Making Serious Programming Games Adaptive

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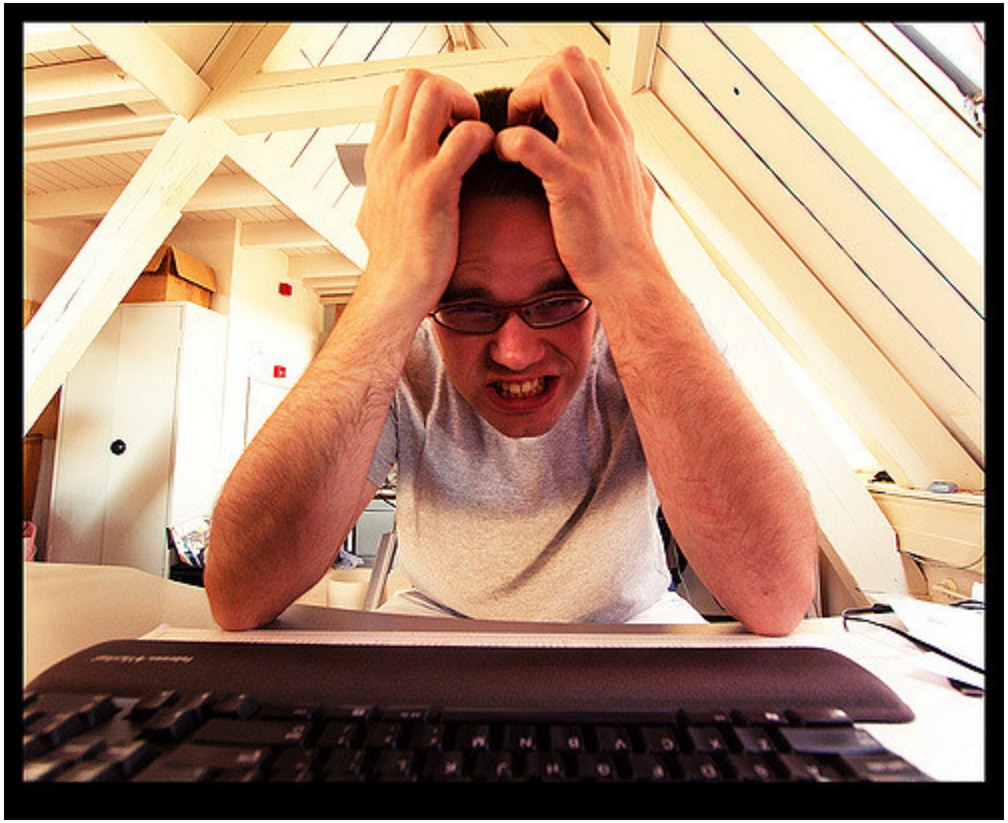
Problem



- **Computer science is a heavily targeted field for serious games**
- **Programming games are rarely customizable**
  - **Large workloads for experts**

Automatic Adaptation

- Algorithmically alter game play **tasks** based on non-invasive player **assessments**
- Use **Competence-based Knowledge Space Theory (CbKST)** to aid in selecting tasks that improve learner competences

