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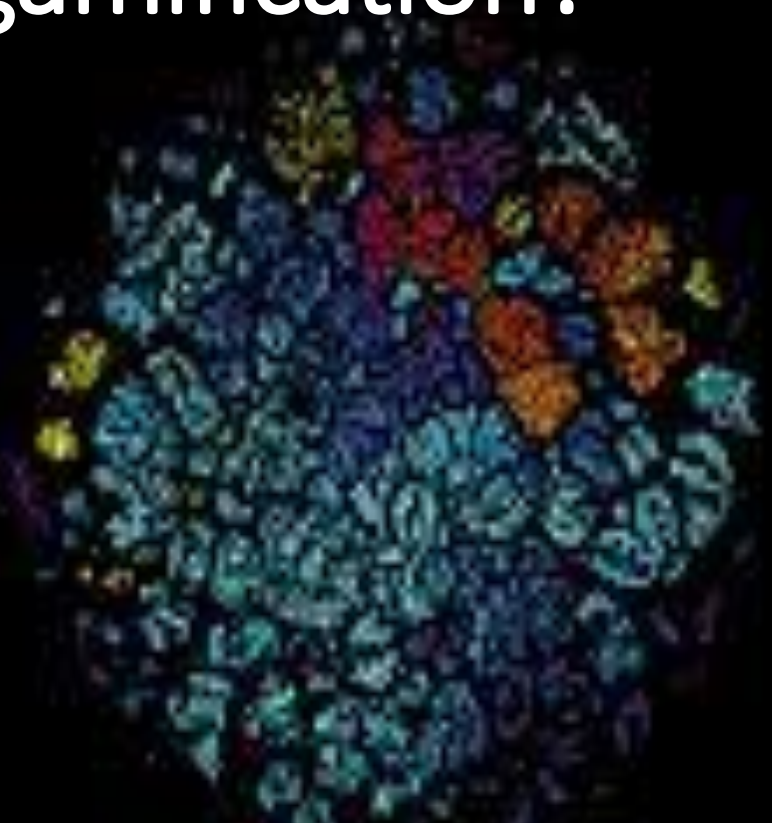
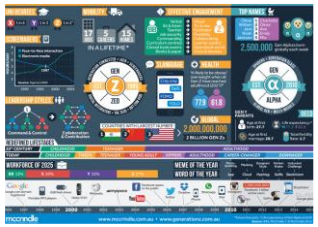
What can we learn from games and gamification?



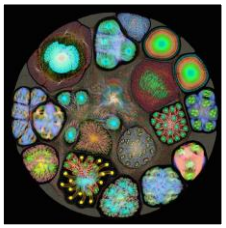
Professor Sara de Freitas
Honorary Research Fellow at Birkbeck College, University of London

Summary: What can we learn from games and gamification



The journey…

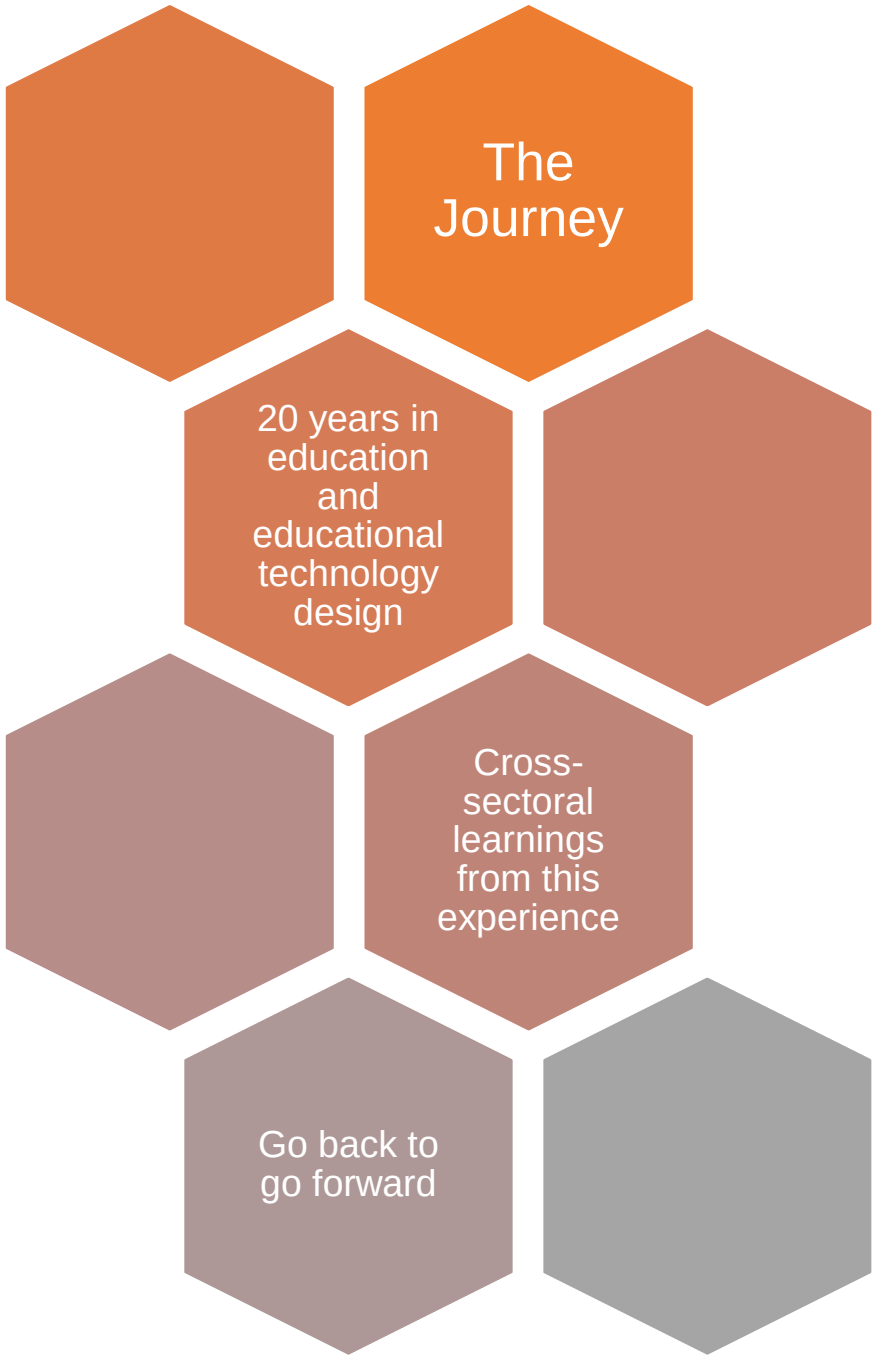
1: How do people learn?



2: Games, gamification and flow

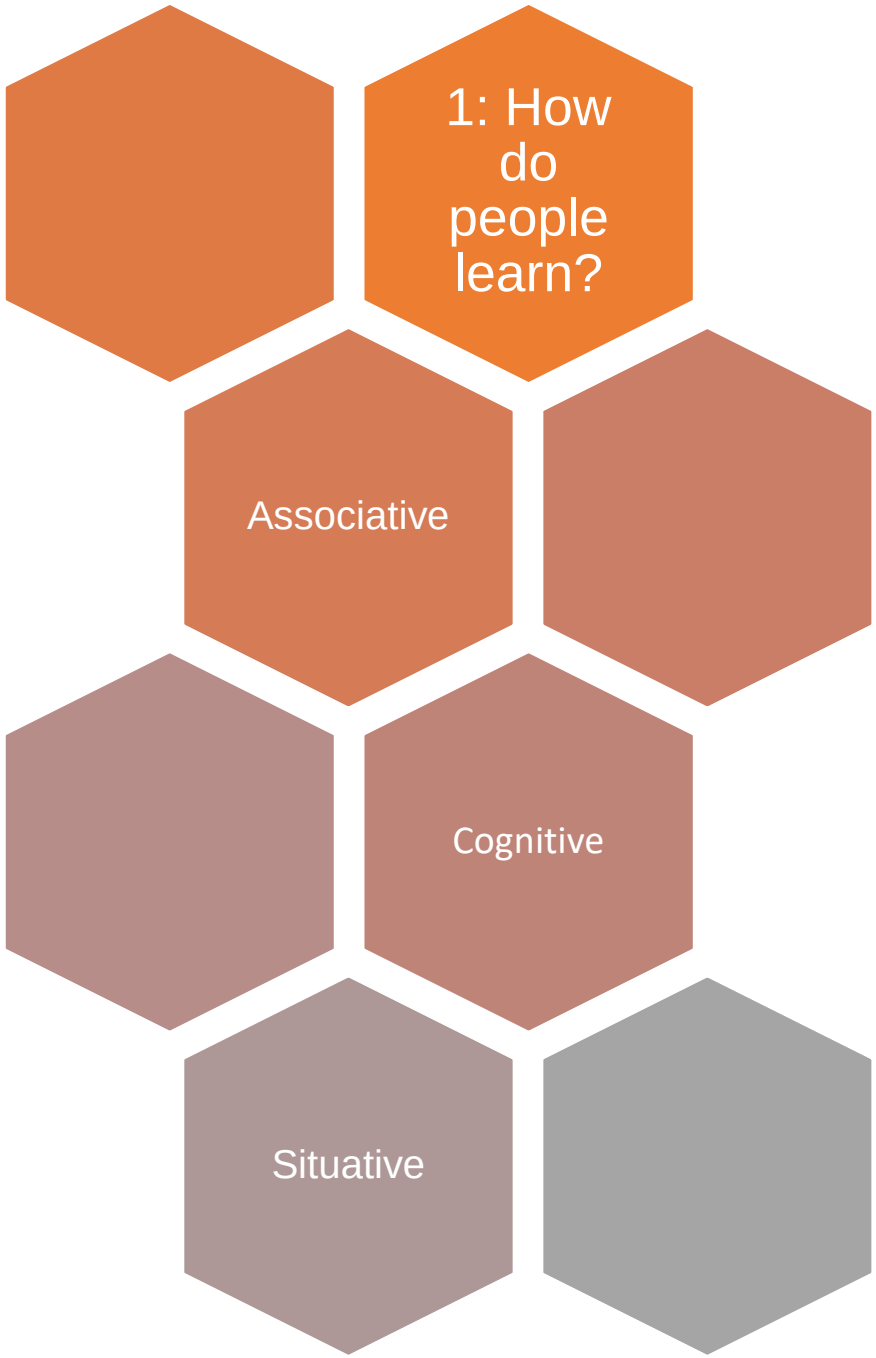
3: How can we design effective learning experiences?

