Implementing learning analytics and learning design at scale

EDUtech Asia 2023 Conference Day 1 @ 09:40

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All papers referred to in this presentation can be accessed via

https://iet.open.ac.uk/people/bart.rienties

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Innovating Learning Design in Higher Education

EDUtech ASIA

My aims with you today

1. Understand where to start with learning analytics and learning design
2. Understand how to effectively support your staff to use data
3. Critically review whether learning analytics and learning design is something for your organisation

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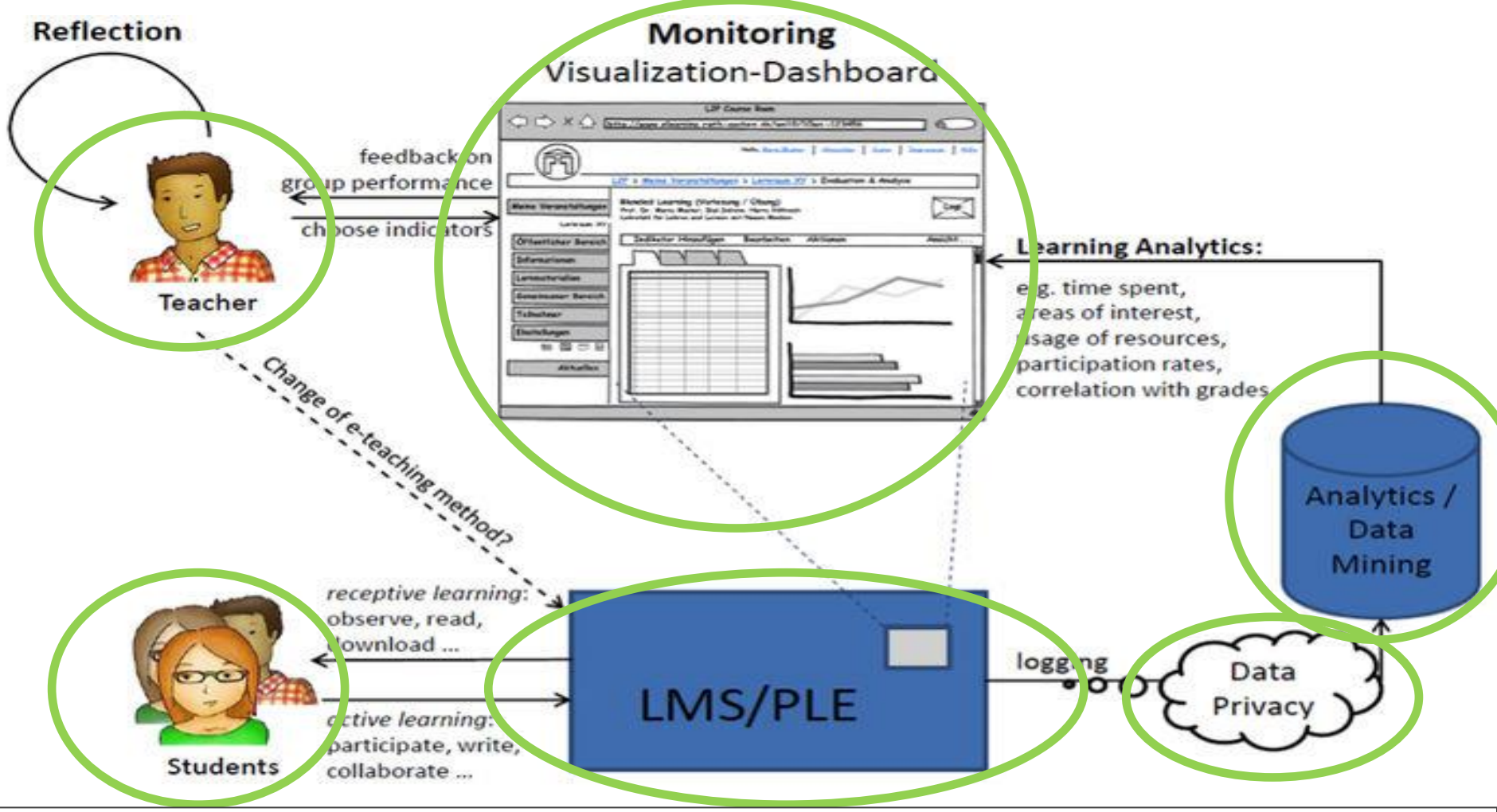
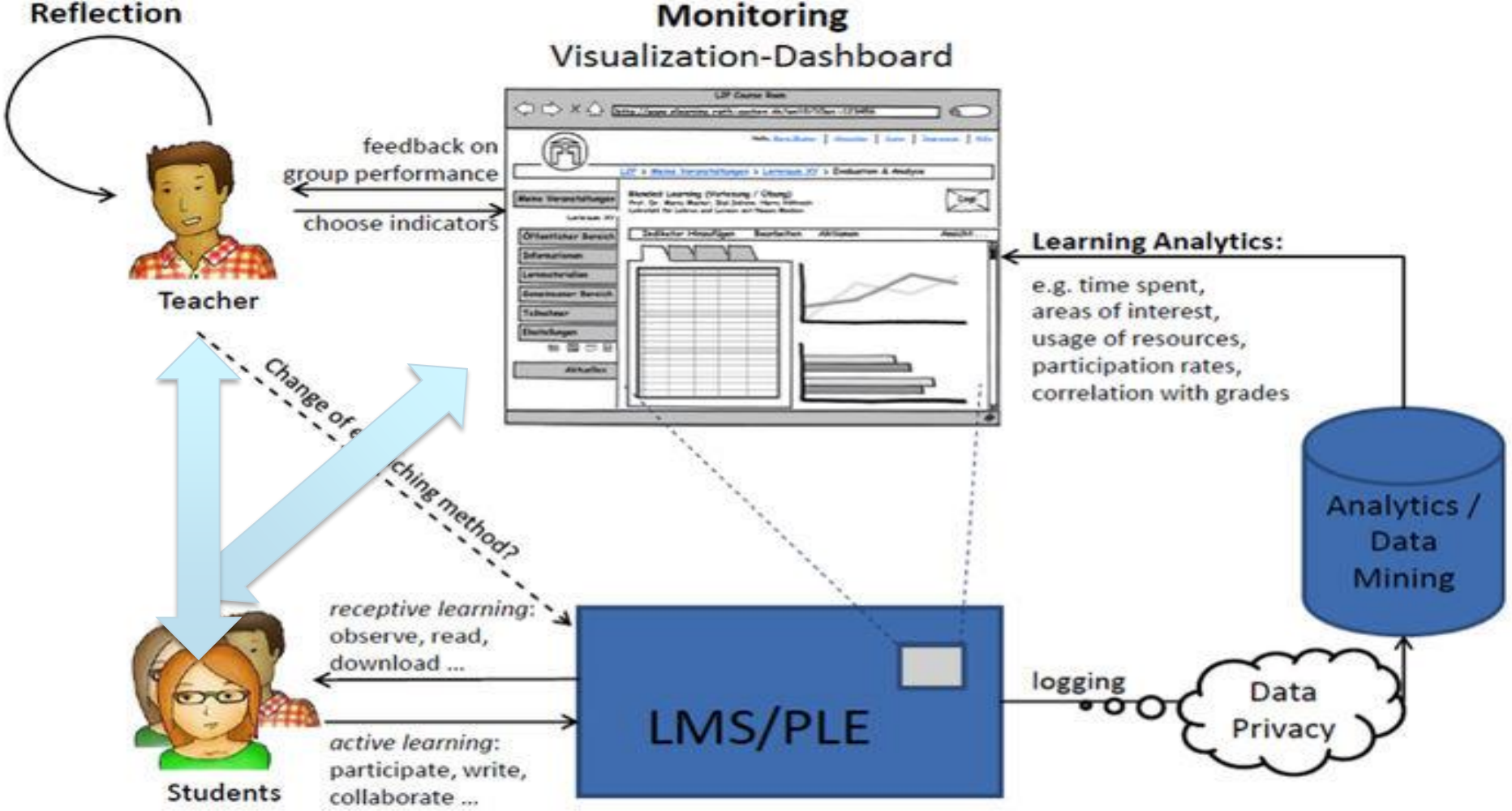


Dyckhoff, A. L., Zielke, D., Bültmann, M., Chatti, M. A., & Schroeder, U. (2012). Design and Implementation of a Learning Analytics Toolkit for Teachers. *Journal of Educational Technology & Society, 15*(3), 58-76.



