Open learner models (OLMs) and learning analytics dashboards: A systematic review

Robert Bodily, Judy Kay, Vincent Aleven, Ioana Jivet, Dan Davis, Franceska Xhakaj, Katrien Verbert

Overview

Why OLM research is relevant to LAK (Judy)

A little history and background about OLMs (Judy)

Results & Highlights (Ioana)

Comparing OLMs and LAK dashboard (Dan)

Implications for future work (Dan)

Why is OLM research relevant for LAK?

What was the motivation for this work?

Motivation

To bring together two strands of research:
Learner-focused learning analytics
Open Learner Models (OLMs)

A little history

OLMs …..

1970s
Artificial Intelligence in Education (AIED)
Intelligent Tutoring Systems (ITS)
Bloom's famous 2-sigma (1984)

Student models

Learner models

~ 1999: **Open learner models**

Learning analytics

Learner-focused learning analytics

1970s
Artificial Intelligence in Education (AIED)
Intelligent Tutoring Systems (ITS)
Bloom's famous 2-sigma (1984)

Student models

Learner models

~ 1999: **Open learner models**

Learning analytics

Learner-focused learning analytics

OLMs are "designed" to model the learner, initially for personalisation of teaching but more recently as independent interfaces …. Just like learning analytics interfaces

What is an Open Learner Model (OLM)?

How is it *similar* to learner oriented learning analytics?

Both OLMS and learner facing learning analytics

Provide an interface for the learner

The interface should enable a learner to do core metacognitive tasks eg monitor their progress, support planning, support self-reflection

The interface should help learners have more agency - more control and awareness

How is it *different* from learning analytics?

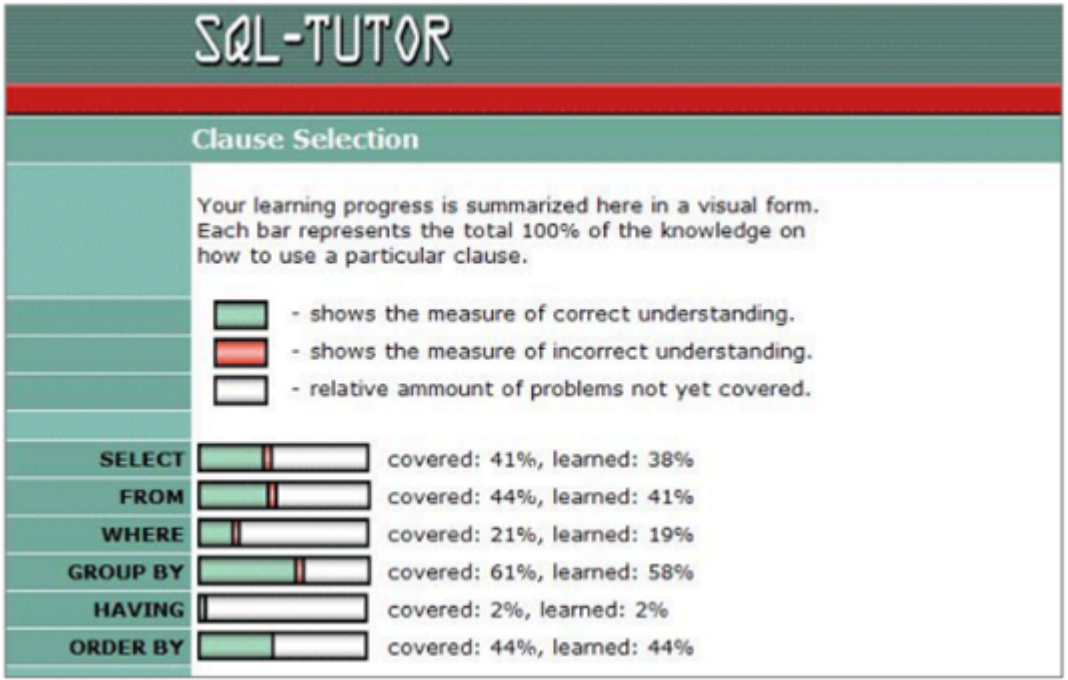
OLM - Developed in parallel to (research) platform
LAD - Developed independently

