



**ALION**  
SCIENCE AND TECHNOLOGY



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# Why Games Work – The Science of Learning

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Modsim World, 2011

## Tutorial Contents

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- 1 – Intro
  - 2 – Science of Learning
  - 3 – How Games Work
  - 4 – Game Design
  - 5 – Connecting the Dots
  - 6 – Conclusion

# PART 1

## Introduction



## The 'Standard' Goal

Learning Theory



Game Design



Awesome!



## Why Games?

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- Entertainment Games <sup>(16)</sup>
  - 65% of US households play games
  - Average age of gamers: 37
  - 42% of gamers are women
  - Games is ~ \$24 Billion industry
  - Ex: Call of Duty - bigger open than Avatar or Titanic
- Learning Games <sup>(17, 25, 26, 28)</sup>
  - Can generate a 2 letter grade increase in economics
  - Can net a 50-80% increase in recruit performance
  - Can encourage kids with cancer to take medication

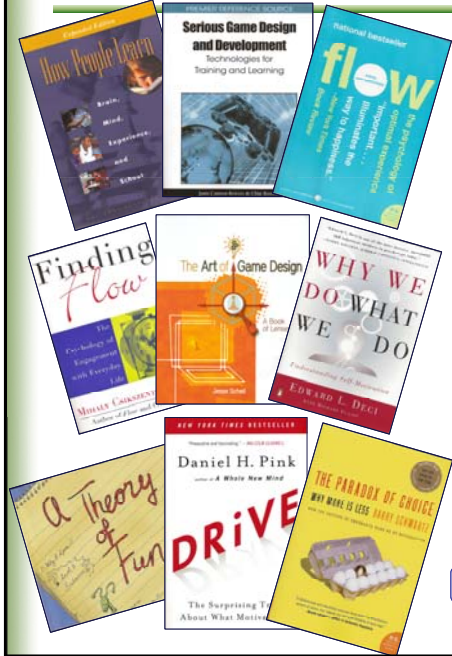
## But Not Always ...

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- The Risk:
  - ‘Academizing’ the fun <sup>(18)</sup>
    - “It is possible to design a game that is the WORST of both worlds – a boring game that makes use of ineffective teaching methods.” - Clint Bowers <sup>(25)</sup>
- We need to understand both
  - The science of learning
  - How games work
- Find a balance

# Resources and References

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- US Army  
Fundamentals of Instruction
- US Navy  
Revolution In Training
- US Air Force  
Train the Trainers
- US FAA  
Aviation Instructor's Handbook
- Susan Coleman
- Clint Bowers
- Bruno Frey
- Jan Cannon-Bowers
- Robert Green
- John Lee
- Richard Ryan
- Richard Van Eck
- James Buchanan
- Talib Hussain
- Edwin Locke
- Richard Wainess
- Dustin Chertoff
- Michael Guerrero
- Kerry Moffit
- Ellen Menaker
- Alan Koenig
- Kelly Pounds
- Richard Blunt
- Mitchell Wade
- Curtiss Murphy

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## PART 2

# The Science of Learning

**“Teaching is a wonderful way to learn.”**  
**Carol Dweck (32)**



## What Improves Learning?

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### Laws of Learning <sup>1,2,3,31</sup>

**Readiness**

**Exercise**

**Effect**

**Intensity**

**Primacy** (\*\*)

**Recency** (\*\*)

\*\* Primacy & Recency are based on time  
Beyond the scope of the paper

## Narrow The Focus

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### Laws of Learning for Games

**Motivation** (from Readiness)

**Feedback** (from Exercise)

**Practice** (from Exercise)

**Positive Feelings** (aka Effect)

**Intensity**

**Choice/Involvement** (\*\*)

\*\* Choice/Involvement are  
from Effect, Readiness, Intensity

## Motivation and Feedback

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- **Motivation** (1, 2, 3, 4, 5, 6, 20, 22, 31)
  - Part of 'Readiness'
  - The holy grail
  - "Quite simply, motivated students learn more than unmotivated students"- US Navy
  - Increases involvement with learning, retention, and student performance
- **Feedback** (1, 2, 3, 4, 8, 23, 31)
  - Part of 'Exercise'
  - Is how we perceive progress
    - Correlates actions to outcomes
  - An interesting thought:
    - 'Without feedback, no learning can occur.'