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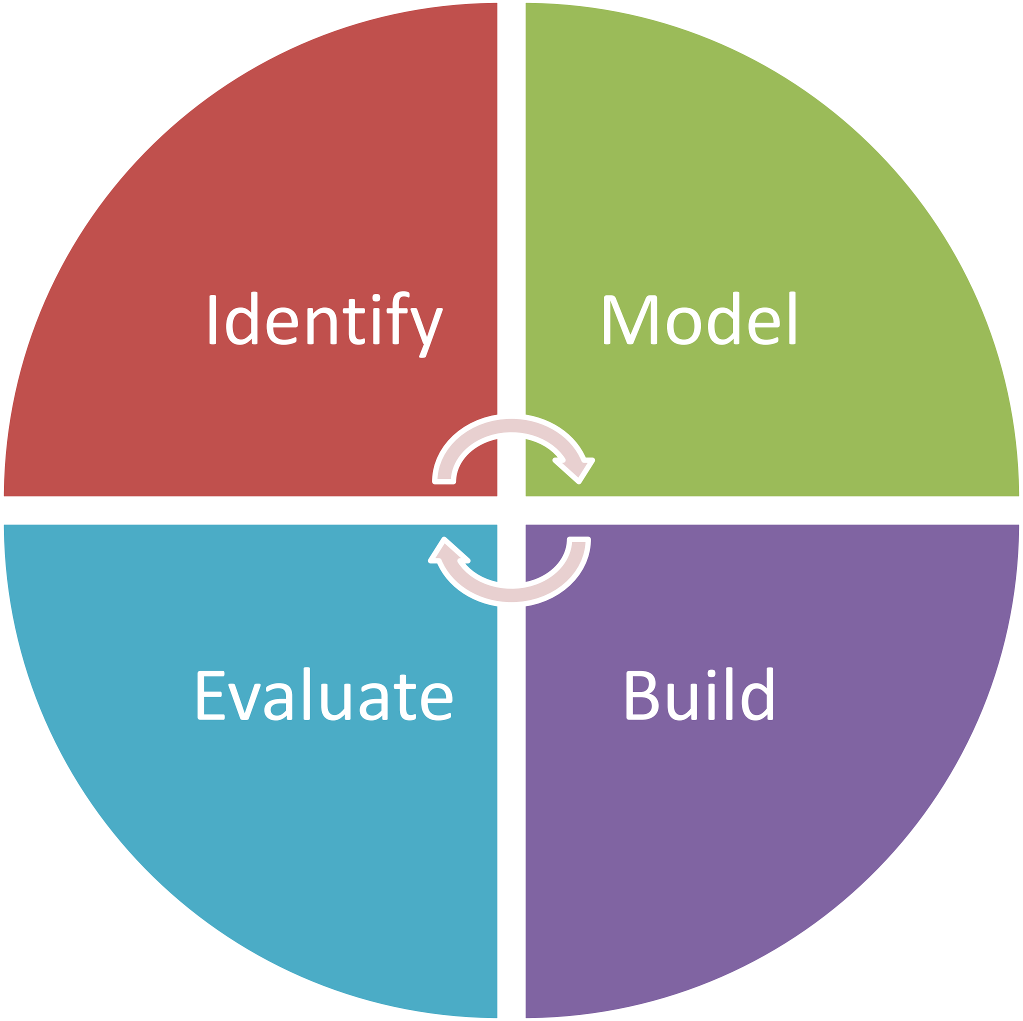
