Keynote, Learning Analytics Summer Institute Asia (LASI-Asia), Seoul, Sept. 2016
http://lasi-asia.org

Envisioning Learning Analytics for 21st Century Competencies

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UTS
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UTS:CIC
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utscic.edu.au

BEFORE WE GO ANY FURTHER…

Acknowledgements to CIC colleagues whose work I'll be sharing…

Ruth Deakin Crick

Professor of Learning Analytics & Educational Leadership

Theresa Anderson

MDSI Coordinator & Senior Lecturer

Roberto Maldonado Martinez

Research Fellow (Educational Data Science)

Simon Knight

Research Fellow (Writing Analytics)

Andrew Gibson

Research Fellow (Reflective Writing Analytics)

Shawn Wang

Developer

…and to the many others I've worked with, without whom I'd have nothing to say!

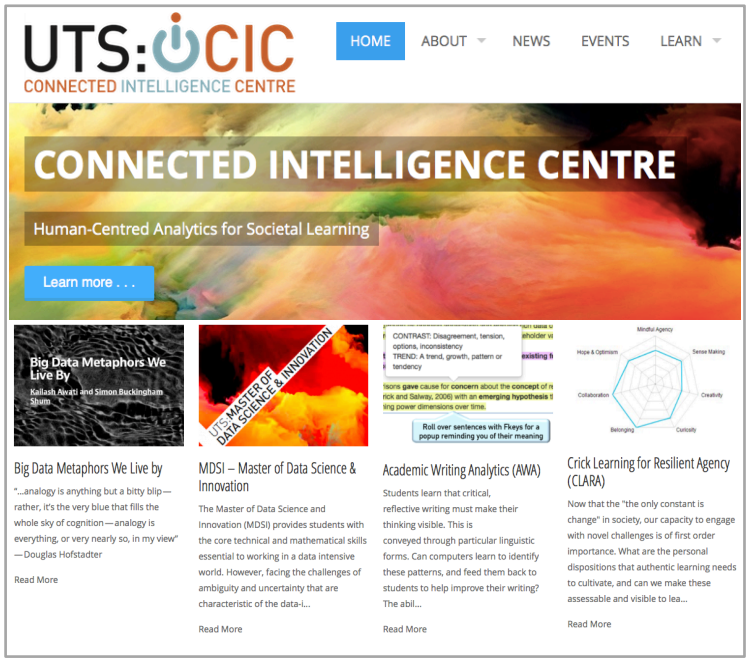
UTS CONNECTED INTELLIGENCE CENTRE

UTSCIC.EDU.AU

CIC catalyses the use of data and analytics among UTS students, educators, researchers and leaders

We teach human-centred data science • design analytics tools for UTS • evaluate these • disseminate internally and globally

We aim to shape debate on big data in education, and human-centred analytics in society



Why “C21 competencies”?

Wicked Problems

Future of Work

Data:Analytics:AI

Wicked problems — academic analysis since the late 1960s (Horst Rittel)

Now spanning policy, management, education, computing…

Try a Google Scholar search on "wicked problems"

"A wicked problem is one for which ***each attempt to create a solution changes the understanding of the problem****.*

Wicked problems always occur in a ***social context*** *— the wickedness of the problem reflects the* ***diversity among the stakeholders*** *in the problem."*

Overview at CogNexus Institute by Jeff Conklin, student of Horst Rittel
http://www.cognexus.org/id42.htm

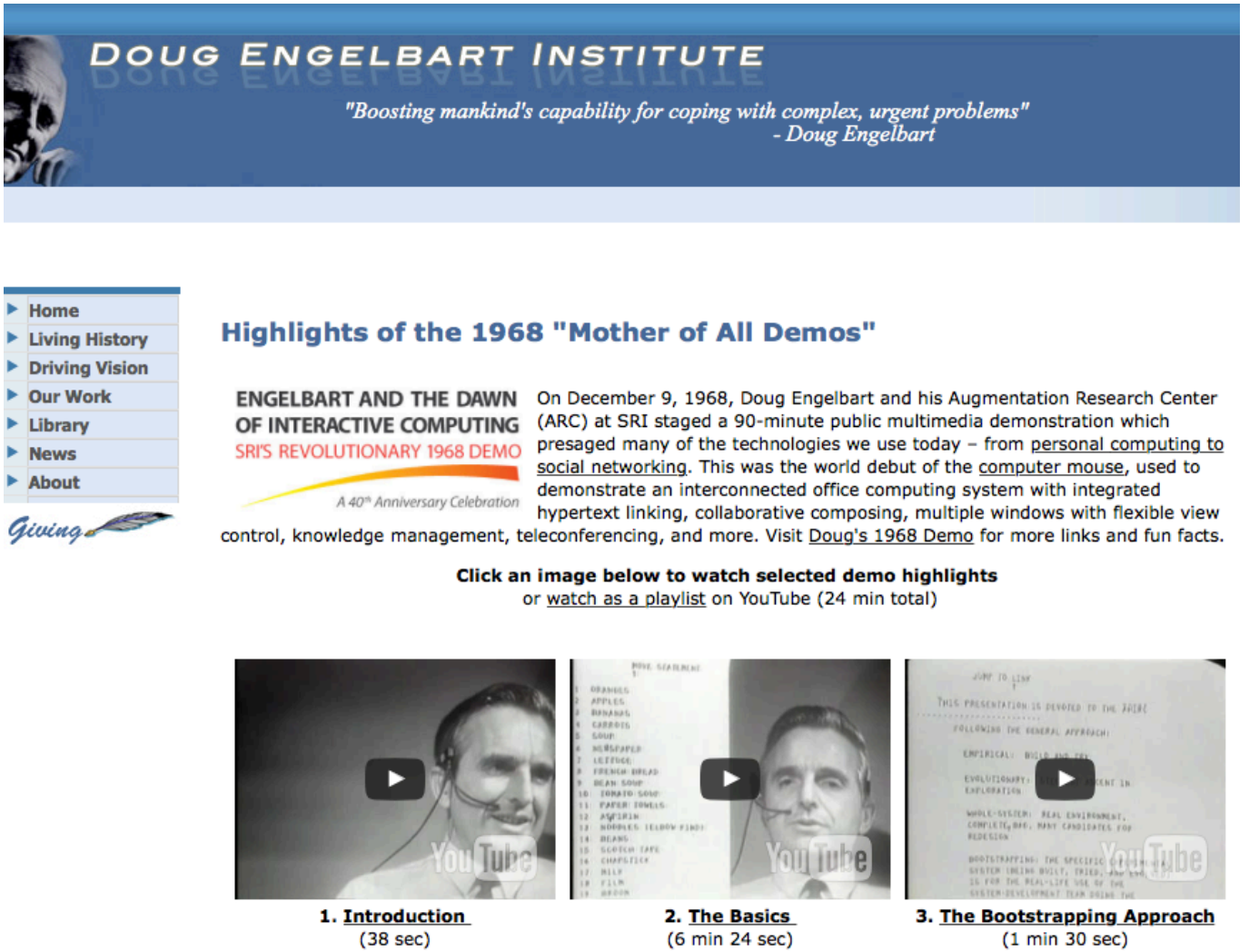
Wicked problems are widely recognised as presenting serious challenges to conventional policy, strategy and design practice

http://www.apsc.gov.au/publications-and-media/archive/publications-archive/tackling-wicked-problems

Techniques for tackling wicked problems are now out of the labs, road-tested, and being documented in accessible forms for practitioners, e.g.

http://hereticsguidebooks.com

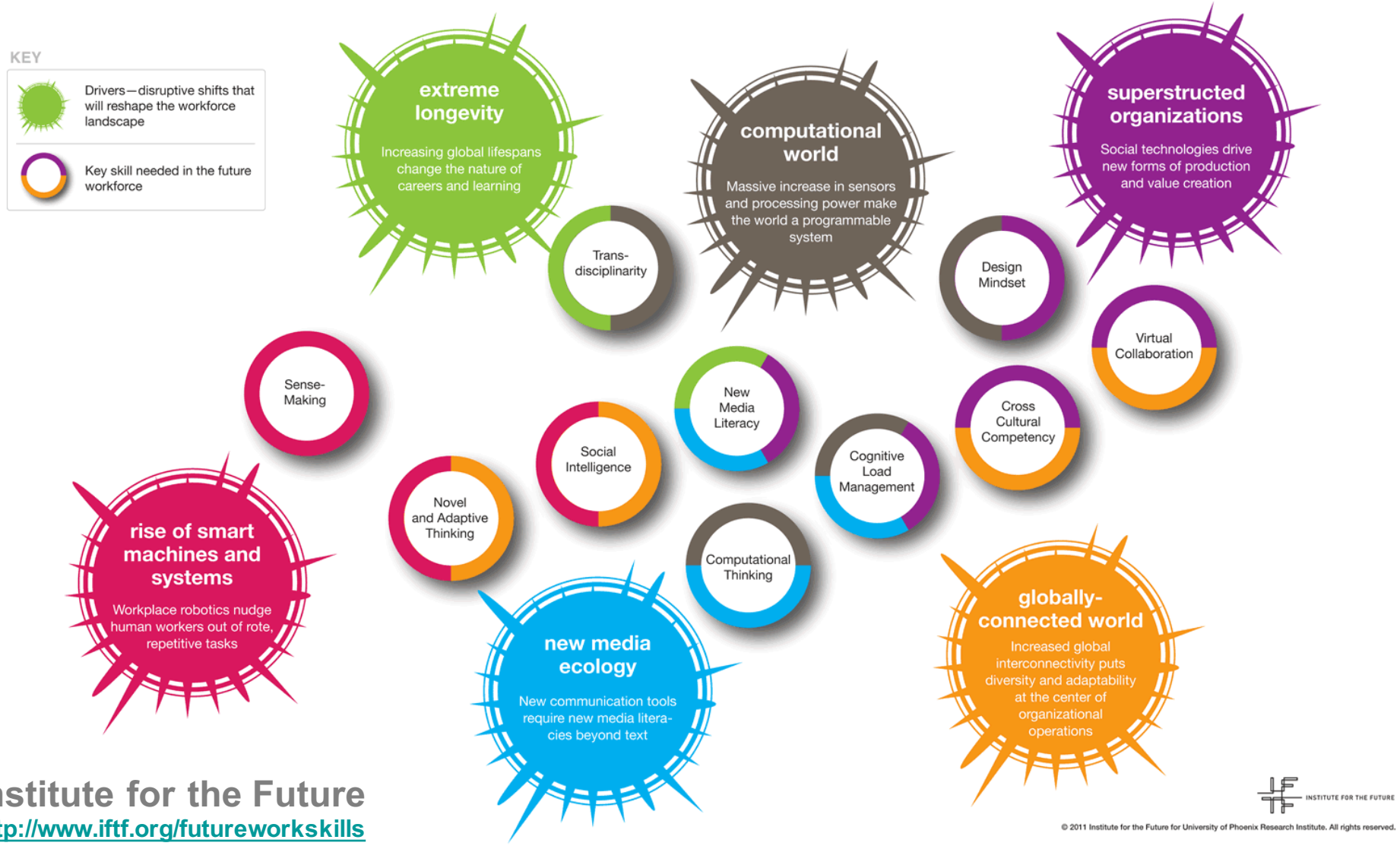
Computational support for tackling wicked problems also goes back to the early 1960s



http://dougengelbart.org/events/1968-demo-highlights.html

Future Work Skills 2020

While all six drivers are important in shaping the landscape in which each skill emerges, the color-coding and placement here indicate which drivers have particular relevance to the development of each of the skills.



Institute for the Future

http://www.iftf.org/futureworkskills

INSTITUTE FOR THE FUTURE

C21
competencies

1 SENSE-MAKING

DEFINITION: *ability to determine the deeper meaning or significance of what is being expressed*

2 SOCIAL INTELLIGENCE

DEFINITION: *ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions*

3 NOVEL & ADAPTIVE THINKING

DEFINITION: *proficiency at thinking and coming up with solutions and responses beyond that which is rote or rule-based*

4 CROSS-CULTURAL COMPETENCY

DEFINITION: *ability to operate in different cultural settings*

5 COMPUTATIONAL THINKING

DEFINITION: *ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning*

6 NEW-MEDIA LITERACY

DEFINITION: *ability to critically assess and develop content that uses new media forms, and to leverage these media for*

7 TRANSDISCIPLINARITY

DEFINITION: *literacy in and ability to understand concepts across multiple disciplines*

8 DESIGN MINDSET

DEFINITION: *ability to represent and develop tasks and work processes for desired outcomes*

9 COGNITIVE LOAD MANAGEMENT

DEFINITION: *ability to discriminate and filter information for importance, and to understand how to maximize cognitive functioning using a variety of tools and techniques*

10 VIRTUAL COLLABORATION

DEFINITION: *ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team.*

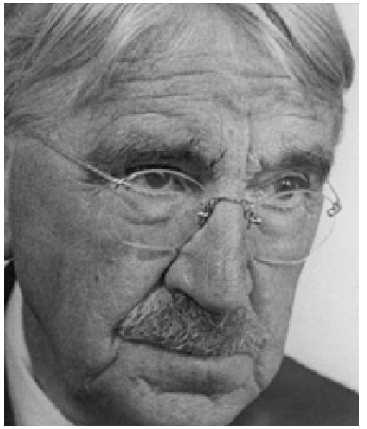
Institute for the Future
http://www.iftf.org/futureworkskills

Knowledge, Skills & Dispositions

"Knowledge of methods alone will not suffice: there must be the desire, the will, to employ them.

This desire is an affair of personal disposition."

John Dewey



Dewey, J. *How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process*. Heath and Co, Boston, 1933

Knowledge, Skills & Dispositions

"It's more than knowledge and skills. For the innovation economy, **dispositions** come into play:

readiness to collaborate;

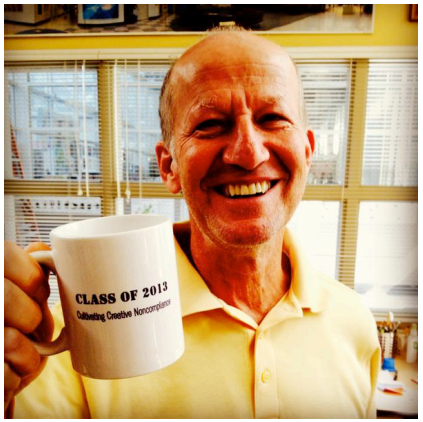
attention to multiple perspectives;

initiative;

persistence;

curiosity."

Larry Rosenstock



High Tech High
San Diego
hightechhigh.org

LearningREimagined project: http://learning-reimagined.com
Larry Rosenstock: http://audioboo.fm/boos/1669375-50-seconds-of-larry-rosenstock-ceo-of-hightechhigh-on-how-he-would-re-imagine-learning

Knowledge, Skills & Dispositions

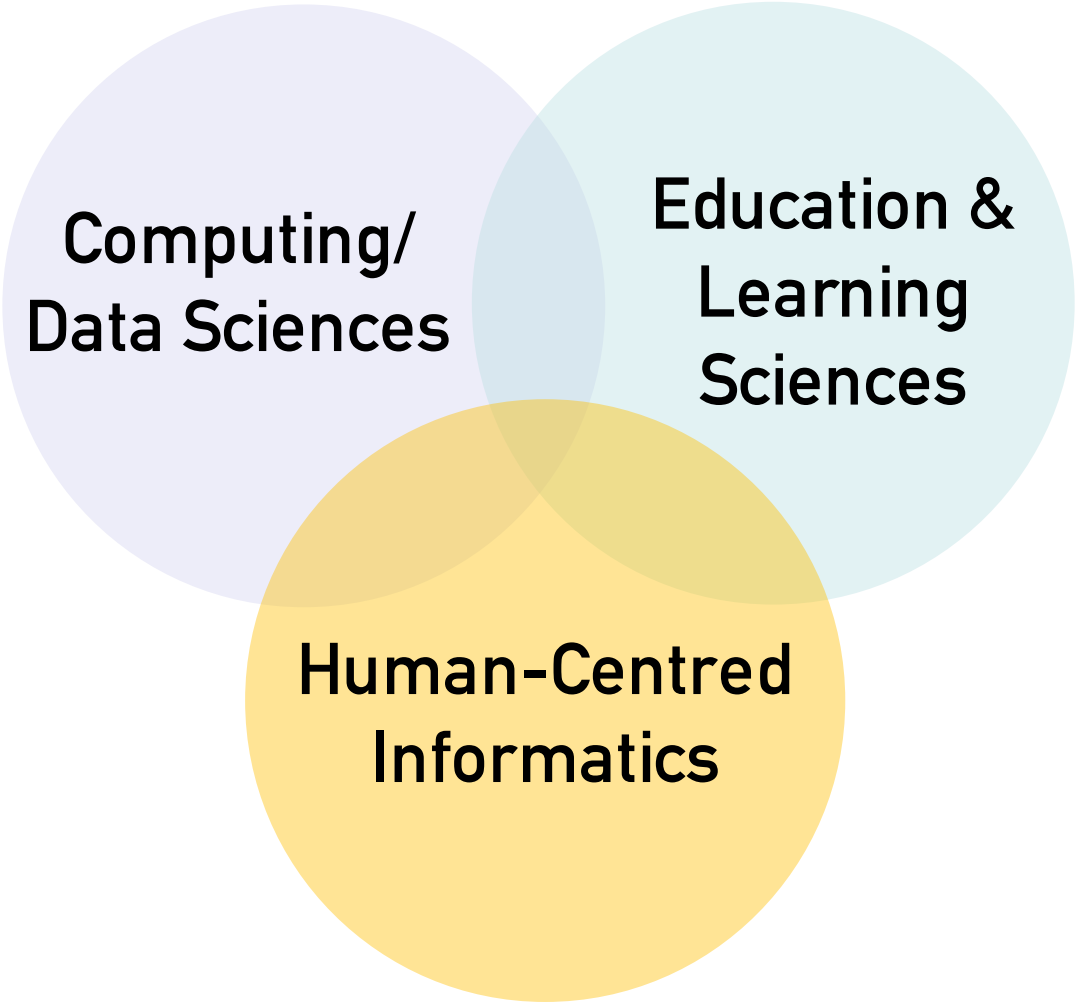
"One of the key issues emerging from these findings was the learner's orientation towards the unknown, uncertainty and ambiguity, and their tendency to either retreat from it or move into it. The former effectively precludes deep learning, and the latter is the beginning point for it."

