Data Storytelling and Learning Analytics in

Physical Spaces

UTS:CIC
CONNECTED INTELLIGENCE CENTRE

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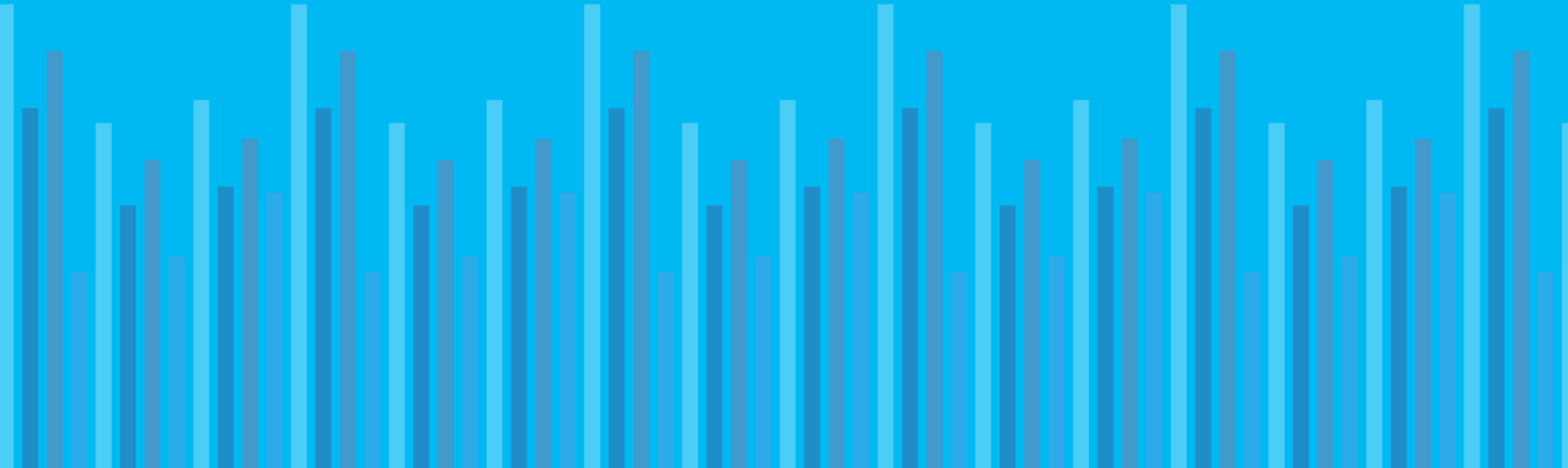
background


2018
2015- Current – Full Time Researcher, Educational Data Science @CIC
2014- 2015 – Postoc, Learning Sciences and Learning Design, USYD
2011- 2014 – PhD in Human-Computer Interaction, AI, Data Mining and Dashboards, USYD
2001- 2009 – Engineering and IT training and self-trianing
1984-2001 – Life in a small Mexican city called Campeche
1984

every **day** more than

2.5

quintillion bytes of data are generated (2017)



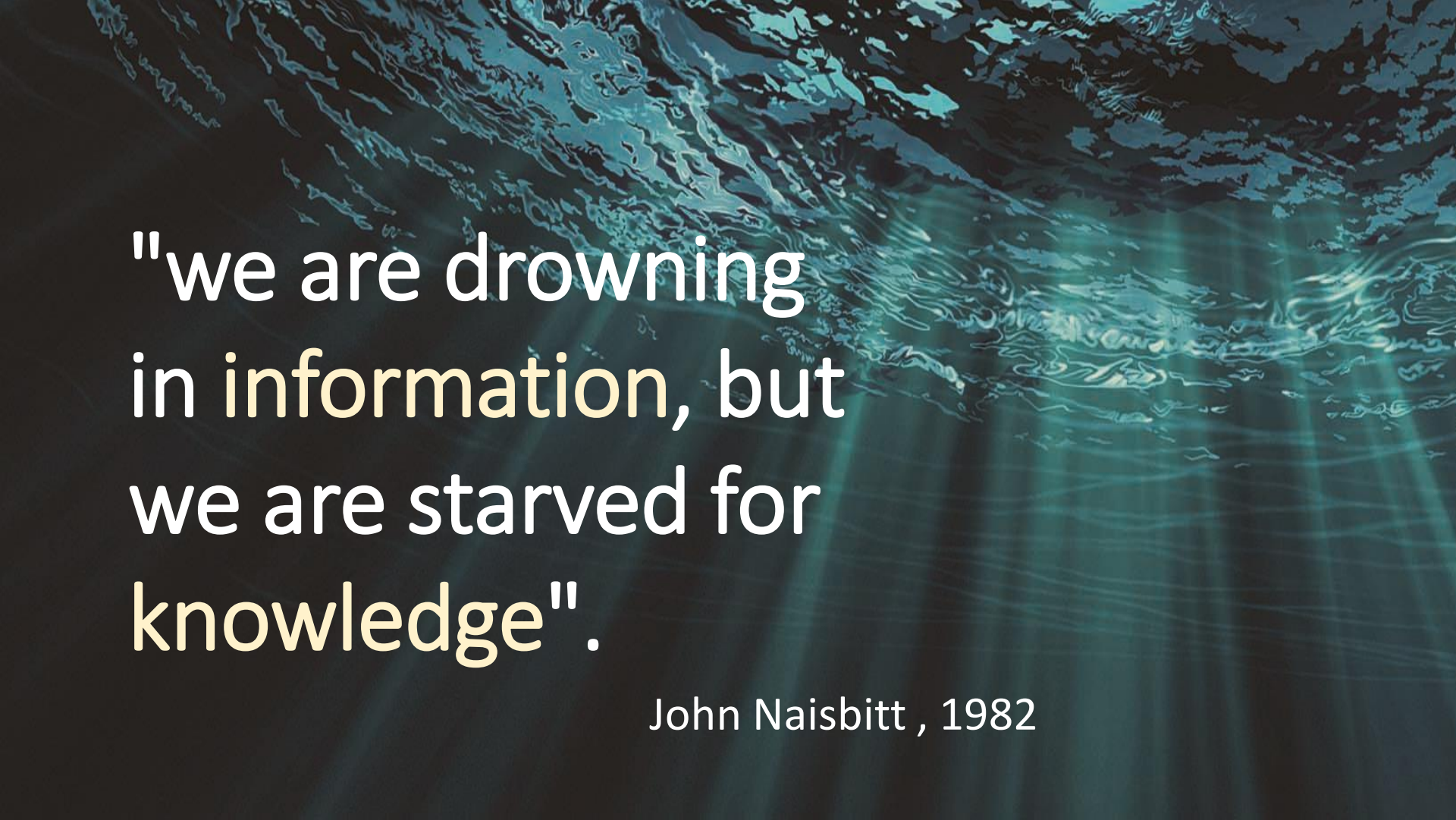
every **day** more than

2.5

quintillion bytes of data are generated (2017)

That is a thousand raised to the power of six (10^{18})


90%
of the data that we have available today has only been created in the last
2-3 years

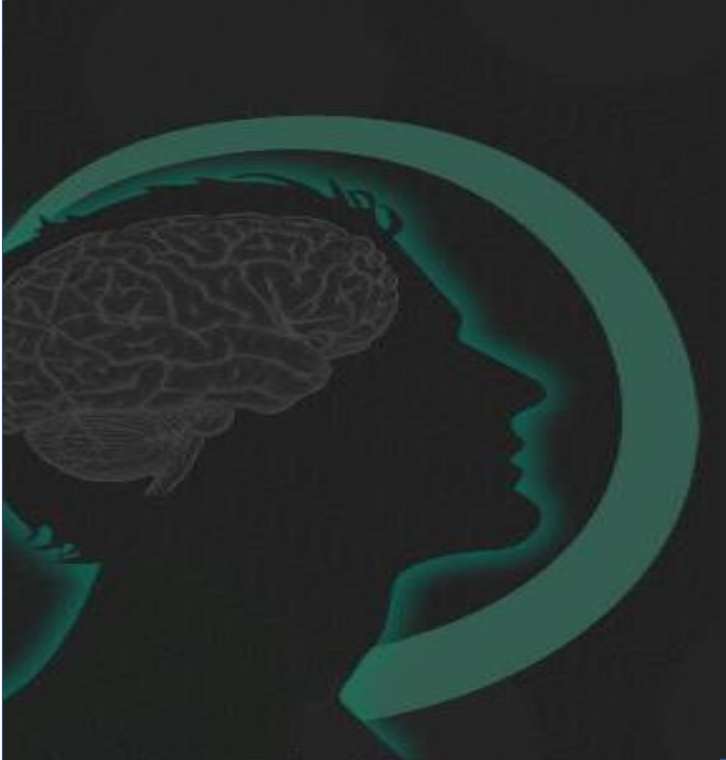

"we are drowning
in information, but
we are starved for
knowledge".
John Naisbitt , 1982


Oysters = Data

Only 1 in about 10,000 wild oysters will yield a pearl

= INSIGHT

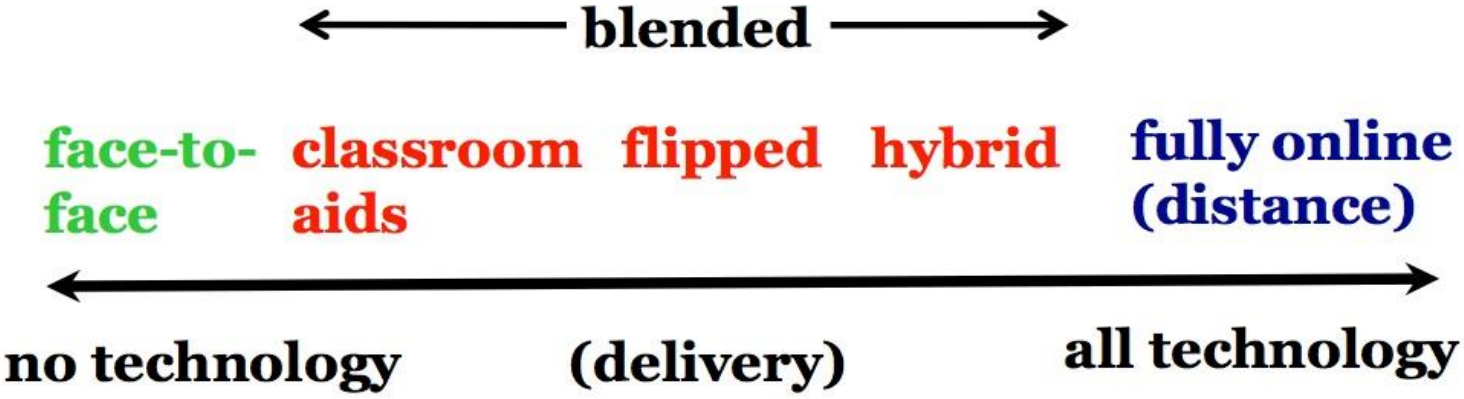
Learning Analytics



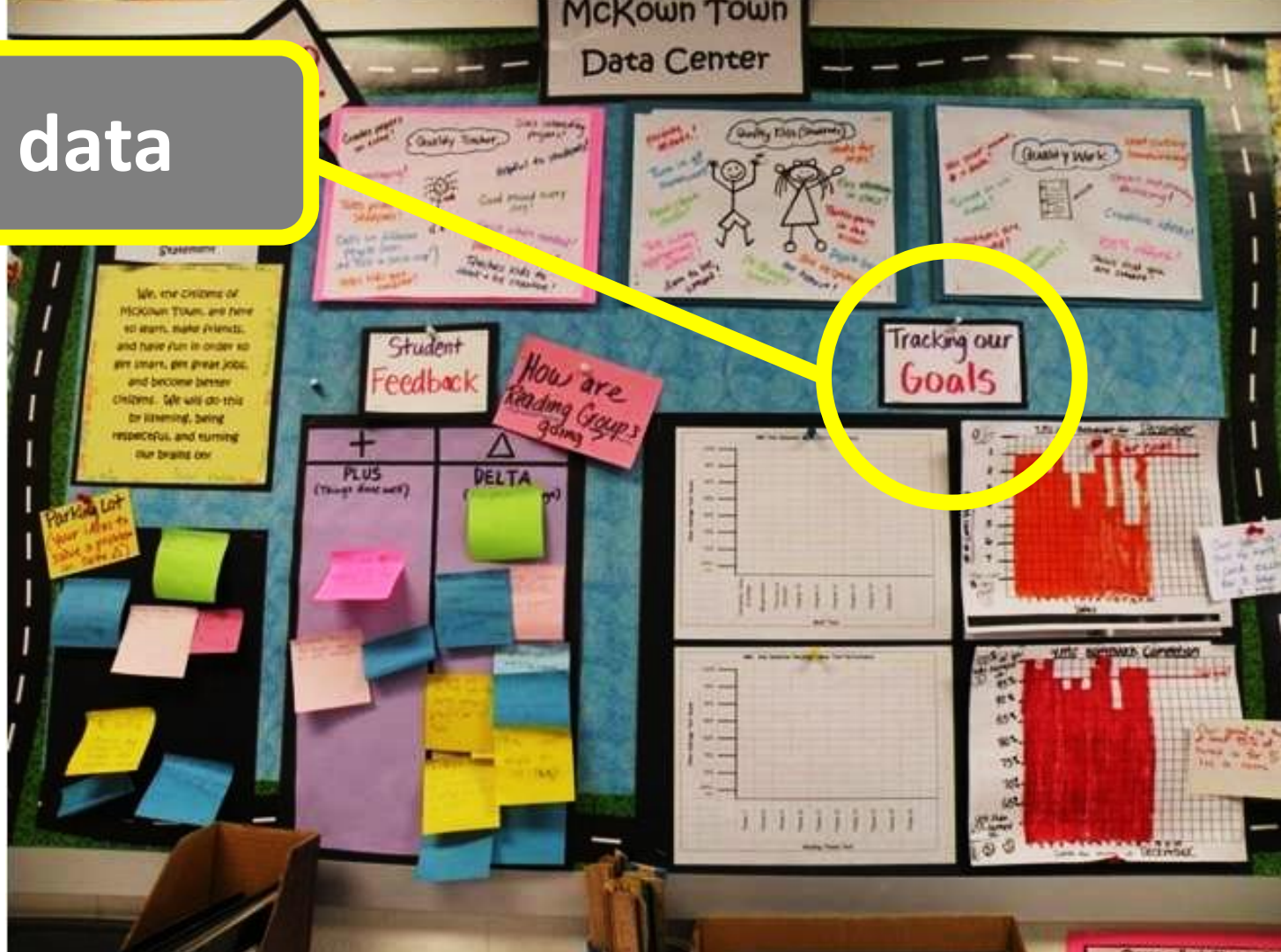
is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs.

