

# Flow, Control, Learning: a discussion of research results

Jon Pearce  
Interactive Design Group  
The University of Melbourne  
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jonmp@unimelb.edu.au



## Overview

- Description of experiments
- Findings:
  - **learning**
  - **flow**
  - **interactivity & control**
- Issues
- Next experiment?

# An experiment

## ■ Aims

- explore learning, flow, control

## ■ Lab experiment

- subjects
- tasks: “simulation” + “movie”
- tests
- skill/challenge measures
- post survey: enjoyment, control, engagement

You have now completed *an activity*.  
 Before you continue please answer the following...

(a) How **challenging** did you find this last activity?

challenge too low      challenge just right      challenge too high

(b) Were **your skills** appropriate for understanding this last activity?

my skills too low      my skills just right      my skills too high

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# (a) Learning

## ■ Overview

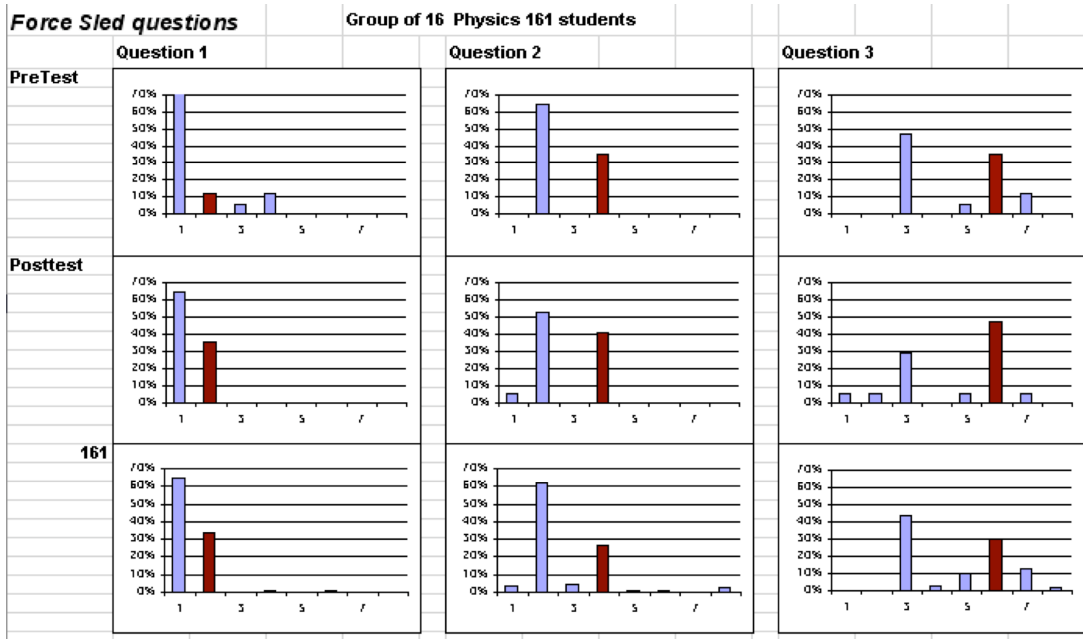
- **IS students - not much!**

Pre	Post	161
33%	32%	31%
19%	24%	22%
26%	28%	26%
23%	23%	15%

- **Physics students - some**

Pre	Post	161
29%	41%	31%
19%	33%	22%
29%	39%	26%
20%	27%	15%

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## Learning: conclusions

- Match between task and test was not optimal
- “Simulation” students learnt slightly more than “Movie” students
- Physics concepts are hard to shift!