Ruth Deakin Crick & Chris Goldspink

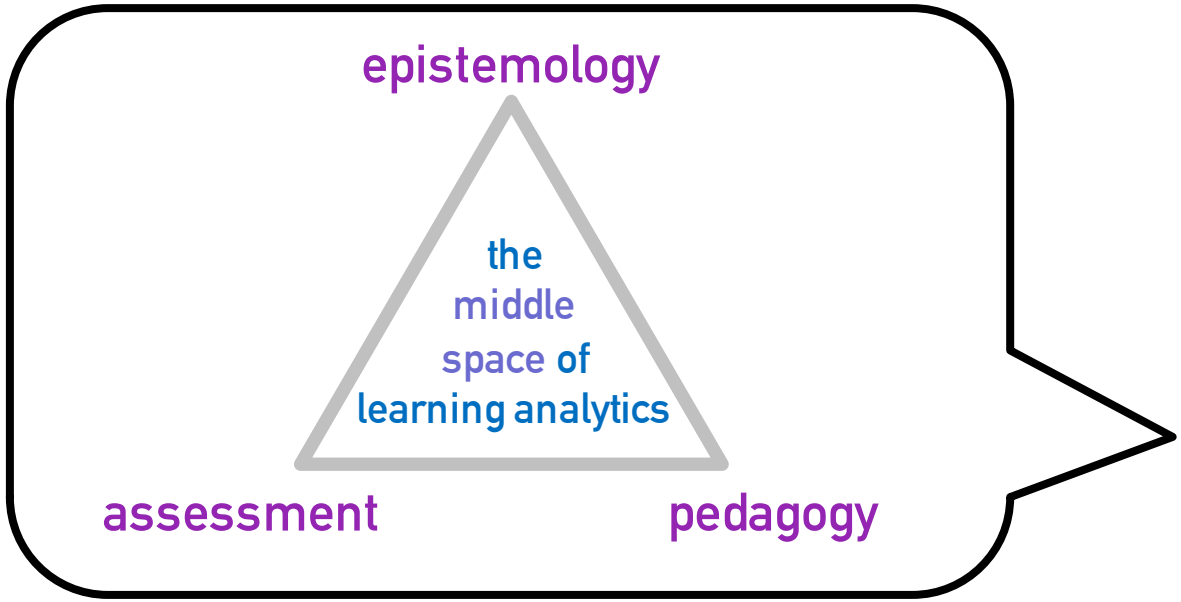
Deakin Crick R. and Goldspink G. (2014) Learning Dispositions, Self-theories and Student Engagement, *British Journal of Educational Studies*, 62,1,1-17. DOI: http://dx.doi.org/10.1080/00071005.2014.904038

learning analytics

Learning Analytics: a form of computational social science



Cautionary note: Learning Analytics are not neutral



What kinds of learner activity do the analytics value by tracking it?
(so what is not valued?)

Do the analytics value the same things as the official assessment regime?

Do learners see the analytics? What does this say about the pedagogy?

Knight, S., Buckingham Shum, S. and Littleton, K. (2014). Epistemology, Assessment, Pedagogy: Where Learning Meets Analytics in the Middle Space. *Journal of Learning Analytics*, 1, (2), pp.23-47. http://epress.lib.uts.edu.au/journals/index.php/JLA/article/download/3538/4156
Knight, S. and Buckingham Shum, S. (In Press). *Theory & Learning Analytics. Handbook of Learning Analytics & Educational Data Mining.*

C21?

learning analytics

As analytics aggregate lower level data
& A.I. gradually automates lower order skills…

Humans must move to the higher ground…

- Train data scientists to combine algorithmic intelligence with the deep skills that won't be automated (anytime soon)
- Deploy all the Educational & Data Science expertise we have to cultivate the higher order graduate qualities

As analytics aggregate lower level data
& A.I. gradually automates lower order skills…

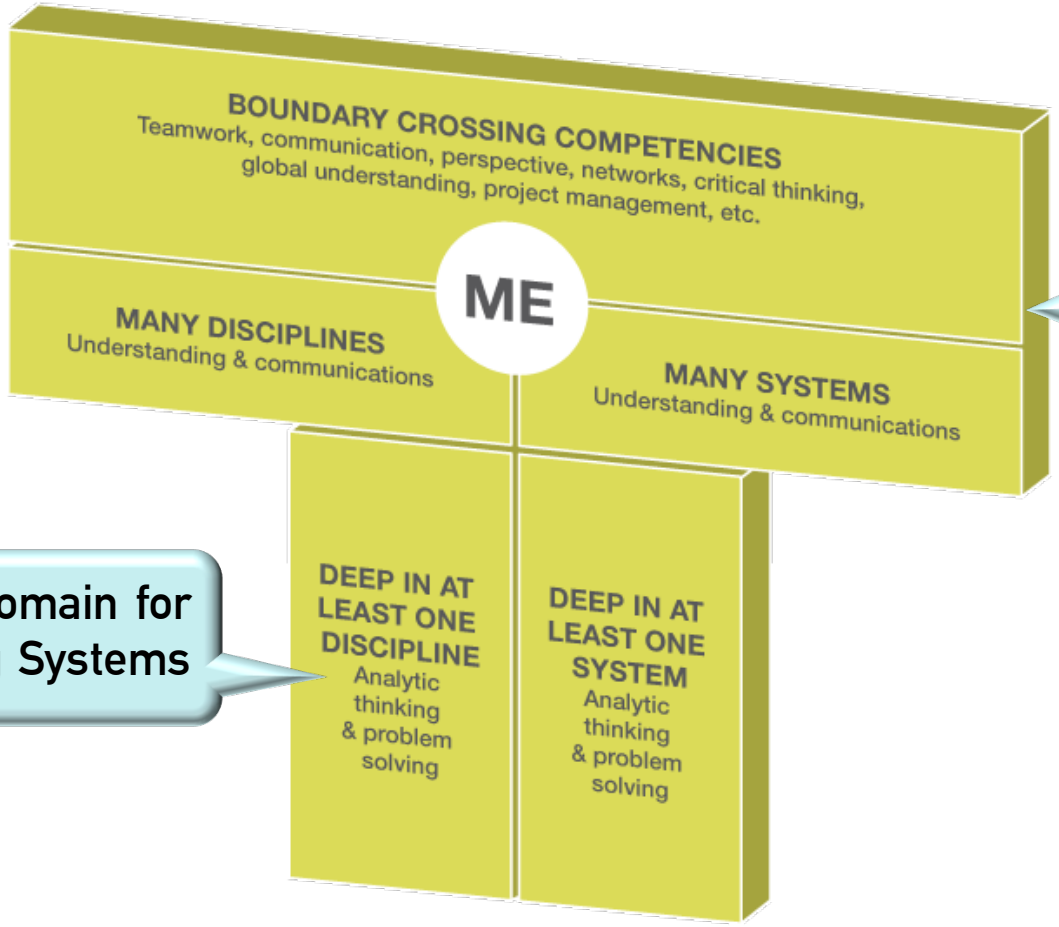
Cultivate those higher qualities that are distinctively human and devise practical, authentic ways to evidence them

Humans must move to the higher ground…

- Train data scientists to combine algorithmic intelligence with the deep skills that won't be automated (anytime soon)
- Deploy all the Educational & Data Science expertise we have to cultivate the higher order graduate qualities

As analytics aggregate lower level data
& A.I. gradually automates lower order skills…

Can learning analytics help cultivate the crossbar for T-shaped graduates?



New process-centric feedback possibilities for Learning Analytics

Traditional domain for Intelligent Tutoring Systems

http://tsummit.org/t

C21 analytics:

self-report & observation

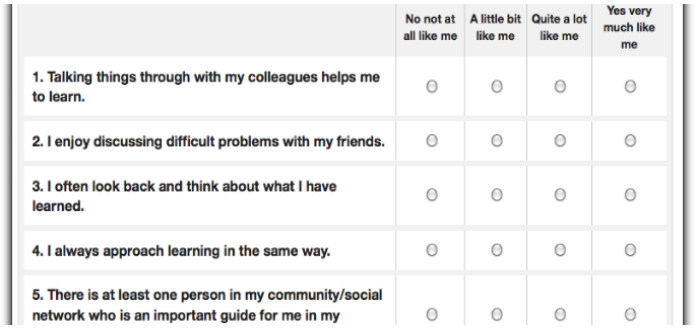
Assessing learning dispositions: Crick Learning for Resilient Agency survey

	No, not at all like me	A little bit like me	Quite a lot like me	Yes, very much like me
I make connections between what I am learning and what I have learned before.	○	○	○	○
I enjoy trying out new ways of learning.	○	○	○	○
I know I can find a way of solving a problem if I have enough time to think.	○	○	○	○
Sometimes good ideas just come into my head.	○	○	○	○
Remembering what I already know often helps me to learn something new.	○	○	○	○
I have a sense of myself getting better at learning.	○	○	○	○
If I find something really hard to learn, I usually think it's because I'm not very clever.	○	○	○	○

Deakin Crick, R., S. Huang, A. Ahmed Shafi and C. Goldspink (2015). Developing Resilient Agency in Learning: The Internal Structure of Learning Power. *British Journal of Educational Studies*: Published online: 24 Mar 2015. http://dx.doi.org/10.1080/00071005.2015.1006574

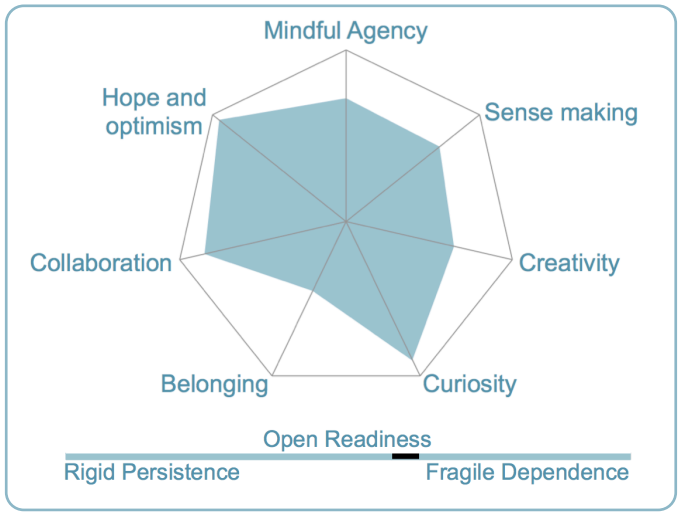
Immediate visual analytic generated by CLARA

(Individual and cohort profiles + detailed reports + spreadsheets enabling further analysis)



	No not at all like me	A little bit like me	Quite a lot like me	Yes very much like me
1. Talking things through with my colleagues helps me to learn.	O	O	O	O
2. I enjoy discussing difficult problems with my friends.	O	O	O	O
3. I often look back and think about what I have learned.	O	O	O	O
4. I always approach learning in the same way.	O	O	O	O
5. There is at least one person in my community/social network who is an important guide for me in my	O	O	O	O

Rapid Visual Feedback to Stimulate Self-Directed Change



A framework for reflection and coaching

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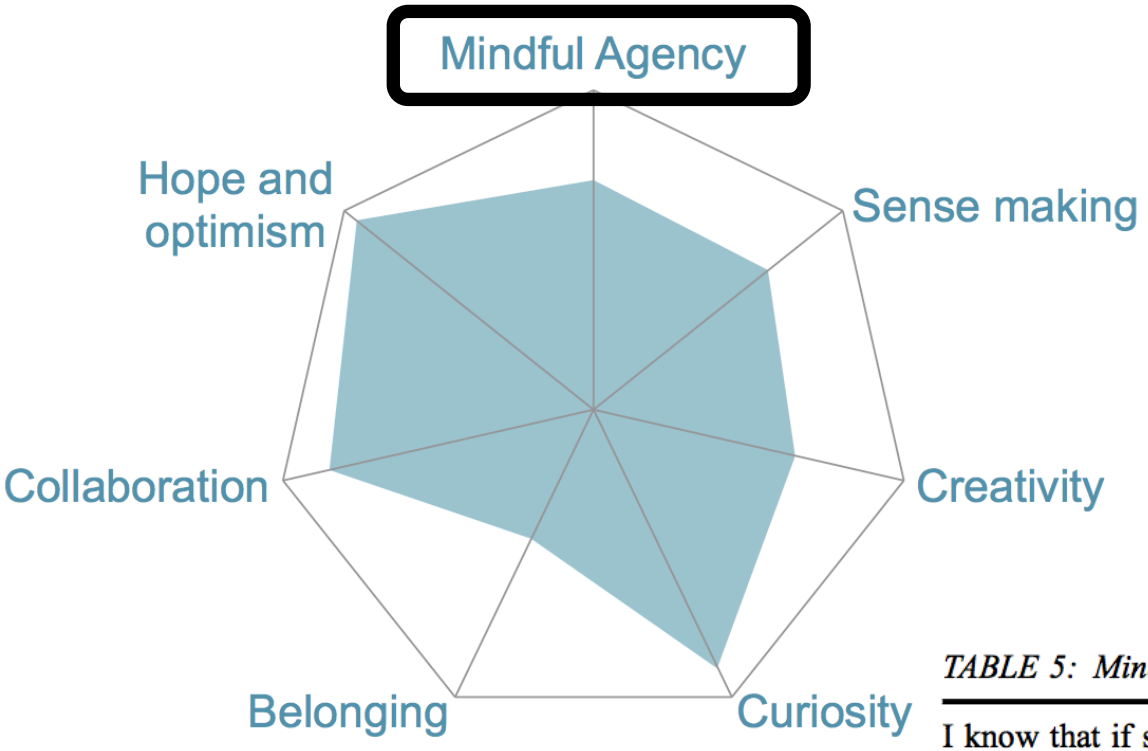


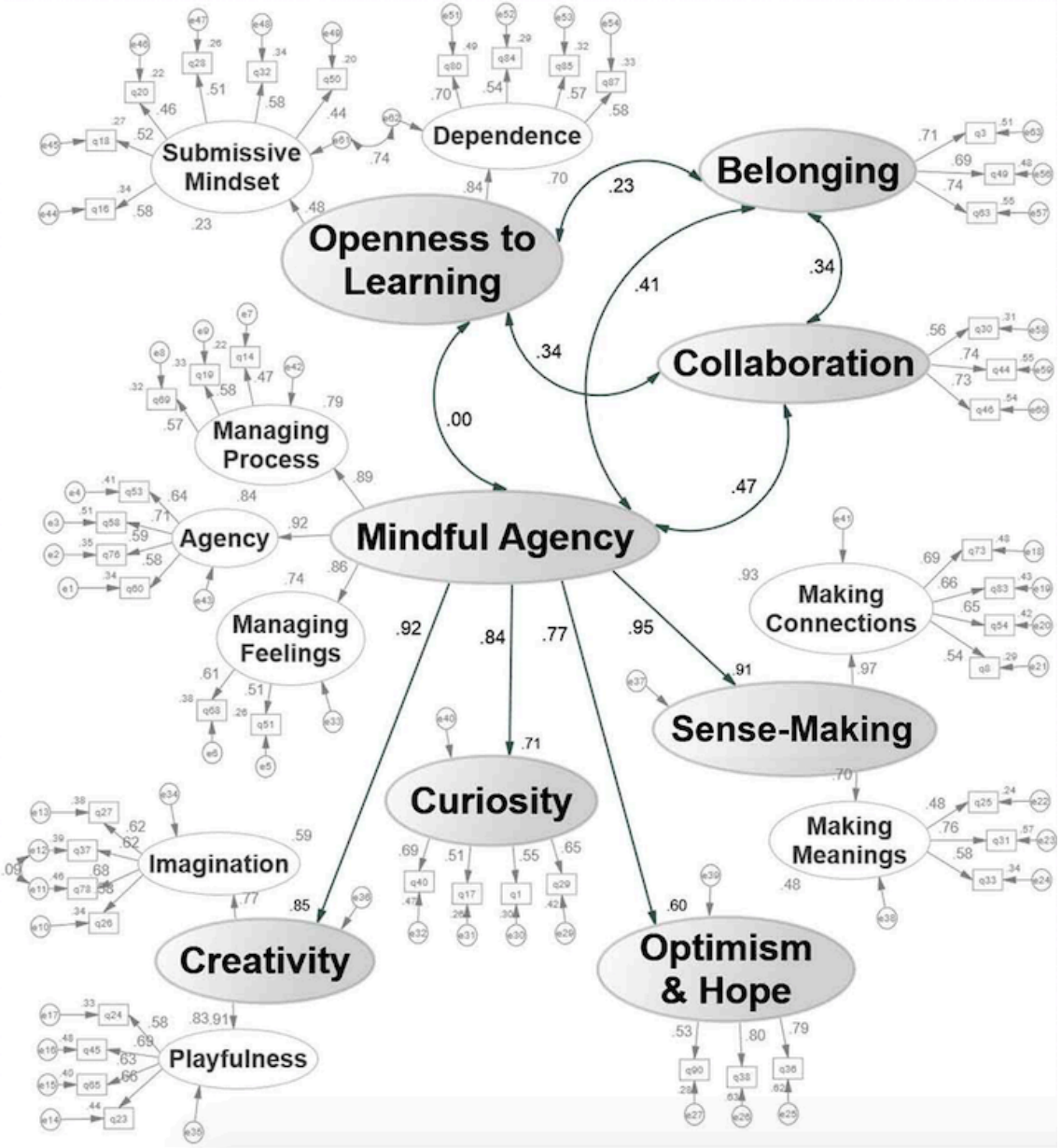
Taking responsibility for my own learning over time through defining my purposes, understanding and managing my feelings, knowing how I go about learning & planning my learning journey carefully.