Conclusions


The Journey
20 years in education and educational technology design
Cross-sectoral learnings from this experience
Go back to go forward

Murdoch

UNIVERSITY


1: How do people learn?
Associative
Cognitive
Situative

Theorists & Researchers

Practitioners

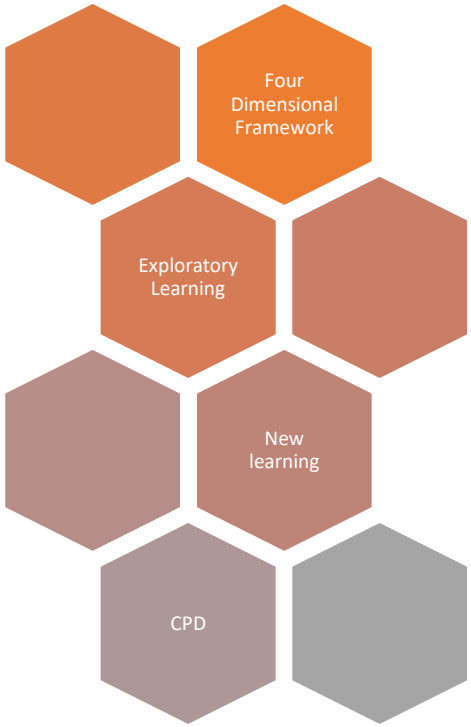
Subject Matter Experts, Designers & Developers

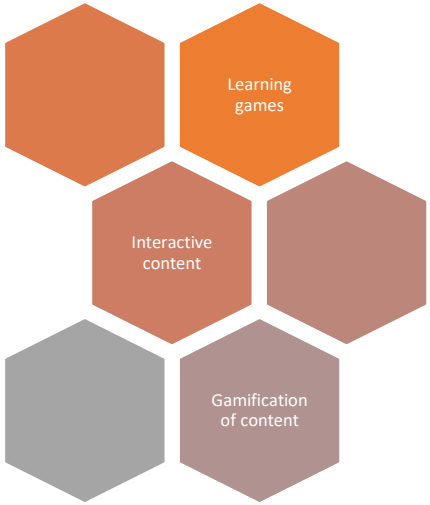
Learners

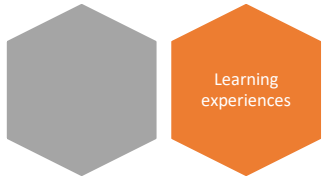
Associative

Cognitive

Situative







How do people learn? Exploration of all learning models

How do we design effective learning?

How do we design effective content and experiences?

How do we design, evaluate and measure learning experiences?

Significant changes in pedagogy predicted

Traditional paradigm of learning	**New learning paradigm**	**Future learning**
Curriculum-based pedagogy	**Challenge and activity-led learning**	Student developed pedagogy
Tutor-led learning delivery	**Peer-focused interactions**	Artificial Intelligence (AI) scaffolded learning
Classroom and lecture hall focus	**Any-time, anywhere learning**	Seamless lifelong learning
Summative assessments	**Formative assessment / Peer assessment**	No assessments / levelling, points and awards
Age and stage	**Competency and personalised learning**	Unique learning patterns
Text-focused	**Multimedia usage**	Adaptive learning
Traditional curriculum e.g. literacy and numeracy	**New curriculum e.g. 21st century skills**	Hidden curriculum e.g. personalised skills and cognition training
Core curriculum	**Work readiness**	Blended work and learning

Case study:
4DF

The Four Dimensional Framework

ELSEVIER

Computers & Education

Volume 46, Issue 3, April 2006, Pages 249-264

How can exploratory learning with games and simulations within the curriculum be most effectively evaluated?

Sara de Freitas [a], Martin Oliver [b, 1]

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https://doi.org/10.1016/j.compedu.2005.11.007

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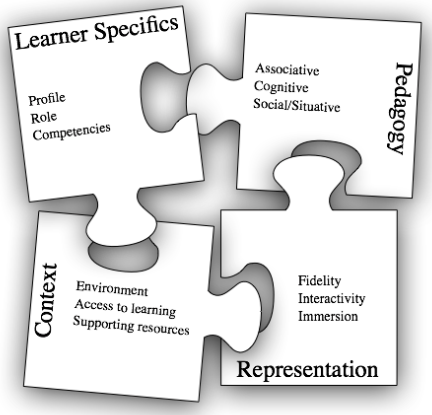
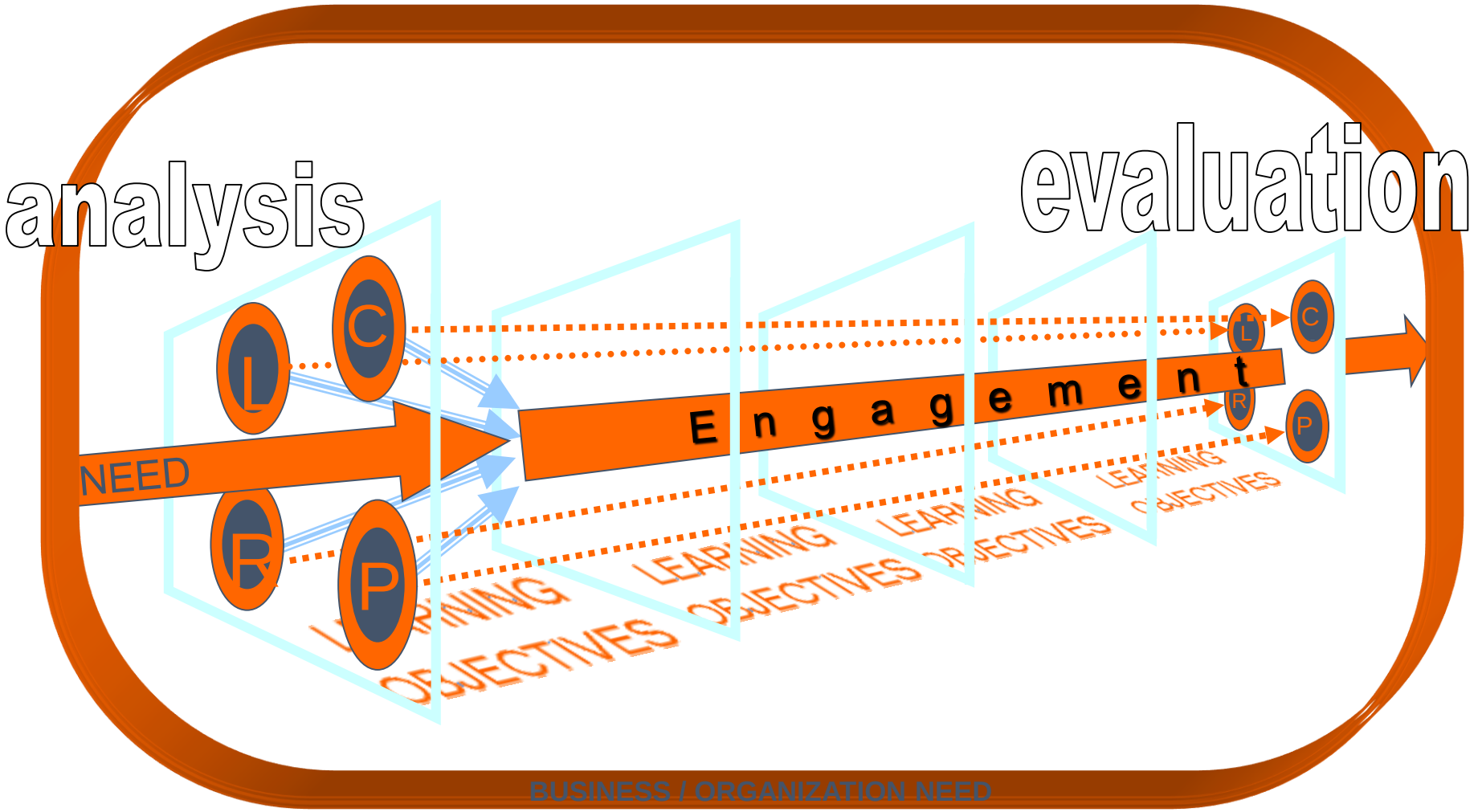
Four Dimensional Framework



Four Dimensional Framework (de Freitas & Oliver, 2006)



Case study: exploratory learning

Exploratory Learning & the 4DF

BJET | British Journal of Educational Technology | BERA

Explore this journal >

Learning as immersive experiences: Using the four-dimensional framework for designing and evaluating immersive learning experiences in a virtual world

Sara De Freitas, Genaro Rebolledo-Mendez, Fotis Liarokapis, George Magoulas, Alexandra Poulovassilis