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What we have learned in 10 years in terms of benefits of LA?

Learners	Enhance engagement of students Personalization of learning Enrich personalized learning environments Increase self - reflection & self-awareness Parents (Monitoring students' activities)	Improve learning outcomes Increase in students adaptivity
Faculty	Enhance Assessment services Get a real - time feedback Understand students learning habits Monitoring students' activities Provide warning signal Improve instructor performance Get a deeper understand teaching/learning Researchers (Increase efficiency Education & serious games, Identify knowledge gaps)	Make efficient interventions Get a real - time insight Modify content for students' desire Predicting student performance Improve teaching strategy Sources recommendation
Institutions	Identifying target course Improve learning design	

1. Support access and inclusion
2. EDI

1. Improved pedagogical awareness
2. Improved data literacy and confidence
3. Driver for change based upon evidence

1. Identify good practice/teachers/modules
2. Alignments between modules/qualifications
3. Indications of good practice between/across institutions

Case-studies included from Arizona State University (*USA*), Dublin City University (IRE), Georgia State University (*USA*), Northern Arizona University (USA), New York Institute of Technology (USA), **The Open University (UK)**, Open Universities Australia (AUS), Purdue University (USA), Rio Salado College (USA), Sinclair Community College (USA), Tecnológico de Monterrey (Mex), University of Alabama (USA), University in Ankara (TUR), University of Maryland (USA), University of Michigan (USA), University of Wollongong (AUS)

Hernández-de-Menéndez, M., Morales-Menendez, R., Escobar, C. A., & Ramírez Mendoza, R. A. (2022). Learning analytics: state of the art. International Journal on Interactive Design and Manufacturing (IJIDeM), 16, 1209–1230. https://doi.org/10.1007/s12008-022-00930-0
331 OU papers on Learning Analytics can be found here: https://tinyurl.com/2p892rf2

What we have learned in 10 years in terms of challenges of LA?

1	**Ethics and privacy**. Various questions arise here, e.g., who has access to the data and personal information, how long it is kept, how much data is safe and who owns the data.	OU has Ethics LA policy since 2014
2	**Scope and quality of data**. Questions that arise include how much data should be collected, how much data should have variety, what type of data has value for learning and how much reliable predictions can be made.	Data Governance
3	**Theoretical and educational foundations**. There is a lack of attention to learning and teaching theories. *LA* should be based on pedagogical and epistemological assumptions.	Actual adoption and sense making
4	**Research.** More research is needed to establish the foundations of *LA* (Dollinger & Lodge, 2018).	OU #1 in Europe, #2 in world
5	**Practice**. There is a lack of transference of *LA* theory to practice (Dollinger & Lodge, 2018). A user center design methodology as well as include the final user in the design process is needed to develop *LA* systems and applications (Domínguez F et al., 2020).	Actual adoption and sense making
6	**Institutions**. It is essential to align the points of view of researchers, educators, learners, educational technologists and administrators regarding *LA* (Leitner & Ebner, 2019).	LA embedded in design and practice
7	**Measurement of impact**. It is well known that *LA* can impact students learning by supporting teaching and learning strategies (Knight, Gibson, & Shibani, 2020).	Good evidence within a module, more needed across qualifications and diversity

Hernández-de-Menéndez, M., Morales-Menendez, R., Escobar, C. A., & Ramírez Mendoza, R. A. (2022). Learning analytics: state of the art. International Journal on Interactive Design and Manufacturing (IJIDeM), 16, 1209–1230. https://doi.org/10.1007/s12008-022-00930-0

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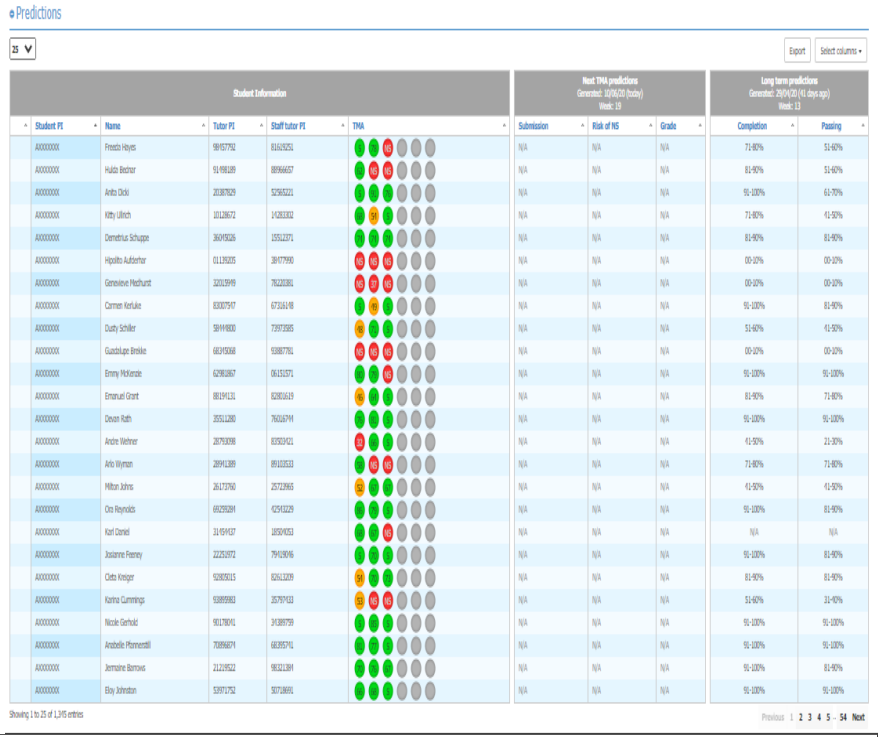
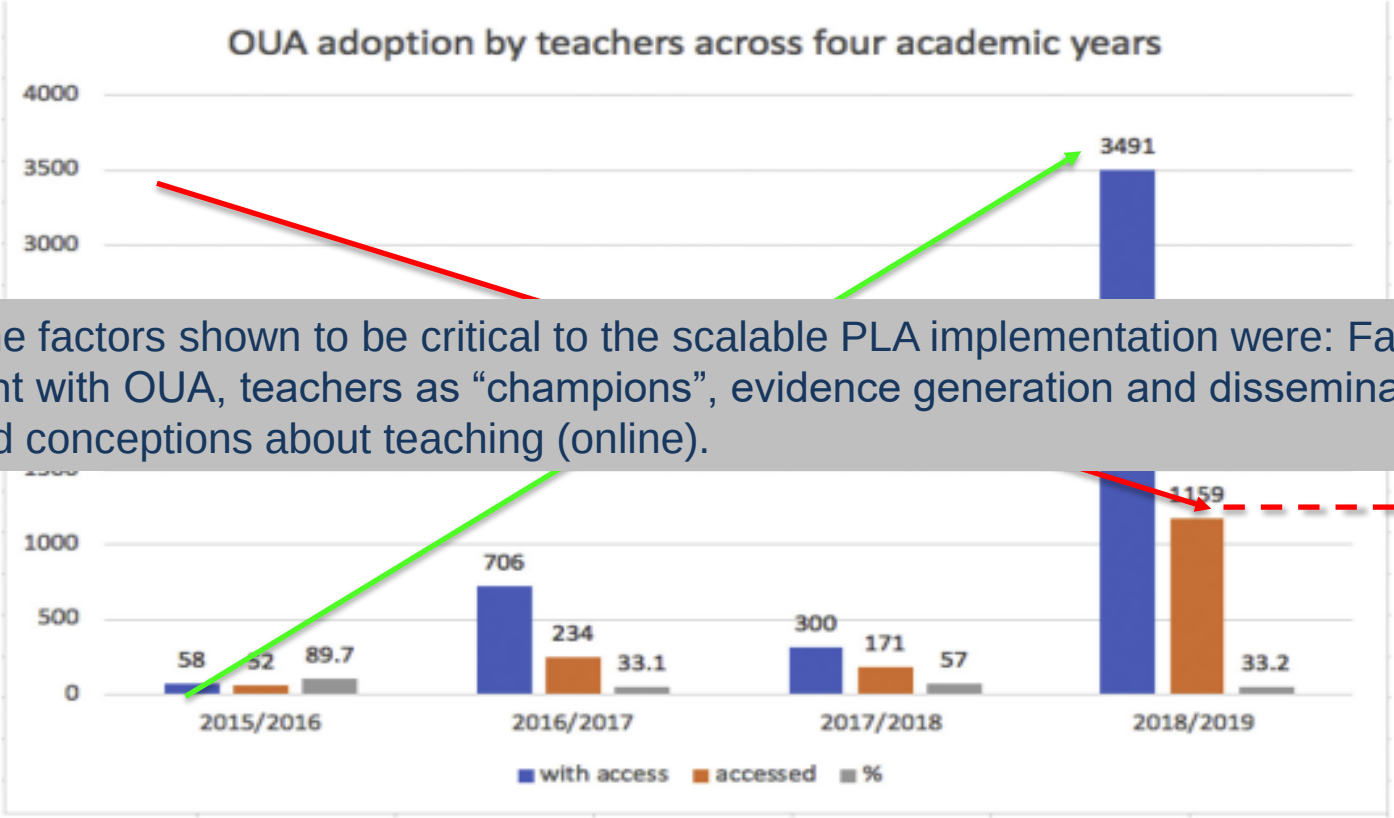
What we have learned from large scale adoption of predictive learning analytics at the OU (2014-2023)



