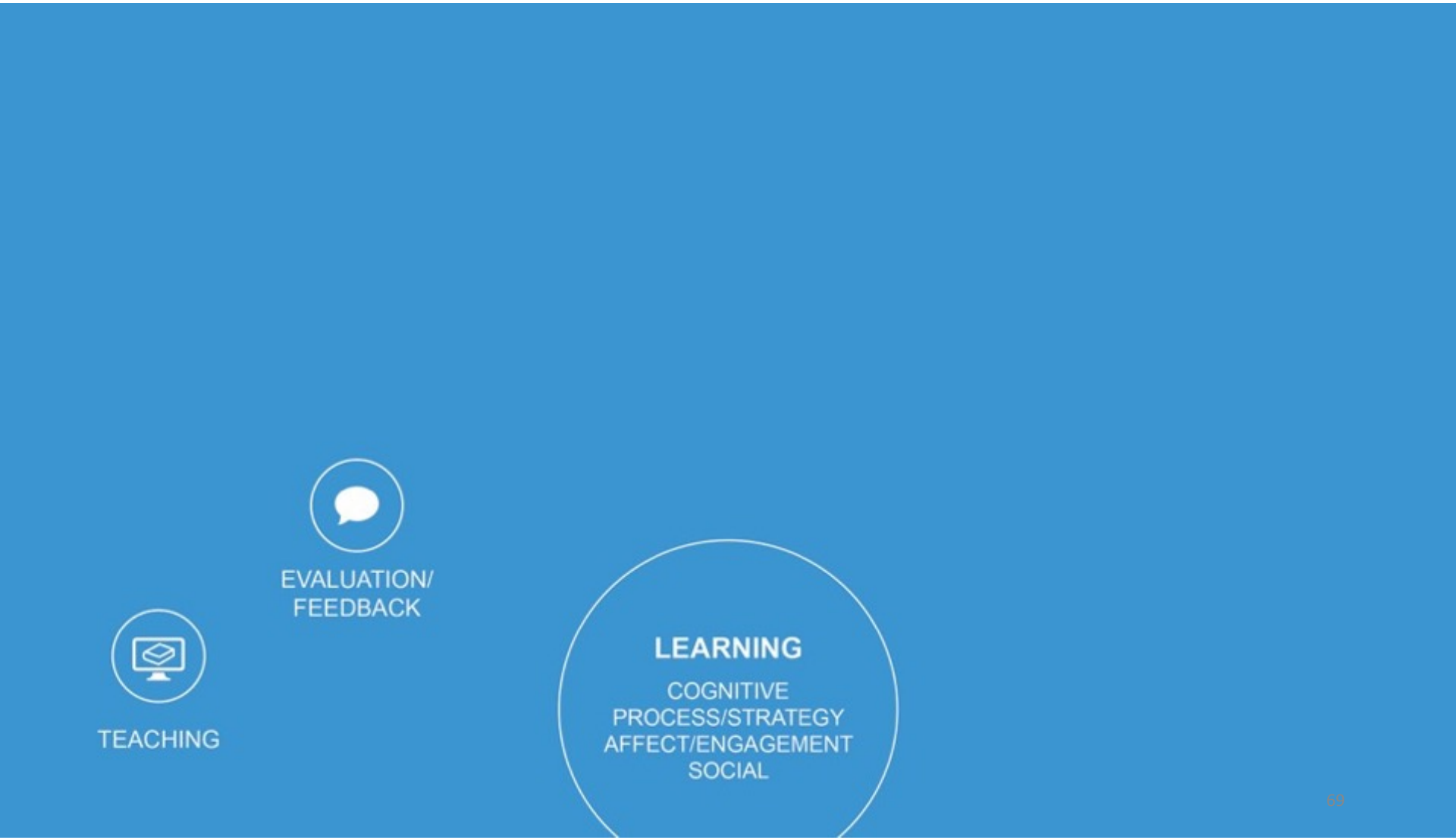
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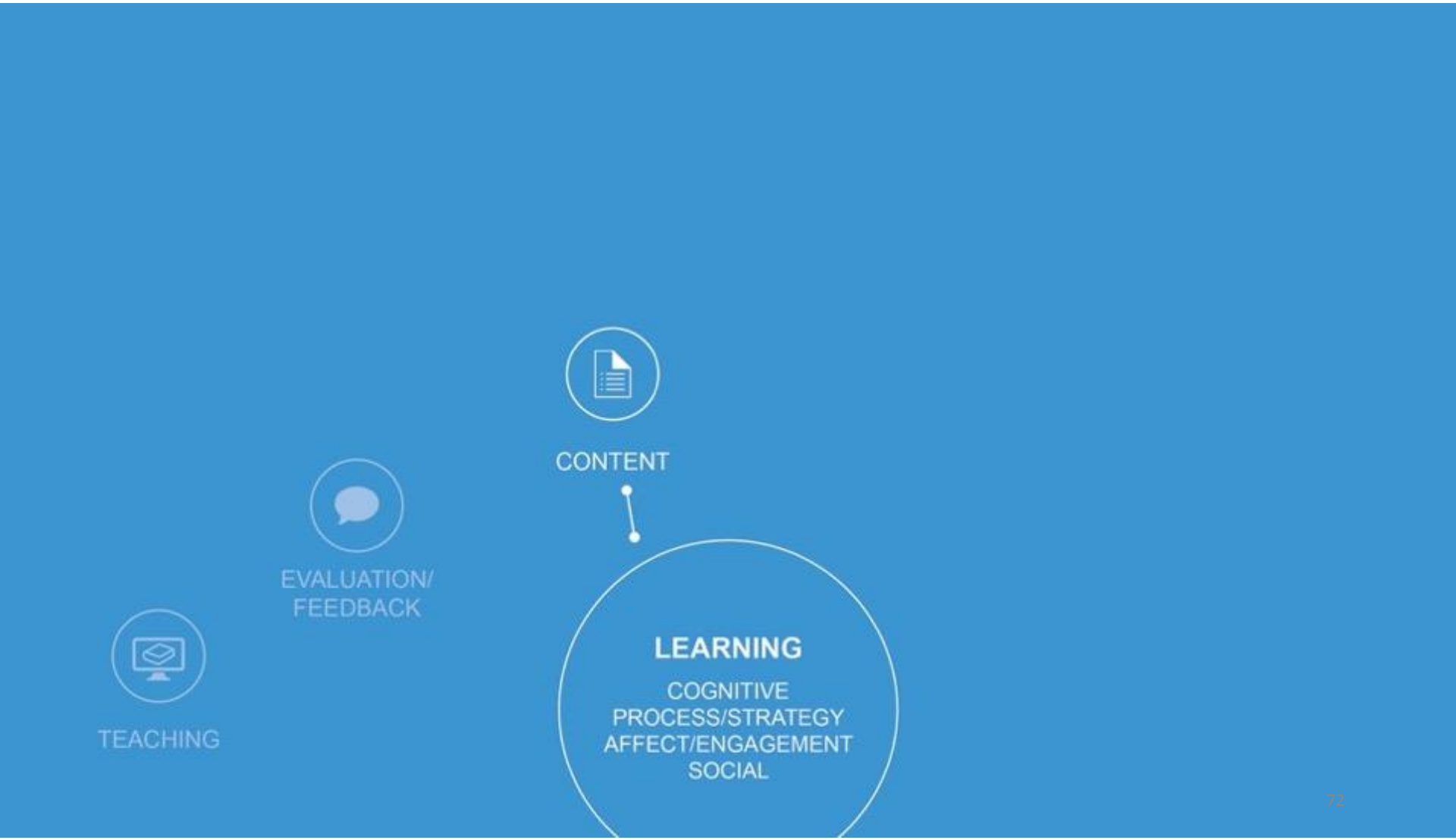
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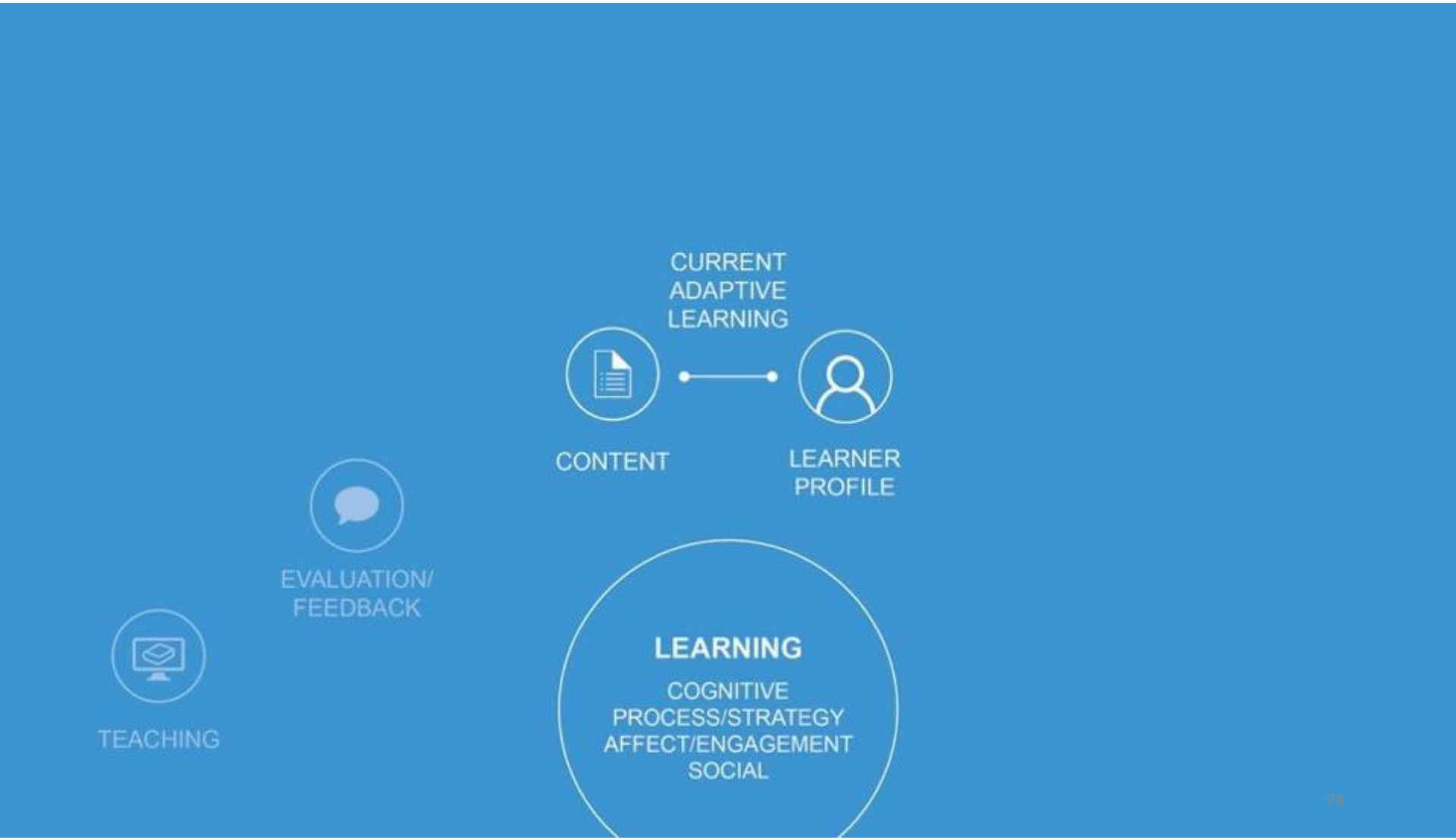
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THE FUTURE OF TEACHING AND LEARNING


