
Across System Learning Environment and Dashboard Design for K12 Teachers and Students -- xAPI Design Cohort 3 Team Across X

Jessie Chuang, Roger Hu

Team members

- Jessie Chuang (designer, coordinator)
 - Kuan-Ting Chen (designer, coordinator)
 - Roger Hu (programmer)
 - Five Cheng (programmer)
 - Yuan-Che Cheng (customer service)
 - Eric Lin (learning analytics)
 - **Delta Electronics: Doris Chen, Ivan Yu**
 - **MiTAC: Dr Lin**
 - **HDK: Irene**
 - **1Know: Bill Yu**
 - Dr Sharma (Director of <http://www.cemca.org.in/>)
-

Major contributions from...

The dashboard and analytics are being developed by [Digital Education Institute \(DEI\)](#), under the umbrella of [Institute for Information Industry \(III\)](#).

III was established in 1979 as a NGO through the joint efforts of public and private sectors, to support the development/applications of the information industry as well as the information society in Taiwan under the supervision of the Republic of China Ministry of Economic Affairs.



[Classroom Aid Inc.](#) provides dedicated consulting services in:

- Learning technology research on demand
- Data driven learning design (Experience API, xAPI, enabled)
- EdTech product/service development

Co-founder Jessie Chuang is the leader of this project, and xAPI Chinese CoP. She designed this project in order to showcase xAPI's potential to Chinese CoP, and build partnership between stakeholders, vendors and developers.



Classroom Aid

Theme - Intelligent Campus

- Implementing xAPI in several educational technologies
 - Flipped learning platform - 1Know
 - IRS and assessment
 - eBook readers
 - Google Apps for Education
 - Mobile Learning Apps
 - Goals
 - Helping Chinese CoP members implement xAPI
 - Across System Learning Environment and Dashboard Design for 350,000+ K12 teachers and students
 - Building the foundation for extensible learning data analytics, functionalities, and services developed/offered by 3rd parties
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Plan

Learning
Planning

*Adaptive design
*Learner preference



Flipped learning system

Activity/Agent Profile API

xAPI data

LRS

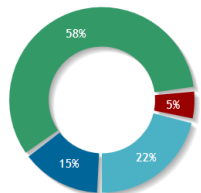
Reporting
Gamification
Dashboard

Mobile Learning
Micro Learning

IRS, Quiz service

ebook

Google Apps for Education



Don't get them(schools) started on data! (pain)

“Give me my \$#% data.”*

“It's our data. Why do we have to negotiate for it?”

“Don't hold our data hostage!”

What school systems want:

- Direct access to their data from software vendors.
- **Help managing their data;**
- **Better data warehousing and data mart solutions that provide actionable, real-time data;**
- **Common data standards** that are shared among software vendors.

*Users are willing to
trade product features
with better system and
data integration!*

Citation: research report from EdSurge: “School and Software, What's Now and What's Next”