OLMS versus learner facing learning analytics

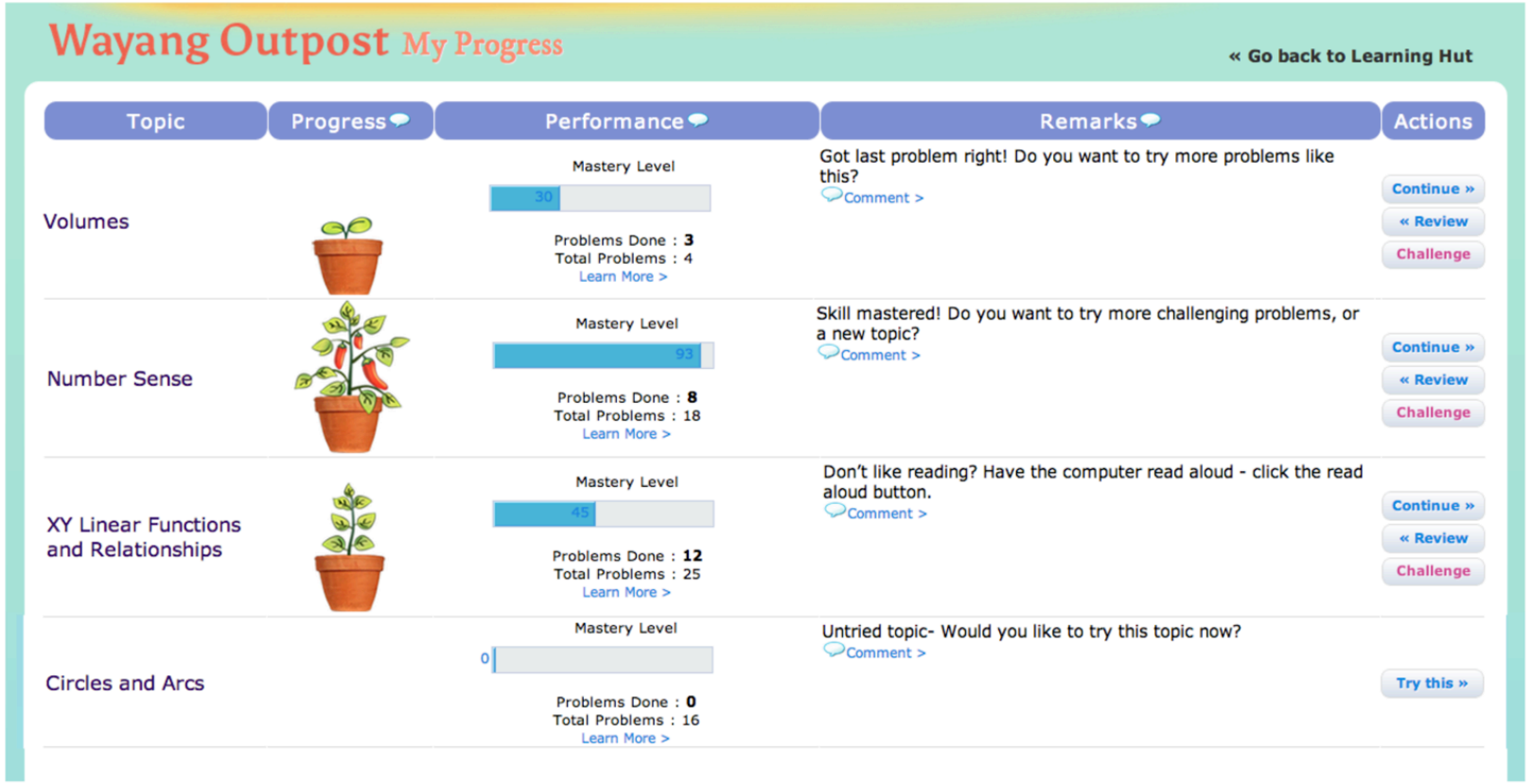
A simplified view of the design of an OLM in 4 steps:

