

# Game-Based Learning

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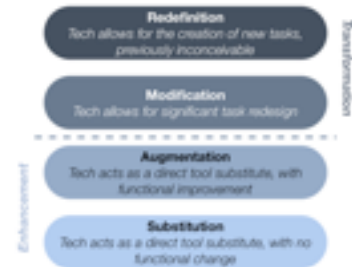
Ruben R. Puentedura, Ph.D

Social Computing

Digital Storytelling

Social

Narrative



Visual

Play

Visualization and Simulation

Educational Gaming


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## Game And Learn: An Introduction to Educational Gaming - Audio/video

Dr. Ruben Puentedura

### Description

Game And Learn: An Introduction to Educational Gaming Videogames can provide learners with rich worlds and complex narratives that both enhance and transform their educational experience. Harnessing this potential calls for understanding the principles underlying successful games, and how to apply them in the classroom. This 14-part podcast series, created by Dr. Ruben Puentedura as part of a joint research project between MLTI and the Ewing Marion Kauffman Foundation, will provide educators the knowledge needed to successfully use educational gaming in their classroom. Dr. Ruben Puentedura, Founder and President of Hippasus, has implemented transformative applications of information technologies for over twenty years in educational institutions, hospitals, and arts organizations. He has worked with the MLTI since 2003, and is the creator of the SAMR model for selecting, using, and evaluating technology in education, as well as research on educational gaming and digital storytelling.

▲	Name	Time	Released	Description	Popularity	Price
1	What Is A Game?	23:07	7/5/09	Professional Development	<i>i</i>	<a href="#">FREE</a>
2	What Is A Good Game?	21:54	7/6/09	Professional Development	<i>i</i>	<a href="#">FREE</a>
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4	Games And Learning	27:03	7/8/09	Professional Development	<i>i</i>	<a href="#">FREE</a>
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11	Case Study: Scratch	25:50	7/21/09	Professional Development	<i>i</i>	<a href="#">FREE</a>
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13	Serious Games	13:40	7/26/09	Professional Development	<i>i</i>	<a href="#">FREE</a>
14	TPCK, SAMR, And Games	18:51	7/27/09	Professional Development	<i>i</i>	<a href="#">FREE</a>

Total: 14 Items

# Some Definitions

## Formal Definition of **Play** (Salen & Zimmerman)

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“Play is free movement within a more rigid structure.”

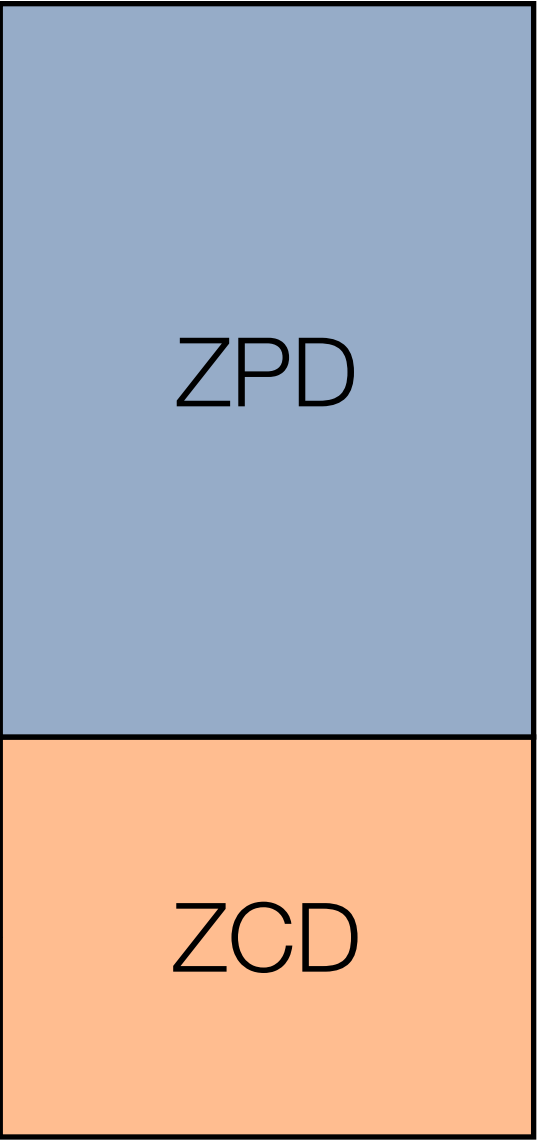
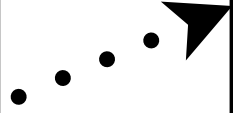
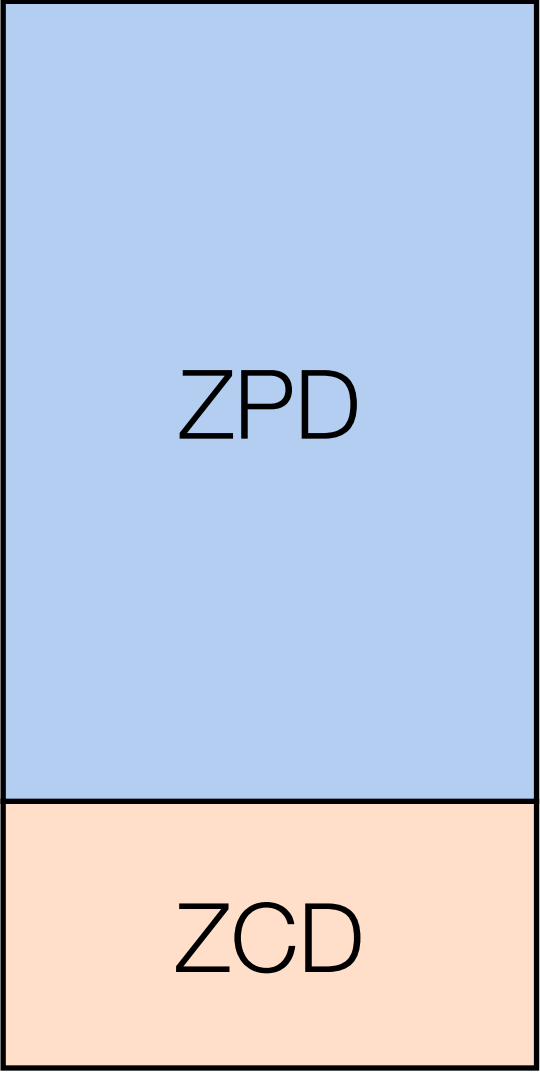








Alone      With MKO



# Vygotsky on Learning

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- Zone of Proximal Development (ZPD):
  - Gap between:
    - what a learner can accomplish independently (the Zone of Current Development, ZCD)
    - what they can accomplish with assistance from a “more knowledgeable other” (MKO)
- *“...what a child can do with assistance today she will be able to do by herself tomorrow.”*
- This is an iterative process:
  - The ZCD and ZPD change over time;
  - Independent practice is required to close the loop.



# Vygotsky on Play and Learning

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“...play creates a zone of proximal development of the child. In play a child always behaves beyond his average age, above his daily behavior; in play it is as though he were a head taller than himself.”

## Formal Definition of **Game** (Salen & Zimmerman)

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“A game is a system in which players engage in an artificial conflict, defined by rules, that results in a quantifiable outcome.”



## Semi-formal Definition of **Sandbox** (Puentedura)

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“A sandbox is the result of relaxing one or more of the definitional aspects of a game.”

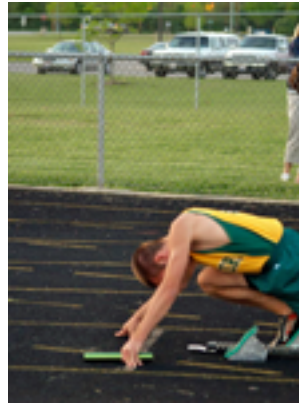




Taxonomies



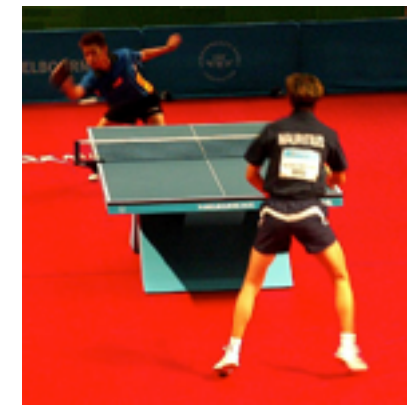
Athletic



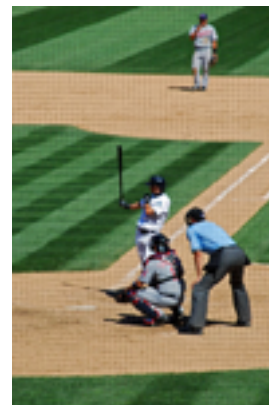
Target



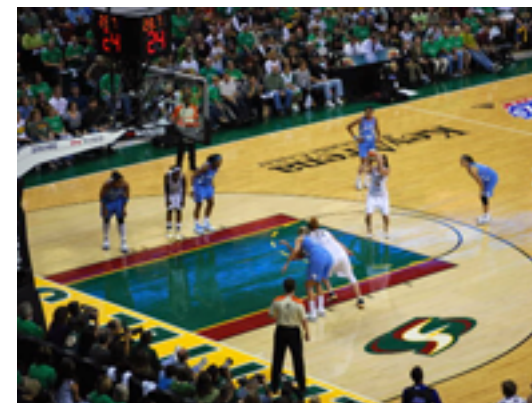
Net/Wall



Batting & Fielding



Territory



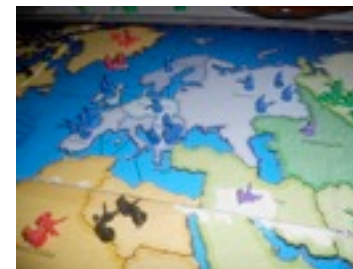
# The T.A.C.T.I.C. Matrix (Bell & Hopper)