Deakin Crick, R., S. Huang, A. Ahmed Shafi and C. Goldspink (2015). Developing Resilient Agency in Learning: The Internal Structure of Learning Power. *British Journal of Educational Studies*: Published online: 24 Mar 2015. http://dx.doi.org/10.1080/00071005.2015.1006574

TABLE 5: Mindful agency scale[1]

I know that if something is important I can find a way to learn it	Agency
I know I can learn in my own way, even if my colleagues think it's a waste of time	
I know I can find a way of solving a problem if I have enough time to think	
I enjoy improving the way I go about things	
I have ways of making myself learn if I don't feel like learning	Managing feelings
If I get distressed when I'm learning, I'm pretty good at finding ways of feeling better	
I tend to be careful and logical in my approach to learning	Managing processes
I think about everything that I will need before I begin a task	
I can generally predict how long it will take me to learn something	

Structural Equation Model underpinning CLARA



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ReView

Explaining to students how their grades are shaped by different Graduate Attributes

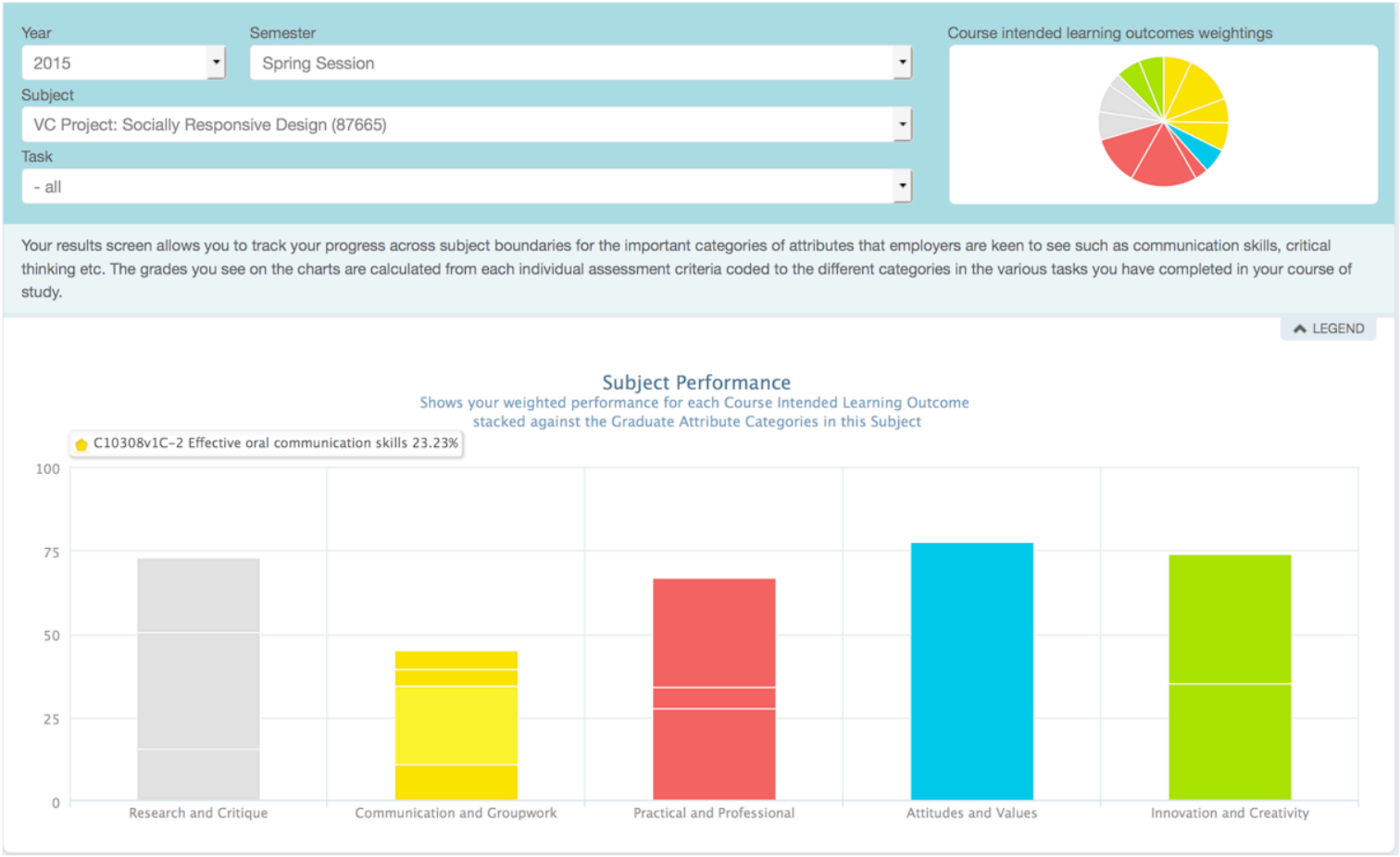


Figure 5: Student screen showing their assessment results in the five CAPRI attribute categories in one subject or unit of study

Thompson, D. (2016). Marks Should Not Be the Focus of Assessment — But How Can Change Be Achieved? *Journal of Learning Analytics*, *3* (2), 193–212. http://dx.doi.org/10.18608/jla.2016.32.9

ReView

Visual interface for **self-assessment**, enabling benchmarking against **cohort** average, and the **tutor's assessment**

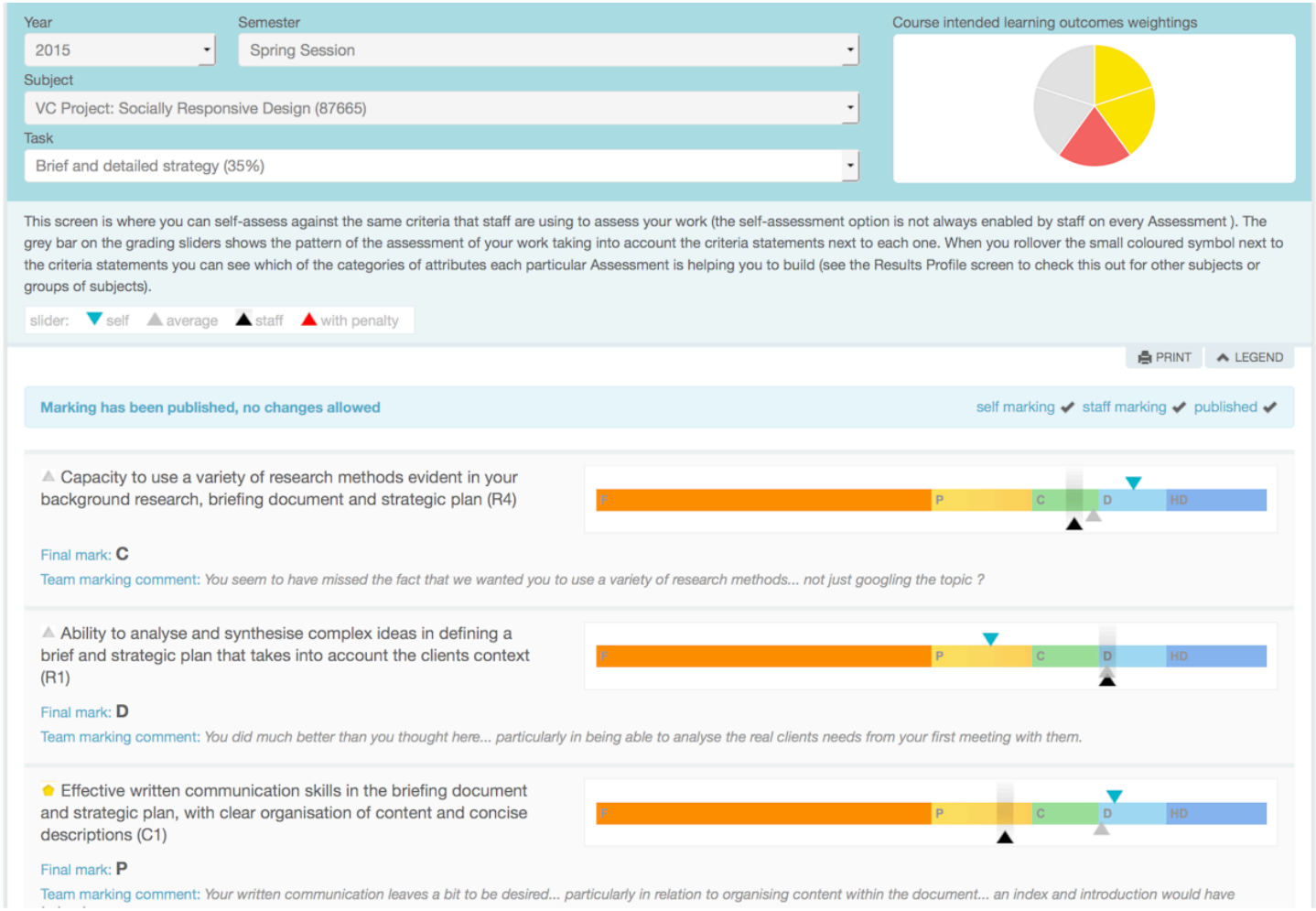


Figure 4: Student view of the marking screen for a task after a staff member has marked and published their own gradings and comments

Thompson, D. (2016). Marks Should Not Be the Focus of Assessment — But How Can Change Be Achieved? *Journal of Learning Analytics*, *3* (2), 193–212. http://dx.doi.org/10.18608/jla.2016.32.9

Student Effort Tracking & Visualisation

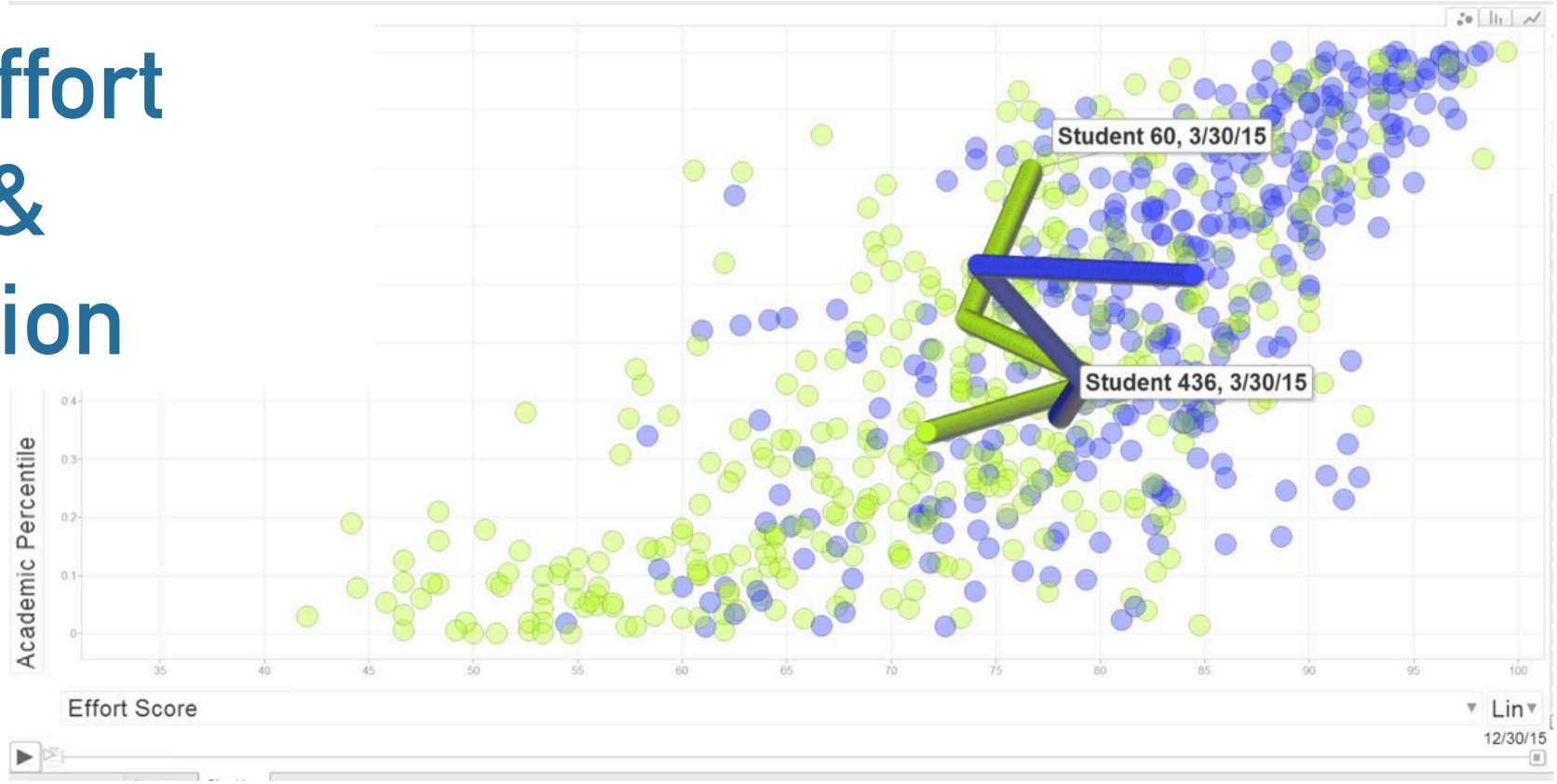


Fig.8. Motion or 'bubble' chart displaying two unique student tracks

To see a demonstration of the motion chart's animation, see: https://vimeo.com/168306314

Nagy, R. (2016). Tracking and visualizing student effort: Evolution of a practical analytics tool for staff and student engagement. *Journal of Learning Analytics, 3* (2), 165–193. http://dx.doi.org/10.18608/jla.2016.32.8

Effort Tracking Rubric

	5- Outstanding	4- Very Good	3- Good	2- Fair	1- Unsatisfactory
	Classroom Conduct and Attitude, Politeness and Respect, Consideration for the Learning of Others				
Behaviour	Proactively models positive classroom behaviour and attitude at all times, avoids distraction and shows respect and consideration for others. Is polite and courteous at all times.	Consistently demonstrates good behaviour and attitude conducive to learning and avoids distractions in class.	Usually demonstrates a positive attitude in class and is rarely distracted.	Generally shows a positive attitude in class but is sometimes distracted or inconsiderate of the learning of others.	Rarely exhibits conduct and attitude appropriate for a conducive learning environment.
	Self-discipline, Self-reflection, Independent Motivation, Persistence, Conscientious Application to Classwork and Homework				
Diligence	Demonstrates an excellent approach to all activities in class and at home, presenting work to the best of his/her ability at all times and bringing all required equipment to class. Is independently motivated and disciplined and takes pride in the quality of all work produced, frequently exceeding expectations of conscientiousness and persistence.	Completes all work to a high personal standard in a timely manner and fulfils all expectations for coursework. Brings all equipment to class. Demonstrates a self-disciplined approach to all activities and often independently persists when academically challenged.	Usually completes work to a good personal standard, brings equipment to class and demonstrates self-discipline in application to coursework.	Shows some self-discipline in completing most coursework with a reasonable level of application.	Rarely fulfils expectations with regard to self-discipline, conscientiousness and application to coursework.
	Classroom Focus, Communication (Verbal and Body Language), Personal Presentation and Punctuality, Participation and Contribution in Groups and Class				
Engagement	Consistently demonstrates the highest standards of attention and focus in class, contributing where appropriate to group or classroom forums and/or demonstrating active listening skills at all times. Is always punctual and well-presented.	Actively listens to all teacher explanations and instructions and where appropriate, participates in group and class forums. Is punctual and well-presented.	Usually demonstrates good focus in class, listening to teacher instructions and explanations and appropriately participating in group and class forums. Is usually punctual and well-presented.	Is generally well-focused and on-task in class, participating from time to time in group class forums.	Is rarely focused in class and often off-task.

Nagy, R. (2016). Tracking and visualizing student effort: Evolution of a practical analytics tool for staff and student engagement. *Journal of Learning Analytics*, *3* (2), 165–193. http://dx.doi.org/10.18608/jla.2016.32.8

C21 analytics…

from self-report/obs.

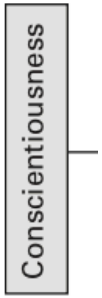
to behaviour

C21 analytics…

from clicks to constructs

From self-report to activity analytics for dispositions?

Proxies for "Conscientiousness"?



Shute, V. J. and M. Ventura (2013). *Stealth Assessment: Measuring and supporting learning in video games.* Cambridge, MA, MIT Press.

Figure 5 from report to The John D. and Catherine T. MacArthur Foundation Reports on Digital Media and Learning
http://myweb.fsu.edu/vshute/pdf/Stealth_Assessment.pdf

From self-report to activity analytics for dispositions?