1st International Conference on Learning Analytics and Knowledge, Banff, Alberta, February 27–March 1, 2011

…most learning analytics efforts are at the right of the spectrum



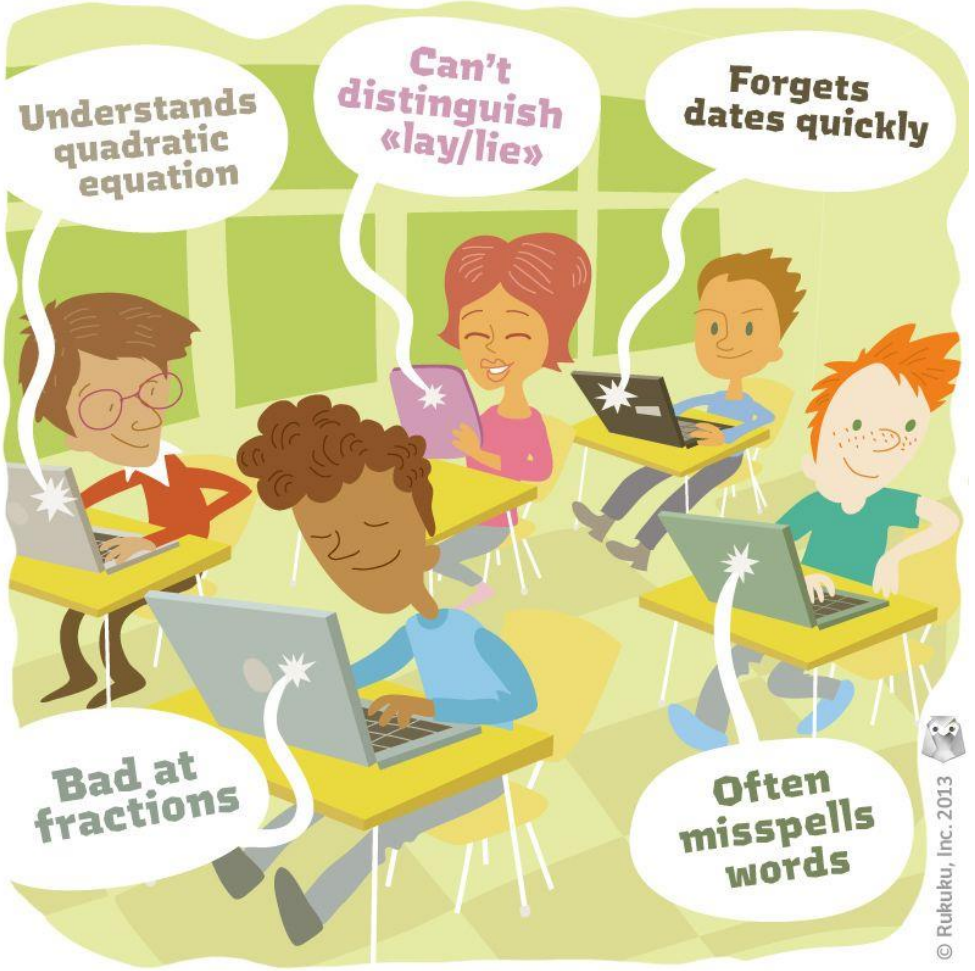
classroom data



increasing interest in

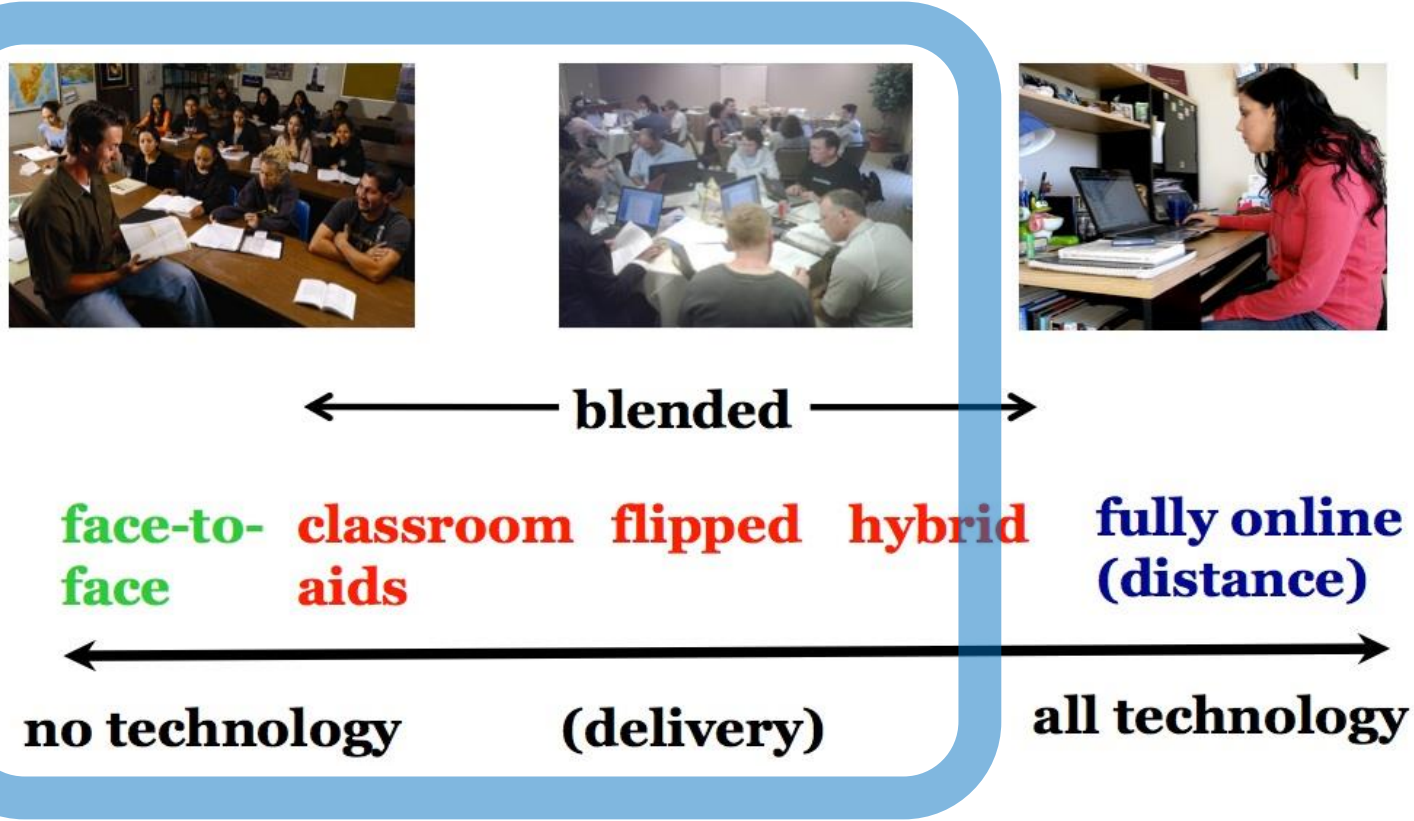
data

utopian scenario




Time Remaining
00:00
TOTAL WORDS READ
55
WORDS READ CORRECTLY
43

Focus of this talk: the left side of the spectrum



why is the classroom **SPACE** so “important”?


high investment in new learning spaces
Body Works


...and it includes all levels,
from K-12...


...to higher education

new learning spaces in libraries are cool too


... they often mimic workplace
spaces


...inherently blended


‘traditional’ classrooms are now hybrid too


...some learning spaces cannot be moved to the virtual world
DNA Detectives


learning can be very physical...


... VERY physical!

the importance of the whole

"Online Learning doesn't happen online!

It happens where the learner is. It can't happen where the learner isn't"

@PeterGoodyear

https://www.teachingenglish.org.uk

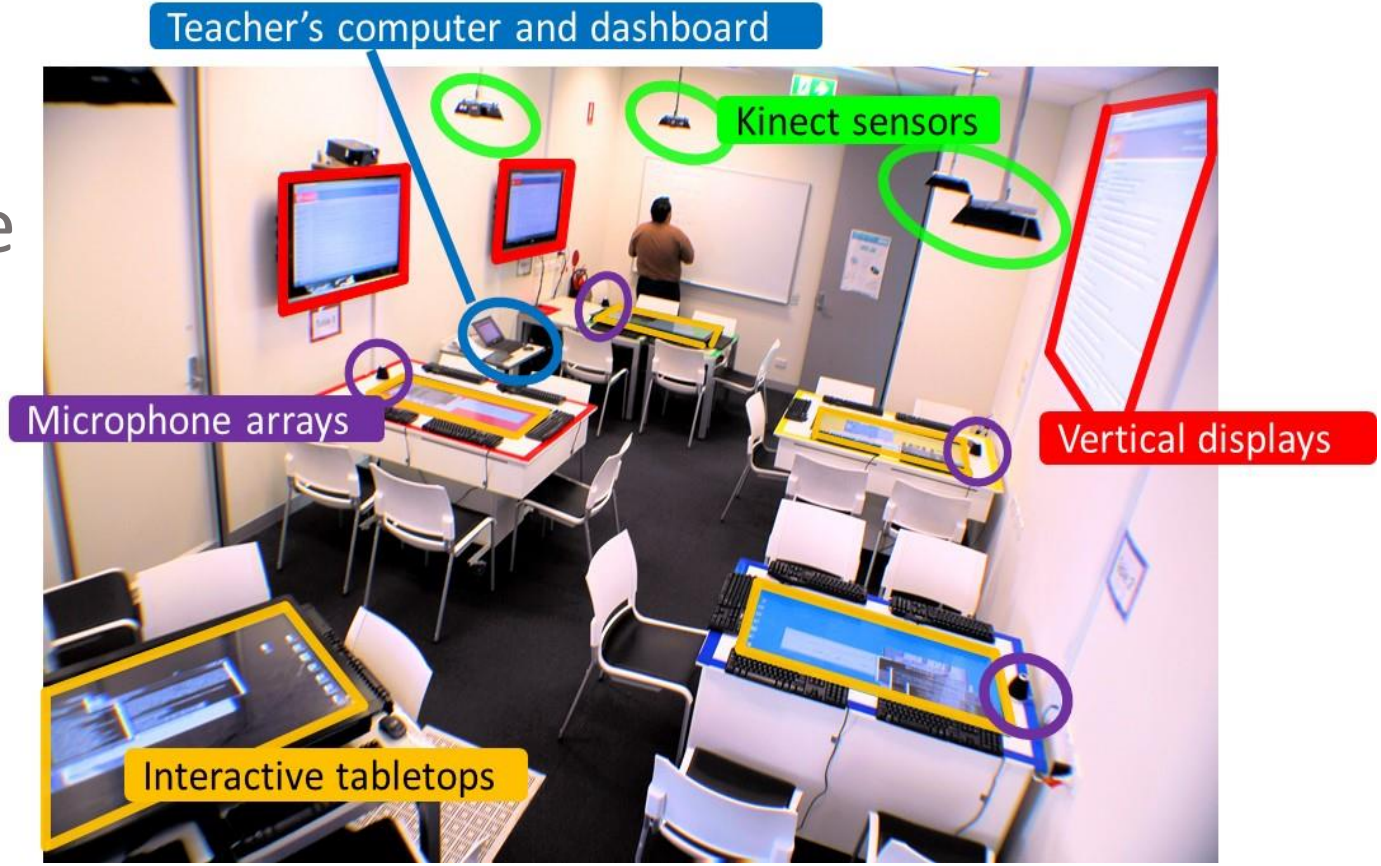
physical learning analytics at three levels

Classroom Analytics

Small-group Collaboration Analytics

Analytics on **Individual** Psychomotor Skills

bringing sensors to the classroom



Martinez-Maldonado, R., Clayphan, A., Yacef, K. and Kay, J. (2015) MTFeedback: providing notifications to enhance teacher awareness of small group work in the classroom. *IEEE Transactions on Learning Technologies,* 8(2):


The translucent classroom
1) assess classroom activity design
2) **orchestration and awareness**

architecture

Multi-tabletop Classroom components

a) Whiteboard projector
b) Depth sensors (Microsoft Kinect)
c) Microphone array (Microcone)
d) Interactive surface hardware (PQ Labs)
e) Concept mapping application (Python)
f) Multi-platform Orchestration Tool (Python)
g) Centralised logging system (MySQL)

