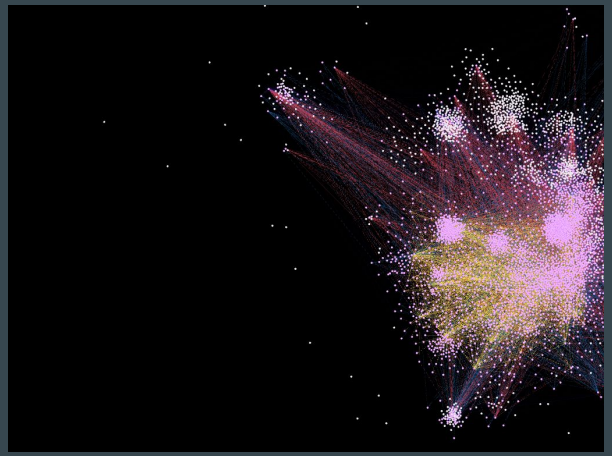
Learner experience complexity as data variables for smarter learning

Investigating learner experience variables: can we capture learner experience variation with data, to make more useful learning analytics?



Pen Lister, PhD Candidate, MSc MA MBCS FHEA

Link to these slides https://tinyurl.com/learner-exp-variables

Abstract

Edit of abstract submitted to AI & Society [11].

The focus of the presentation is on whether it is possible to assign 'learner experience variables' data values to learner generated content (both images and text), to inform future smart learning journey development with more intelligent delivery of user journey interface pathway choices and the knowledge content they provide.

Through phenomenographic analysis of smart learning participant interview data, layers of experience complexity can be discovered. These clearly align with surface to deep learning, and pedagogical approaches can be devised to support progression in these hierarchical layers. I discuss possible ways of assigning values to learner generated content that represent learner experience complexity using a multi-score concept aligned with Bloom's Revised taxonomy. This could build a landscape of learner experience variation data to support location based smart learning environments.

The presentation is not overtly technical in nature as research is based in learner experience qualitative data, not statistical analysis. However, discussing potential interpretations of this kind of data in more technical contexts is a possible useful alternative view to discourse on intelligent tutoring and personalised learning in scenarios of smart cities and social change, to support digital literacy and competency for urban citizens.

Digital interactions are made of human behaviours, purposes, feelings, prior knowledge and experience, expectations and priorities in a time based framing of past-present-future.

This presentation explores ideas around the challenges of seeing and capturing *learner experience variations* data in a learning city.

Pen Lister, PhD Candidate, MSc MA MBCS FHEA

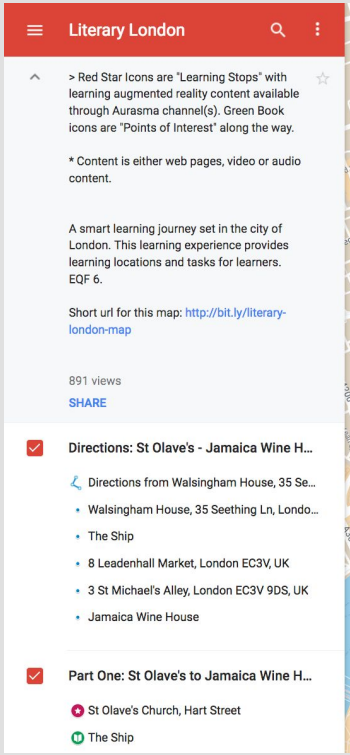
Context

My work focuses on digitally mediated *smart learning journey* activities in learning cities.

This kind of learning could be formal or informal, with students, citizens or children.

Activities could be community based, creative, local heritage, sustainability or any other topic or reason to learn while out in the real world.

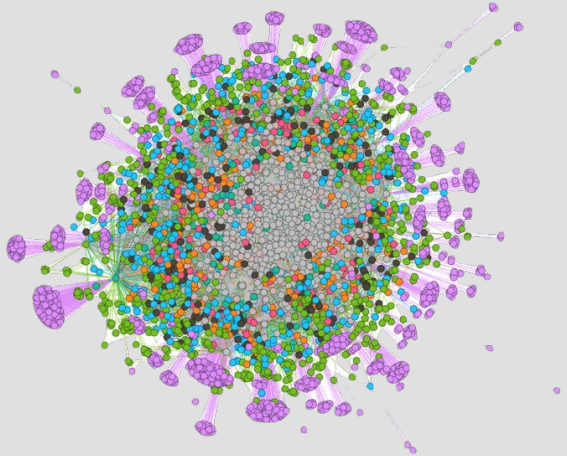
This talk is about findings from research about these kinds of learning activities, and possible implications for richer learning analytics concepts that could support an autonomous participatory activity in a learning city.



Consider scenarios where ***learners generate data*** that may help to create

- smarter delivery of knowledge content
    - autonomous learning participation

in learning cities



Digital interactions while *learning*

- *Common learning analytics:* Time on page, bounce rate, goal conversion, course progression, referral from, entry page, exit page, download stats, journey path... but what purpose do they have?

  > *"Verbert, Duval, Klerkx, Govaerts, and José (2013) provide a meta-analysis of 15 different learning analytics dashboards. They conclude that almost all the implementations are designed primarily for instructors and administrators." (Godwin-Jones, 2017)*

- Do we need to know more about *the actual learning*, the type of learning, the behaviour and experience of learning?
- Do we need deeper understanding to inform ***better, smarter delivery*** of content and ***participation interaction provision***?

Digital interactions while *learning*

Blackboard Data Dashboard

Image saved by Tim Lee, on Pinterest.https://www.pinterest.com/pin/3307399698554413/

Digital interactions while *learning*

Breakdown of interaction history			
Action (*What user did:)*	**Digital Manifestations**	**Timeline** (*Real time/position)*	**Context**
Clicked on Spoke – answered, posted first, reacted with new post etc. Made Shared Voted Starred Favourited Saved Downloaded	Image Video Text Like Vote Up Vote Down Favourited Save for later?	Examples: Begin learning (study unit) Entry page First task Second task… Mid multi-task activity End task assessment Open ended task Optional task Set task end/exit	Side chat Ext social media Tutor question Upload and share Download, manipulate, re-upload Save for later Non set behavior early Non set behavior mid Non set behavior later Non set behavior end or after

Digital interactions while *learning*

Personalisation of learning *is usually* based on ‘profile’: personality ‘traits’, learning preference or style, prior achievement, ‘intellectual skills’ (IQ), interactions history, or other factors[14].