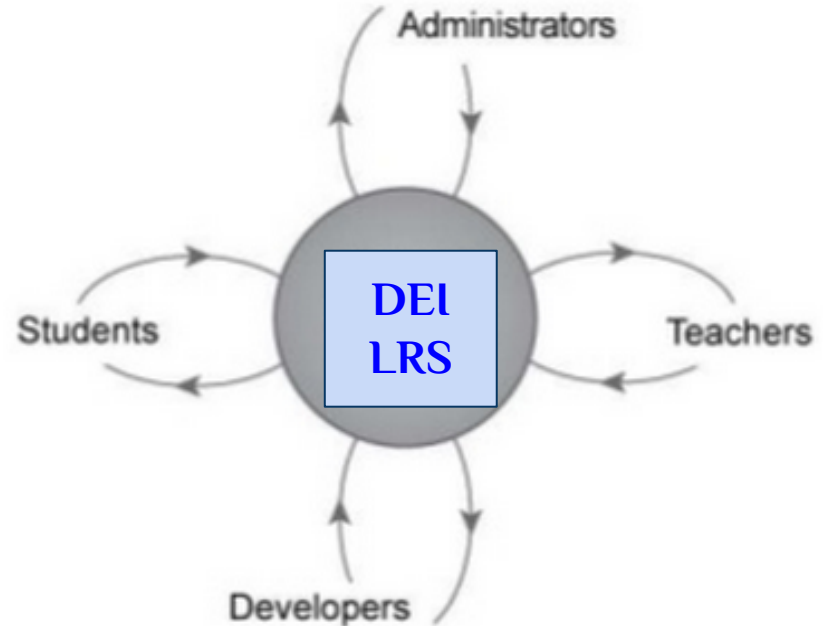
Interconnected Feedback Loops

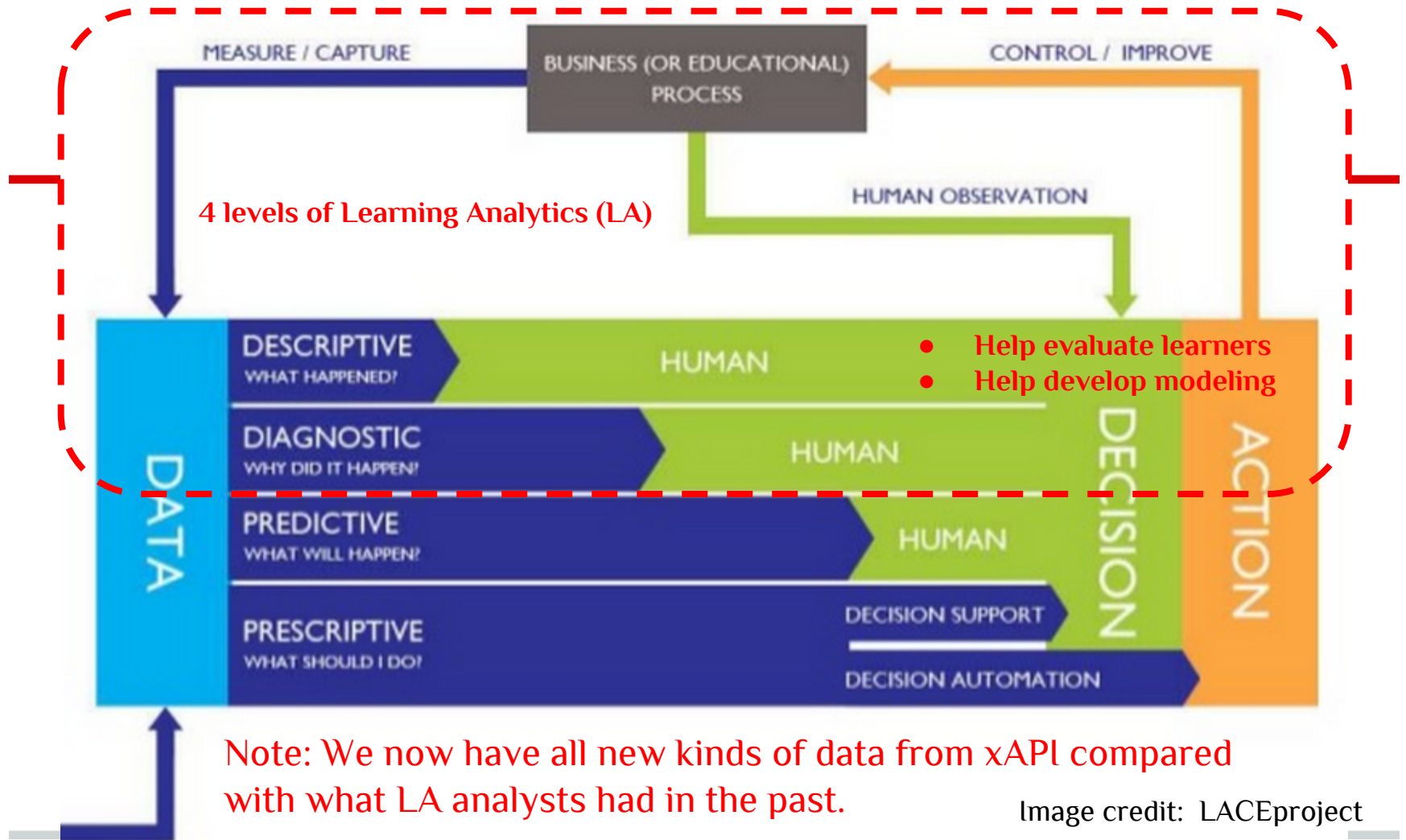
National Educational Technology Plan

“The goal of creating an interconnected feedback system would be to ensure that key decisions about learning are informed by data and that data are aggregated and made accessible at all levels of the education system for continuous improvement.”

*(U.S. Department of Education
2010, p. 35)*

Data Loops AND Action Loops

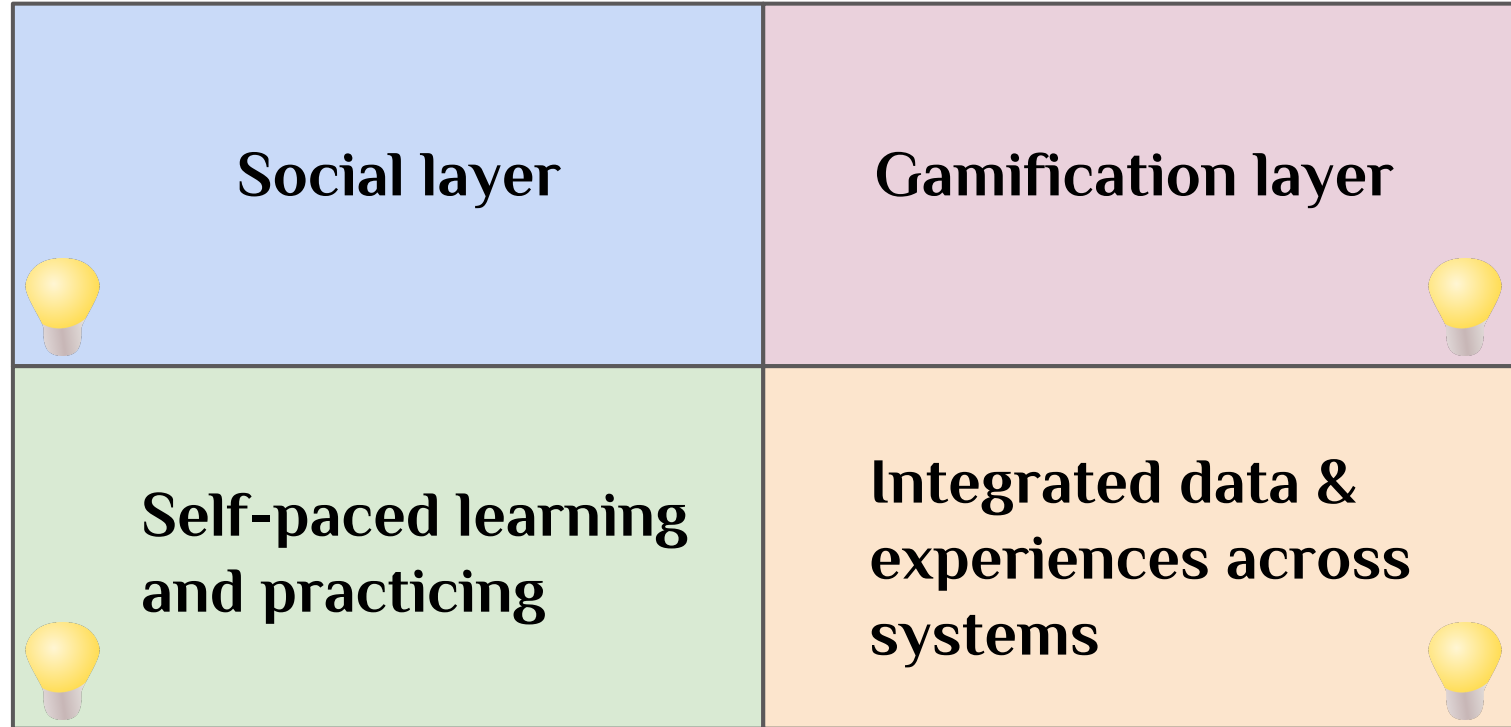




Development Approach

1. Build the high level use case including workflow (teacher, student), data flow, learning design framework, **questions to answer and problems to solve**. (some functionalities aren't ready yet)
 2. **Create the story and narratives** with virtual settings, then **create xAPI dummy data accordingly for simulation**. (try to cover major corners and variables - e.g. learner preferences and behavior patterns)
 3. **Design analytics(backbone components) to visualize and analyze** those dummy data, and later build recommendation algorithm. In this way we can
 - a. build xAPI analytic capability without the limitation of current systems or tools,
 - b. envision future possibilities with xAPI,
 - c. let learning design lead the technology development.
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Major learning design goals