authentic deployments

38 tutorials

3 semesters

School of Business and
School of IT

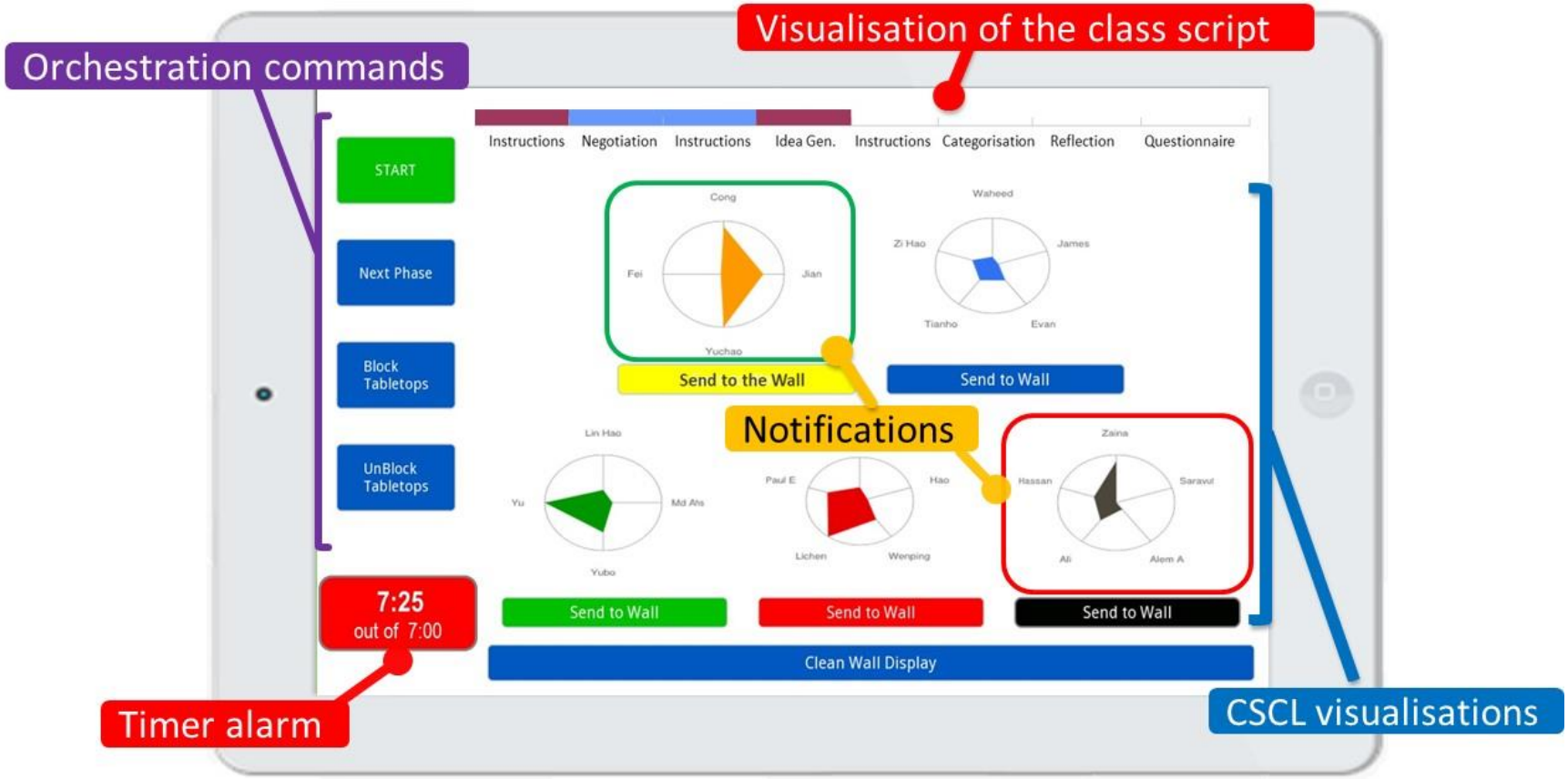
~80 small groups

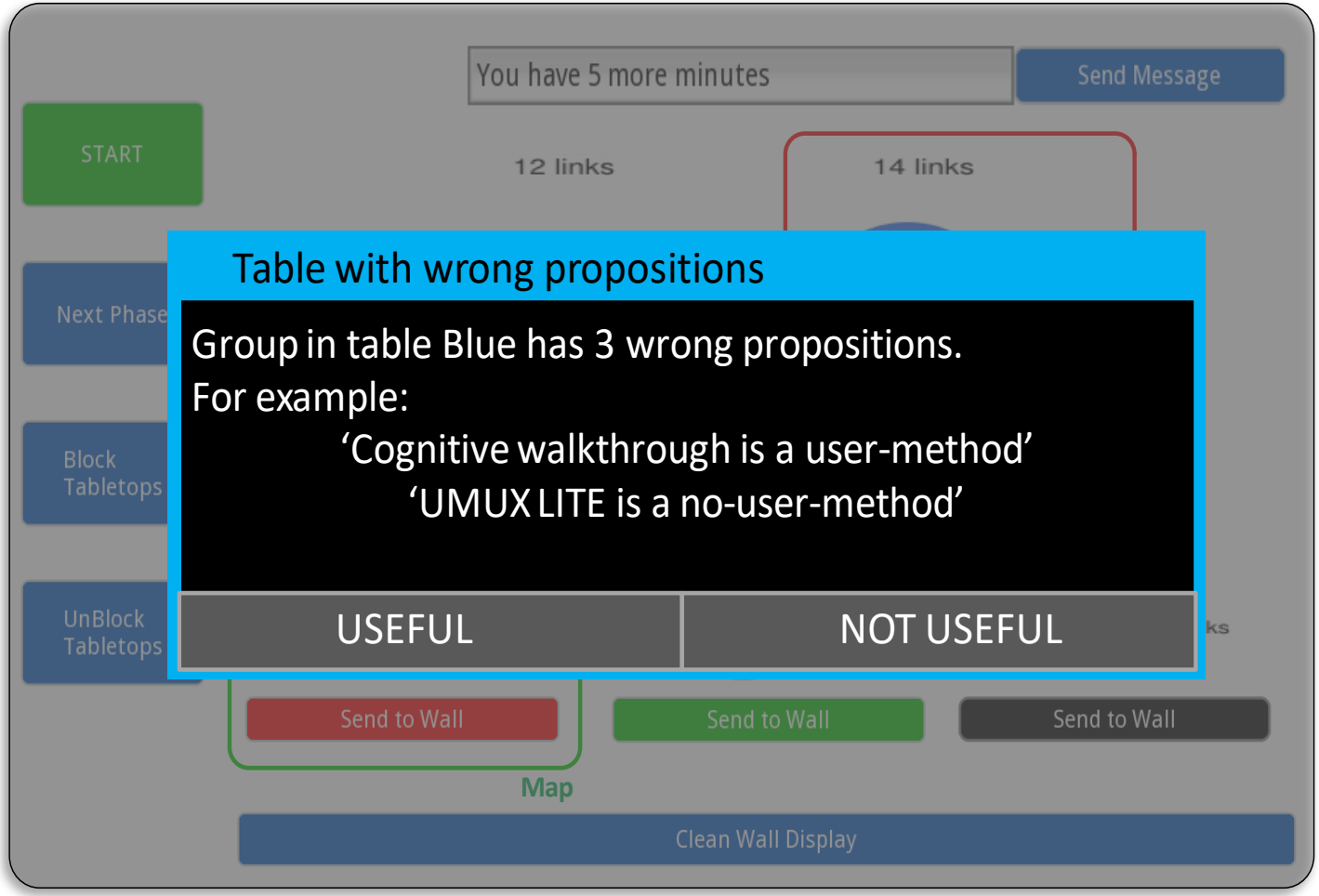
+400 students

4 teachers

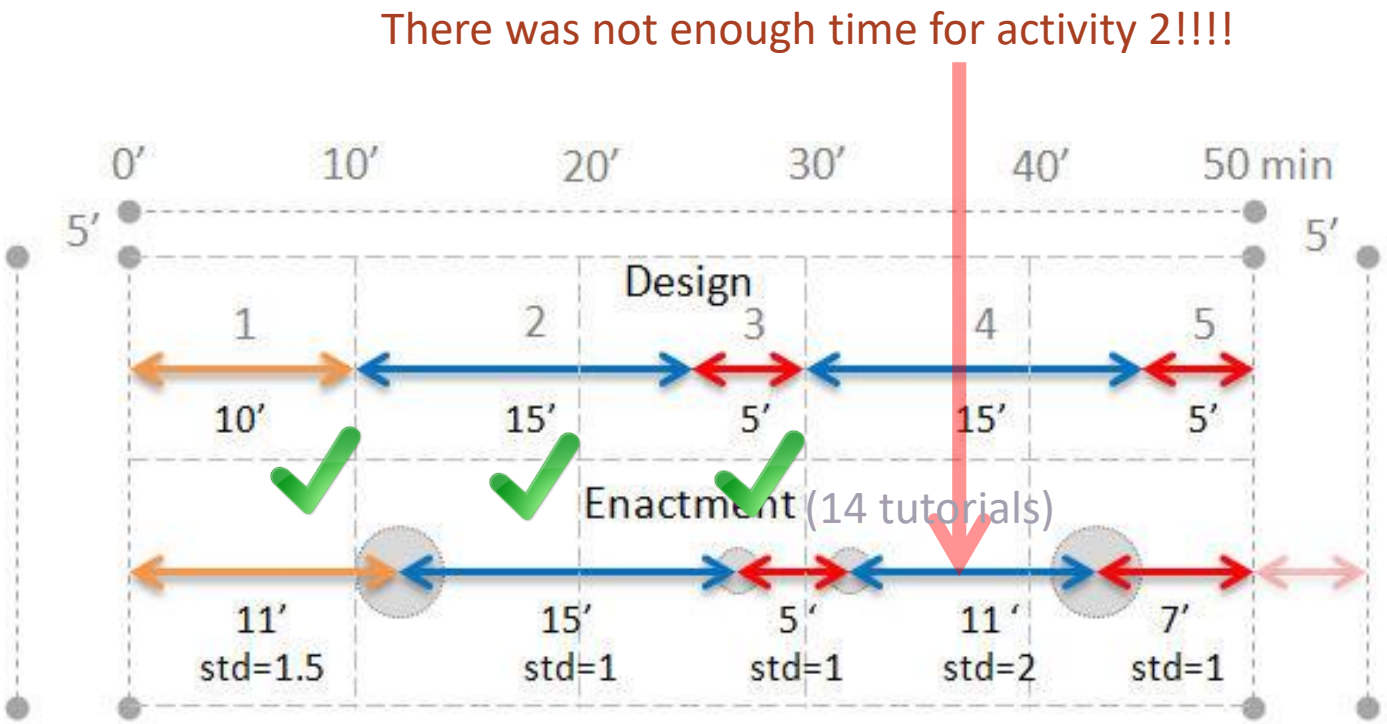
Martinez-Maldonado, R., Clayphan, A., Ackad, C. and Kay, J. (2014) Multi-touch Technology in a Higher Education Classroom: Lessons In-the-wild. *Australian Computer-Human Interaction Conference, OZCHI 2014*.

A teacher's dashboard for classroom orchestration

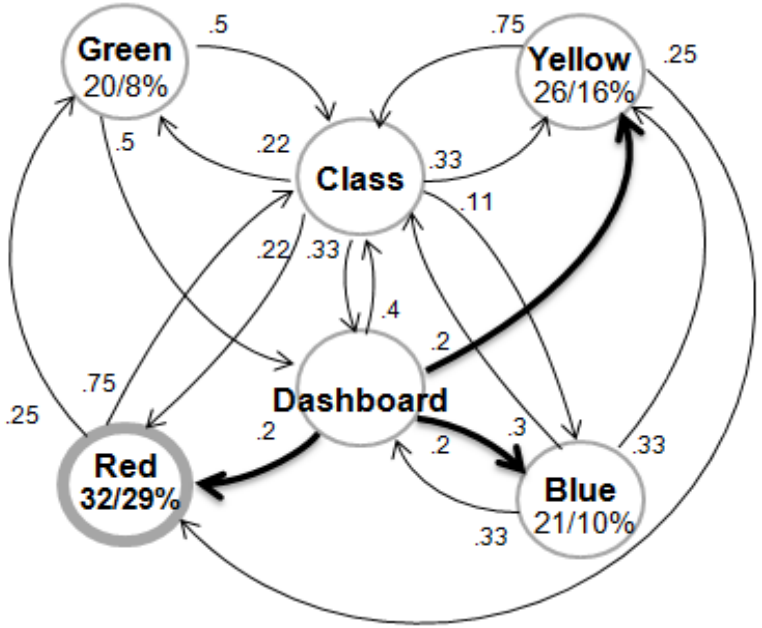



You have 5 more minutes
Send Message
START
12 links
14 links
Next Phase
Block Tabletops
UnBlock Tabletops
Table with wrong propositions
Group in table Blue has 3 wrong propositions.
For example:
'Cognitive walkthrough is a user-method'
'UMUX LITE is a no-user-method'
USEFUL
NOT USEFUL
Send to Wall
Send to Wall
Send to Wall
Map
Clean Wall Display

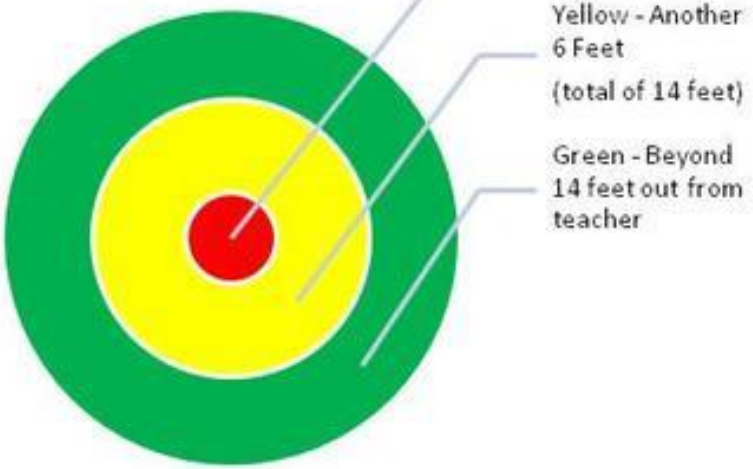
adherence to the class script

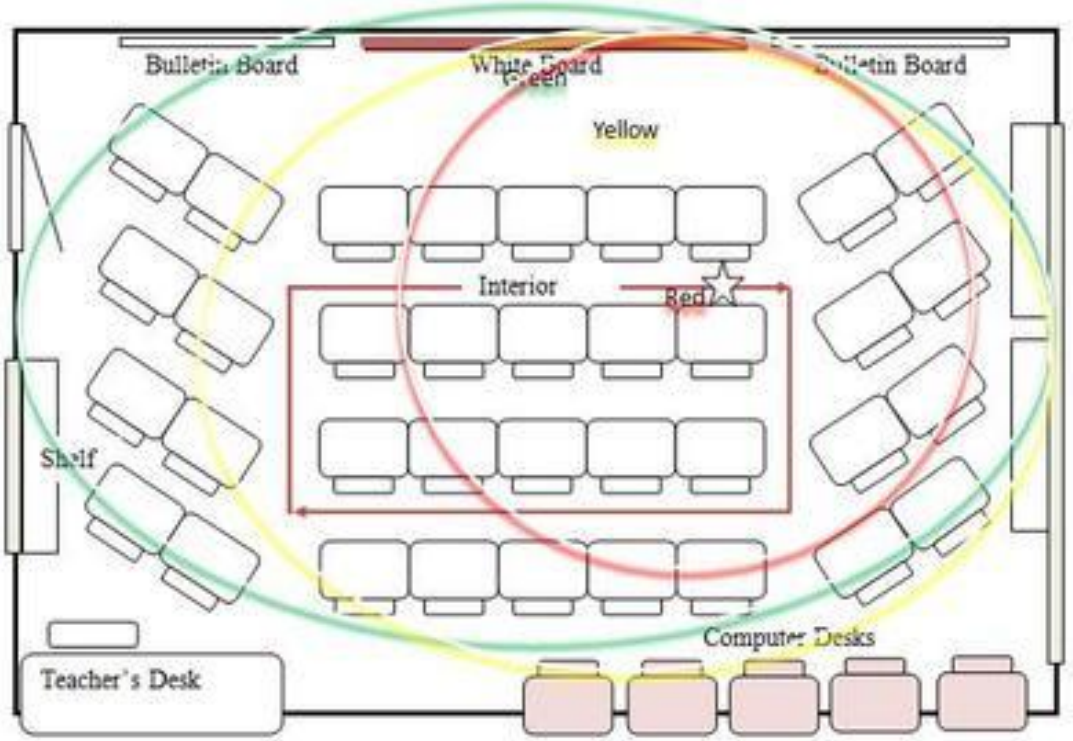


Example of following a teacher in a collaborative classroom holding a tablet-based dashboard