First published: 20 December 2009 Full publication history

DOI: 10.1111/j.1467-8535.2009.01024.x View/save citation

View issue TOC
Volume 41, Issue 1
January 2010
Pages 69–85

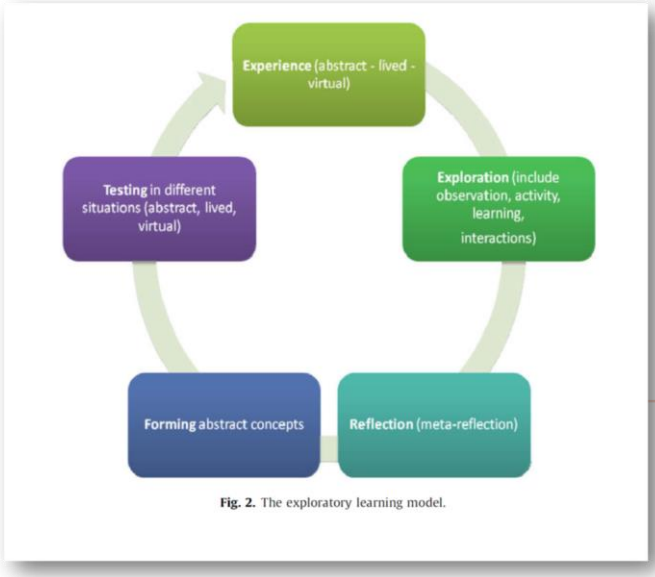
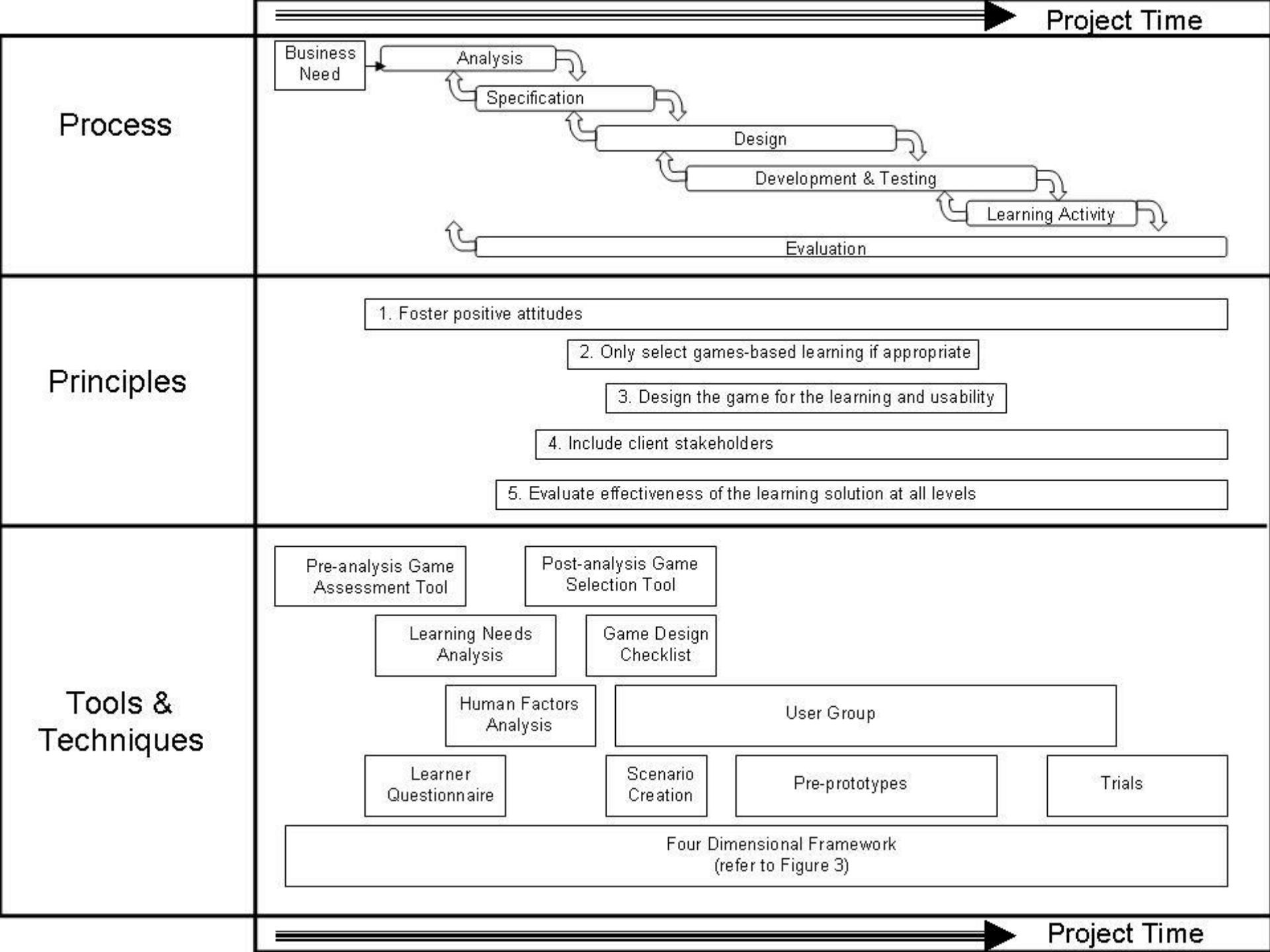


Fig. 2. The exploratory learning model.


Project Time
Process
Business Need
Analysis
Specification
Design
Development & Testing
Learning Activity
Evaluation
Principles
1. Foster positive attitudes
2. Only select games-based learning if appropriate
3. Design the game for the learning and usability
4. Include client stakeholders
5. Evaluate effectiveness of the learning solution at all levels
Tools & Techniques
Pre-analysis Game Assessment Tool
Post-analysis Game Selection Tool
Learning Needs Analysis
Game Design Checklist
Human Factors Analysis
User Group
Learner Questionnaire
Scenario Creation
Pre-prototypes
Trials
Four Dimensional Framework (refer to Figure 3)
Project Time

Case study: Learning and game mechanics

Mapping learning and game mechanics

BJET | British Journal of Educational Technology | BERA

Explore this journal >

Original Article

Mapping learning and game mechanics for serious games analysis

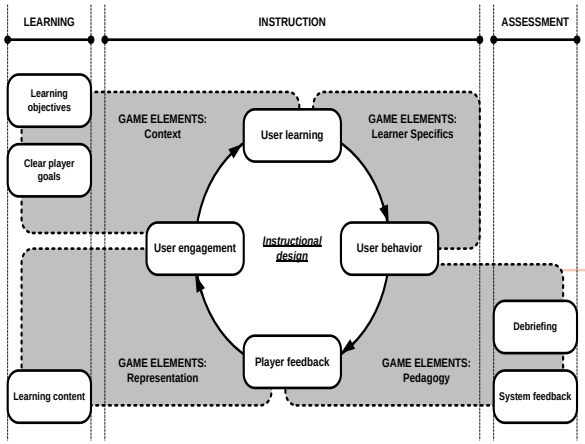
Sylvester Arnab ✉, Theodore Lim, Maira B. Carvalho, Francesco Bellotti, Sara de Freitas, Sandy Louchart, Neil Suttie, Riccardo Berta, Alessandro De Gloria

First published: 5 January 2014 Full publication history

DOI: 10.1111/bjet.12113 View/save citation

Volume 46, Issue 2
March 2015
Pages 391–411

View issue TOC
Special Issue:
Teacher-led Inquiry and Learning Design



Case study: measuring immersion in games

Triage Trainer study findings

Resuscitation

Volume 81, Issue 9, September 2010, Pages 1175-1179

Simulation and education

Serious gaming technology in major incident triage training: A pragmatic controlled trial ☆

James F. Knight [a], Simon Carley [b], Bryan Tregunna [c], Steve Jarvis [c], Richard Smithies [d], Sara de Freitas [e], Ian Dunwell [e], Kevin Mackway-Jones [b]

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https://doi.org/10.1016/j.resuscitation.2010.03.042

Case study: Triage Trainer: How can we measure immersion?

Triage Trainer

Triage Trainer: The Results

Triage Trainer (tt) trial summary:

- 5 trials: september 2007 – january 2008

Independently conducted by the University of Birmingham

Trial participants:

- 91 UK NHS doctors, nurses & paramedics
- all on Major Incident Medical Management and support training courses

Participants were randomly distributed:

- TT game (n = 47)
- Non-game (n = 44)

Triage Trainer: The Results

TT game group

- 15 minute tutorial in game play / user interface
- 60 minutes playing the TT game on their own
- instructor available to answer questions

Non-game group

- 75 minute normal ALSG instructor-led table top exercise
- Sort cards with vital signs variables written on them into priority groups

Triage Trainer: The results

Trial results of tt game trainees versus non-game trainees:	
Tagging accuracy of tt game trainees:	• *Significantly higher* accuracy [$\chi 2 = 13.126$, $p<0.05$]
Step accuracy of tt game trainees. comparing the ratios of participants who achieved an 8/8	
Accuracy rating (i.e. followed the correct protocol for all 8 casualties):	• *Significantly more accurate* (28%) than the non-game group (7%) [$\chi 2 = 7.29$, $p<0.05$]
Time taken by tt game trainees to complete triage of all 8 casualties:	• *No significant difference* on time taken ($p>0.05$)

Triage Trainer: Possible conclusions

A ‘serious game’ such as ‘triage trainer’ offers the potential to:

