



LEARNING ANALYTICS AND EDUCATIONAL DATA MINING: AN OVERVIEW OF RECENT TECHNIQUES

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OUTLINE



- Intro
- Overview of Learning Analytics
- Learning Analytics and Serious Games
- Drawbacks and Challenges
- Learning Analytics Toolbox



INTRODUCTION



- Educational assessment
 - Gathering information about a learner relative to specific competencies, learning objectives etc.
 - Summative assessment
 - Formative assessment
- Computer-based education
 - Variety of technologies used for educational purposes



INTRODUCTION



- Learning Analytics (LA) and Educational Data Mining (EDM)
 - Making sense of learning data
 - Accounting for educational data from diversity of systems/tools

„Big data, applied to education“

(Horizon Report, 2013)



LA OVERVIEW – DEFINITION, KEY CONCEPTS



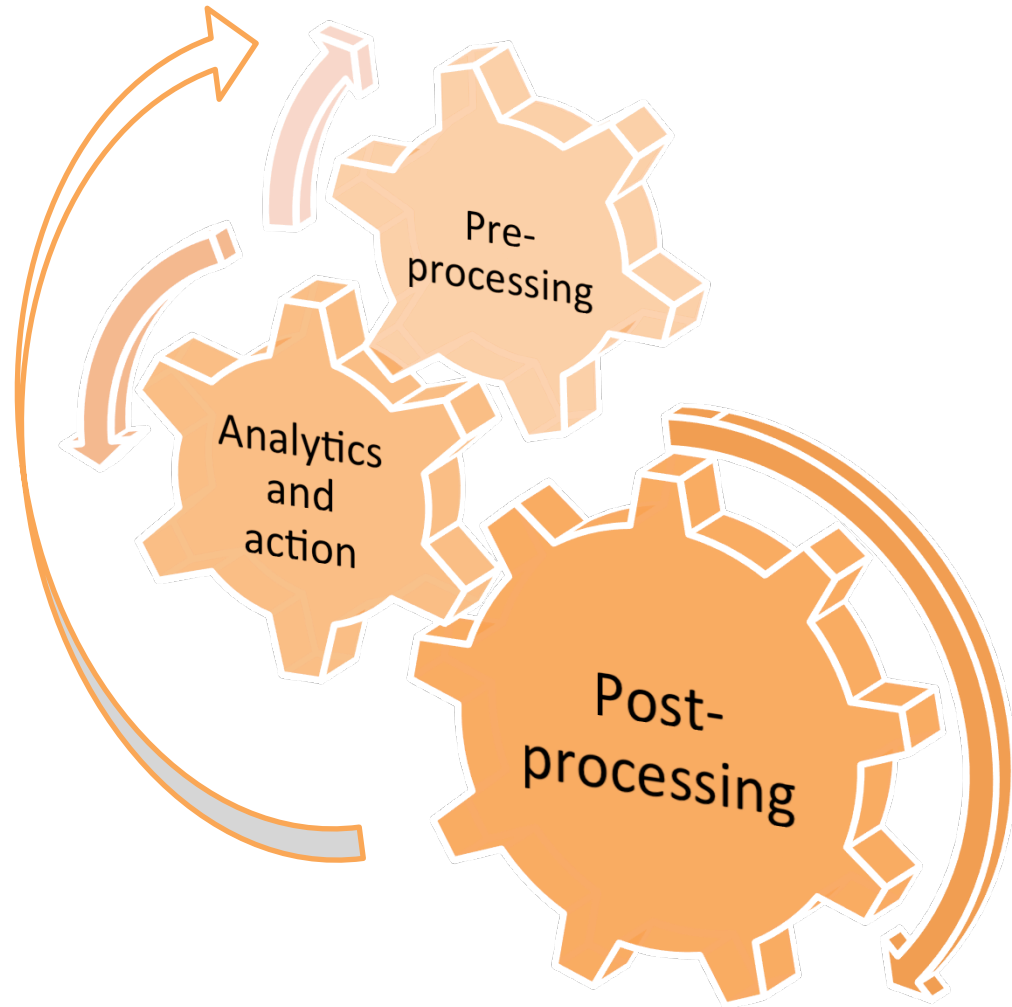
- LA & EDM

- LA: „Measurement, **collection, analysis and reporting of data about learners and their contexts**, for purposes of **understanding and optimising learning** and the environment in which it occurs.“ (SoLAR)
- EDM: „Discipline, concerned with developing **methods for exploring** the unique types of **data that come from educational settings**, and using those methods to better **understand students**, and the **settings** in which they learn in.“ (Int. EDM Society)