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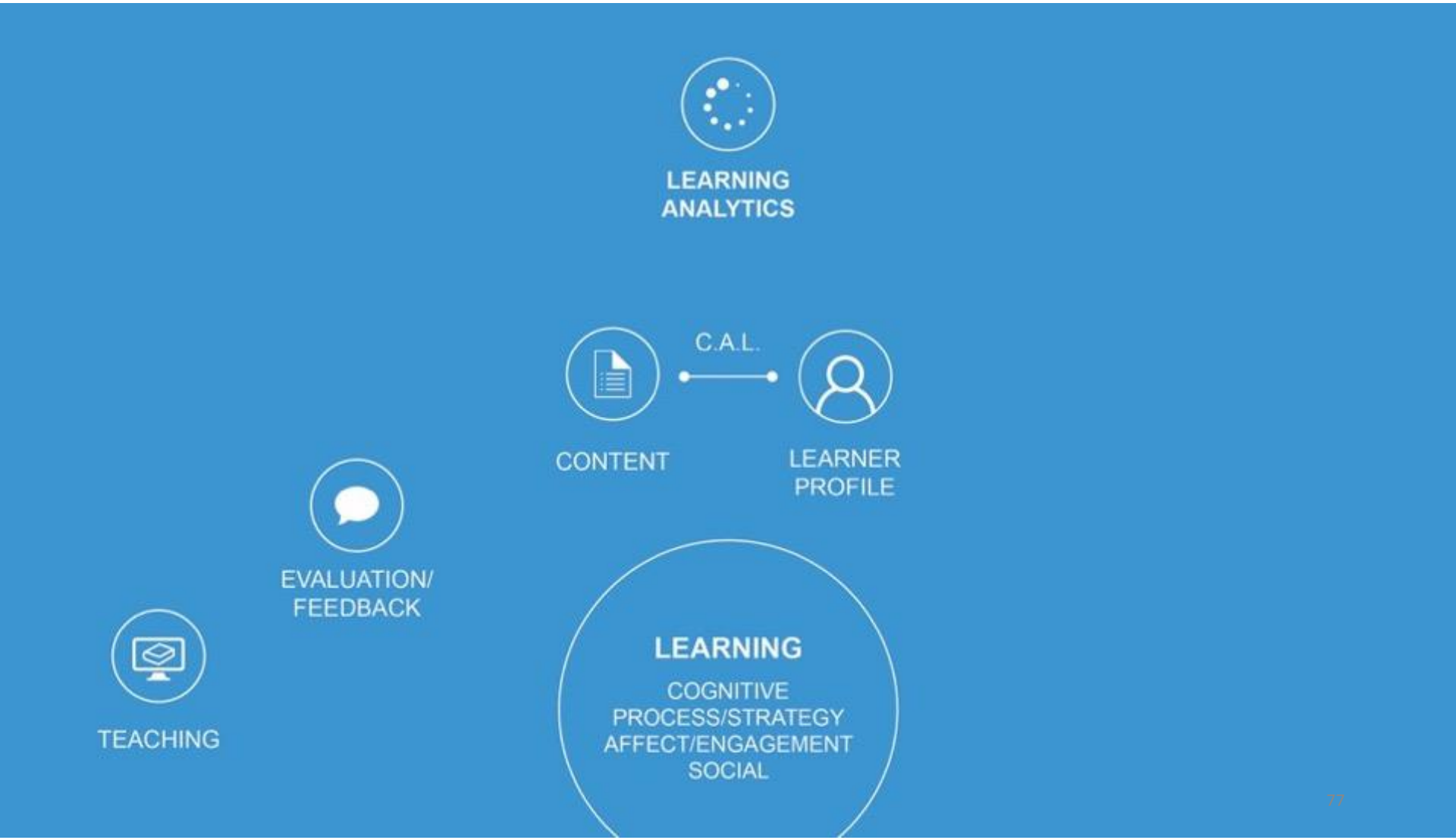
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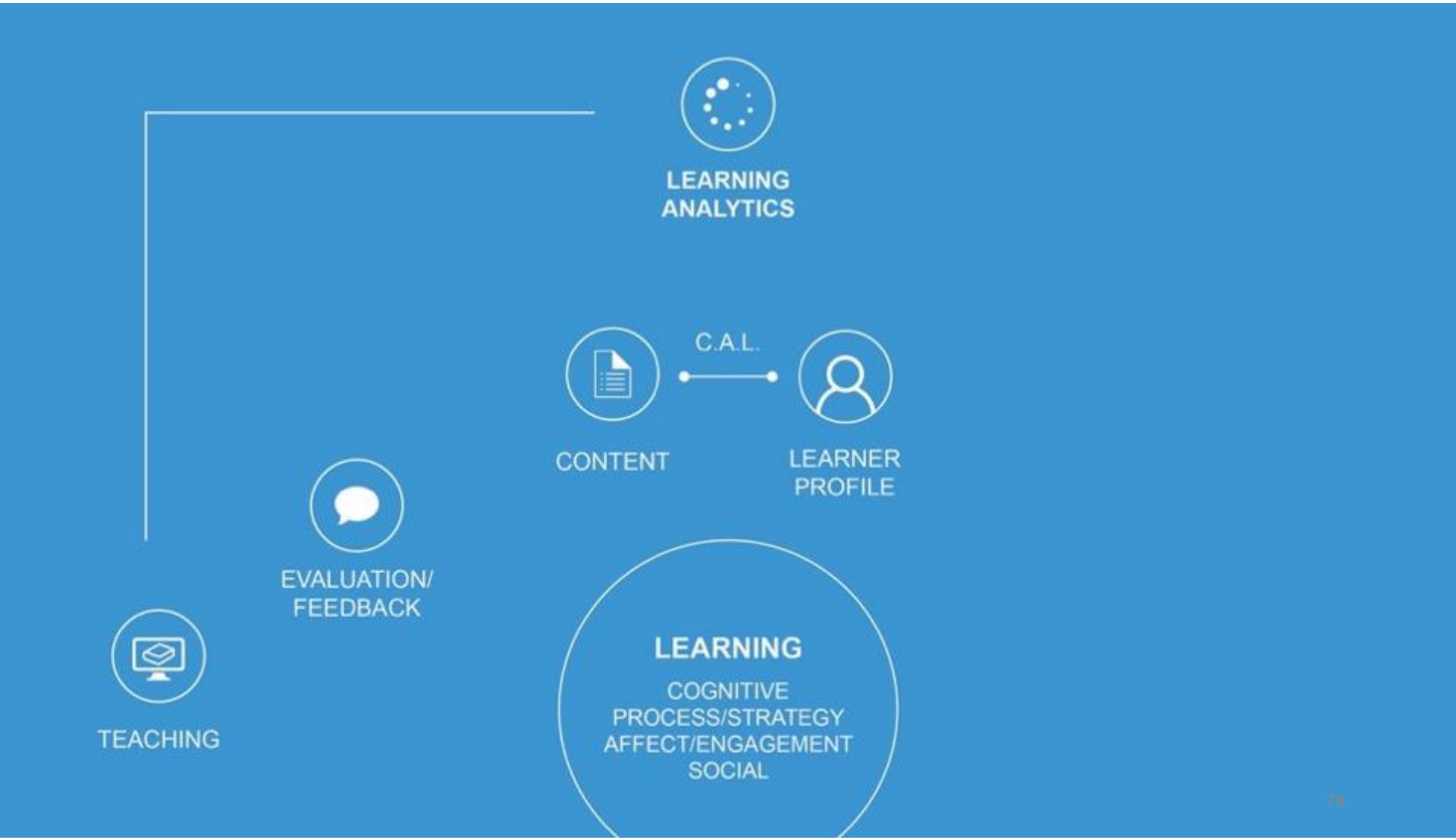
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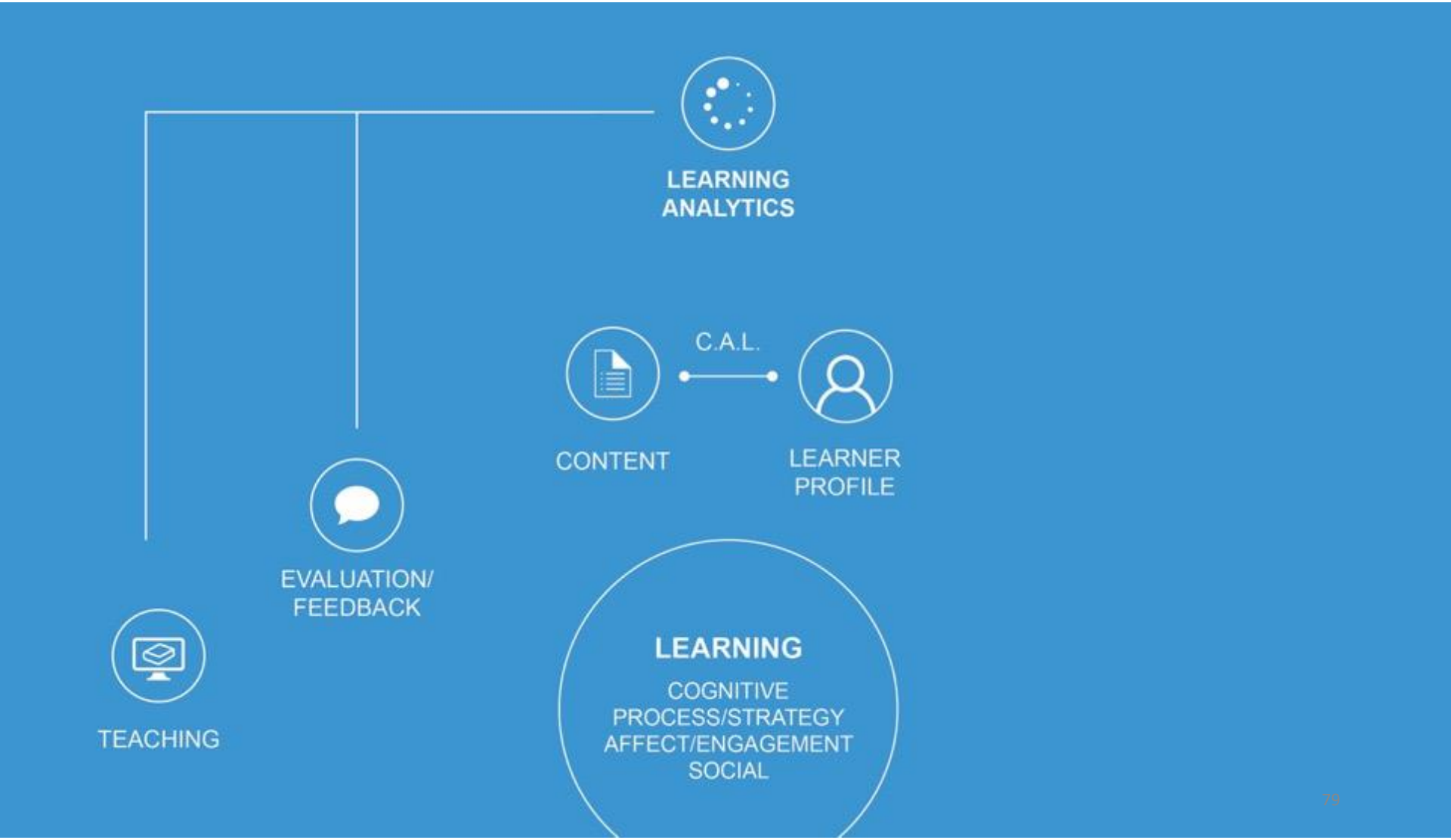
