Active Learning Techniques for General Education Computing

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Goals

- Why I adopted my instructional design
- Give a feel for how that supported/enabled the experiences students reported in the class
  - Confidence, Changed View of Technology, Analysis, Transfer, Communication
  - Questions that I dropped, because I stopped thinking like someone training "computer scientists"
  - What they can "do" on the final exam
- What supporting materials would help you?
  - What alternatives to "clickers" are there?

Why Peer Instruction?

- Concern: People seem to think university faculty have teaching methods to be modeled
  - 40-60% fail or withdraw rates are not uncommon in CS1
- Me: Architecture/Compilers -> Computing Education Research
  - Science Teaching and Learning Fellow
- CS1: Using Media Computation AND Peer Instruction
  - Retention 76% -> 91% 1 year later (20% attraction)
  - Withdraws down to 0-3 per term
  - Pass Rate 81% -> 88%

Exploratory Homework → **QUIZ** → Lecture → Lab → Exam
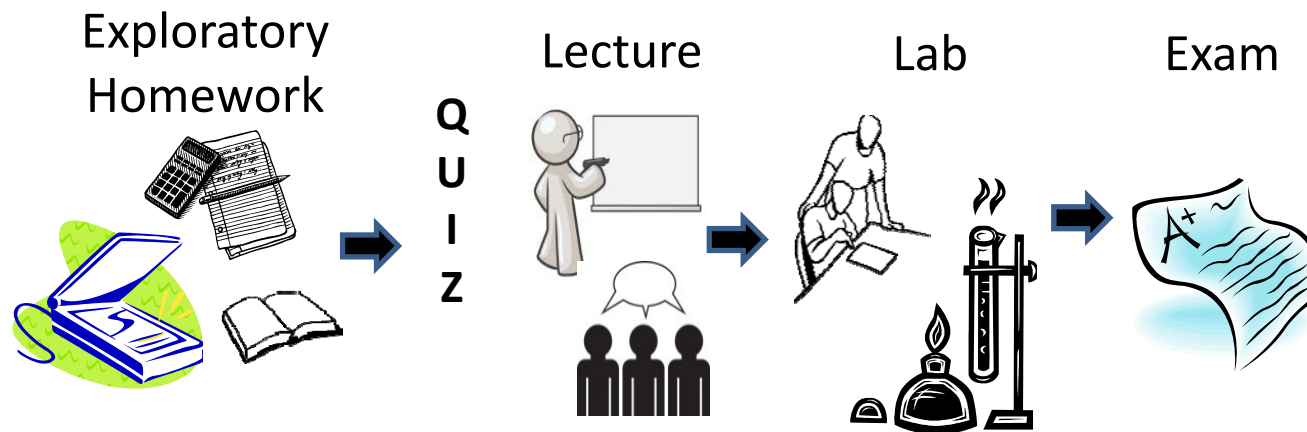
1) Individual Vote
2) Group Discussion (fixed 3 person)
   Tutors actively engage groups in justifying/talking
3) Group Vote (consensus required)
4) Class-wide Discussion
   Led by Students First – Explain WRONG answers
   Final Cognitive Modeling by Instructor

Simon, et. al. Experience Report: Peer Instruction in Introductory Computing, SIGCSE 2010

What does this code do?

- World with three "drivable" objects
  - Forward, Turn by .12 revolutions (1/8th of the way around)
  - Midterm Practice: How many events would I need and what would they control? (hint > 4)

  The scene: ⟶

When does a party happen?

A. If any of the objects is near the palmtree

B. If all of the objects are near the palmtree

C. Something else (e.g. multiple parties...)

```
⊟If   whiteRabbit ▾   is within  .2 meters ▾   of  island.palmtree ▾  ▾
    World.party partier1 = whiteRabbit ▾   partier2 = cow ▾   partier3 = penguin ▾
Else
    ⊟If   cow ▾   is within  0.2 meters ▾   of  island.palmtree ▾  ▾
        World.party partier1 = whiteRabbit ▾   partier2 = cow ▾   partier3 = penguin ▾
    Else
        ⊟If   penguin ▾   is within  0.2 meters ▾   of  island.palmtree ▾  ▾
            World.party partier1 = whiteRabbit ▾   partier2 = cow ▾   partier3 = penguin ▾
        Else
            Do Nothing
```

Let's make the beetles do a more complicated dance...

- Like this:

Which structure would you want?

A. One ForAllInOrder loop

B. One ForAllInOrder loop with an if statement inside

C. One if statement with a ForAllTogether inside

D. None of the above

Does this code correctly implement our intended behavior?

For all **World.Beetles**, one **Obj** item_from_Beetles at a time
> For all **World.Beetles**, every **Obj** item_from_Beetles_#2 together
>> item_from_Beetles_#2 move forward 1 meter more...
>> item_from_Beetles_#2 turn left 1 revolution more...
>> item_from_Beetles_#2 move backward 1 meter more...