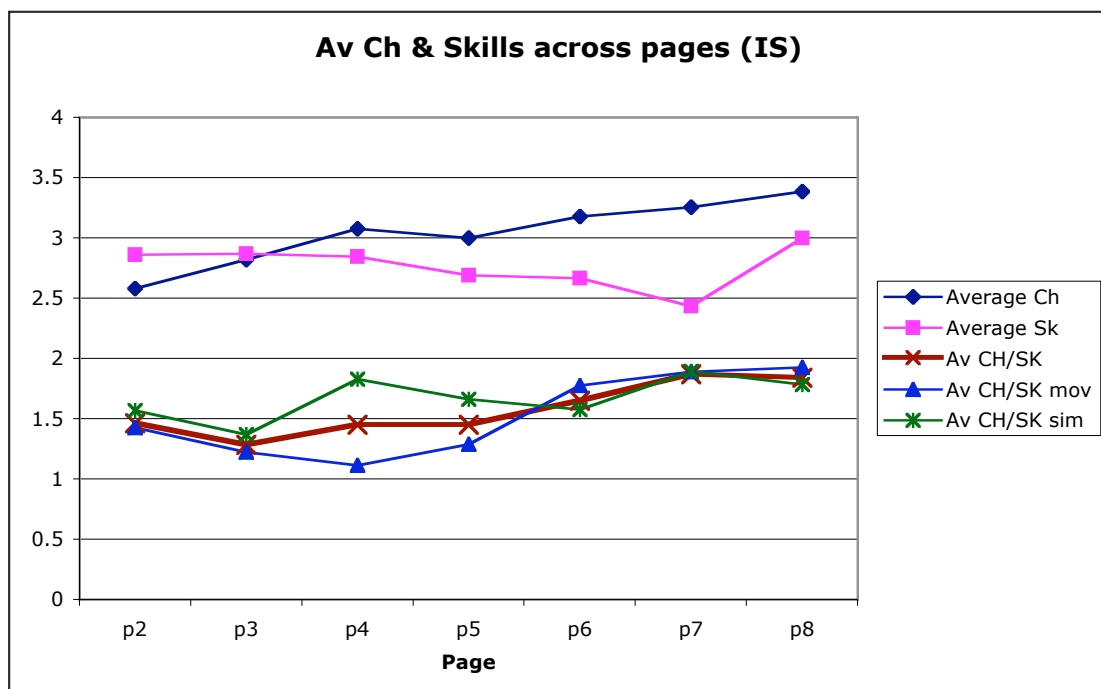
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## (b) Flow

- Two models:
  - **Ghani Flow = enjoyment + engagement**
  - **Webster Flow = enjoyment + engagement + control**
- Measured throughout tasks
- Measured in survey at end:
  - **PCA => “enjoyment’ & “lack of control”**

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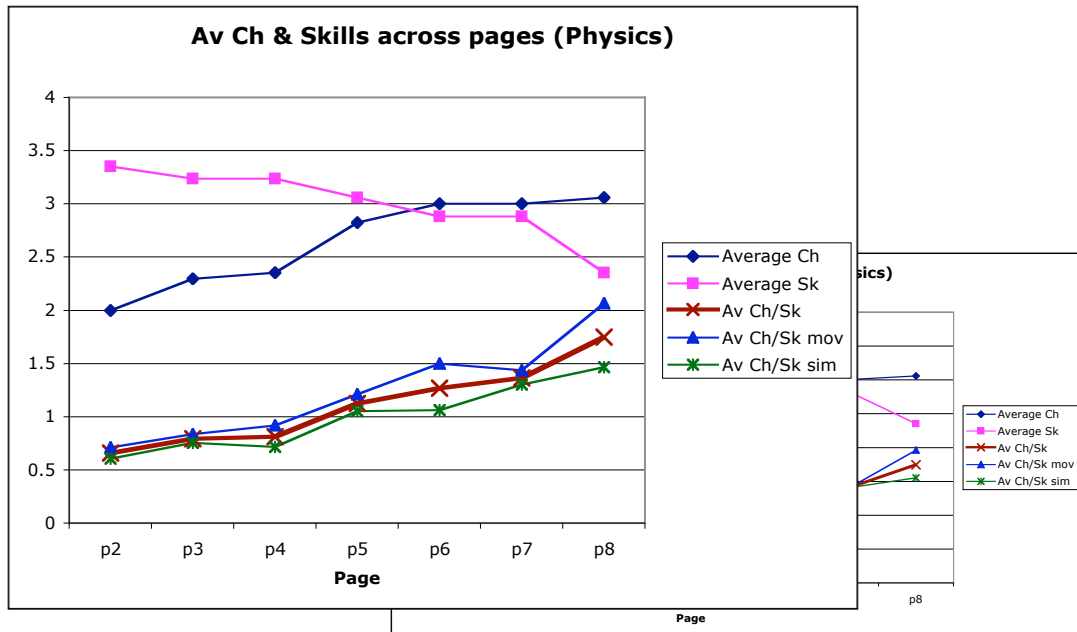
## Flow through the tasks



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(updated plot - 12-02-03)