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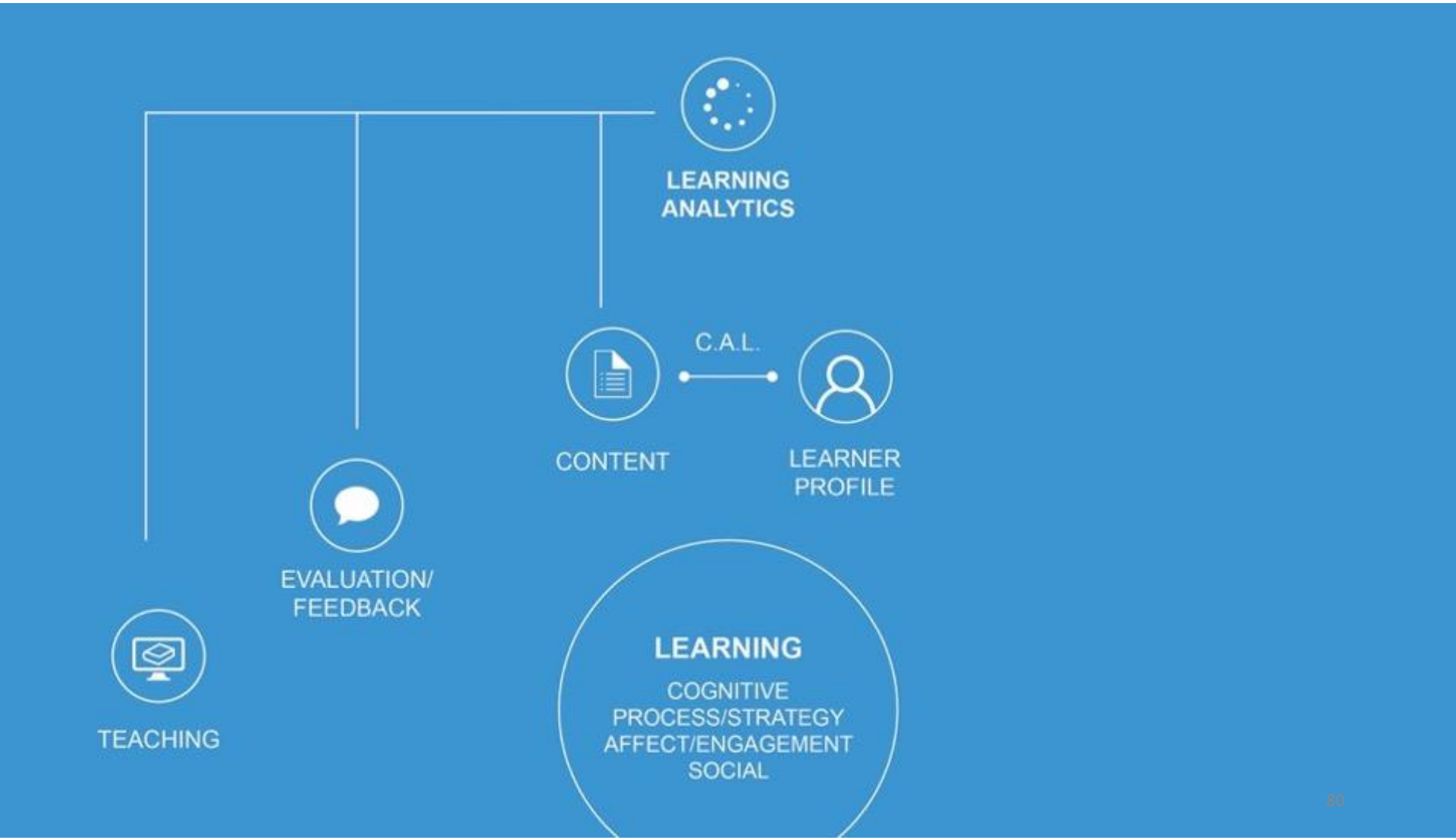
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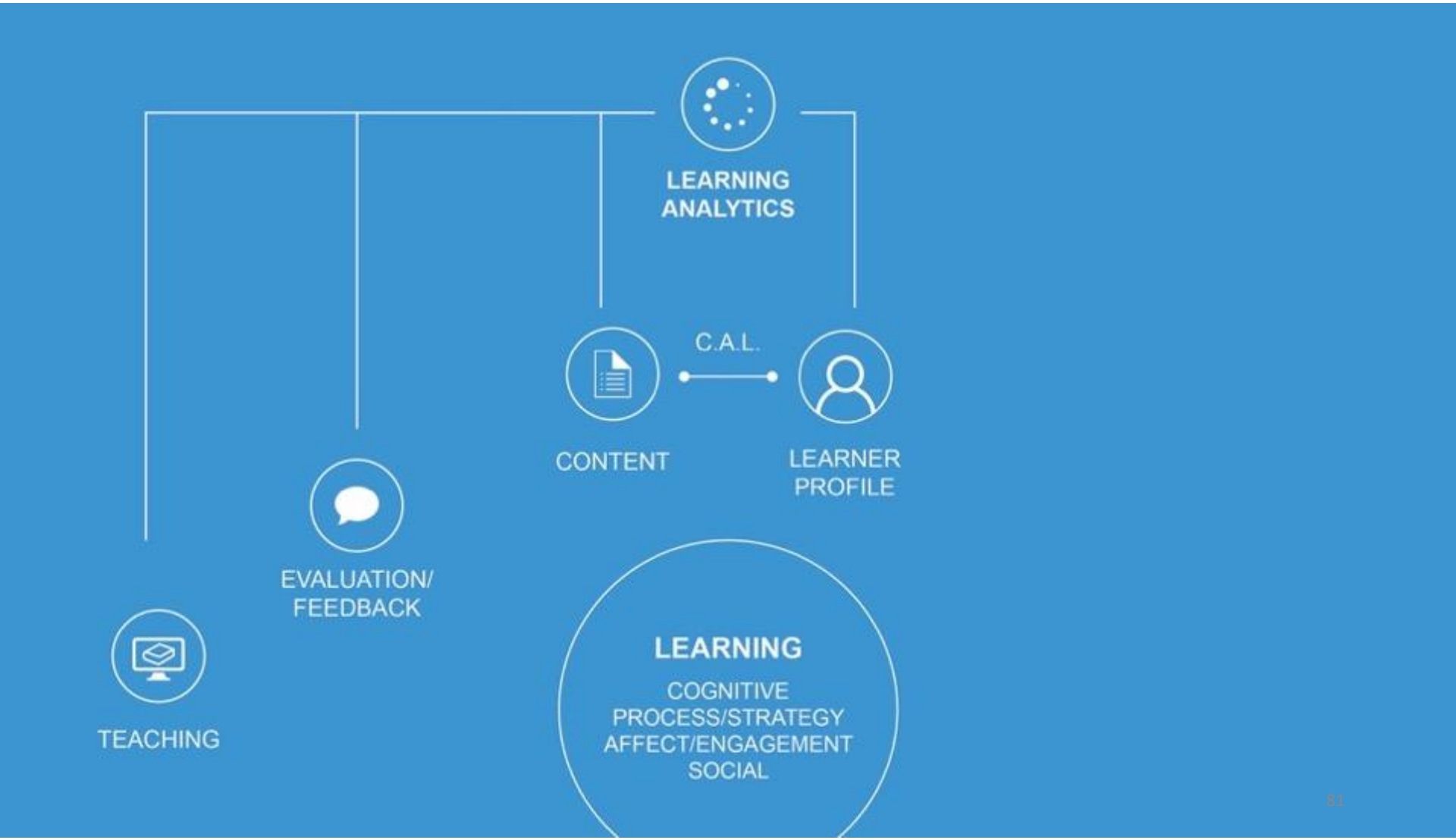
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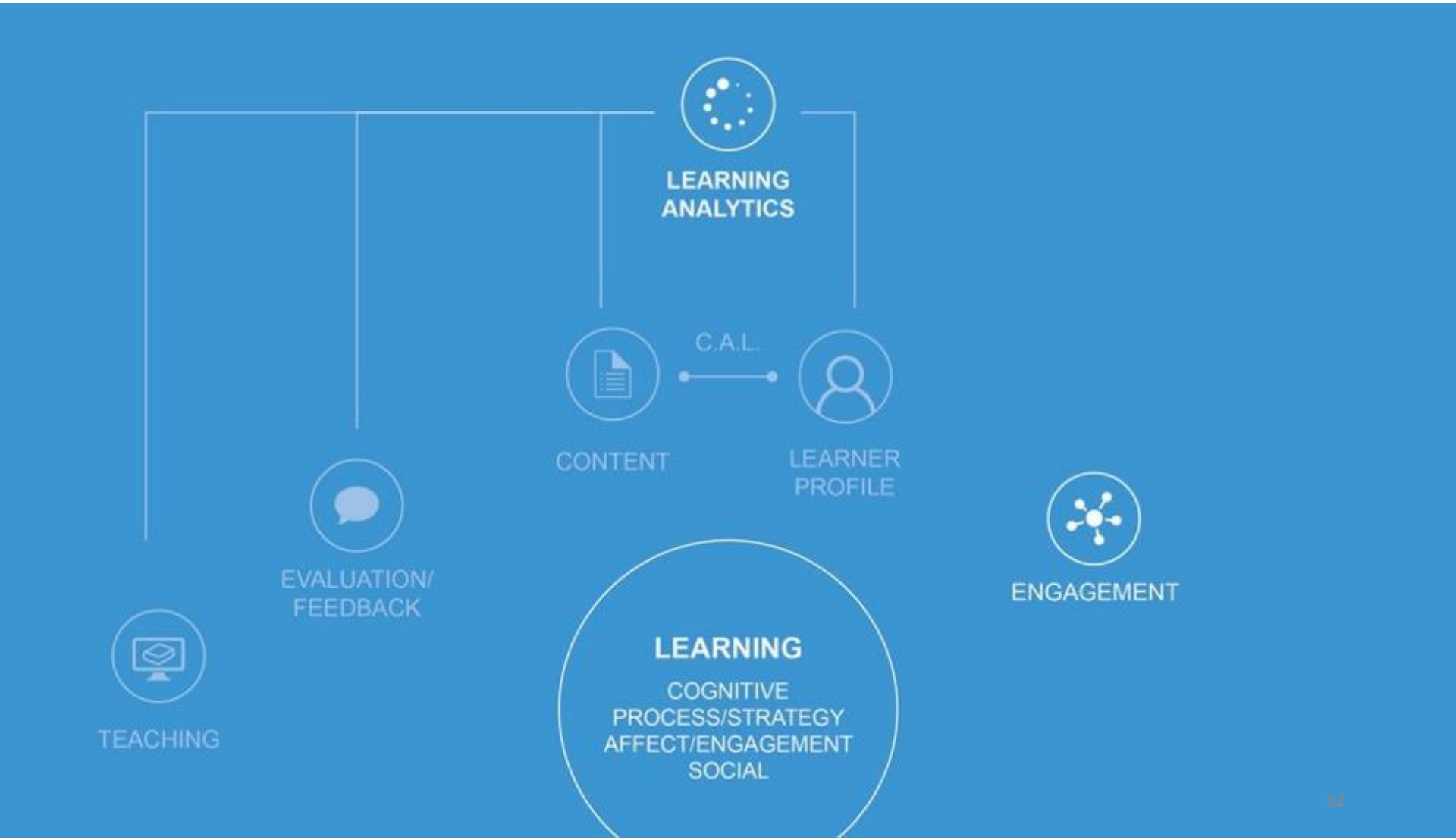