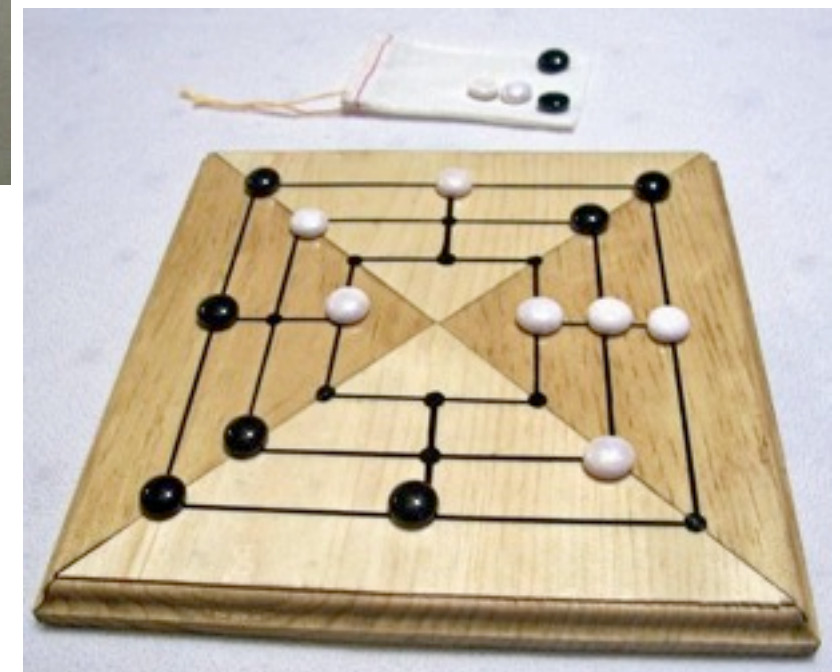
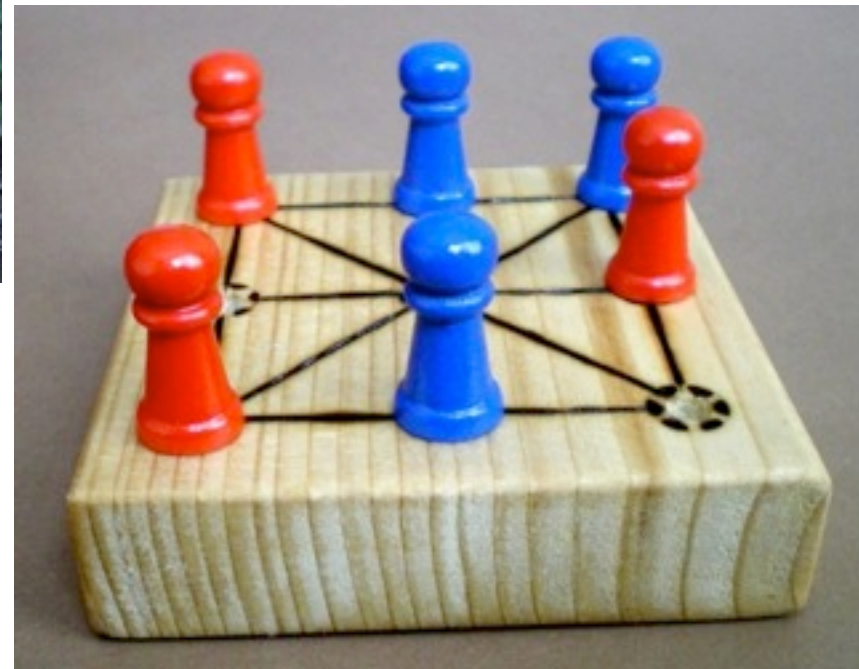
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Game and Focus (from taxa)	Principles of Play (depth)	Tactical Awareness Components (breadth)				
		Initial			Advanced	
		Space	Force	Time	In relation to...	
		<i>Where</i>	<i>How</i>	<i>When</i>	<i>Self</i>	<i>Other</i>
Systems, rules, objectives of game	Basic elements of play that structure effective game playing	Where an object should be placed/ where a player should go in the area of play	How much and where to apply force on an object/self for height, directional control, distance	When to execute a skill, or create time to execute a skill, or reduce opponent's time to execute a skill	In relation to what you are able to do, what should you do to gain a tactical advantage over your opponent?	In relation to what your opponent is able to do, what should you do to gain a tactical advantage over your opponent?

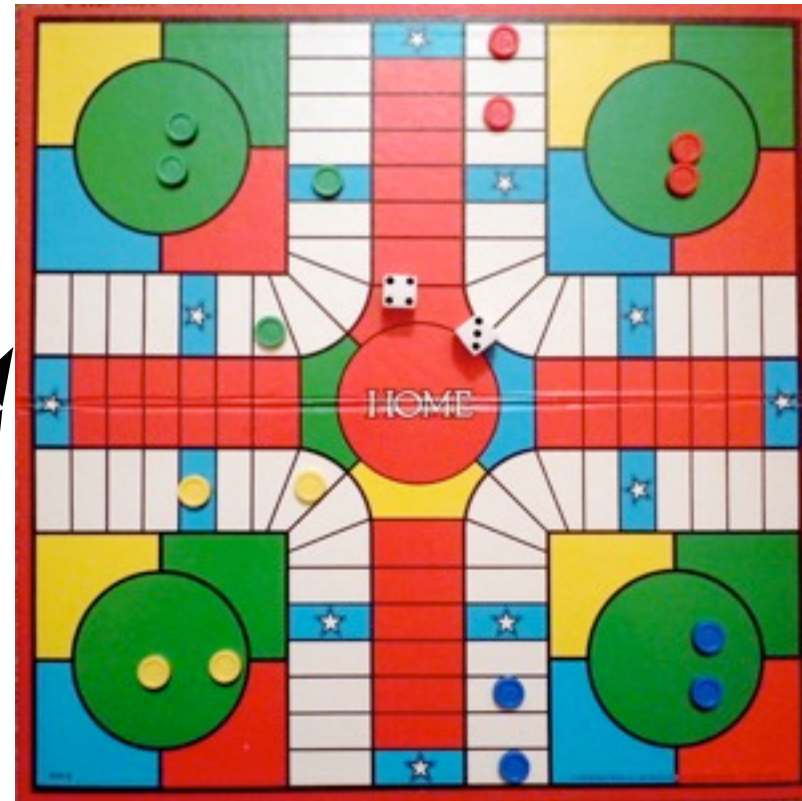


- **Abstract Strategy**
  - Figures in a landscape
- **Themed Strategy**
  - Figures in a landscape + resources
- **Wargames**
  - Multidimensional figures, resources on a terrain
- **Deduction Games**
  - Derive answers from clues
- **Role-Playing Games**
  - Storytelling as gaming
- **Card and Tile Games**
  - Accumulate or shed points
- **Party and Social Games**
  - Match dexterity/speed/signaling/trivia/word









# Narrative

IF



Graphic Adv.



Action/Adv.



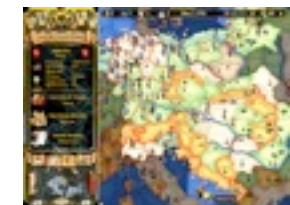
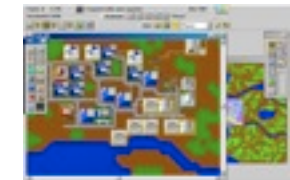
RPGs



MMOGs



ARGs



Sims

RTS

Mil.

TBS

Mid.