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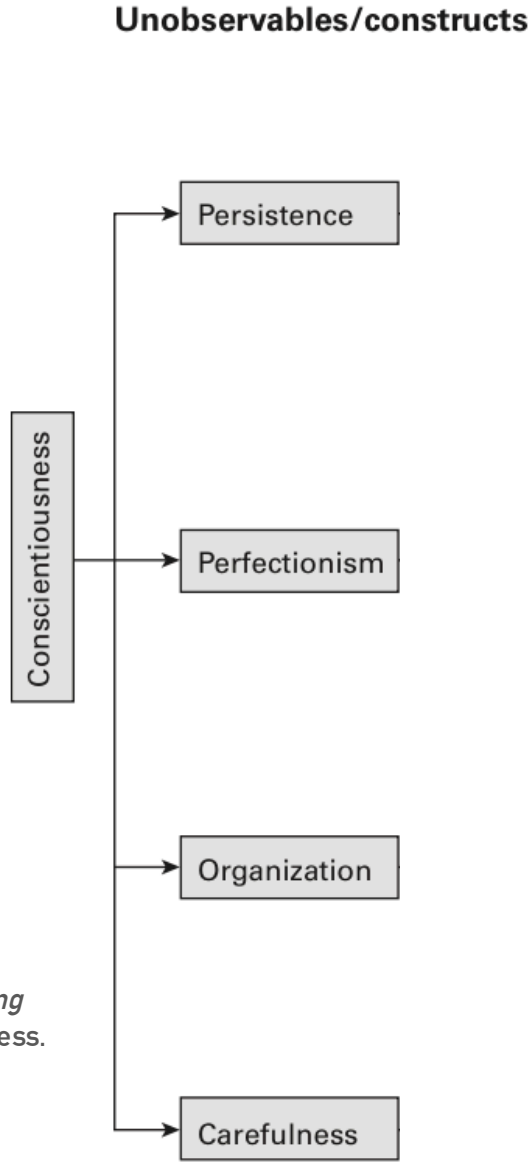

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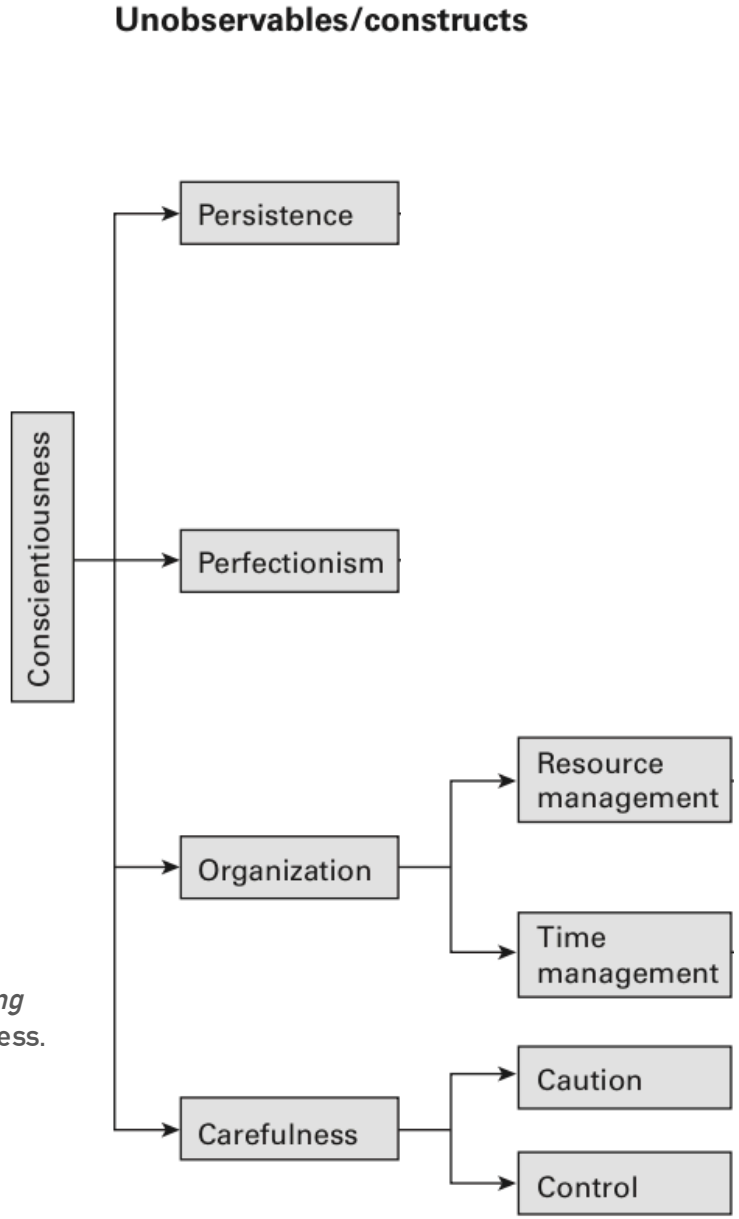

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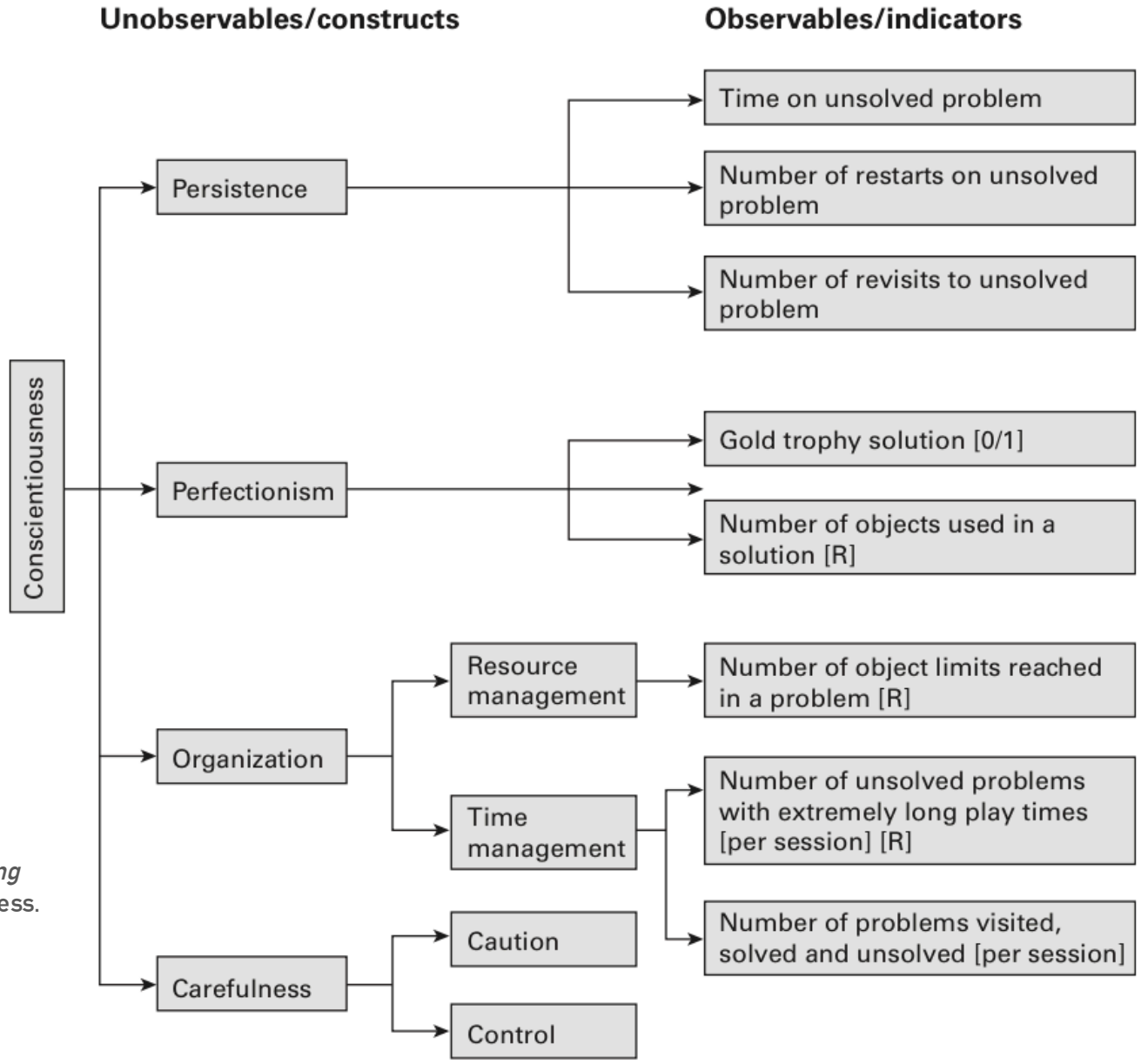

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http://myweb.fsu.edu/vshute/pdf/Stealth_Assessment.pdf

From clicks to constructs in the iRemix system

Table 2. 21st century learning opportunities framework

DYN theme related to 21st century learning
Creative production: **Understanding and utilizing appropriate media, elaborating and refining ideas and work, creating new and worthwhile ideas, developing media literacy and technological fluency and confidence through production and participation**
Self-directed learning: **Reflecting on learning experiences and processes, personalizing learning through making connections with individual interests and goals, taking initiative, being a lifelong learner, developing self-direction, making decisions, seeking out information.**
Social learning: **Communicating and collaborating around work and ideas, being open to new ideas and perspectives, teaching and learning from others**

Martin, C., Nacu, D. & Pinkard, N. (2016). Revealing opportunities for 21st century learning: An approach to interpreting user trace log data. *Journal of Learning Analytics*, *3* (2), 37–87. http://dx.doi.org/10.18608/jla.2016.32.4

From clicks to constructs in the iRemix system

Table 2. 21st century learning opportunities framework

DYN theme related to 21st century learning	Intended learning opportunity
Creative production: **Understanding and utilizing appropriate media, elaborating and refining ideas and work, creating new and worthwhile ideas, developing media literacy and technological fluency and confidence through production and participation**	Define creator identity
	Create media
	Revise work
Self-directed learning: **Reflecting on learning experiences and processes, personalizing learning through making connections with individual interests and goals, taking initiative, being a lifelong learner, developing self-direction, making decisions, seeking out information.**	Use resources
	Monitor progress
	Seek support
	Seek opportunities
Social learning: **Communicating and collaborating around work and ideas, being open to new ideas and perspectives, teaching and learning from others**	Participate in groups
	Explore work of others
	Explore community
	Communicate

Martin, C., Nacu, D. & Pinkard, N. (2016). Revealing opportunities for 21st century learning: An approach to interpreting user trace log data. *Journal of Learning Analytics*, *3* (2), 37–87. http://dx.doi.org/10.18608/jla.2016.32.4

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Table 2. 21st century learning opportunities framework

DYN theme related to 21st century learning	Intended learning opportunity	Logged iRemix Action
Creative production: **Understanding and utilizing appropriate media, elaborating and refining ideas and work, creating new and worthwhile ideas, developing media literacy and technological fluency and confidence through production and participation**	Define creator identity	Edit profile page
	Create media	Post created media
	Revise work	Edit own work Resubmit work
Self-directed learning: **Reflecting on learning experiences and processes, personalizing learning through making connections with individual interests and goals, taking initiative, being a lifelong learner, developing self-direction, making decisions, seeking out information.**	Use resources	Open activity resource
	Monitor progress	View own pathway progress
	Seek support	Post question to educator about assignment
	Seek opportunities	View potential activity
Social learning: **Communicating and collaborating around work and ideas, being open to new ideas and perspectives, teaching and learning from others**	Participate in groups	Create new group Join existing group
	Explore work of others	Open work of user
	Explore community	Open user profile Open user portfolio Open existing group Open existing forum
	Communicate	Post comment Provide critique rating

Martin, C., Nacu, D. & Pinkard, N. (2016). Revealing opportunities for 21st century learning: An approach to interpreting user trace log data. *Journal of Learning Analytics*, *3* (2), 37–87. http://dx.doi.org/10.18608/jla.2016.32.4

From clicks to constructs in the iRemix system

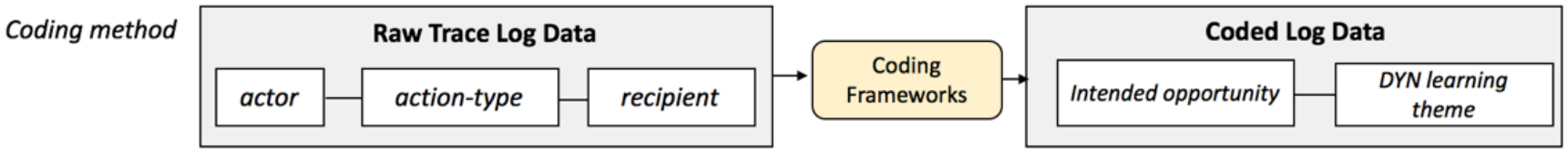

Figure 4. Summary of automated coding of raw trace log data

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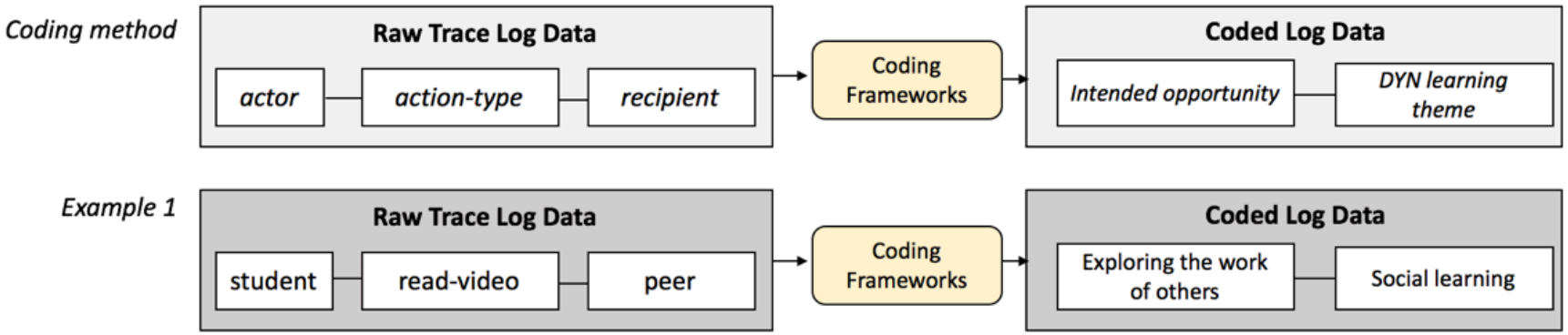

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From clicks to constructs in the iRemix system

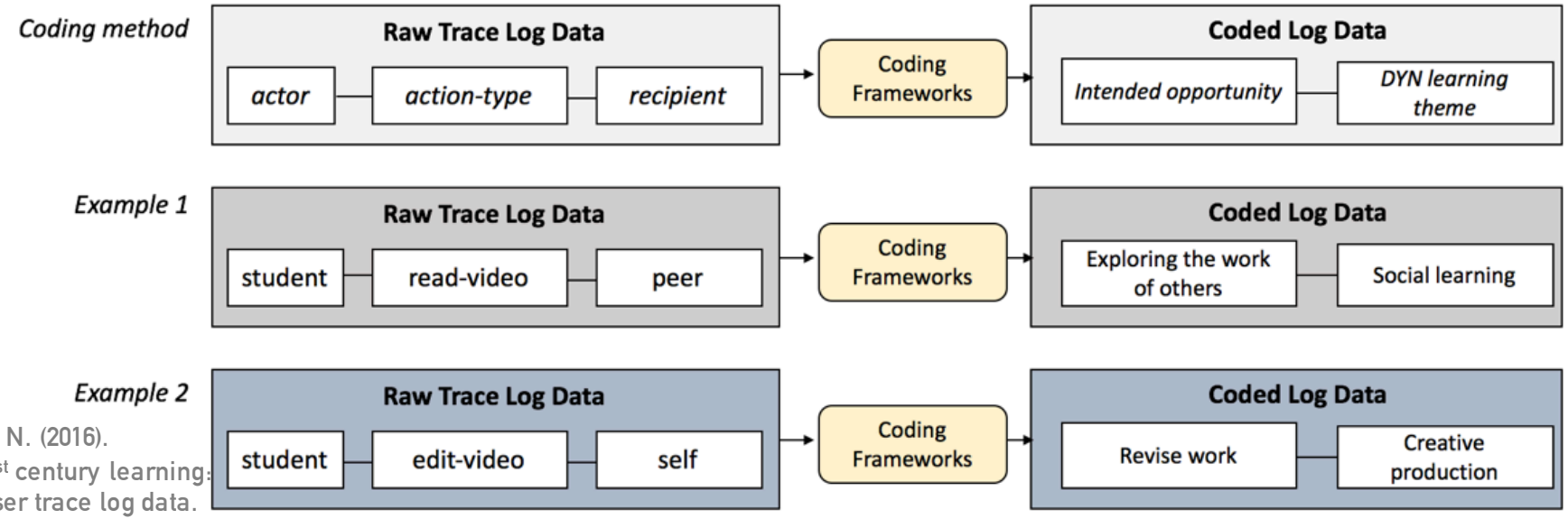
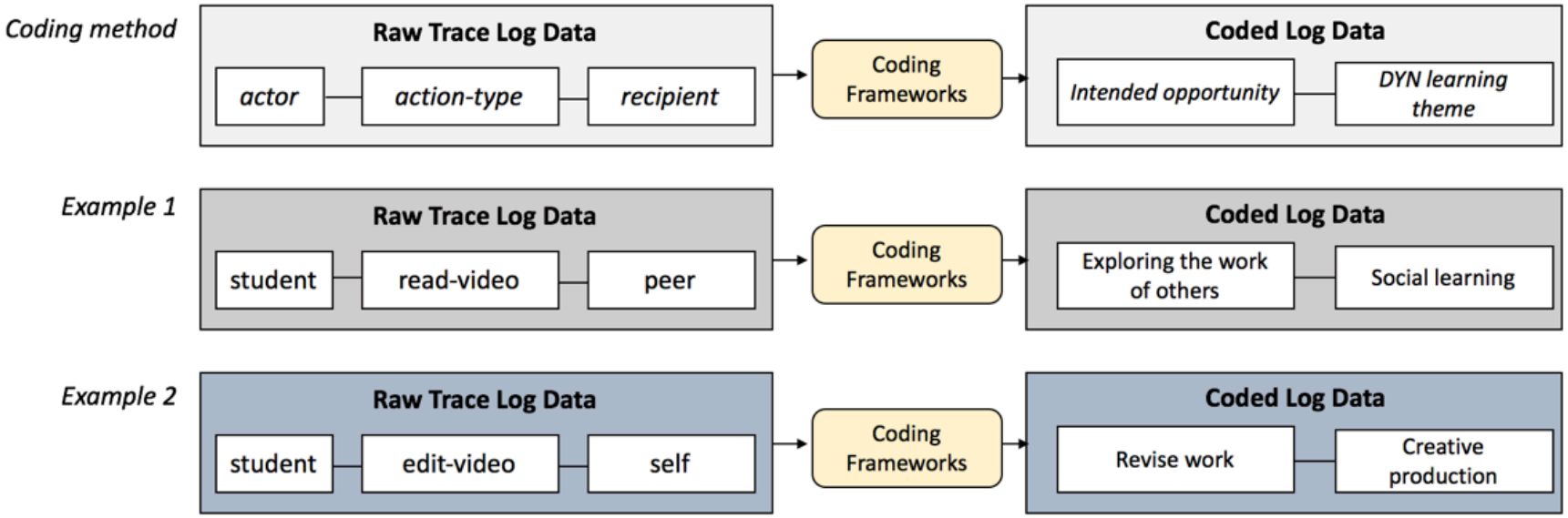


Figure 4. Summary of automated coding of raw trace log data

Martin, C., Nacu, D. & Pinkard, N. (2016). Revealing opportunities for 21st century learning: An approach to interpreting user trace log data. *Journal of Learning Analytics*, *3* (2), 37–87. http://dx.doi.org/10.18608/jla.2016.32.4

From clicks to constructs in the iRemix system

[…] the coding framework considers the actor and the recipient of the action. For Example 1 in **Figure 4**, if a student (the actor) clicks a button to view the posted video (action-type: read-video) of a peer (the recipient), this action will be coded as exploring the work of others, and linked to the higher level DYN learning theme of social learning. In Example 2 in **Figure 4**, if the log data indicates that the video was one that this particular user created (self), and the action is edit, it will be coded as reflecting the learning opportunity to revise work, which relates to the theme of creative production.