## Practice and Positive Feelings

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- **Practice** (1, 2, 3, 4, 21, 31)
  - Part of Exercise
  - "A student learns by applying what he has been taught." – USAF
  - Time on task creates opportunities to learn
  - Repetition is 'necessary, but not sufficient'
- **Positive Feelings** (1, 2, 3, 4, 31)
  - Aka – 'Effect'
  - Learning is stronger with pleasant emotions
  - Keeps students engaged longer

## Intensity and Choice

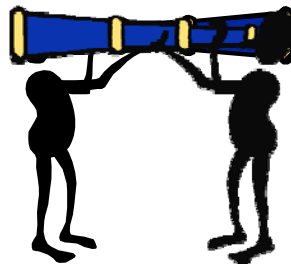
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- Intensity (1, 2, 3, 4, 31)
  - Learning increases with vivid, sharp, intense activities – whether positive or negative
  - Practiced activities are more intense than passive lessons or texts
  - Real is most intense – aka learn on the job!
- Choice/Involvement (1, 2, 3, 25, 31)
  - Sub-parts of Effect, Readiness, and Intensity
  - Choice of challenge affects motivation
  - Coercion and external rewards are negatively associated with learning
  - Is complex - as we will see

## Change Perspective

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**Learning  
Design**



**Game  
Design**

- Let's flip this puppy around
- Now we can ask...

# PART 3

## Why Games Work



## The Big Question

### “Why Do Games Work?”

- Is it art?
- Is it mystical?
- Maybe it's a secret?
  
- I propose an answer
  - A simple
    - Powerful realization





## The Answer

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- Games work for the same reasons that learning works

Motivation (from Readiness)

Feedback (from Exercise)

Practice (from Exercise)

Positive Feelings (aka Effect)

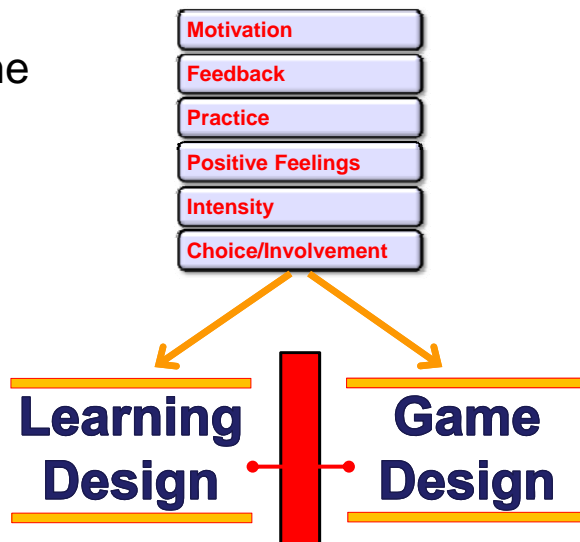
Intensity

Choice/Involvement (\*\*\*)

## What's It Mean?

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- Let's assume
  - It's true
- If so, then



- That's powerful!

# PART 4

## Game Design



## Game Techniques

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1. Flow
2. Feedback
3. Simplicity
4. Choice/Involvement
5. Immersion & Engagement
6. Practice
7. Fun

## 1 - Flow

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- (References: 5, 6, 7, 8, 9, 11, 15, 19, 20, 23, 26)
- What is Flow?
  - The optimal human experience
  - The ‘state in which people are so involved in an activity that nothing else seems to matter’ (8)
    - Mihaly Csikszentmihalyi
  - Complete focus - one with activity
  - Time becomes distorted
- Flow can occur in ANY activity

## Why Flow Matters

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- The essence of games
  - This is why we play
- Flow
  - Is intrinsically **motivating**
  - Is a “magnet for learning” (9)
  - Is **pleasurable**
  - Involves **feedback**
  - Involves learner control (**choice**)

## How to Create Flow?

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- There are four conditions for Flow:

### Clear Task

- Understand what must be done

### Feedback

- Clear feedback about progress
- Shows what succeeds and fails
- Usually immediate