TBS

# Simulation

Narrative

Simulation

Action

Other

# Other

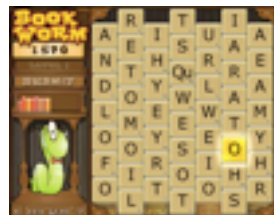
Board



Traditional



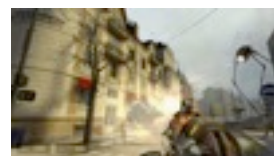
Puzzle



Shmups



Platformers



FPS



Fighting



Sports



Vehicle



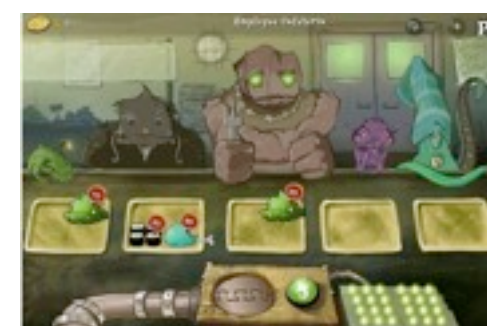
Rhythm

# Action



# Games People (Might) Play

- RTS: *Plants vs Zombies*  
<http://www.popcap.com/allgames.php?p=online>
- Puzzle: *Bookworm*  
<http://www.popcap.com/allgames.php?p=online>
- Platformer: *Portal: the Flash Version*  
<http://portal.wecreatestuff.com/>
- Interactive Fiction: *Bronze*, *Lost Pig*, or *Photopia*  
<http://parchment.toolness.com/>
- Graphic Adventure: *Samorost 1*  
<http://www.amanita-design.net/samorost-1/>
- Puzzle (Educational): *Lure of the Labyrinth*  
<http://labyrinth.thinkport.org/www/>



# Narrative

IF



Graphic Adv.



Action/Adv.



RPGs



MMOGs



ARGs



Shmups



Platformers



FPS



Fighting



Sports



Vehicle



Rhythm



Narrative

Other

Action

Simulation

Sims

RTS

Mil.

TBS

Mid.

TBS

# Simulation

# Other

Board

Traditional

Puzzle

# Action

What Makes a Game Engaging?



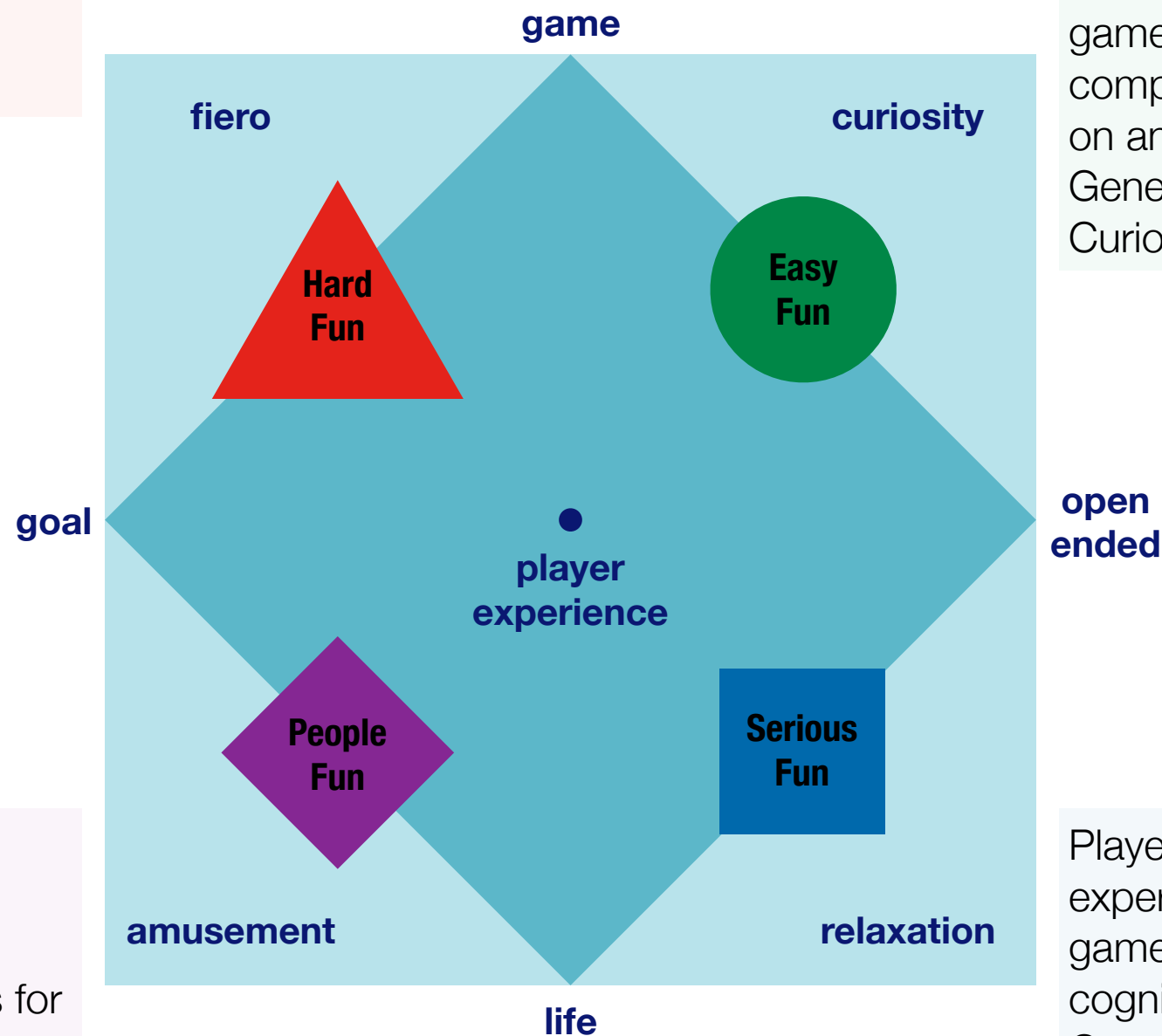


# Games and Fun (Koster)

Successful Games	
Include These Items...	...To Avoid
Preparation before challenges	Results due to pure chance
A sense of a game space	The perception of the game as trivial
A solid core mechanic	The game not being perceived as a game
A range of challenges	The game being exhausted too quickly
A range of required abilities	The game being perceived as simplistic
Skill in using the required abilities	The game being perceived as tedious
Also Have...	...Because
Variable feedback	Players like to see greater skill result in greater rewards
Ways to accommodate beginners & experts	Beginners need not get clobbered, or experts “bottom feed”
A definite cost for failure	Players feel cheated by “never-lose” games
In Boring Games	
When Players Say...	...They Mean
The game is too easy	Game patterns are too simple
The game is too involved	They are uninterested in the info required to detect patterns
The game is too hard	Patterns are perceived as noise
The game becomes too repetitive	New patterns are added too slowly
The game becomes too hard	New patterns are added too fast
The game runs out of options	All game patterns are exhausted

# Four Keys to Emotion in Games (Lazzaro)

Players like the opportunities for challenge, strategy and problem solving.  
Generates Frustration, Fiero



Players enjoy intrigue and curiosity, becoming immersed in games that absorb their complete attention or take them on an exciting adventure.  
Generates Wonder, Awe, Curiosity, Mystery.

Players use games as mechanisms for social experiences of competition, teamwork, and opportunities for social bonding and personal recognition.  
Generates Amusement, Schadenfreude, Naches.