Workflow

one example

xAPI in system level

xAPI in LO level

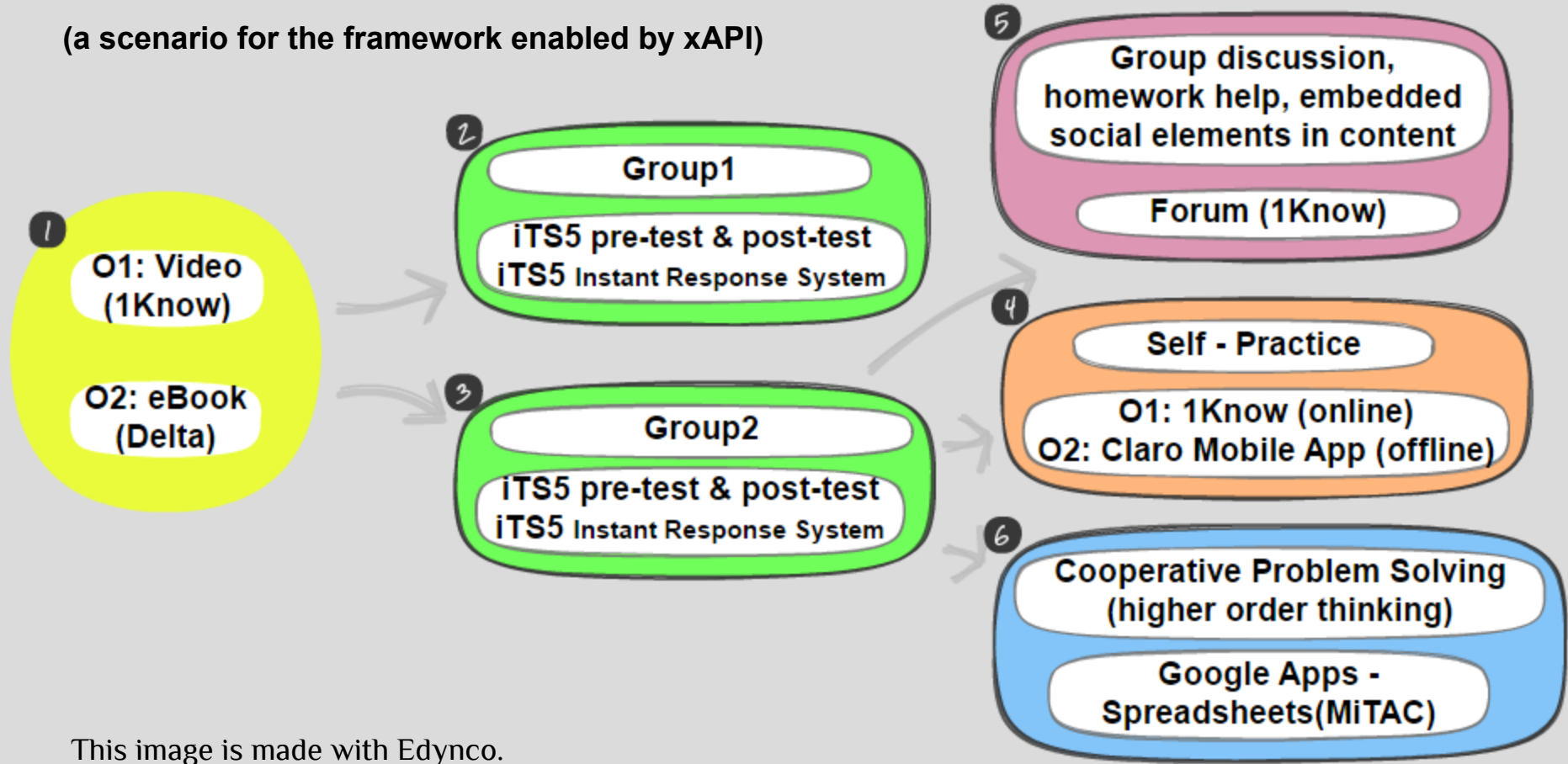


Before Class

In Class

After Class

(a scenario for the framework enabled by xAPI)



xAPI Use Cases

- A lesson plan created by the instructor beforehand (Activity profile API)
- Video
- Assessment
 - MCQ test with time constraint
 - IRS (like quizzes embedded in videos, here quizzes in slides)
- Self - practice(exercises) with hint, link to videos or feedback when fail (same content in both online and offline options)
- eBook (fixed-layout eBook or presentations, for this project)
- Cooperative problem solving in Google Apps(spreadsheet)
- Quizzes embedded inside videos, ebooks (to probe learning)
- Social layer:
 - Forum for discussion and homework help from peers, learners can also ask questions when watching videos, reading ebooks, self-practicing (exercises)
 - Note-taking inside video, ebook, self-practice (shared within team)
- “Request help” right inside videos, ebooks, and self-practices (to teacher)

Learning Plan

Learning Plan	f2f=face to face					
				5/1/2015	5/2/2015	5/3/2015
				teacher sent lesson plan	student self-study before f2f class	
5/4/2015	5/5/2015	5/6/2015	5/7/2015	5/8/2015		
10:00 f2f: pre-test→teacher lecture + IRS		10:00 f2f: student discussion in groups, teacher is on demand		10:00 post-test		

- All self-practice exercises have hints and feedback so that learners can learn independently - **feel free to fail and re-trying is encouraged**. (we can analyze xAPI data to get insights)
- **Between 5/1 ~ 5/7 (this game turn), team cohort should help each other** to maximize learning outcomes of all. (social interactions on forum, in person, in class discussion time)

Story Settings

Virtual students

- 10 students (different types)
- 7-1 (grade7, class1)
- 7-1-1, 7-1-2 (grade7, class1, group1,2)

Virtual contents

- Aligned to learning standard - http://teach.eje.edu.tw/9CC/fields/math_3_1.php
 - Math competency standard: 7-a-04
 - Performance index: Bloom's levels (for quizzes, self-practices)
 - CPS evaluation: <http://classroom-aid.com/extensions/CPS-rubrics>
 - Team work (peer learning): <http://classroom-aid.com/extensions/team-work>
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Gamification Across Systems

Teacher can experiment the weighting on each behavior, and there are 4 metrics (badges) for 4 different categories (to recognize multiple values):

- **XP (efforts, engagement)** - time spent in all activities
- **PowerA (personal competency in subject knowledge)**
 - Test scores, practiced exercises and passed levels
 - Thinking process in CPS and forum (the teacher evaluates & inputs score)
- **PowerX (study skills - with goals)**
 - Verb counts from ebook, video, self-practice and interaction with feedback widget (highlighted, noted, attempted, completed, answered, requested, interacted) => **encouraging taking actions!!**
- **Force (soft skills)**
 - Verb counts from forum and CPS (asked, posted, responded, liked, edited)
 - Evaluated by the teacher
 - Team work (peer learning, from group data improvement)
 - Help others on forum (from xAPI records of answering other's questions, and peers' rating)
 - Cooperation shown in problem solving (teacher judges & inputs score)

Game Rules (to learners)

- Your time spent and actions will increase your **XP**, using XP you can buy hints when doing practices/quests, doing more practices/quests correct will **level you up (PowerA)**. XP also can be used to buy challenges to speed up leveling up.
 - In any content or practices, if you do quests, that's your chance to gain **PowerA** if you answer the questions right. (you level up according to PowerA)
 - These actions will increase your study skill points -- **PowerX**: taking notes, highlighting, reviewing notes and highlights, requesting help (ask real questions, not silly ones) when stuck, interacting with feedback widget, self-reporting of learning records outside content assigned by the teacher (like self check-in).
 - These actions will increase your **Force**: participating in forum and get vote-ups, collaborating with peers to solve problems given in Google sheets.
 - **The competition is between groups, not between individuals. (need to cooperate to win!)**
-

Learner feedback widget embedded in contents

- Agent profile API will record learner's competency level:
 - real-time display in feedback widget
 - learners will get appropriate practice items no matter what resource he/she is using
- Next step: assignment, repetitions, practices recommended, study skill reminder, urgent msg from teacher, special event... (must-have: content units aligned to competency standard etc.)



