Design of computer video games

9. Serious games

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Agenda

- Introduction to serious games - history, definitions and goals

- Taxonomy of serious games - types and use in different sectors

- Learning games

- Evaluate motivation and the effect of learning through serious games

- Problems and trends

- Examples

References

- Adams, E. Fundamentals of Game Design, Third Edition, Pearson Education, Inc., ISBN-13: 978-0-321-92967-9, 2014

- Salen, K., Zimmerman, E . Rules of Play - Game Design Fundamentals, MIT Press Cambridge, Massachusetts London, England, ISBN 0-262-24045-9, 2004.

- Bontchev, B. Trends and challenges in digital games' and entertainment evolution, Plenary lection at the 7th Int. Conference on Game and Entertainment Technologies, Lisbon, Portugal, 2014

- Bontchev, B. Serious games for and as cultural heritage, Plenary lection at DIPP'15, V. Tarnovo, Bulgaria, 2015
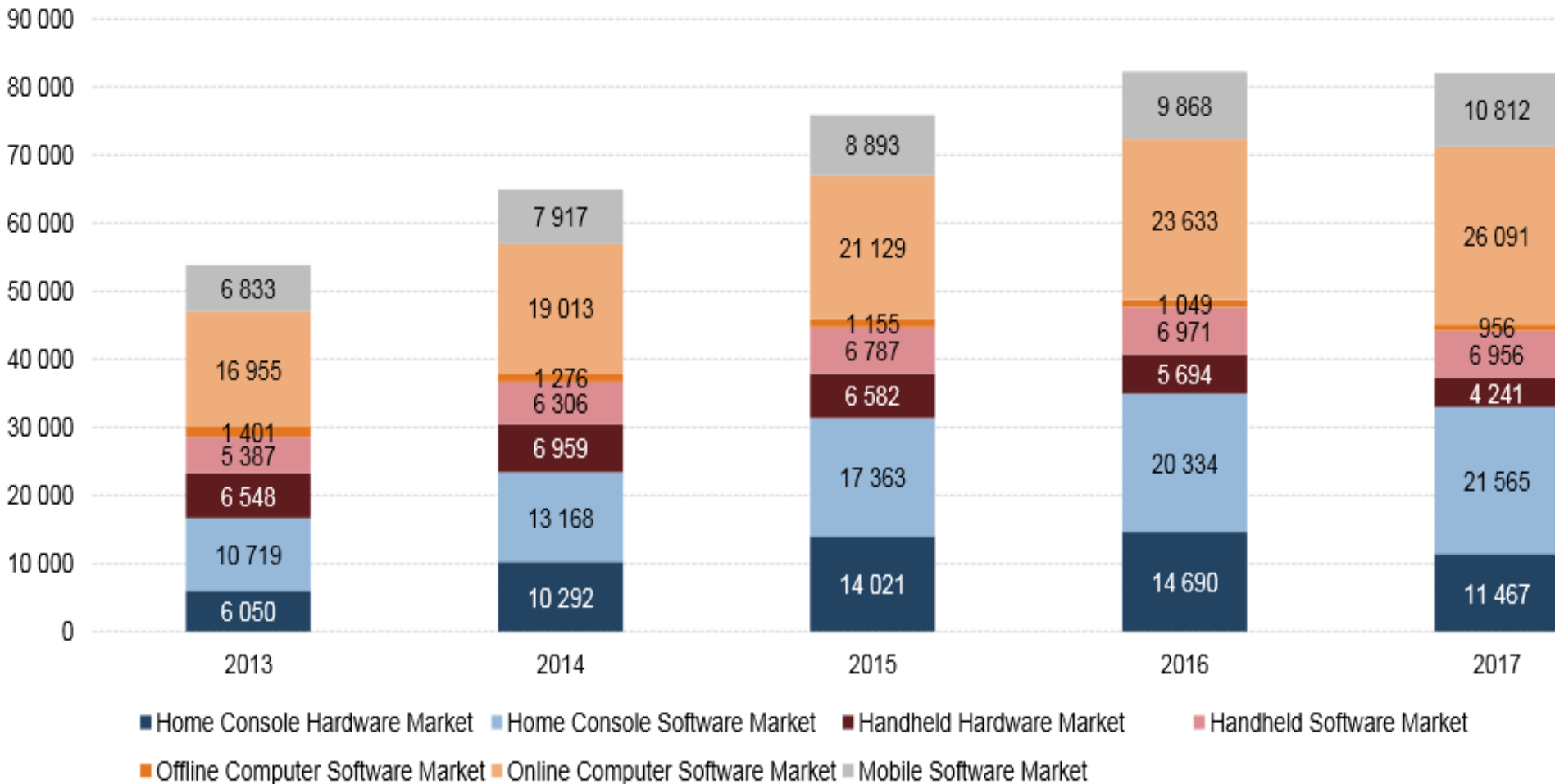
Introduction

- Henry Ford once said:
  - Anyone who keeps learning stays young.
  - The greatest thing in life is to keep your mind young.
- All the games keeping our mind young.
- Computer games are effective mean for retaining interest of learners by attracting their attention for much more time than traditional approaches

World Video Game Market, 2013-2017 (millions EUR)

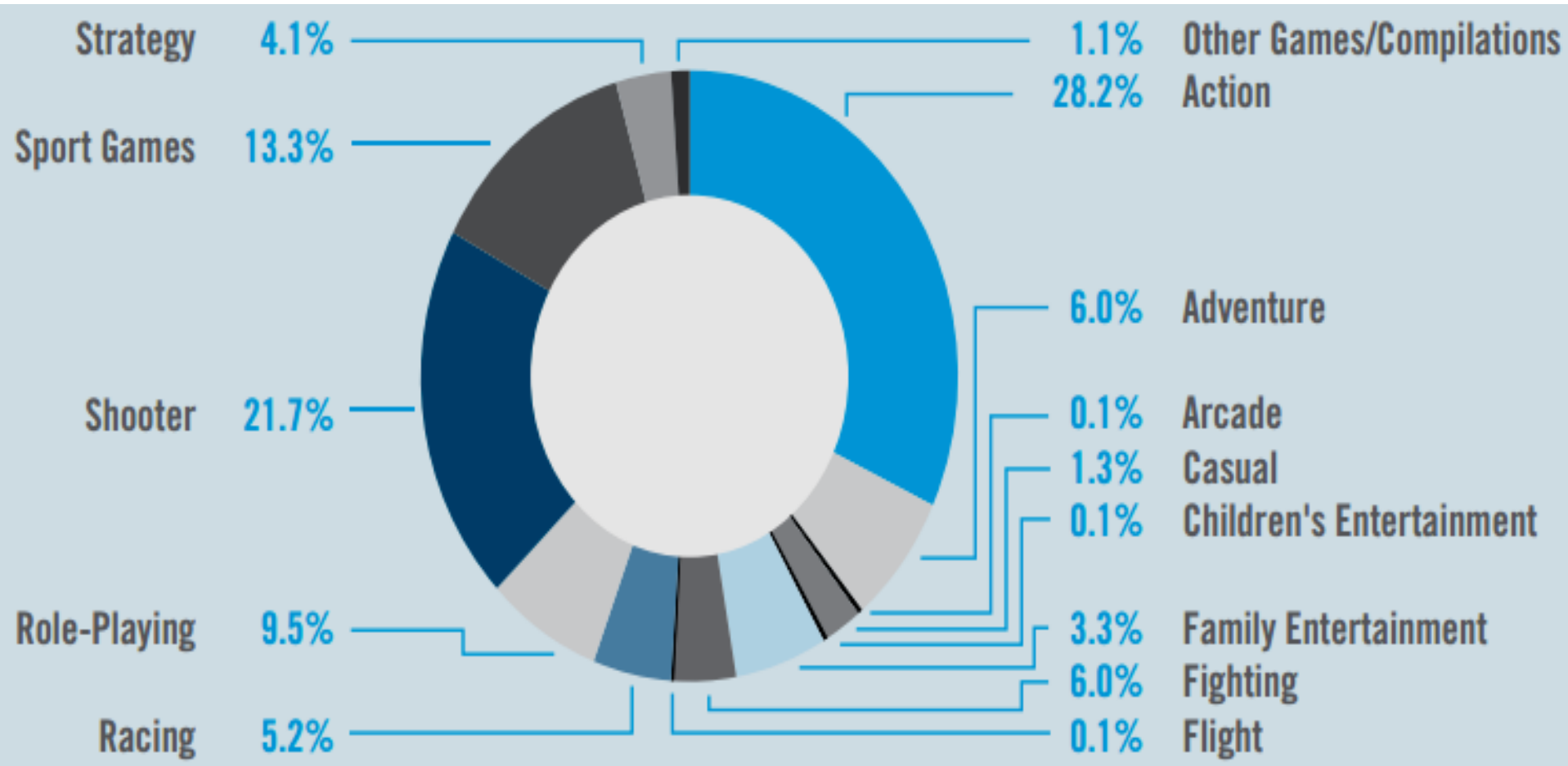*Source: IDATE, December 2013*

Modern Video Games types 1/2

- Competitive versus noncompetitive games
- Interactive versus non-interactive games
- Physical versus non-physical games