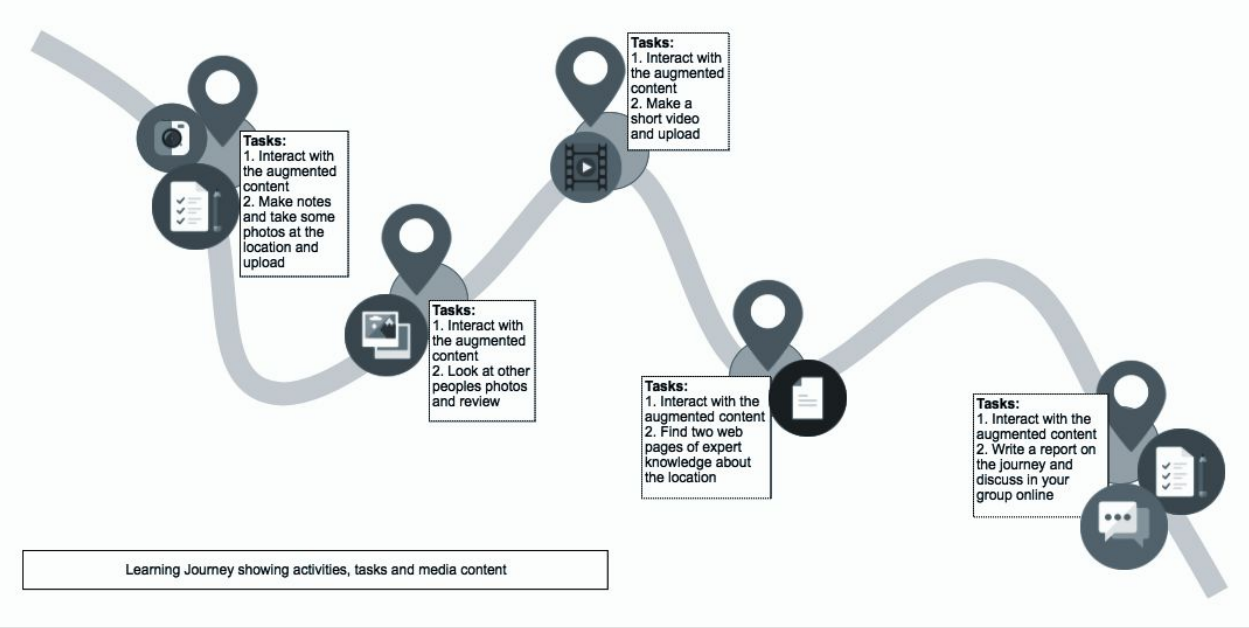
This relies on prior database held information. But this won’t work in flexible ad-hoc smart (citizen) learning, as **there is no prior database of learner profile ontology**[13].

> In a smart learning city we need a seamless connection between machine-learned ***learner experience variation*** interactions and how a learner is behaving *at that time*, to deliver relevant content and interaction choices. This preserves privacy, yet can offer flexible smarter content delivery to anonymous users via their choices plus deep learned user dataset patterns.

Digital interactions while learning

Consider the ***smart learning city***: anonymous 'on the fly' learners, participating for any number of reasons in technology mediated, probably informal learning: community projects, gamified culture tours, actual games, art discovery and creativity in real locations, environmental, sustainability or other civic projects...

Digital interactions: *imagine learning* in a smart city



Learning Journey showing activities, tasks and media content

Learning *outside* in the technically enhanced learning city

Time
Content
Detail
Participation

At *real* places: features, locations, buildings...

Capturing interactions while *learning*

To offer some personal control of the activity, we could make user journey interfaces offer different learning tracks, asking the learner at the start about Time, Participation, Content, Detail.

Capturing interactions while *learning*

But if we want to offer real flexibility, this won't work.

- It's too complicated.
- It channels people down a single route - difficult to change *much*
- It still has the idea of user journey as a user persona - beginner, intermediate, advanced.
- BUT people are a mixture of these. They (potentially) change mid task, change their minds, or moods, or amount of time available...

Capturing *learner experience* interactions

Change ways of thinking about the user-learner journey.

Think about ***learner experiences as collective variations*** rather than types of people who are always one sort of learner.

Think about ***learning in all kinds of ways that might not be planned*** [5], that might be implicit, hidden, yet important. The topic of learning is perhaps only one aspect of this kind of ***smarter learning***.

Capturing *learner experience* interactions

Think about "*learning in all kinds of ways that might not be planned*"

What counts as learning? If we embrace the idea of ***supporting citizens in digital competencies and participatory pedagogy*** [9] then we might think of:

- Learning to participate
- Learning to use and negotiate Maps and AR
- Learning to work as a group
- Learning to make digital content and upload it
- Learning to understand surroundings
- Learning to make decisions
- Learning about the topic itself

Capturing *learner experience* interactions

- Understanding experience variation as a set of categories can give us a grid of 'experience complexity'.
- This grid forms a potentially useful way of thinking about different kinds of ***learner experience variation*** interactions as data
- These might be referred to as ***learner experience variables***

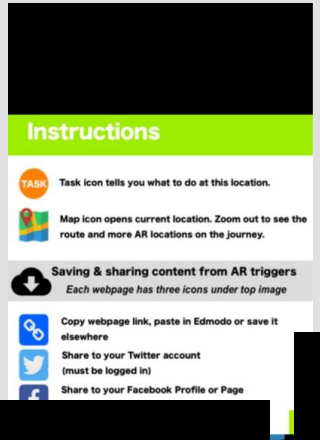
Think about ***learner experience variables*** as potential data.