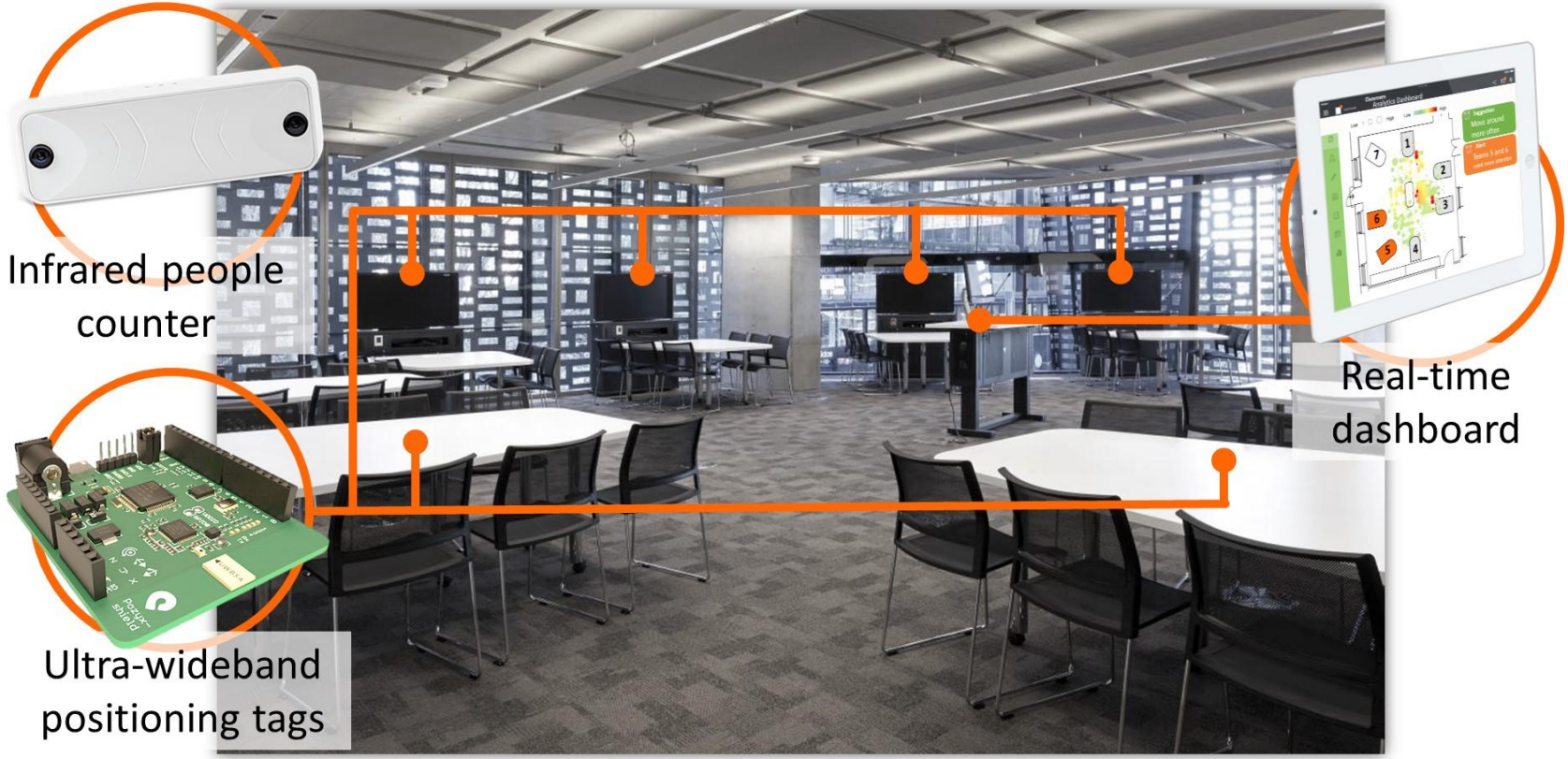
Teacher's mobility and proximity

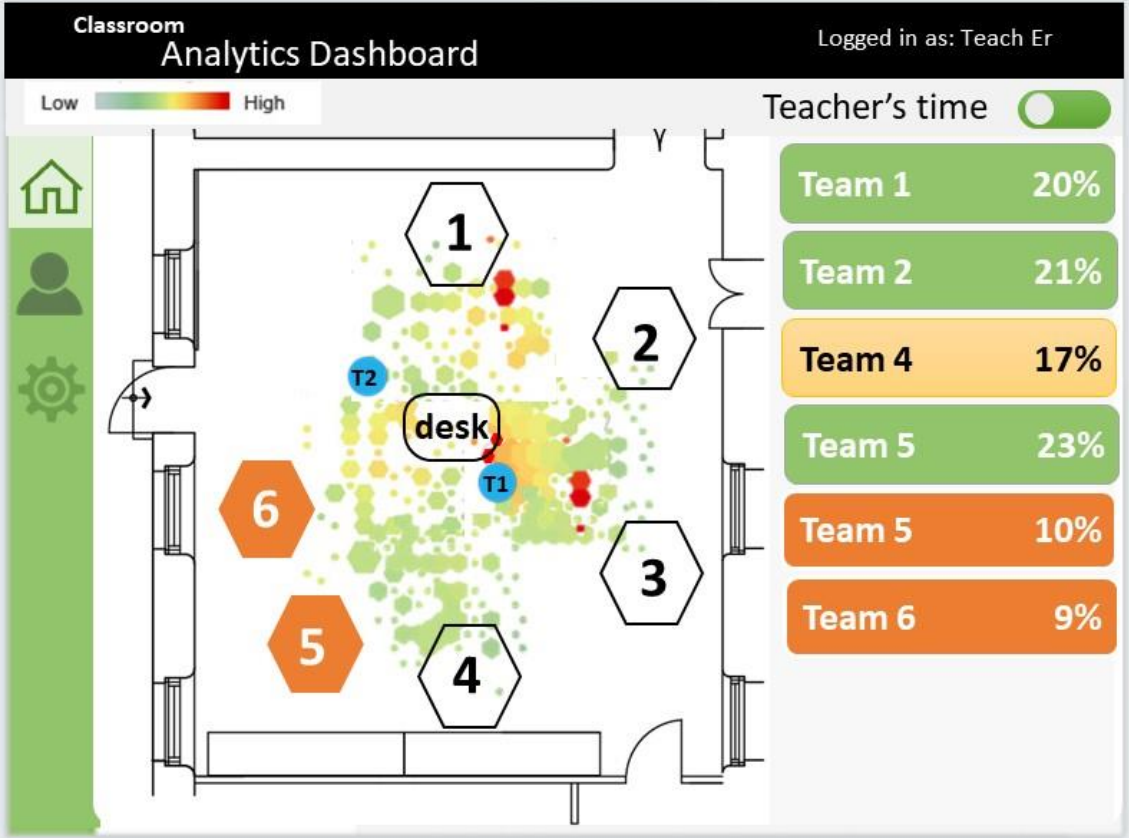




SOURCE: Fred Jones Tools for Teaching

Instrumenting Learning Spaces




Classroom
Analytics Dashboard
Logged in as: Teach Er
Low
High
Teacher's time
1
2
3
4
5
6
T1
T2
desk
Team 1 20%
Team 2 21%
Team 4 17%
Team 5 23%
Team 5 10%
Team 6 9%

Possible application in the clinical field

Original research

Tracking workflow during high-stakes resuscitation: the application of a novel clinician movement tracing tool during in situ trauma simulation

Andrew Petrosoniak,[1,2] Rodrigo Almeida,[3] Laura Danielle Pozzobon,[1] Christopher Hicks,[1,2] Mark Fan,[4] Kari White,[5] Melissa McGowan,[1] Patricia Trbovich[4,6]

ABSTRACT

Introduction Clinician movement and workflow analysis provides an opportunity to identify inefficiencies during trauma resuscitation care. Inefficient workflows may represent latent safety threats (LSTs), defined as unrecognised system-based elements that can negatively impact patients. In situ simulation (ISS) can be used to model resuscitation workflows without direct impact on patients. We report the pilot application of a novel,

especially during trauma resuscitations, can be difficult as clinical environments are often dynamic and complex.

In situ simulation (ISS) provides a valuable opportunity to recreate clinical scenarios for focused analysis of workflows and patient care within the actual clinical environment.[2] Using ISS, high-risk or rarely performed scenarios can be replicated to better understand a complex system and

Possible application in the clinical field

To our knowledge however, there are no free, readily available tools to objectively analyse clinician movement within the confines of a resuscitation room. As a result, the development of this video overlay tool offers a unique application for workflow analysis. Application of this tool for ISS is useful to comparatively analyse human movement during clinical care for several reasons: (1) scenarios are reproducible and actions/procedures are predictable; (2) rare procedures may be preferentially selected for analysis and; (3) risk to actual patients is minimised.

physical learning analytics at three levels

Classroom Analytics

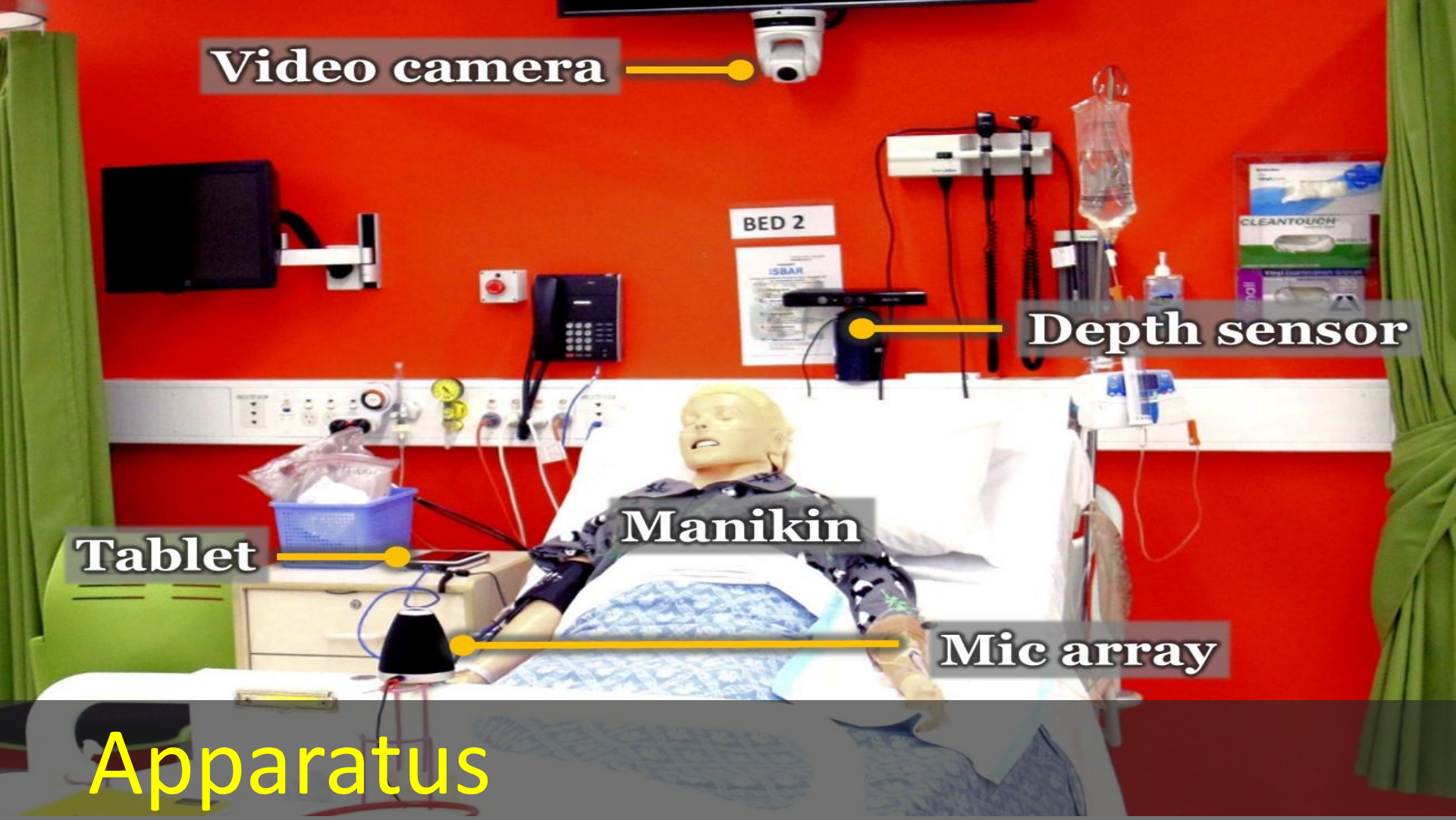
Small-group Collaboration Analytics

Analytics on **Individual** Psychomotor Skills


Collocated Groupware

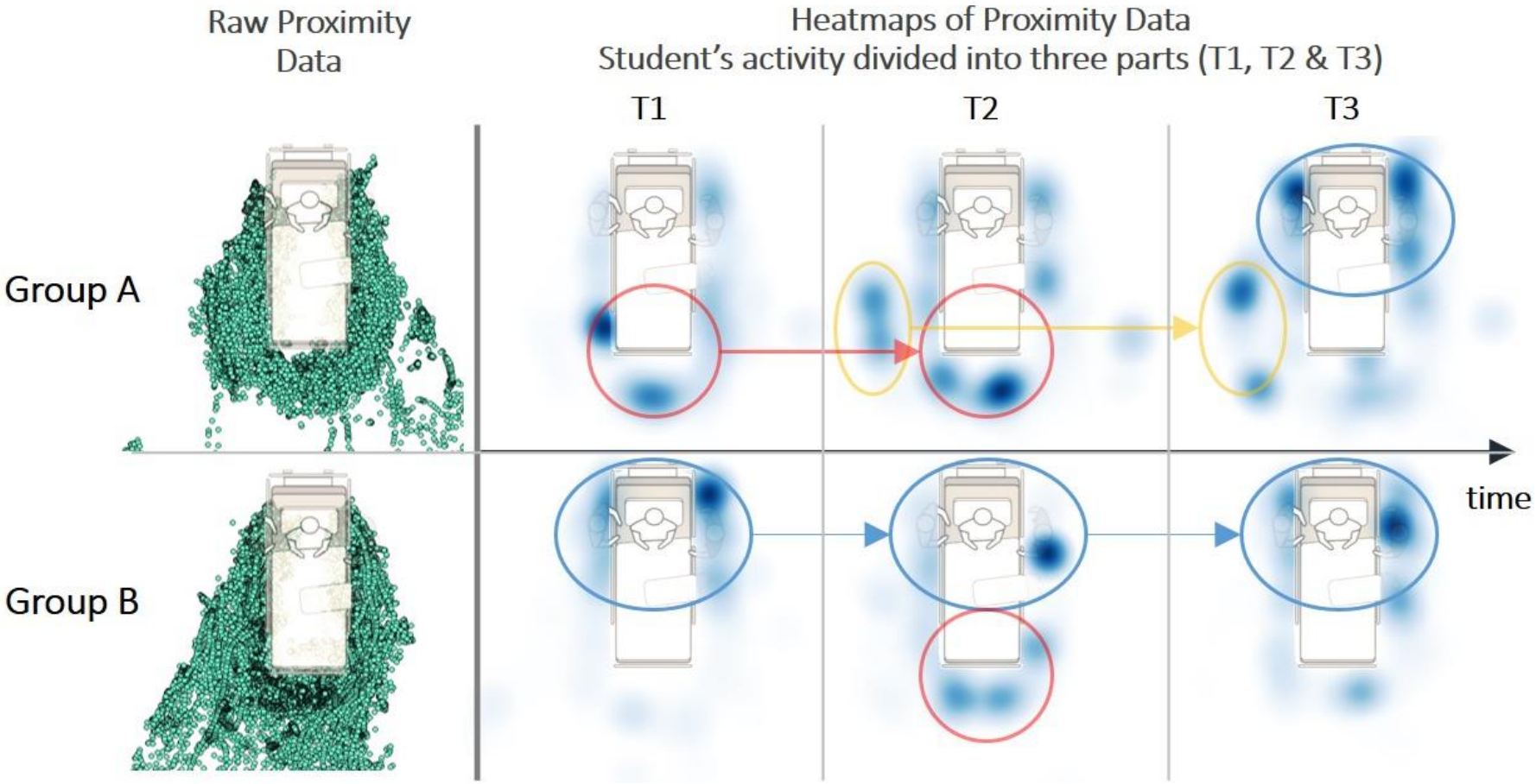
Proximity Analytics in healthcare simulation classrooms


BED 3
Learning Analytics meet Patient Manikins


Video camera
BED 2
ISBAR
Depth sensor
Manikin
Tablet
Mic array

Apparatus


1 - ...
8 - ...
6 - ...
9 - ...
3 - ...
2 - ...