(Vosen, 2004)

- Platforms – personal computers or tablets; game consoles like Microsoft Xbox, Nintendo Wii U, or Sony PlayStation; mobile phones
- Playing mode - multi- or single-player;
- Milieu (social environment) - describes the visual type of a video game - science fiction, fantasy, horror, etc…

(Apperley, 2006)

Modern Video Games types 2/2

- Distribution – paid or free
- Openness – games with open code or not
- Mod's – modified games with altered content
- Linear vs non-linear gameplay – while linear gameplay provides fixed sequence of challenges, non-linear gameplay poses challenges that can be completed in different sequences
- Progressive vs emergent gameplay – some games (like 'The Sims') do not have story structure planned in advance and, thus, offer emergent gameplay

Entertainment Video Games

Strategy — 4.1%
Sport Games — 13.3%
Shooter — 21.7%
Role-Playing — 9.5%
Racing — 5.2%

1.1% Other Games/Compilations
28.2% Action
6.0% Adventure
0.1% Arcade
1.3% Casual
0.1% Children's Entertainment
3.3% Family Entertainment
6.0% Fighting
0.1% Flight

(Entertainment Software Association, 2014)

Serious (applied) Video Games

■ *"have an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement "*

(Abt, 1970)

■ *"produced, marketed, or used for purposes other than pure entertainment; these include, but are not limited to, educational computer games, edutainment and advertainment"* + *"health games and political games"*

(Nielsen, Smith, Tosca, 2008)

Simulation
Representing characteristics of one system through the use of another system, especially a computer program designed for purpose…

Serious Games
A software or hardware application developed with game technology and game design principles for a primary purpose *other than pure entertainment*

Video Games
Any of various games played using a microchip-controlled device, as an arcade machine or hand-held toy …

# Serious games taxonomy (Sawyer and Smith, 2008)

- content dimension of SGs - includes games for health, advergames (advertising games used for marketing), games for training, for education, for science and research, production, and games as work;

- sectoral dimension of SGs: government & NGO, defense, healthcare, marketing & communications, education, corporate, industry

Serious gaming taxonomy (Sawyer & Smith, 2008)

	Games for Health	Advergames	Games for Training	Games for Education	Games for Science and Research	Production	Games as Work
Government & NGO	Public Health Education & Mass Casualty Response	Political Games	Employee Training	Inform Public	Data Collection / Planning	Strategic & Policy Planning	Public Diplomacy, Opinion Research
Defense	Rehabilitation & Wellness	Recruitment & Propaganda	Soldier/Support Training	School House Education	Wargames / planning	War planning & weapons research	Command & Control
Healthcare	Cybertherapy / Exergaming	Public Health Policy & Social Awareness Campaigns	Training Games for Health Professionals	Games for Patient Education and Disease Management	Visualization & Epidemiology	Biotech manufacturing & design	Public Health Response Planning & Logistics
Marketing & Communications	Advertising Treatment	Advertising, marketing with games, product placement	Product Use	Product Information	Opinion Research	Machinima	Opinion Research
Education	Inform about diseases/risks	Social Issue Games	Train teachers / Train workforce skills	Learning	Computer Science & Recruitment	P2P Learning Constructivism Documentary?	Teaching Distance Learning
Corporate	Employee Health Information & Wellness	Customer Education & Awareness	Employee Training	Continuing Education & Certification	Advertising / visualization	Strategic Planning	Command & Control
Industry	Occupational Safety	Sales & Recruitment	Employee Training	Workforce Education	Process Optimization Simulation	Nano/Bio-tech Design	Command & Control

Educational games and game-based learning (GBL)

❑ **Freedom**
❑ **Uncertainty for outcome**
❑ **Non-productiveness**
❑ **Make believe (not real)**
                    (Caillois, 2001)
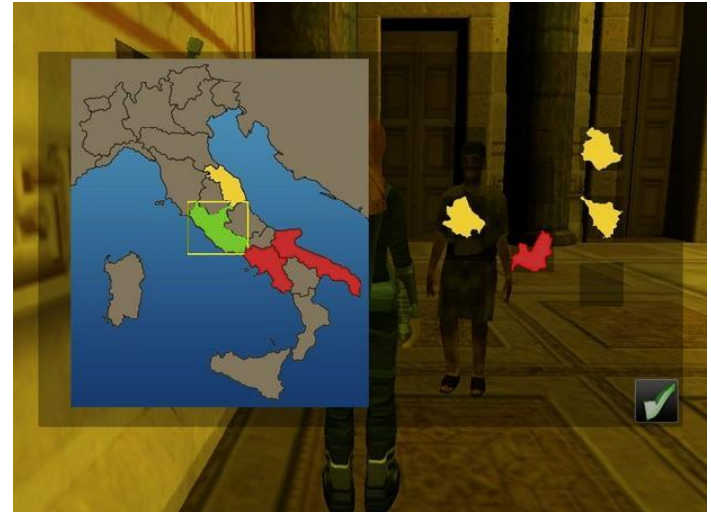
❑ **Immersive**
❑ **Indeterminate completion time**
❑ **Informal learning**
                    (Royle, 2009)

Games and types of learning

❑ Individual learning: competence to acquire new information as a consequence of a personal experience with the environment, through for example trail and errors mechanisms;

❑ Social learning: ability to acquire new knoledge and practices via the interactions with other humans assumed as models and expert to imitate

SG are mixed and balanced forms of individual and social learning:

✓ Imitation of best practices via simulation of real situations

✓ Follow paths designed by experts (SG multidisciplinary team)

✓ The user is the main characther asked to actively be involved in the game's situation and having degree of freedom to make their make his choices and decisions

Aspects of learning games

- Games as "engines" or authoring platforms: AUTHORING SYSTEMS
- Games as content: CONTENT SYSTEMS
- Games as simulations: MANIPULATING SYSTEMS
- Games as context: TRIGGER SYSTEMS
- Games as technology gateways: GATEWAY SYSTEMS
- Games as illustration: REFLECTIVE SYSTEMS
- Games as exemplars of point of view: POV SYSTEMS
- Games as Code Worlds: CODE SYSTEMS
- Games as Documentary: DOCUMENTARY SYSTEMS
- Games as text: IDEOLOGICAL SYSTEMS
- Games as research: RESEARCH SYSTEMS
- Games as assessment: ASSESSMENT SYSTEMS