### Attainable, Balanced Goal

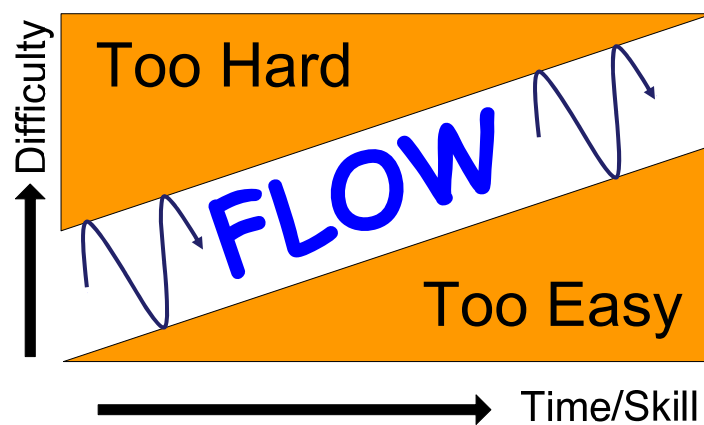
- Goal is challenging
- But within abilities
- And not overly long

### Concentration / Focus

- Lack of distractions
- Can fully attend to task

## What Flow Looks Like

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Flow creates a cycle of increasing learning

## 2 - Feedback in Games

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- Two Types
- Type One - short term
  - Task completion
  - Progress
  - Immediate



- Natural consequences



Sims 3



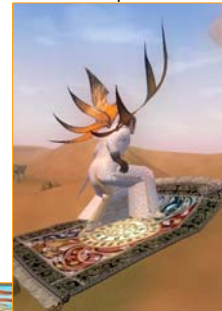
Damage Control Trainer

## Feedback in Games

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- Type two – holistic
  - Repetition - play again
  - Player development
  - Narrative progression
  - 'Meta' growth

Everquest 2



Damage Control Trainer



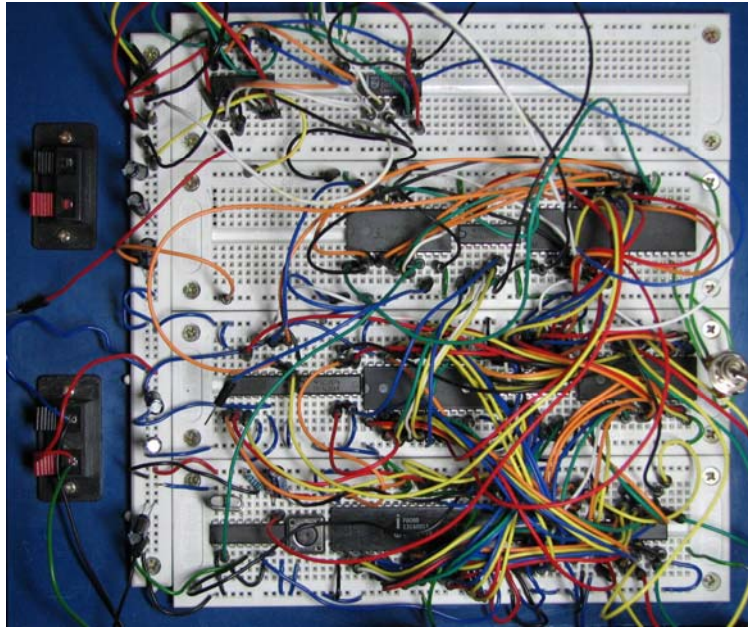
League of Legends



Royal Envoy

## 3 - Simplicity

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## Simplicity

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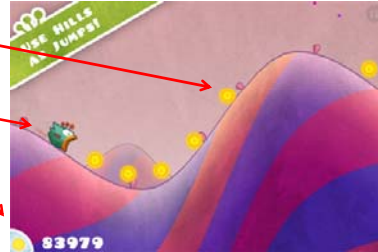
- Games simplify the world to
  - “goals and rules for action” – Csikszentmihalyi <sup>(8)</sup>
- Games offer ‘transcendence’:
  - “the player is more powerful in the game world than they are in the real world.” – Schell <sup>(11)</sup>