1. Design the “ontology” of the model - what components will be modelled
    - eg The learner can write simple loops in C
2. Design the evidence sources to reason about each component
    - eg create an environment where students do programming tasks
3. Reason from the evidence to conclude the level of knowledge
    - eg. analyse the detailed correctly completed tasks, the ones that were done incorrectly, the ones still not attempted, taking account of potential for slips and guesses
4. Create an interface that enables the learner to answer questions
    - eg Have I mastered writing of C loops to the required level

One elegant example of an OLM



Mitrovic's SQL tutor



(Muldner et al., 2015)

Skill Meter


Extract an embedded list
Extract info from an embedded list
Extract info from a list
Deleting an extra node from the parameter li
Coding a variable
Declaring a function parameter
Coding a function name
Coding DEFUN
Remove N Items
Skip over Items
Work From the Back of the List
Extract the Last Item
Extract the Nth Item
Coding LIST - embedded lists involved

Methodology

Methodology

- Search Method
- Inclusion Criteria
- Code book & coding
- Compare to LAD review (Bodily, 2017)

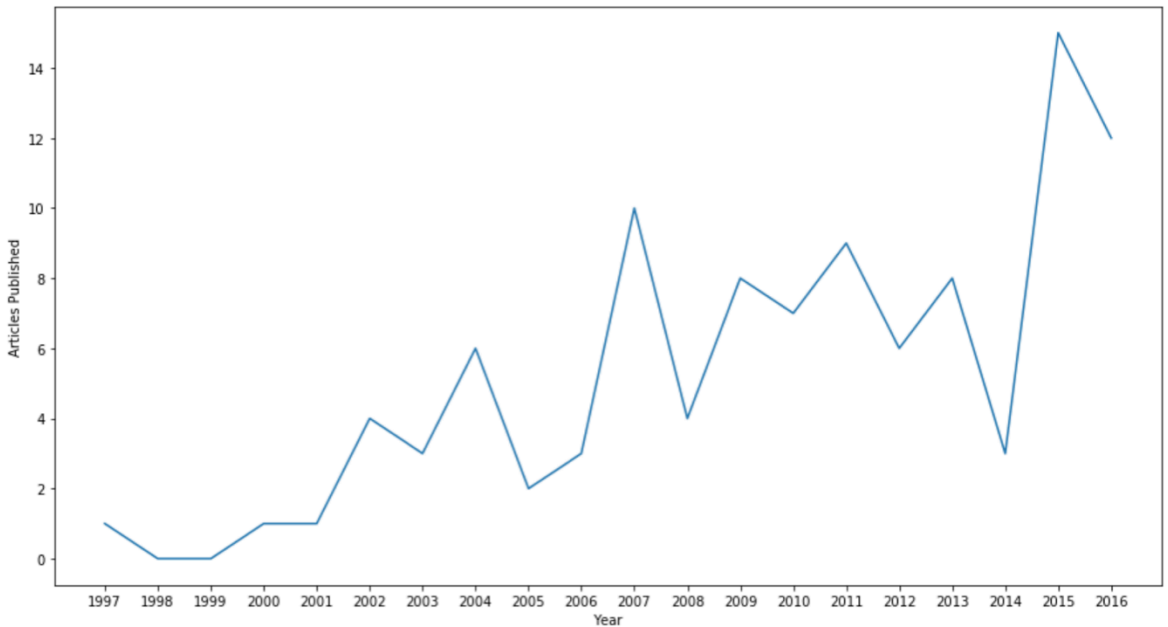
Key Findings & Highlights

Trends in OLM Research

- Publication venue
- Authors
- Top cited articles
- Publications over time

Trends in OLM Research

- Publication venues
  - small overlap between LAD and OLM
- LAD review papers to date have not purposely included OLM research in their inclusion criteria