In "Moving learning games forward", by E. Klopfer et al, 2010

Learning with serious games
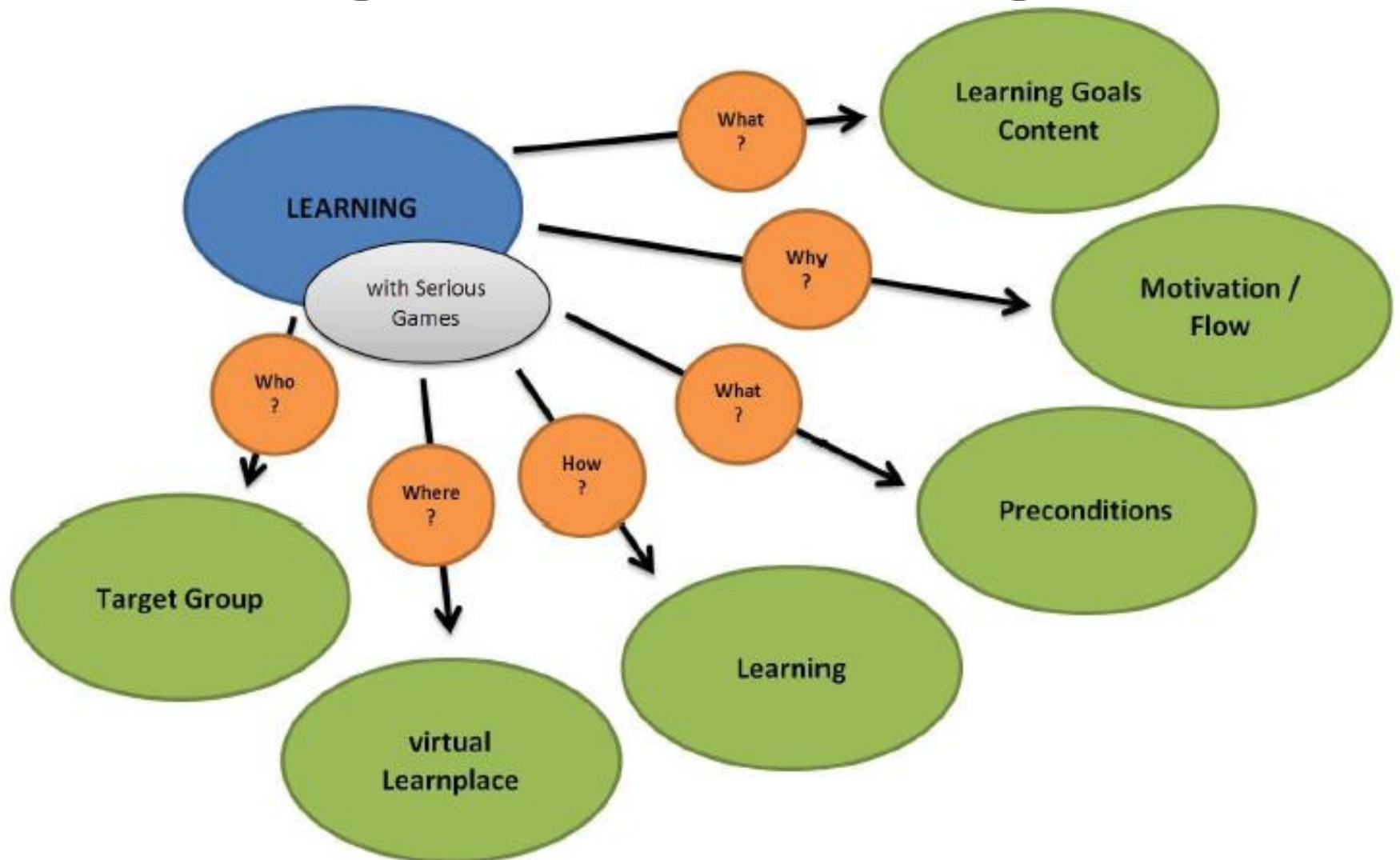
Source: Theory and Taxonomies of Serious Games, ENTRExprorer project,
July 15, Lisbon, Portugal

EDUCATIONAL GAMES AND GAME-BASED LEARNING (GBL)

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Video Games for Cultural Heritage

- Unlike other traditional media, video games are capable to make deeper our understanding and feelings of cultural heritage (*both tangible and intangible*) in a *very interactive way*

- All video games do always reflect somehow human culture because they are "*objects produced and played within culture at large*", however, "*not all games manifest transformative cultural play to actually transform culture*" (Salen and Zimmerman, 2007)

Virtual heritage environments vs. Games

- **Interactivity** – exploration of environments, meaningful tasks to be completed, dialogues - between players or with a non-player character (NPC), and quizzes;

- **Meaning** – incorporates culture and history (intangible heritage) and story (interactive narrative);

- **Player character** – role-play (in a historical environment), 3D avatar (visual equivalent of the player in the virtual world), and its personalization;

- Others elements – inclusion of NPC as **virtual (inter)active inhabitants and multiplayer mode**;

- Cultural and historical/visual and behavioral/environmental/auditory/olfactory **accuracy and realism**.

(Granström, 2013)

Serious Video Games for Cultural Heritage

- **Use:**
  - interactive simulation of realistic virtual heritage scenarios
  - virtual and augmented reality
  - artificial intelligence – for NPC control and content generation
  - adaptivity

- **Offer:**
  - free choice of learning place
  - choice of learning time and speed
  - autonomous and self-controlled learning in the game context
  - problem-solving
 - willingness for cooperation

Interactive virtual museums

- use gaming technology for both entertaining and educating visitors usually by incorporating some exploration and reassembling tasks and quizzes

- examples - 'Virtual Egyptian Temple', 'Olympic Pottery Puzzle', 'Walk through Ancient Olympia' and 'ThIATRO'

'Walk through Ancient Olympia'

GAITATZES, CHRISTOPOULOS, PAPAIOANNOU: The Ancient Olympic Games: Being Part of the Experience (*VAST, 2004*)

'ThIATRO'
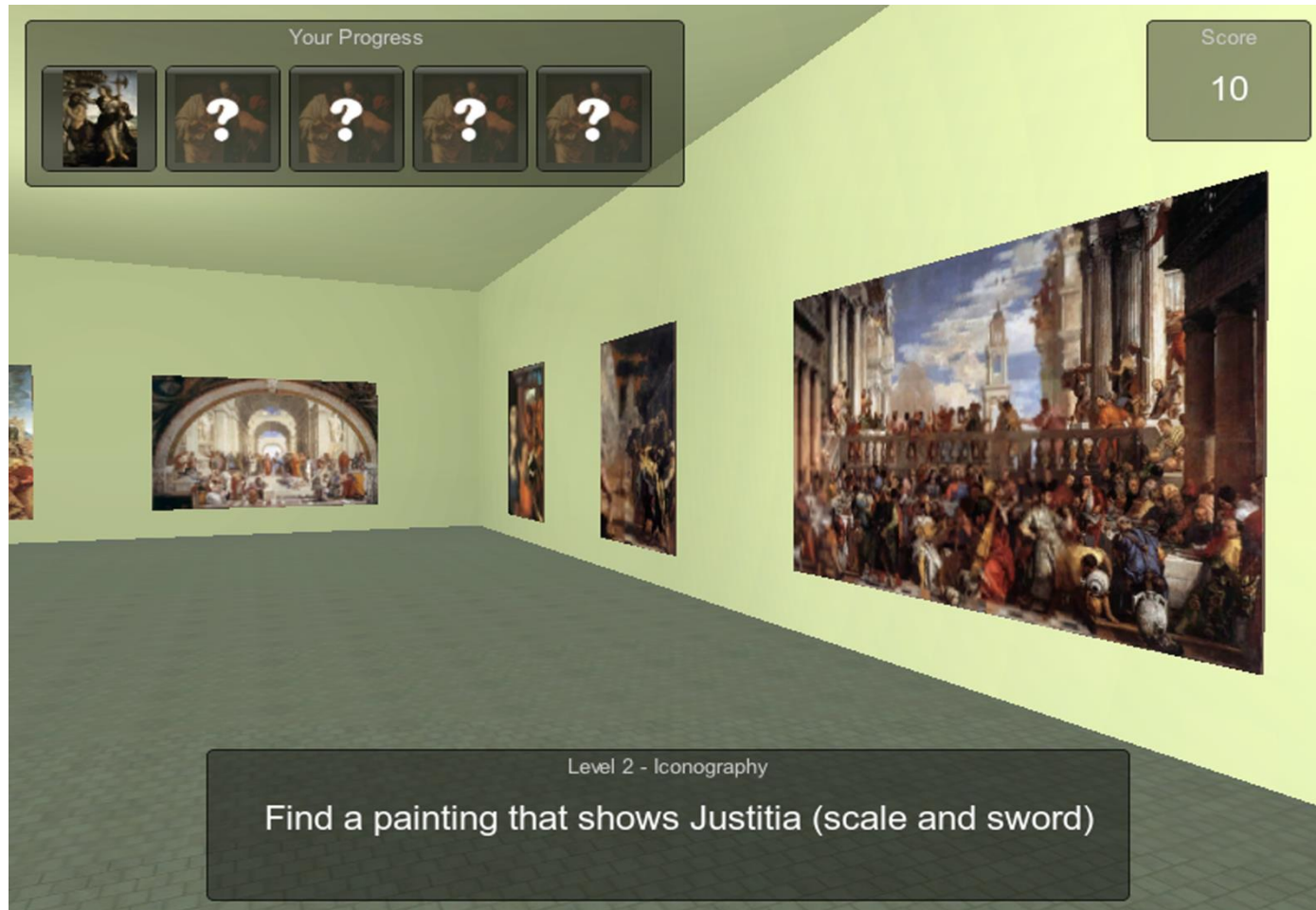
Froschauer et al, Design and Evaluation of ThIATRO, 2012