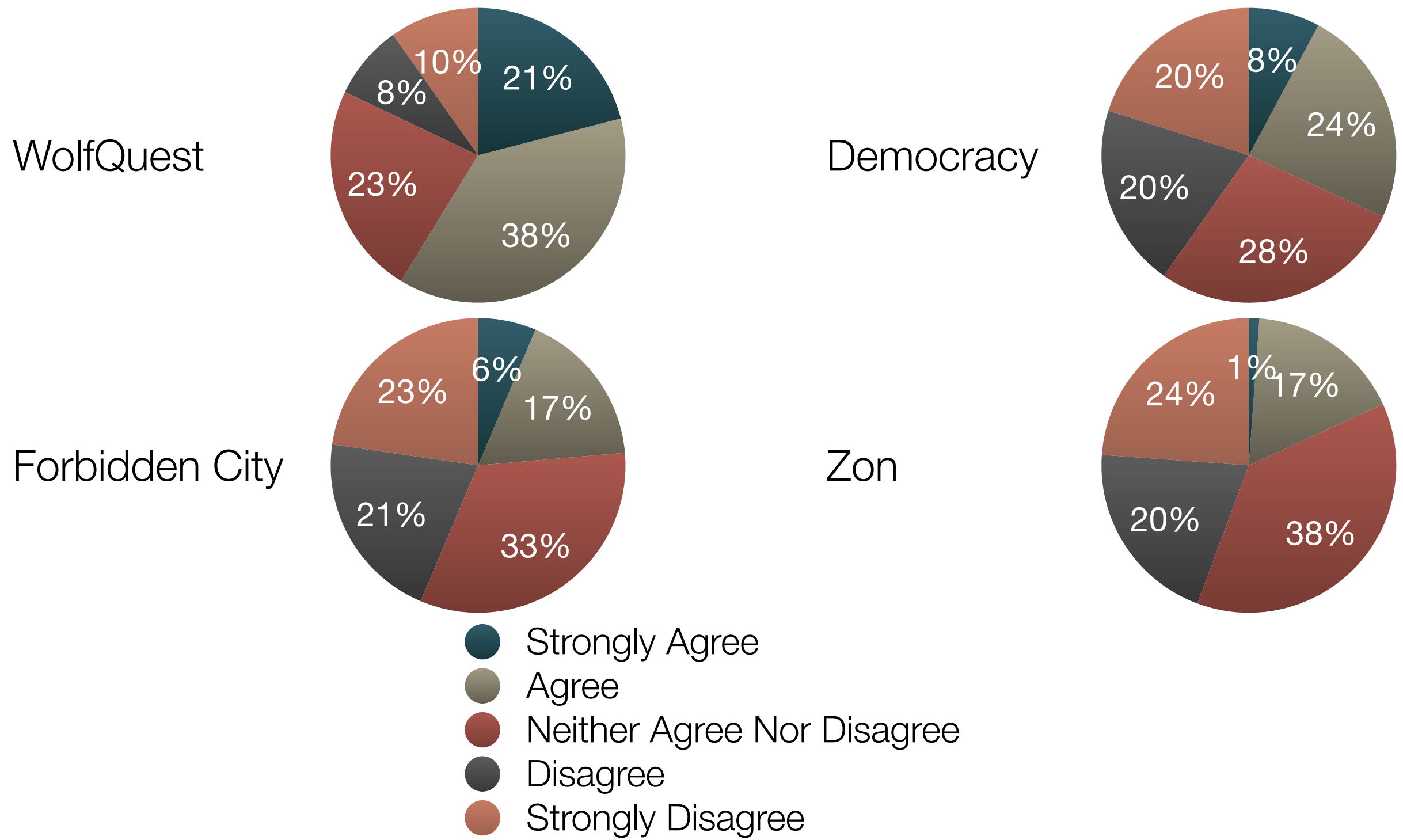
Players enjoy the internal experiences in reaction to the game's visceral, behavioral, cognitive, and social properties.  
Generates Excitement, Relaxation.

# The Question of Agency

# A Study of Educational Games in Maine (Puentedura, 2010)

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## Did Students Enjoy The Games?



# Agency and Games

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No Agency



Agency



# Learning from Games (Gee)

# Active Learning

Gamers Learn From:

1. Doing and reflecting critically

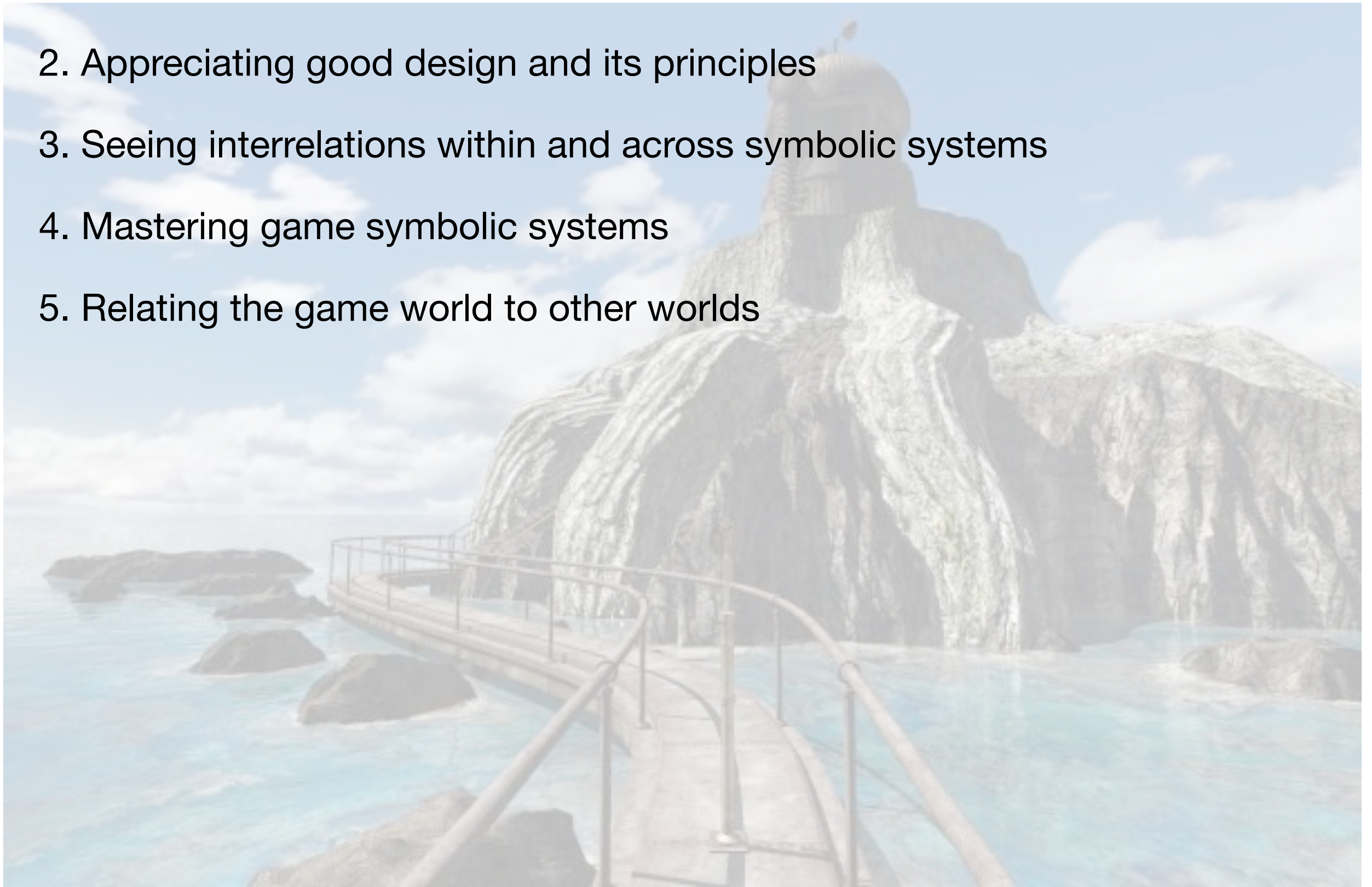




# Symbolic Systems

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2. Appreciating good design and its principles
3. Seeing interrelations within and across symbolic systems
4. Mastering game symbolic systems
5. Relating the game world to other worlds