Engage learners

Improve transfer of training

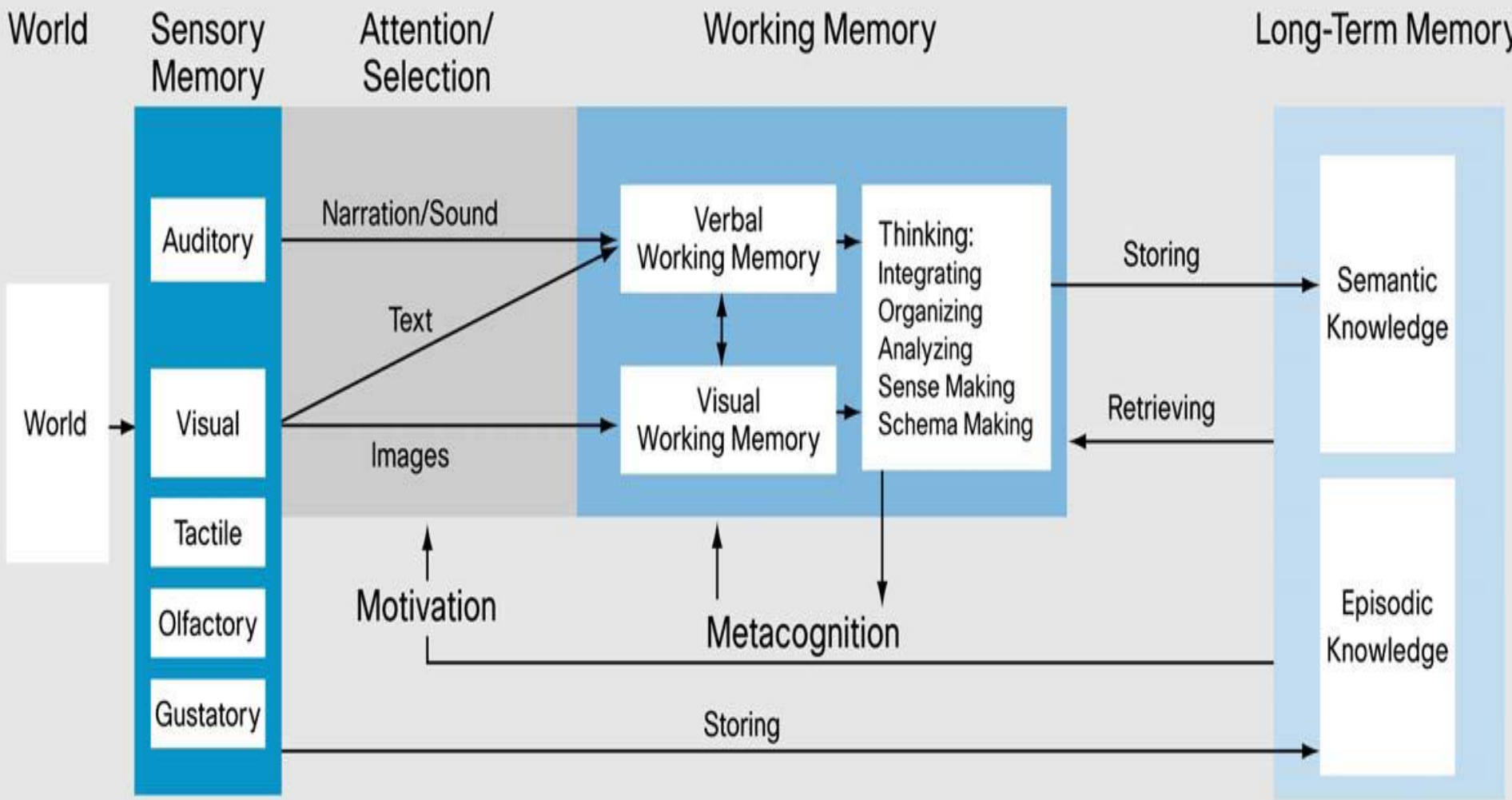
Possible reasons are that the game offers:

Opportunity to practice skills and knowledge gained on the course in a more realistic and more engaging environment

Personalised feedback which enables the game player to correct procedural errors made, through repeated play

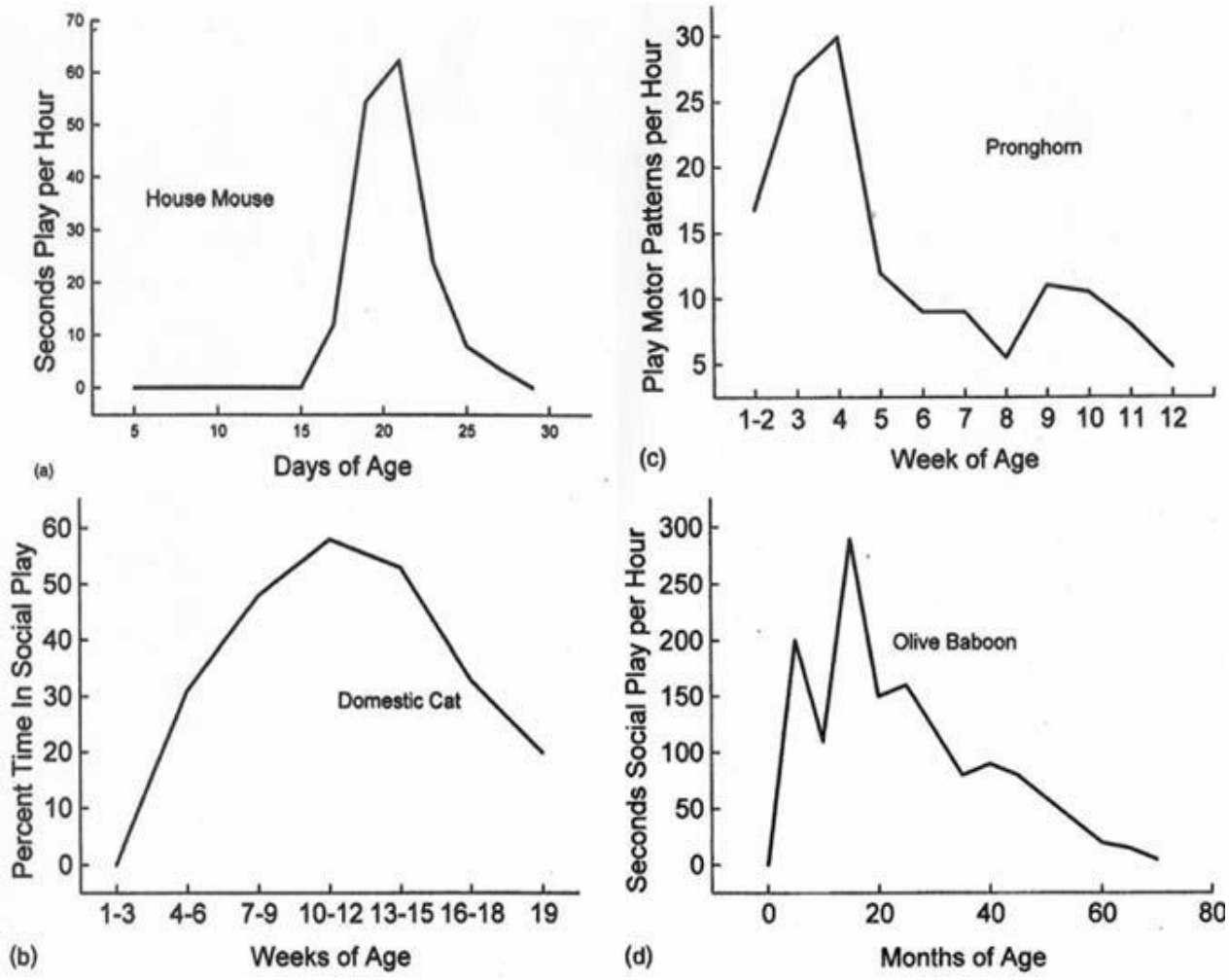
‘Sensitive period’ of learning	Cognitive and physiological impact of learning in games
	‘The sensitive period’ of learning, can it be replicated?
	Towards a more sophisticated model of feedback

Thinking: Physiological and Cognitive Functions

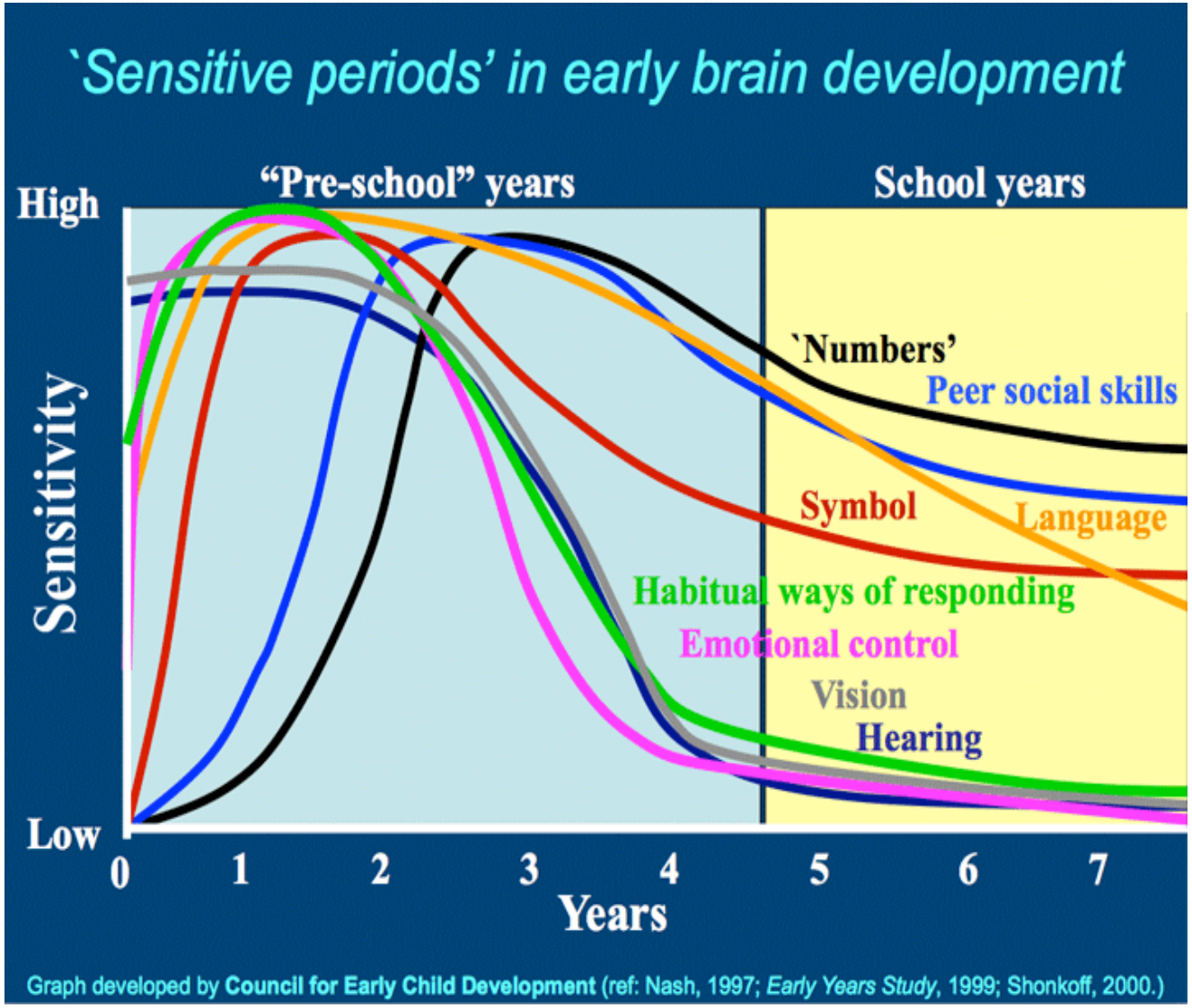


Based on Mayer (2003); Moreno & Mayer (2007); Marois (2005); and Miyake, et al (1999).