Reporting

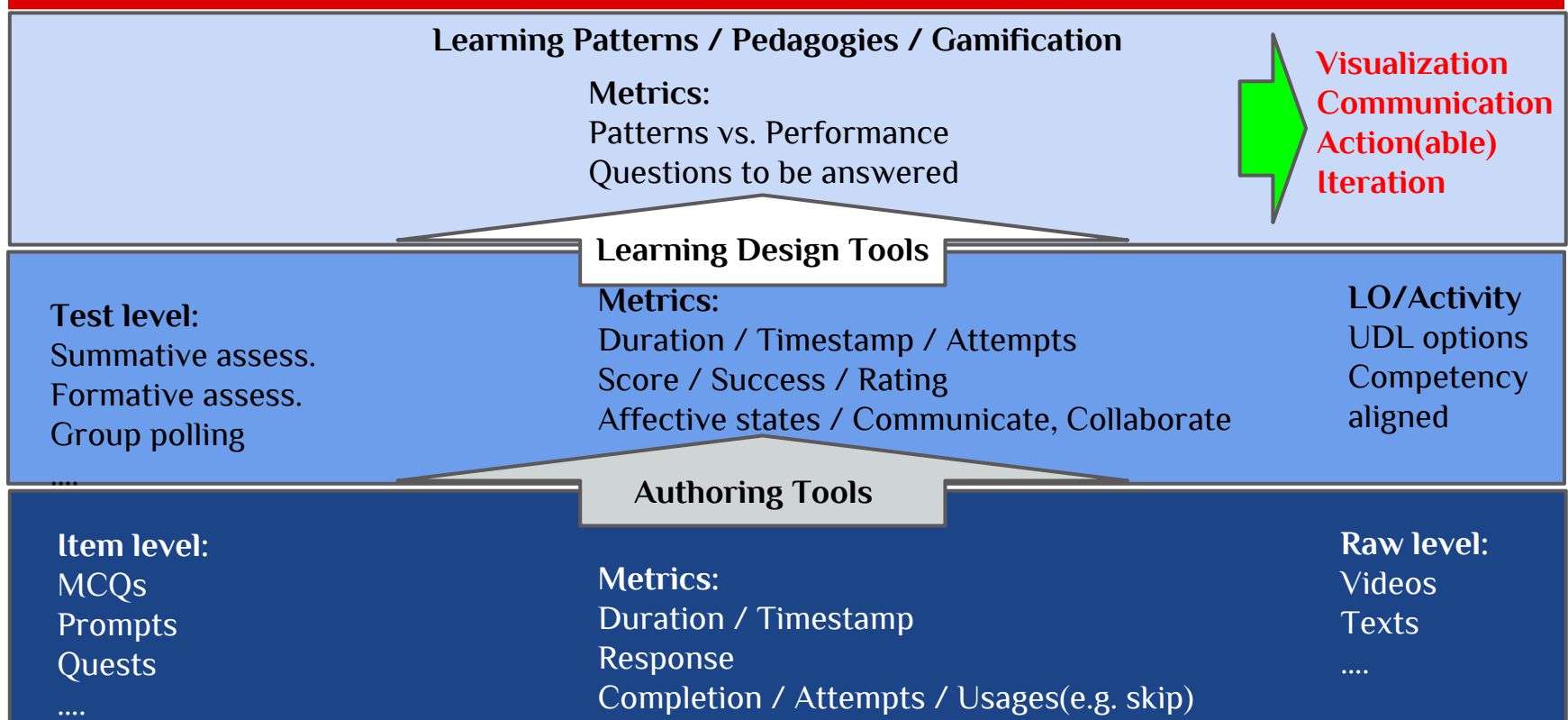
Basic metrics and context(in other table) are set for basic components, for example, a video, a quiz item will have its standard reporting plot according to its content type. (similar to “recipe” concept, but more rules to specify what should be recorded in “result”, “context”)

Reporting with hierarchy structure and modularized components, in this way no matter how the content is mixed - quizzes inside a video, a video inside a quiz etc. - we can visualize the data from levels top-down on a timeline or a learning map, and allow users to drill down each component.

If the above is called *vertical*, then the reporting will allow reporting “*horizontal*” too, for example, plotting time spent on all quizzes vs content unit, or other correlations analysis for multi-variates.

Different metrics in different levels (conceptual)

by Classroom Aid Inc.



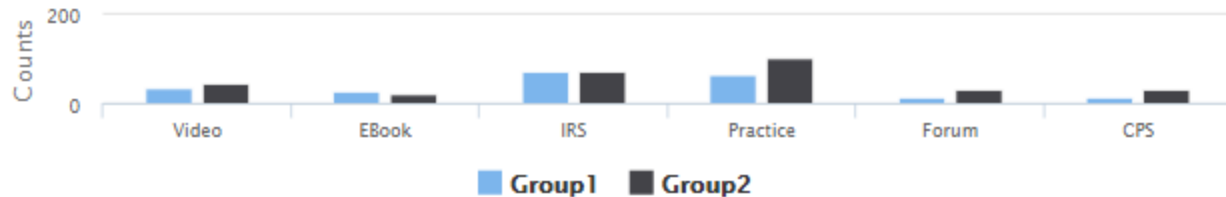


Customized
Interaction design

Overview **Analytics backbone**

Last 30 days records

Activity Type Counts



Plan Heatmap

Load Group Profile HeatMap

Open Student Widget

	Name	Video	EBook	IRS	Practice	Forum	CPS
1	Roger	08:37		45:30	33:00	02:00	
2	James		15:30	44:10	25:00	02:30	
3	Irene	23:30	55:30	01:09:55	01:12:00	02:00	
4	Steven	14:30		48:55	01:06:00		
5	Abby			40:45	00:45		
6	Andy	14:40		45:25	01:32:00	14:00	

activities included in
the lesson plan

=> Data can be drilled down

Load Group Profile HeatMap

Open Student Widget

	Name	Video	EBook	IRS	Practice	Forum	CPS	Total Spent Time
1	Roger	08:37		45:30	33:00	02:00		01:29:07
2	James		15:30	44:10	25:00	02:30		01:27:10
3	Irene	23:30	55:30	01:09:55	01:12:00	02:00		03:42:55
4	Steven	14:30		48:55	01:06:00			02:09:25
5	Abby			40:45	00:45			41:30
6	Andy	14:40		45:25	01:32:00	14:00		02:46:05
7	Jennifer	22:08		47:50	52:00	28:30		02:30:28
8	Roy	06:45	07:00	45:15	01:16:00	06:00		02:21:00
9	Jane		01:10:30	45:13	59:00	08:00		03:02:43
10	Sean	04:00		46:40	59:00			01:49:40

