Programming Goes Back to School

Broadening participation by integrating game design into public school curricula

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part 1

“Programming is hard and boring”
“programming is hard and boring”
where we want to be

Holy Grail

cognitive

easy

hard

boring
affective

exciting
where we were

cognitive
easy

compute
prime
numbers

C++, Emacs

hard

boring

affective

exciting
making programming easier

Syntactic Support
Mission Accomplished

not quite

1995:
AgentSheets pioneers drag and drop programming
Now that you have Spelllllllchecking...

Go ahead and write a best selling novel!
making programming easier

- Semantic Support
- Syntactic Support

cognitive

easy

hard

boring

affective

exciting
Pre-bugging
making programming exciting

Ownership & Creativity
Creativity$^{3D}$ Tools

Inflatable Icons
does it work?
> 10,000 students
“programming, oh no... I know what is going to happen. The teacher writes a program onto the blackboard, we type it into the computer and it never works” – student
strategy

exposure, motivation, education, and pedagogy
strategy Exposure

Try the vegetables once!

sneak a one week game design unit in between keyboarding and PowerPointing of “forced electives”
results Exposure

- study: over 10,000 students in inner city, remote rural, and Native American Communities
- some middle schools expose 350 students per year
- 45% girls, 55% boys
- 48% underrepresented
- Alaska, California, Colorado, Georgia, Ohio, South Dakota, Texas and Wyoming...
strategy Motivation

Scalable Game Design:

start with simple 2D games that everybody can build in a couple of hours

gradually advance to sophisticated 3D games with advanced AI, visualization, ...
results Motivation

- 74% of boys, 64% of girls (100% for some schools); 69% of minority students want to continue
- used in elementary, middle, high schools and university level
strategy Education

Computing
Computational Thinking
results Education

we have created the Computational Thinking Pattern Analysis instrument that can track student learning outcomes and indicators of transfer
Systematically investigate the interaction of pedagogical approaches and motivational levels so that teachers can broaden participation.
Pedagogy is the key to broadening participation

- Guided discovery (inquiry-based)
- Self-directed discovery (open ended exploration)
- Direct instruction (step-by-step tutorials)

Motivation girls:
- Less scaffolding
- More self-directed discovery

Motivation boys:
- More scaffolding
- Less direct instruction

Results Pedagogy
Design for Sustainability
Project First Pedagogy

Csikszentmihalyi meets Vygotsky
Zones of Proximal Flow

AgentSheet & AgentCubes projects

City Traffic
the Sims
Bridge Builder
Pac Man

Forest Fire
Frogger

simulations
games

challenges

anxiety
ZPD
Flow
boredom

skills

0% computational thinking patterns
100% computational thinking patterns

Project first, then principles; Project first, principles first.
2 minute demo

- access AgentCubes online:
  - need to have HTML5 compliant, WebGL enabled browser, e.g., Chrome, FireFox, Safari (with WebGL enabled)
  - Google Chromebooks work!

- http://hourofcode.com/ac
conclusions

🔹 We can move from “hard and boring” to accessible and exciting and bring computer science education to schools.

🔹 **INVITATION**: If you are interested in exploring Scalable Game Design in your country please contact me.
• http://scalablegamedesign.cs.colorado.edu
• ralex@cs.colorado.edu
• http://hourofcode.com/ac
• WIRED article on programming, October issue