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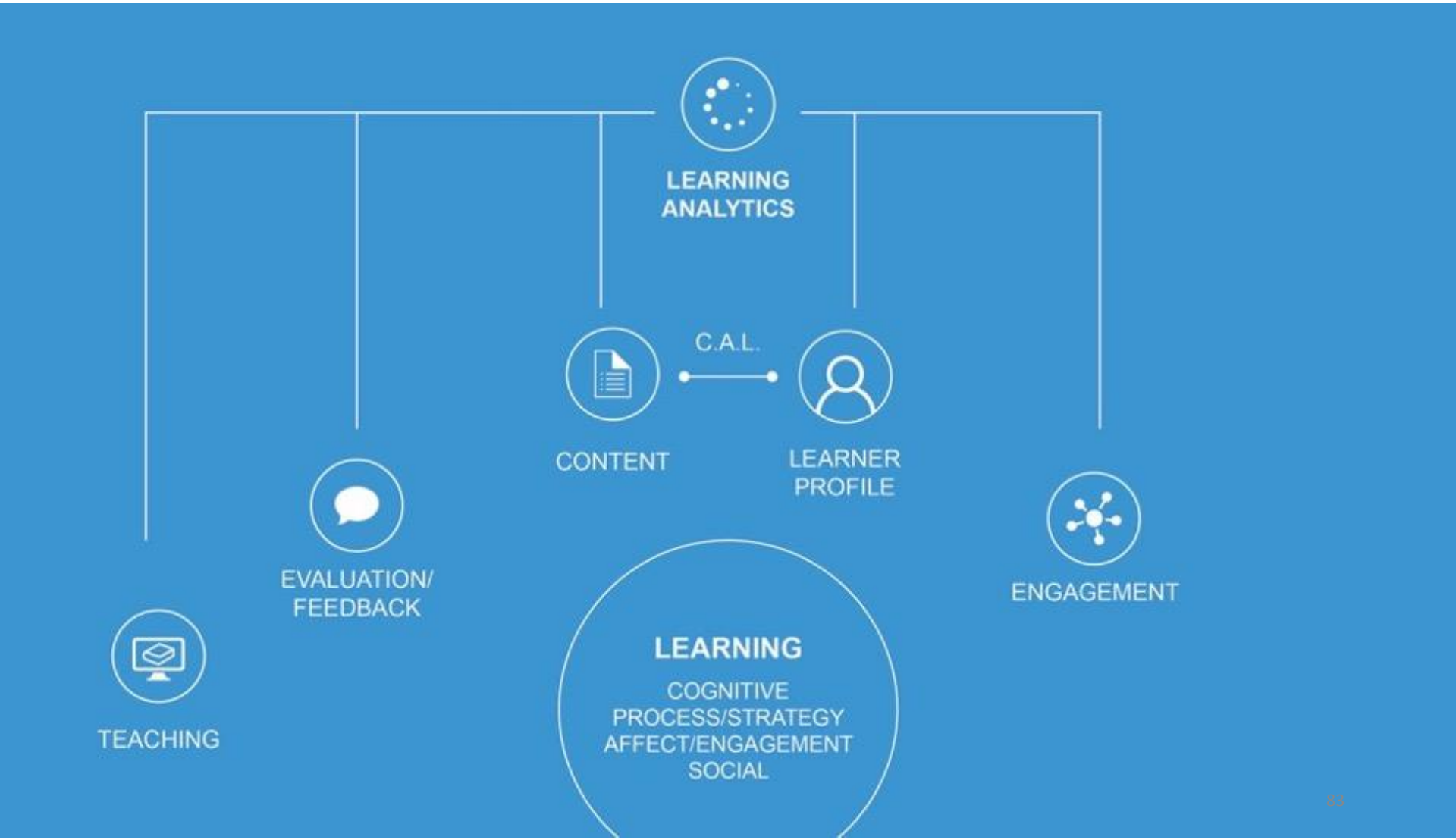
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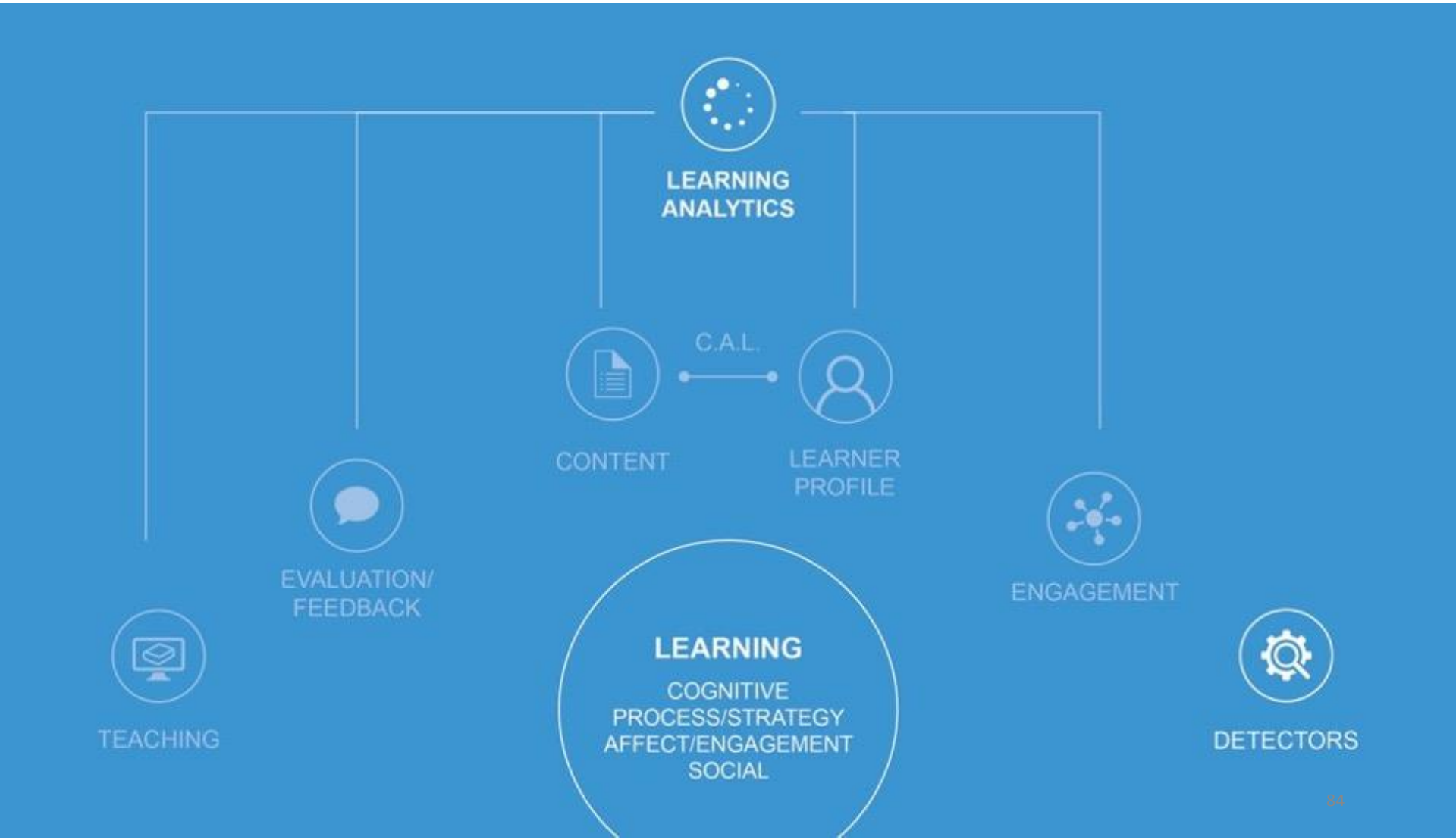
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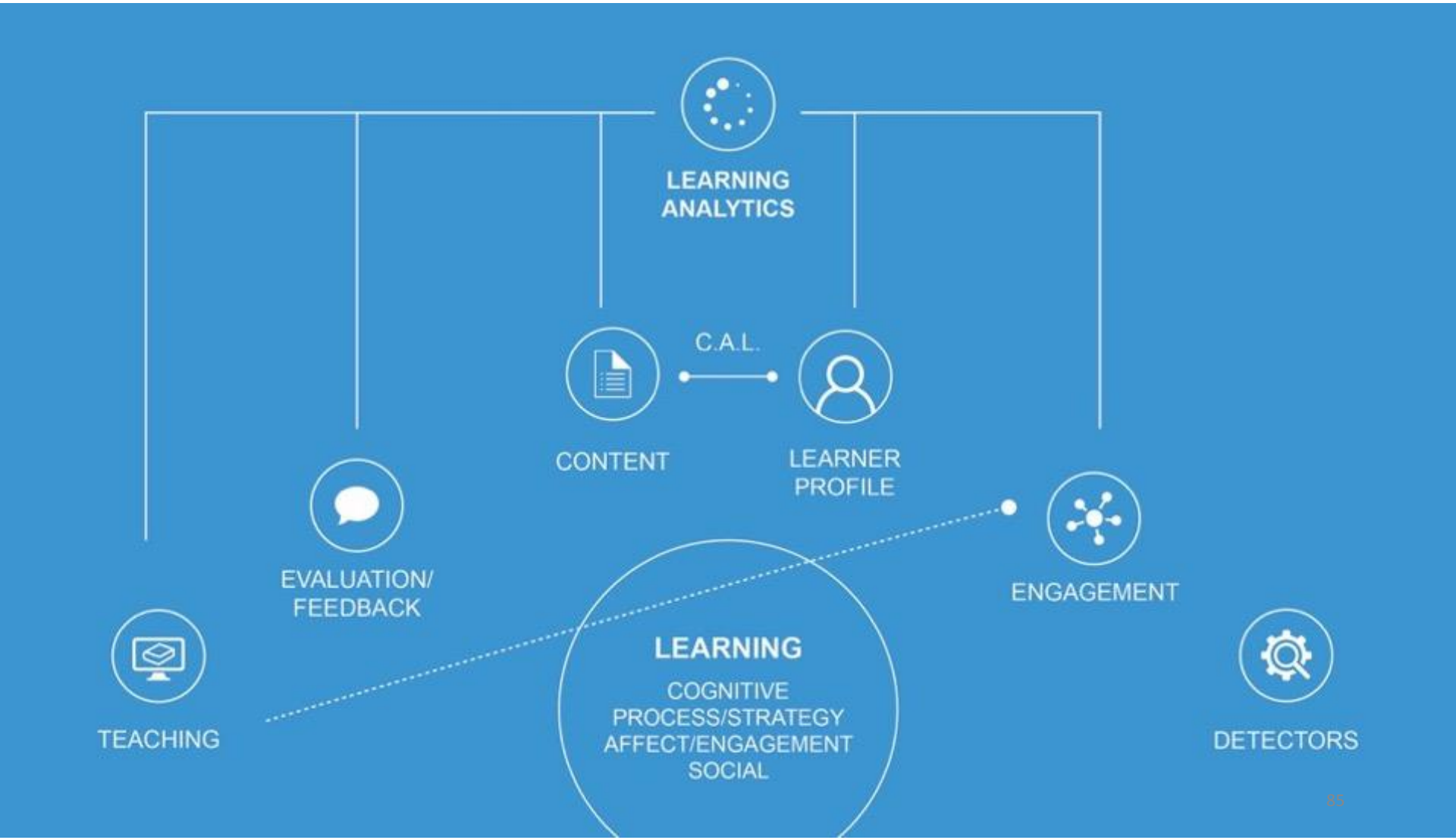