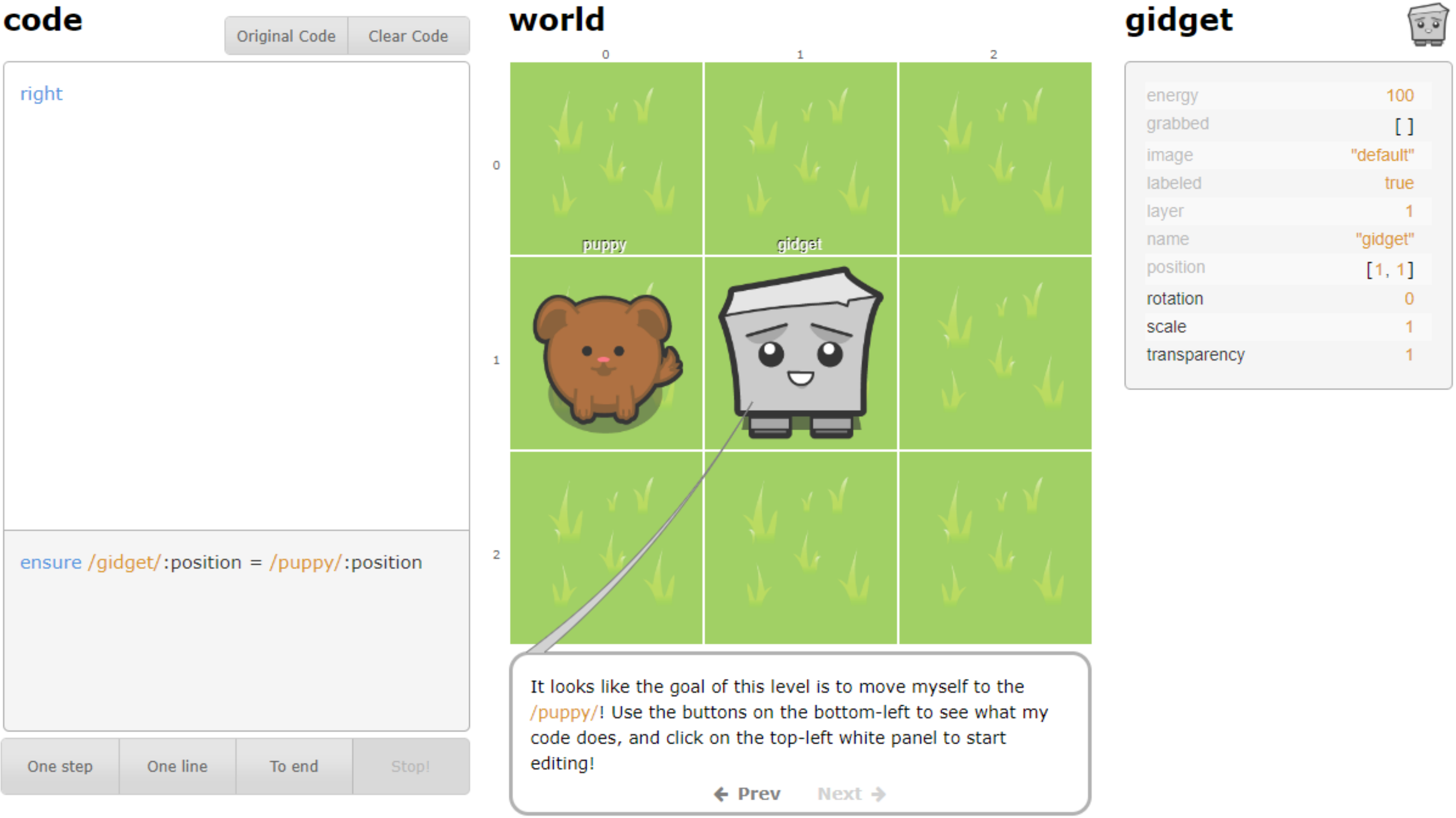
Methodology