LA OVERVIEW

- LA process



LA OVERVIEW - STAKEHOLDERS & OBJECTIVES



- Learners
- Teachers
- Educational institutions
- Administrators, authorities
- Training developers and providers
- Researchers



LA OVERVIEW - STAKEHOLDERS & OBJECTIVES



- Monitoring and analysis
- Prediction and intervention
- Tutoring and mentoring
- Assessment and feedback
- Adaptation
- Personalisation and recommendation
- Reflection

(Chatti et al., 2012)



LA OVERVIEW - DATA



- Educationally relevant!
- Centralised vs. distributed
 - Challenge of data integration
- Data set
 - Extensive data
 - Intensive data



LA OVERVIEW - DATA



- Indicators
 - Dispositional indicators
 - Activity and performance indicators
 - Student artefacts

(Brown, 2013)



LA OVERVIEW - ANALYTICS



- Prediction methods
 - Forecast a certain variable from combination of indicators
- Structure discovery
 - Detecting structure in educational data
- Relationship mining
 - Relationships between variables

(Baker & Siemens, in press)



LA OVERVIEW - ANALYTICS



- Discovery with models
 - Using results of one analytics method within another analysis
- Distillation of data for human judgement
 - Providing humans access to reports and visualisations of learner data for judgement
- Discourse analysis
 - Analysing written evidence of learning activities and online communication

(Baker & Siemens, in press; De Liddo et al., 2011)



LA OVERVIEW - VISUALISATIONS



- Visualisations make LA results actionable
 - Reporting back information to learners, teachers, other stakeholders
 - Overview on large amounts of data
- Visualisation of
 - Activity data
 - Inferences drawn – understanding, competencies
- Visualisations are used
 - To promote metacognition
 - To support on-the-spot decision making



LA AND SERIOUS GAMES



- Serious games as educational tools
- LA as an approach for supporting performance measurement, assessment, and improvement in and of serious games
- Purpose of LA in serious games
 - Measuring student success for feedback to learners and teachers
 - Game evaluation
 - Dynamic adaptation during gaming



LA AND SERIOUS GAMES



- Diversity of games as a challenge for development of LA approaches and tools
- Generic approach of LA in serious games
 - Utilising and visualising general interaction data
 - Teacher-defined, game-specific assessment rules
 - Combination of game trace variables to obtain new information

(Serrano-Laguna et al, 2014)



LA AND SERIOUS GAMES



- On-line/stealth assessment
 - Continuous assessment of performance and progress
 - Evidence centred design
 - Micro-adaptive assessment and interventions
 - Use of learner interactions to feed and update the student model (competence, motivation...)
 - Supporting teaching and learning
 - Monitoring and documenting learning curve
 - Timely and tailored interventions and feedback
 - Individualisation of game experience

(Shute et al., 2009; Kickmeier-Rust & Albert, 2010)



LA AND SERIOUS GAMES



- LA in games still at the beginning
- Serious games as part of multiple learning tools and activities
 - Data integration instead of isolation



DRAWBACKS & CHALLENGES



- Research and practice gap
- Need to answer relevant educational questions
- From user tracking to meaningful insight
 - E.g. on competencies and skills
- Meaningful integration of distributed learning data
- Need for user friendly tools
- Ethics



LEARNING ANALYTICS TOOLBOX



- LEA'S BOX Project (FP7 STREP)
 - Competence-centred and theory-grounded LA
 - Competence-based Knowledge Space Theory
 - Formal Concept Analysis
 - Novel visualisation approaches
 - Continuous engagement and evaluation with schools

(Albert & Lukas, 1999; Wille, 2005)



LEARNING ANALYTICS TOOLBOX



- Triangulating learning data from multiple sources
- Hybrid approach combining bottom-up and top-down procedures
 - Theory-driven competence models
 - Data-driven sophistication and refinement
- Visualisations – OLM
 - Competence structures, concept lattices
 - Reflection, negotiation



WRAP UP



- Further work on LA is needed to...
 - Integrate LA in educational practice
 - Bring together data from a diversity of sources
 - Advance LA for serious games
- Meaningful, new insights on learning and teaching
- Maximising benefit and significance



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