Jennifer's Profile Progress

	Timestamp	Video	EBook	IRS	Practice	Forum	CPS
1	2015-05-02	10:53					
2	2015-05-03						
3	2015-05-04	11:15		47:50	03:00	05:30	
4	2015-05-05				49:00	20:00	
5	2015-05-06					03:00	
6	2015-05-07						

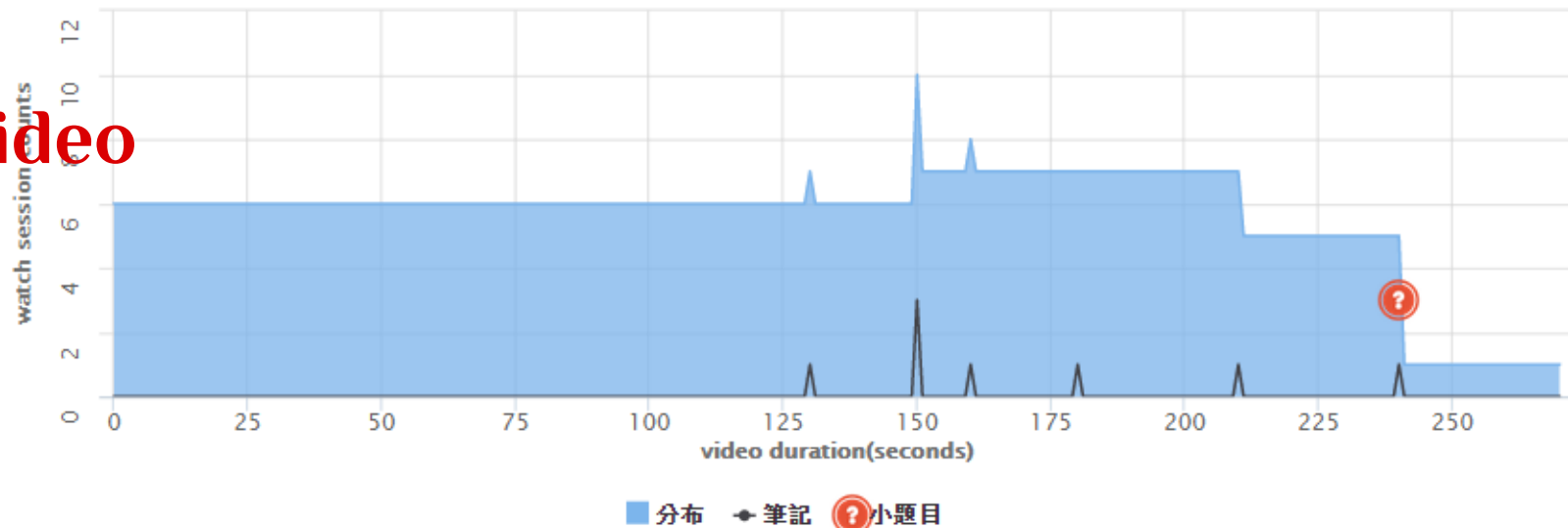
Steven's Profile Progress

	Timestamp	Video	EBook	IRS	Practice	Forum	CPS
1	2015-05-02	05:00					
2	2015-05-03	01:30					
3	2015-05-04			48:55			
4	2015-05-05						
5	2015-05-06	08:00					
6	2015-05-07				01:06:00		

Time patterns

Each activity type can be drilled down on timeline.

Video



Name	Second	Note	Time
Andy	150	筆記.....	2015-05-04T19:15:30.201Z
Irene	150	筆記.....	2015-05-06T10:15:53.201Z
Irene	150	筆記.....	2015-05-04T19:15:30.201Z
Name	Second	Note	Time

Quizzes (Click the dot to see details)

quiz	Irene	Jennifer	Roger	Steven	Andy	Alignment	Bloom
1	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>				Application

still some to-do items left

Practice

Encoding data with colors

Can be drilled down

Different practices offered for different learners

Quiz ▲	Blooms	Roger	James	Irene	Steven	Abby	Andy	Jennifer	Roy
1001	Remembering					●			
1002	Remembering					●			
1003	Remembering					●			
1004	Remembering					●			
1005	Remembering					●			
2001	Understanding		●		●		●		●
2001	Application							●	
2002	Understanding		●		●		●		●
2002	Application							●	
2003	Understanding		●		●		●		●
2003	Application							●	
2004	Understanding		●		●		●		●
2004	Application							●	
2005	Understanding		●		●		●		●
2005	Application							●	
2006	Understanding		●		●				●
2006	Application								
2007	Understanding		●		●				●
2008	Understanding		●		●				●
2009	Understanding				●				●
2010	Understanding				●				●
2011	Understanding				●				
2012	Understanding				●				
3001	Understanding						●		●
3001	Application	●		●			●	●	
3002	Understanding						●		●
3002	Application	●		●			●	●	
3003	Understanding								●

Practice viz drilled down

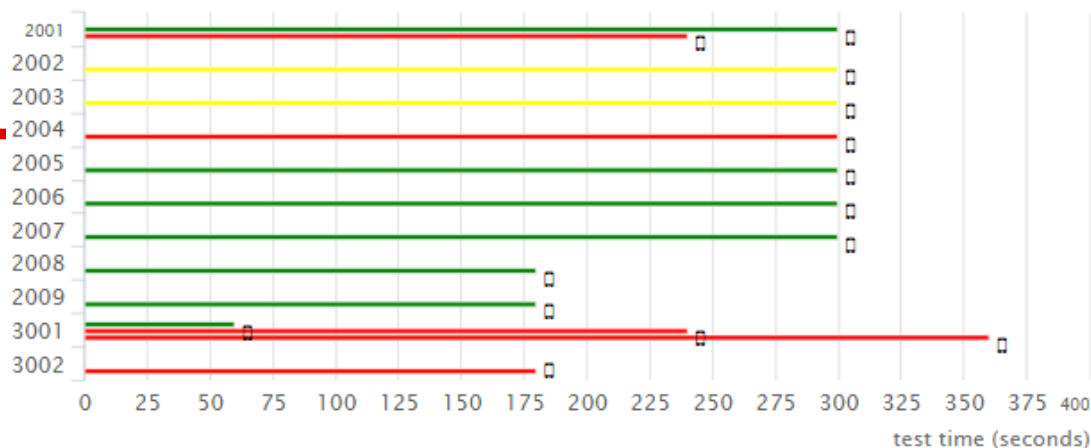
Time spent

Use hint/feedback?