# Flow through the tasks



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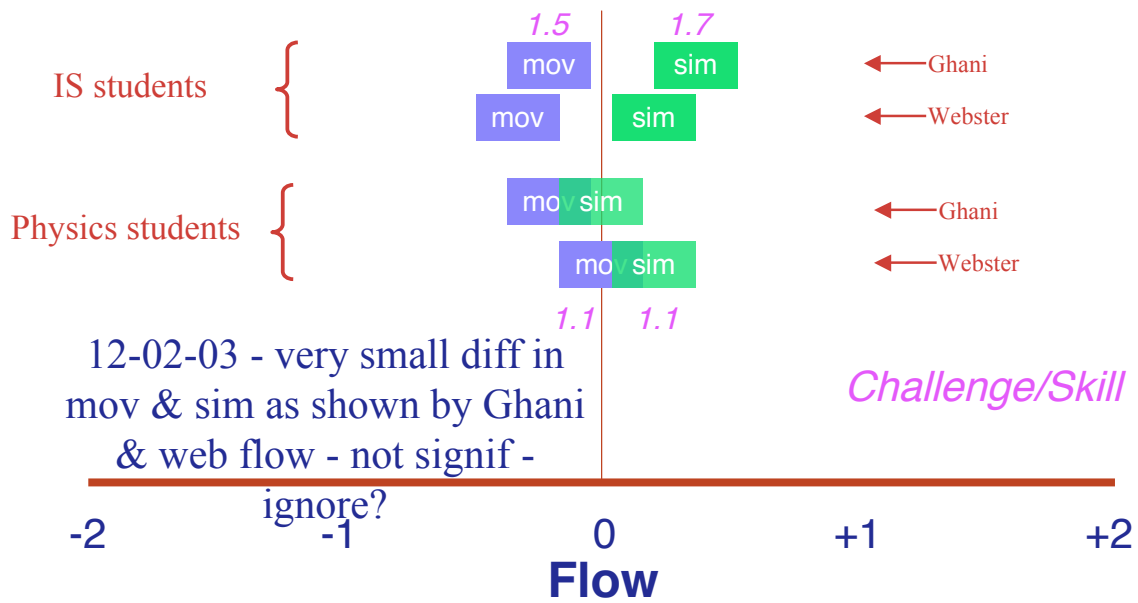
# Flow average measures

	Ch/Sk (1-5)	Ghani & Webster (norm'd)	
	<i>I =&gt; flow?</i>	<i>high =&gt; flow?</i>	
<input type="checkbox"/> IS (mov)	<b>1.5</b>	<b>-0.2</b>	<b>-0.3</b> (sig 0.08)
<input type="checkbox"/> IS (sim)	<b>1.7</b>	<b>+0.3</b>	<b>+0.2</b>
<input type="checkbox"/> Physics (mov)	<b>1.1</b>	<b>-0.1</b>	<b>+0.04</b> (not sig)
<input type="checkbox"/> Physics (sim)	<b>1.1</b>	<b>-0.04</b>	<b>+0.1</b>
<input type="checkbox"/> IS	<b>1.6</b>	<b>+0.03</b>	<b>-0.04</b> (not sig)
<input type="checkbox"/> Physics	<b>1.1</b>	<b>-0.08</b>	<b>+0.1</b>
<input type="checkbox"/> Total (mov)	<b>1.4</b>	<b>-0.2</b>	(sig ~0.1)
<input type="checkbox"/> Total (sim)	<b>1.5</b>	<b>+0.2</b>	

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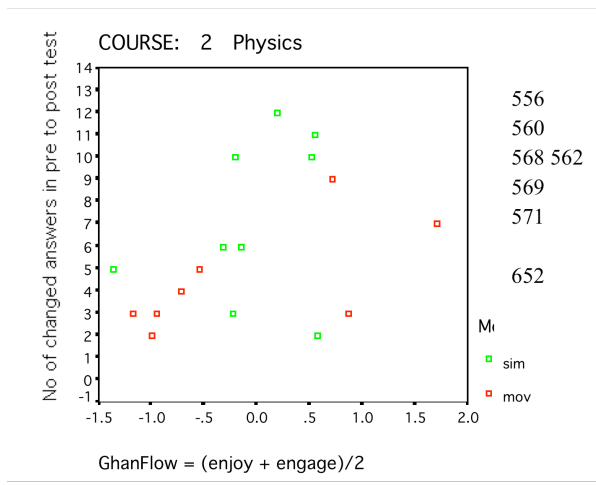