Prototypes and demonstrators

- games based on 3D virtual reconstruction 3D and geo-referenced modeling of ancient historical sites

- provide not only realistic archaeological exploration with historical accuracy but also political, religious and artistic walkthrough with crowd restauration of ancient characters with procedurally generated NPC

- examples - 'Pompei: The Legend of Vesuvius' edutainment SG and 'Roma Nova' brain-controlled SG

SG for acquisition of cultural knowledge and intangible heritage

- include intercultural skills and language training games with high-fidelity 3D simulation of cultural settings

- examples - 'Croquelandia', 'Adaptive Thinking and Leadership System' (ATL), 'Second China', the Tactical Language and Culture Training System (TLCTS), BiLAT, and the 'Virtual Environment Cultural Training for Operational Readiness' (VECTOR)

Social tagging and knowledge acquisition SG

- SG for encouraging players to submit accurate information about cultural artifacts embedded into the games for further knowledge verification and mining
- Examples - 'One-Up' is a multi-round mobile crowdsourcing metadata tagging game fostering players to propose high-quality metadata and rewarding them based on metadata (Flanagan et al, 2013)
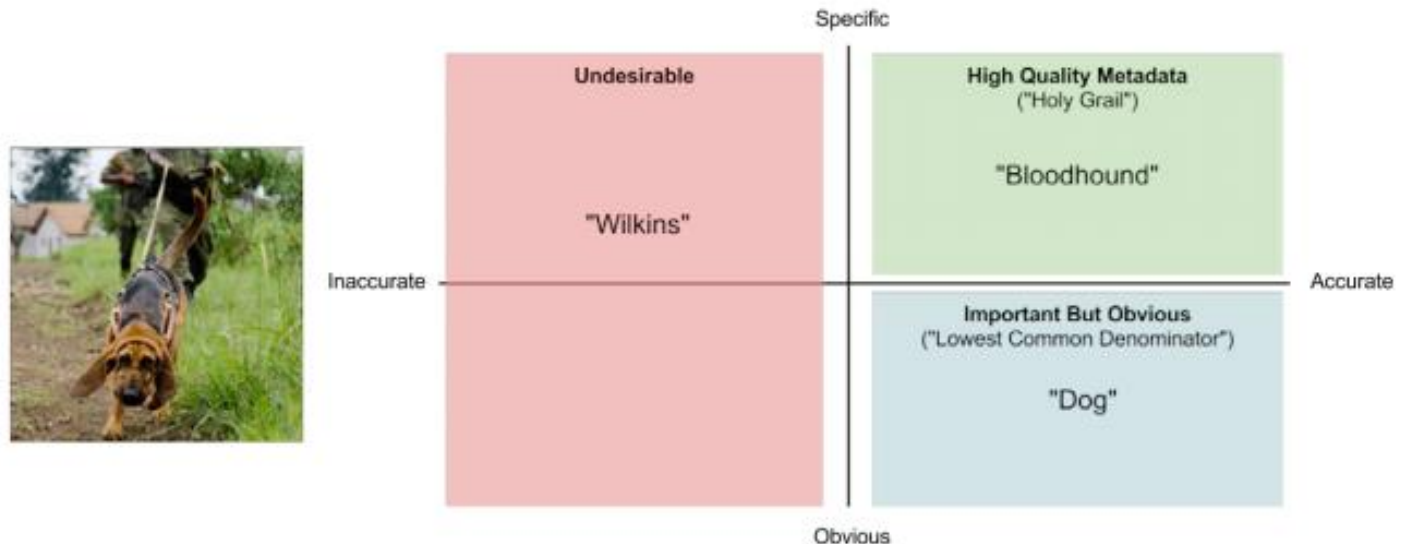
- 'Waisda?' is a video labeling game used to annotate TV heritage by integrating tags with professional annotations (Hildebrand, 2013)

TYPES OF ONLINE GAMES PLAYED MOST OFTEN:

Other

Persistent Multi-Player Universe

8%

11%

Casual/ Social Games

30%

24%

Action, Sports, Strategy, Role-Playing

Puzzle, Board Game, Game Show, Trivia, Card Games

28%
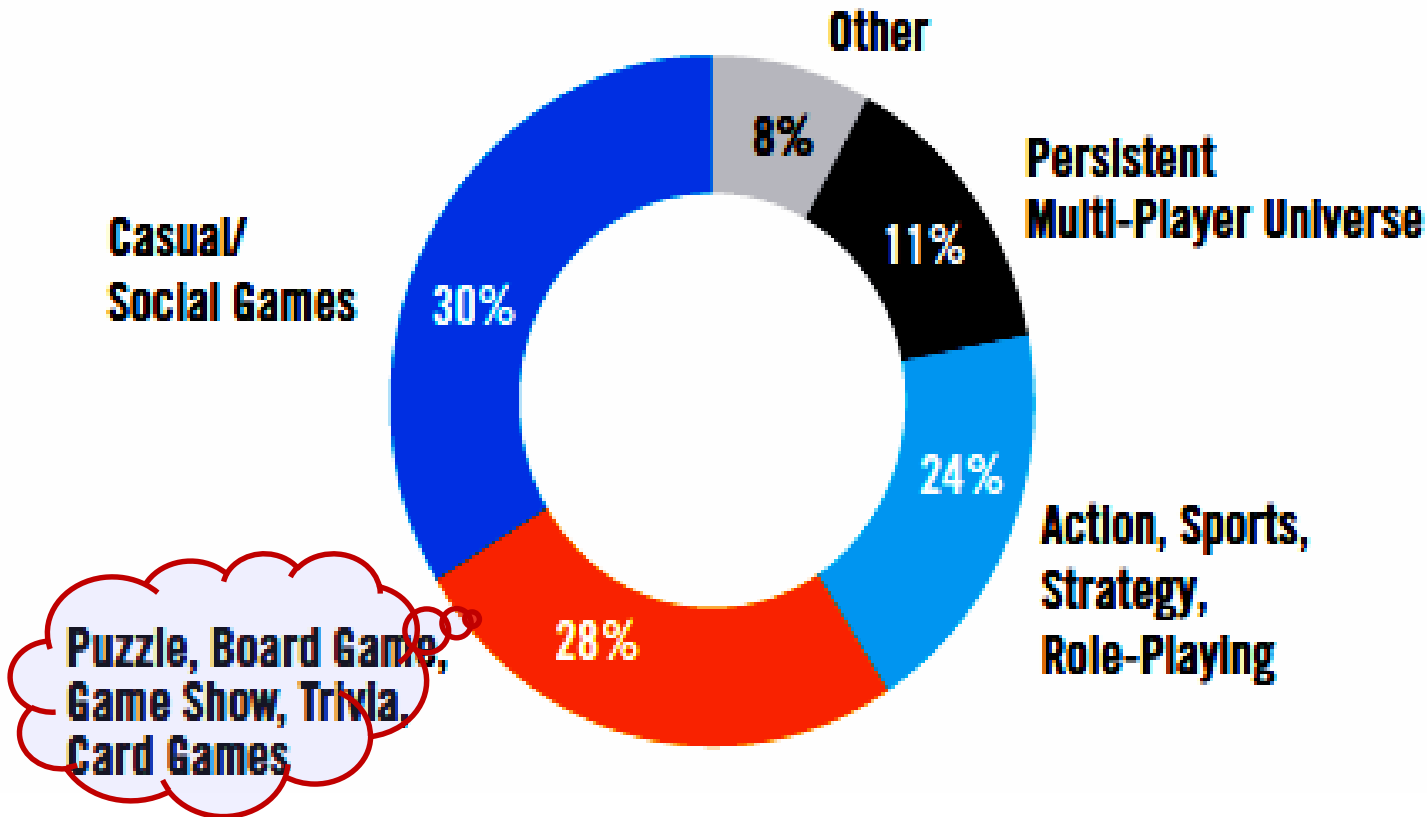
(Essential Facts about Computer Game Industry, 2014)

Educational logic/board/word games

- Quizzes are purposed for producing more fun and increasing motivation for learning.