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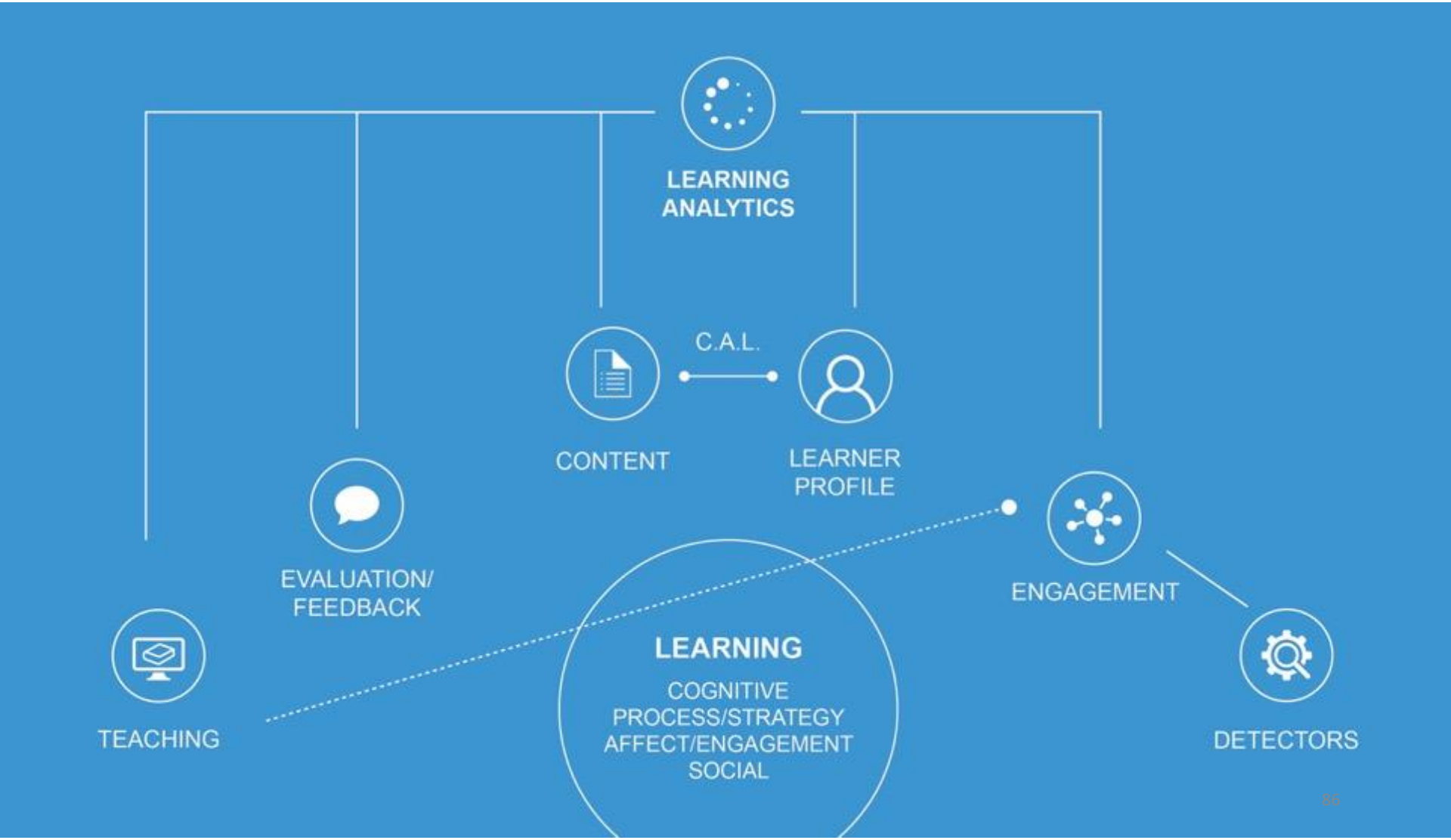
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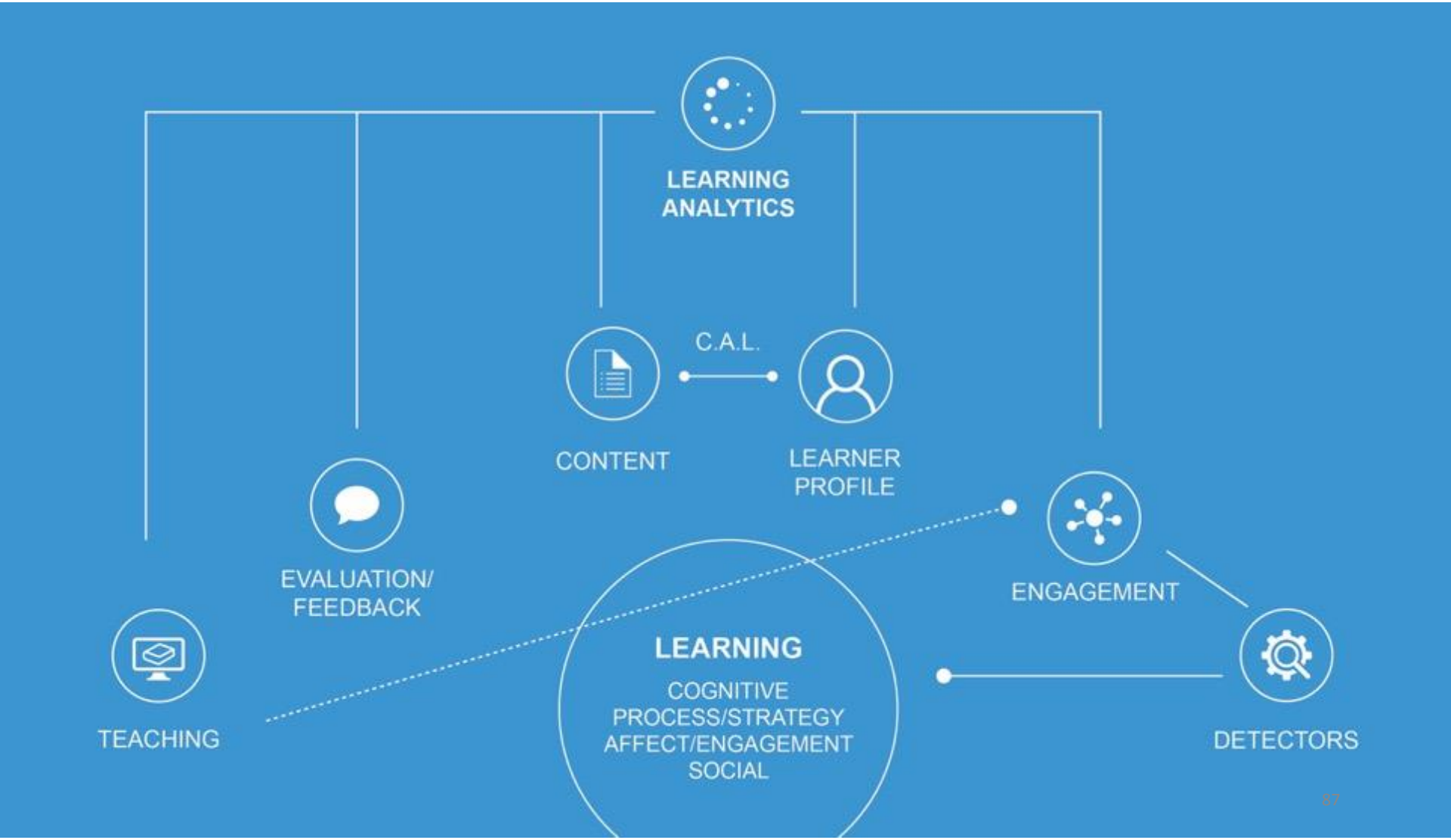
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A bit of context
Digital
Data
Distributed
Imagining our future