Example: Gidget



```
right
```

```
ensure /gidget/:position = /puppy/:position
```

energy	100
grabbed	[ ]
image	"default"
labeled	true
layer	1
name	"gidget"
position	[1, 1]
rotation	0
scale	1
transparency	1

It looks like the goal of this level is to move myself to the /puppy/! Use the buttons on the bottom-left to see what my code does, and click on the top-left white panel to start editing!

Identify

- **Technical Factors**
  - Prefer open-source ✓
  - High quality and robust code ✓
  - Games with a playability study ✓
- **Learning Factors**
  - Determine topics and learning outcomes ✓
  - Prefer games with a diverse audience ✓
  - Games with existing evaluations ✓✓✓

Task Model

Goal/Objective

- Move Gidget to the dog

Learning Content

- Debugging

Game Elements

- Starting code

Parameters

- Energy limit

Assessment Model

Success Rate

- Number of failed submissions

Comprehension

- Errors in levels with conditionals

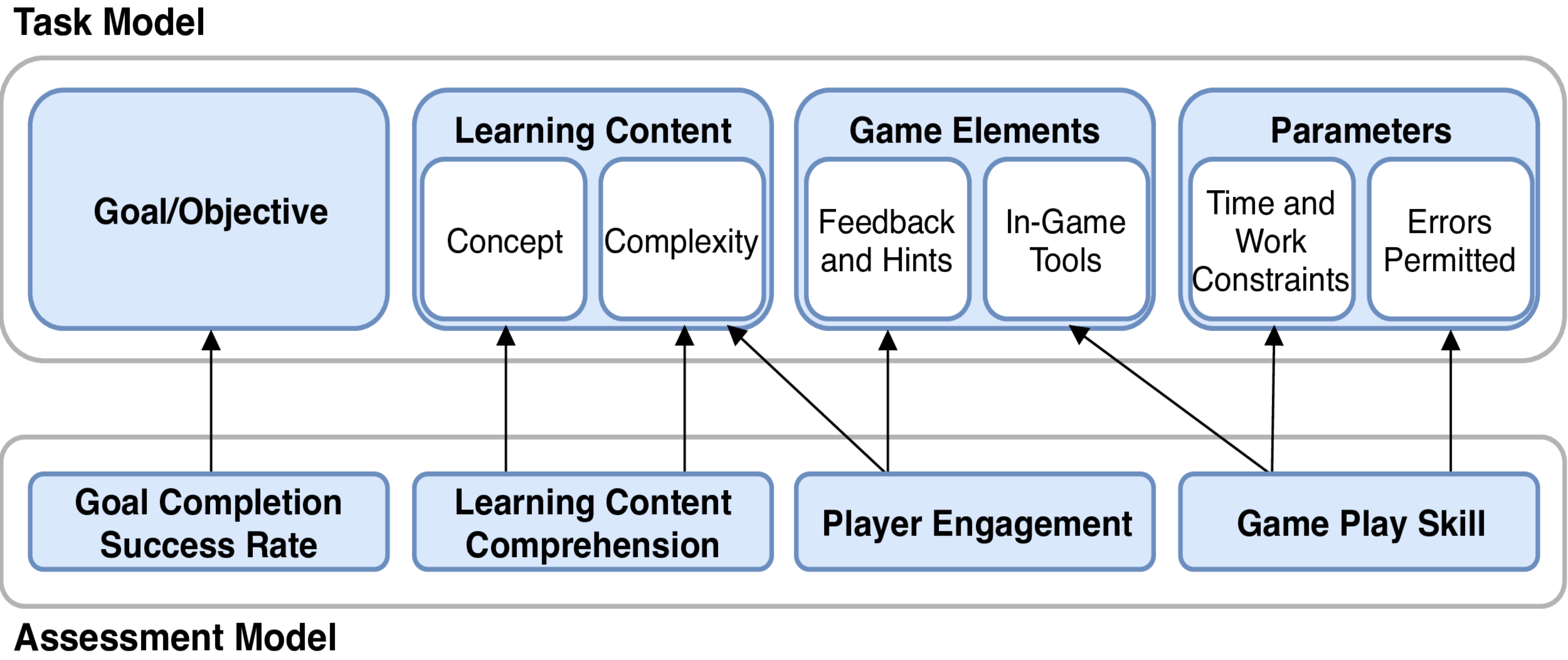
Engagement

- Completed 10/15 levels before quitting

Play Skill

- Completed previous level in 3 minutes

Model Relationships

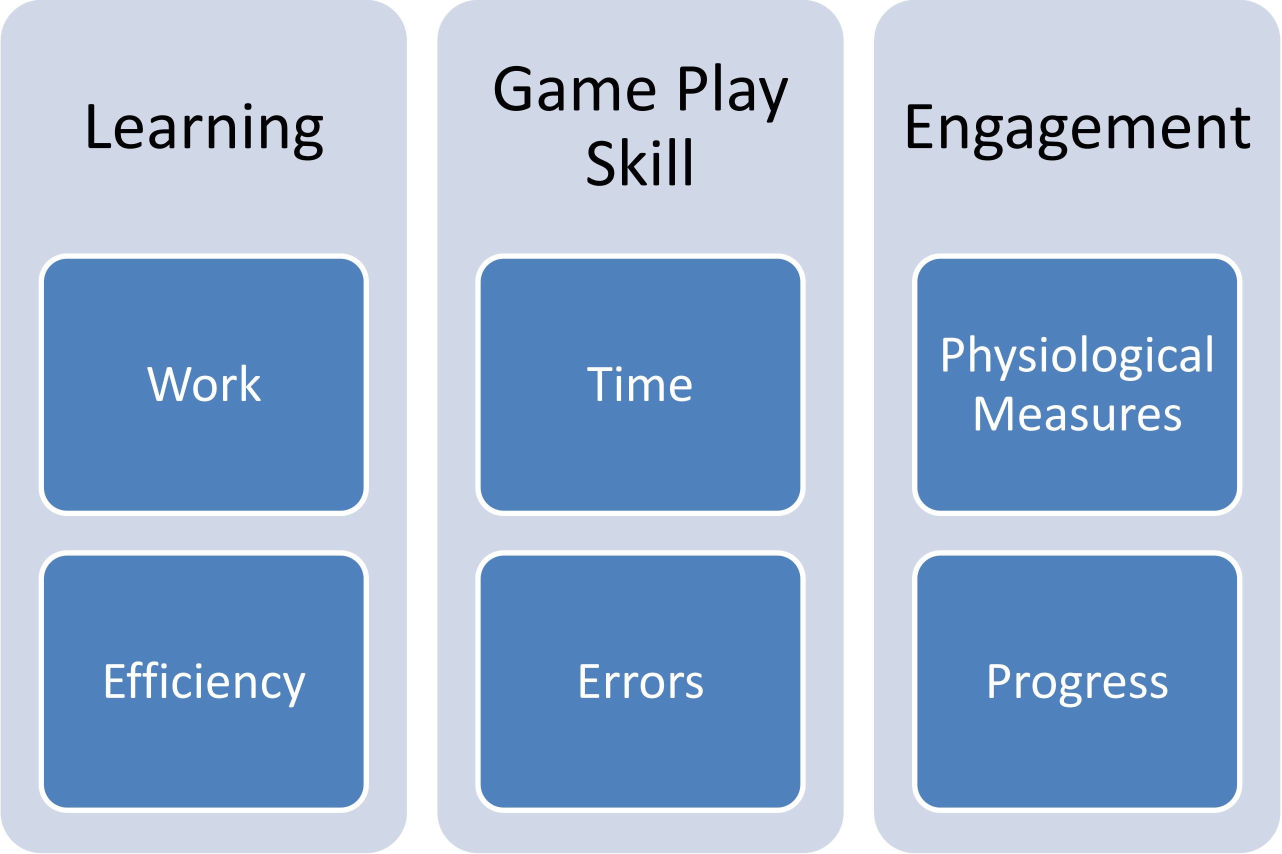


Build

- **Plan Adaptation**
  - Select an algorithm that incorporates CbKST* ✓
    - E.g. Rules-based using game metrics
  - Adapt task features based on player past performance ✓
    - E.g. Stricter energy requirements