Central Themes in OLM

Central Themes in OLM

Keywords
intelligent tutoring systems
learning analytics 🔑
self-regulated learning 📈
self-assessment 📈
learner model
reflection
visualization/visualisation
intelligent tutoring system
user trust ?
learner independence

🔑 OLM community is more aware of LA community than vice versa

📈 SRL and reflection are a focus -> suggesting the purpose of opening the model to the learner.

? Inspectable or negotiated uncommon in LAD

Central Themes in OLM

Abstract

paper
system
approach
study
results
social 👭
support
based
knowledge
learners
adaptive 🤖

👭 Rise of OSSM

🤖 intent to personalise or adapt instruction to learners

OLM Data & Modeling

OLM Data & Modeling

Category	# of OLMs	% of OLMs
Single type of data	62	57.9%
Behavioral Metrics	35	32.7%
Multiple applications	6	5.6%
Input provided by the user	42	39.3%
Complex Modelling	40	37.2%

OLM Data & Modeling

Category	# of OLMs	% of OLMs
☆ Single type of data	62	57.9%
☆ Input provided by the user	42	39.3%
☆ Complex Modelling	40	37.2%

OLM Evaluations

OLM Evaluations

Category	# of OLMs	% of OLMs
Authentic evaluation	42	39.3%
Evaluation	80	74.8%
Multiple evaluations	11	10.3%
Formal domain	53	49.5%
Tertiary education	58	54.2%
Secondary education	12	11.2%

OLM Evaluations

Category	# of OLMs	% of OLMs
👉 Authentic evaluation	42	39.3%
👉 Formal domain	53	49.5%
👉 Tertiary education	58	54.2%

Comparing OLM & LAD

Comparing OLM & LAD

Category	LAD	OLM
Evaluation percentage	59%	75% ✅
Behavioral metrics	✅75%	33%
Assessment data	37%	100%✅
Comparison	38%	52% ✅
Interactive	31%	81% ✅

Comparing OLM & LAD

- **Evaluation:**
  - OLM is a more mature field (1997 vs 2011)
- **Data:**
  - Tracking activity traces of learners is indeed at the core of learning analytics;
  - assessment data is not a prerequisite for useful dashboards
  - visualizing assessment can provide a solid foundation for learning analytics dashboards to support student retention
- **Comparison:**
  - OLM used for interpretation and reflection by students - interesting point to adopt in LAD
- **Interaction:**
  - LAD belief that a dashboard is a single screen of important information, understood at a glance.
  - Two shortcomings:
    - Trust & negotiation
    - Lack of user input

Comparing OLM & LAD

Category	LAD	OLM
Behavioral metrics	✅75%	33%
Assessment data	37%	100%✅

OLMS versus learner facing learning analytics

A simplified view of the design of an OLM in 4 steps:

1. Design the “ontology” of the model - what components will be modelled
    - eg The learner can write simple loops in C
2. Design the evidence sources to reason about each component
    - eg create an environment where students do programming tasks
3. Reason from the evidence to conclude the level of knowledge
    - eg. analyse the detailed correctly completed tasks, the ones that were done incorrectly, the ones still not attempted, taking account of potential for slips and guesses
4. Create an interface that enables the learner to answer questions
    - eg Have I mastered writing of C loops to the required level

Limitations

- Only include articles that introduce a new OLM
- Search sources and searching in titles, abstracts and keywords: missing relevant literature
    - Expert checks and adding articles based on the most prominent authors in the field
- Comparison with LAD: using one review that covered Jan 2005 - June 2016.

Implications for the future

Recommendations

- Unify terminology for LAD and OLM
- Learn from each other
  - Eg, develop LAD in parallel with platform