Kuzilek, J., Hlosta, M., Herrmannova, D., Zdrahal, Z., & Wolff, A. (2015). OU Analyse: analysing at-risk students at The Open University LACE Learning Analytics Review (Vol. LAK15-1). Milton Keynes: Open University.

Kuzilek, J., Hlosta, M., & Zdrahal, Z. (2017). Open University Learning Analytics dataset. Scientific Data, 4, 170171. doi: 10.1038/sdata.2017.171

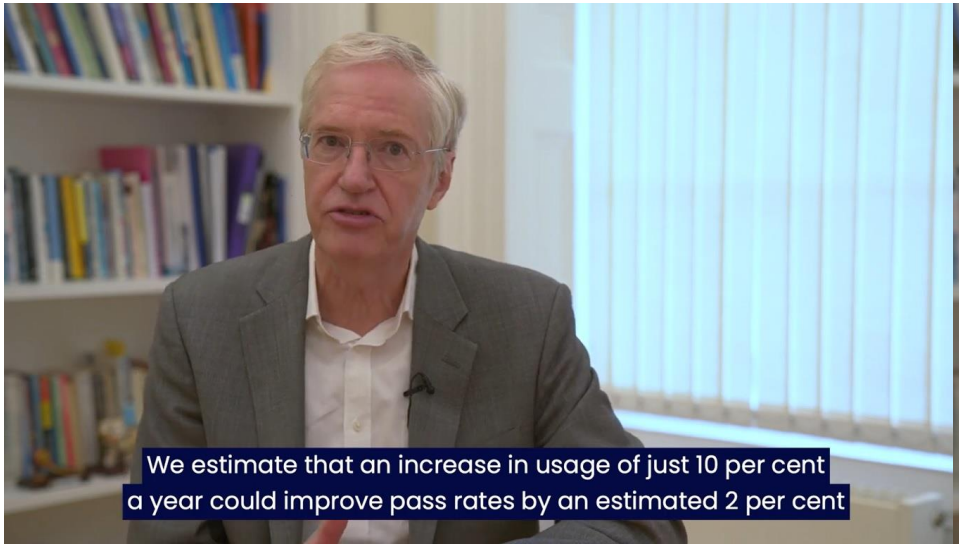
Wolff, A., Zdrahal, Z., Herrmannova, D., Kuzilek, J., & Hlosta, M. (2014). Developing predictive models for early detection of at-risk students on distance learning modules, Workshop: Machine Learning and Learning Analytics Paper presented at the Learning Analytics and Knowledge (2014), Indianapolis.

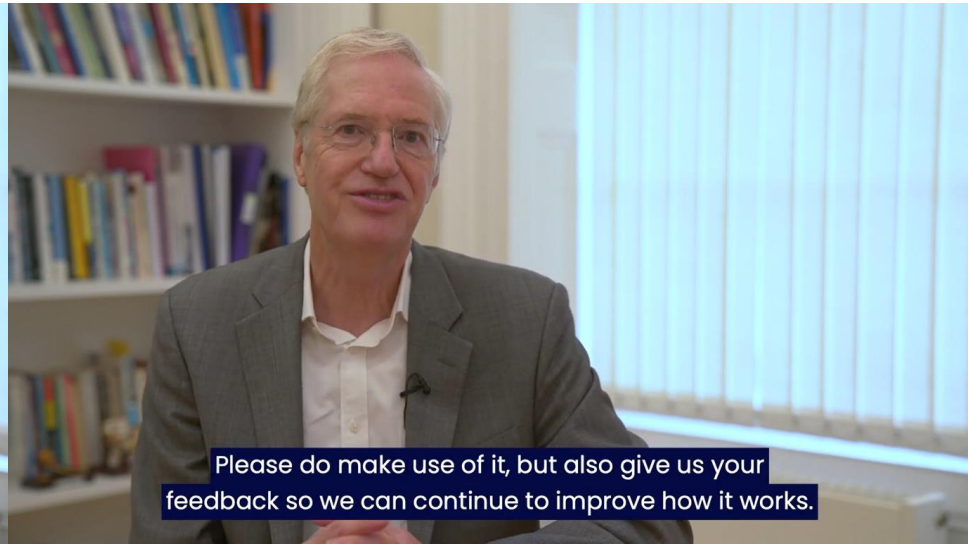


Amongst the factors shown to be critical to the scalable PLA implementation were: Faculty's engagement with OUA, teachers as “champions”, evidence generation and dissemination, digital literacy, and conceptions about teaching (online).

Fig. 2. OUA adoption by teachers during the last 4 academic years.

Herodotou, C., Rienties, B., Hlosta, M., Boroowa, A., Mangafa, C., Zdrahal, Z., (2020). Scalable implementation of predictive learning analytics at a distance learning university: Insights from a longitudinal case study. *Internet and Higher Education, 45,* 100725.





Prof Tim Blackman, Vice Chancellor The Open University, 11 November 2022
https://www.youtube.com/watch?v=Lir6ThLg6bM

Figure 22. Heat map example of the density of the fixations on stimuli

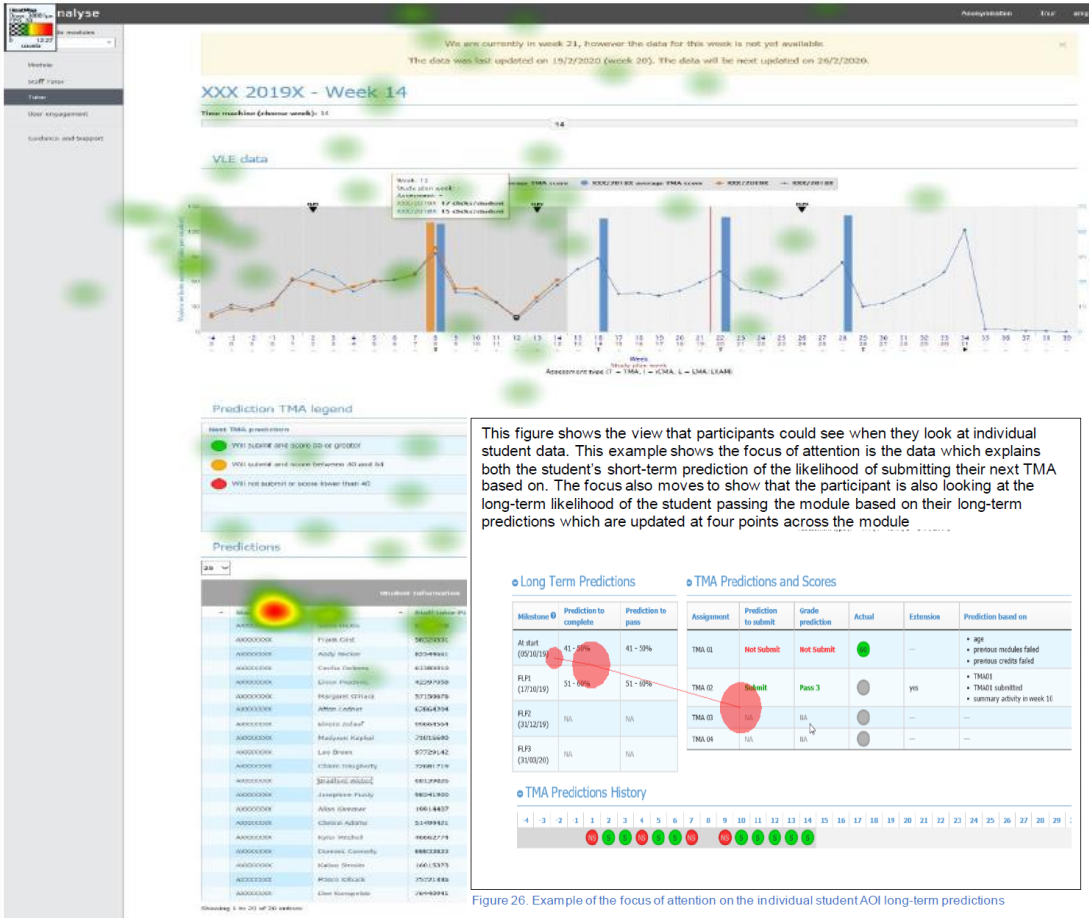


Figure 26. Example of the focus of attention on the individual student AOI long-term predictions