* Competence-based Knowledge Space Theory

Data Logging



Learning

Work

Efficiency

Game Play Skill

Time

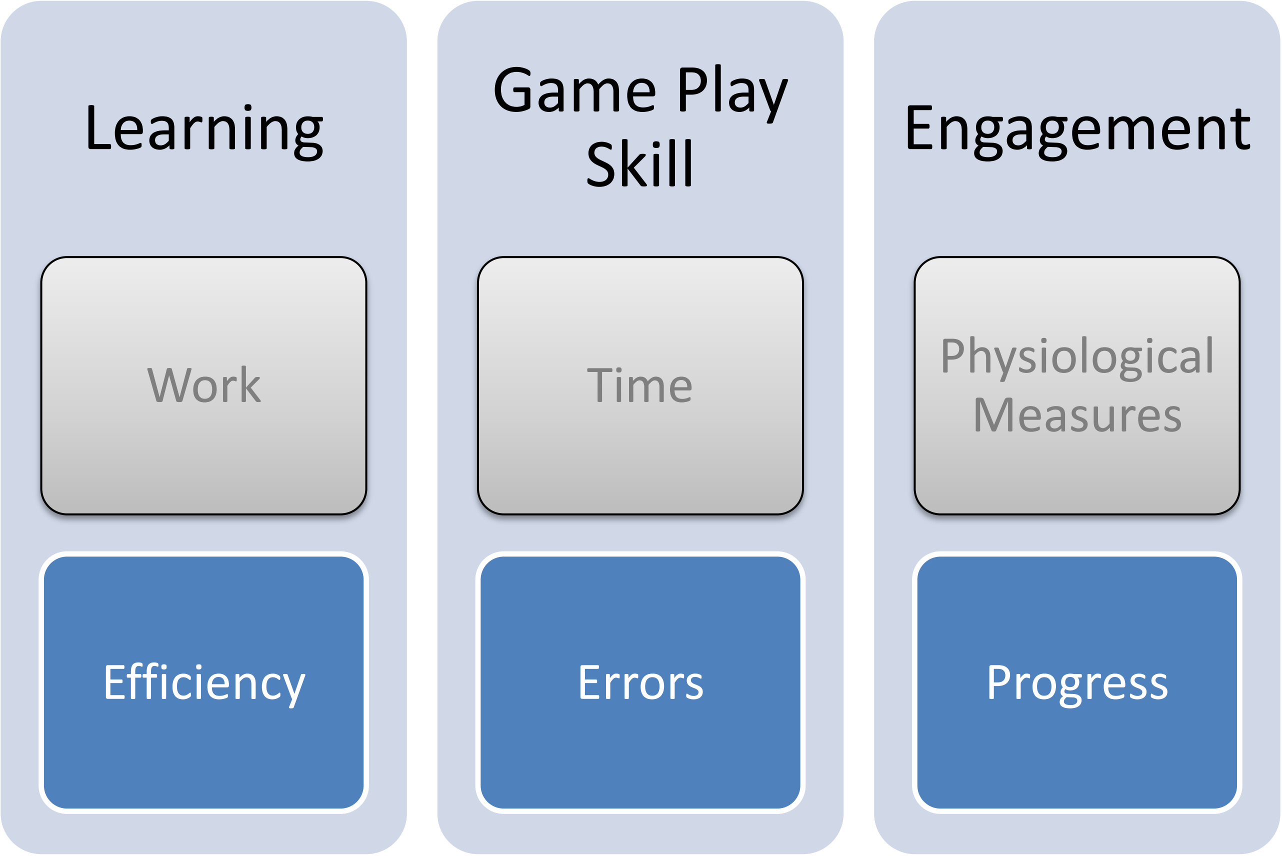
Errors

Engagement

Physiological Measures

Progress

Data Logging



Learning

Work

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Game Play Skill

Time

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Physiological Measures

Progress

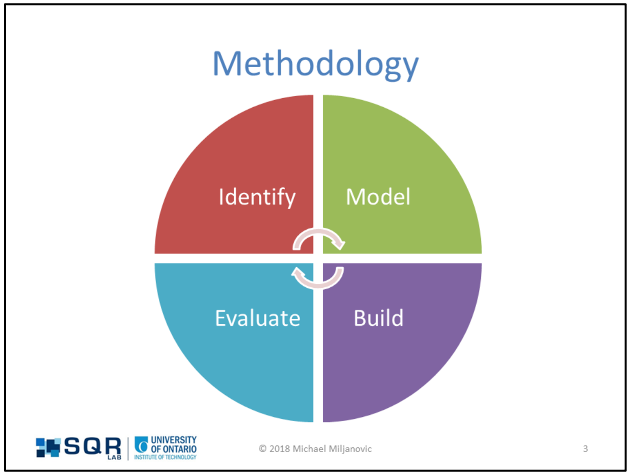
Evaluation

- **Reproducing past studies**
  - Replicate the game’s past studies and compare to the adaptive version
- **Multiple methods approach**
  - Use a variety of instruments (questionnaires, skill tests, interviews, game metrics)