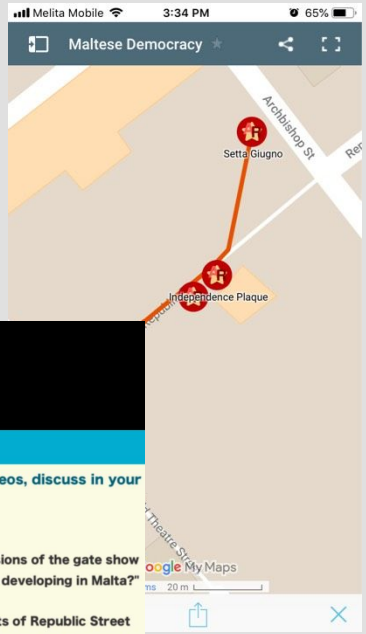
Measuring a *learning experience*

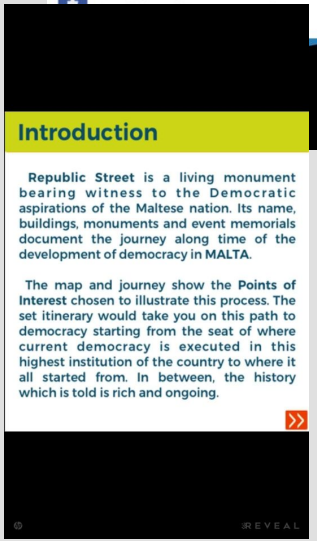
Levels of experience complexity[10] for a smart learning journey (a *geo-spatially situated participatory learning activity*.

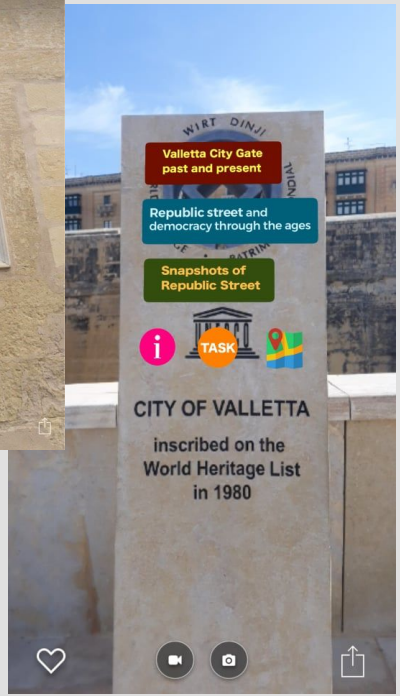
Four categories of variation, with four levels of complexity.

	Category A Doing the tasks	**Category B Discussing**	**Category C Being there**	**Category D Knowledge and place as value**
Level 4	Research tasks and topic beforehand, take time doing and reflecting on tasks	Share tasks and content, do additional learning, discuss related experience and knowledge	Live it, being in the picture, live the atmosphere, take more time, seeing the whole and related parts	Knowing and seeing knowledge and place as valuable, personal experience, deeper engagement and ‘possibilities’
Level 3	Tasks indirectly related to coursework or assessment	Discuss tasks and topic in relation to time and place	Experience in the place relating to other people, aspects and memories. Make connections between places and knowledge	Engage further with knowledge in topics, create upload content for tasks and at locations
Level 2	Do the tasks of interest, directly related to coursework or assessment	Discuss the tasks, help each other with tasks and tech	Locations are of some interest, potential for learning, creativity or inspiration	Click a few content links, save links ‘for later’, make screenshots of augmentations or tasks
Level 1	Do the tasks, go home	Discuss who does the tasks, how technology works	Go to locations, do tasks, go home	No engagement with content or knowledge, don’t create or upload content









Learner Generated Content* Image Uploads: Tasks, functions, AR, instructions

Category A, Level 1 & 2, Category D Level 2

* [12] 'Learner generated content'

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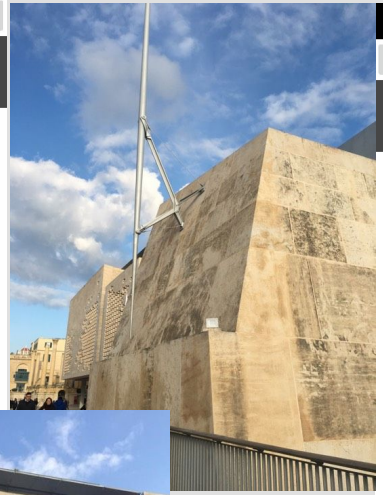
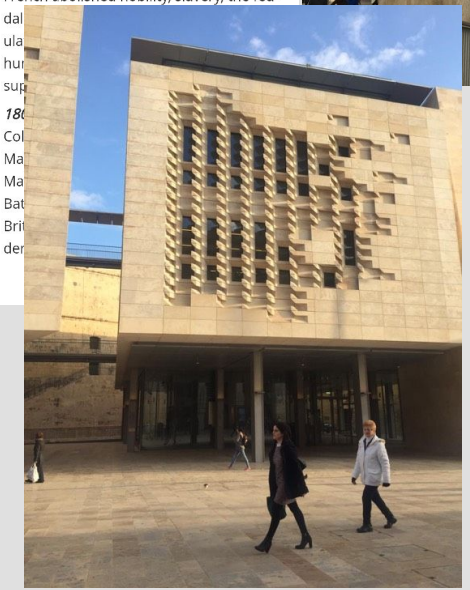
activities.

Historical dates in Maltese democratic history

- ***1530 – 1798:*** The coming of the Order of the St John and their establishment as the government of the island till 1798, laid down the foundations of European principles and institutions that would eventually contribute to the development of the Maltese nation-state.
- ***1798 – 1800:*** French Occupation: The French abolished nobility, slavery, the feu-
- ***18***





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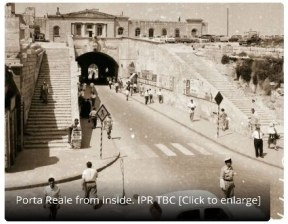
The original simple gate of the 16th century included a door, a bridge, a moat, and several guns. This structure represented military austerity and was needed to emphasize the autonomy and security of the city.

Porta Reale from inside



The second 'city gate' was a single tunnel (seen from inside city) through the city's ramparts. It was opulent and reflected security and ambition.

Nineteen-sixties City Gate

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This post is intended for use with the Maltese Democracy walking tour and smart learning activities.

Here is a collection of some images illustrating the changing nature of the design and approach of Valletta's City Gate, the main entrance to the fortified city. The changing shape of the gate and its area is reflective of the current political thinking.