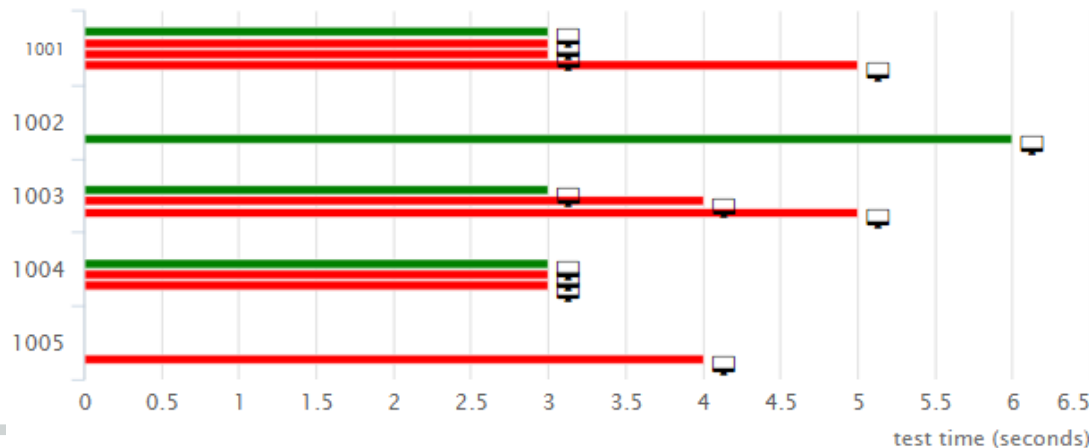
Device preference?

Sean's MCQ Answer History

X軸為作答時間(秒)，每個題目如果作答多次，最後作答結果在最上面，第一次作答結果在最下面



X軸為作答時間(秒)，每個題目如果作答多次，最後作答結果在最上面，第一次作答結果在最下面

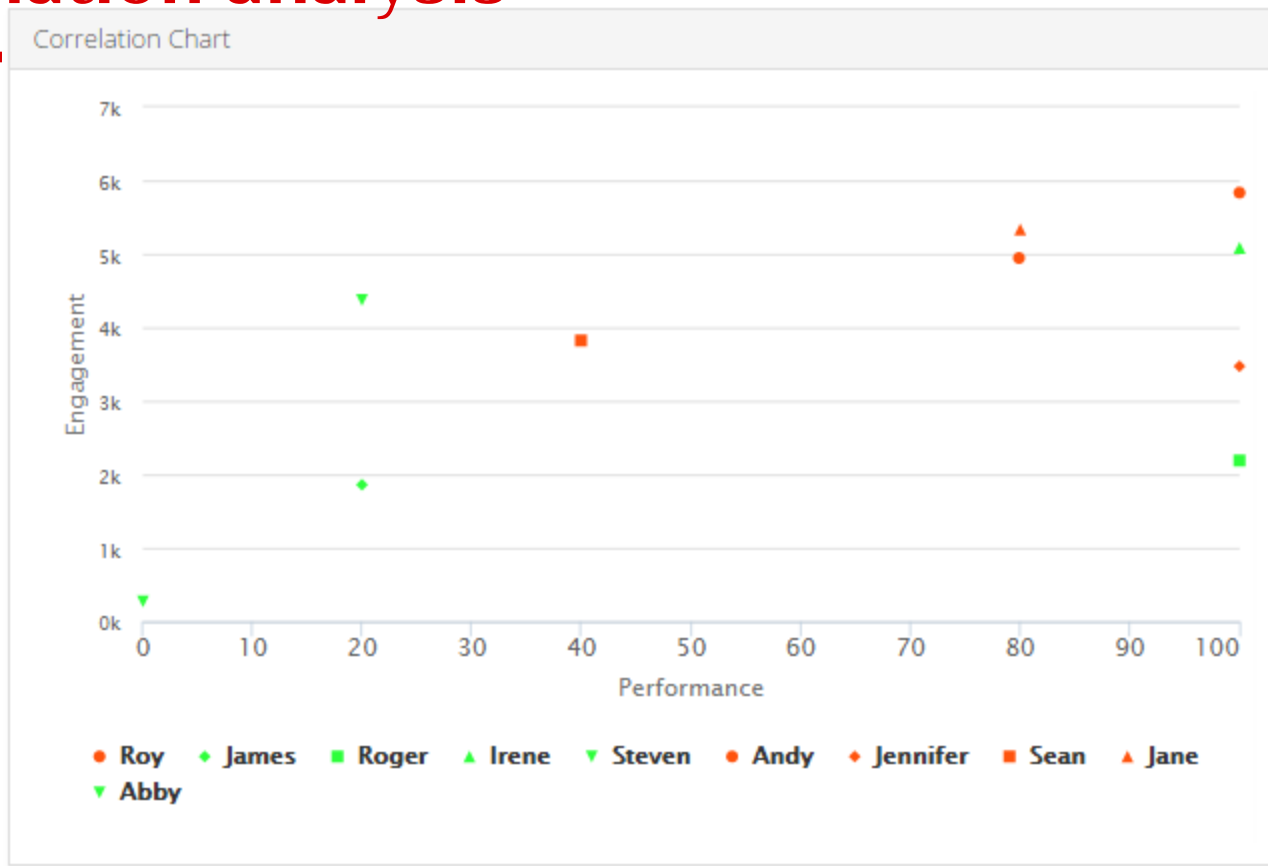


Multivariate analysis

Which verb counts matter?

Name	Performance ▲	watch	noted	read	responded	requested	interacted	answered
Abby	0	0	0	8	0	0	0	23
James	20	0	6	12	2	0	0	20
Steven	20	7	0	9	0	0	1	28
Sean	40	2	0	9	0	0	1	25
Roy	80	3	2	11	2	0	1	37
Jane	80	0	5	14	2	0	1	36
Roger	100	3	2	9	1	0	1	20
Irene	100	8	19	17	1	1	3	30
Andy	100	8	8	8	6	2	1	36
Jennifer	100	13	13	8	9	0	4	26