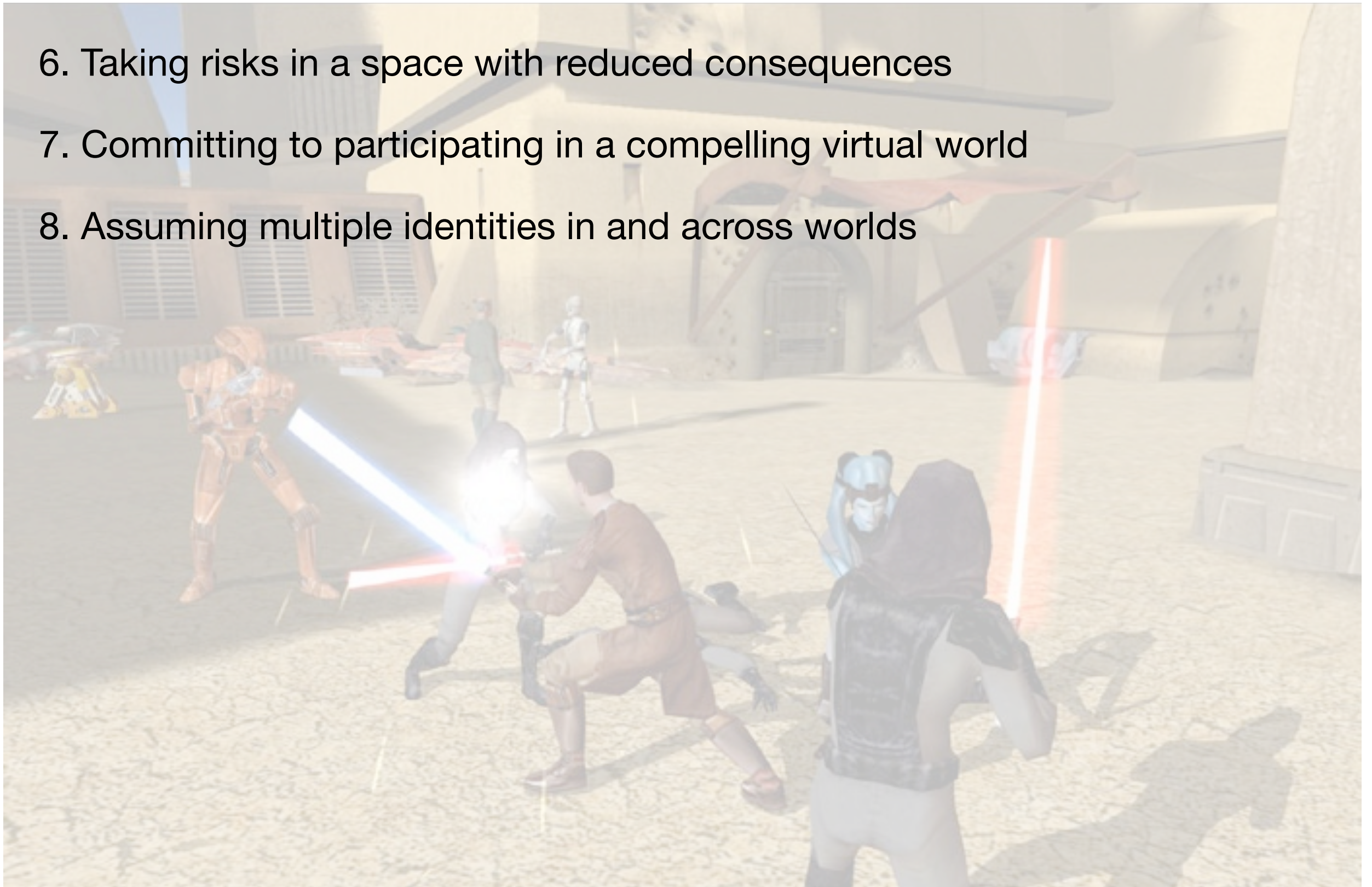




# Worlds and Identities

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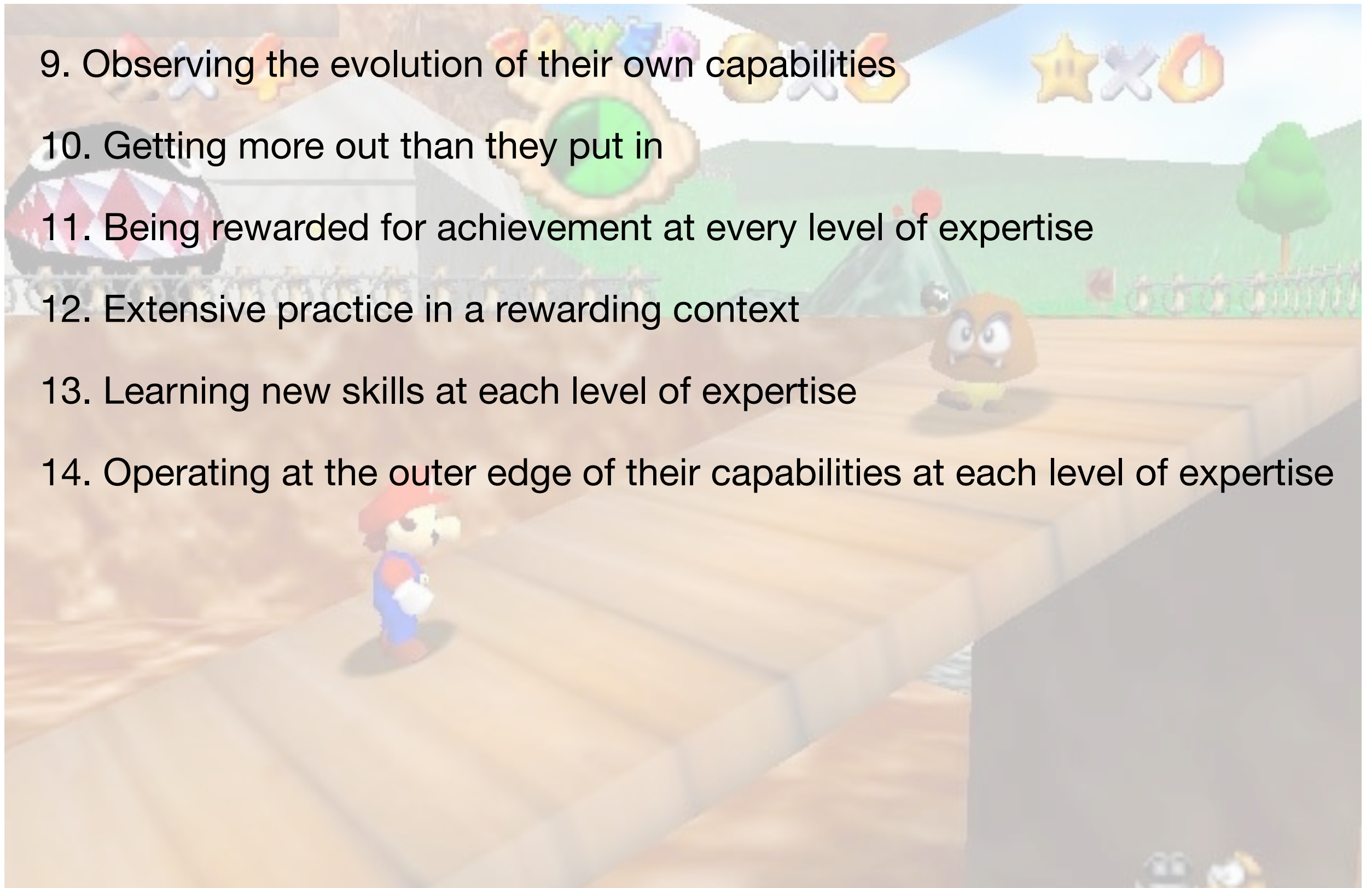
- 6. Taking risks in a space with reduced consequences
- 7. Committing to participating in a compelling virtual world
- 8. Assuming multiple identities in and across worlds