in order for us to truly create and contribute to the world, we have to be able to connect countless dots, to cross-pollinate ideas from a wealth of disciplines, to **combine and recombine** these pieces and build new castles.

Maria Popova

Knowledge development, learning, is (should be) concerned with **learners understanding relationships**, not simply memorizing facts.

i.e. naming nodes is “low level” knowledge activity, understanding node connectivity, and implications of changes in network structure, consists of deeper, coherent, learning

Connectivism:

1. Knowledge is **networked** and distributed
2. The experience of learning is one of **forming** new neural, conceptual and external networks
3. Occurs in **complex**, chaotic, shifting spaces
4. Increasingly aided by **technology**

Exploration

Learning is the exploration of the unknown…

… not just mastery of what is already known.

Compelling Questions

Habitable Worlds:

Are We Alone?

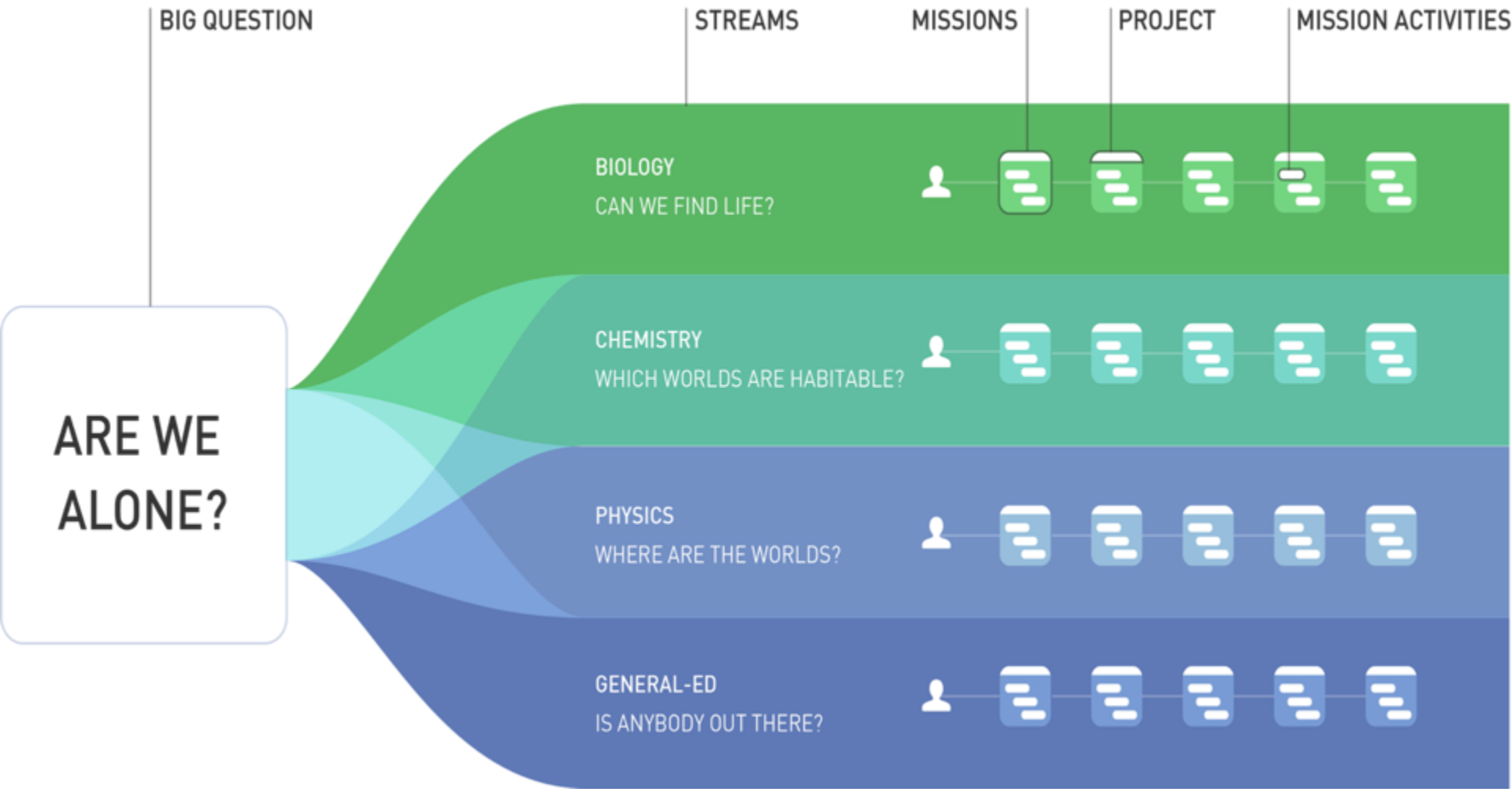
Contagion:

Can We Survive?

Transdisciplinary

The questions we care about don't fit in silos

Smart Courses



Tempus vs. Hora

Simon, H. A. (1962). The architecture of complexity. Proceedings of the American Philosophical Society, Vol. 106, No. 6. (pp. 457-476).

Reducing the basic units of education:

From courses/workshops/modules to competencies

Information fragmentation… loss of narratives of coherence

The problem:

Once we've fragmented content and conversation,
we need to stitch them together again so we can act meaningfully

Agents in a system possess only partial information

(Miller and Page 2007)

…to make sense and act meaningfully requires connections to be formed between agents

A bit of context
Digital
Data
Distributed
Imagining our future

How to Use MOOCs to Get Your Dream Job

Find out how MOOCs can improve your chances of snagging your dream job.

Print

The **Massive Open Online Course** is a recent invention, but people are already using them to stay competitive in the job market. Just as online universities were once seen as inferior to traditional colleges and are now gaining widespread credibility, MOOCs can now do a lot to improve your own job prospects if you follow the correct steps.

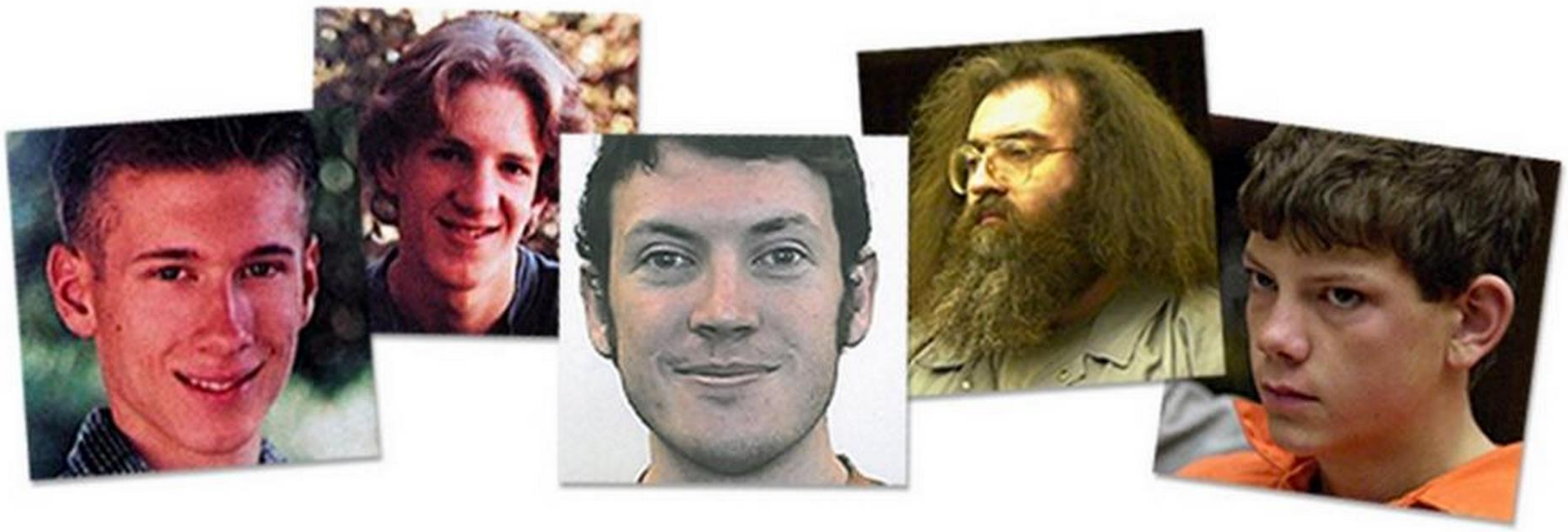
Employers want what MOOCs teach.

MOOCs can't give you a degree, but they can teach real-world skills that employers want. Many of the available MOOCs involve computer-related topics. A brief look at the courses of the popular MOOC website **Udacity** show classes like:

Deadliest U.S. mass shootings | 1984-2015

By LOS ANGELES TIMES STAFF

OCT. 1, 2015 12:39 P.M.



Tags: Public place School Work place Workplace Worship place

De 15

By LOS A

OCT. 1, 20

Tags: Public place School Work place Workplace Worship place

The origins of the financial crisis

Crash course

The effects of the financial crisis are still being felt, five years on. This article, the first of a series of five on the lessons of the upheaval, looks at its causes

Sep 7th 2013 | From the print edition

Timekeeper

Our definition of the role of education is too narrow. Much of our research reflects this narrowness

“Perhaps in reaching to educate the brain, we should also consider reaching for the heart”

(Peer Reviewed (by me) message on Slack, Catherine Spann, 2015)

1. Moving beyond assumptions based on legacy education system

(completion, courses, learning, interaction, i.e. what is unique when learning@scale?)

2. Use existing research

(Tutors, support structures, cognitive development)

3. Personalization and adaptivity

(Support during learning, assessment)

Smaller, contextual learning experiences,

introduced into work/life/learning processes and networks

through social and analytic approaches.

4. Open learner profile development

(Who are the learners? What do they know)

Personal Knowledge Graph

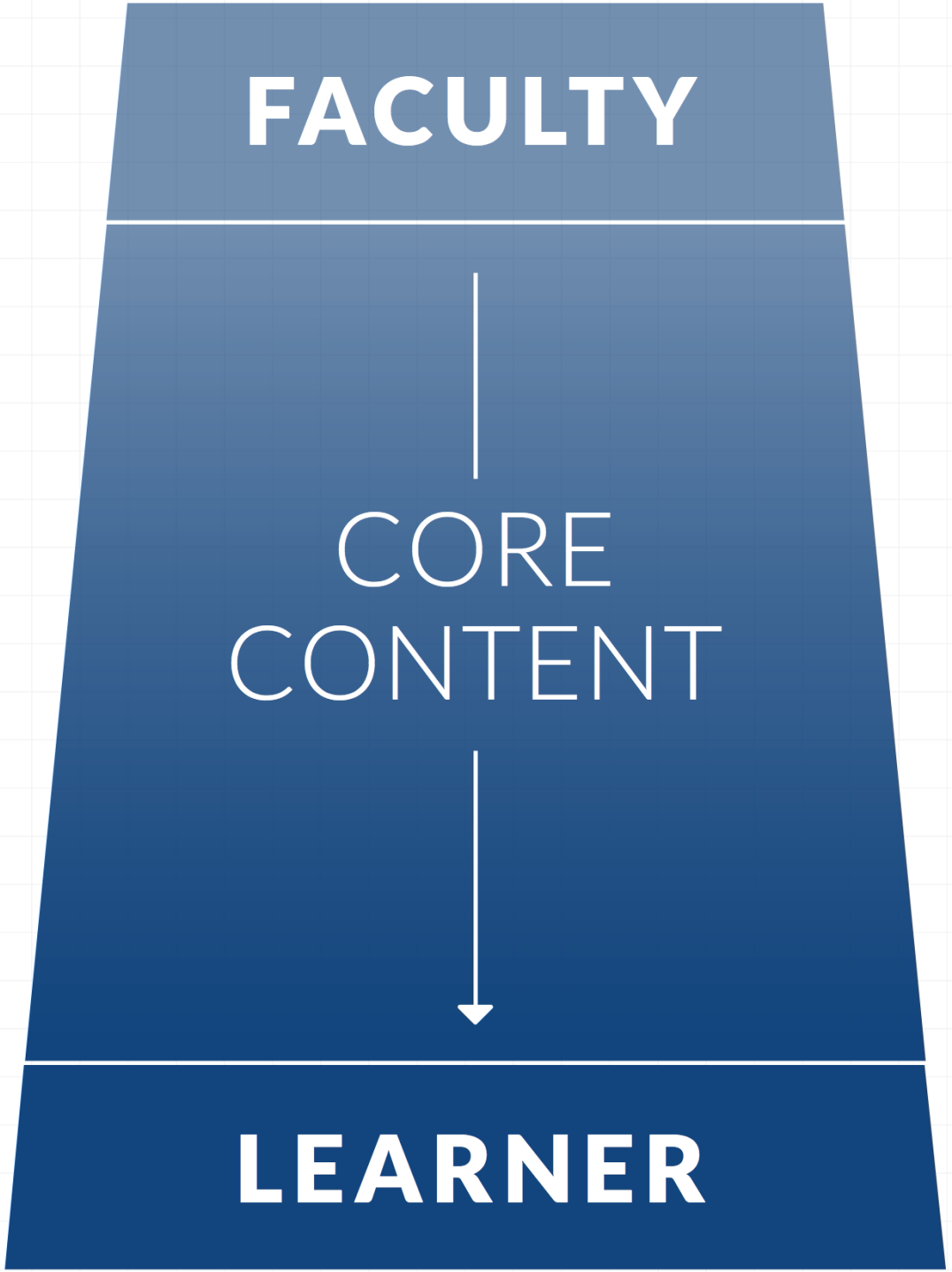
People – learners, students, everyone – should have a personal knowledge graph (PKG)