- Eye-tracking combined with think-aloud protocol of experienced teachers using PLA
- Most teachers comfortable with main dashboard, but worried about ethics/data
- Some erroneous interpretations and sense making of actual data
- Uncertainty about what options to address identified issues

Gillespie, A. (2022). Teachers' Use of Predictive Learning Analytics: Experiences from The Open University UK. Doctorate in Education, Milton Keynes.

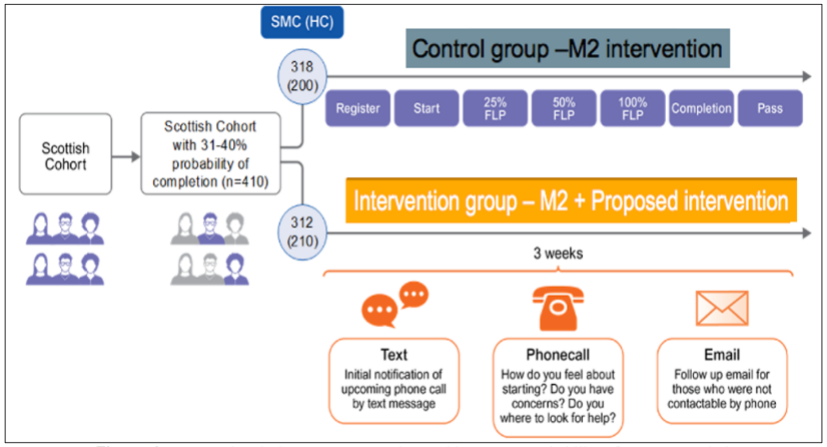


Figure 1. Intervention design to support students with 31–40% probability of course completion.

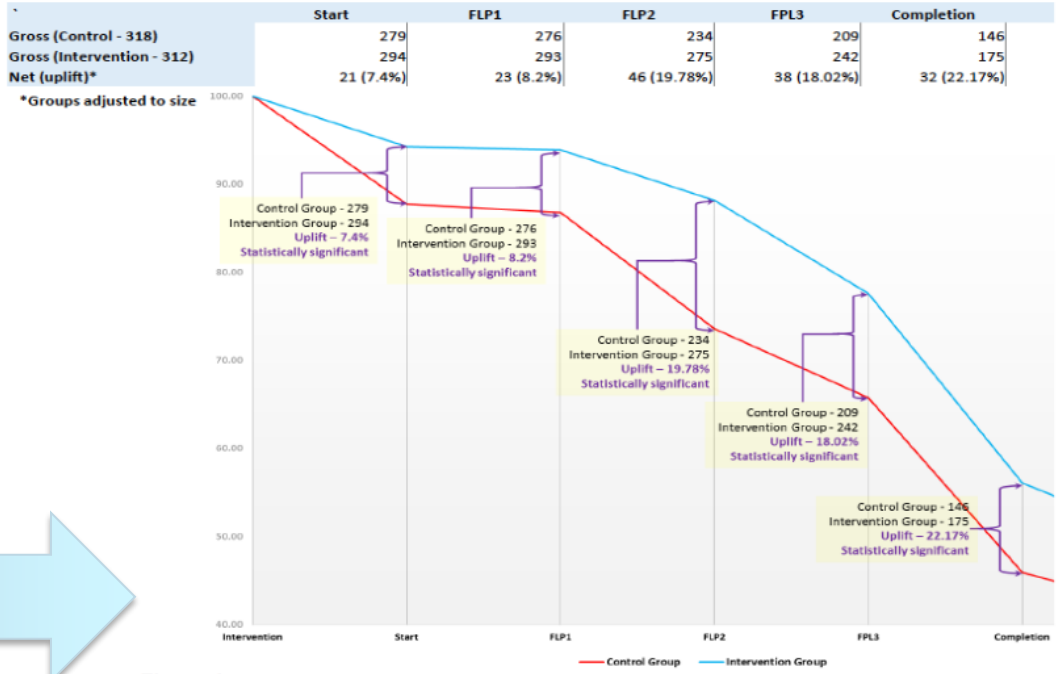


Figure 2. Student retention rates (number of students present) at each course milestone.

Herodotou, C., Naydenova, G., Boroowa, A., Gilmour, A., & Rienties, B. (2020). How can predictive learning analytics and motivational interventions increase student retention and enhance administrative support in distance education? *Journal of Learning Analytics*, 7(2), 72-83. https://doi.org/10.18608/jla.2020.72.4

Magic of learning design (does not come easy)

TechTrends
https://doi.org/10.1007/s11528-020-00498-0

AECT

ORIGINAL PAPER

Check for updates

Learning Design: European Approaches

Barbara Wasson[1] · Paul A. Kirschner[2]

Abstract
Research on instructional and learning design is 'booming' in Europe, although there has been a move from a focus on content and the way to present it in a formal educational context (i.e., instruction), to a focus on complex learning, learning environments including the workplace, and access to learner data available in these environments. We even see the term 'learning experience design' (Neelen and Kirschner 2020) to describe the field. Furthermore, there is an effort to empower teachers (and even students) as designers of learning (including environments and new pedagogies), and to support their reflection on their own practice as part of their professional development (Hansen and Wasson 2016; Luckin et al. 2016; Wasson et al. 2016). While instructional design is an often heard term in the United States and refers