- Some of the educational logic and word games are implemented as combinations between board games and quizzes.

- These games use board rules for navigation within a quiz.

- It could be used different strategies for selecting a question, its level of difficulties and area of knowledge, depending on the learner/player profile

Effective game based learning

Four main issues for effective GBL:
- Personalization
  - ☐ Game interface
  - ☐ Goals, preferences…
- Adaptivity:
  - ☐ Adaptive e-learning through games
  - ☐ Adaptive games
- Intelligence - AI agents playing roles of:
  - ☐ Opponents
  - ☐ Collaborators
  - ☐ Advisors (the PRIME FP6 project)
- Semantic orientation:
  - ☐ Semantically structured learning (domain) content
  - ☐ Players' annotations
  - ☐ Stimulated engagement and managed cognitive load

Semantically Rich Educational Games (Bontchev, 2012)

- Logic and board games like word and problem-oriented games need a special organization of course content in order to integrate it to the game.

- A semantic structuring of the content will enable game engine to extract specific terms and their inter-relationships dynamically during the play process.

Semantic Organization of Educational Content

- Taxonomy - provide only hierarchical structuring of domain content but not relationships between terms

- Thesaurus - represents a structured vocabulary mostly used for retrieval of resources with consistent indexes

- Ontology - provides a formal, explicit specification of a shared conceptualization

- UML class diagrams - classes, mono- and poly-hierarchies, class attributes, relationships and axioms; may be transformed into OWL

UML Concepts, Instances, Metadata and Model Relationships

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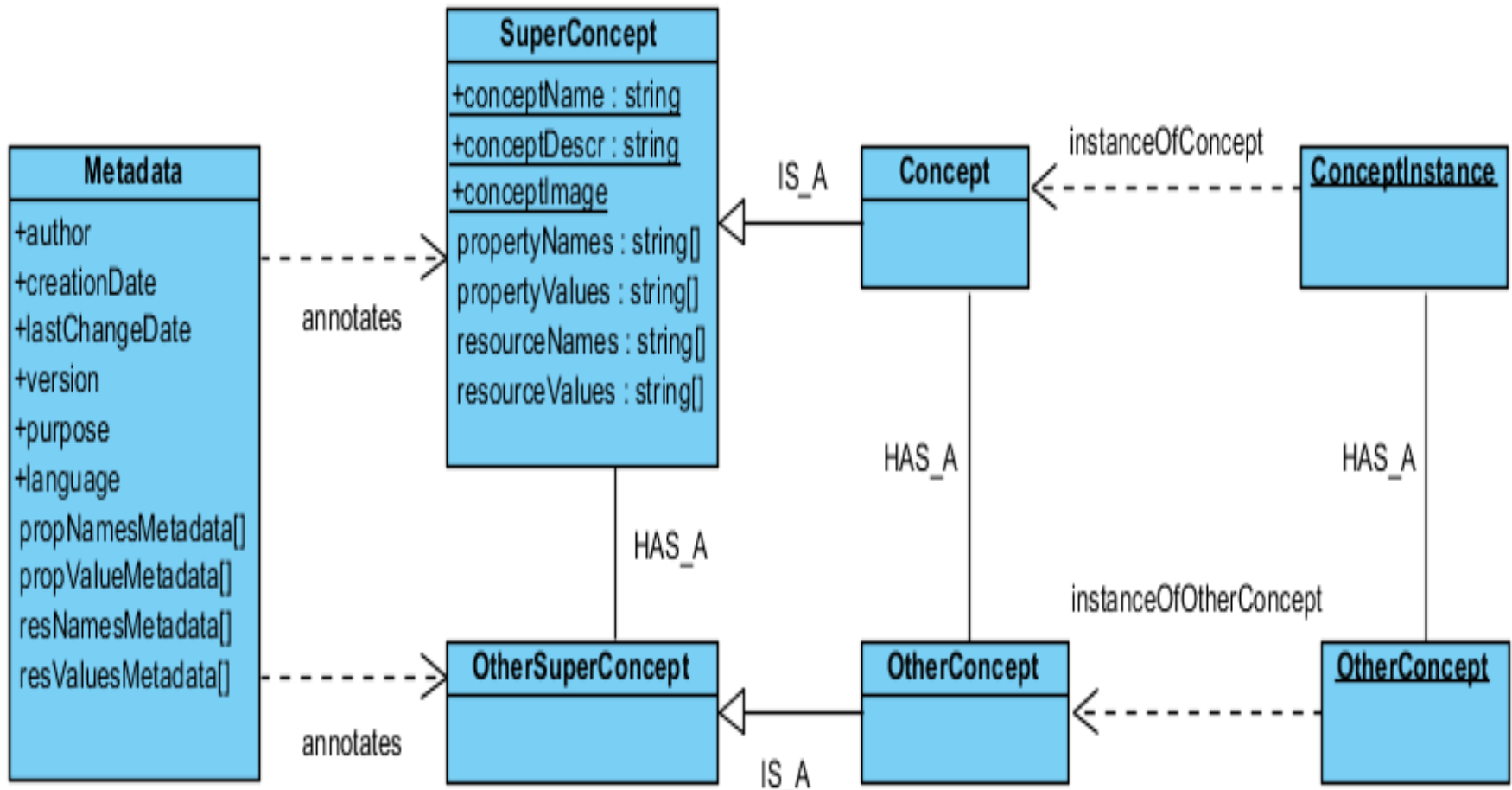
XML terms and their relationships & instances as UML diagram
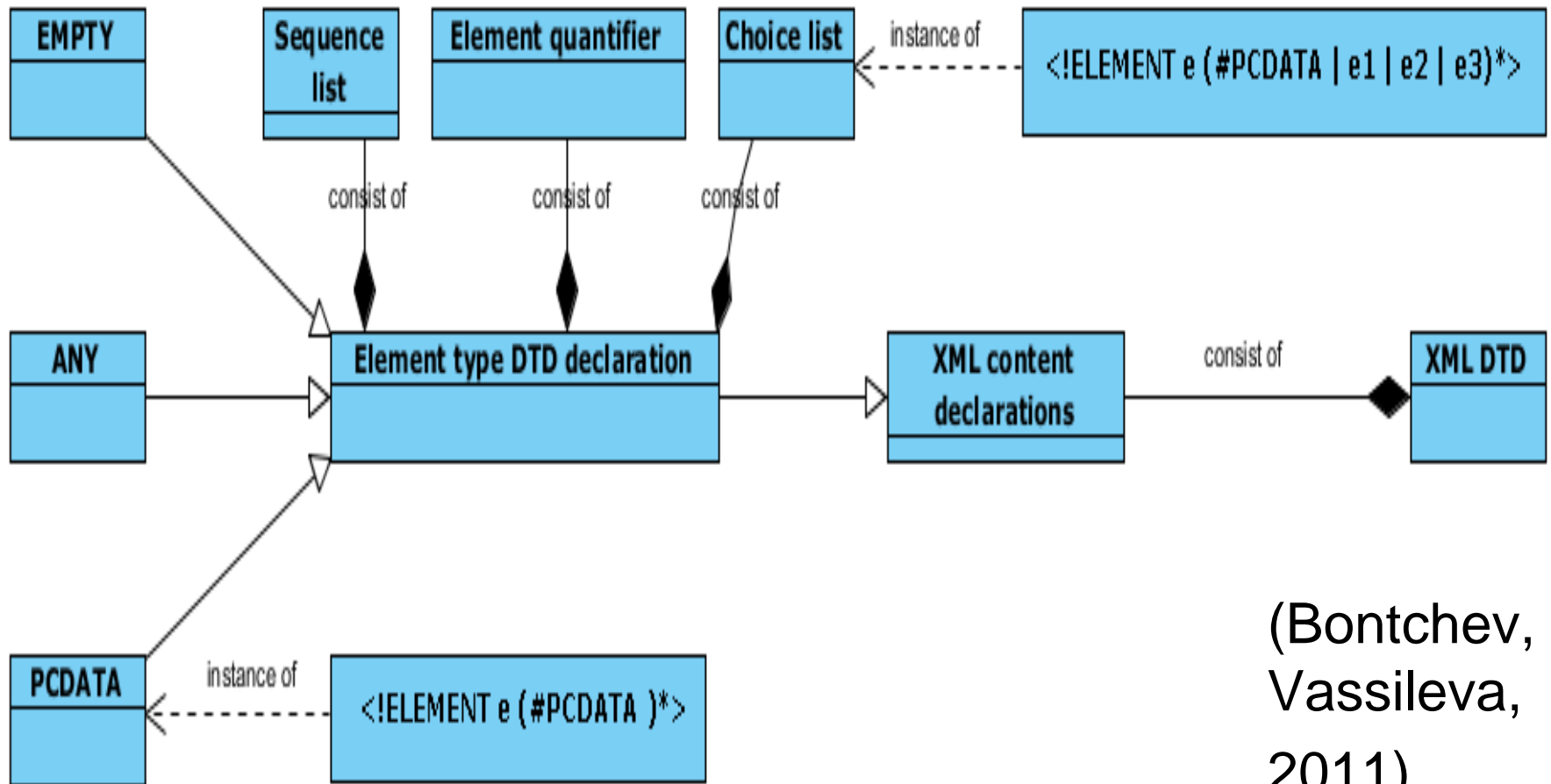
(Bontchev, Vassileva, 2011)

