Paper Summary

<!--META_START-->

Title: Learning analytics dashboard: a tool for providing actionable insights to learners

Authors: Teo Susnjak, Gomathy Suganya Ramaswami, Anuradha Mathrani

DOI: https://doi.org/10.1186/s41239-021-00313-7

Year: 2022

Publication Type: Journal

Discipline/Domain: Educational Technology / Learning Analytics

Subdomain/Topic: Learning Analytics Dashboards (LADs), Actionable Insights, Predictive and Prescriptiv

Eligibility: Eligible

Overall Relevance Score: 92

Operationalization Score: 95

Contains Definition of Actionability: Yes (explicit and implicit)

Contains Systematic Features/Dimensions: Yes

Contains Explainability: Yes

Contains Interpretability: Yes

Contains Framework/Model: Yes (proposed LAD integrating descriptive, predictive, prescriptive, interpret

Operationalization Present: Yes

Primary Methodology: Mixed Methods (Systematic Literature Review + System Design)

Study Context: Higher Education, learner-facing dashboards

Geographic/Institutional Context: Massey University, New Zealand

Target Users/Stakeholders: Students (primary), instructors, higher education institutions

Primary Contribution Type: Conceptual framework + prototype implementation

CL: Yes

CR: Yes

FE: Yes

TI: Partial

EX: Yes

GA: Yes

Reason if Not Eligible: N/A

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Learning analytics dashboard: a tool for providing actionable insights to learners

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Discipline/Domain:

Educational Technology / Learning Analytics

Subdomain/Topic:

Learning Analytics Dashboards, Actionable Insights, Predictive and Prescriptive Analytics

Contextual Background:

The paper addresses the design, capabilities, and challenges of learner-facing Learning Analytics Dashb

Geographic/Institutional Context:

Massey University, New Zealand

Target Users/Stakeholders:

Students (primary), instructors, institutional decision-makers

Primary Methodology:

Mixed Methods (Systematic Literature Review + Prototype Dashboard Design & Implementation)

Primary Contribution Type:

Conceptual framework, synthesis of literature, and novel LAD prototype integrating multiple analytics laye

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General Summary of the Paper

The study systematically reviews 17 recently published LADs (2018–2021) to assess their capabilities, fo

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Eligibility

Eligible for inclusion: **Yes**

How Actionability is Understood

Actionability is framed as the LAD’s ability to provide learners with insights that can trigger informed, spec

> “…understand why a model produced given predictions… what insights can be derived… in order to trig

> “Prescriptive outputs… tailored to each learner… issue advice on behavioral adjustments and learning

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What Makes Something Actionable

- Interpretability and explainability of predictive models.
- Presentation of counterfactuals showing how specific changes could improve outcomes.
- Contextually relevant, personalized recommendations.
- Evidence-based and data-driven suggestions.
- Clarity and avoidance of cognitive overload.
- Integration of predictive accuracy and confidence communication.
- Goal alignment with learner objectives.

How Actionability is Achieved / Operationalized

- **Framework/Approach Name(s):** Proposed Multi-Panel LAD with descriptive, predictive, prescriptive,
- **Methods/Levers:** Machine learning models (CatBoost, scikit-learn), model interpretability tools (Anch
- **Operational Steps / Workflow:** Data collection from LMS (Moodle) → preprocessing → predictive mo
- **Data & Measures:** Engagement metrics, assignment/test scores, demographic info, predictive risk sc
- **Implementation Context:** Higher education institution pilot, 20 classes, ~4000 student dataset.

> “…counterfactuals indicate… minimal changes… would produce… more positive outcomes…” (p. 17)

> “…conversion of a black-box predictive model into a glass-box, human interpretable model…” (p. 16)

Dimensions and Attributes of Actionability (Authors’ Perspective)

- **CL (Clarity):** Yes — Minimal use of colors, clear data-to-ink ratio (p. 17).
- **CR (Contextual Relevance):** Yes — Learner-specific metrics and comparisons (p. 16).
- **FE (Feasibility):** Yes — Recommendations based on minimal changes in controllable factors (p. 17).
- **TI (Timeliness):** Partial — Emphasis on early predictions for timely intervention, but no explicit real-ti
- **EX (Explainability):** Yes — Feature importance, anchors, counterfactuals (p. 17–18).
- **GA (Goal Alignment):** Yes — Advice aimed at maximizing course completion and learning outcomes
- **Other Dimensions:** Ethical transparency, cognitive load minimization.

Theoretical or Conceptual Foundations

- Explainable AI (XAI)

- Counterfactual explanations (Wachter et al., 2017)
- Learning analytics layers (descriptive, predictive, prescriptive)
- Cognitive load theory in dashboard design (Tufte, 2001; Bera, 2016)

Indicators or Metrics for Actionability

- Predictive model accuracy (%)
- Feature importance rankings
- Risk classification (high/low)
- Minimal change thresholds for outcome improvement

Barriers and Enablers to Actionability

- **Barriers:** Lack of interpretability in most LADs, technical complexity, concept drift, small datasets, eth
- **Enablers:** Emerging XAI tools, counterfactual generation methods, integrated data sources, agile ins

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Relation to Existing Literature

Positions itself as first LAD to fully integrate descriptive, predictive, and data-driven prescriptive analytics

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Summary

This paper identifies significant gaps in the ability of existing LADs to deliver actionable insights, emphasi

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Scores

- **Overall Relevance Score:** 92 — Strong conceptual framing of actionability with explicit features and
- **Operationalization Score:** 95 — Fully articulated operational model with specific tools, data sources,

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Supporting Quotes from the Paper

- “Models need to possess explanatory characteristics… in order to trigger actionable behavioral adjustm
- “Prescriptive outputs… tailored to each learner… advice on behavioral adjustments…” (p. 4)
- “Counterfactuals indicate… minimal changes… would produce… more positive predictive outcomes.” (p
- “Conversion of a black-box predictive model into a glass-box… so that they can understand how their pr

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Actionability References to Other Papers

- Wachter et al. (2017) – Counterfactual explanations

- Ribeiro et al. (2018) – Anchors for interpretability
- Adadi & Berrada (2018) – Explainable AI
- Baneres et al. (2019, 2021) – Early warning systems and predictive analytics in LA
- Rets et al. (2021), Valle et al. (2021) – Need for prescriptive recommendations in LADs