Raw Proximity Data
Heatmaps of Proximity Data
Student's activity divided into three parts (T1, T2 & T3)
T1
T2
T3
Group A
Group B
time

Analytics about tutors scripting

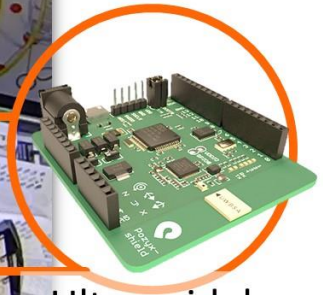
Enactment of the tutorial design in two classroom sessions

Martinez-Maldonado, R., Power, T., Hayes, C., Abdipranoto, A., Vo, T., Axisa, C., and Buckingham Shum, S. (2017) Analytics Meet Patient Manikins: Challenges in an Authentic Small-Group Healthcare Simulation Classroom. *International Conference on Learning Analytics and Knowledge, LAK 2017*

new installation: indoor localisation, physiological tracking and audio recording

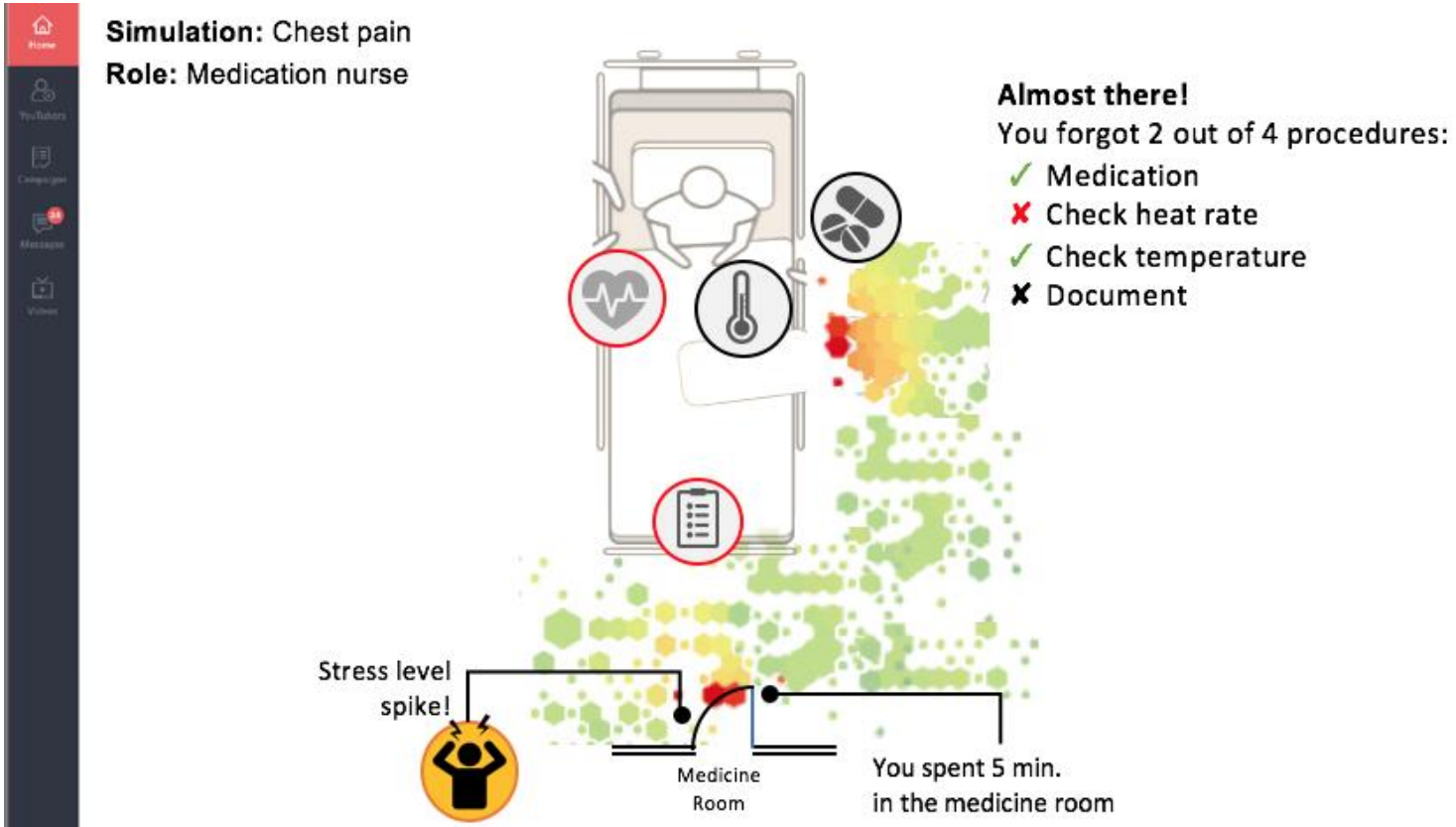
Physiological wristbands

Omnidirectional microphone

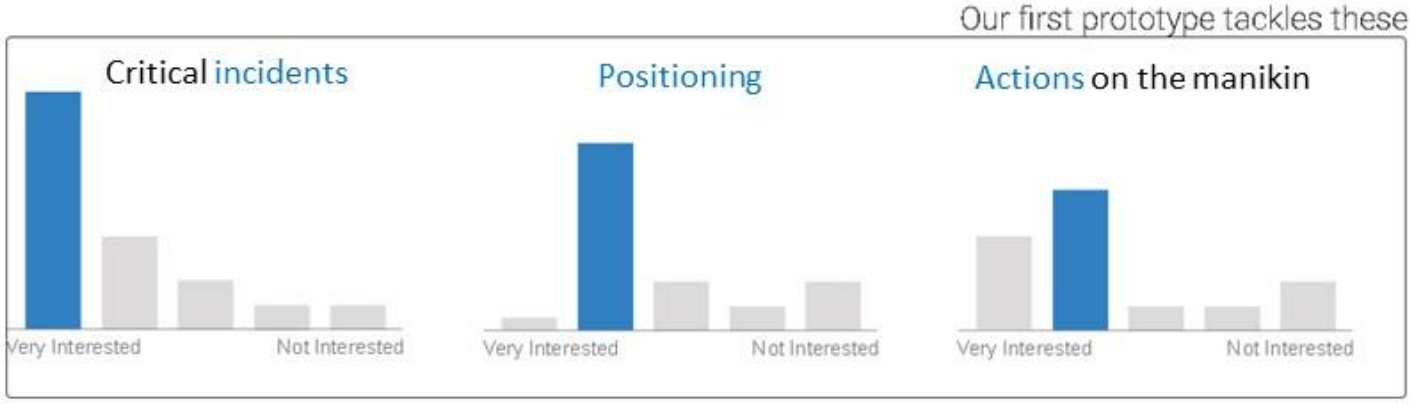


Ultra-wideband positioning tags

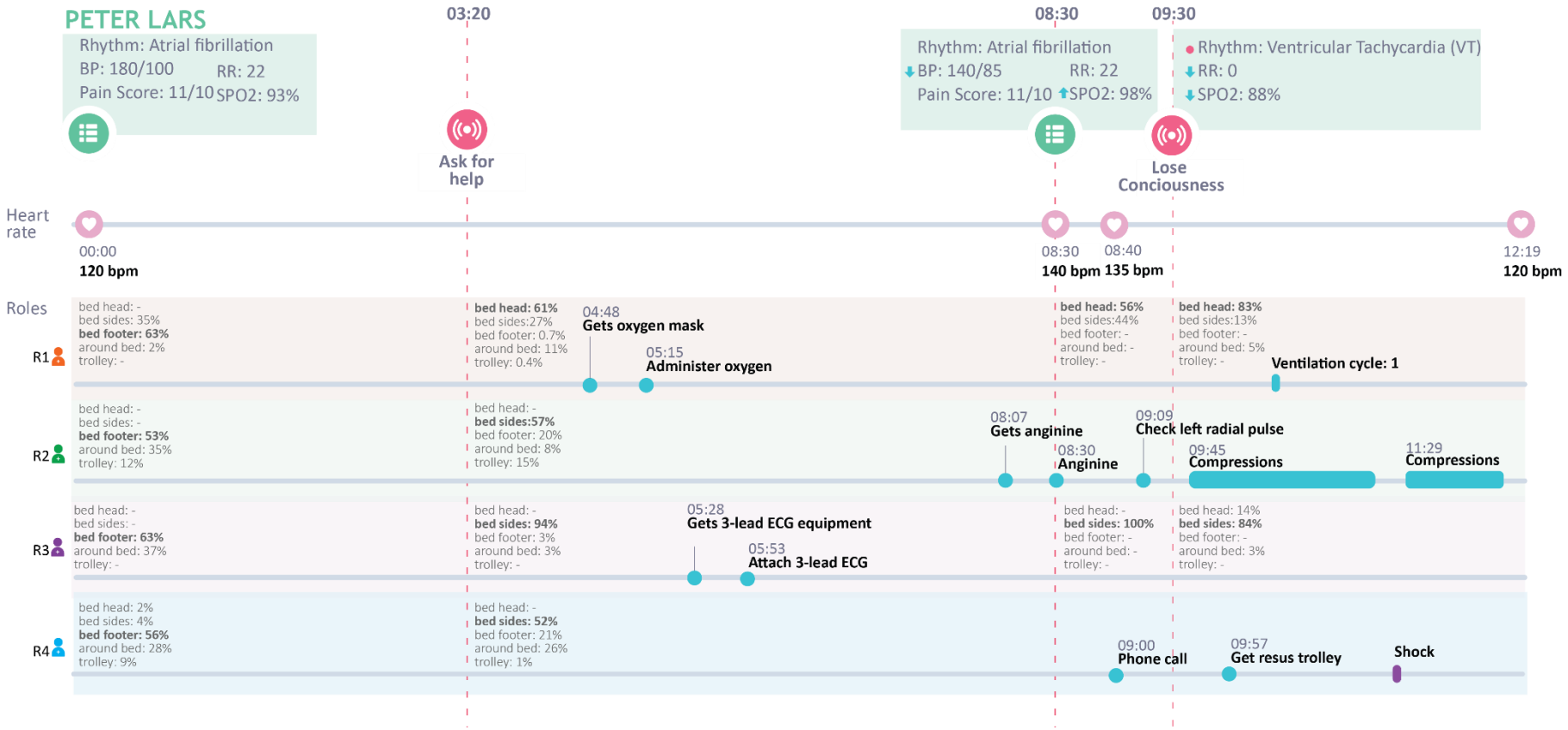
Initial prototype of a reflection tool



students' feedback preferences



second prototype of a reflection tool



physical learning analytics at three levels

Classroom Analytics

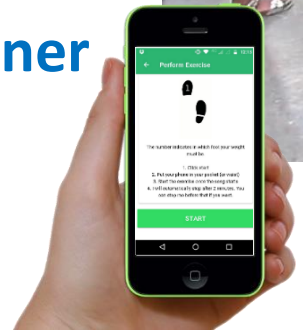
Small-group Collaboration Analytics

Analytics on Individual Psychomotor Skills


Motion Analytics
for Social Dance Education

Pervasive Motion Tracking while dancing

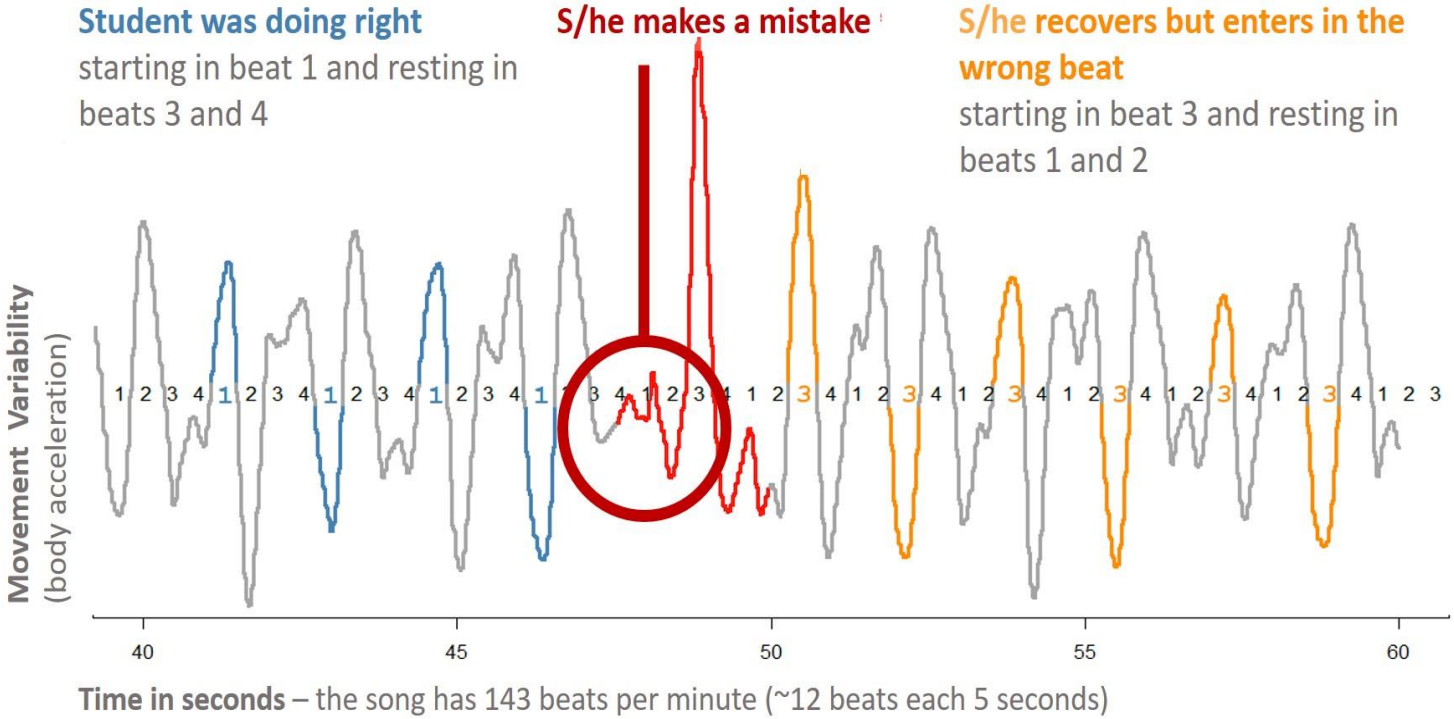
Forró Trainer



Santos, A., Tang, L. M., Loke, L., and **Martinez-Maldonado, R**. (2018) You Are Off The Beat! Is Accelerometer Data Enough for Measuring Dance Rhythm?. *International Conference on Movement and Computing, MOCO 2018*.