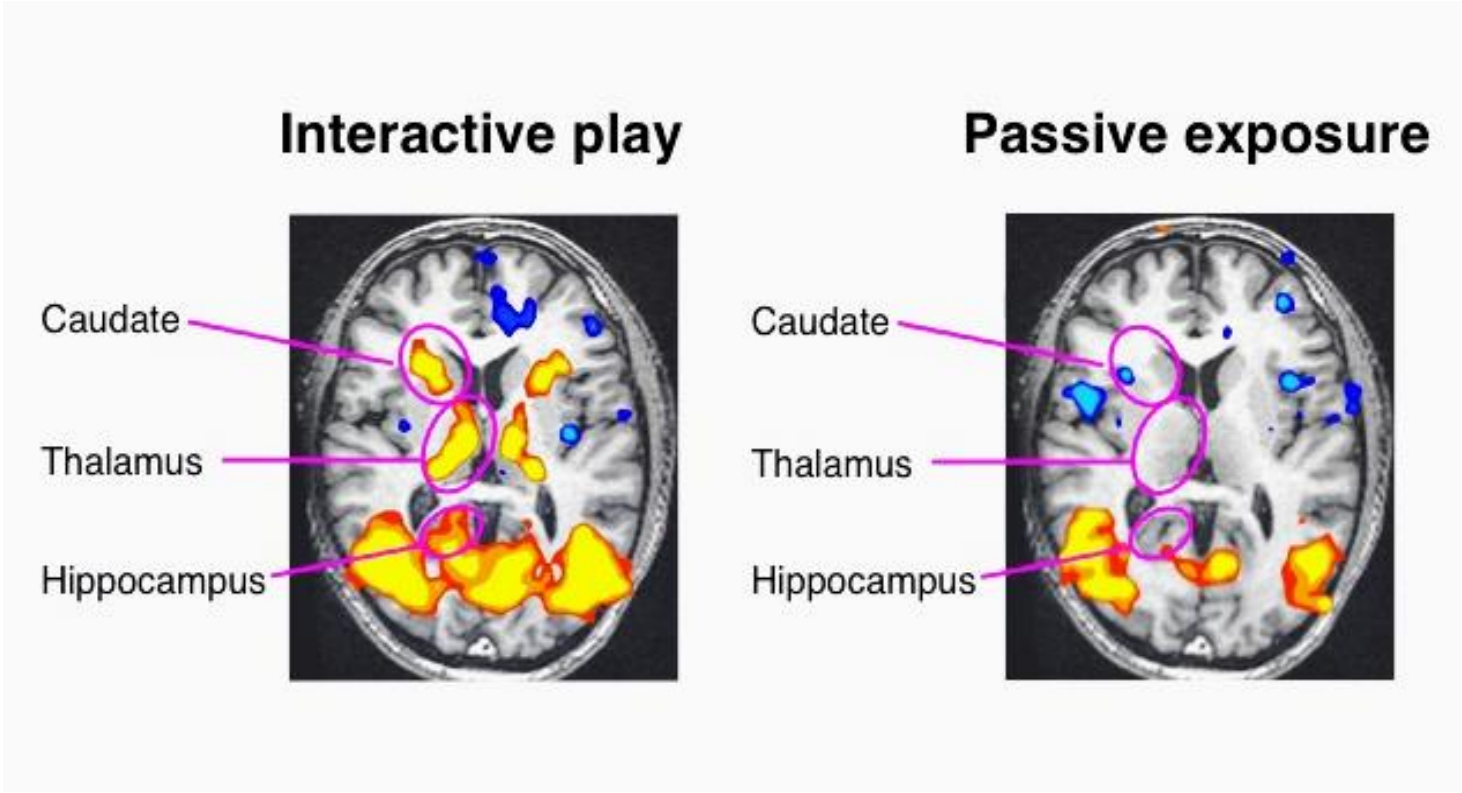
Learning and cognition: 'Sensitive period' or play in animals (Byers, 1997)