# Flow average measures



# Flow & learning - one view

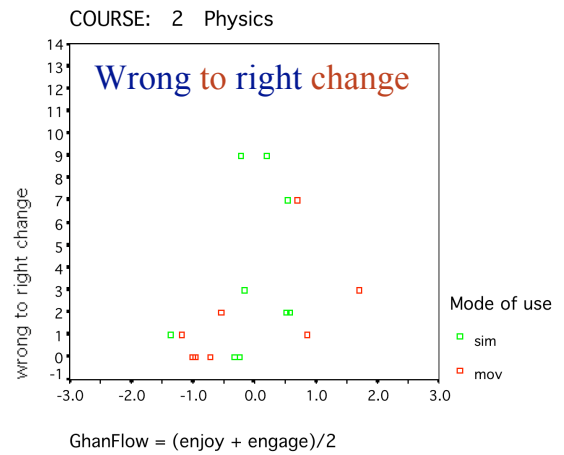
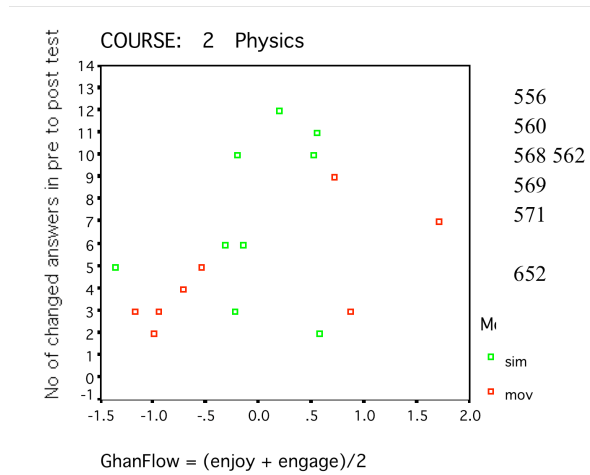
Changed answers of Physics group as fn of GhanFlow - labelled by mode





# Flow & learning - one view

Changed answers of Physics group as fn of GhanFlow - labelled by mode

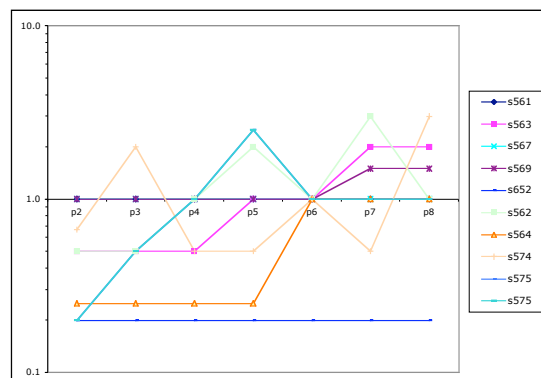
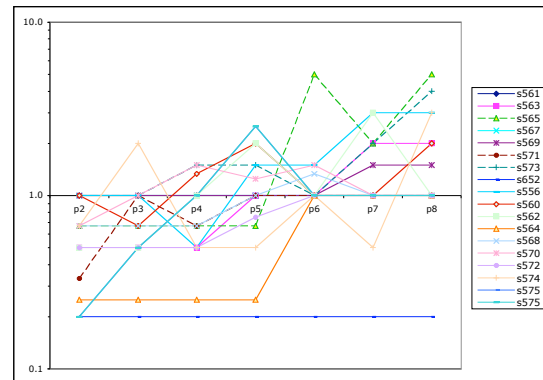
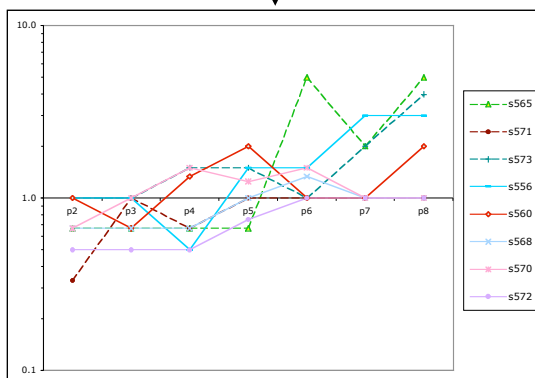


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## Another view

Physics students  
all  
“difficult”  
“stimulating”



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## Flow: conclusions

- Interpretation of “challenge”
- Indication that *simulation* produced more flow than *movies*
- Hard to relate flow to any learning outcomes
- Hard to measure flow!

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## (c) Interactivity & control

- “Perceived control”
  - **Physics students perceive better control than IS**
    - (0.5 compared with -0.2, normalised, sig. 0.02)
    - Difference more pronounced for “movie”:

	Physics	IS
Sim	0.5	0.0
Movie	0.4	-0.3

- **(diffs within courses not signif)**

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# Interactivity & control

- Learning & Control
  - **Physics show slight negative relation between learning & control (none for IS)**
- Interactions
  - **Who clicks? Simulation more than movie**
  - **Who learns?**
    - movie - minimal clickers
    - simulation - minimum up to double, but not a lot
  - **Who's in control? more clicks  $\Leftrightarrow$  less control (weak)**

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# Interactivity conclusions

- Click patterns and control have some weak relation to learning

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## Issues

- Need better learning/testing experience
- Need more focused task

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## What next?

- Experiment...
  - focused task(s)**
  - directed, exploratory instructions**
  - secondary distracting task?**
  - by observation or remote data collection?**
  - still look for flow, control, learning?**

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