A software framework for construction of word games at Sofia University

- E-R data model – keeps the semantically structured course content

- Game business logic – contains modules with classes for content's term management, terms inter-relationships management, and events management

- Visual components – the level contains Text and Graphic components, and listeners to Effects

- Game components – contains a class for each implemented logic word game and a games factory for launching a game (with possible parameterization)
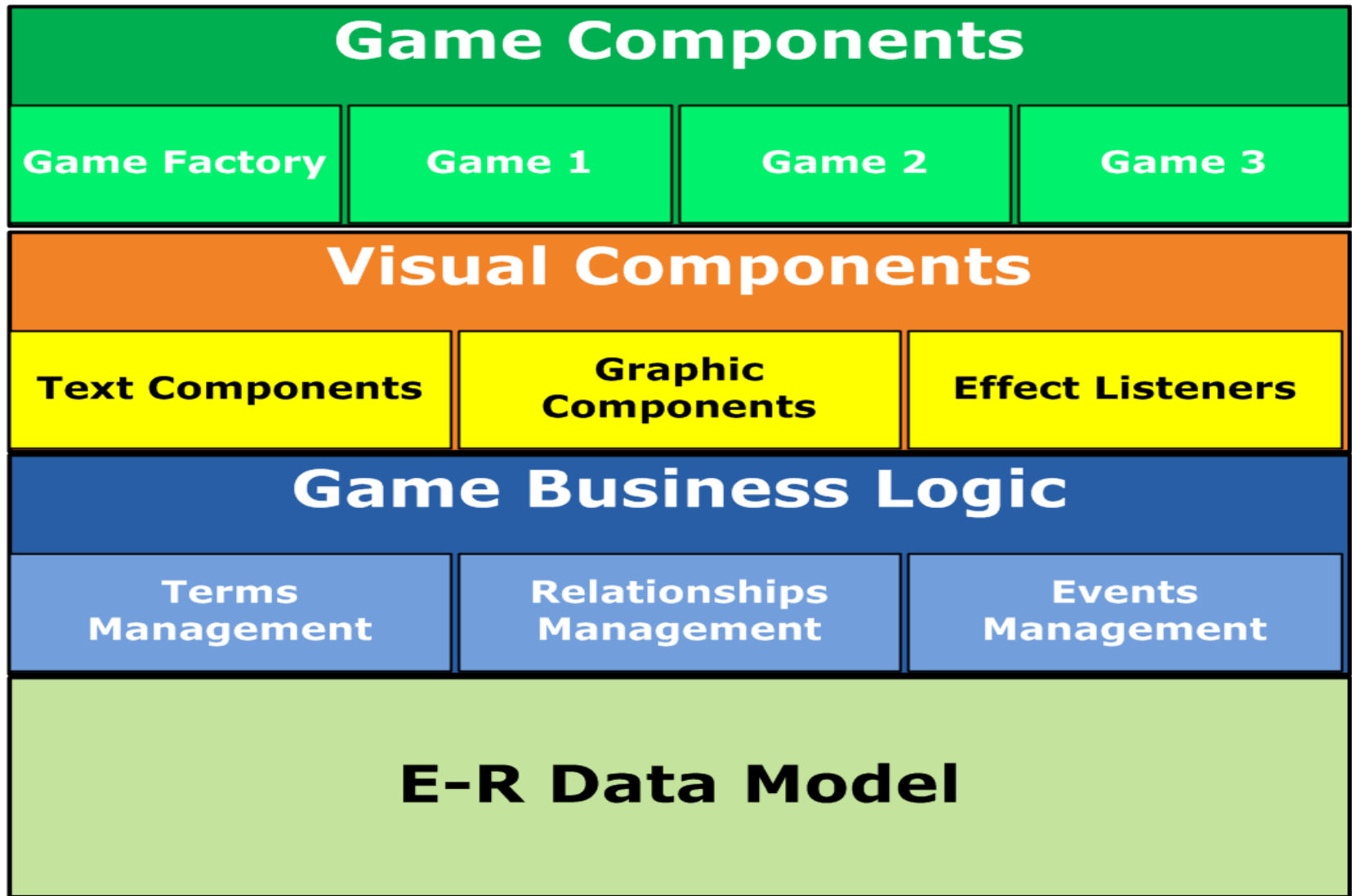
The software platform for construction of word & logic games
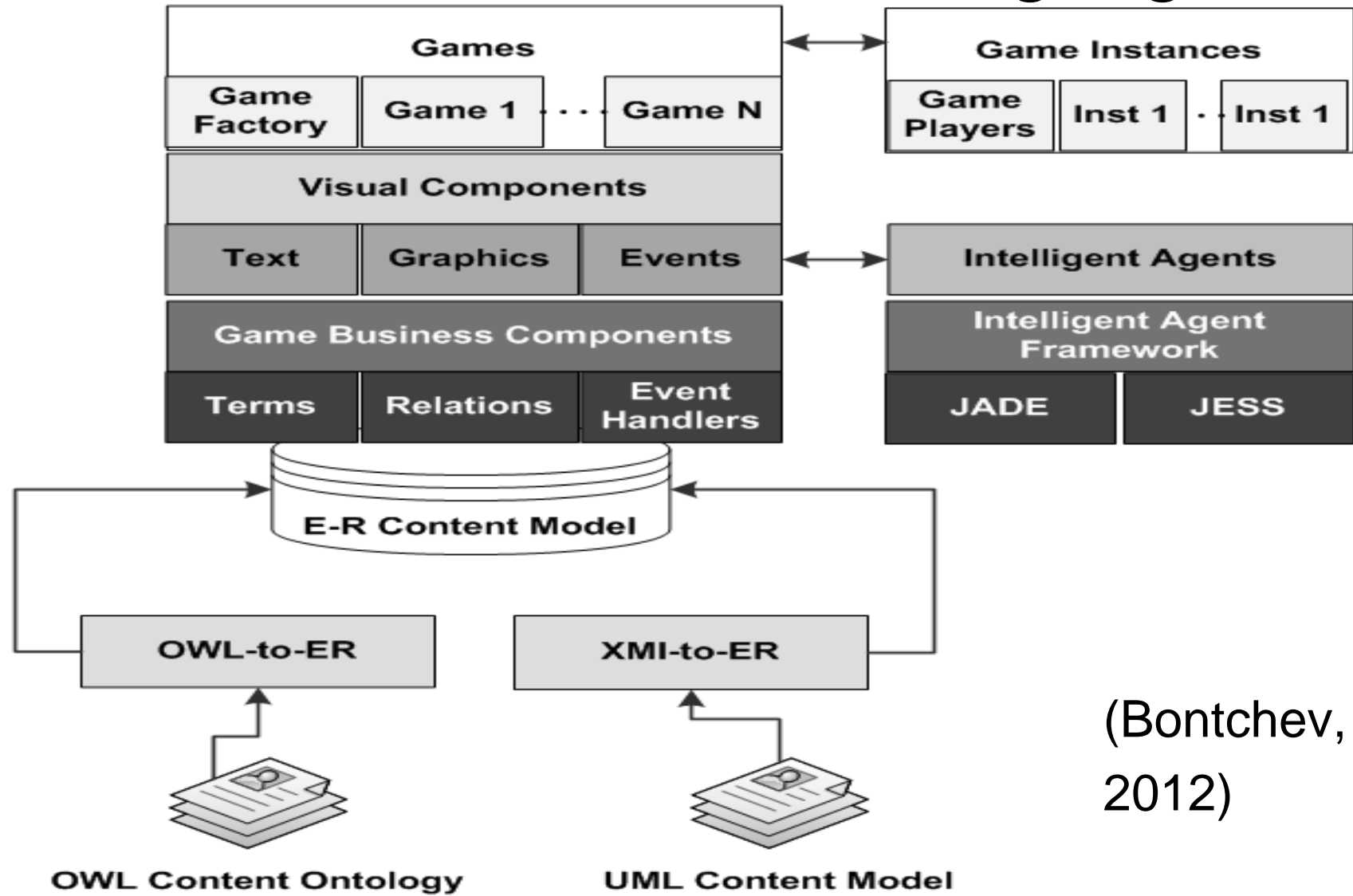
(Bontchev, 2012)