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NOVICE	BEGINNER	EMERGENT	COMPETENT
Believes that the goal of learning is mastery of stable, objective, generalizable knowledge and understandings, defined by experts		⟵	***THEME 1: EPISTEMIC STANDPOINT*** ⟶
VALUES ABSTRACT KNOWLEDGE	**VALUES APPLIED ABSTRACT KNOWLEDGE**	**VALUES APPLIED, CONTEXTUALIZED KNOWLEDGE**	**VALUES PRACTICAL WISDOM IN OWN CONTEXT**

From clicks to constructs in MOOCs

Defining a C21 capability of "Crowd-Sourced Learning"

Milligan, S. and Griffin, P. (2016). Understanding learning and learning design in MOOCs: A measurement-based interpretation. *Journal of Learning Analytics*, *3*(2), 88– 115. http://dx.doi.org/10.18608/jla.2016.32.5

	COMPETENT	EXPERT
PISTEMIC STANDPOINT		*See learning as growth in mastery in a domain; values practical wisdom and experience, including knowhow, attitudes, beliefs, values, ethics, and conventions; believes that knowledge changes, is context dependent, is widely distributed around networks, and is socially defined.*
E	**VALUES PRACTICAL WISDOM IN OWN CONTEXT**	**VALUES BROADLY DISTRIBUTED PRACTICAL WISDOM**

	COMPETENT	EXPERT
PISTEMIC STANDPOINT		*See learning as growth in mastery in a domain; values practical wisdom and experience, including knowhow, attitudes, beliefs, values, ethics, and conventions; believes that knowledge changes, is context dependent, is widely distributed around networks, and is socially defined.*
E he in nd	**VALUES PRACTICAL WISDOM IN OWN CONTEXT** **Breadth of attention**: scans the full range of MOOC features **Systematicity, orderliness, persistence**: persistent and systematic; engages strongly with authoritative teacher-supplied documents and feedback, and sometimes forums	**VALUES BROADLY DISTRIBUTED PRACTICAL WISDOM** **Breadth of attention**: eclectic in use of the range of MOOC elements, including texts, case studies, exercises such as quizzes, in-class responses; seeks inputs of experienced and expert peers through forums and other social media **Systematicity, orderliness, persistence**: engages with the range of elements of the course over the full duration of the course, persistently, frequently, and systematically **Perspective taking**: seeks out and explores diverse perspectives; curious; trusts value of learning from contexts unlike their own

NOVICE	BEGINNER	EMERGENT	COMPETENT
Believes that the goal of learning is mastery of stable, objective, generalizable knowledge and understandings, defined by experts		← ***THEME 1: EPISTEMIC STANDPOINT*** →	
VALUES ABSTRACT KNOWLEDGE **Breadth of attention:** focuses on content from authoritative sources; aims to cover course content	**VALUES APPLIED ABSTRACT KNOWLEDGE** **Breadth of attention:** focuses on range of inputs from authoritative texts and sources	**VALUES APPLIED, CONTEXTUALIZED KNOWLEDGE** **Breadth of attention**: scans the range of MOOC features **Systematicity and persistent:** in relation to authoritative texts and teacher-based feedback features	**VALUES PRACTICAL WISDOM IN OWN CONTEXT** **Breadth of attention**: scans the full range of MOOC features **Systematicity, orderliness, persistence**: persistent and systematic; engages strongly with authoritative teacher-supplied documents and feedback, and sometimes forums

Table 1: A theoretically derived developmental progression for C-SL capability with construct themes and their behavioural correlates.[2]

NOVICE	BEGINNER	EMERGENT	COMPETENT	EXPERT
Believes that the goal of learning is mastery of stable, objective, generalizable knowledge and understandings, defined by experts		***THEME 1: EPISTEMIC STANDPOINT***		*Sees learning as growth in mastery in a domain; values practical wisdom and experience, including knowhow, attitudes, beliefs, values, ethics, and conventions; believes that knowledge changes, is contextual, is widely distributed around networks, and is socially defined.*
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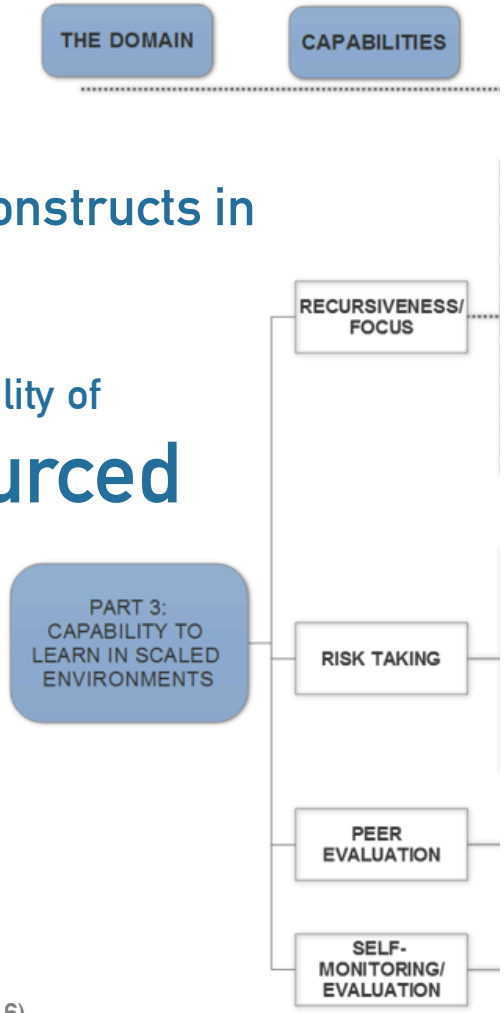
Sees learning as a process of individual consumption of expert knowledge; sees expert teachers as responsible for resources, processes, assessments, and standards		***THEMES 2 & 3: ORIENTATION TO TEACHING AND LEARNING***		*Sees learning as a messy, effortful, emotionally demanding co-production; regards teaching services as being diverse and distributed; believes learners in networks have the capacity and responsibility for teaching and supporting the learning of others*
INDEPENDENT CONSUMER of EXPERT KNOWLEDGE **Production**: completes graded exercises only	**INDEPENDENT CONSTRUCTOR OF LEARNING** **Production**: understands learning as the organized consumption of content from authoritative sources, and as a process of incorporation of knowledge and understanding; accesses teacher texts, and exercises and completes graded exercises only **Recursiveness:** focuses on teaching texts	**PARTICIPATIVE CONSTRUCTOR OF OWN LEARNING** **Production**: sees learning as involving both consumption and production. Tries out own understanding and knowledge, through accessing automated response features like quizzes **Recursiveness**: focuses on teaching texts and automated exercises and feedback **Dialogic activity, reciprocity, critical consumption, risk taking:** sees teachers as responsible for sourcing resources, content, ideas, assessments; experienced peers might assist in interpretation	**COLLABORATIVE CONSTRUCTOR OF OWN LEARNING** **Production**: sees learning as involving both consumption and production; tries out ideas, attitudes, theories; practices skills; generates "performances" **Recursiveness**: recursively interrogates available automated feedback from sources such as quizzes, automated feedback, or reflective processes or peer comment **Dialogic activity**: open to using opportunities for dialogue and collaboration with others; interested in observing others' views, especially if in contexts similar to own **Reciprocal learning/teaching**: recognizes that others might provide resources, ideas, or experience of value to own learning; open to sharing	**RECIPROCAL LEARNER/TEACHER, CONSTRUCTING OWN AND OTHERS' LEARNING** **Production**: sees learning as involving both consumption and production; actively tries out ideas, attitudes, theories; practices skills; actively and frequently generates "performances" with posts, essays, blogs, images; argues new positions; articulation of new processes; explores gaps **Recursiveness**: recursively interrogates available feedback on own performance from diverse sources such as quizzes, automated feedback, or reflective processes or peer comment, until value is exhausted **Dialogic activity**: creates opportunities for and engages in extended dialogue with others through viewing, posting and voting, and use of social media **Reciprocal learning/teaching**: recognized and acknowledged by peers for leadership in opinion, advice; takes responsibility for collective learning; values reciprocity in learning/teaching; uses crowd-sourcing; open to learning from diverse sources and working with diverse others; contributes to the learning of others **Critical consumption**: independent-minded, consumes critically, makes independent judgments of the relevance and value of inputs and contributions to learning; trusts own judgment of quality of input and acts on it **Risk taking**: open to reputational risk; expresses opinion; may generate negative response or express non-conformist views; open to risk of failure, trying new things, being confused, and emotionally involved
Regulated by course structure; relies on teacher/expert judgment to gauge success		***THEME 4: REGULATION OF LEARNING***		*Self-regulated; internalizes and reflects on standards; sets own learning goals and monitors, explores, supports, and evaluates own and others' learning, and adjusts learning accordingly*
EXTERNALLY REGULATED **Monitoring/evaluation**: Sees standards as fixed, external to self; relies on grading assessments	**EXTERNALLY REGULATED** **Monitoring/evaluation**: engages with grade-related assessment; sees standards as fixed, external to self; trusts guidance and judgments on performance from authoritative sources	**EXTERNALLY REGULATED** **Monitoring/evaluation**: engages with some formative assessment and feedback features of the MOOC; applies performance standards set by teachers to evaluate own and others performance for grading	**SELF-REGULATED** **Monitoring/evaluation**: engages with the range of assessment and feedback features of the MOOC; generates feedback on own performance on tasks; interested in other's performance **Peer evaluation:** applies performance standards set by teachers to evaluate own and others performance; conscientious in peer evaluation.	**SELF-REGULATED AND CO-REGULATING** **Monitoring/evaluation**: self-reflective; engages with the range of formal and informal assessment and feedback features of the MOOC; seeks to generate feedback and advice on own performance and the performance of others in tasks and at holistic level; seeks to reconcile conflicting feedback **Peer evaluation:** actively seeks out opportunities to collaborate, share, express, and share opinions about performance standards; interprets performance of others in a range of contexts on tasks, informal and formal, and at holistic level; seeks to provides helpful learning feedback and teacherly advice to peers

From clicks to constructs in MOOCs

Defining a C21 capability of

Crowd-Sourced Learning

(Part of a larger map)



Milligan, S. and Griffin, P. (2016). Understanding learning and learning design in MOOCs: A measurement-based interpretation. *Journal of Learning Analytics*, *3*(2), 88– 115. http://dx.doi.org/10.18608/jla.2016.32.5

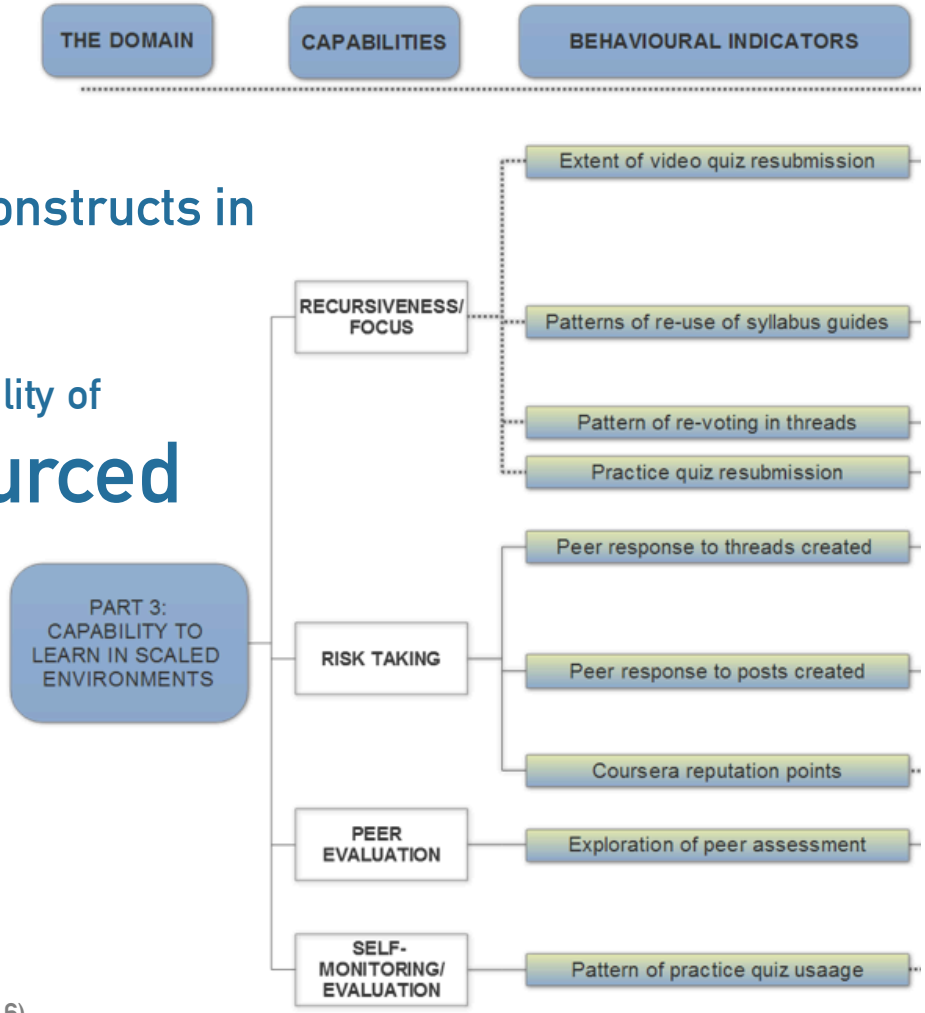
Figure 1: Construct map for the C-SL capability as expressed in MOOC log stream data

From clicks to constructs in MOOCs

Defining a C21 capability of

Crowd-Sourced Learning

(Part of a larger map)



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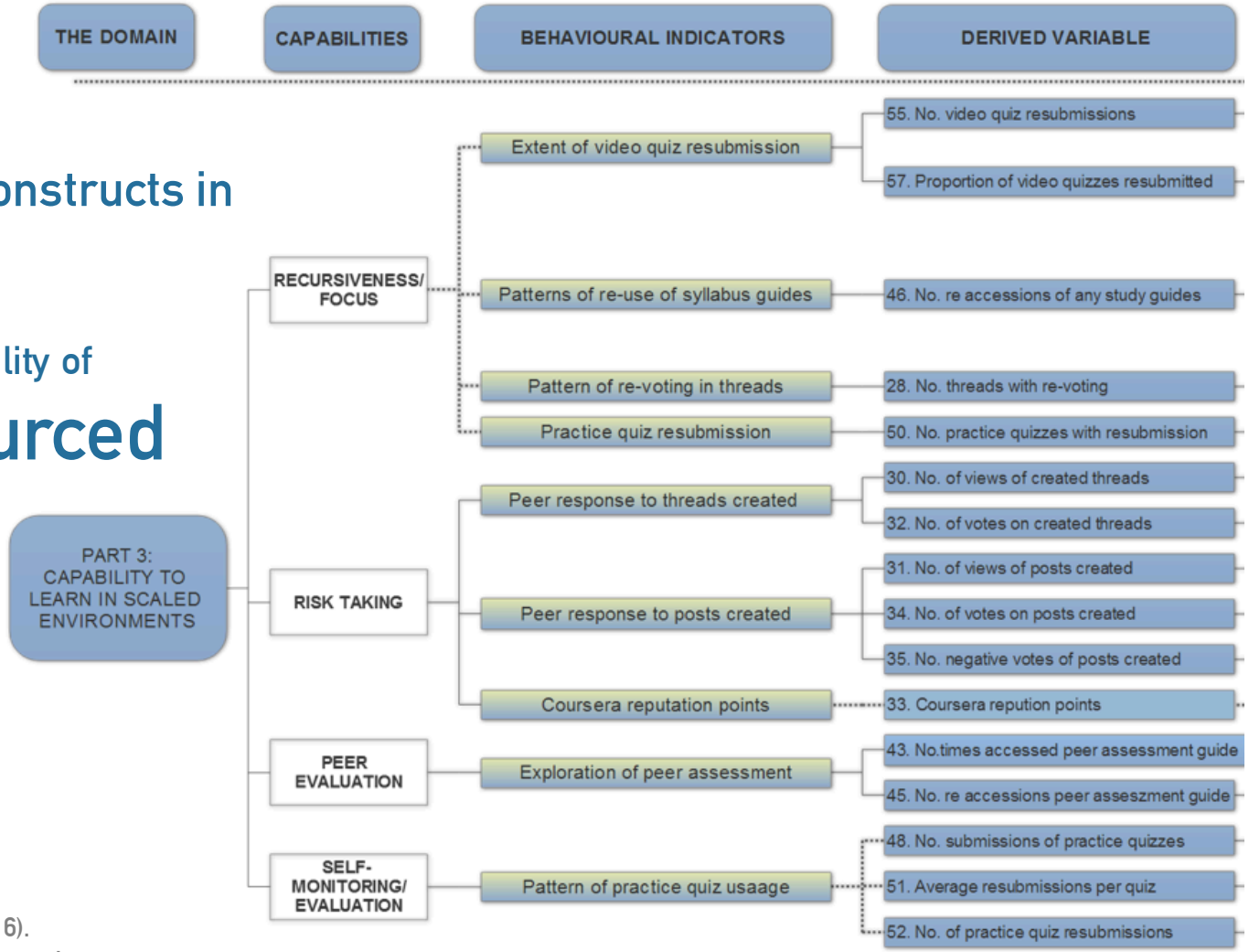

