Learning Analytics and Serious Games: Trends and Considerations

ACM Multimedia Serious Games Workshop Nov 7, 2014

Modelling for LA
- Learning Domain
- Application Concept
- Learner Modelling

Choosing Data
- Intensive vs. Extensive Data
- Single Player vs. Multiplayer
- Generic vs. Game-Specific

Deployment Results
- Visualization
- Adaptation
- Prediction

Analyzing Data
- Evidence-Centered Design
- Statistical Data Mining
- Machine Learning

Capturing Data
- Activity Logs
- Multimodal LA
- Mobile/Ubiquitous LA

Aggregating Data
- Aggregation Across Users
- Aggregation Across Modalities

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Serious Games – Team

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Martin Knöll
UNICO, architecture
Urban Health Games

Interdisciplinary research area „Serious Games“ since 2011
→ 15 groups

EXIST uniworlds
Serious Games – *Games more than fun*

**Approach**
- Game technology & concepts
- + further RTD concepts
- → application areas

**Characteristics**
- Real data & real users
- Complex, interdisciplinary
- Fun & Characterizing Goal
- Personalization & adaptation
- Authoring, control & evaluation
Serious Games – Research Field

Overall Aim: Maximise effects & fun

characterizing goal (health..) user / game experience

Serious Game
- Game state, game world
- Game Design, gameplay
  - Single / Multiplayer
  - Offline / Online / Mobile

Adaptive Serious Games

Adaptation
- Adaptive control
- Adaptive gameplay
- Difficulty adaptation
- Procedural Content

personalization

Adaptive control
Adaptive gameplay
Difficulty adaptation
Procedural Content

State Monitoring
- (mobile) sensing
- Context awareness
- Player state & behaviour
- Psychophysiologic data

sensing

Adaptive gameplay
Difficulty adaptation
Procedural Content

Knowledge Base
- Description & model for Serious Games
- Game patterns & interaction templates
  - User profile, player / learner model
  - (dynamic) Game Data, e.g. vital data
- (domain) knowledge, situation/adaption base

interpretation

Aggregation

Dynamic Game Data, e.g. vital data
Situation/adaption base

1. (mobile) sensing
2. Context awareness
3. Player state & behaviour
4. Psychophysiologic data

1. Adaptive control
2. Adaptive gameplay
3. Difficulty adaptation
4. Procedural Content

1. Game state, game world
2. Game Design, gameplay
3. Single / Multiplayer
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Outline ’Learning Analytics & Serious Games‘

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Definition – What is Learning Analytics?

“Learning analytics is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs.” George Siemens 2011

http://edtechreview.in/event/87-webinar/835-can-learning-analytics-enable-personalized-learning
Motivation

Why Learning Analytics & Serious Games?

• Evaluation of Serious Games
  • Justifying expense in learning contexts
  • Objective and cost-effective approach

• Evaluation with Serious Games
  • Provide a big amount of gameplay data
  • Interactive and engaging nature
    → Stealth Assessment
  • Enable insight about learner attributes and learning progress

Conceptual Approach Learning Analytics & SG

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Modelling for Learning Analytics in SG

- **Content**
  - Competence-based Knowledge Space Theory (CbKST)
    - Requires learning domains to be modelled as a prerequisite competency structure

- **Users**
  - Open Learner Model (OLM)
    - Presenting to the learner an understandable visualization of his current knowledge state
    - Proven to improve learning outcomes

- **Player Model by Bartle**
  - Achiever, Explorer, Killer, Socializer

- **Content & Users**
  - Narrative Game-Based Learning Objects (NGLOB)
    - Additionally considers player type and narrative aspects
    - Triple vector: Narrative, Gaming and Learning Context
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Choosing and Capturing Data I

Recording data depends on

- Learning goals, tasks and setting
- Game genre, mechanic and platform
- Single-Player vs. Multiplayer
  - additional social component in collaborative learning
- Fun vs. Learning (effects)

Designing games „with analytics in mind“

www.storytec.de

StoryTec Authoring Environment with StoryPlay – Learning Analytics Tool
Choosing and Capturing Data II

Data modalities and interactions

- **Multimodal Learning Analytics**
  - Includes biometric data and other multimodal data for **assessing motivation, fun** and collaboration aspects in learning settings

- **Mobile and Ubiquitous Learning Analytics**
  - Data of mobile game-based learning appliances
  - Interaction with mobile devices
  - Considering contextual information
Conceptual Approach Learning Analytics & SG

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Aggregating and Analyzing Data

„Aggregation Model“
- using semantic rules to map game actions or states to meaningful (machine-readable) expressions under which similar events are grouped

Analyzing data depends on learning context and application
- By instructor (via browser/analyzer)
- Automatic Analysis (for intelligent tutoring systems and adaptive Serious Games)
  - Measures to be derived:
    - Gaming: general in-game performance, in-game learning, in-game strategies, player type
    - Learning: general traits and abilities of the learner, general knowledge, situation-specific state, learning behaviors, learning outcomes
  - Rules and algorithms (applied during learning sessions) governing the interpretation of in-game sources of evidence to infer competencies and to update competency models
  - Data Mining and Machine Learning approaches can be used for identifying solution strategies, error patterns and player goals
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Deploying Results for Learning Analytics in SG

Visualization
- visualizations of narrative structure, player model and skill tree
- graphs, Hasse Diagrams, Heat Maps
- for games, a special need for real-time operation, extensibility and interoperability

Adaptation
- **macro-adaptivity**: system responds by choosing the appropriate next learning object or narrative event
- **micro-adaptivity**: adjusting aspects within a learning task like task difficulty or feedback type
Questions & Contact

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