Images of the old city gate

Side view of Porta Reale

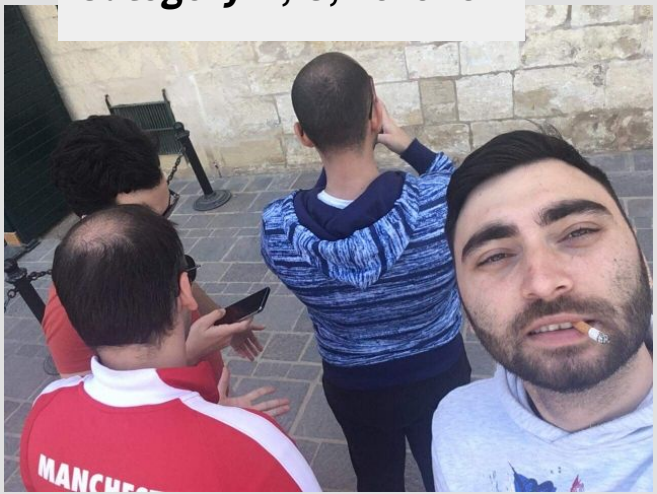
Learner Generated Content Image Uploads: Content and facts in locations

Category D, Level 3

Learner Generated Content Image Uploads: Social, being there, creativity

Category B & C, Levels 3 & 4

Category B, C, Level 3

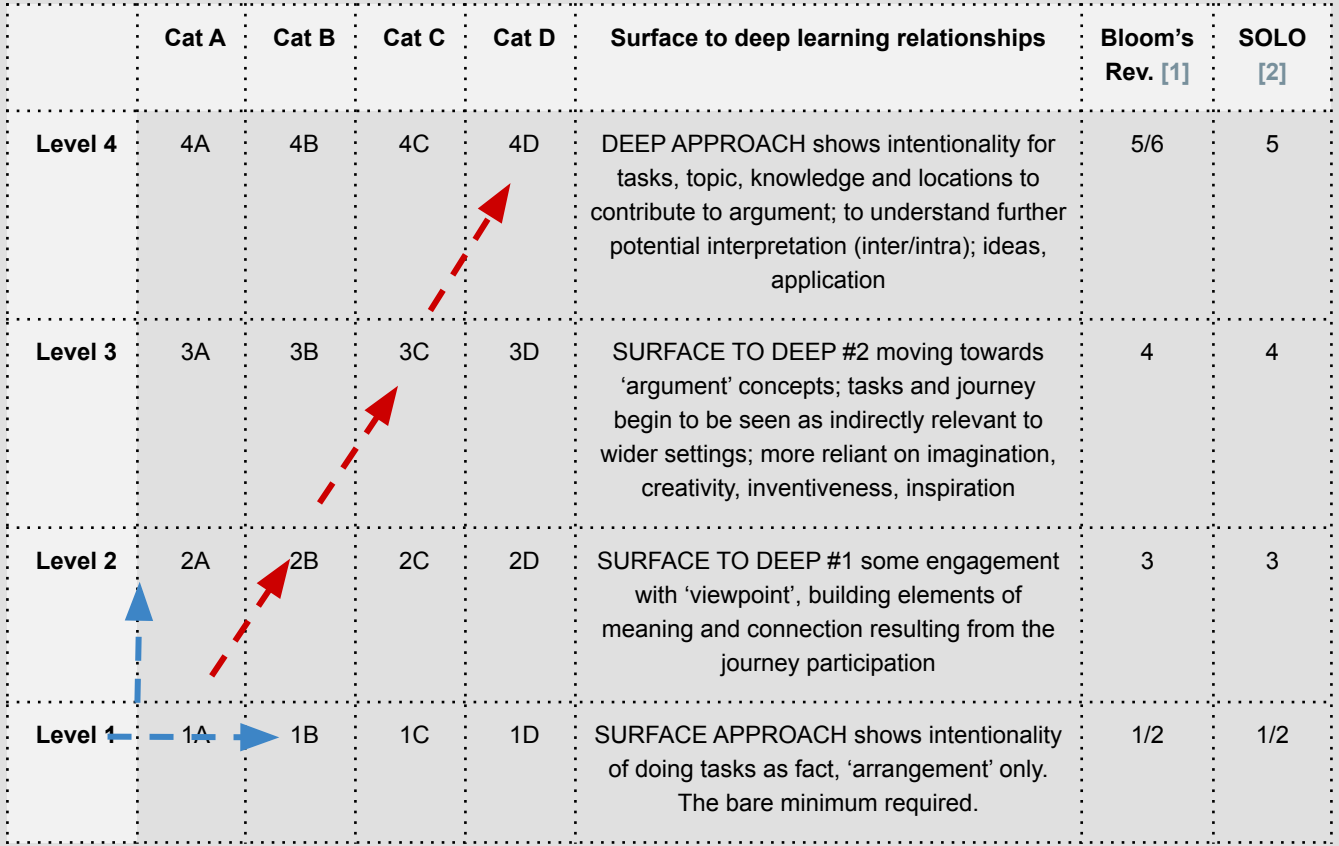


Category C, D, Level 4

Measuring a *learning experience*

Possible interpretation of experience as measurement of learning, and potential data points. These might be generated from a mixture of:

- Machine *seeing* of content interactions:
  - AR info triggers at coords;
  - LGC uploads at coords;
  - LGC machine *interpretation*
- Participation interactions
- Machine *or* human generated assessment quality



	Cat A	Cat B	Cat C	Cat D	Surface to deep learning relationships	Bloom's Rev. [1]	SOLO [2]
Level 4	4A	4B	4C	4D	DEEP APPROACH shows intentionality for tasks, topic, knowledge and locations to contribute to argument; to understand further potential interpretation (inter/intra); ideas, application	5/6	5
Level 3	3A	3B	3C	3D	SURFACE TO DEEP #2 moving towards 'argument' concepts; tasks and journey begin to be seen as indirectly relevant to wider settings; more reliant on imagination, creativity, inventiveness, inspiration	4	4
Level 2	2A	2B	2C	2D	SURFACE TO DEEP #1 some engagement with 'viewpoint', building elements of meaning and connection resulting from the journey participation	3	3
Level 1	1A	1B	1C	1D	SURFACE APPROACH shows intentionality of doing tasks as fact, 'arrangement' only. The bare minimum required.	1/2	1/2