Automated detection of dancing mistakes

….. and feedback provision



Time in seconds – the song has 143 beats per minute (~12 beats each 5 seconds)

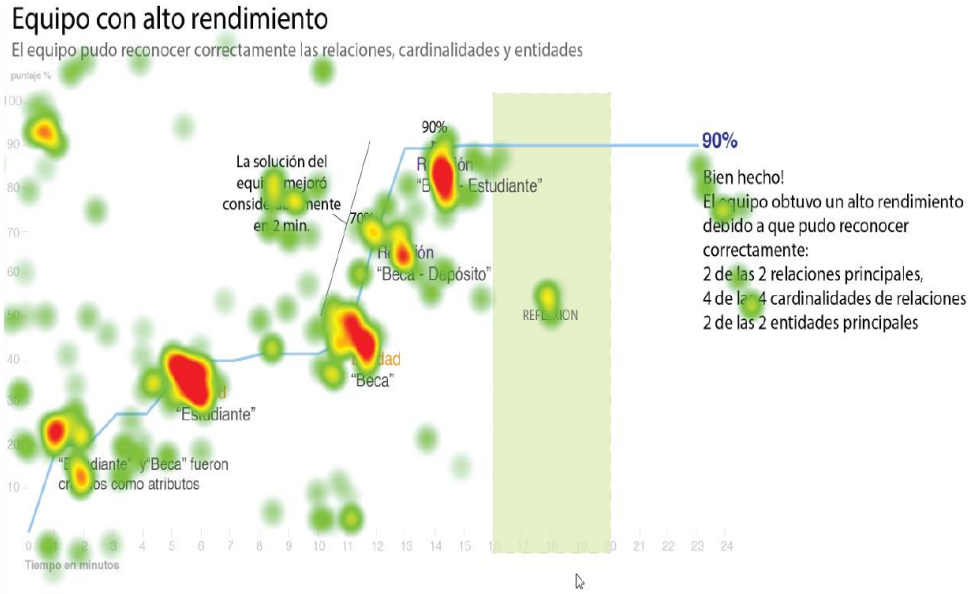
why is the **SPACE** so “important”?

because collaboration and learning are cognitive, affective, social and physical processes?

= INSIGHT

future directions

Data Storytelling

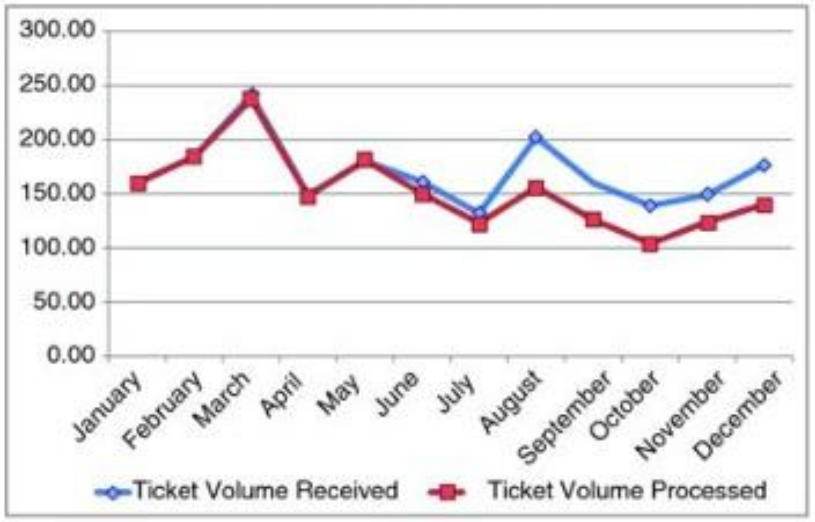


Echeverria, V., **Martinez-Maldonado, R**. Granda, R., Chiluiza, K., Conati, C., and Buckingham Shum, S. (2018) Driving Data Storytelling from Learning Design. *International Conference on Learning Analytics and Knowledge, LAK.*

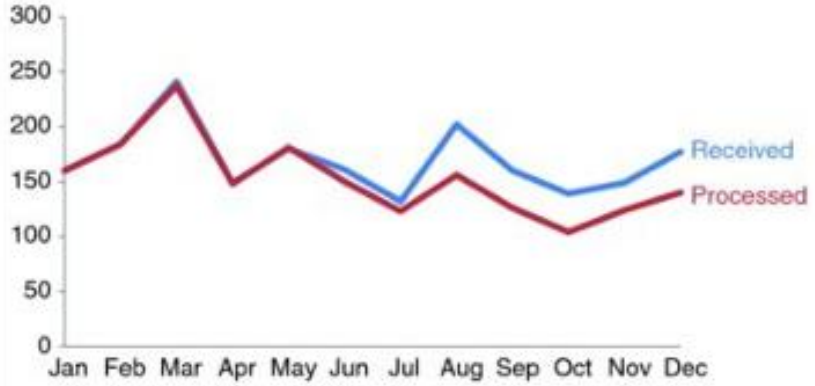
What is data storytelling?

First step: decluttering a graph

before



after

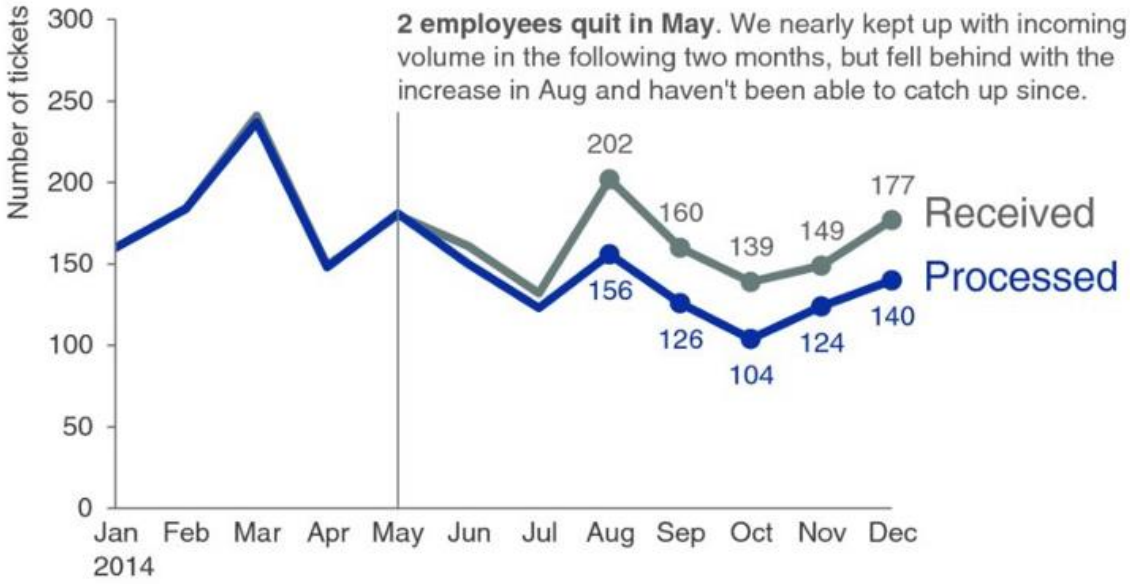


Data storytelling is about **communicating insights**

Please approve the hire of 2 FTEs

to backfill those who quit in the past year

Ticket volume over time



Data source: XYZ Dashboard, as of 12/31/2014 I A detailed analysis on tickets processed per person and time to resolve issues was undertaken to inform this request and can be provided if needed.

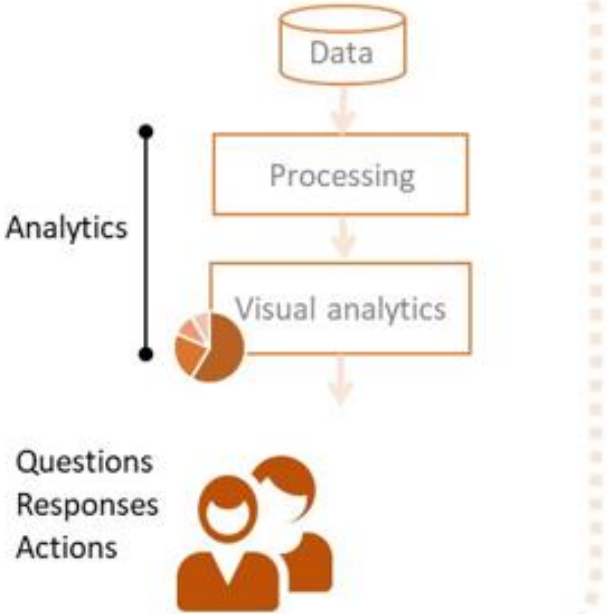
Most visualisations used in current Learning Analytics deployments are **Exploratory** rather than **Explanatory**