Correlation analysis



Questions to Answer and Actions

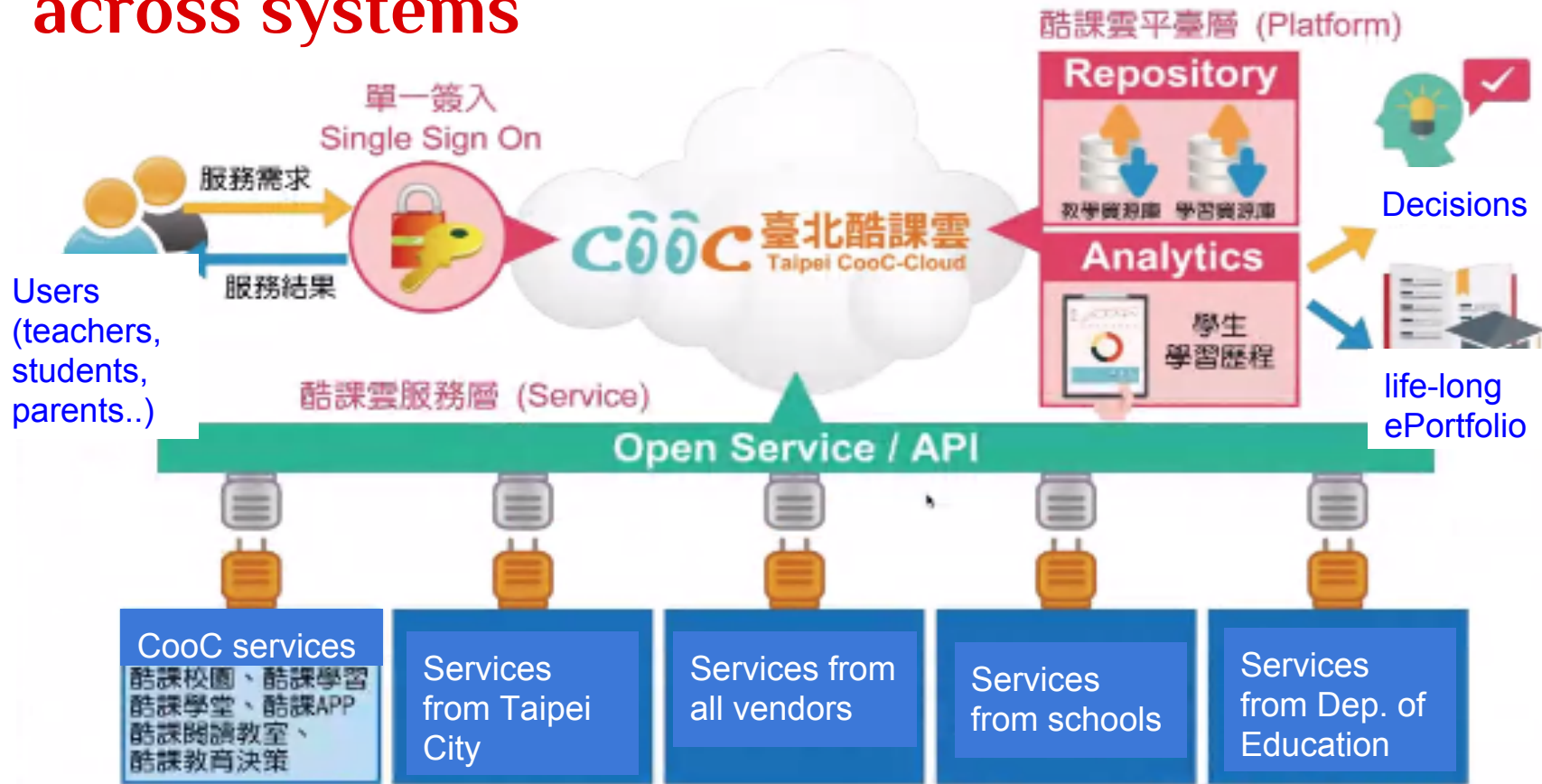
- Outside classroom, which content is better for self-study ([compare content's impact](#)), which type of content is better for whom([learning style](#)), you can always do [A/B testing](#).
 - Before entering classroom, the teacher reads the report to know self-study records, in class, he can probe students' understanding by pre-test, and IRS polling, real-time report assists him to decide his lecture content. (he knows [how well flipped learning works](#) instantly, and identify reasons)
 - Students are grouped according to performance(hi+lo), teachers give some questions for group discussion, later post-test will be similar to these. [Peer learning](#) impact is measured by pre-test and post-test results. (*The teacher can tie group overall performance to individual score to enhance peer learning.*)
-

Questions to Answer and Actions (con't)

After class, there are 3 dimensions:

- **Practice:** (which content helps high performers or low performers?)
 - Online or offline, teachers can see which has greater results and usage, and analyze the hint or feedback design of practice exercises
 - Bitmax will suggest students who aren't doing well to check out resources or ask help on forum, high performers can proceed to more difficult levels
 - **Group/class discussion:** (does it help high performers or low performers?)
 - Students can ask help on forum or to the teacher privately
 - The teacher can recognize/reward who helps others
 - **Cooperative problem solving**(CPS, real world problem, [example](#)):
 - On Google Sheets, everyone's contribution is recorded by xAPI
 - For the results and process of higher order thinking, the teacher will judge and score
-

Integrated services across systems



Next step

Building **customized** version of *integrated functionalities (consolidated workflow/data flow)*, *dashboard and analytics* according to target users and purposes. (also iteration strategy using xAPI tracking & polling)

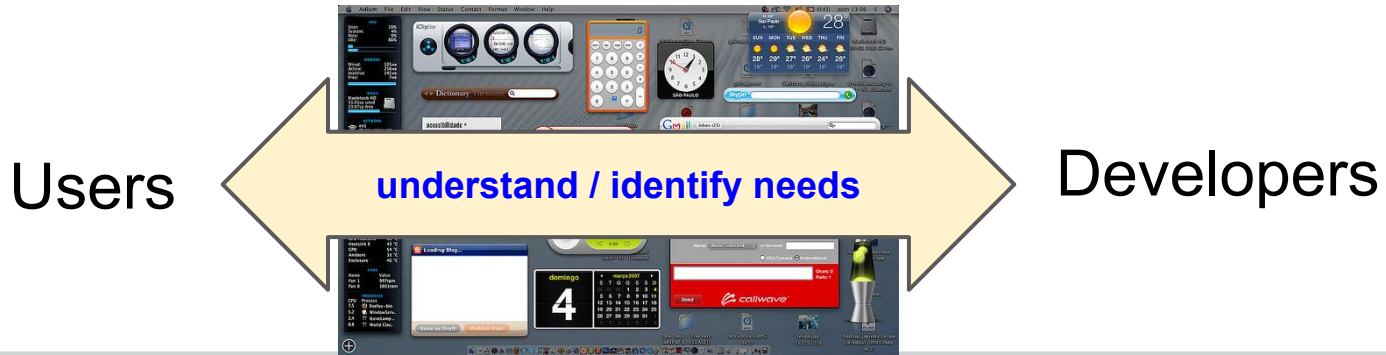
A dashboard is a visual display of
the most important information needed
to **achieve one or more objectives**
that has been consolidated on a single computer screen
so it can be
monitored at a glance. (provides an overview)

-- *Stephen Few*

Next step (con't)

Ready **open API of LRS** to **extend** functionalities and analytics capabilities, also make them **transferrable/applicable** to other domains; e.g.