## Simplicity (26)

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- Good Interfaces are Simple

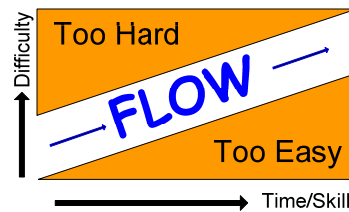
- Highlight goals
- Provide clear **feedback**
- Seem 'invisible'



Tiny Wings

- Promote **Flow**

- Avoid cognitive overload
- Balance difficulty
- Don't distract



## 4 - Choice (26)

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- Game play IS choice
- Games are 'just a series of interesting and meaningful choices' – Sid Meier
- But wait!
  - There are some big 'Buts!' with choice

## Paradox of Choice

31

- Barry Schwartz (7)
  - Some choice is good
    - But too much choice is bad!



- “As the number of choices grows ... we become overloaded. At this point, choice ... debilitates.” (7)

## Paradox of Choice (26)

32

- Three problems:
  - Increases difficulty (A LOT)
    - Option paralysis
    - Postpone decisions
  - Leads to ‘worse’ decisions
    - People are not good at comparing
    - We simplify the criteria (→ random)
    - Hard to correlate feedback
  - Adds regret & sense of ‘loss’



## Cost of Choices

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- Opportunity Cost (Buchanan) <sup>(10)</sup>
  - Cost includes
    - The value of the option
    - PLUS the cost of missed opportunities
  - Ex: Cost of this session is
    - The value of this talk
    - PLUS you missed other talks!

- Thank you for attending!



## The Impact! <sup>(10, 7, 30)</sup>

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- Breaks Flow!
  - Increases difficulty
  - Adds distractions
  - Confuses feedback
- Decreases motivation
- Design Guidelines
  - Less > More -- Limit # of options
  - Spread decisions out over time
  - Simplicity!!

## 5-Immersion and Engagement (24)<sup>35</sup>

- Immersion ← Passive
  - Becoming engrossed in a story
  - Creates Presence (ie ‘being there’)
  - Generates **positive feelings**
  - Passive consumption
- Engagement ← Active
  - Working to solve a puzzle
  - Trying to apply an idea
  - Actively thinking - increases **motivation**

## Games Use Both!

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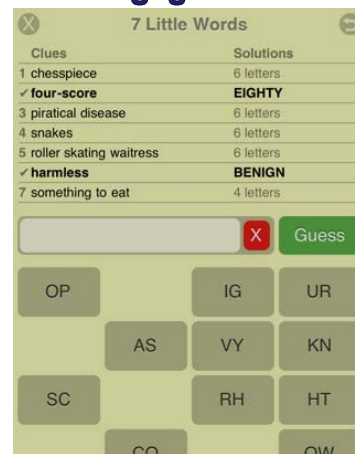
- Games = Immersion + Engagement
  - Creates **intensity!**
    - Vivid experiences

### Immersion



Red Dead Redemption

### Engagement



7 Little Words

## 6 - Practice

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- This is obvious...
  - I hope
- Games use practice to promote mastery
- Games encourage replay
- Games use failure
  - With games, “failure is a part of the process that leads to success” – Beck <sup>(13)</sup>
- Caution – don’t break flow! <sup>(27)</sup>
  - Excessive practice – boredom
  - Instant death
  - Long recoveries



## Repetition... Again...

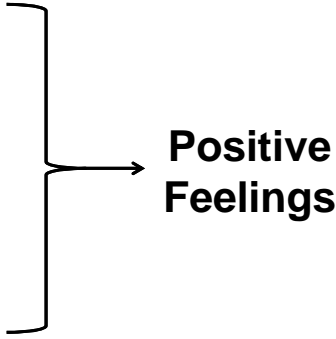
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- Repetition
  - Games are great at encouraging replay <sup>(27)</sup>
- Example
  - Closing doors. Over...
    - And over
      - And over ...
      - Until ...
  - Transference!
- More cautions:
  - Repetition without learning <sup>(26)</sup>
    - Ex: What's on a Penny?
  - Necessary <sup>(4)</sup>
    - But not sufficient