‘Sensitive periods’ in early brain development in humans

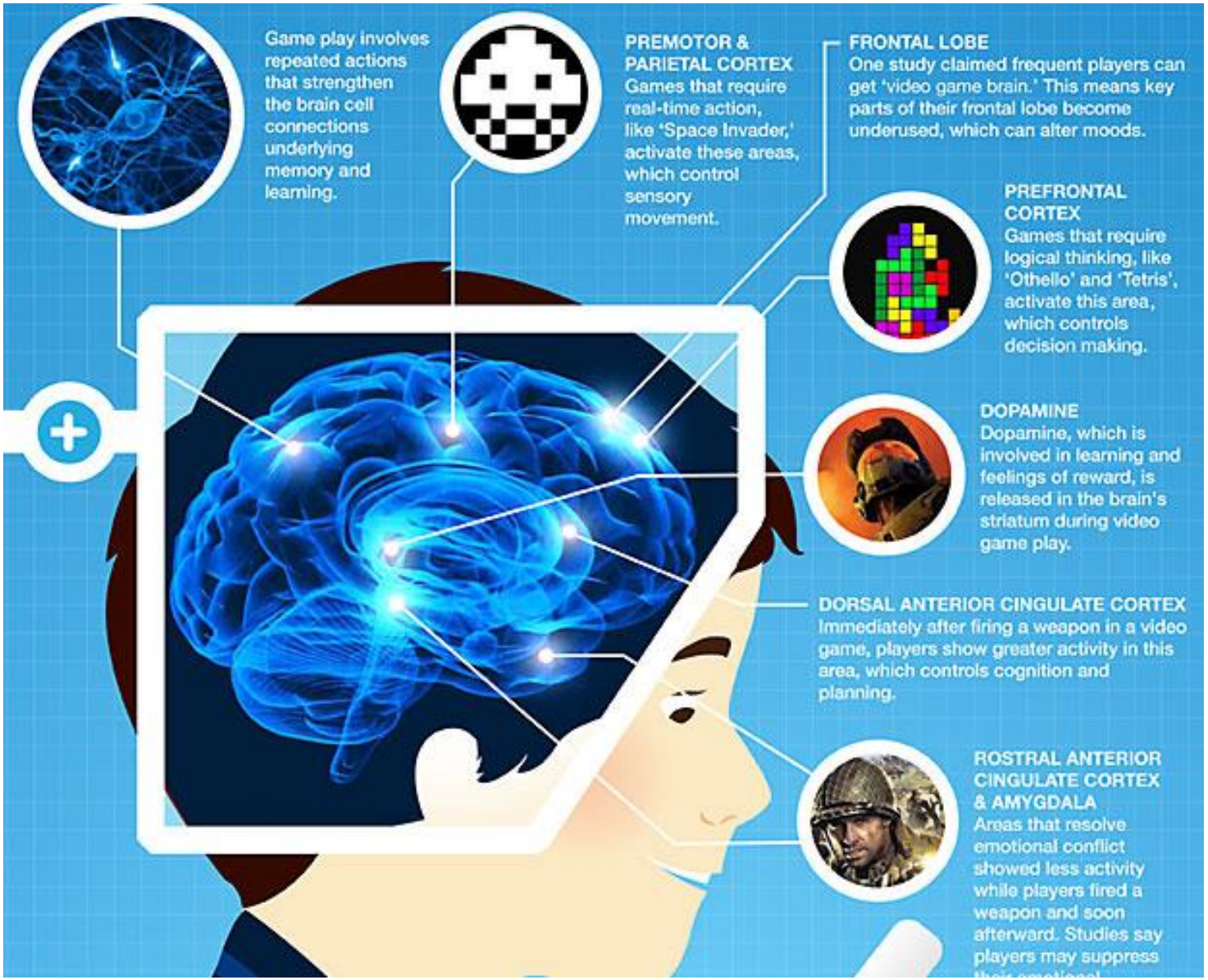


Brain activity in game play

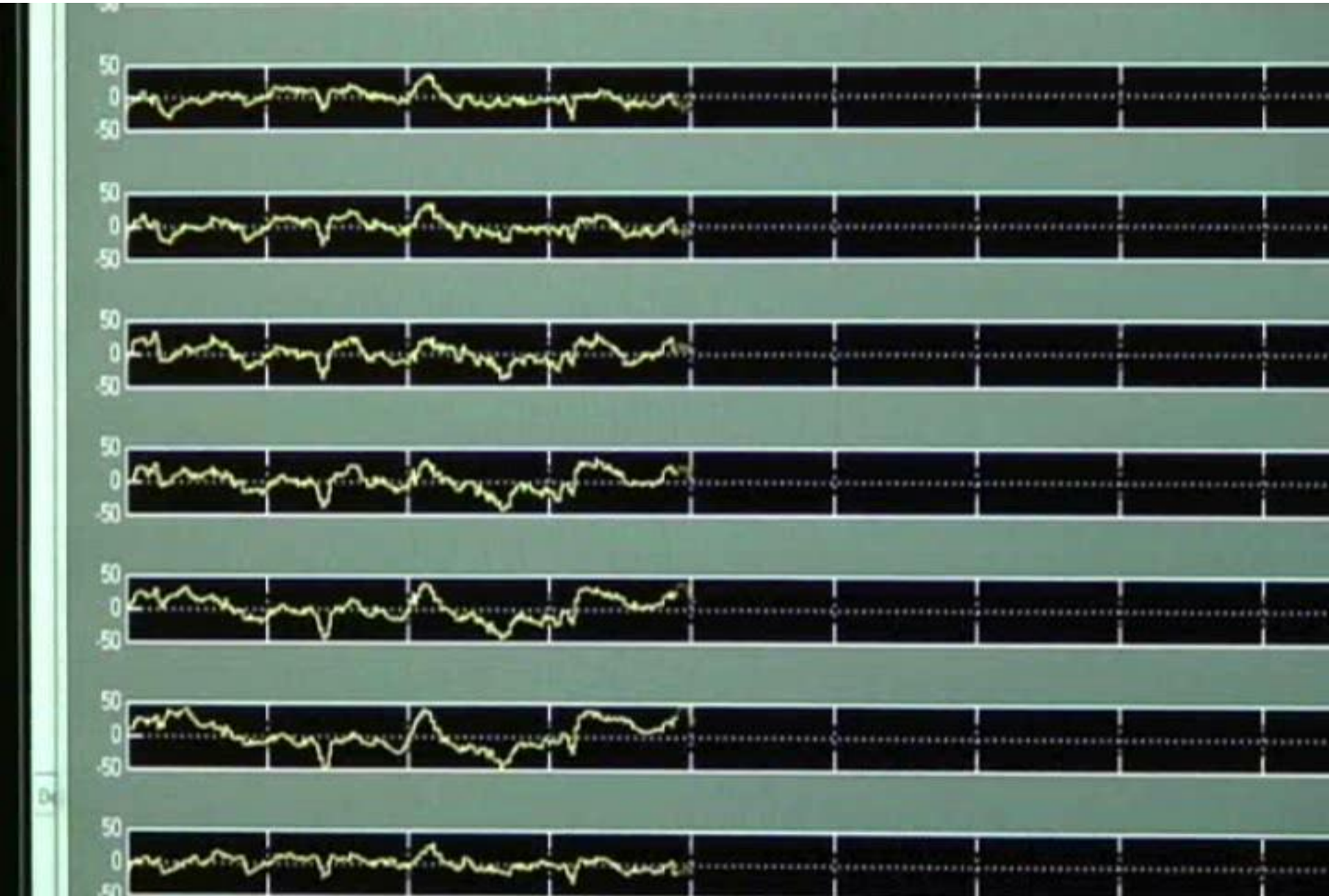


Brain volume increases in gamers (BBC Horizon)

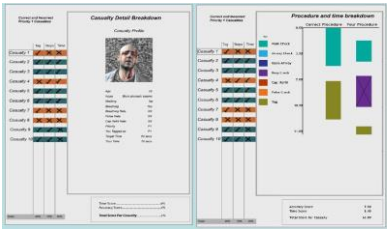
Brain activity in game play

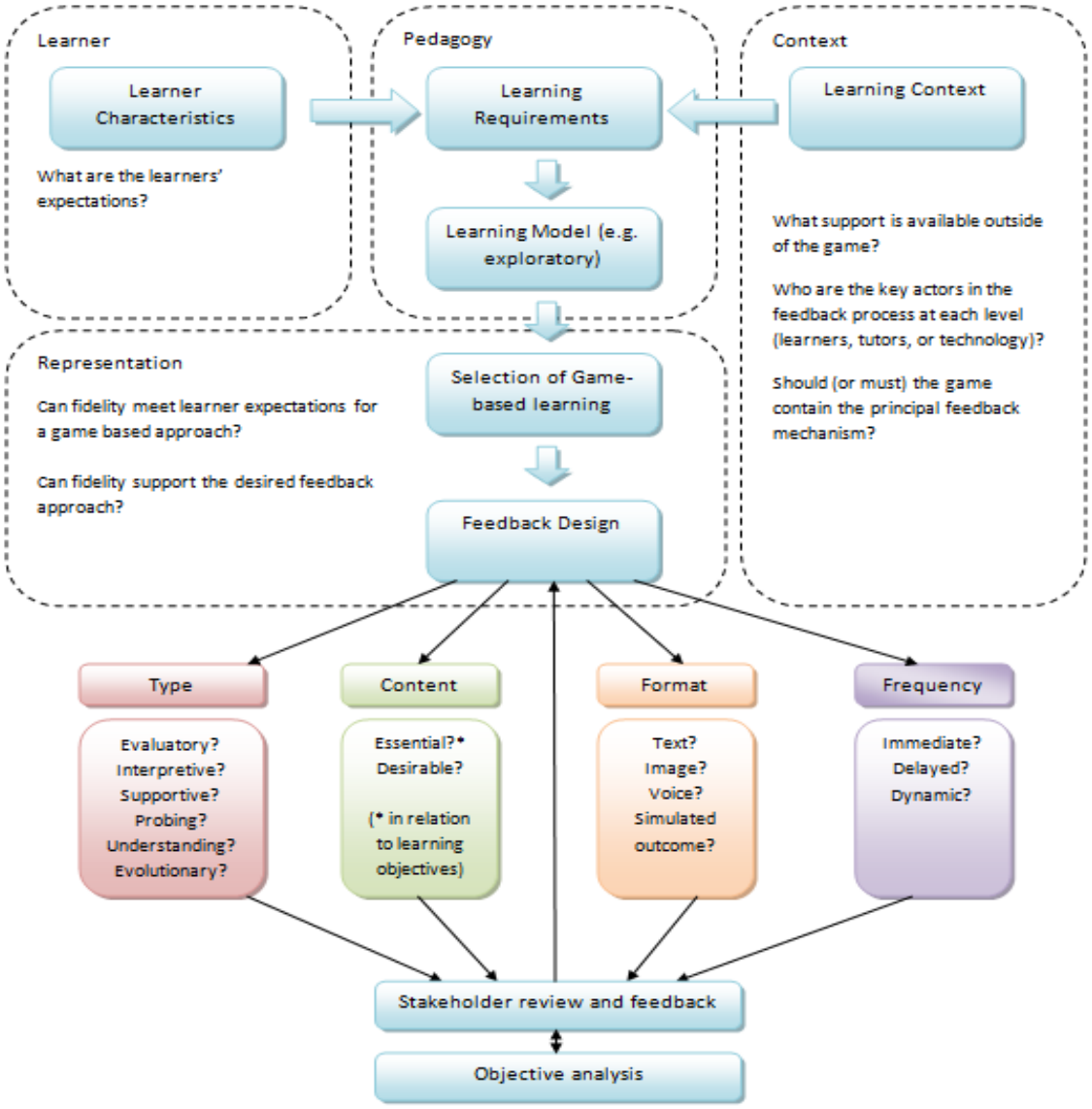


Neuro-scientific studies with Graz University



Feedback modelling in games (Dunwell et al., 2011)

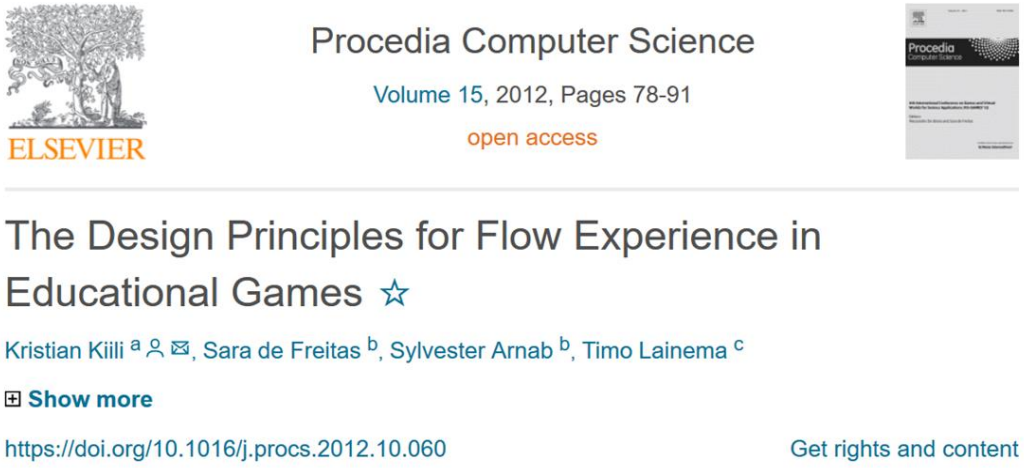





3: Games, gamification and flow
Feedback
Efficacy
Retention and engagement

Flow, gamification and games in education

Flow for understanding game design



ELSEVIER

Procedia Computer Science

Volume 15, 2012, Pages 78-91

open access

The Design Principles for Flow Experience in Educational Games ☆

Kristian Kiili [a], Sara de Freitas [b], Sylvester Arnab [b], Timo Lainema [c]

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https://doi.org/10.1016/j.procs.2012.10.060