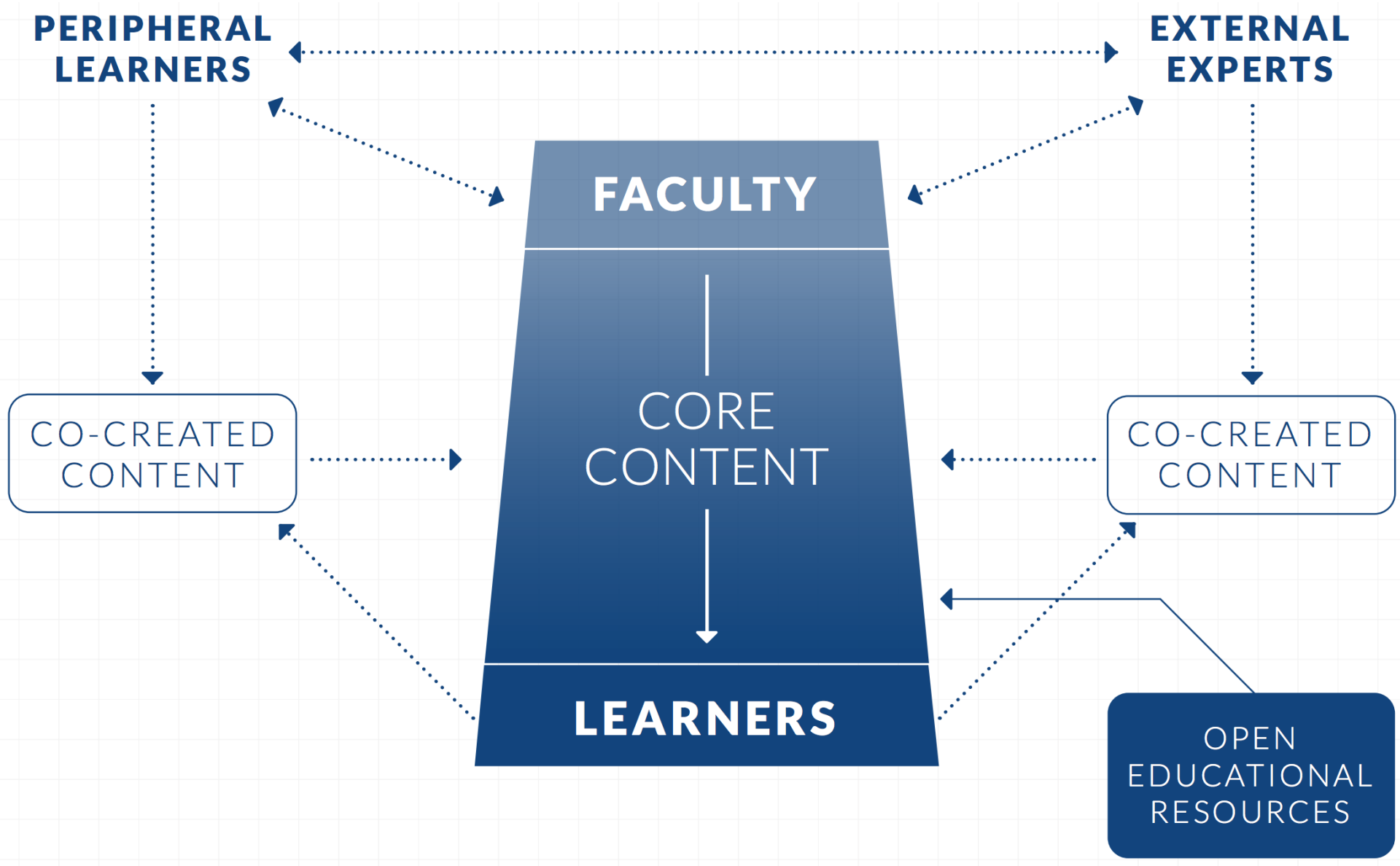
A network model of what we know

Learner-owned

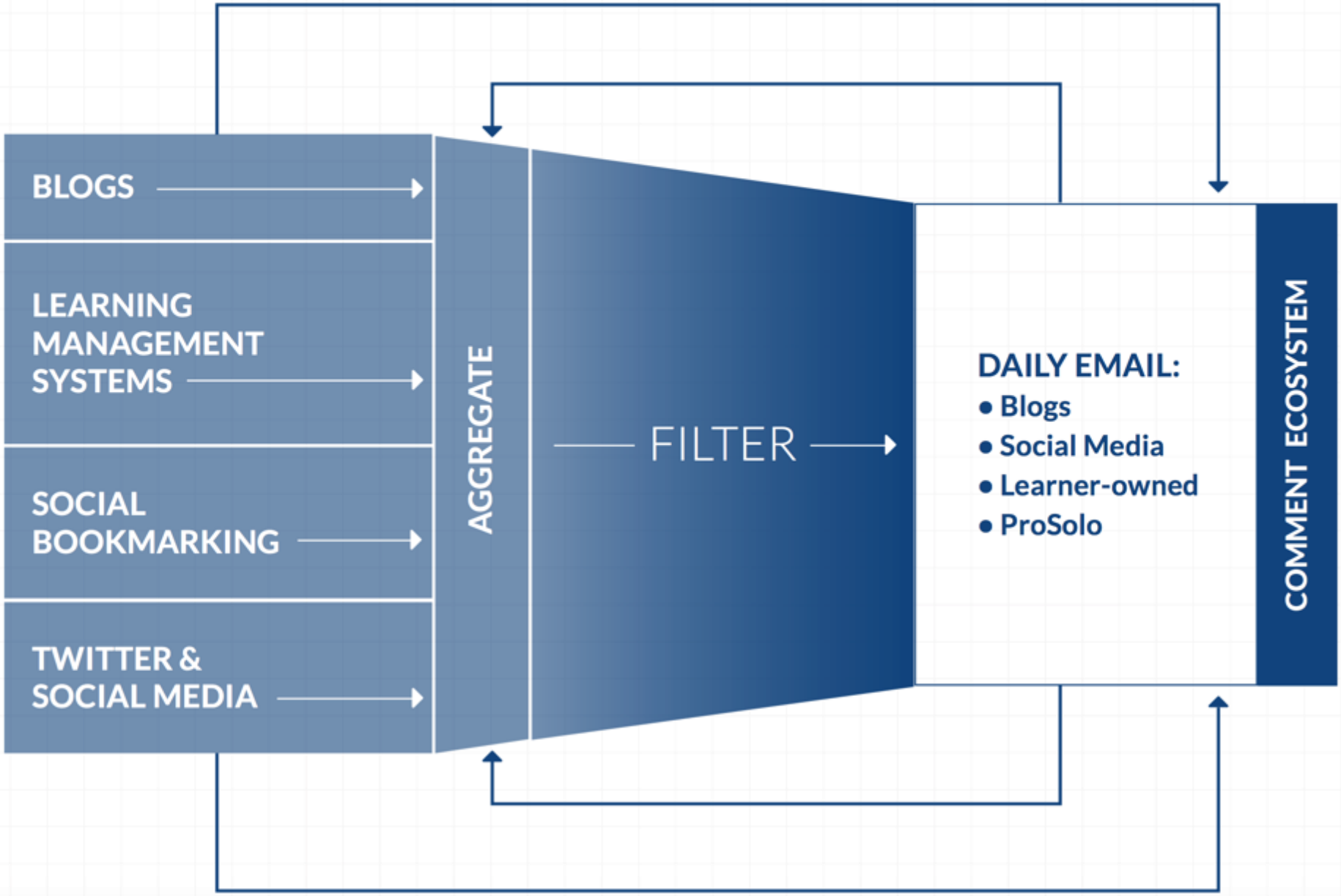
5. Participatory learning

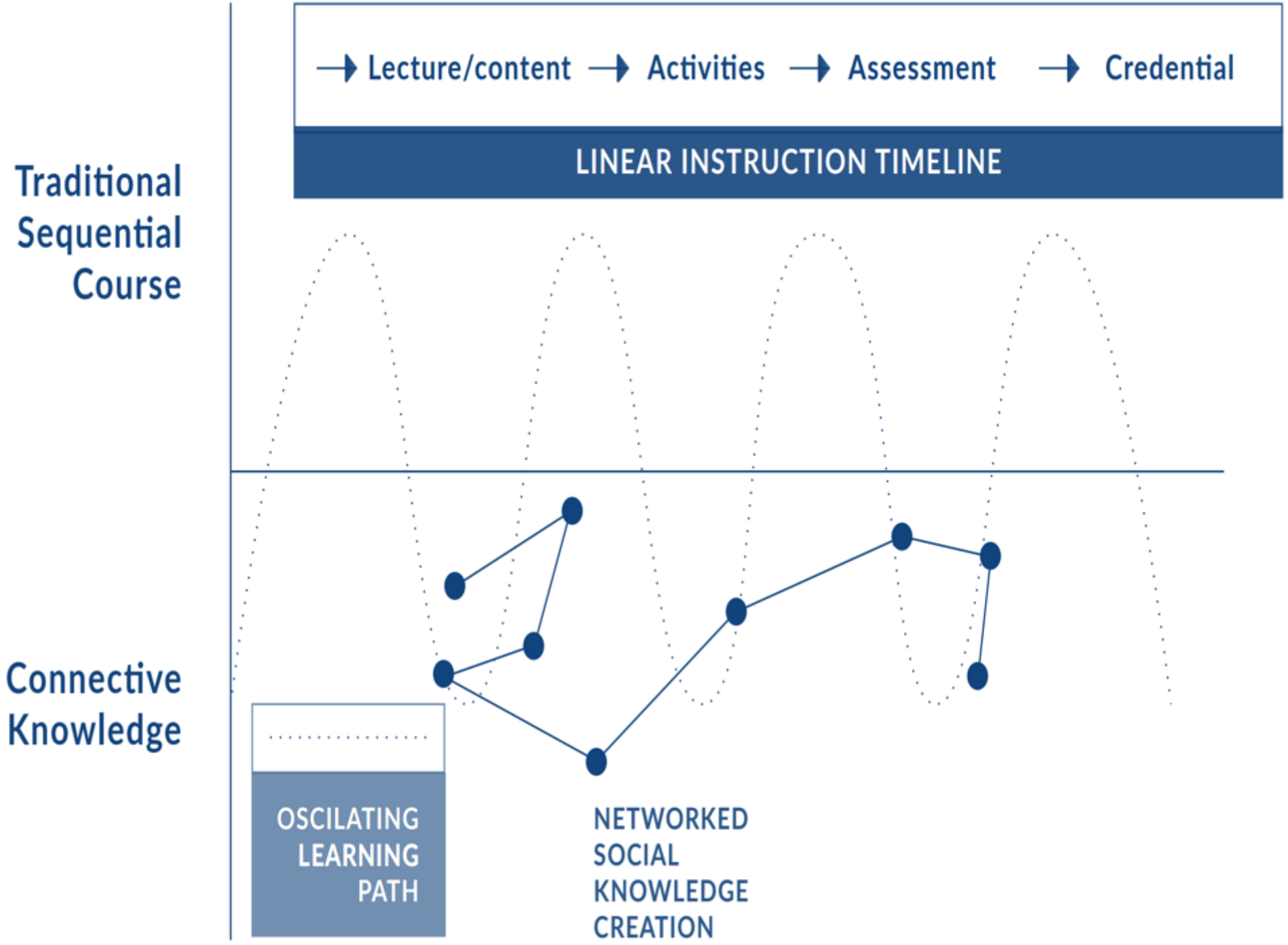
(PBL, social, community, self-organized, pathways)