General workflow for educational game creation and delivery

Common repository

Authoring Tools

LOs

Semantically Structured Content

Content Author

Instuctor Tool

Games

Game Framework

Game Developer

Game Instances
Parametrization, Adaptation, Intelligent Agents

Course Instructor

Player Tool

Learner

(Bontchev, 2012)
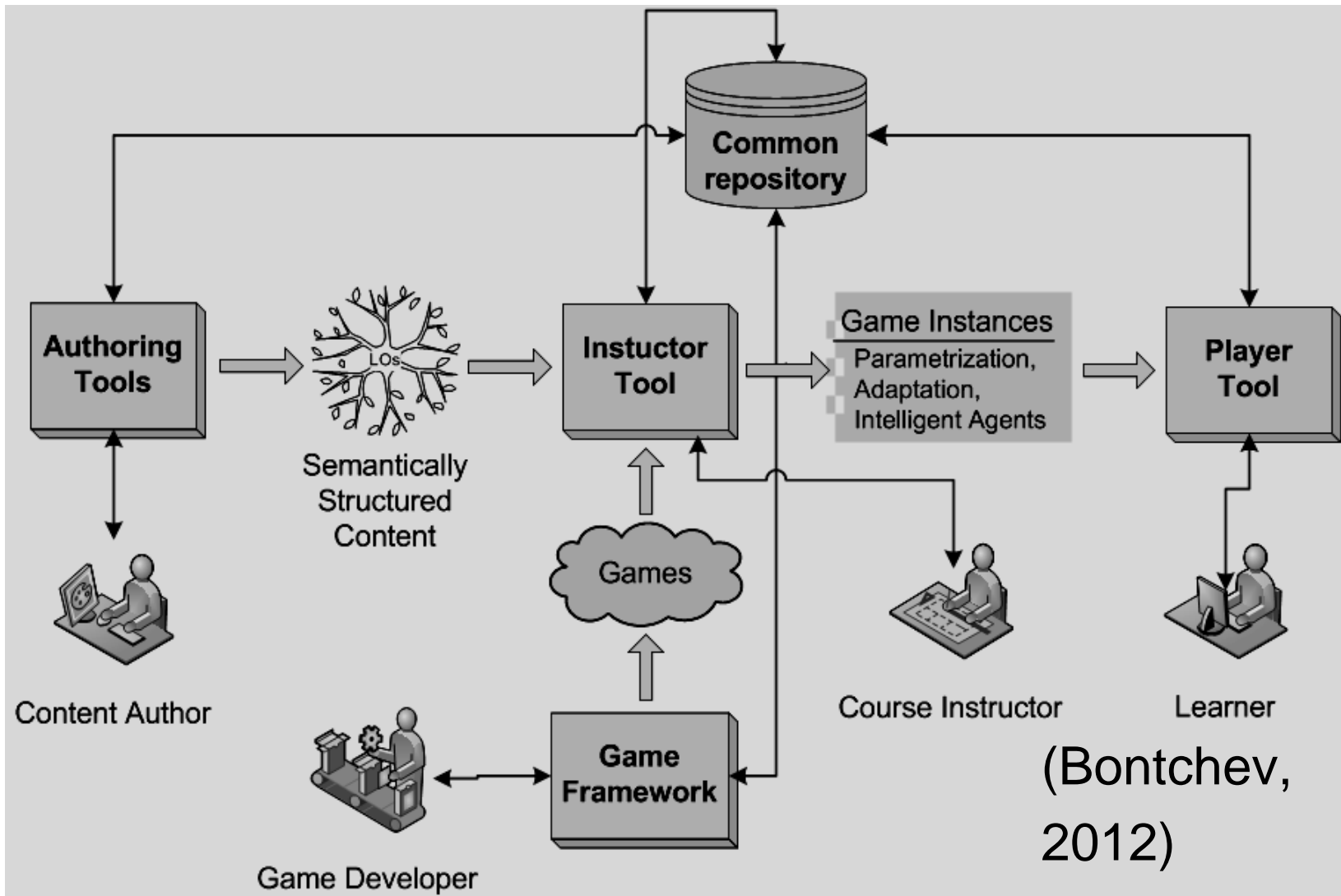
Partial view of the hangman game with XML terms

July 15, Lisbon, Portugal

Partial view of the XML term relationships game

A Memory game generated upon the Semantic Content Model, with AI agents

Match **things** to **concepts** in this memory game.

	A, B[3]		XML[1]		
		Record for A followed by B[3]			
	Markup Language[1]				
				XPath expression[2]	child::*[2]

Your score: Good 3 Bad 9

Your move

Best results:

BobSun against AA	64%
Иван vs. AA	57%
mitaka vs. AA	53%
Иван vs. AA	50%
vs. AA	50%
pavel vs. AA	50%
Akseniya vs. AA	47%
Assen single	44%
Ivan vs. AA	43%
BobSun single play	43%
Иван vs. AA	42%
single	41%
pavel single	41%
Stef vs. AA	40%
mmx single	40%
Ivan single	38%
Иван vs. AA	38%
ss vs. AA	35%
pavel single	35%
mitaka single	33%

(Bontchev, Varbanov, Vassileva, 2011)

A framework for strategic video games (Bontchev et al, 2013)