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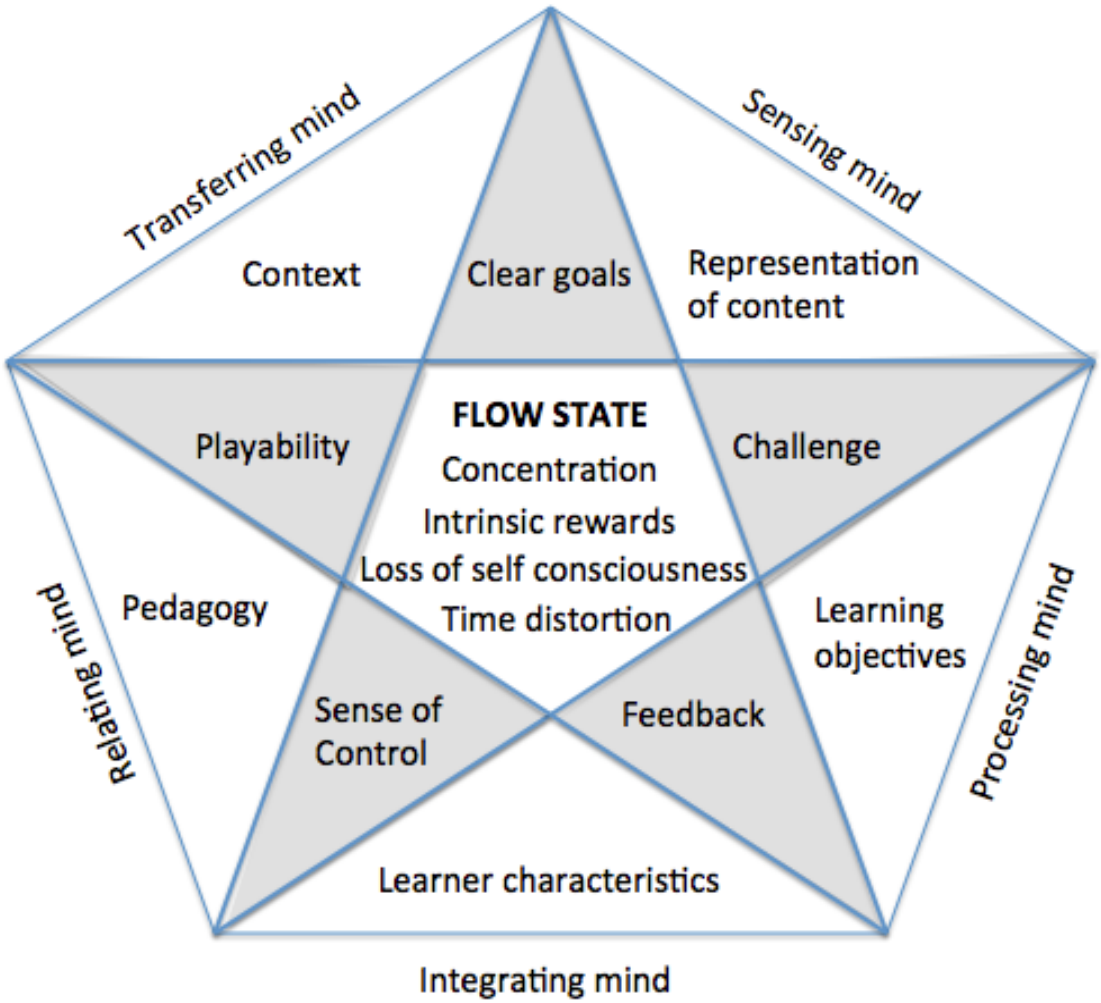
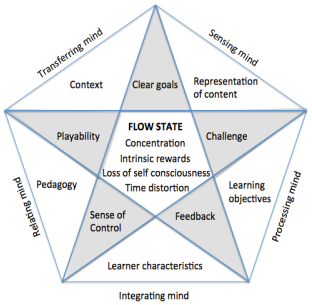
Impact upon learning design of understanding how flow works and can be effectively modelled in learning experience design

Flow in gamification (Killi et al., 2012)

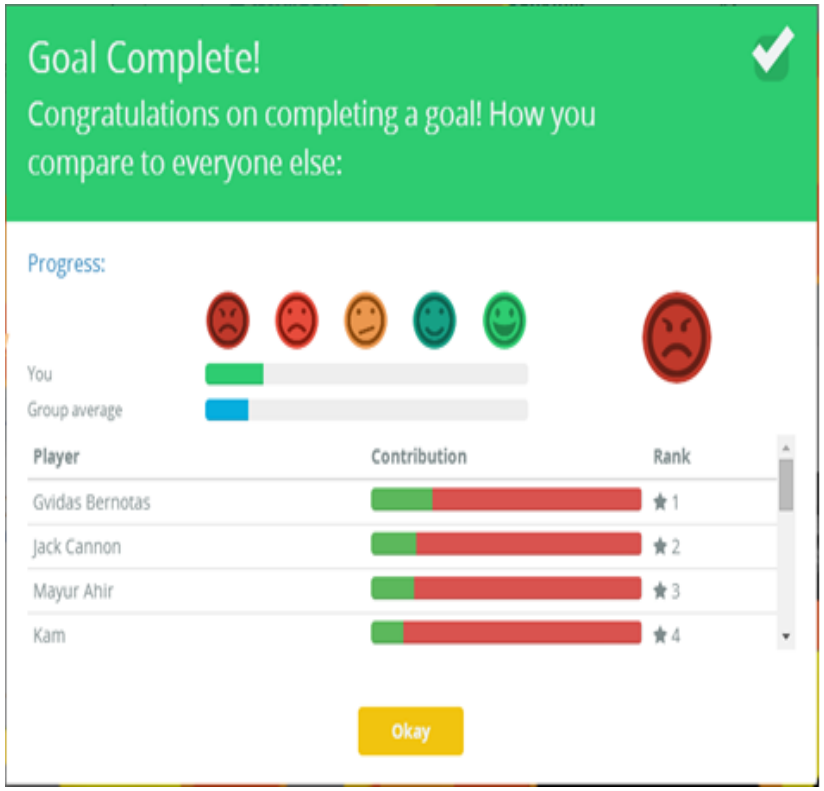


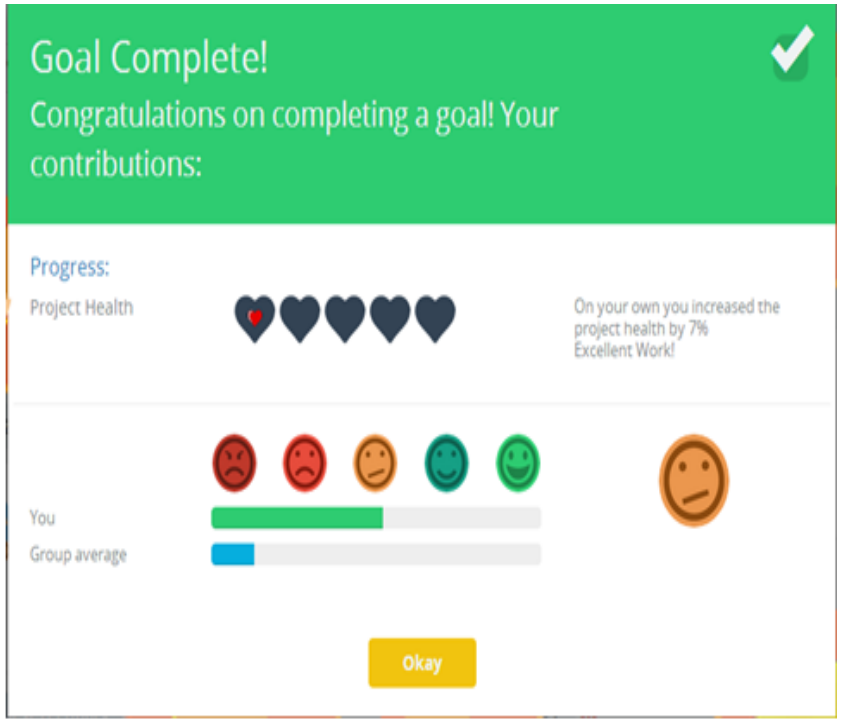
Flow in gamification (Kiili et al., 2012)



Flow dimension	M	SD
Challenge – skill balance	4.81	.98
Clear goals	4.95	.90
Feedback	4.40	1.13
Playability	4.18	1.27
Sense of control	5.14	.97
Rewarding experience	4.43	1.05
Concentration	4.46	1.10
Loss of self-consciousness	4.44	1.35
Time distortion	4.57	1.06
Flow experience (construct)	4.60	.62

StarQuest (Star, 2016)





Feedback as game elements (Star, 2016)

Game Elements	Brief Description	Alternative Terms	Sample (n=40)*
Points	A unit for measuring or counting action or activity.	Experience points, karma points, social points, redeemable points, skill points, score	68% (n=27)
Badges	Visual icon denoting achievement.	Achievement, trophy	38% (n=15)
Level / Status	Increasing stages usually denoting overall progress. Can be numeric or textual.	Stage, title, rank, progress	35% (n=14)
Goals	Stated objectives or the aim or desired result of activity.	Objectives, challenges, quests	28% (n=11)
Leaderboards	Display of name of participants and associated scores.	Scoreboard, ranking	23% (n=9)
External Rewards	Physical or tangible desirable items.	Prizes, gifts, incentives	13% (n=5)
Role play / Story	The narrative premise of the activity.	Narrative, character	10% (n=4)

‘employing points alone increases quantitative measures of task performance while narrative increases intrinsic motivation and quality of output’ Star, 2016


3: How can we design effective learning experiences
Games motivate and engage
Experience design principles
Collaboration vs. competition

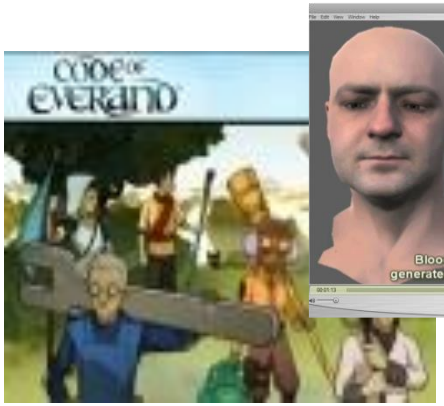
What can we learn for learning design?	
	Importance of immediate and formative feedback
	Games are highly motivating and often immersive
	Game design can be used to engage students
	Gamification can be easily integrated into existing courses (e.g. progress bar, badging)