Conclusions

- **A new practice for evolving legacy programming games**
  - Adaptation improves games by incorporating learner needs
  - Automated adaptation reduces the strain on human experts to select content
- **Future work**
  - Collecting empirical data from Gidget players
  - Looking for **feedback** about further applications

Review



Methodology

Identify

Model

Evaluate

Build

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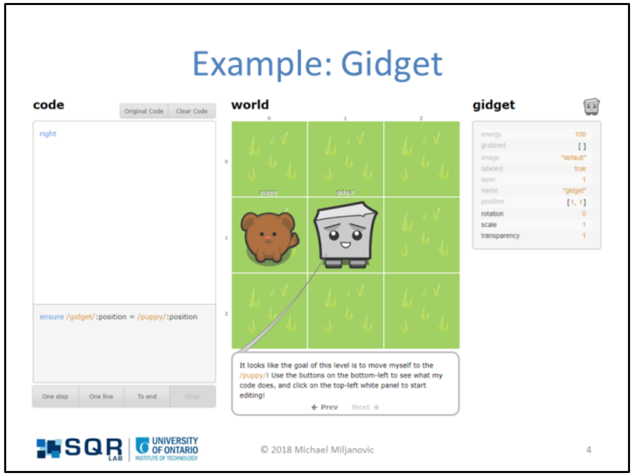

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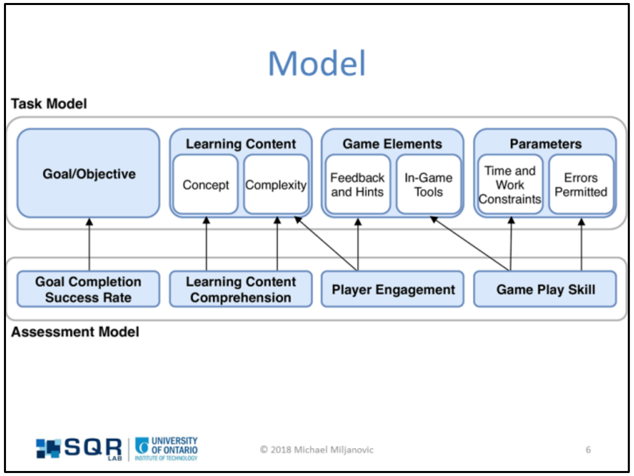

Model

Task Model

Goal/Objective

Learning Content: Concept, Complexity

Game Elements: Feedback and Hints, In-Game Tools

Parameters: Time and Work Constraints, Errors Permitted

Goal Completion Success Rate

Learning Content Comprehension

Player Engagement

Game Play Skill

Assessment Model

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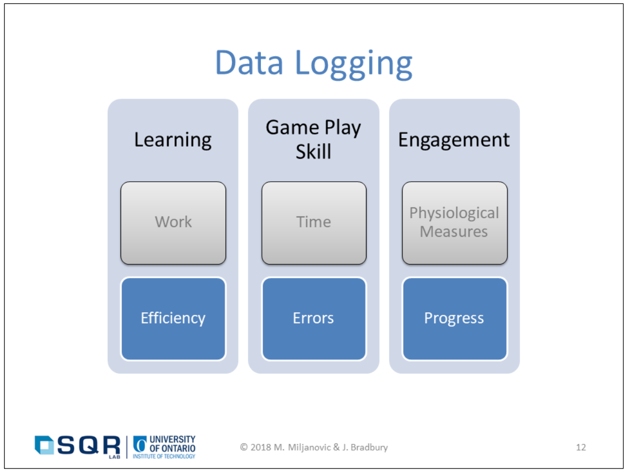

Data Logging

Learning	Game Play Skill	Engagement
Work	Time	Physiological Measures
Efficiency	Errors	Progress

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