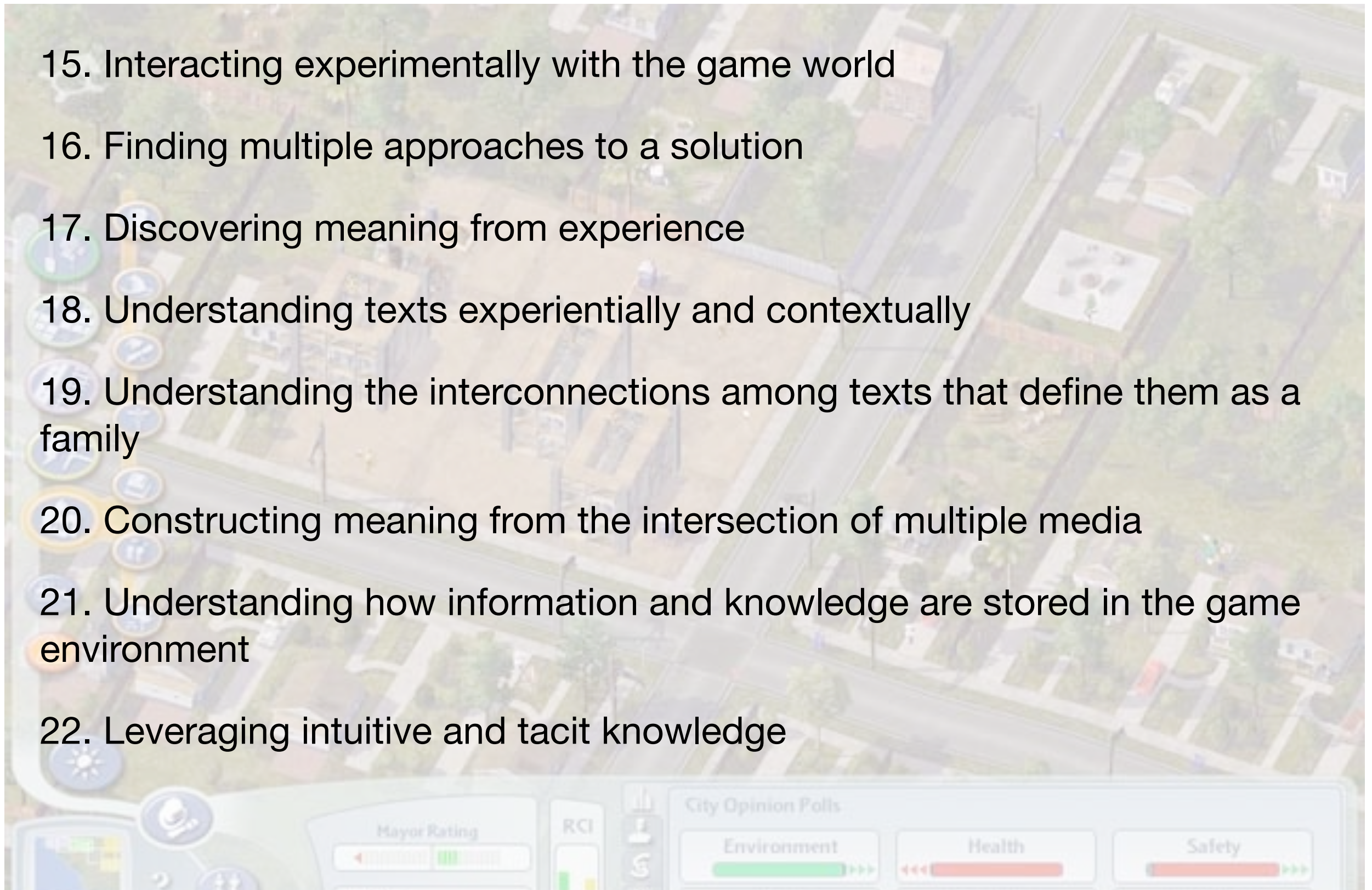
# Development of Capabilities

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- 
- 9. Observing the evolution of their own capabilities
  - 10. Getting more out than they put in
  - 11. Being rewarded for achievement at every level of expertise
  - 12. Extensive practice in a rewarding context
  - 13. Learning new skills at each level of expertise
  - 14. Operating at the outer edge of their capabilities at each level of expertise



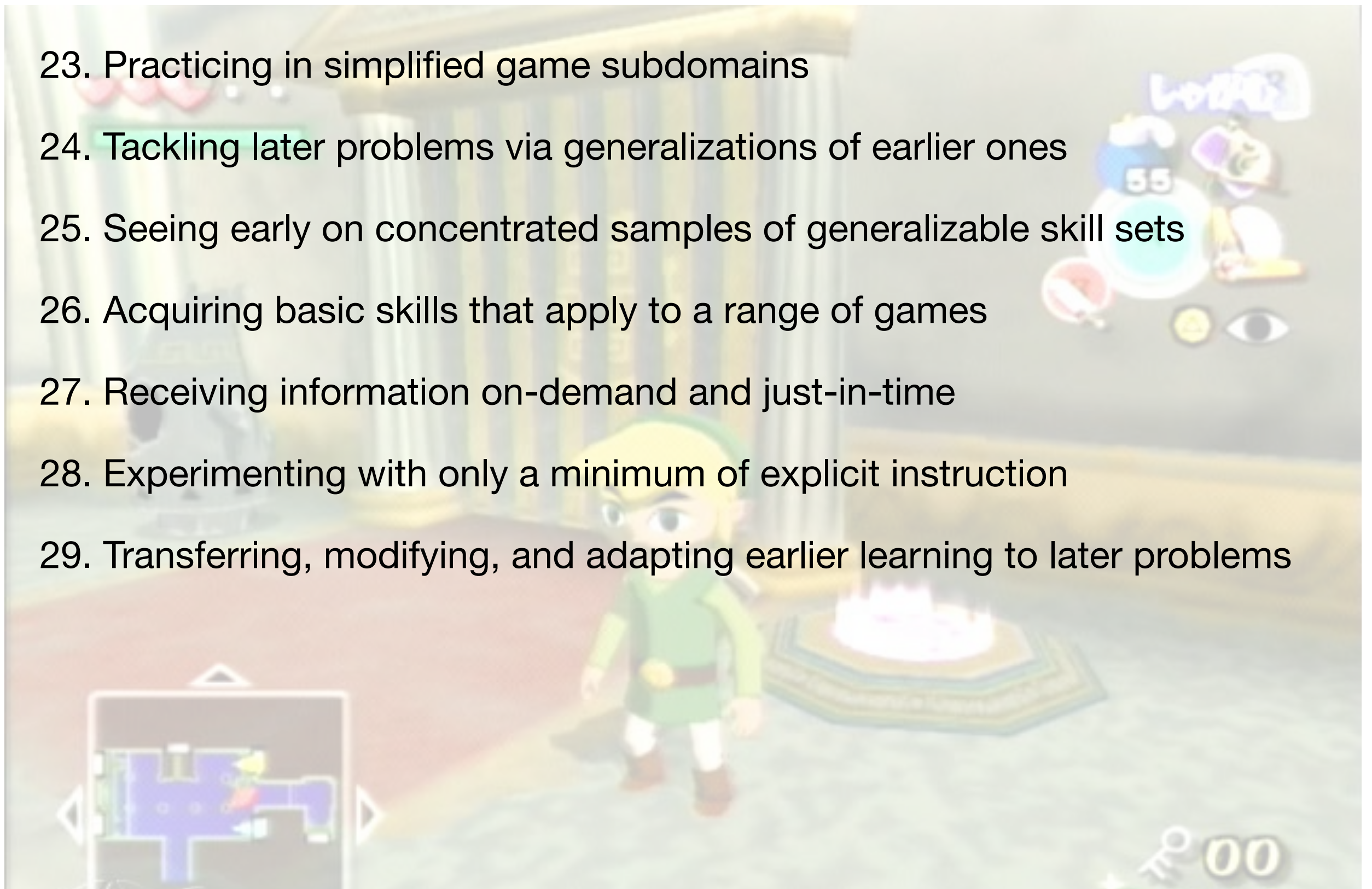
# Experiential Learning

- 
15. Interacting experimentally with the game world
  16. Finding multiple approaches to a solution
  17. Discovering meaning from experience
  18. Understanding texts experientially and contextually
  19. Understanding the interconnections among texts that define them as a family
  20. Constructing meaning from the intersection of multiple media
  21. Understanding how information and knowledge are stored in the game environment
  22. Leveraging intuitive and tacit knowledge



# Developing Skills

- 23. Practicing in simplified game subdomains
- 24. Tackling later problems via generalizations of earlier ones
- 25. Seeing early on concentrated samples of generalizable skill sets
- 26. Acquiring basic skills that apply to a range of games
- 27. Receiving information on-demand and just-in-time
- 28. Experimenting with only a minimum of explicit instruction
- 29. Transferring, modifying, and adapting earlier learning to later problems