Measuring a *learning experience*

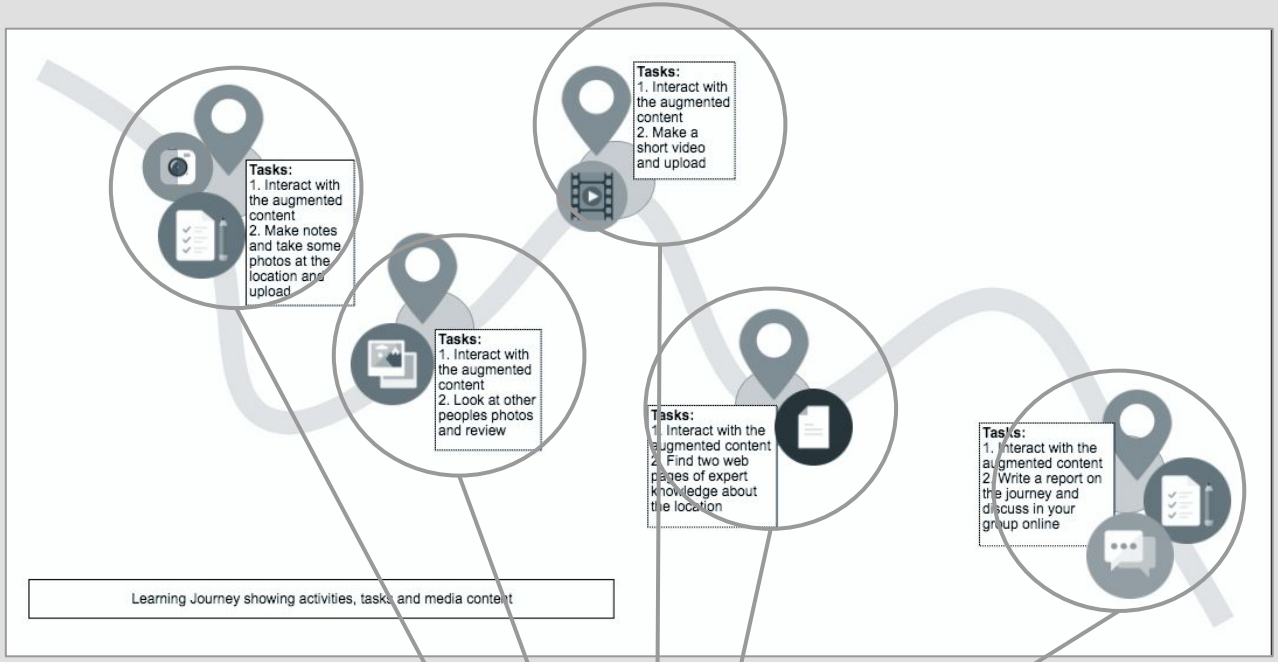
This grid of scores could track ***learner participation experience variables*** in relation to ***learning quality values***.

- *Human assessment* might grade in a way consisting of 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; along a set of micro activities.

- Build a dataset from multiple smart learning projects (for example).

	Cat A	Cat B	Cat C	Cat D	Bloom's Rev. [1]
Level 4	4A	4B	4C	4D	5/6
Level 3	3A	3B	3C	3D	4
Level 2	2A	2B	2C	2D	3
Level 1	1A	1B	1C	1D	1/2

Measuring a *learning experience*



1A2; 2B3;
2C3; 3C3;
2C3; 3D4;
4D5; 4C6;

1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A2; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A2; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3; 3C3; 2A3; 3D4; 4D5; 4C6; 1A2; 2B3; 2C3;

Tracking a *learning experience*

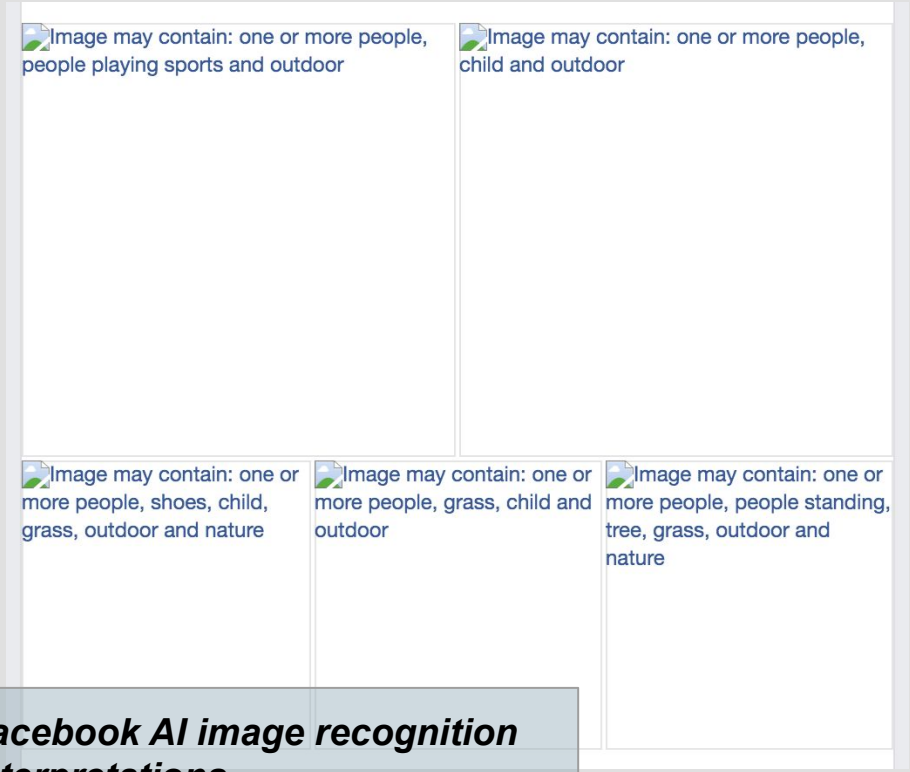
Matching the learner experience variables to ***image recognition labels*** might build a way of measuring learner generated image content in relation to the learner experience it reflects.