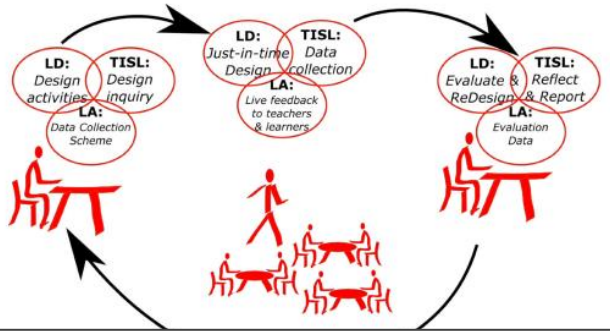
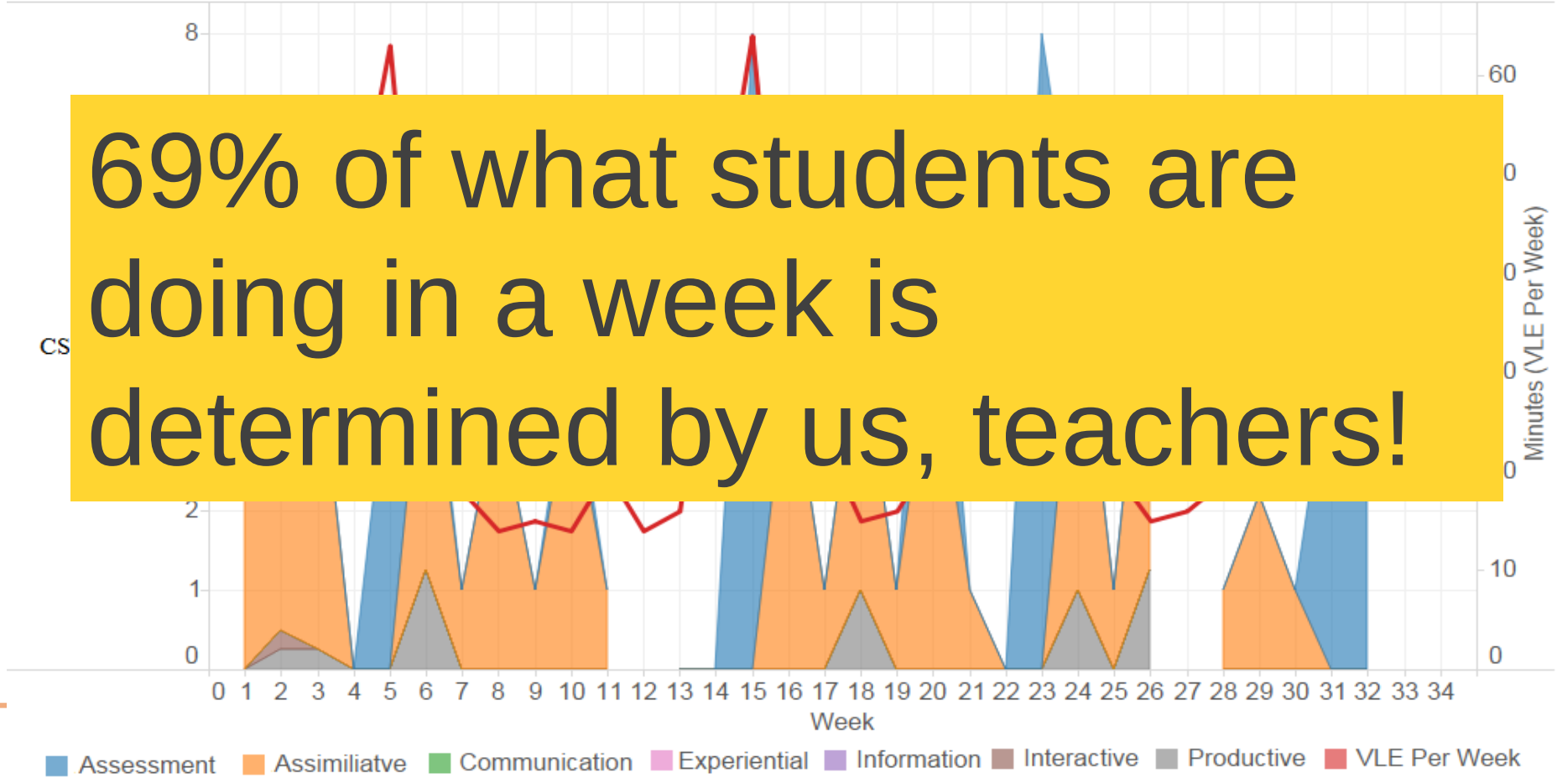


Fig. 7 Teacher-led design inquiry of learning and innovation cycle (Wasson et al. 2016)

"Research on **the relationship between learning design and learning analytics** has also been a focus in European research in recent years. For example, in their research at **the Open University UK**, Toetenel and Rienties combine learning design and learning analytics where learning design provides context to empirical data about OU courses enabling the learning analytics to give insight into learning design decisions. **This research is important as it attempts to close the virtuous cycle between learning design to improve courses and enhancing the quality of learning, something that has been lacking in the research literature**. For example, they study the impact of learning design on pedagogical decision-making and on future course design, and the relationship between learning design and student behaviour and outcomes (Toetenel and Rienties 2016; Rienties and Toetenel 2016; Rienties et al. 2015)."

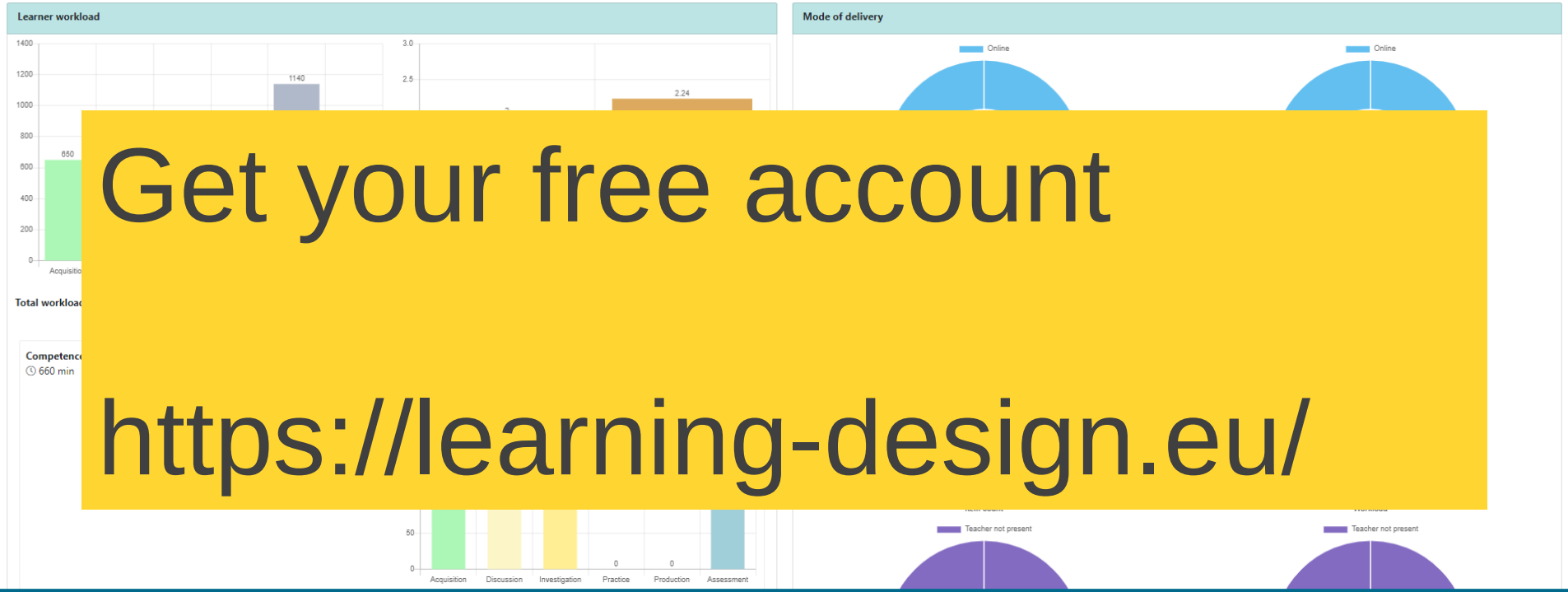
Wasson, B., & Kirschner, P. A. (2020). Learning Design: European Approaches. *TechTrends*, 1-13.



Nguyen, Q., Rienties, B., Toetenel, L., Ferguson, R., Whitelock, D. (2017). Examining the designs of computer-based assessment and its impact on student engagement, satisfaction, and pass rates. *Computers in Human Behavior*. DOI: 10.1016/j.chb.2017.03.028.

Teaching entrepreneurial competences1

COURSE DETAILS PLANNING ANALYSIS



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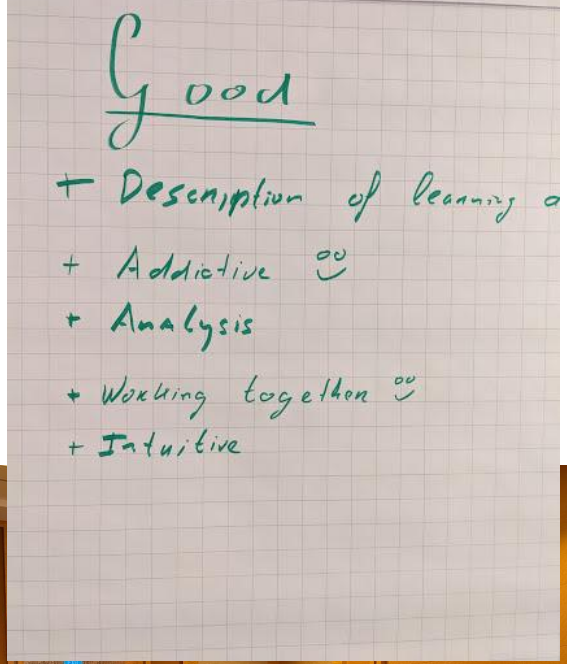
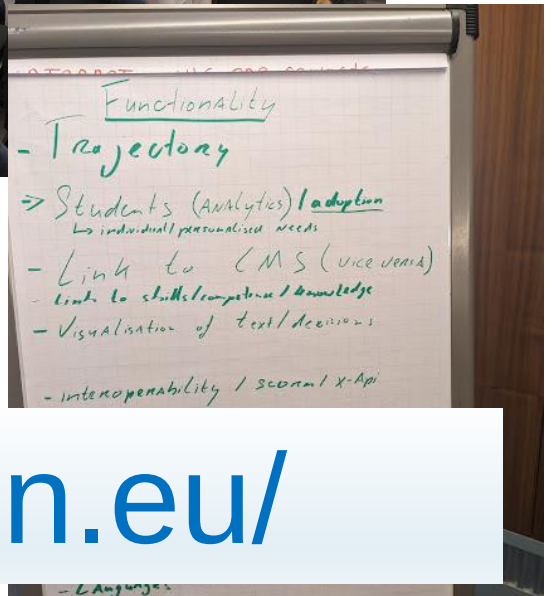
RAPIDE
Relevant assessment and pedagogies for inclusive digital education