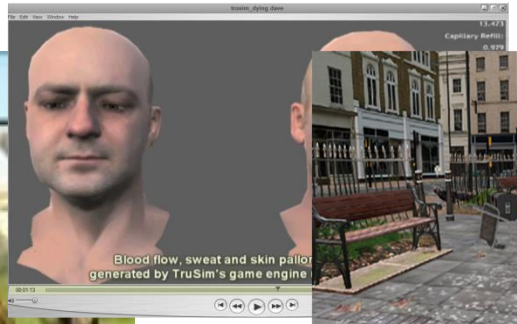
56 projects and ~20 games developed

meducator

alice

code of everand





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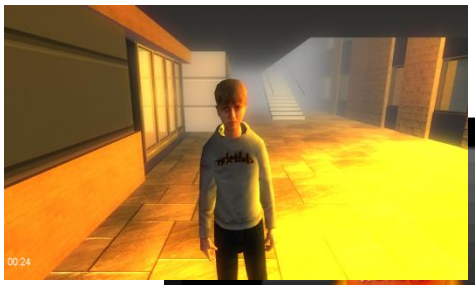
magellan

floodsim

modes



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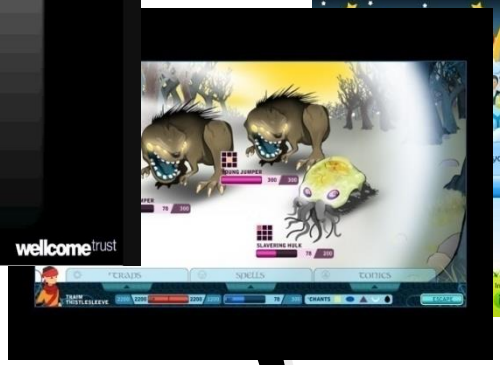
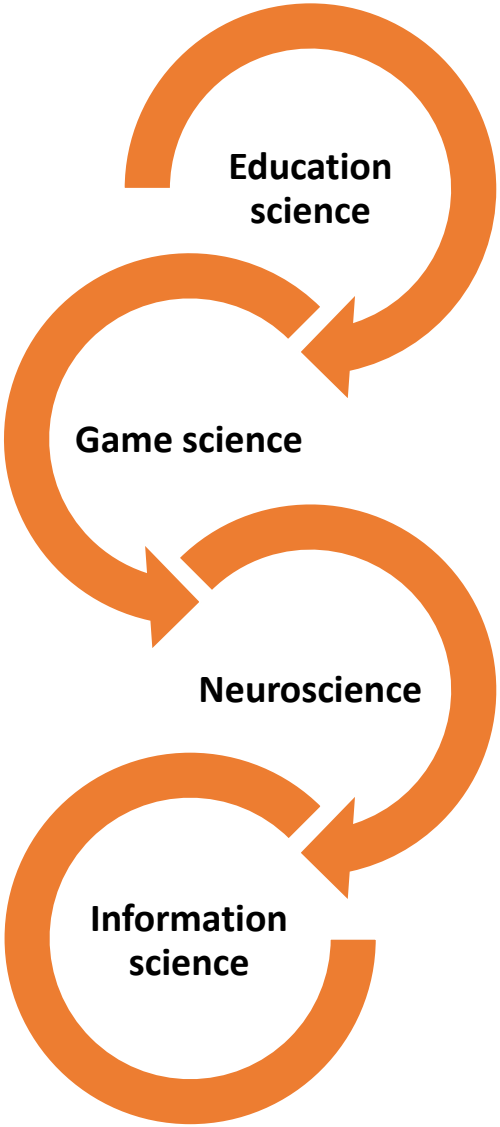


maseltov

PrePare


SIMAULA
inspiring inquiry learning
SGI
Continue
New Game
Settings
Credits
Exit Game

Cross-disciplinary integration of findings and design approaches



Advances and new areas at intersection of education and 'game science'

Contribution from education science:

- Importance of play to learning has been confirmed in play studies e.g. identification of importance of play (Piaget, 2013; Wittgenstein & Docherty, 1991)
- Longitudinal studies of examining play patterns (e.g. Twenge & Campbell, 2003; 2008)
- How patterns of play can impact learning (e.g. Chudacoff, 2007; Gray, 2011)

Contribution from game studies/science:

- Game Studies and Science literature includes insights such as increased motivation (e.g. Star, 2015; Plass et al., 2015; Attali & Arieli-Attali, 2015)
- Pragmatic and randomised trials have confirmed that games can be more effective learning tools than traditional modes (advance on e-learning which found no significant difference with traditional modes) (e.g. Knight et al. 2010; Miller & Robertson, 2011; Straker et al., 2011)
- Use of combined measures introduced including qualitative and quantitative measures (e.g. Kato et al., 2008)

Contribution from neuroscience:

- Greater brain volume and plasticity with game play (Kuhn et al., 2011 and 2014)
- Greater transferability of skills such as hand eye coordination and visual acuity (Bavelier, 2003 (with Green) and 2014 papers)

Contribution from information science:

- Data modelling will allow us to map human behaviour more closely by using data interactions in games (e.g. Gibson & de Freitas, 2016)
- Analytics allows for personalization in games (e.g. El-Nasr, Drachen & Canossa, 2013; Drachen et al., 2013)

Key learnings:

- Games more effective than traditional
- Blended most effective
- Importance of getting game design right
- Multi-skilled teams required
- Cost associated can be high
- Feedback needs to be designed into the game and scaffolds development
- Learner engagement and motivation increased
- Greater brain activity during gameplay

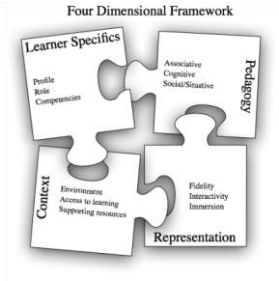
Gaps in literature:

- More research needed on analytics, feedback, motivation, engagement
- *Why* are games effective for learning
- Feedback research not based on logical assumptions, positive bias
- Not as many studies showing negative findings

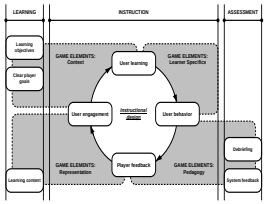
Future research:

- Analytics driven studies
- Longitudinal studies
- Rigorous evaluations
- More combined RCT and qualitative studies
- Develop more effective practitioner tools and frameworks

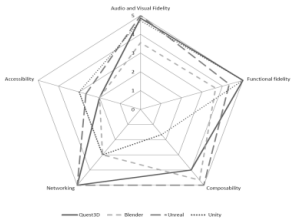
Mapping human behaviours to increase personalization and immersion in digital learning environments



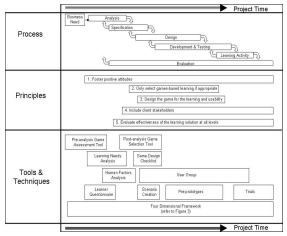
design



theory



interactivity



feedback

adaptivity

a: neuro-psychology approaches to learning with games

b: visualization and modelling

c: multimodal interfaces

d: artificial intelligence and life

e: semantic web, standards and metadata

Interactive playful environment

new learning

Conclusions: Games and gamification allow us to map human behaviour within systems

Video games affects several aspects of perception, attention and cognition

Human behaviour can be mapped in game environments

Links between motivation, flow and engagement

Gamification easy to deploy in LMS (micro-credentialling)

Better approaches to measuring efficacy of learning emerging

Need to develop more rigorous metrics for via learning analytics / dashboarding

More research needed to understand feedback

References

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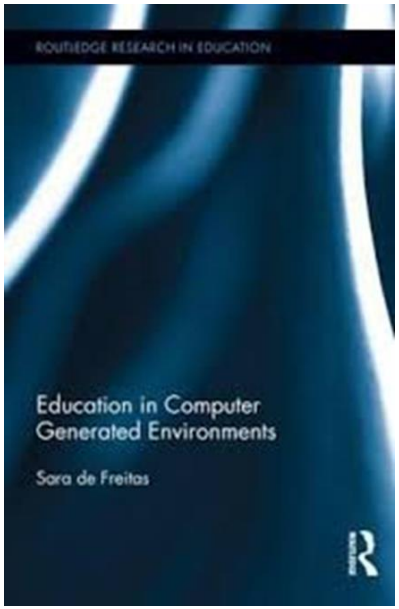

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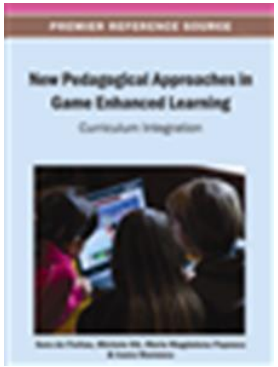

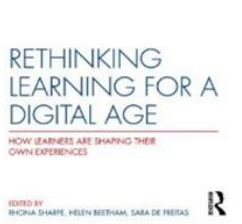

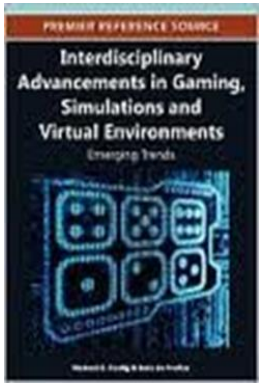

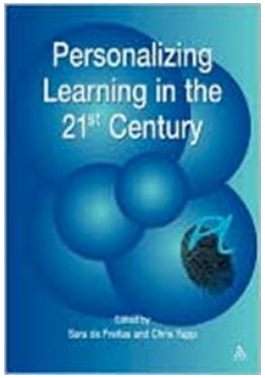

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