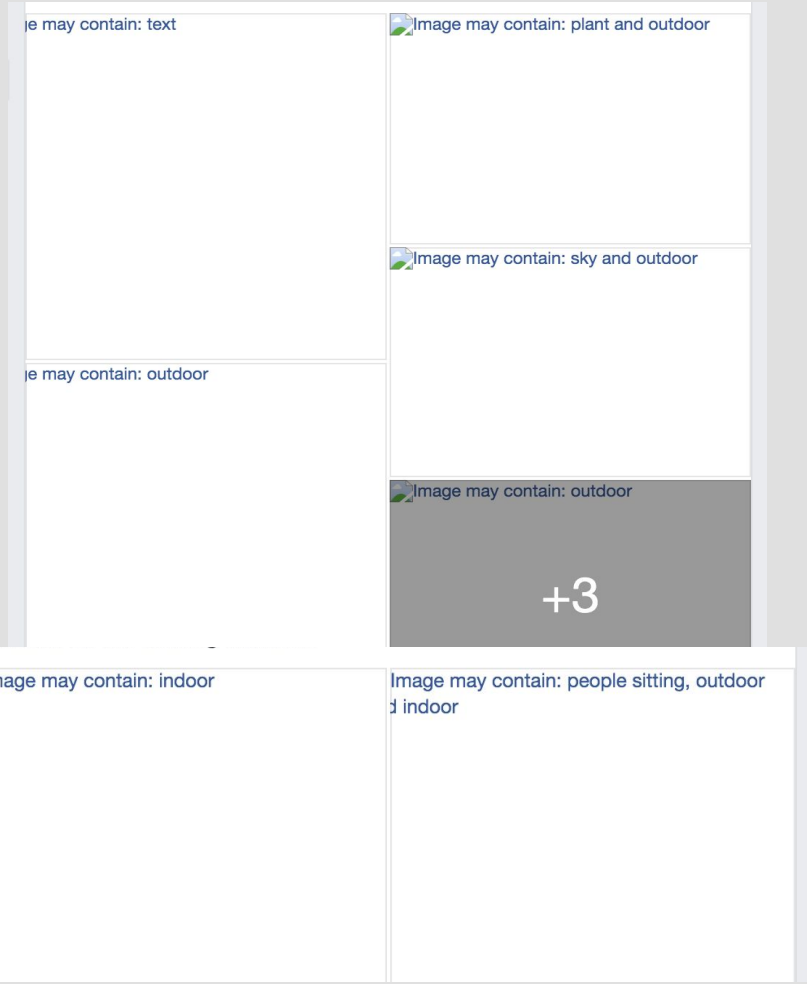
Deep learning could then learn to interpret this for learner generated content and interactions to then deliver the right content at the right time, in suitable form*

* *"... information needs of target users should be identified... The challenge is to best meet those needs with content that is understandable, relevant and delivered in a usable form...*

... Digital solution design can best serve low-literate and low-skilled users by using appropriate media mixes, input methods and UI approaches..." Designing Inclusive Digital Solutions and Developing Digital Skills 2018 [15]

Learner Generated Content Uploads:
Machine seeing...

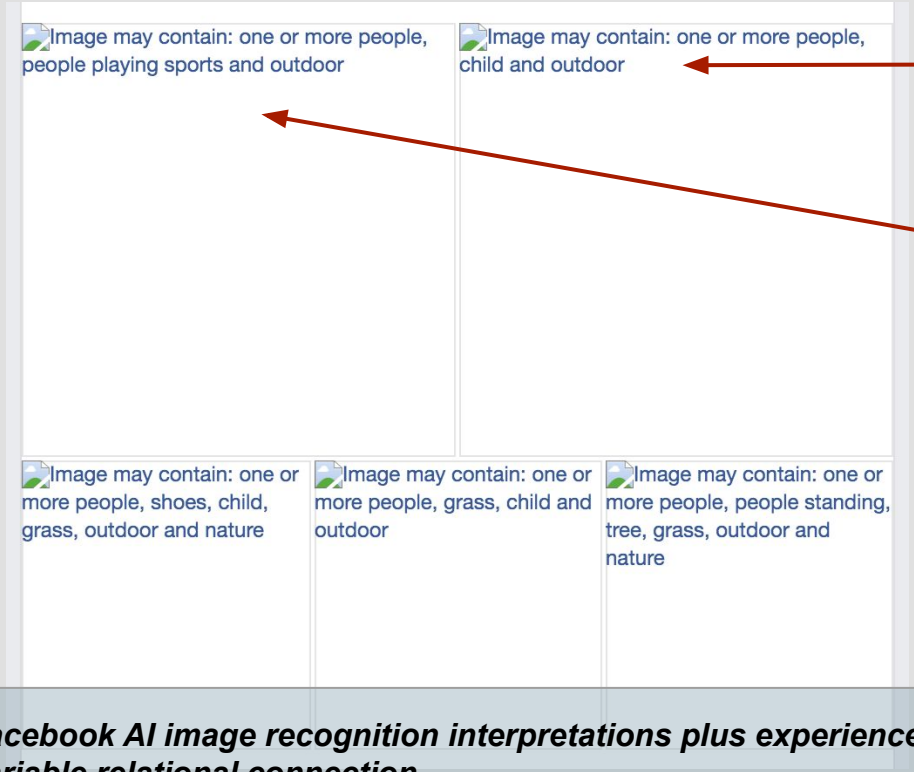




Facebook AI image recognition interpretations

Learner Generated Content Uploads:

Machine seeing...



2B3; 2C3;

2B3; 2C3; 3C3; 3D4;