TEACH 4EDU4





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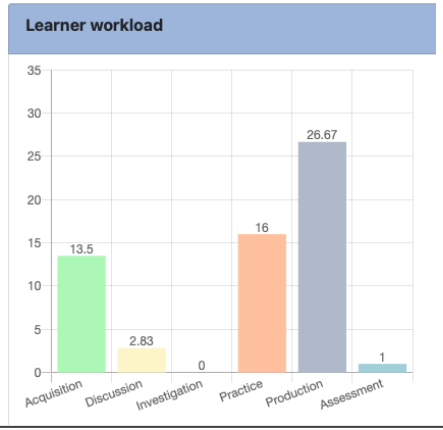
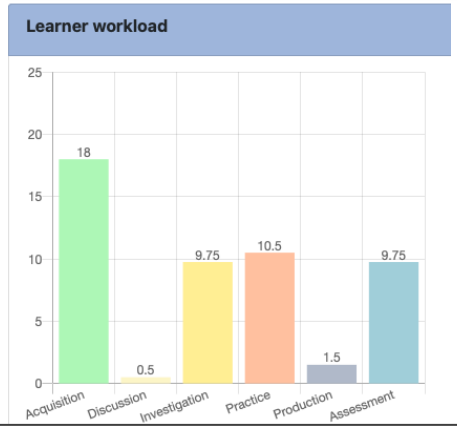
We have already engaged with 1200+ educators from 40+ countries using this approach with 425+ learning designs, and most educators find the tool and its related analytics useful and insightful, and helps them to implement innovation in their practice. **Preliminary results indicate that educators and students find the visualisations useful for their planning their time**.

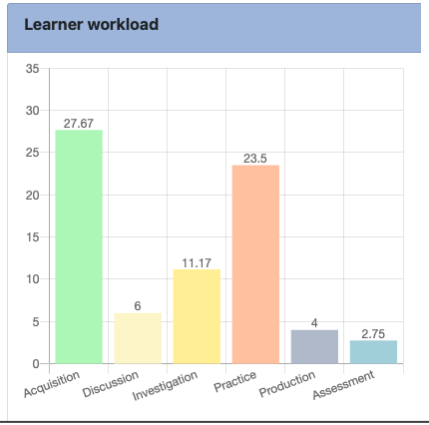
TEACH 4EDU4

Co-funded by the Erasmus+ Programme of the European Union

RAPIDE
Relevant assessment and pedagogies for inclusive digital education







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Rienties, B., Balaban, I., Divjak, B., Grabar, D., Svetec, B., & Vonda, P. (2023). Applying and translating learning design approaches across borders. In O. Viberg & A. Gronlund (Eds.), *Practicable Learning Analytics*. Springer Nature.

Prepare!

Acquisition
1 [FOI*] Introductory reading on work-based learning (WBL)
A short reading material presenting a summary of research on WBL in online environments.
30

Acquisition
2 Introductory video on FC and WBL
Introduction to the key concepts related to FC and WBL in general, with examples from project HEIs.
20

Acquisition
3 [FOI*] Introductory reading on flipped classroom (FC)
A short reading material presenting a summary of research on FC in online environments.
30

Assessment
4 [FOI*] Quiz on FC and WBL
A short quiz covering the key notions related to FC and WBL, based on the reading material.
30 2

Discussion
5 Discussion on prior experiences
Participants share experiences in FC and WBL in a discussion forum. The discussion is moderated by the OU.
60

Engage!

Discussion
1 Reflect on FC and WBL experiences from colleagues
Participants discuss (synchronously) their experiences related to FC and WBL and compare those based on the introductory read.
60 2

Investigation
2 Investigation of students' perspectives on FC and WBL
Participants explore available case studies related to FC and WBL.
120

Production
3 Preparation of a design on FC
Participants work in groups to prepare proposals for designing and (potentially) implementing FC approaches.
180

Assessment
4 Peer review of FC
Peer-assessment of the proposed FC design.
30 10

Production
5 Preparation of a design on WBL
Participants work in groups to prepare proposals for designing and (potentially) implementing WBL approaches.
180

Assessment
6 Peer assessment of WBL
Peer-assessment of the proposed design of WBL
30 10

Discussion
7 Q&A and live discussion
Participants discuss further questions related to FC and WBL in a moderated live (synchronous) discussion. The first part includes presentations of a few WBL and FC concepts. The second part includes a discussion on the key challenges related to WBL and FC.
120 2

Extend!

Investigation
1 Further reading and individual research
Reading material related to most recent research on FC and WBL, with hints for investigation.
120

Practice
2 Problem solving related to FC and WBL
Participants reflect together on the potential benefits and risks of FC and WBL. Participants provide their interpretation, followed by peer-assessment.
120

Assessment
3 Peer-assessment
Solutions to the problem assignement are peer-assessed.
60 10

Investigation
4 Further reading
Participants are provided with additional research articles for independent learning
300

RAPIDE e-course on relevant pedagogies and LA

COURSE DETAILS | PLANNING | ANALYSIS | EXPORT

Edit TLA

Name: Peer-assessment

Description: Solutions to the problem assignement are peer-assessed.

Learning type: Assessment

Description: Use this category to allocate time to activities which are directly assessed, either by a tutor, a peer or a computer. Assessment includes both formative and summative assessment.

Example usage: Quizzes, tests, written assignments, peer assessment activities,...

Workload in minutes: 60

Activity delivery: Online | On-site | Hybrid

Synchronous | Asynchronous

Teacher-present | Teacher not present

Collaboration: ☐

Work in groups: ☐

Feedback: ☑

Feedback provider: ☑ Teacher ☐ Automated ☑ Peer ☐ Other

Assessment: ☑

Assessment type: Summative

Assessment provider: ☑ Teacher ☑ Automated ☐ Peer ☑ Self ☐ Other

Assessment points: 10

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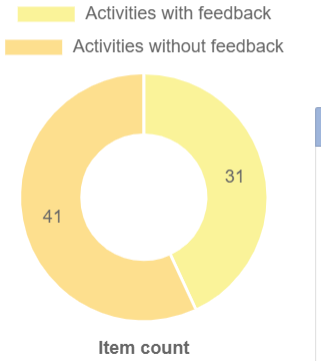
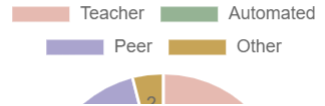
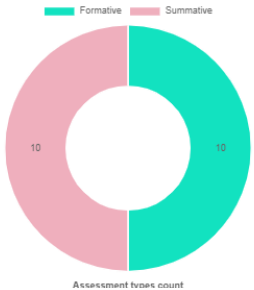
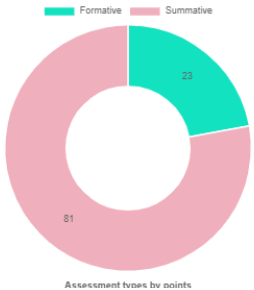
Feedback





Assessment





Assessment and learning outcomes

Topic	Assessment		Describe the concept of innovative teaching approa... (8)	Design and implement FC and WBL in online environm... (12)	Design and implement assessment methods related to... (12)	Implement peer-assessment and student project asse... (10)	Analyse aspects in which learning analytics can be... (10)	Analyse LA models and dashboards that support stud... (10)	Interpret LA data taking into account ethical aspe... (10)	Choose appropriate assessment methods, taking into... (8)	Estimate the impact of innovative pedagogies on th... (10)	Relate LA to the social impact and informed decisi... (10)
	Formative	Summative										
Innovative pedagogies (FC & WBL)	6	30	90%	90%	10%						10%	
Assessment related to innovative pedagogies	4	11	10%	10%	90%	100%				100%		
Learning analytics and dashboards	11	20					100%	100%	90%			20%
Impact of innovative pedagogies	2	20							10%		90%	80%
Total	**23**	**81**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
	104											

Divjak, B., Grabar, D., Svetec, B., & Vondra, P. (2022). Balanced Learning Design Planning: Concept and Tool. *Journal of Information and Organizational Sciences*.