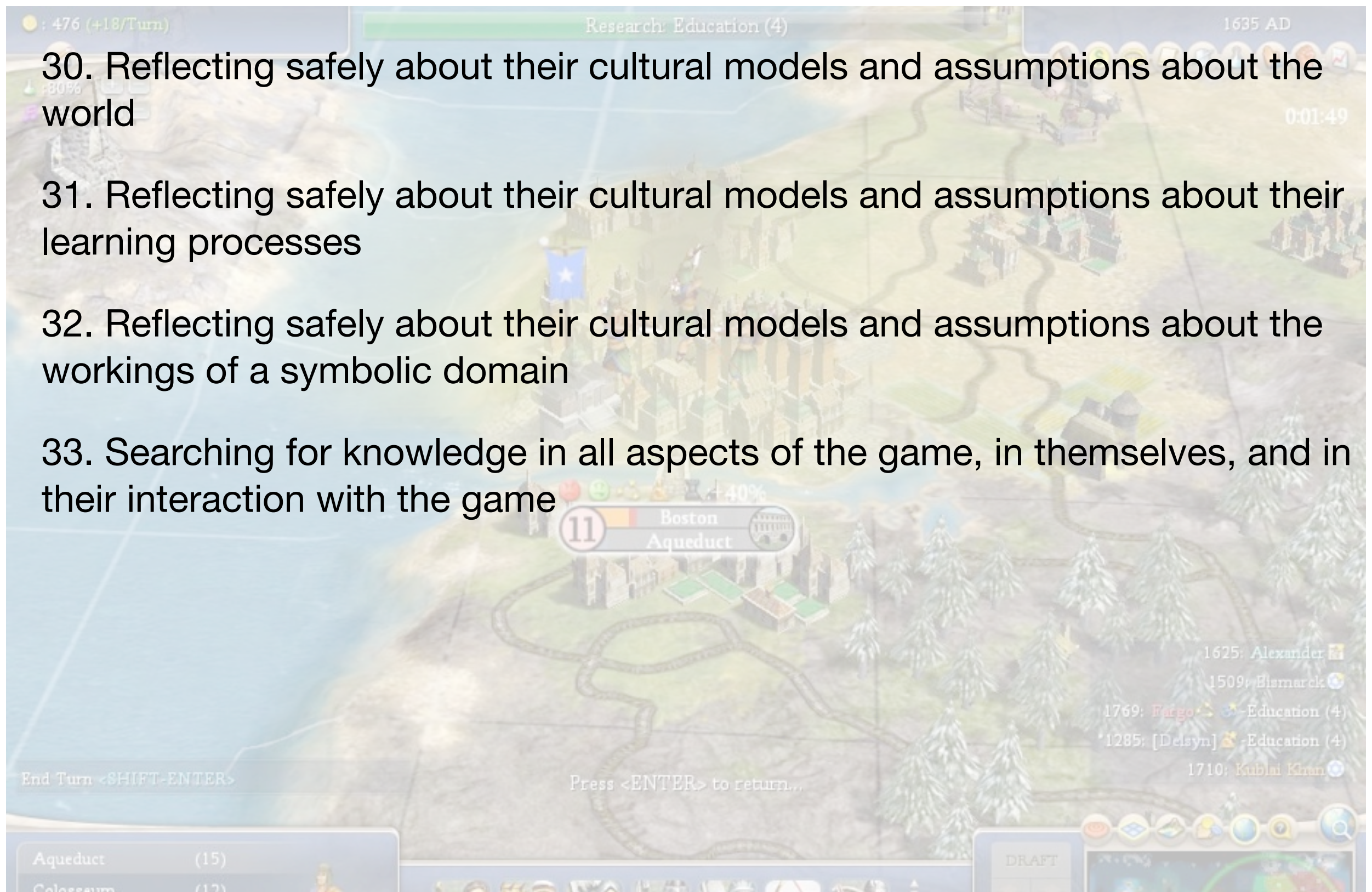
# Cultural Models

30. Reflecting safely about their cultural models and assumptions about the world

31. Reflecting safely about their cultural models and assumptions about their learning processes

32. Reflecting safely about their cultural models and assumptions about the workings of a symbolic domain

33. Searching for knowledge in all aspects of the game, in themselves, and in their interaction with the game





# Community

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- 34. Sharing their knowledge with other players
- 35. Forming a distinct community via shared interests in the gaming world
- 36. Teaching others and modifying the game experience





# The Educational Research

# Some Facts About Videogame Players

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- The average videogame player is 34 years old
- 40% of all videogame players are women
- 67% of households play videogames
- Among teens ages 12-17:
  - 97% play videogames (99% boys, 94% girls)
  - 80% play five or more different game types; 40% eight or more
  - 76% play games as a social activity:
    - 65% play with others in the same room; 27% online
  - Same-room game play relates positively to civic outcomes
  - Game-related social interaction relates positively to civic outcomes

# Effectiveness of Games in Education I

## (Randel, Morris, Wetzel, and Whitehill)

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- Meta-study of 68 studies from 1963-1991
  - Social sciences; mathematics; language arts; logic; physics; biology
- Most effective: language arts and mathematics
  - 12 out of 14 studies showed positive results
- Next most effective: social sciences
  - 13 out of 46 showed positive results
  - 33 out of 46 were as effective as traditional methods
- Game learning overall showed better retention than traditional learning
- Students showed greater interest in topics taught via games or simulations



# Effectiveness of Games in Education II

## (Fletcher and Tobias)

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- Review of research from 1992-2005
  - 42 papers directly related to use of games in instructional settings
- Topics:
  - Transfer to Real-Life Tasks: 5 positive, 1 neutral, 1 mixed
  - Facilitating Performance, Learning, and Transfer: 4 positive
  - Transfer to Related Tasks or Domains: 8 positive, 1 neutral
  - Effects on Different Variables: 5 positive
  - Effects on Cognitive Processes: 9 positive
  - Team Characteristics of Game Players: 1 positive, 2 mixed
  - Motivational Effects: 3 positive, 2 mixed

# Effectiveness of Games in Education III

## (Mayo)

**Table 1.** Learning outcomes of several games compared to lecture on same material.

Game	Topic	Audience	N (study size)	Learning outcome over lecture	Reference
Dimenxian/ Evolver	Algebra	High school	193	7.2%	(37–39)
Geography Explorer	Geography	College	273	15 to 40%	(40)
NIU Torcs	Numerical methods	College	86	2× more time spent on homework, much more detailed concept maps	(10–11)
River City	Ecology/ biology	Middle/high school	≈2000	15 to 18%, on average	(13)
Supercharged!	Electrostatics	Middle school	90	+8%	(41)
Virtual Cell	Cell biology	College	238	40%, on average	(40)

# Gamification: Why You Should (Probably) Avoid It



# Two Key Challenges

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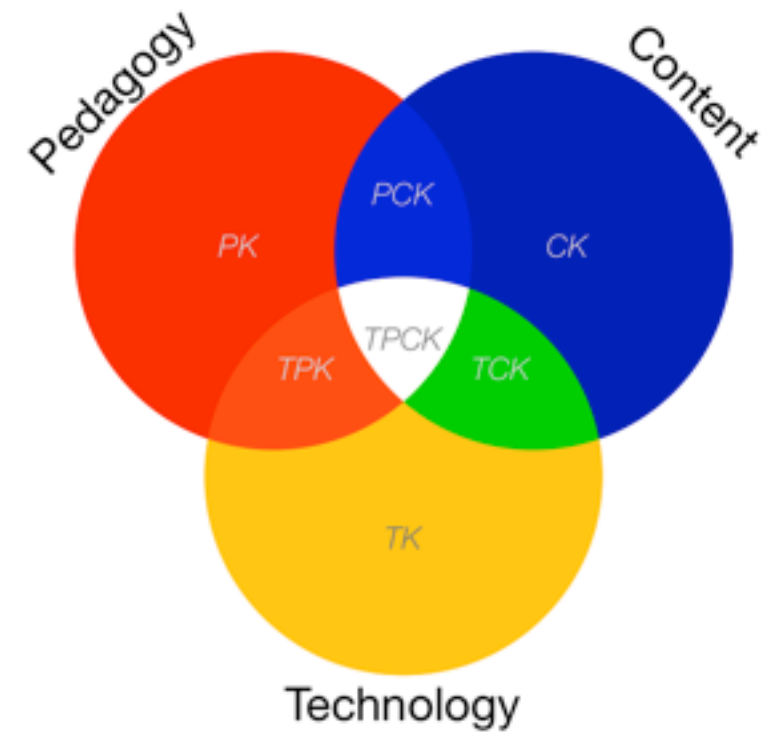
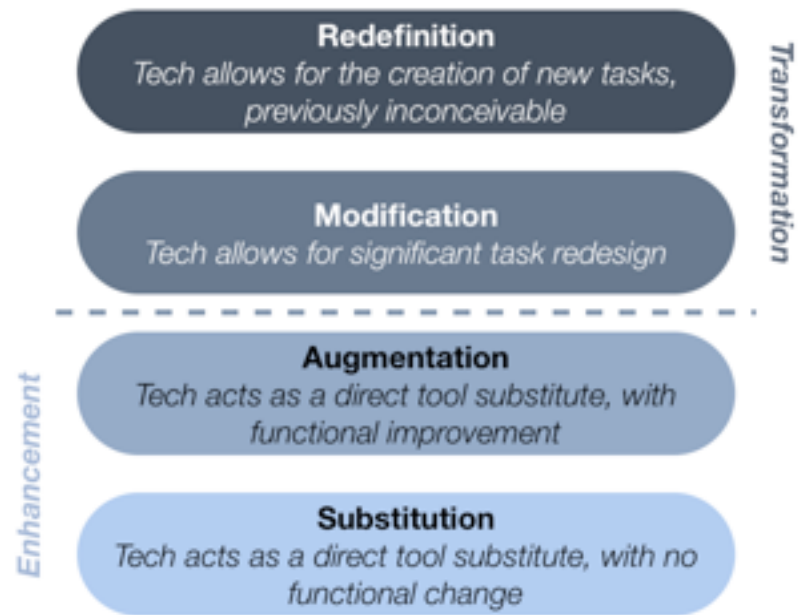
- **The Ethical Challenge:**

- “If an activity is disagreeable, shouldn't we fix the activity, rather than gloss it over with gamified attributes?”

- **The Game Design Challenge:**

- “In a well-designed game, achievements are intrinsically linked to true acquisition of skills in the game. In a poorly designed game, they are either arbitrary, or linked primarily to player persistence. Shouldn't we aim to incorporate the features of good game design into our classrooms?”