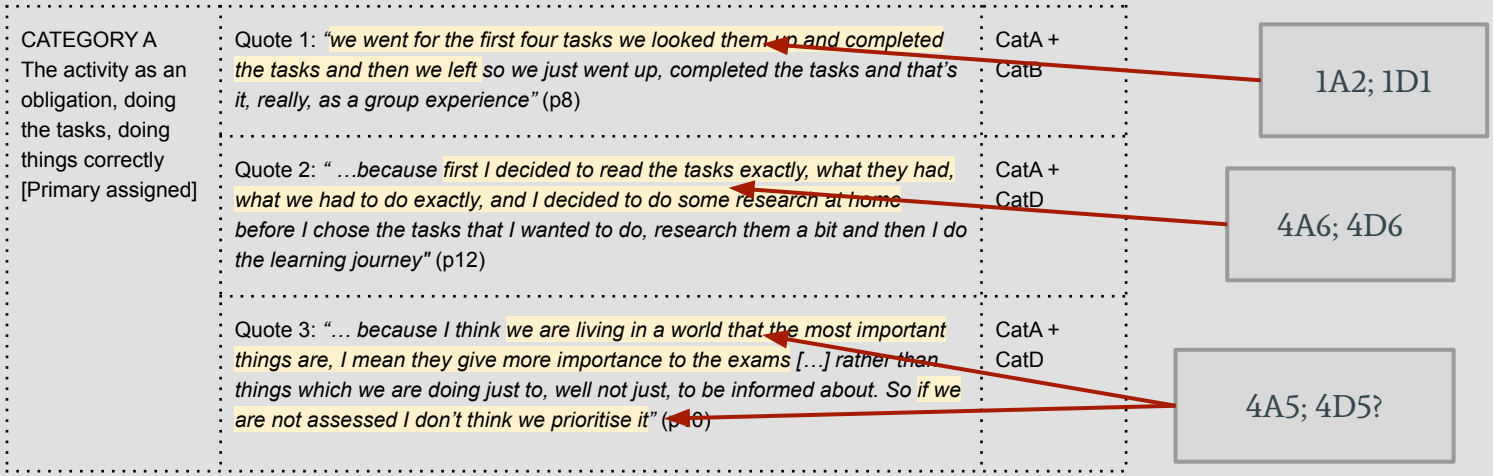
Creating a machine readable relational connection between a learner experience variable and image content labels

Facebook AI image recognition interpretations plus experience variable relational connection

Learner Generated Content - text

CATEGORY OF DESCRIPTION	QUOTES	Related category
CATEGORY A The activity as an obligation, doing the tasks, doing things correctly [Primary assigned]	Quote 1: *"we went for the first four tasks we looked them up and completed the tasks and then we left so we just went up, completed the tasks and that's it, really, as a group experience"* (p8)	CatA + CatB
	Quote 2: *" …because first I decided to read the tasks exactly, what they had, what we had to do exactly, and I decided to do some research at home before I chose the tasks that I wanted to do, research them a bit and then I do the learning journey"* (p12)	CatA + CatD
	Quote 3: *"… because I think we are living in a world that the most important things are, I mean they give more importance to the exams […] rather than things which we are doing just to, well not just, to be informed about. So if we are not assessed I don't think we prioritise it"* (p10)	CatA + CatD
CATEGORY B Discussing, to do with classmates or other friends [Primary assigned]	Quote 1: *"I believe it is essential to be honest to have someone who is with you and is doing the same journey with you… so basically having different opinions different experiences are essential to the development of the journey"* (p13)	CatB+ CatD
	Quote 2: *"well I did it on my own … so I think I if I have to do it with my friends it would've been much more interesting because we would be looking at things and discussing …" … " I think if I have to be amongst other students at that moment we would've chatted at that time and sort of like telling to each other 'Oh I am here you go over there', for example it would've been much more interesting …"* (p7)	CatB + CatC + CatD
CATEGORY C Being there, living the experience, live the atmosphere, being in the place, at that time [Primary assigned]	Quote 1: *"you can imagine maybe how it was in the past no, you can say oh my God I am staying in that, I'm in the same place that, I am reading about and all this happened all those years ago, so yes for me but maybe it's because I like history a lot so I do think of these things like wherever I go…"* (p11)	CatC
	Quote 2: *"… but at the moment you are, you're like doing this you're being engaged into seeing what you have to do and take pictures and do the task at that time"* (p7)	CatC + CatA
	Quote 3: *"I think it was also useful being in the place and experiencing history in the different venues its uses useful to motivate me and actually capture my interest about the different tasks and the different information which was provided and the images came up when you open the trigger"* (p12)	CatC + CatD + CatA

Learner Generated Text Content: *Machine seeing…*



Creating a machine readable relational connection between a learner experience variable and textual content analysis

Textual content analysis interpretations for experience complexity variables

Experience based learning analytics

Assuming we could map these rich variations of experience from learners into machine readable data, what could we do with that?

Key challenges of ‘personalised’ learning are privacy preservation, sustained flexibility, decision choices and levels or types of content.

Why would we want to do this in citizen based activities? The UNESCO/Pearson design guide[15] is useful for these ideas, along with DigComp 2.1, the EC digital skills framework for citizens[4].

The next section briefly covers possible ways that learner experience complexity variables could inform dynamic content delivery, **perhaps matching experience variables data with RDF metadata[7] for topic, level and media types[8]** to deliver content and interaction choices suitable to the experience being shown by the learner *at that time*.

Learner Generated Content and *AI*

How AI could help build meaningful learner experiences

- To build a user profile *in real time*
- To match profile behaviour to suitable content needs and choices
  - Short videos
  - Short audio
  - Shorter text/ longer text
  - Image slideshow/clickthrough's
  - Informal webpage content
  - Formal academic journal research
- To offer simplified interfaces if digital literacy is indicated as lower
- To be sensitive to time on page or task and type of content uploaded

> *information needs of target users should be identified... The challenge is to best meet those needs with content that is understandable, relevant and delivered in a usable form... Digital solution design can best serve low-literate and low-skilled users by using appropriate media mixes, input methods and UI approaches... (UNESCO Designing Inclusive Digital Solutions and Developing Digital Skills 2018[15])*

Delivering knowledge *for learning*

Could ***learner experience data variables*** impact knowledge delivery?