Rienties, B., Balaban, I., Divjak, B., Grabar, D., Svetec, B., & Vonda, P. (2023). Applying and translating learning design approaches across borders. In O. Viberg & A. Gronlund (Eds.), *Practicable Learning Analytics*. Springer Nature.

Machine learning approaches

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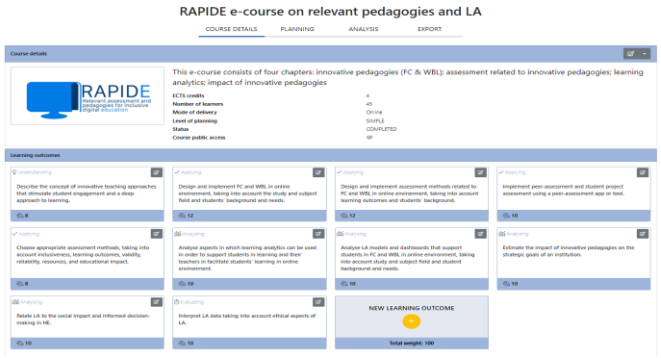
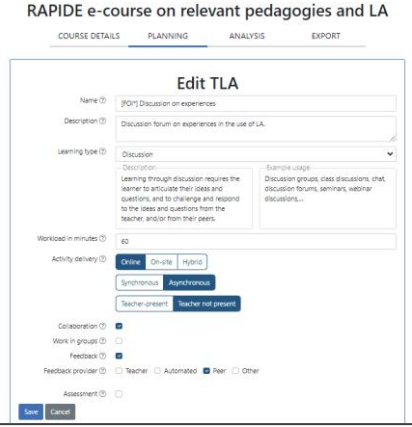
1. We explored how 165 educators designed and integrated 12,749 teaching and learning activities (TLA) in 218 Learning Designs using clustering, pattern-mining, and correlational analysis.
2. The findings suggest educators use a combination of four common learning design nucleobases (i.e., Collaboration, Generating independent learning, Assessment, Traditional classroom activities).





Albuquerque, J., Rienties, B., Divjak, B. (Submitted: 02-10-2023). Unpicking the DNA of learning design decisions. 14th LAK conference, Kyoto, Japan

Cluster analysis C, G, A, T

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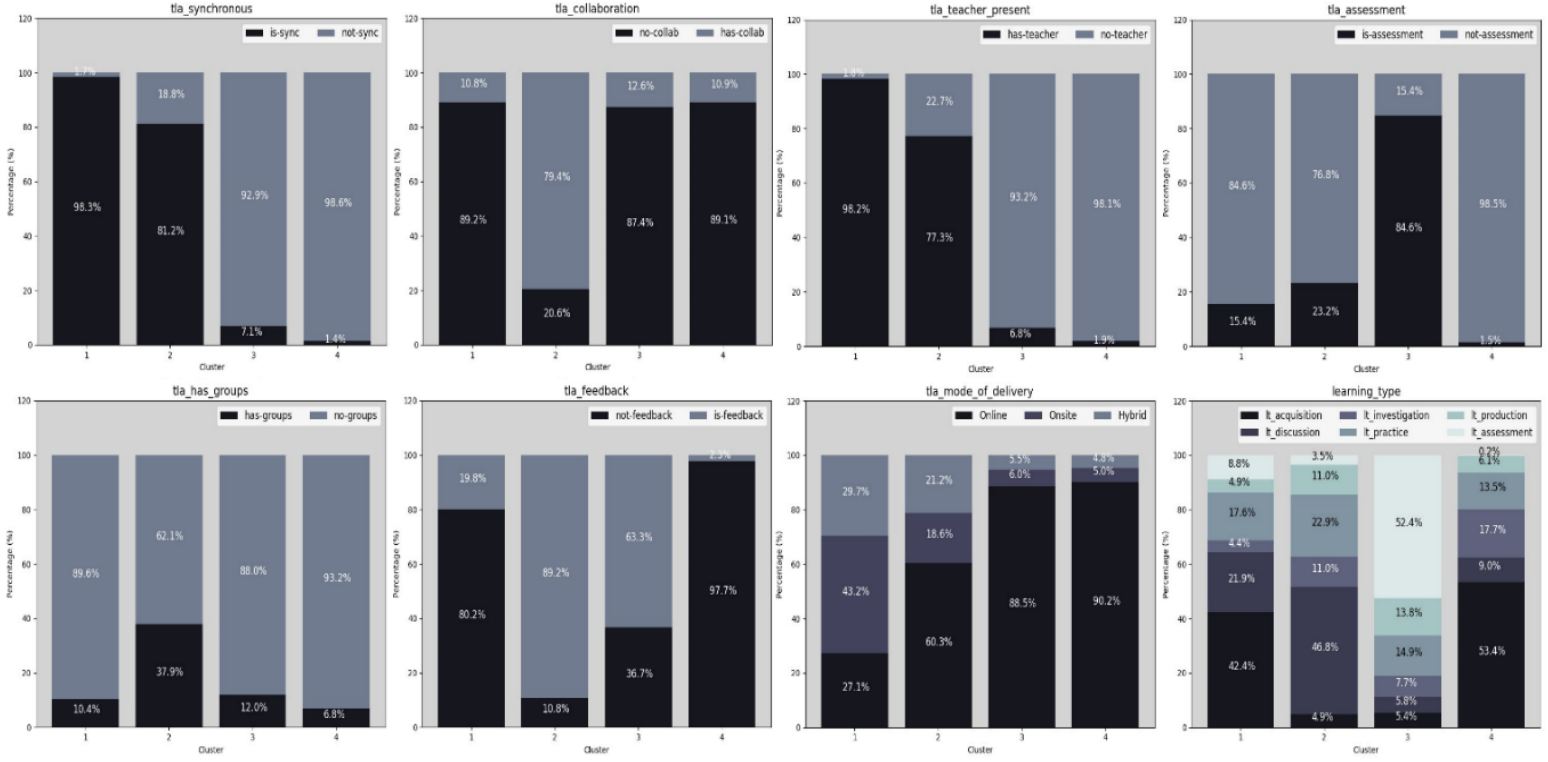

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Generating independent learning (G)

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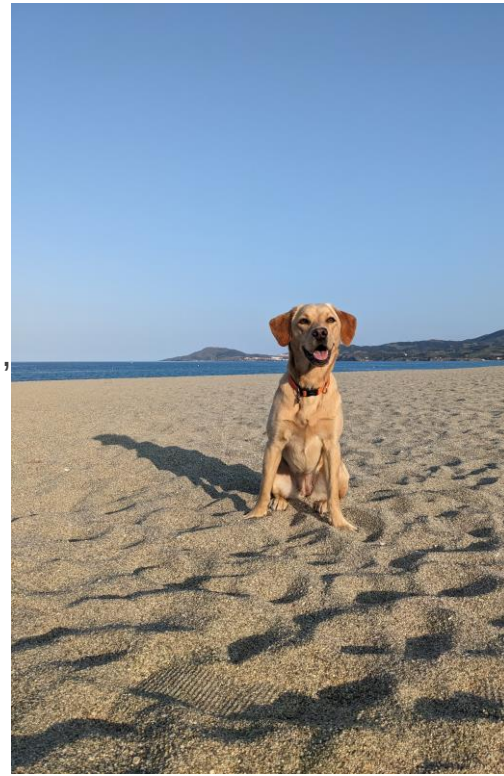
The most commonly used LD nucleobase (30.61%). This nucleobase was primarily asynchronous without a teacher being present, focused on the individual learner, primarily online. The pedagogical focus of G was on the acquisition of knowledge, skills, and competences.