# TPCK + SAMR: A Game Design Perspective





*Interactive Fiction*



*Role-playing Games*



*MMOGs*



*ARGs*



*Sims*



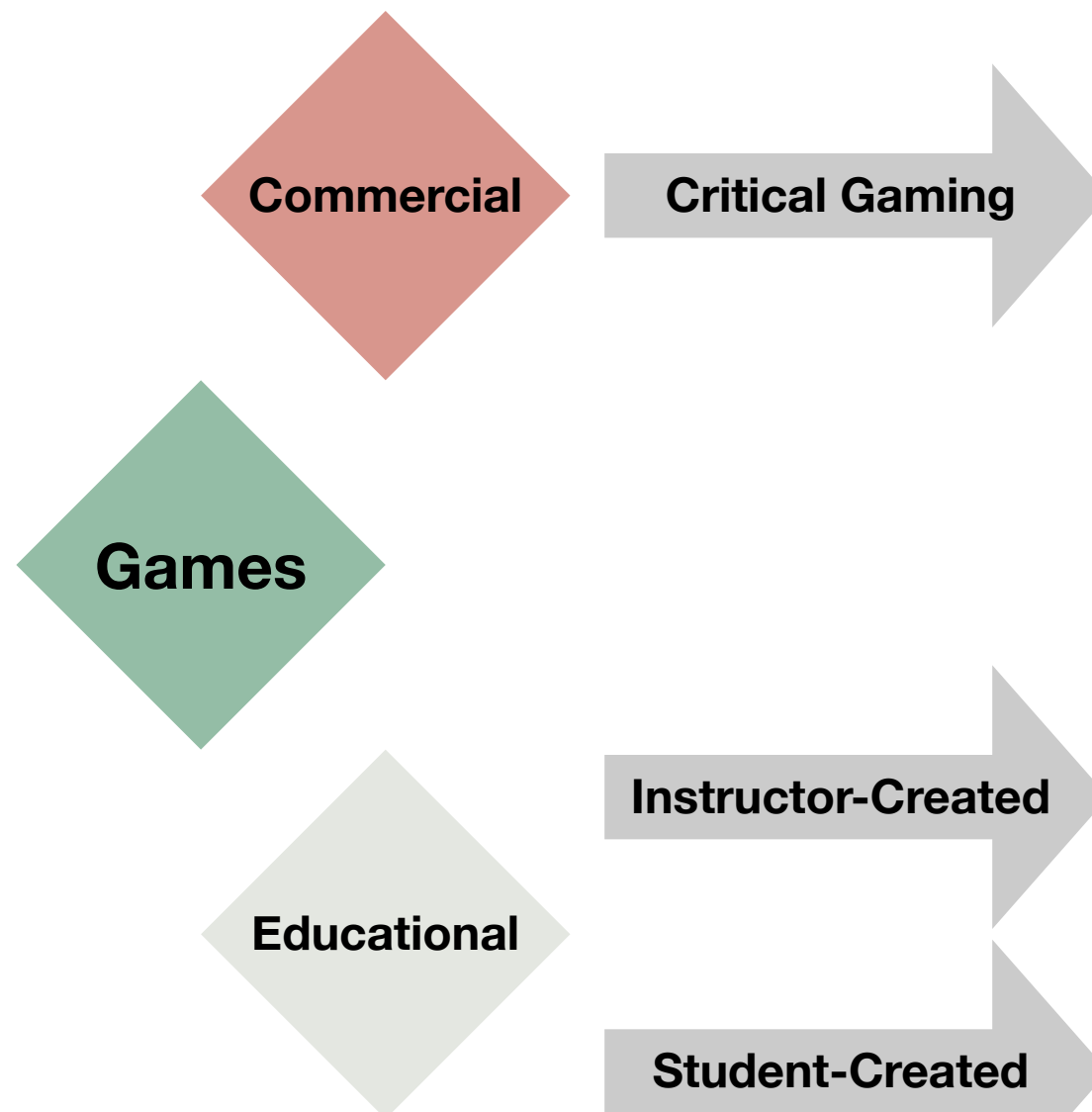
*Real-Time Strategy Games*



*Turn-based Strategy Games*



*Twitch and Rhythm Games*



- Provide domain-specific analytic and problem-solving approaches
- Enhance skill transfer to related tasks or domains
- Enhance general skills or cognitive processes

- Provide domain-specific content
- Provide domain-specific analytic and problem-solving approaches
- Enhance skill transfer to related tasks or domains
- Enhance general skills or cognitive processes
- Develop specific social structures
- Improve participant motivation

# Particularly Interesting Categories

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- Interactive Fiction
  - Narrative structure analysis
- Role-playing Games
  - Dramatic structures, narrative building support, derived media creation
- MMOGs
  - Narrative building support, derived media creation, Social Sciences research
- ARGs
  - Narrative building support, media literacy
- Sims
  - Systems modeling, statistical analysis, research methodologies
- Real-Time Strategy Games
  - Modeling, decision optimization
- Turn-based World Strategy Games
  - Historical assumptions and causality analysis
- Twitch Games
  - Dexterity skills, spatial perception

# TPCK As Game Design Process - An Introduction

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- CK:
  - Select the core content elements/reasons you want to make into a game;
  - Boil them down to essentials.
- PCK <-> PK:
  - Which genre is a good match for your content and intent?
  - What general learning goals are you looking to achieve?
  - What will make your game fun?
- TPK:
  - What key game elements will factor into your design?
  - How will they interact with your goals?
  - How will you use them for formative/summative assessment?
- TK:
  - Which toolkit will you use?
- TCK:
  - What exemplars exist in your chosen game genre/content area?
- TPCK:
  - What research exists in applying games in your subject area?



# SAMR as Game Design Process - Some Examples

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- Substitution:
  - Games that reiterate traditionally taught points (note: not via disguised multiple choice)
  - Games that exercise procedural mechanics in weakly related settings
- Augmentation:
  - Games that exercise procedural mechanics in strongly related settings
  - Games that provide for student discovery of semi-explicit rulesets
- Modification:
  - Games that allow for exploration of non-explicit underlying systems and rulesets
  - Games that allow for construction of social superstructures and activities on the game
- Redefinition:
  - Games that allow for development of previously unexplored student capabilities
  - Games that allow for exploration of previously inaccessible knowledge domains

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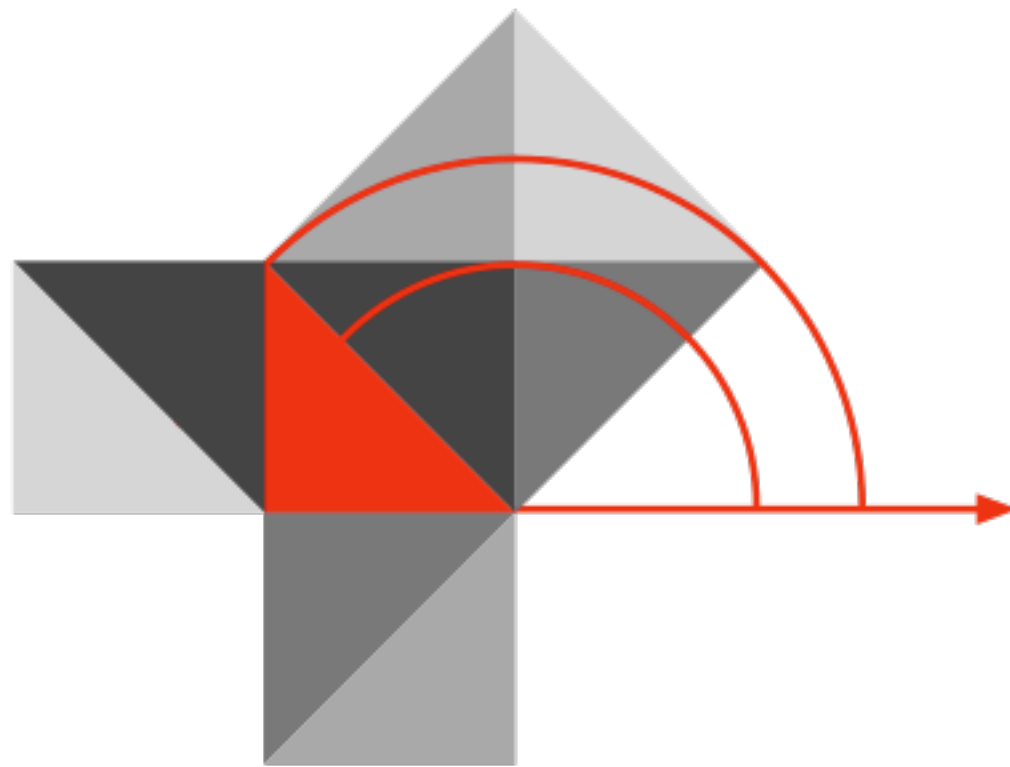
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[http://www.pewinternet.org/PPF/r/263/report\\_display.asp](http://www.pewinternet.org/PPF/r/263/report_display.asp)
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# Hippasus

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