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From clicks to constructs in MOOCs

Defining a C21 capability of

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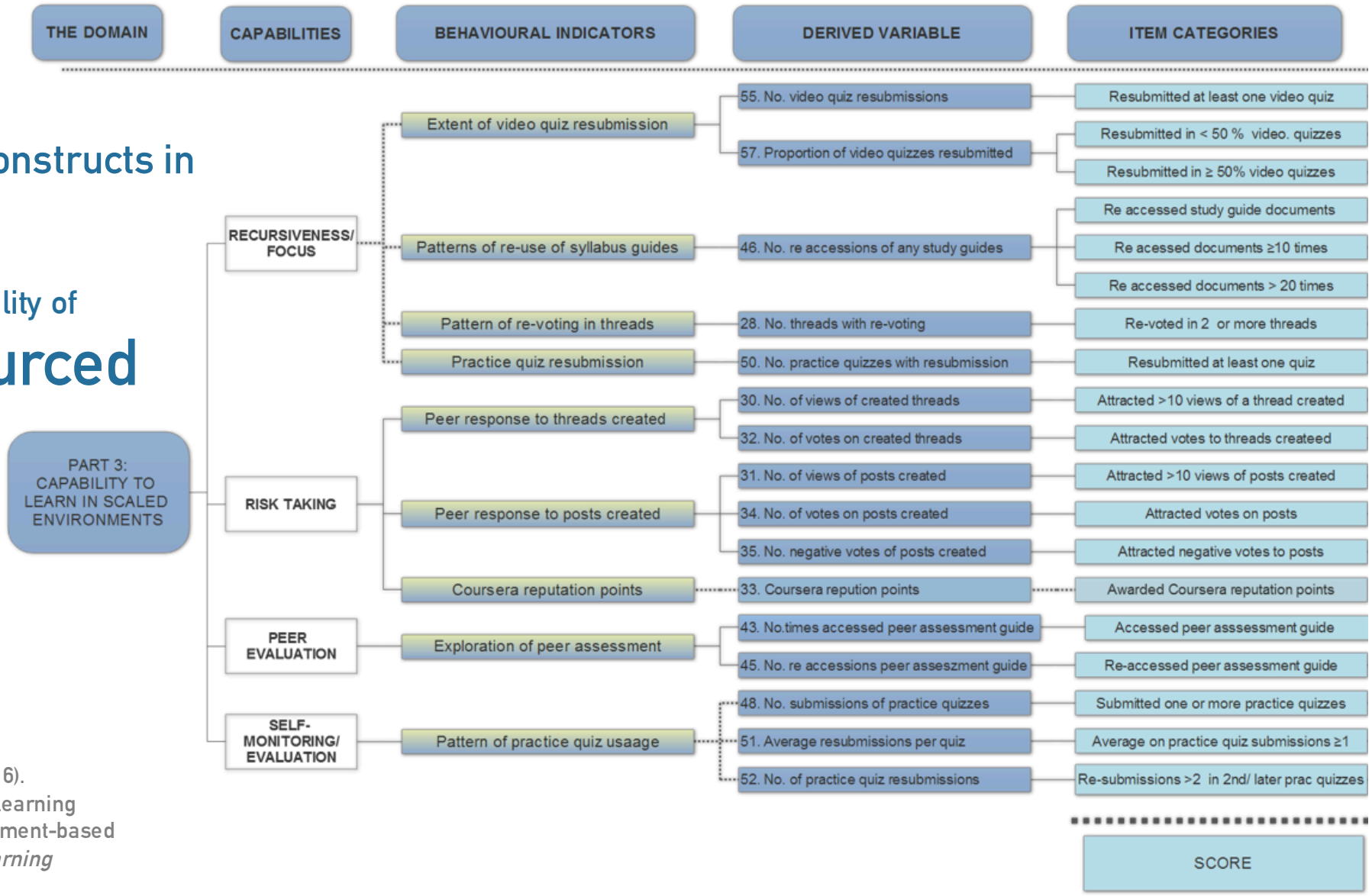

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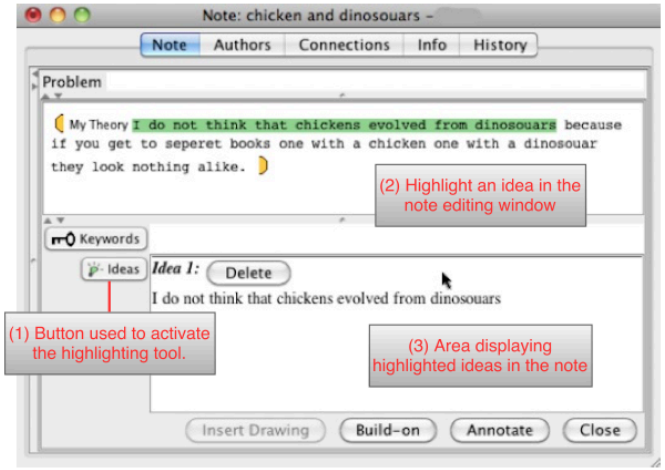
From clicks to constructs in Knowledge Forum

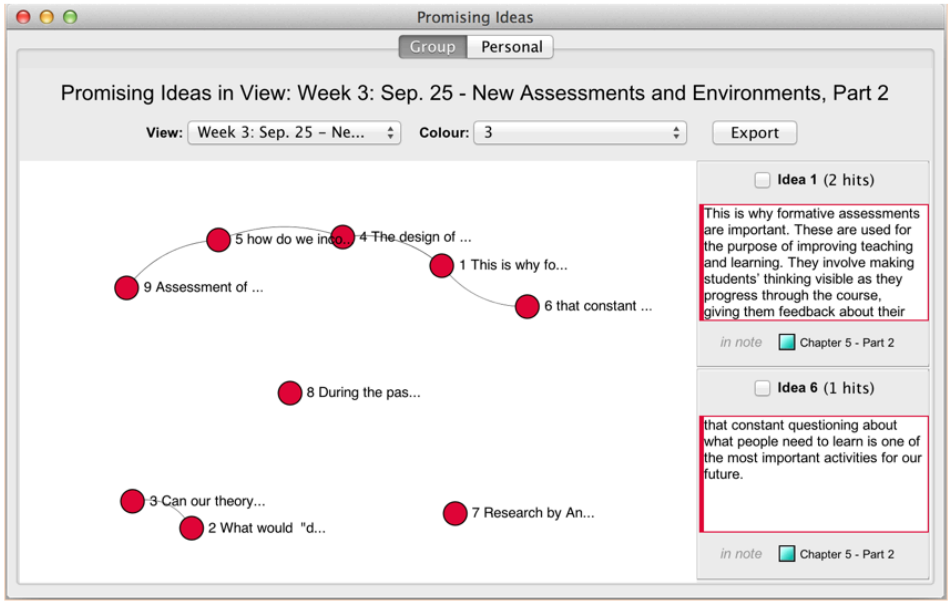
A focus on learner agency and design-mode thinking

Example: Promising Ideas Tool

Choice-Making among emergent ideas



(a) A note with one promising idea highlighted from a third grade class (adapted from Chen et al., 2015).



(b) The network layout of idea aggregation window from a graduate-level class. In this layout, semantic linkages among ideas are visualized. The user can review two ideas together by clicking on the edge between them.

Chen, B. & Zhang, J. (2016). Analytics for Knowledge Creation: Towards Epistemic Agency and Design-Mode Thinking. *Journal of Learning Analytics*, *3* (2), 139–163. http://dx.doi.org/10.18608/jla.2016.32.7

From clicks to constructs in Knowledge Forum

A focus on learner agency and design-mode thinking

Example: Epistemic Discourse Moves tool

Choice-Making among discourse moves

To support meta-discourse by students, an Epistemic Discourse Moves tool has been developed for Knowledge Forum (Figure 4). The tool garners epistemic markers, known as scaffolds (e.g., "My theory…," "I need to understand…," "A better theory…") that are left by students when making contributions (see Figure 1). By aggregating scaffold use, the tool captures epistemic moves made by students and feeds this information back to them. […]

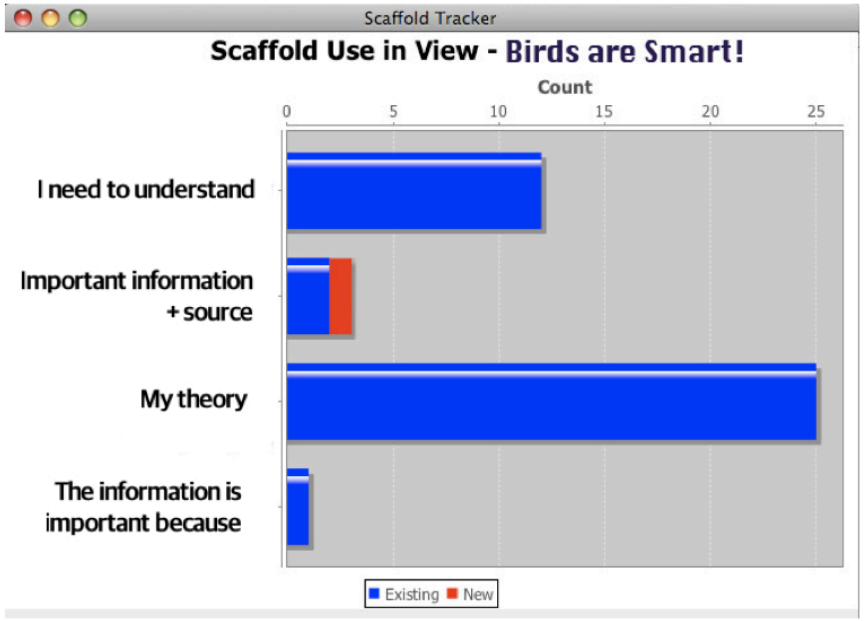


Figure 4: Epistemic Discourse Moves tool in a second grade view about birds.

Simple as the tool appears to be, when it was piloted in a second-grade class (seven-to-eight-year old children), students immediately realized they had contributed too many theories and questions but not enough information (Resendes et al., 2015). Visualizations created forms of feedback that allowed second-grade students to attend to facets of their knowledge work that are otherwise inaccessible and

Chen, B. & Zhang, J. (2016). Analytics for Knowledge Creation: Towards Epistemic Agency and Design-Mode Thinking. *Journal of Learning Analytics*, *3* (2), 139–163. http://dx.doi.org/10.18608/jla.2016.32.7

C21 analytics…

embodied learning

Instrumenting collaborative spaces

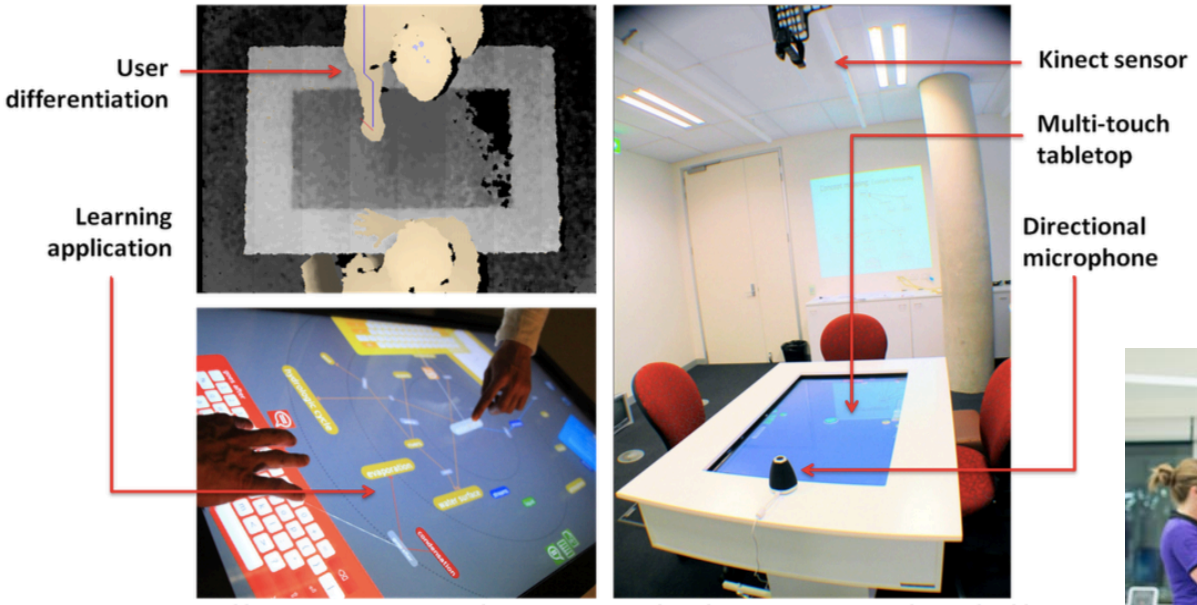


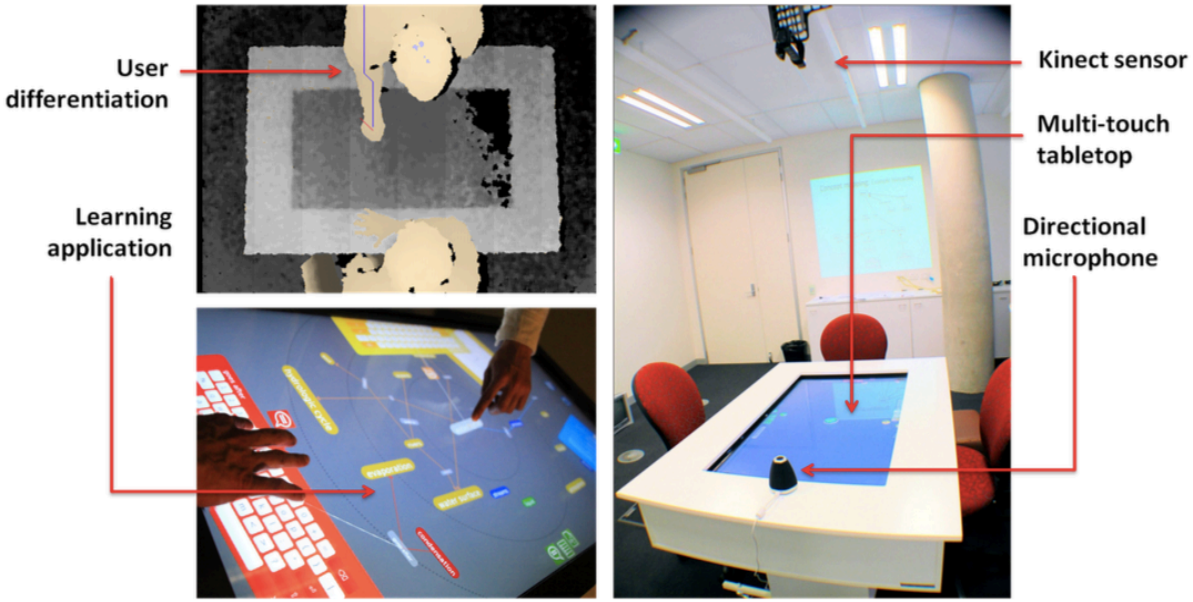
Figure 1. Digital learning environment and capturing system based on an interactive multi-touch tabletop.

Analyse the students' activity traces for significant patterns

Timely feedback for personal and team reflection

R. Martinez, K. Yacef, J. Kay, and B. Schwendimann. (2012). An interactive teacher's dashboard for monitoring multiple groups in a multi-tabletop learning environment. *Proceedings of Intelligent Tutoring Systems*, pages 482-492. Springer

Multimodal data streams



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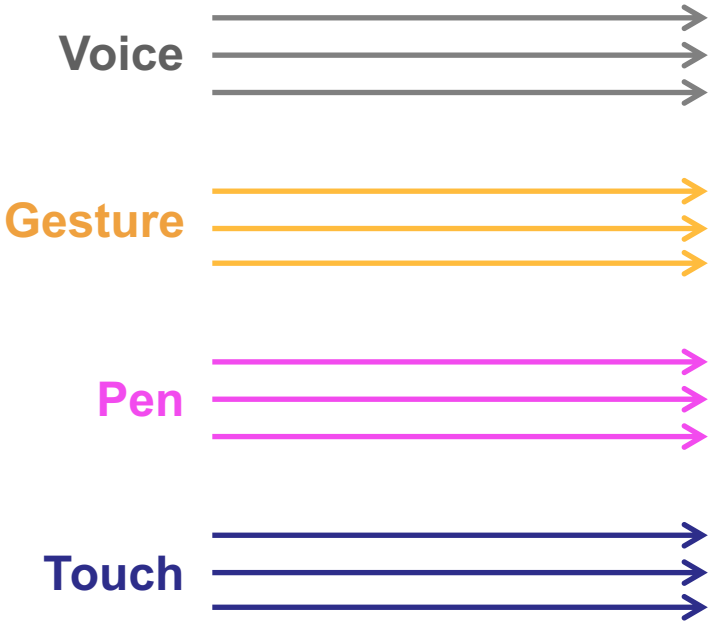