FACULTY
CORE
CONTENT
LEARNER


PERIPHERAL LEARNERS
EXTERNAL EXPERTS
FACULTY
CORE CONTENT
LEARNERS
CO-CREATED CONTENT
CO-CREATED CONTENT
OPEN EDUCATIONAL RESOURCES

DISTRIBUTED CONTENT & CONVERSATIONS

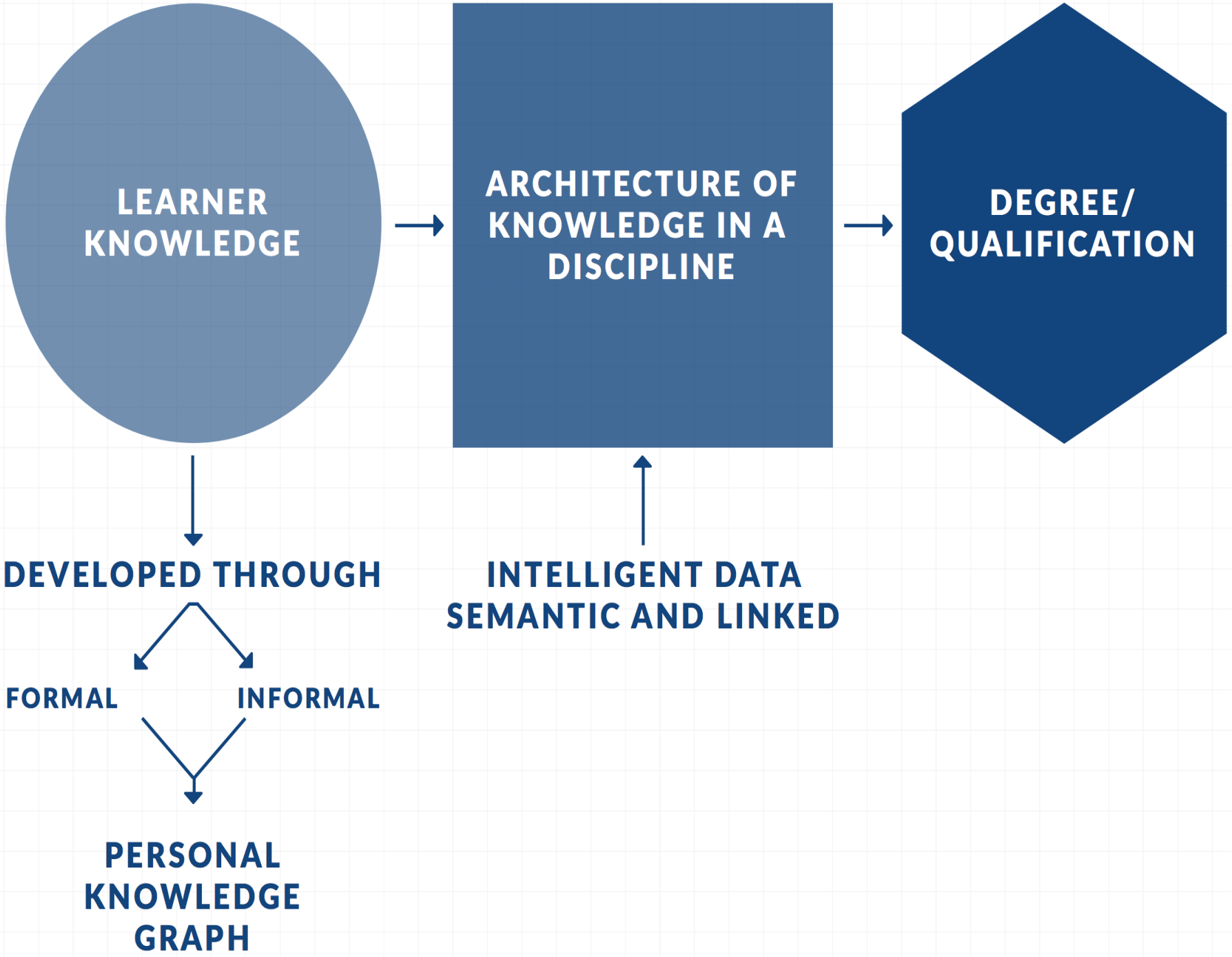


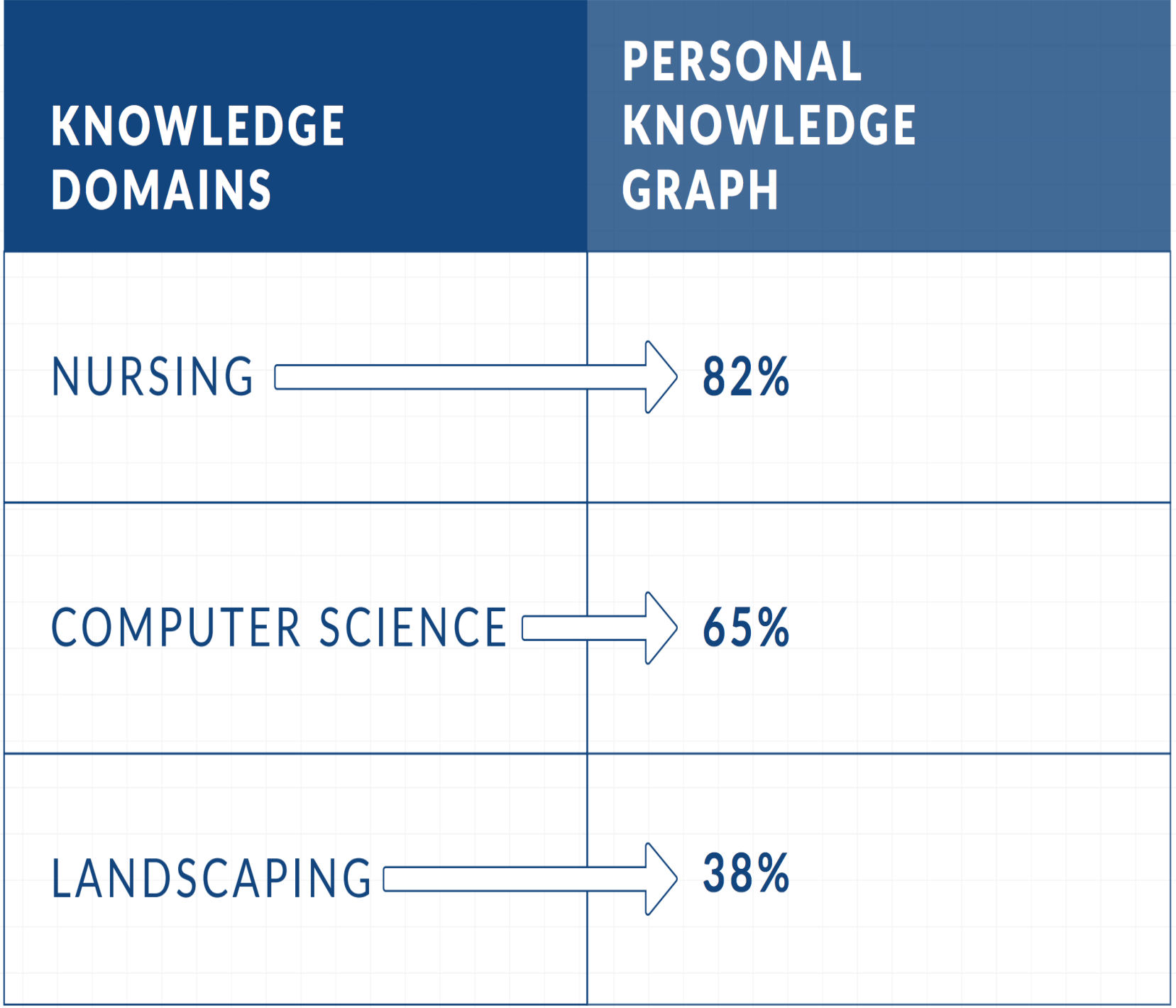

Lecture/content
Activities
Assessment
Credential
LINEAR INSTRUCTION TIMELINE
Traditional Sequential Course
Connective Knowledge
OSCILATING LEARNING PATH
NETWORKED SOCIAL KNOWLEDGE CREATION

6. Granularized learning and assessment

(multiple systems, learner owned, competencies)

Computed curriculum


LEARNER KNOWLEDGE
ARCHITECTURE OF KNOWLEDGE IN A DISCIPLINE
DEGREE/ QUALIFICATION
DEVELOPED THROUGH
INTELLIGENT DATA SEMANTIC AND LINKED
FORMAL
INFORMAL
PERSONAL KNOWLEDGE GRAPH


KNOWLEDGE DOMAINS
PERSONAL KNOWLEDGE GRAPH
NURSING
82%
COMPUTER SCIENCE
65%
LANDSCAPING
38%

7. Use of data and analytics to solve challenges that matter

(in decentralized, open, interconnected systems)

8. Wholeness, wellness, mindfulness, happiness

All the good ness’s

The future that I envision

To enable all students to achieve **an education that enables quality of life and meaningful employment** through

a) exceptional quality research and;
b) sophisticated data collection and;
c) advanced machine learning & human learning analysis/support.

Questions?