July 15, Lisbon, Portugal
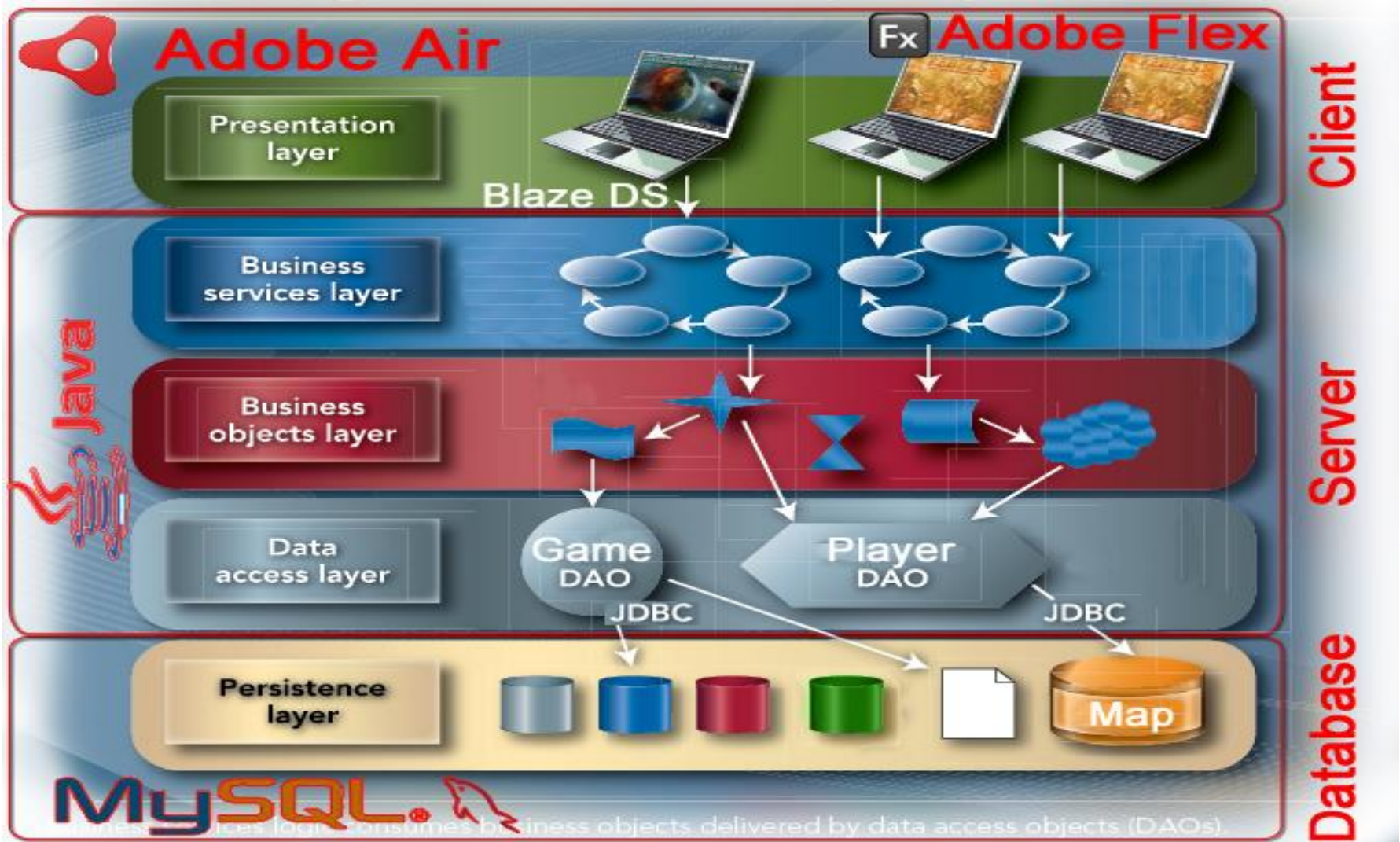
The REBELS strategic video game (Bontchev et al, 2013)

July 15, Lisbon, Portugal
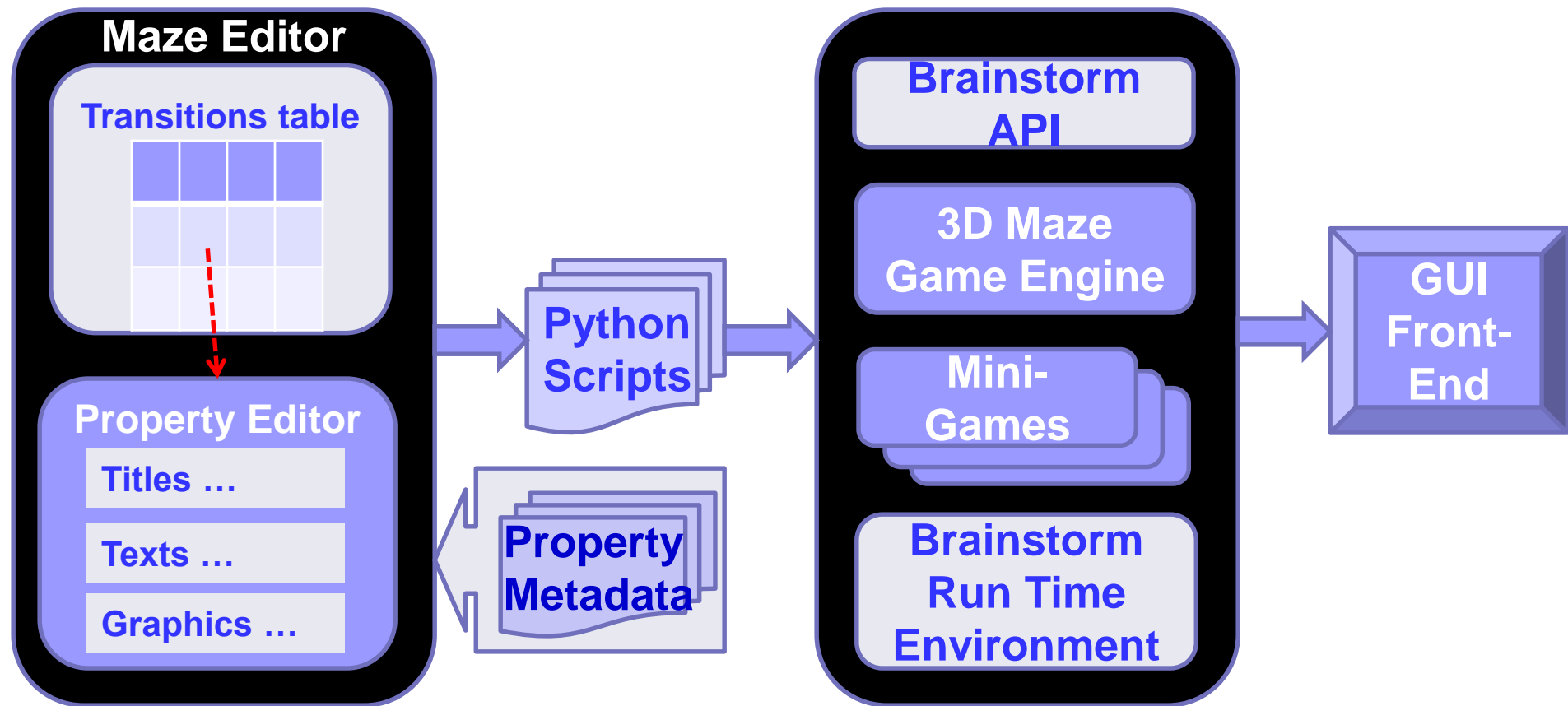
Software platform for generation of labyrinth games

http://adaptimes.eu/
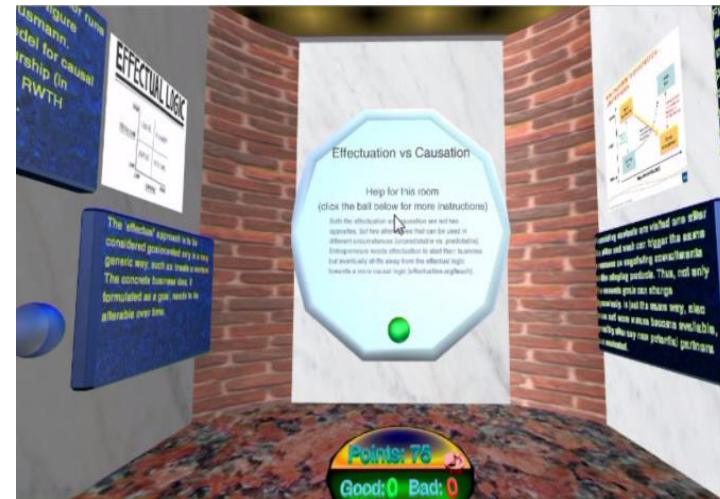
A generated labyrinth game with a 3D quiz and a 3D puzzle

Problems of SG 1/2

- Higher development cost

- Lower attractiveness compared to entertainment games

- Transition between instructional design and actual game design implementation - how Game Mechanics impact and interact with the Learning Mechanics

- Personalization and adaptation – based on:
  - ☐ Emotional state
  - ☐ Physiological/neurophysiological signals
  - ☐ In-game performance & game progression metrics

D1.6 GALA Roadmap 2, Nov. 2011

Problems of SG 2/2

- Harmonization of distributed SG Environments supporting reusability, interoperability and standardization

- Human-Computer-Interaction & neuroscience - non-intrusive and natural interaction in SG by 2020

- Assessment - effectively tracking and analysing of the right parameters related to learners' progress (knowledge gain, reflection and application)

- How psychological theories should be used in the design of realistic and convincing NPCs?

- How different pedagogical paradigms relate to SG and SG mechanics - reference framework needed!

D1.6 GALA Roadmap 2, Nov. 2011

Conclusions - supposed solution to problems of SG

- The rise of cheap, ubiquitous hardware.

- Robust networks that allow for connectivity without the administrative constraints of the past.

- Extreme pressure on schools to produce outcomes – too many kids are getting through high school with no meaningful job skills.

- Adoption of brain science software.

Nolan Bushnell, Atari

Въпроси