therefore, they don’t communicate insights

Exploratory visualisation about student's performance

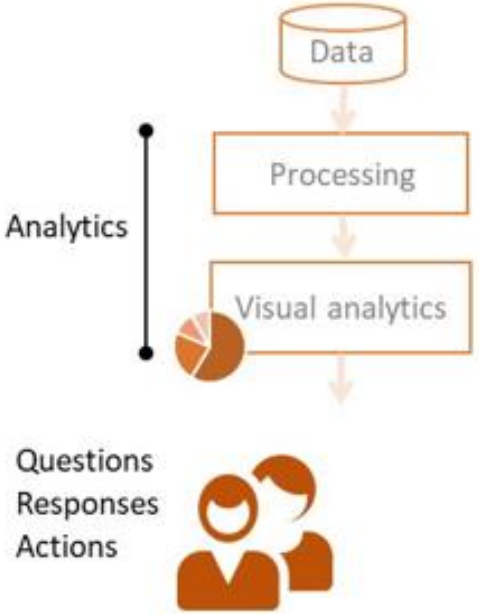
Data-driven

visual analytics approach



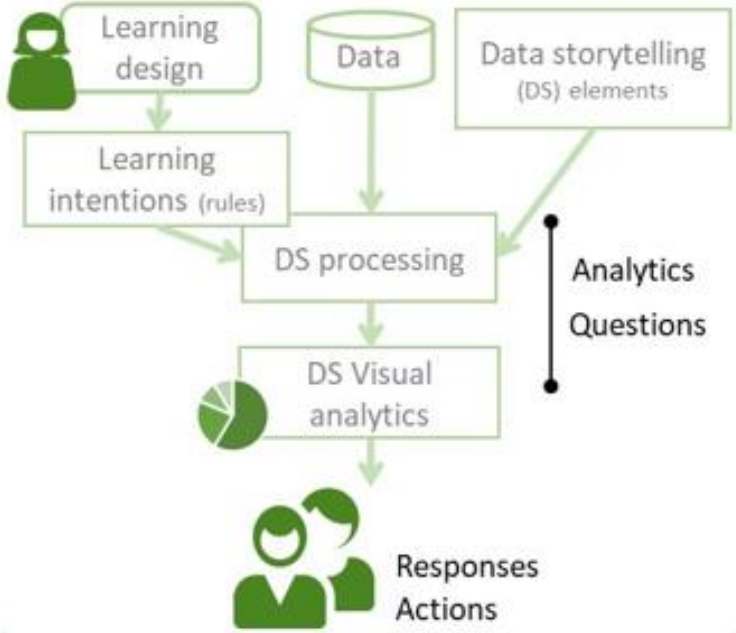
Data-driven

visual analytics approach



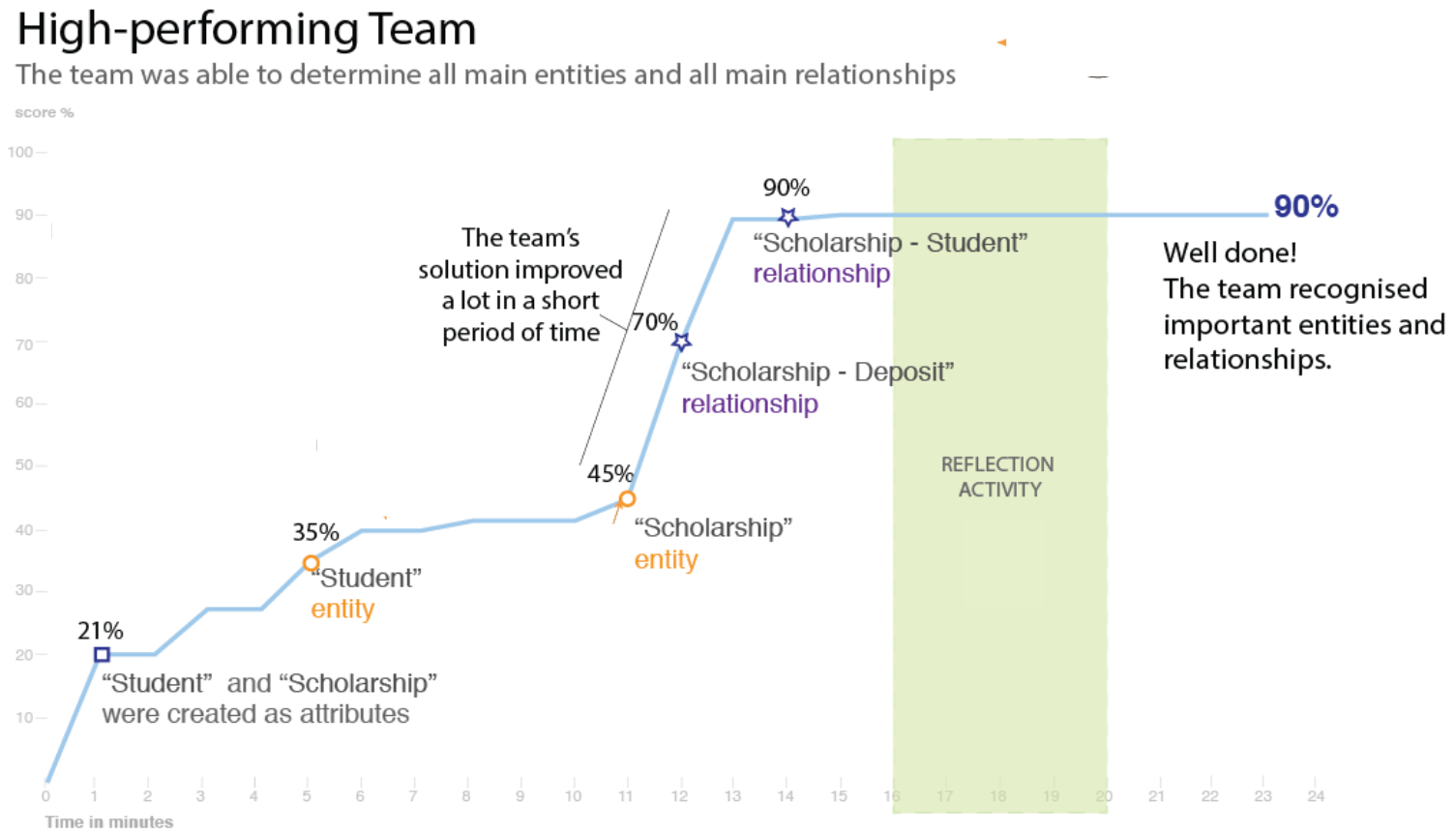
Learning design driven

data storytelling approach

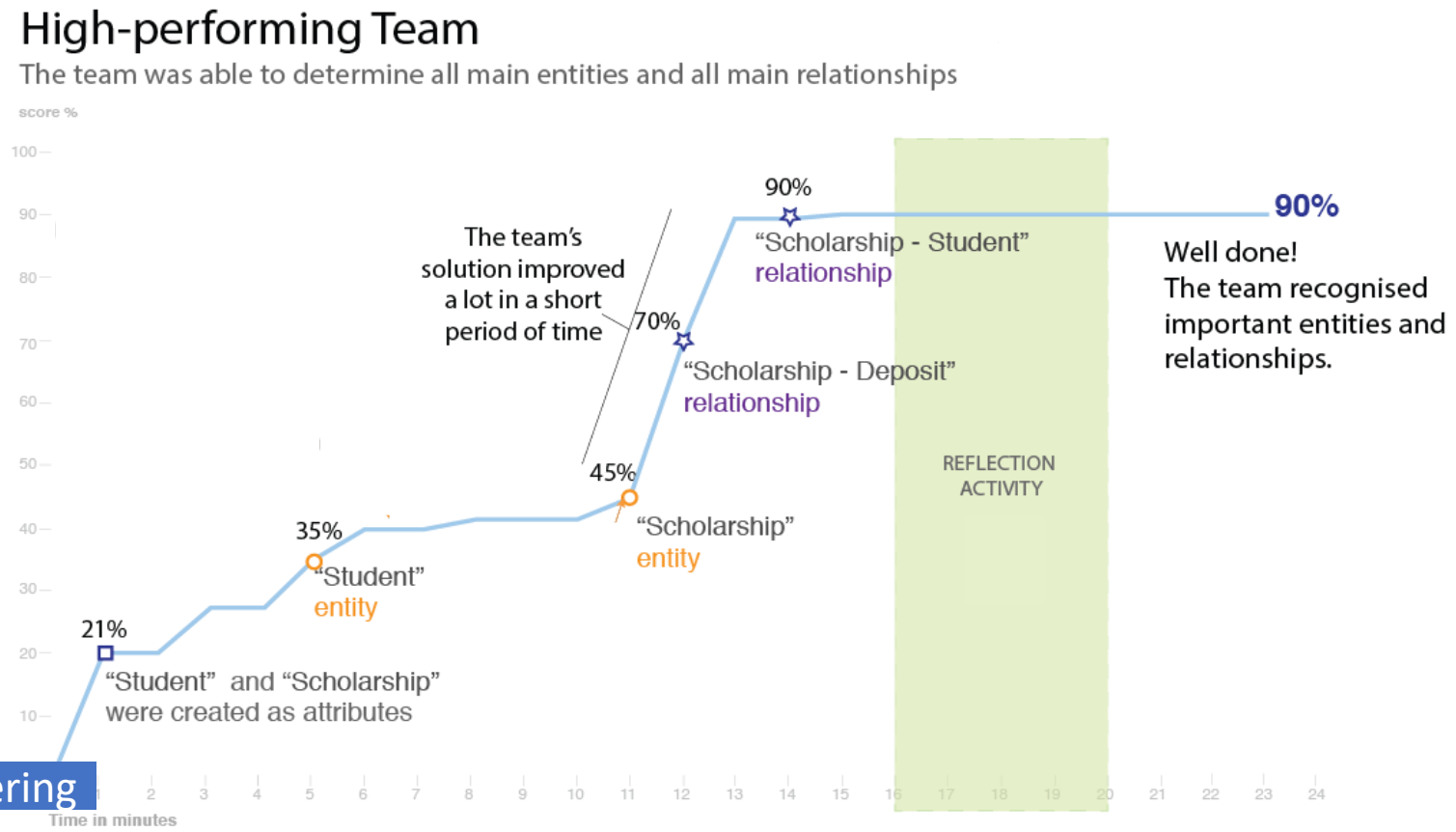


Exploratory visualisation about student's performance

Explanatory visualisation about student's performance



Explanatory visualisation about student's performance



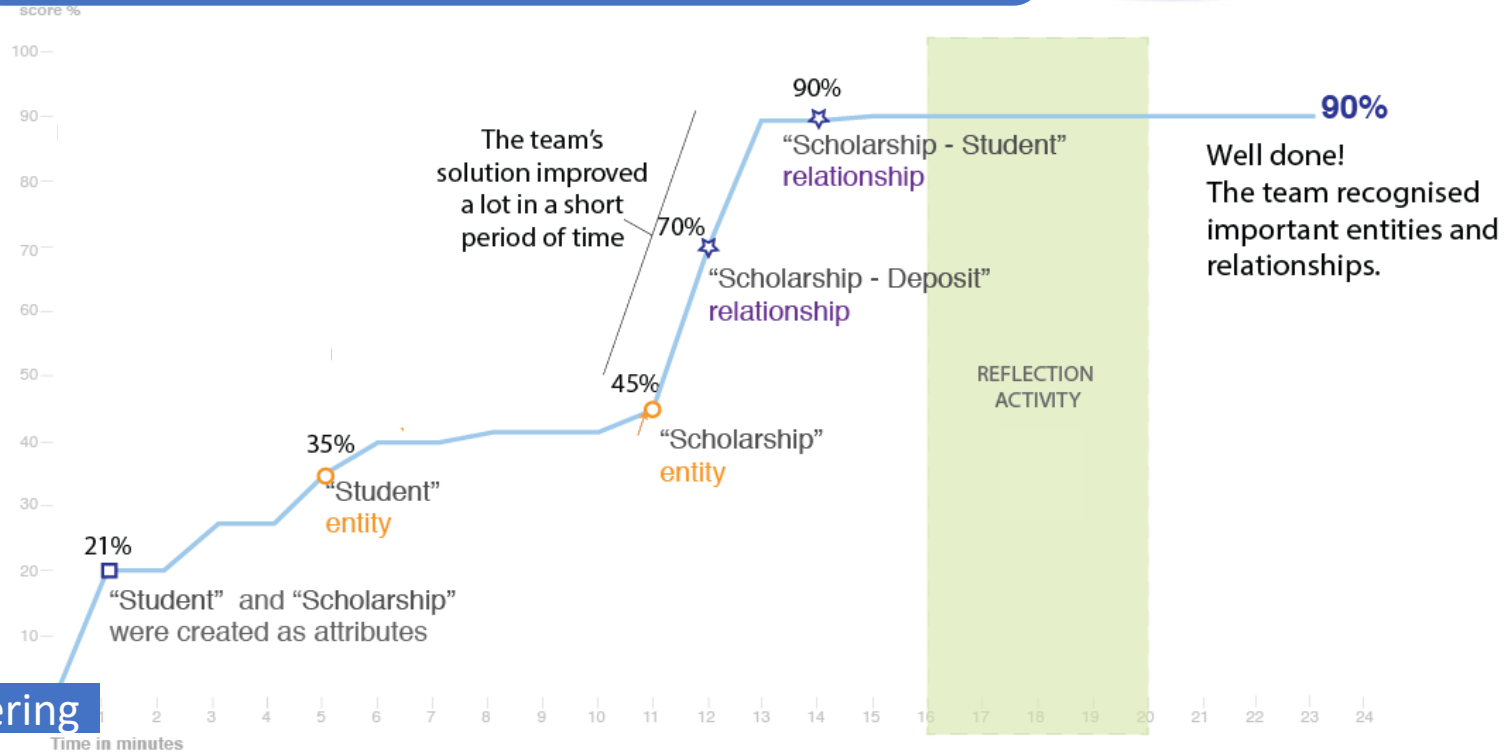
Decluttering

Explanatory visualisation about student's performance

High-performing Team

Prescriptive title

The team was able to determine all main entities and all main relationships



Decluttering

Explanatory visualisation about student's performance

Prescriptive title

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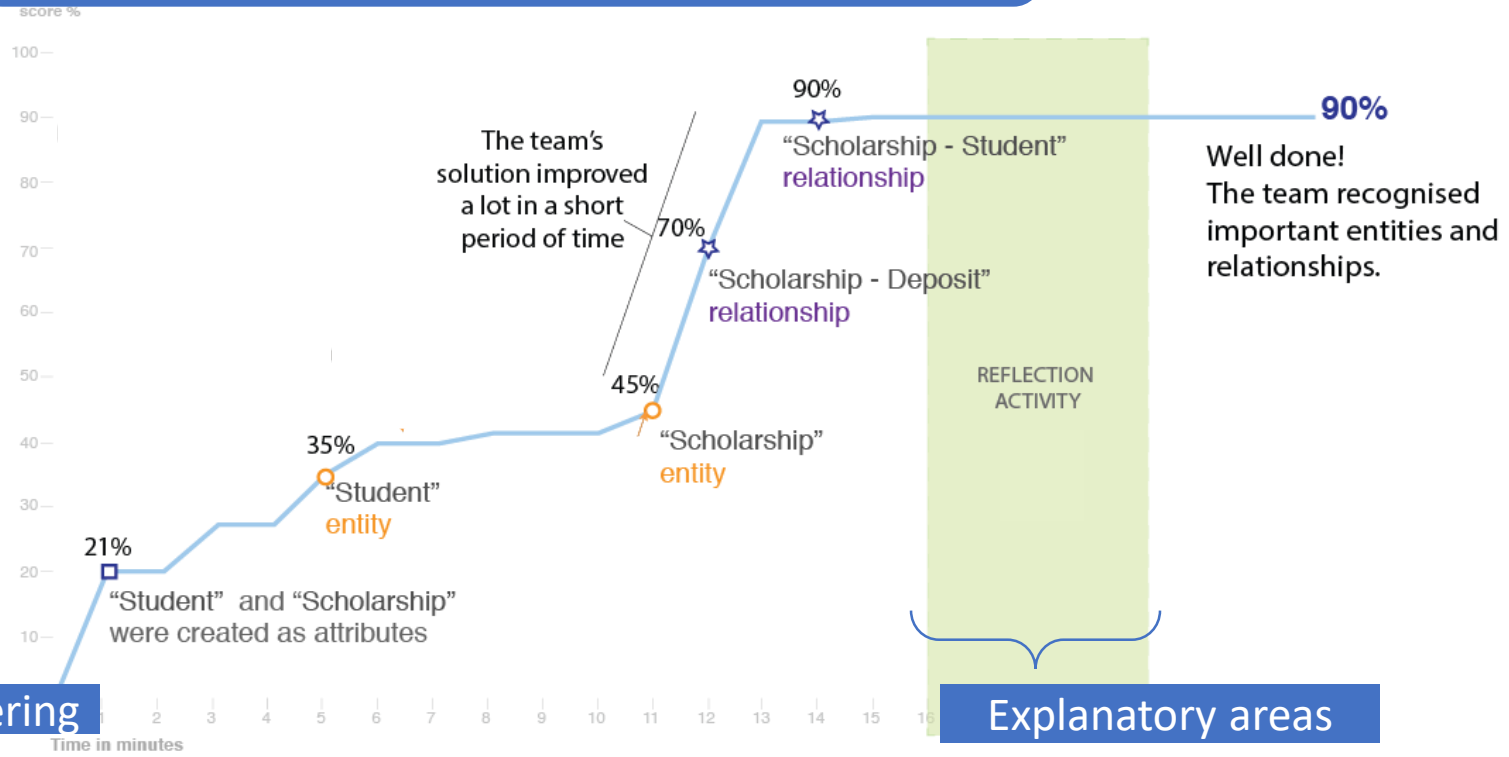
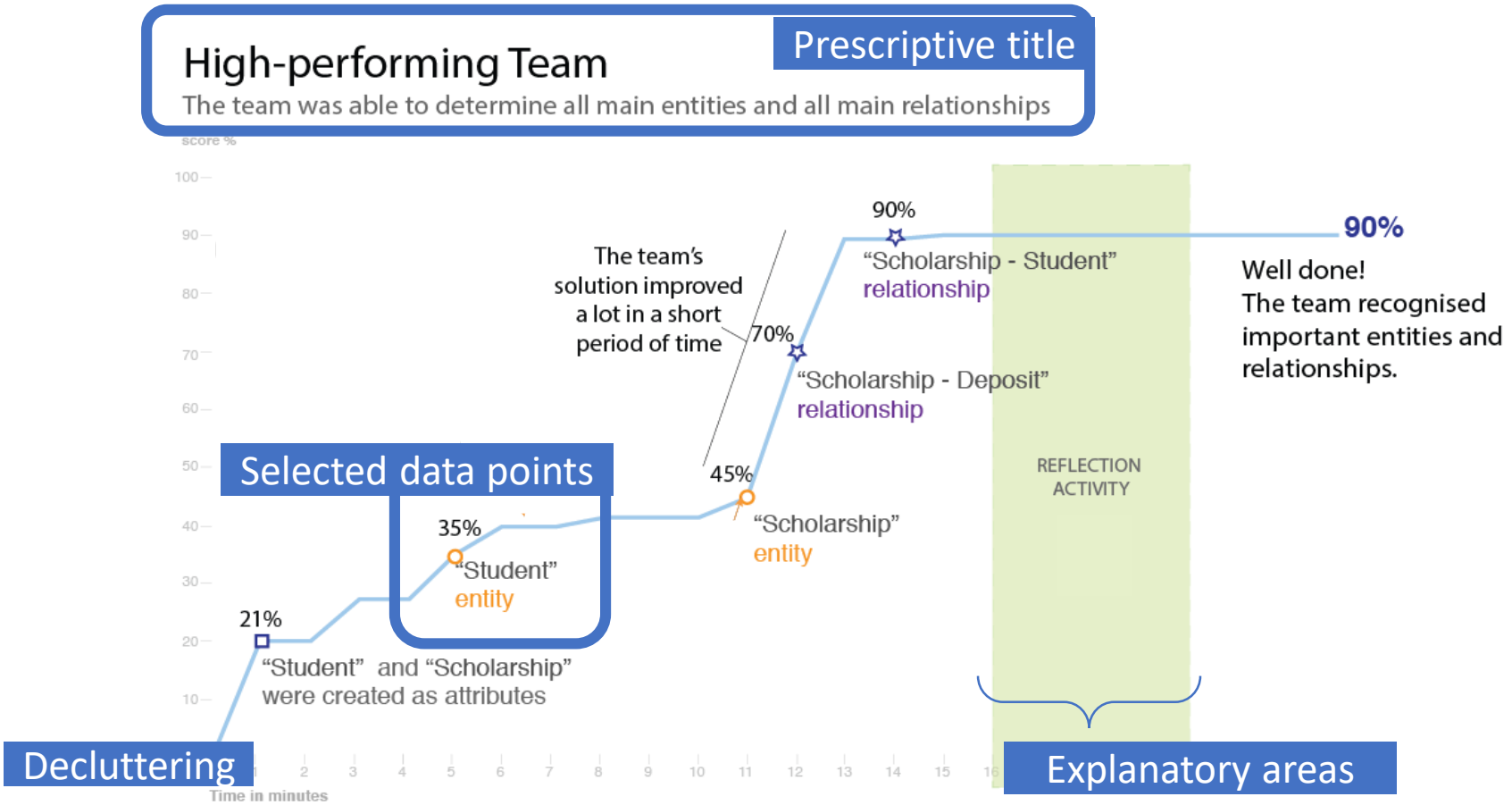