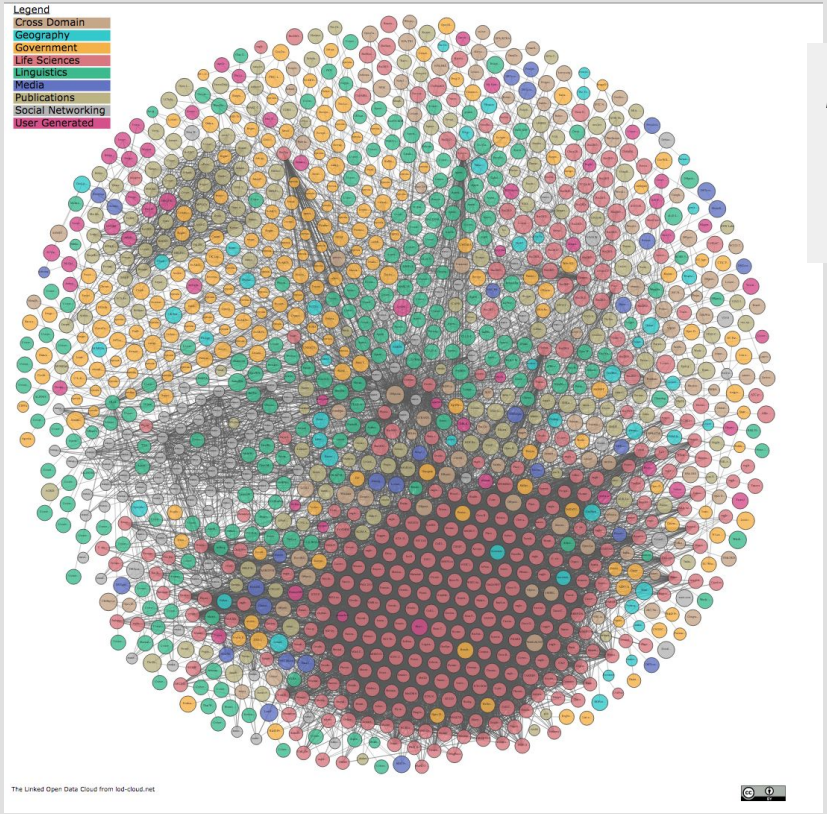
- Knowledge needs connecting to learners in better ways
- Mapping knowledge means it has smarter findability

Existing examples

- *Linked Open Data*
- *Citation lists (often including a DOI)*
- *Referral tracking*
- *Metadata/microdata (RDFa) such as Open Graph, Schema (or Dublin Core)*
- *Geotagged content*

A great short post explaining RDF, linked data, open data and Linked Open data (LoD) is here:
https://blog.soton.ac.uk/webteam/2011/07/17/linked-data-vs-open-data-vs-rdf-data/

Delivering knowledge *for learning*



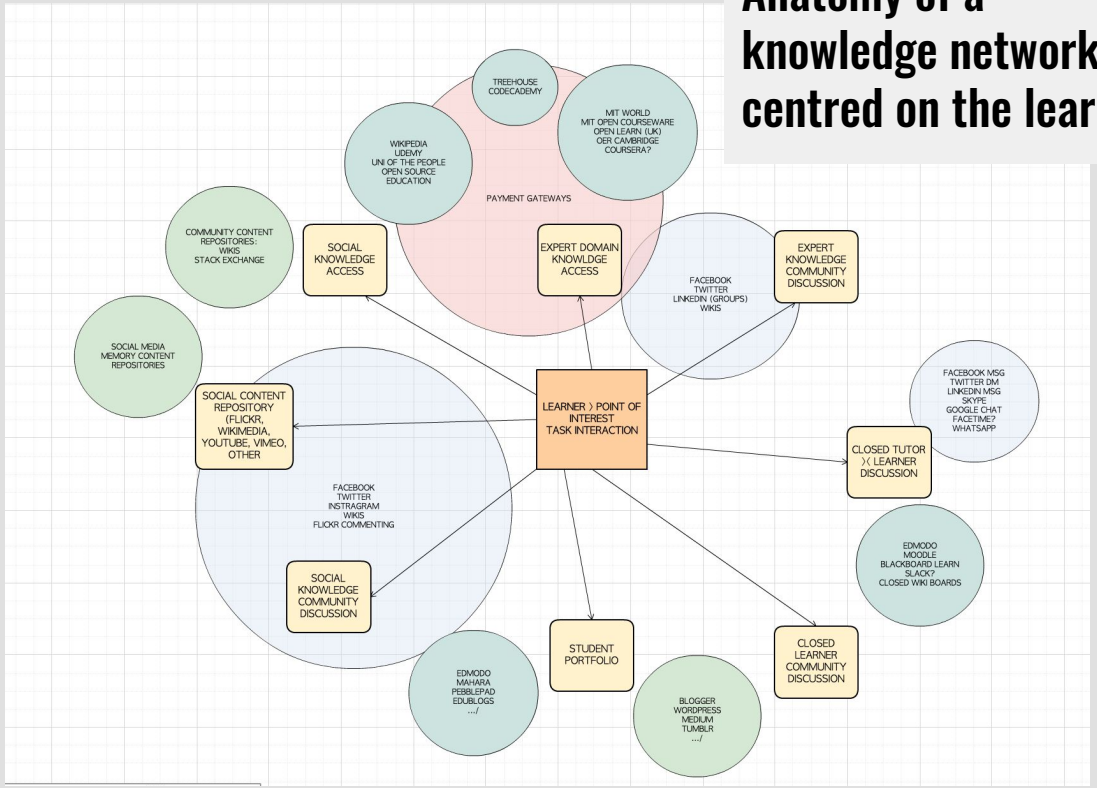
https://lod-cloud.net/clouds/lod-cloud.svg

Anatomy of a knowledge network: Linked Open Data

There are a lot of edges and nodes in the LOD network.

Could we connect this content via RDF attributes to learning experience variables?

Delivering knowledge *for learning*



Anatomy of a knowledge network, centred on the learner

A personal knowledge network consists of multiple sources both formal and informal.

Permissions dependent

Connected at learner account level, to deliver relevant content of various types, depending on choices and past interaction behaviours. This *could* use learner experience variables data, making use of personal profile information, if the learner chose to save their data.

Delivering knowledge *for learning*

Over time, by first using human assessed learner generated content, could we train an algorithm (e.g. Flovik, 2019) to estimate the experience being shown by a piece of image or text content, and steadily build up algorithmic understanding for how to estimate a wide range of experience variation?

Novel ways of training algorithms might be employed in addition to a model provided by human graded learner experience variables data, such as discussed by Alan Brown in a 2016 Nautilus article[3]:
"Machine learning science is not only about computers ... but about humans, and the unity of logic, emotion, and culture."

Digital data for *learning: challenges*

Privacy preservation - the biggest challenge, how to provide smart learning without requiring log in

Accessibility - one-interface-fits-all is not always the best fit

Digital Literacy - how to see it, track it and deal with it more efficiently

Going beyond the 'ad-model' - better recommender system principles to deliver content more intelligently

'Intellectual Debt'[16] - knowing why things work, not just that they *do*, and deciding on appropriate success criteria

sources

1. Anderson, L.W., & Krathwohl, D.R. (Eds.) (2001). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. New York: Addison Wesley Longman.
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