- a. Learner App (study aid, gamification elements ...)
- b. Assist teacher/trainer workflow (evaluation, differentiation, grouping...)
- c. Learning analytics modeling/ recommendation algorithms
- d. Learning design tools (gamification design & tuning, lesson planning, badge implementation...)



When xAPI meets Gamification...



Mobile
Learning

I collect granular learning behavior data and enable activities to be facilitated across systems.



xAPI



Gamification



I design content/context and engineer granular behaviors for positive outcomes.

Data-Driven Solution

Both are like a layer on the top of learning and workplace activities. (whatever can be recorded) xAPI is the core for analytics, gamification is the skin and flow design.

Gamification elements

Avatar/NPC/mentor: your pet / study pal

The pet needs to be fed by your XP

If the student doesn't login to any system in 3 days, send notifications

In this case, mentor is the teacher, but it could be AI

Context:

Story; Alternate Reality Game; video game maybe Minecraft (can be dev. by 3rd party)

Social layer with peers; objects(contents, activities) can be social elements (nodes) too

Mechanism/consequence:

Rules and rewards

Badges for learning path design and positive enhancement for desired behaviors

Competition between groups (must cooperate within group)

Bitmax

Hello,

I am Bitmax, your personal learning companion. I know all your learning progress across systems, I am here to help you. You have completed watching video V, now it's time to ...

Triggered by xAPI statements, I can facilitate the learning flow by:

- Notify you the next step or options

- Encourage you when doing nice

- Recommend you related learning resources

- Notice that your friends are learning ..., would you like to ...

- Ask your feedback (on the scale of 1 to 10, how confident are you with this test? or how will you rate this video?)



Next step (con't)

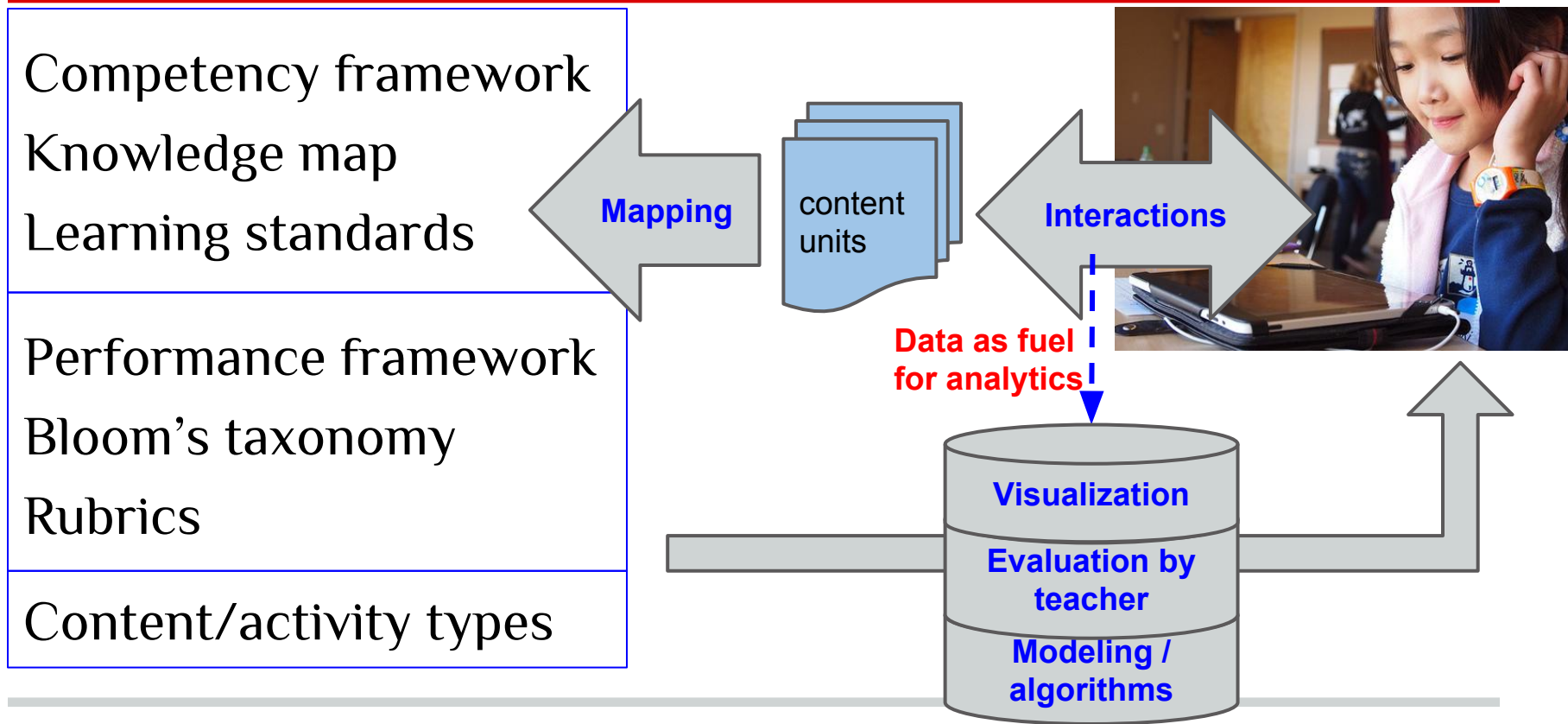
Building **business model** and **broader partnership** (practitioners, developers, vendors, scholars) for sustainable ecosystem development, and leveraging xAPI data and algorithms to recommend free or paid services / products. (also track / analyze / optimize learning outcomes for sustainability)

Benefits for vendors/developers:

- cross-marketing/sales
- know your learners well
- adaptive learning infrastructure



The foundations of adaptive learning



Verbs, Activity Types, Profiles, Extensions keys

- [AcrossX vocabularies, profiles and extensions keys](https://docs.google.com/spreadsheets/d/1OW8xKfgNoeisOrg1ZH4n84uwFoyNlSeGbzgH3kwKqjY/edit#gid=0) : <https://docs.google.com/spreadsheets/d/1OW8xKfgNoeisOrg1ZH4n84uwFoyNlSeGbzgH3kwKqjY/edit#gid=0>
 - English grammar? Chinese grammar? Does it matter? What matters?
 - Thinking of Verbs:
 - One English verb matched to different Chinese translations for different contexts
 - Chinese verbs used in different countries(Taiwan, China, HK...) might be different, can be managed
 - Is “noted” social? You can’t tell from the verb itself. The whole info. of context and settings is needed.
-



Thank you!

Your thoughts, comments, questions

Contact : Jessie@classroomaid.org