Decluttering

Explanatory areas

Explanatory visualisation about student's performance



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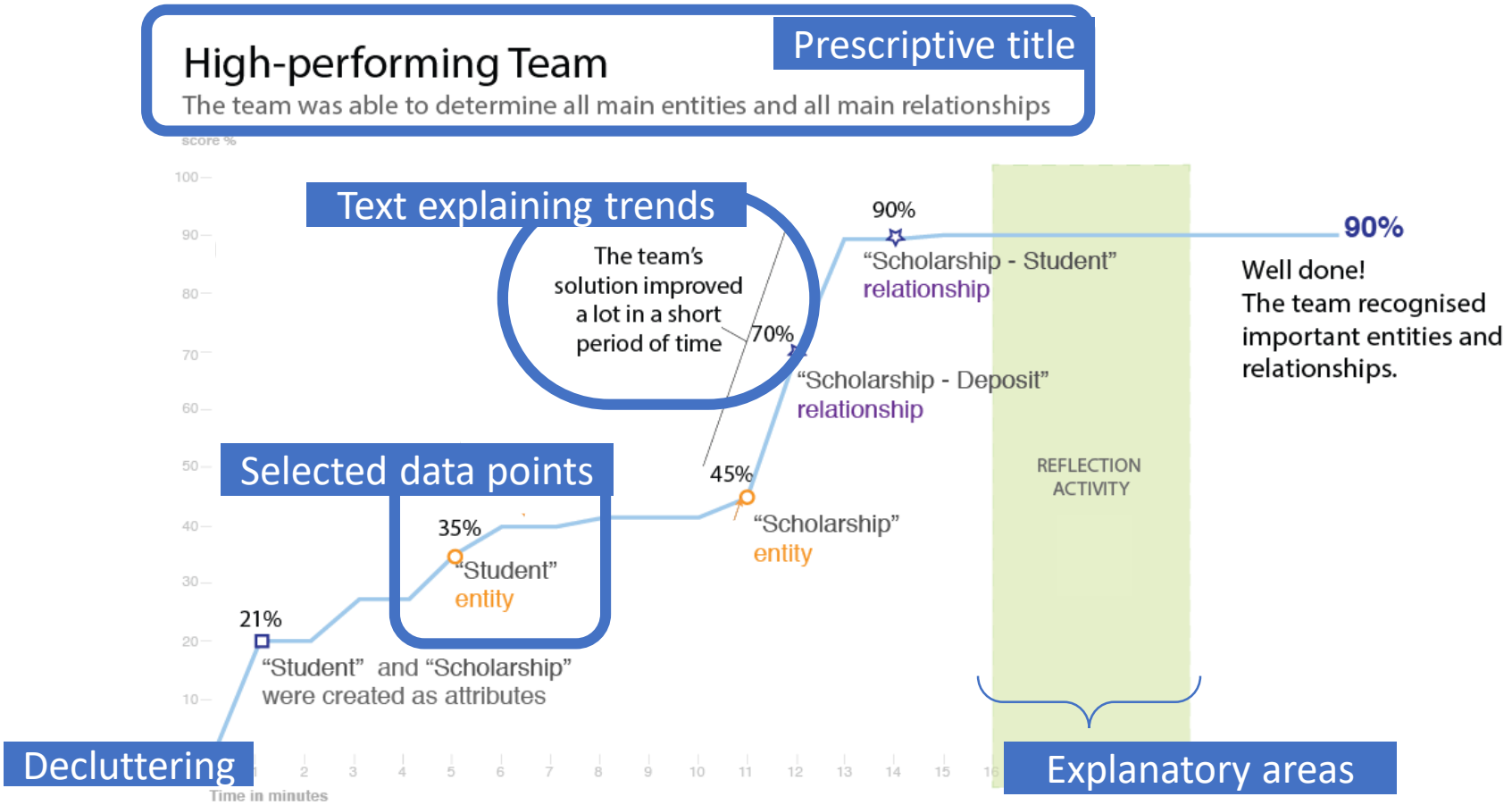
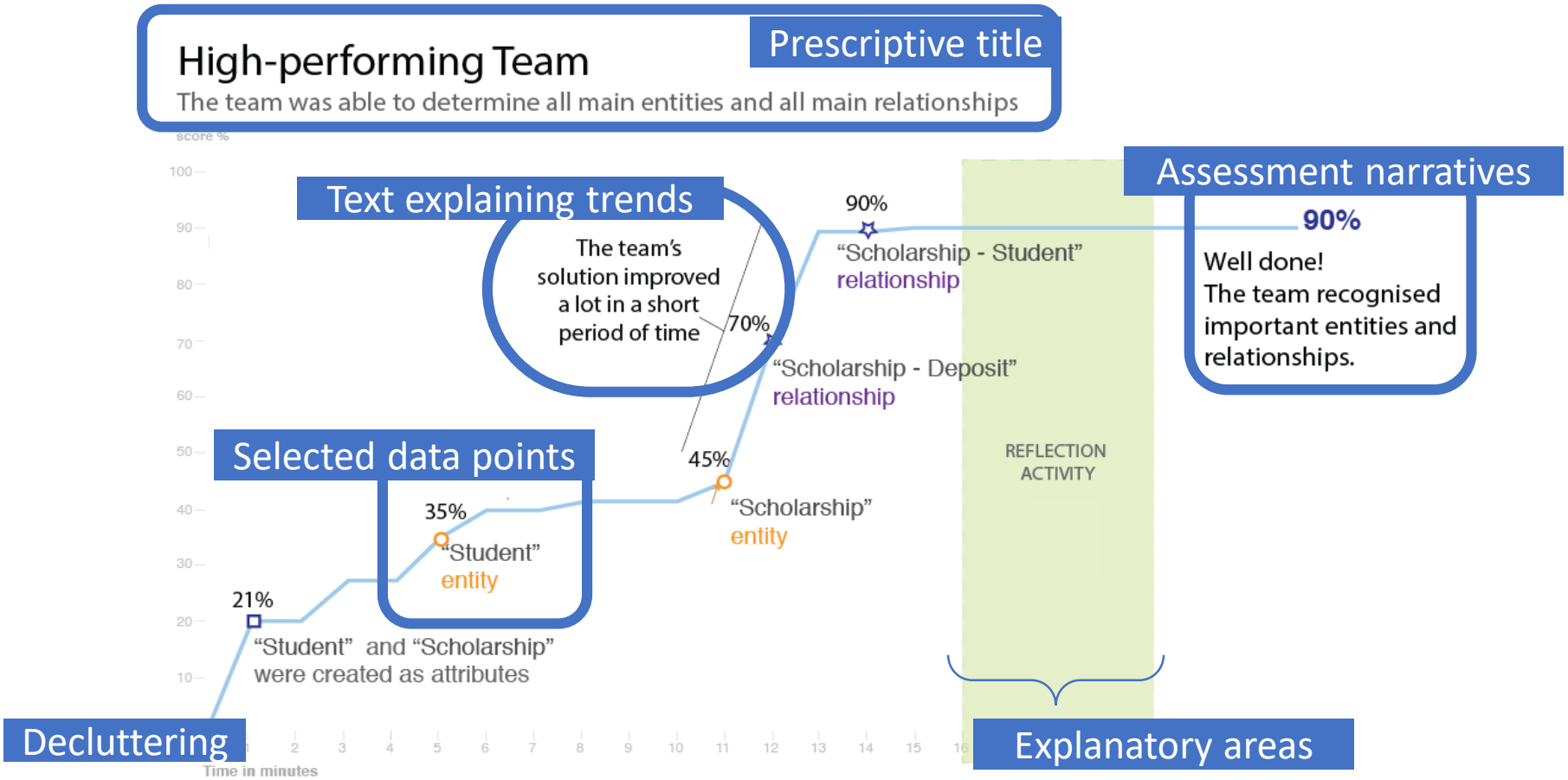
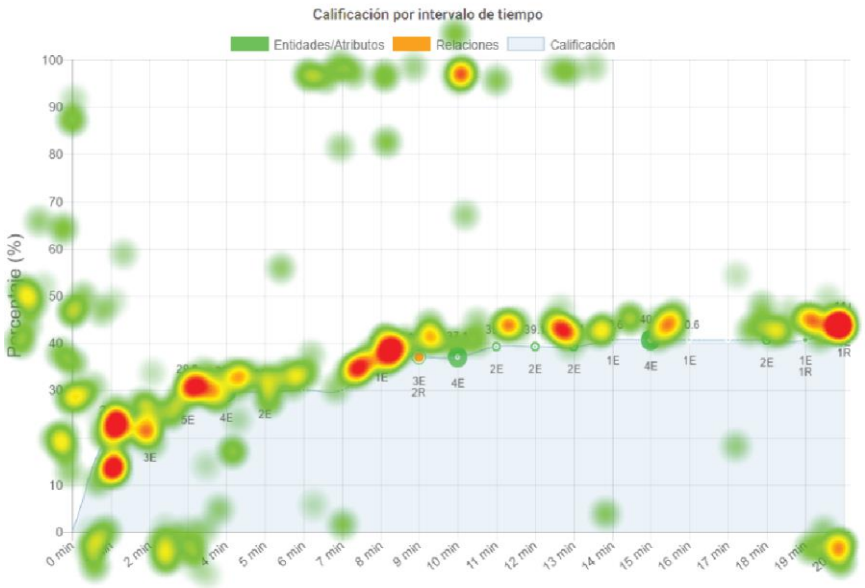


Explanatory visualisation about student's performance

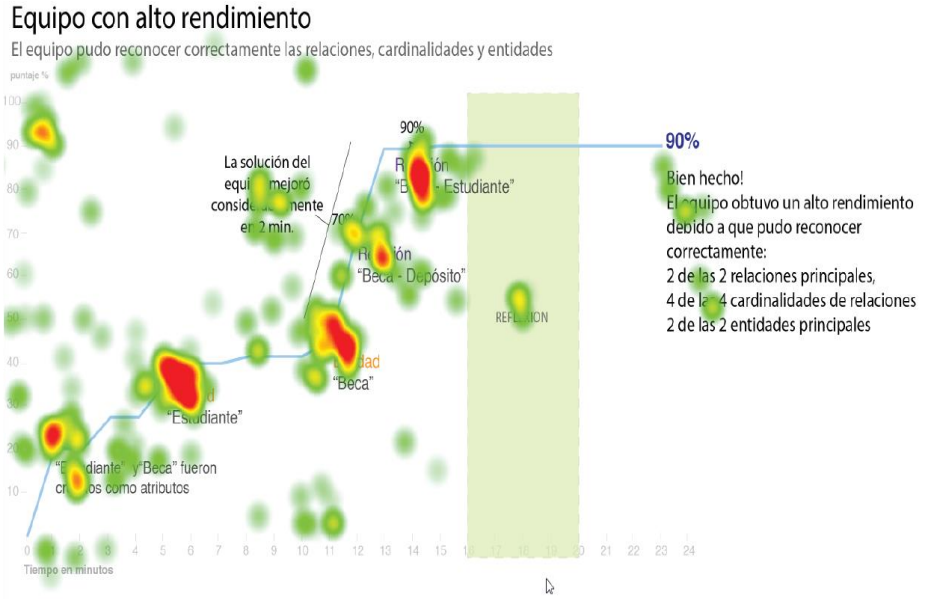


Preliminary analysis

Exploratory visualisation



Explanatory visualisation



Echeverria, V., **Martinez-Maldonado, R**. Granda, R., Chiluiza, K., Conati, C., and Buckingham Shum, S. (2018) Exploratory versus Explanatory Visual Learning Analytics: Driving Teachers' Attention through Educational Data Storytelling. *Journal of Learning Analytics (under review).*

Two items for the future Learning Analytics agenda?

Learning Analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs.

1st International Conference on Learning Analytics and Knowledge, Banff, Alberta, February 27–March 1, 2011

1- Embracing complexity:

collaboration and learning involve cognitive, affective, social and **physical** processes?

2- Focusing on human factors:

Reporting, communicating or supporting the generation of **insights** rather than just reporting data

THANKS!

UTS:CIC
CONNECTED INTELLIGENCE CENTRE

Collaborators
and students

For more information
and literature visit:

bit.ly/utscic

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