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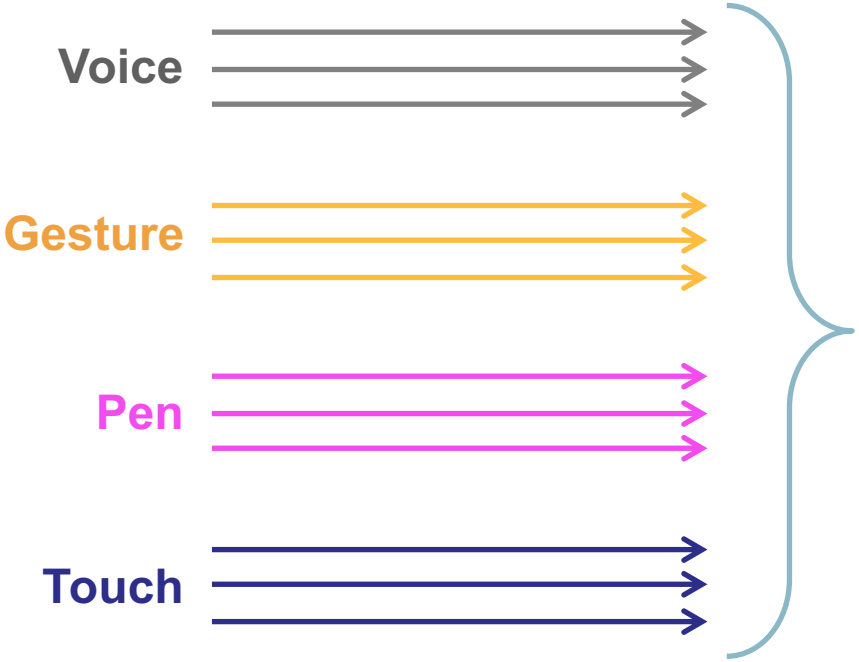
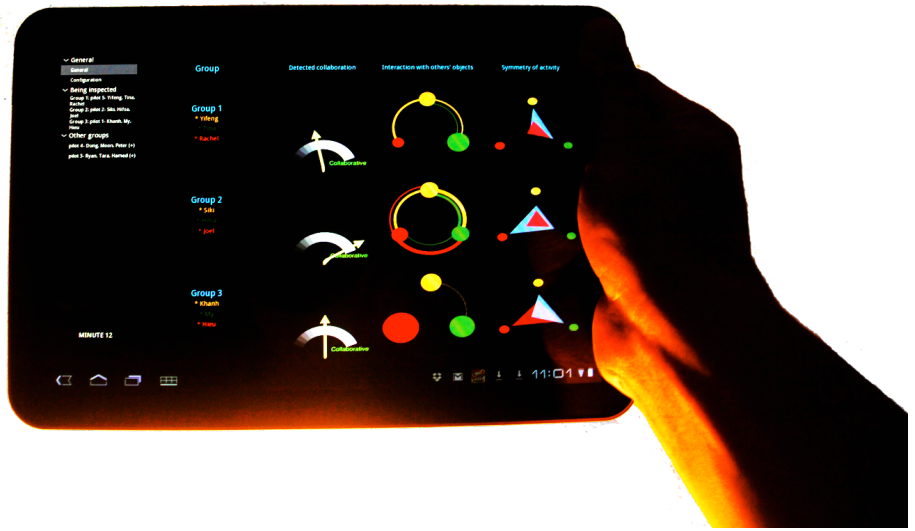
Co-location activity dashboards

Multimodal data fusion and analysis…



…to deliver visual analytics for reflection
e.g. this dashboard shows team member participation on different modalities



R. Martinez, K. Yacef, J. Kay, and B. Schwendimann. (2012). An interactive teacher's dashboard for monitoring multiple groups in a multi-tabletop learning environment. *Proceedings of Intelligent Tutoring Systems*, pages 482-492. Springer

Visual analytics of f-f teamwork

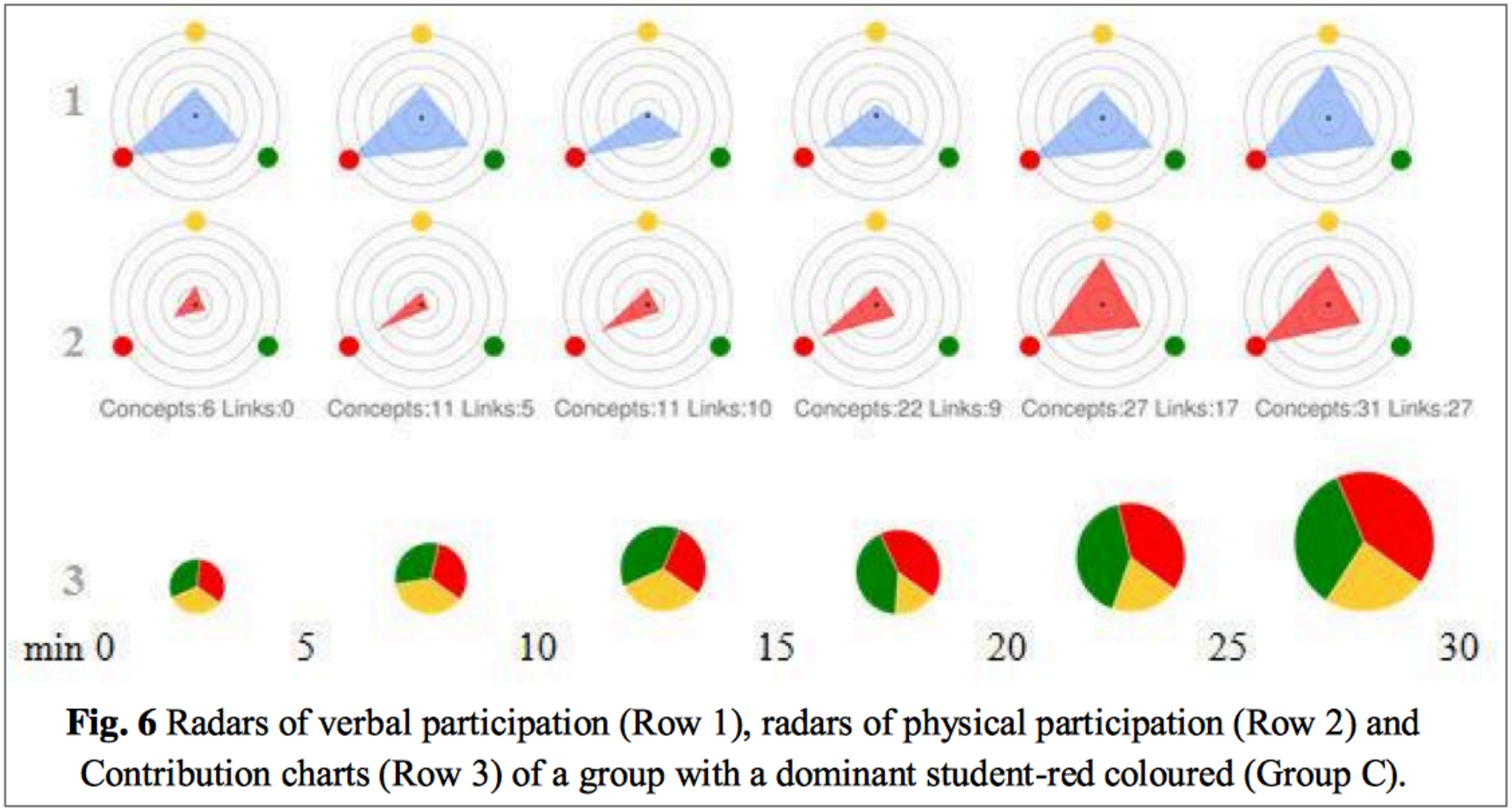
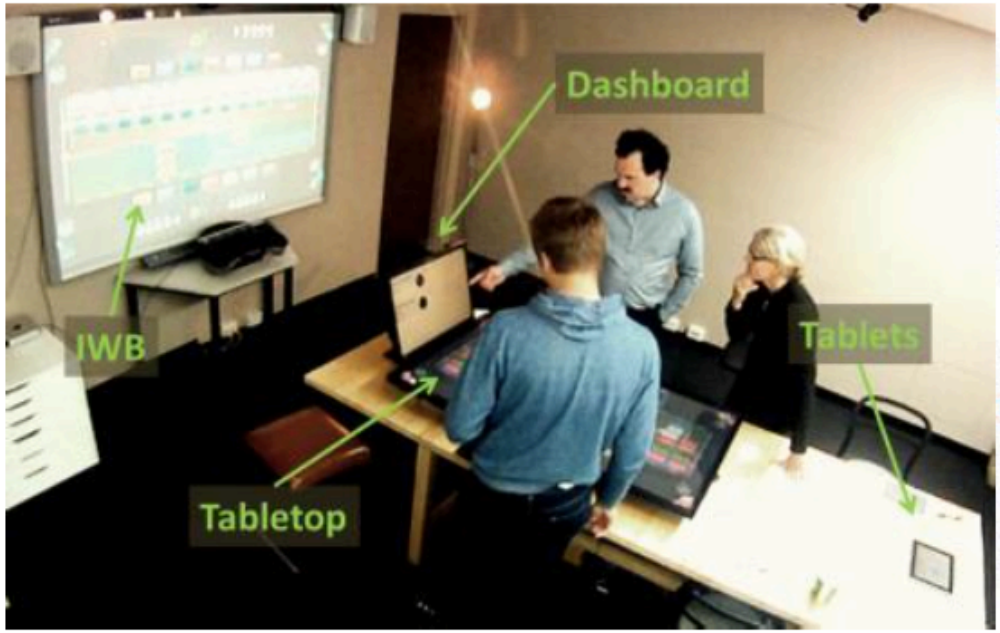


Fig. 6 Radars of verbal participation (Row 1), radars of physical participation (Row 2) and Contribution charts (Row 3) of a group with a dominant student-red coloured (Group C).

R. Martinez, K. Yacef, J. Kay, and B. Schwendimann. An interactive teacher's dashboard for monitoring multiple groups in a multi-tabletop learning environment. *Proceedings of Intelligent Tutoring Systems*, pages 482-492. Springer, 2012.

Other surface-based collaboration analytics



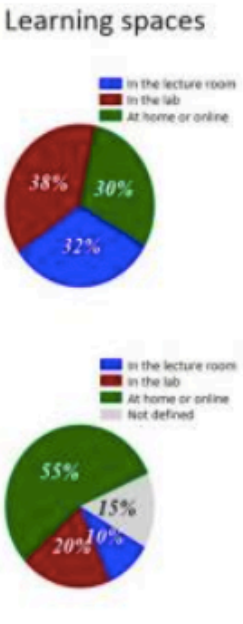
Patterns

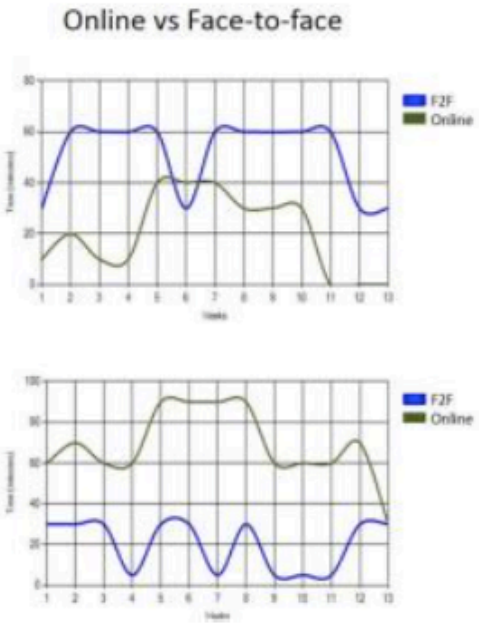
Candidate A

Pattern	Instances
Face to face Lecture	11
Online Lecture	2
Lab practice	10
Brainstorming	6
Think-Pair-Share	3
Test	3
Group concept mapping	2
Pyramid	2
Group Project	1
TOTAL STUDENT TIME	75 hours

Candidate B

Pattern	Instances
Online Lecture	10
Online forum task	6
Reading	4
Face to face Lecture	2
Lab practice	6
Test	4
Jigsaw	2
Pyramid	2
Group Project	2
TOTAL STUDENT TIME	52 hours





Martinez-Maldonado, R., Schneider, B., Charleer, S., Buckingham Shum, S., Klerkx, J. and Duval, E. (2016). Interactive Surfaces and Learning Analytics: Data, Orchestration Aspects, Pedagogical Uses and Challenges. *6th International Learning Analytics & Knowledge Conference (LAK16).* Edinburgh, UK. ACM. http://dx.doi.org/10.1145/2883851.2883873

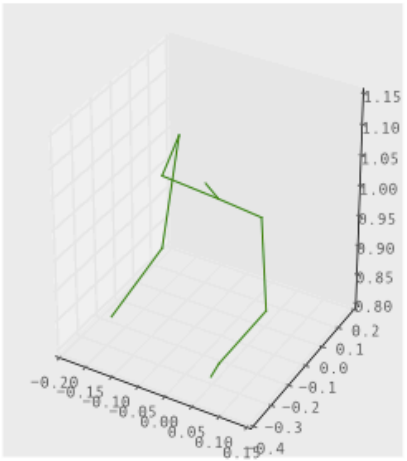
Posture correlated with learning gains

Figure 2: Students interacting with EarExplorer. The left picture shows students in the first condition ("listen") and the right picture shows the second condition ("discover"). Students in the "listen" condition followed a video tutorial, shown by a red arrow.

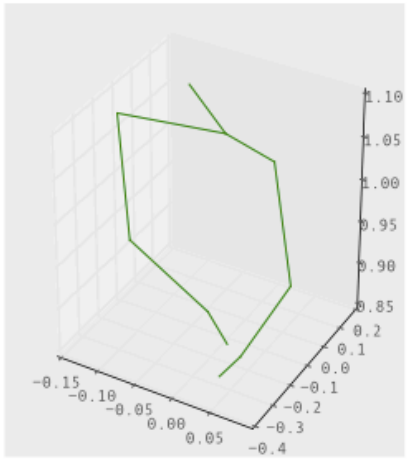
Bertrand Schneider, Paulo Blikstein. (2015). Unraveling Students' Interaction Around a Tangible Interface using Multimodal Learning Analytics. *Journal of Educational Data Mining*, Volume 7, No 3, pp.89-116. http://www.educationaldatamining.org/JEDM/index.php/JEDM/article/view/JEDM102

Posture correlated with learning gains

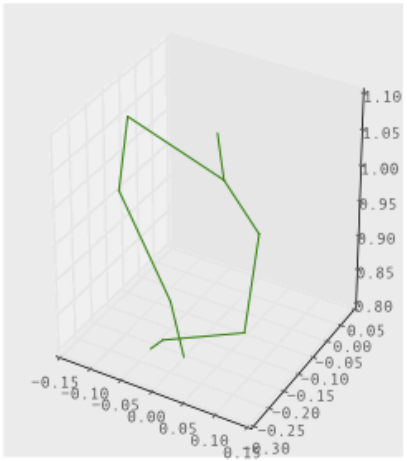
Active posture
(both arms on table)



Passive posture
(arms crossed)



Semi-active
(one hand on table)



"the "active" posture is positively associated with students' learning gains … while the "passive" one is negatively correlated with students learning gains

…Additionally, we found that the number of times students *transitioned* from one posture to another was also significantly correlated with their learning gains"

Bertrand Schneider, Paulo Blikstein. (2015). Unraveling Students' Interaction Around a Tangible Interface using Multimodal Learning Analytics. *Journal of Educational Data Mining*, Volume 7, No 3, pp.89-116. http://www.educationaldatamining.org/JEDM/index.php/JEDM/article/view/JEDM102

A field exercise…

Posture analysis of fieldwork students

Figure 6: 3D change of learners' postures according to learning topics being considered.

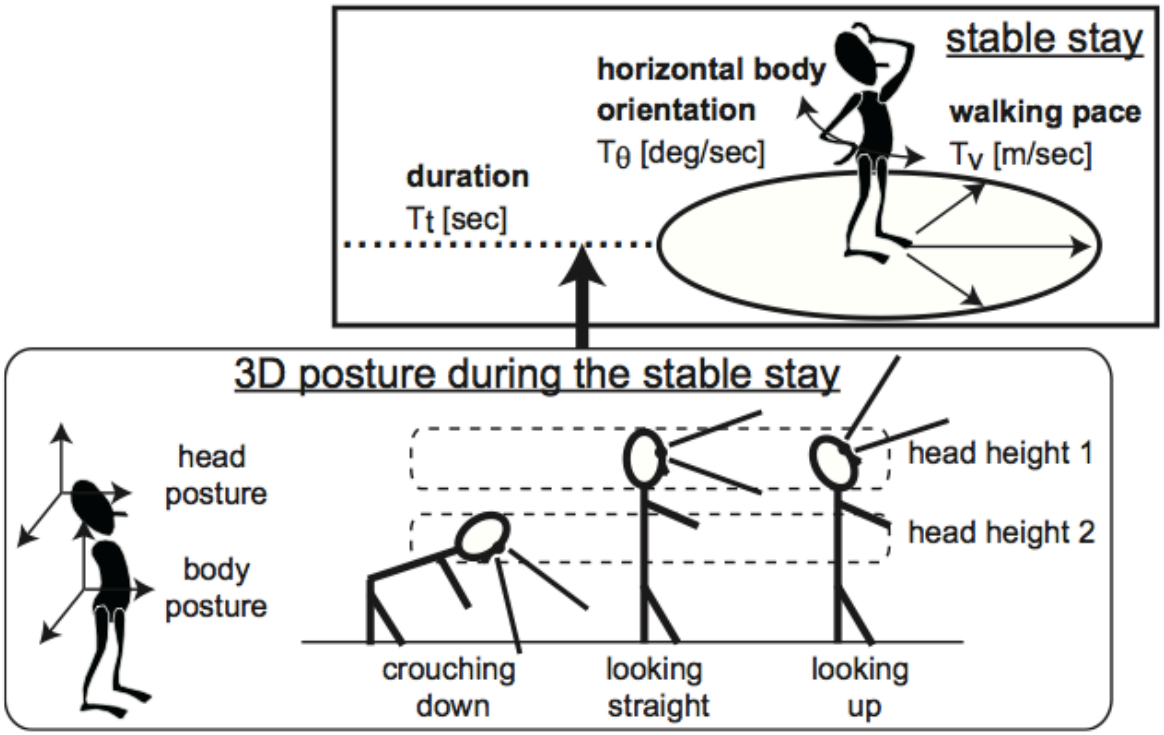


Figure 7: Estimating 3D posture during the state of stable stay.