A. Yes

B. No

C. I don't know

And WHY!

For all World.Beetles , one ⊞Obj item_from_Beetles at a time

item_from_Beetles move forward 1 meter more...

⊟For all World.Beetles , every ⊞Obj item_from_Beetles_#2 together

item_from_Beetles_#2 turn left 1 revolution more...

item_from_Beetles move backward 1 meter more...

What is new about this code?

- Nested "for all" loops
- A loop that "iterates" over all items in a list
  - Inside that is another loop that goes over all the items in a list
  - In this case, happen to be the same list
- Wow, you can do complicated things now... ☺

Questions I Dropped
Once I Accepted I Wasn't Training Computer Scientists

- Caring that students understand the rationale behind object-oriented design

- Testing

- All but the vocabulary is REQUIRED to have precise conversations
  - Parameter, Class Method, World Method, Event, Event Handler

Do you agree:
A chicken-class method cannot take a parameter that is a chicken object

A. True, If you are tempted to pass a chicken object as a parameter, use should be using the object that called the method

B. True, (see above) but it would be OK to have a different Object as a parameter

C. False, you could pass a chicken object as a parameter if that was the object the chicken should interact with

D. False, you should always have a chicken object parameter in a chicken-class method

Testing is more important in interactive worlds (than "animation" styles before)
What BEST explains why?

A. The interactive worlds have more methods in them

B. The interactive worlds allow the user to supply input

C. The interactive worlds can run (e.g. Play) in many different ways

D. I don't know

How To Write a Bad Clicker Question: Ask…

- About a simple definition
- Them to do something EXACTLY like you asked them to do in exploratory homework
- A question where getting the answer right doesn't require understanding the issue in depth
- A question you don't care about
- A question which doesn't inspire/require discussion

The Final Exam

- I believe:
  - Emphasizes Analysis
  - Checks for Deep Understanding of Concepts
  - Requires no/little memorization
- Your Feedback:
  - Seems simple?
  - Seems much too hard?
- Previous Version of Course's Exam:

9. From smallest to largest, the correct order is
   A. kilobyte, megabyte, terabyte, gigabyte
   B. gigabyte, kilobyte, megabyte, terabyte
   C. kilobyte, megabyte, gigabyte, terabyte
   D. terabyte, kilobyte, megabyte, gigabyte

10. Complete the following anchor tag that will display the Google logo (google_logo.gif) as the clickable hypertext image and when the image is clicked the browser will go to www.google.com – just like in Lab3 Gaga for Google – your first web page:

<a _____ ="_____"> <_____ src="_____"> <____>

11. Briefly describe why you would need to use the UCSD web proxy server?

12. An 8-bit sequence of memory in the computer is called a(n) _____ .

13. The _____ tag is a way to get more than one consecutive space in a line on a web page.

14. In an HTML tag like <hr width="50%">, the width part is called a(n) _____ .

15. In JavaScript, global variables are declared:
   A. inside the <script> </script> tags but outside any function definition
   B. inside the curly braces of a function definition

What (free) alternatives to clickers are there?

- Ubiquitous Presenter (http://up.ucsd.edu)
  - Students txt in or vote via web browser
  - Instructor Tablet no required (Windows required)
- Polleverywhere.com
  - Problems with latency
- Others?

What programming construct would you use?

> ⊟ **For all** world.froggies ▽ , one 🔲 item_from_froggies at a time
> item_from_froggies ▽ say Hello ▽ more... ▽

A. An if statement inside the For all in order

B. A counted loop inside the For all in order

C. An if statement before the For all in order

D. A counted loop outside the For all in order

E. I don't know…

- Big Idea: Previously we've used loops over lists to do the same thing to every item in the list, but we could use an if statement to do different things for different items.

- Correct Answer and Why: A – We'll use the if statement to figure out which froggie is currently the item_from_froggies so that frog says Bud, etc. That is – it depends on which frog it is to know what it is he should say (on the left should say Bud, in the middle should say Wei, etc.)

  PROGRESION NOTE don't say too much as we'll ask them to select the "best" if statement next

- Why Might Students Pick Other Answers/What Sort of Questions Might Be Asked:
  B They might pick this since they know that 3 things should be said. But we get the "3" from the fact that there are 3 frogs in the world.froggies list. A counted loop inside the current forall would have something happen 3 times for each frog (for a total of 9 things happening).
  C An if statement before the loop would only happen/execute once. Assuming the if tries to figure out what frog we have, we haven't started looping over all the frogs – we don't have an "item_from_froggies" yet to check in our boolean expression controlling the if
  D Similar to C, anything outside the loop only happens once – what would the counted loop be doing? How many times would it run

Would This Work for You?
Why? Why Not?