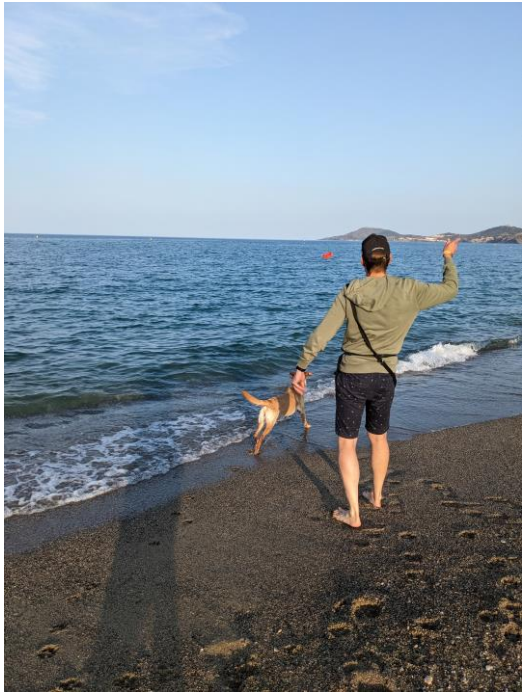
Activity Type: Asynchronous ('not-sync') and without a teacher ('no-teacher'), similar to Assessment (A) but stands out for not being assessment-focused ('not-assessment' at 98%).
Structure: Highly individual-focused ('no-collab' at 89%, 'no-groups' at 93%), suggesting an emphasis on independent work.
Mode of Delivery: Almost exclusively online (90%), the highest among all clusters.
Learning Type: Predominantly 'lt_acquisition' (53%), but without assessments, making it unique in its focus on individual learning acquisition.
FP-Growth Insights: There was almost certain confidence (around 99.8%) that in online learning settings focused on individual acquisition ('lt_acquisition') with no teacher ('no-teacher') or collaboration ('no-collab'), group activities are almost invariably absent ('no-groups').



Traditional classroom activity (T)

The second most commonly LD nucleobase (29.57%). This nucleobase was primarily synchronous in the classroom with a teacher present and teacher-led, and would typically form part of a lecture, seminar, teaching session, or lab session. Like G also in this activity T the pedagogical focus was on acquisition of knowledge, skills, and competences, but the main differences seemed to be teacher presence and the focus on synchronous, mostly face-to-face activities.

- **Activity Type**: Predominantly synchronous ('is-sync' at 98%) with a teacher present ('has-teacher').
- **Structure**: Highly individual-focused ('no-collab' at 89%, 'no-groups' at 89%), suggesting a lack of collaborative activities.
- **Mode of Delivery**: Mostly onsite (43%), which was unique among the clusters.
- **Learning Type**: Strong focus on 'lt_acquisition' (42%), emphasizing the traditional method of information transfer.
- **FP-Growth Insights:** The algorithm exhibited extremely high confidence (nearly 99.7%) that in settings focused on individual acquisition of information ('lt_acquisition') and where group activities were absent ('no-groups'), a teacher was almost certainly present ('has-teacher').



Assessment activity (A)

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The third most commonly used LD nucleobase (24.35%) was assessment activity (A). This nucleobase was primarily asynchronous without a teacher being present, focused on the individual learner, and the pedagogical focus was on the assessment of knowledge, skills, and competences, and providing/receiving feedback.

- **Activity Type**: Distinguished by its asynchronicity ('not-sync' at 93%) and absence of a teacher ('no-teacher' at 93%).
- **Structure**: Individual-focused ('no-collab', 'no-groups'), but uniquely characterized by a high focus on assessments ('is-assessment' at 85%).
- **Mode of Delivery**: Overwhelmingly online (88%).
- **Learning Type**: Leans towards 'lt_assessment' (52%), suggesting it had assessment-oriented courses.
- **FP-Growth Insights**: The algorithm showed near certainty (around 99.1%) that in online environments focused on assessment ('lt_assessment'), where neither collaboration ('no-collab') nor a teacher ('no-teacher') was involved, there were likely no group activities ('no-groups').

Collaborative classroom activity (C)

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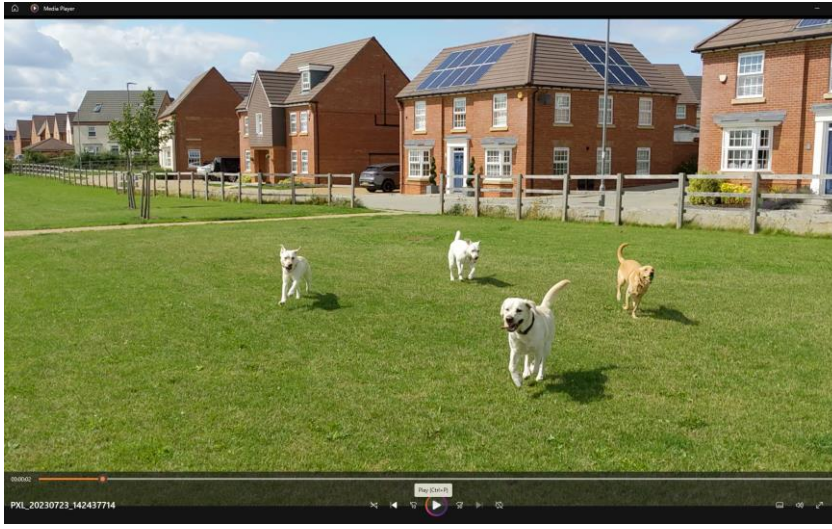
The least commonly used LD nucleobase (15.46%). This nucleobase was primarily synchronous in various online, blended, and face-to-face formats with a teacher present, but in contrast to the three other nucleobases was highly collaborative, where the pedagogical focus was on discussion of knowledge, skills, and competences, and providing/receiving feedback.

- Activity Type: Synchronous ('is-sync'), but uniquely characterized by its strong emphasis on teacher presence ('has-teacher') and feedback ('is-feedback' at 89%).
- Structure: Highly collaborative ('has-collab' at 79%), which sets it apart from other clusters.
- Mode of Delivery: Primarily online (60%), notable for its blend of online and collaborative elements.
- Learning Type: A particular focus on 'lt_discussion' (46.8%), highlighting dialogic forms of learning.
- FP-Growth Insights: There was high confidence (about 97%) that when the environment was synchronous ('is-sync') and has no group activities ('no-groups'), it was highly likely that a teacher will be present ('has-teacher'). Furthermore, there is also strong confidence (around 96%) that in settings where a teacher was present and feedback is given ('is-feedback'), the activity is likely to be synchronous ('is-sync').



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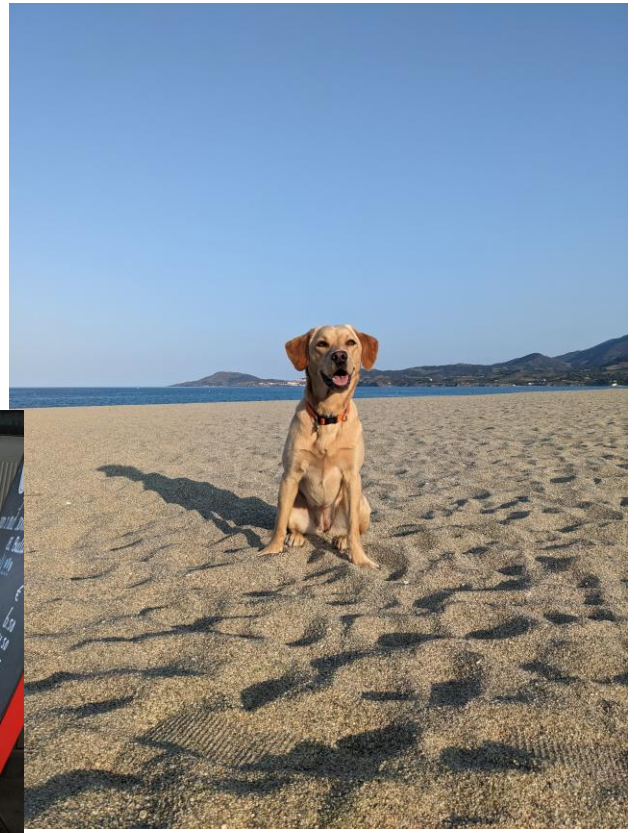

Next steps

1. How to use AI to identify common design patterns by teachers?
2. How to use AI to semi-automate some of the design decisions?
3. How to use AI to provide automatic recommendations of TLA activities

Ooh yeah, and what about the role of educators and students?

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All papers referred to in this presentation can be accessed via

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Implementing learning analytics and learning design at scale

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