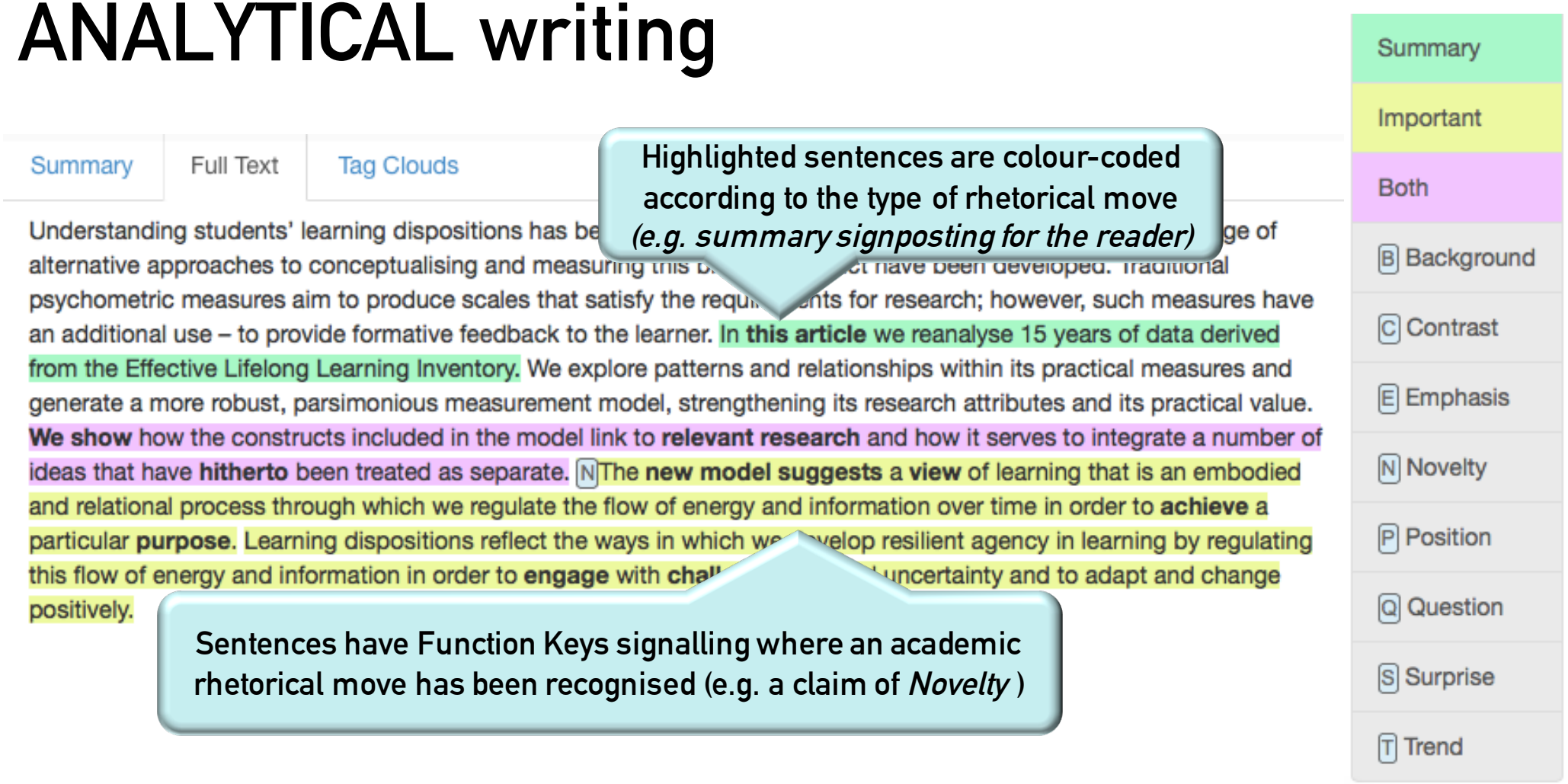
Masaya Okada and Masahiro Tada. 2014. Formative assessment method of real-world learning by integrating heterogeneous elements of behavior, knowledge, and the environment. *Proceedings 4th International Conference on Learning Analytics and Knowledge* (LAK '14). ACM, New York, NY, USA, 1-10. DOI= http://dx.doi.org/10.1145/2567574.2567579

C21 analytics…

writing as a window on the mind

AWA: Academic Writing Analytics

ANALYTICAL writing



UTS Civil Law: student feedback

- "takes the emotion out of having your work scrutinized" *Respondent 12*
- "it was not embarrassing in the way that it can be when a tutor or marker gives feedback" *Student 7*
- "I realise now what descriptive writing is - the software had quite a bit to say about my lack of justification - also true - pressed for time and difficult circumstances have caused this for me in this instance - good to see it sampled." *Respondent 9*
- "I definitely found it useful. It also made me realise that I tend to use bold, certain language in making my point towards the end of each paragraph rather than up front at the beginning (when introducing my point)." *Respondent 5*

Knight, S., Buckingham Shum, S., Ryan, P., Sándor, Á., & Wang, X. (Forthcoming). Academic Writing Analytics for Civil Law: Participatory Design through Academic and Student Engagement. *International Journal of Artificial Intelligence in Education*

Reflective writing – sharing what you experience, feel, are unsure of… how you are changing, and intend to change…

expressions about learning context and its effect on thoughts and feeling

> 'From previous experience this approach has always worked as I have been eager to learn.'

expressions of reflecting specifically on changes in learning

> 'I will develop goals for myself for each week I have learned a new skill…By becoming aware of my learned cultural viewpoints I can understand how to overcome them.'

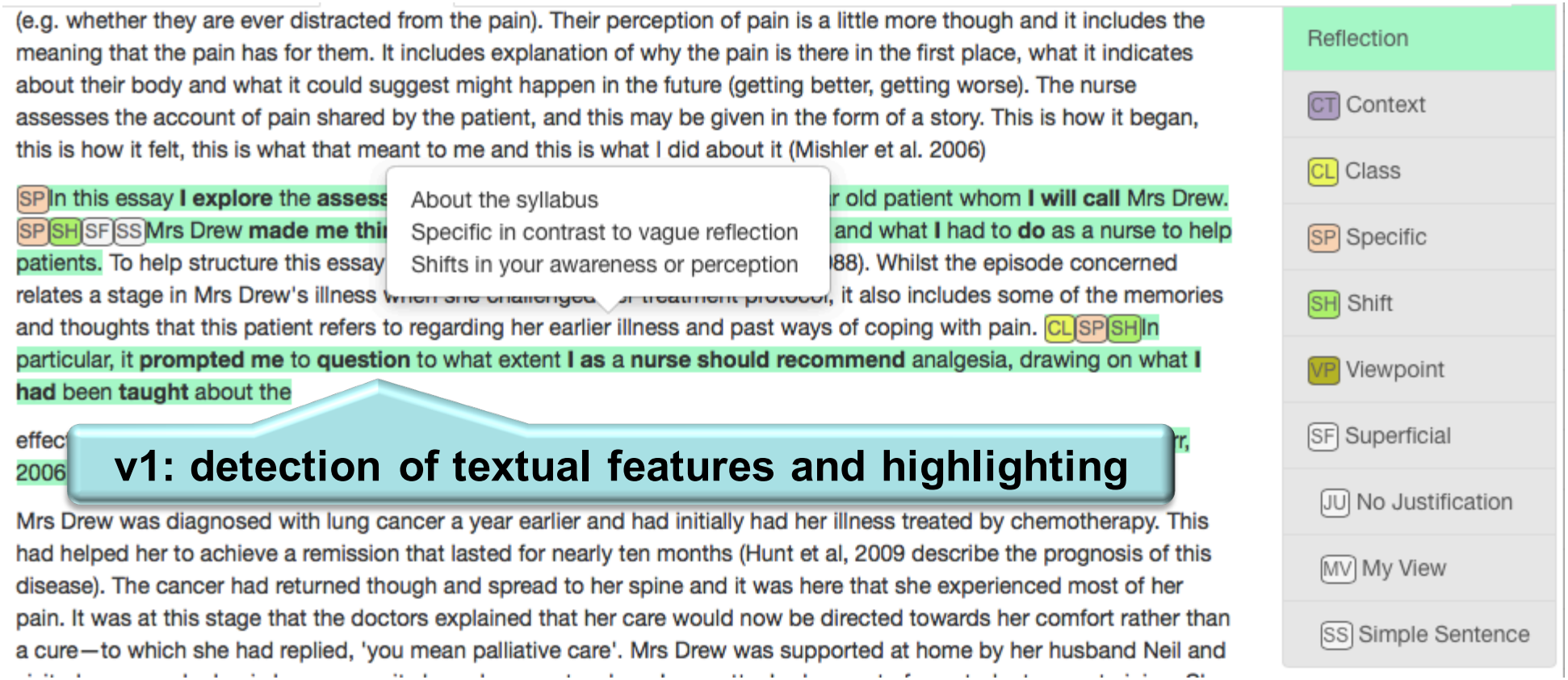
expressions about applying theory to practice

> 'I realized that there are different ways of doing something; what we were taught is not how they do things here.'

verbs that show awareness or shifts in perception

> I began to understand… I could see… I could visualize… I could perceive… I became aware…

Reflective writing (Nursing)



Buckingham Shum, S., Sándor, Á., Goldsmith, R., Wang, X., Bass, R. and McWilliams, M. (2016). Reflecting on Reflective Writing Analytics: Assessment Challenges and Iterative Evaluation of a Prototype Tool. *6th International Learning Analytics & Knowledge Conference (LAK16).* Edinburgh, UK. ACM Press. http://dx.doi.org/10.1145/2883851.2883955

C21 analytics…

emergent

themes

C21 analytics…

multiple

intelligences

holistic

learning

Towards analytics for an integrative educational system

Randy Bass

Georgetown University

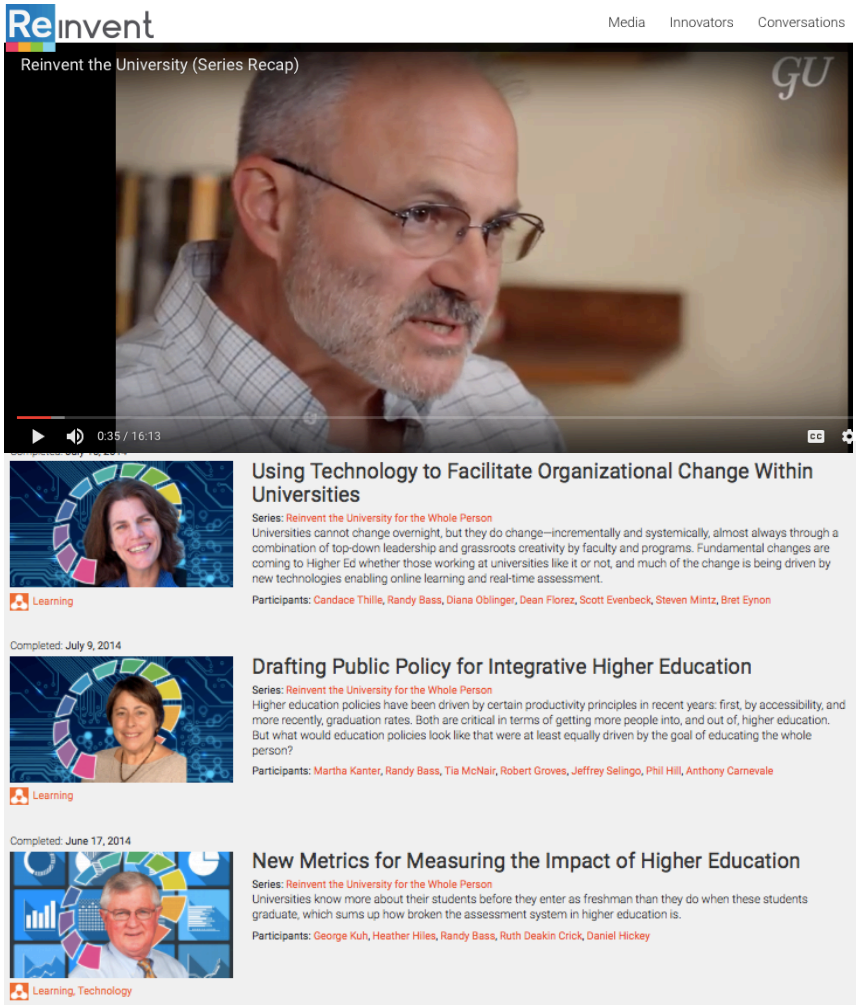
Thought leadership on the future of higher education and the role of analytics for **holistic learning**

Reinventing Higher Ed series

http://reinvent.net/series/reinvent-the-university

Formation by Design Project

https://futures.georgetown.edu/formation



C21 analytics…

scepticism & transparency

Let's pretend for a moment that we actually wanted to create "21st century learners"…

…who are sceptical of tracking technology and imposed authority — so they may have fun gaming the analytics and they want to know what's in the black box

…who want to be creative — could our analytics encourage thinking outside the box? Do our analytics dictate the use of a single tool for all activity?

…who care about where the world's going and how they can make a difference — could our analytics equip them to learn on real world problems?

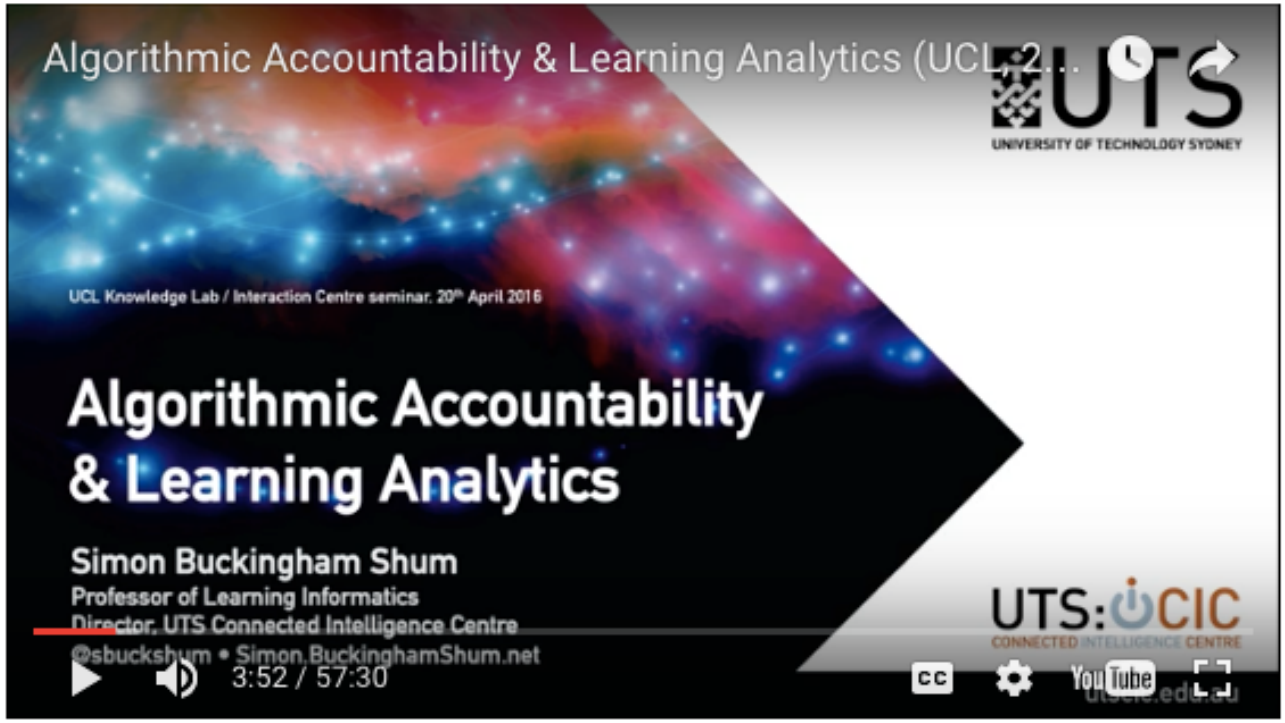
Let's pretend for a moment that we actually wanted to create "21st century learners"…

…who understand the importance of diversity in perspective for complex problems — do our analytics assume one correct answer, or build collective intelligence to negotiate a solution?

…who value their autonomy, but want to belong — do our analytics attend to agency, community building, and social learning?

…who know they need to nurture reflective, contemplative space if they're to grow as people — do our analytics have anything to contribute to this kind of internal narrative?

Algorithmic accountability in learning?



http://simon.buckinghamshum.net/2016/03/algorithmic-accountability-for-learning-analytics

e.g. a *Cluetrain Manifesto* attitude to analytics?

cluetrain.com

1. Markets are conversations.

2. Markets consist of human beings, not demographic sectors.

15. In just a few more years, the current homogenized "voice" of business—the sound of mission statements and brochures—will seem as contrived and artificial as the language of the 18th century French court.

39. The community of discourse *is* the market.

73. You're invited, but it's our world. Take your shoes off at the door. If you want to barter with us, get down off that camel!

74. We are immune to advertising. Just forget it.

Etc…

C21 analytics…

learn to work with

ambiguity

Engaging with Risk and Uncertainty

"developing an awareness of and being in **uncertainty** is a **critical condition** in any **creative** endeavour"

Theresa Anderson

Shapeshifters - Culturing Innovation

https://www.youtube.com/watch?v=ri_lsR9fHZg

Anderson, T.K. 2010, 'Kickstarting Creativity: Supporting the productive faces of uncertainty in information practice', *Information Research*, vol. 15, no. 4, pp. 1-16. http://InformationR.net/ir/15-4/colis721.html

"Liminal Space… when you have left the tried and true but have not yet been able to replace it with anything else.

…when you are between your old comfort zone and any possible new answer… If you are not trained in how to hold anxiety, how to live with ambiguity, how to entrust and wait, you will run…

anything to flee this terrible cloud of unknowing."

Richard Rohr O.F.M

Limina is the Latin word for threshold, the space betwixt and between
http://sojo.net/magazine/2002/01/grieving-sacred-space

C21 analytics…

could shift our

assessment

regimes

To go deeper…

http://learning-analytics.info

Learning Analytics for 21st Century Competencies. (Eds.) Buckingham Shum S. & Deakin Crick, R. (2016). *Journal of Learning Analytics (Special Section)*, 3(2), pp. 6-212. http://dx.doi.org/10.18608/jla.2016.32.2

Thank You! / twitter @sbuckshum / Simon.BuckinghamShum.net