## 7 - Fun

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- 'Fun' is hard to define
    - But it matters to game designers
  - Includes
    - Immersion
    - Engagement
    - Satisfaction
    - Fiero (triumph)
    - The joy of doing
  - Fun is “Another word for learning” (12)
- Positive Feelings**
- 

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## PART 5

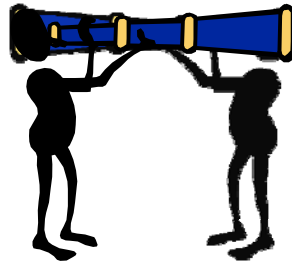
# Connecting the Dots



## Perspective... Again...

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**Learning  
Design**



**Game  
Design**

## Putting It All Together

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<b>Laws of Learning</b>	<b>Game Techniques</b>
Motivation	Flow. Intrinsic Motivation. Games are fun. Moment to moment decisions.
Feedback	Feedback is essential to Games. Part of flow. Simplicity correlates actions to outcomes. Near-term/holistic.
Practice	Practice to promote mastery. Failure. Increasing difficulty. Repetition.

## Putting It All Together (cont)

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Laws of Learning	Game Techniques
Positive Feelings	Fun. Flow is pleasurable. Simplicity and involvement encourages accomplishment and mastery.
Intensity	Flow is intense focus. Immersion and engagement → intensity. Feedback loop is intense actions/outcomes.
Choice/ Involvement	Games simplify the world to meaningful decisions. Learning via moment to moment actions.

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## PART 6

# Conclusion



## The Sawyer Effect

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- From Mark Twain's
  - Tom Sawyer

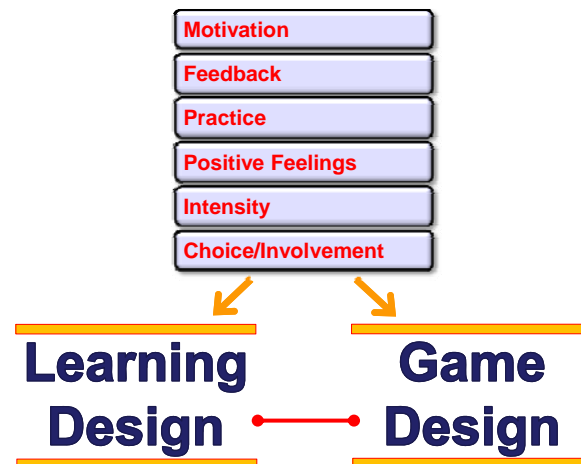


– “Practices that can either turn play into work or turn work into play” – Pink, Deci (5, 6)

## The Question and the Answer

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- Q: “Why Do Games Work?”
  - **A: For the same reasons as learning!**



# The Standard Goal

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Learning Theory



Game Design



Awesome!



# A Change in Perspective!

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Learning Theory



- Motivation
- Feedback
- Practice
- Positive Feelings
- Intensity
- Choice/Involvement

Game Design



Awesome!





# THE END

**Thank you for attending!**

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- Game Acknowledgements
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  - Sims 3 (Electronic Arts)
  - Everquest 2 (Sony)
  - Royal Envoy (Playrix)
  - League of Legends (Riot)
  - Tiny Wings (Andreas Illiger)
  - Red Dead Redemption (Rockstar Games)
  - 7 Little Words (Blue Ox Technologies)
- Photo Credits (Flickr.com)
  - Forest Fairy (Deeble)
  - Thinking (gavinzac)
  - Guitar Hero 1 (Severin Sadjina)
  - Interobang (Stewf)
  - Too many choices (cwgoodroe)
  - #19-Too many choices (elviskennedy)
  - Designed for men, by women (Kaptain Kobold)
  - Colorful door (Brentdanly)
  - Domino Spiral (fracturedpixel)
  - Bird Amazement (skywidedesign)
  - Green Pac-Man (Patrick Hoesly)
  - Electric me with more lasers (navfy)
  - Red Dead Redemption (Gamer Gourmet)
  - Magic of the holidays (jmtimages)
  - Teaching the adult learning cycle (pmorgan)
  - I will meet you in the garden gate (bitzcelt)