Research Questions

Does explicitly indicating sub-skills and providing practice for each sub-skill improve students performance in reading, explaining, and writing code? How does it affect their process of reasoning about code?

Data to collect:

- Assessment
    - Performance on assessment
        - Changes they make
    - Types of errors they make
- Instruction
    - Questions they ask

Contacts

Benji: ----------
Dastyni: ----------

Preparation

Confirmation (Wed morning)

- Room number
- Email if can't make it

Reminder Email (Fri morning)

- Bring laptop they can use
    - Laptop has latest version of Chrome, internet access
    - Can borrow from STLP and UW Libraries,
- Glasses, any medications or other things you might need during the day
- Water bottle
- Black pen

Logistics: Day Of

Location

Condition	Person	Room Number	Time Reserved	Capacity
Experimental	Benji	xxx xxx	9-4	30
Control	Dastyni	xxx xxx	9-4	30

Both rooms have equivalent equipment. This includes whiteboard, projector, clock, window. Students seated at fixed tables with chairs.

Schedule

Start: 10AM

Activity	Time Spent (in min)	Description	Time
arrival	10		10-10:10
Introduce study	5	Study objectives, privacy, agenda of day, end time	10:10-10:15
pre-survey	10		10:10-10:25
Instructions: curriculum	5	Explain curriculum structure, rules for working	10:25-10:30
Work on curriculum	150-165	2 hr 30 min scheduled, but can go up to 2 hr 45 min	10:30-1:15
break	10	snacks!	1:15-1:25
Buffer: rotation task	5-10	Mental rotation task	1:25-1:35
Instructions: assessment	10		1:35-1:45
assessment	60?		1:45-2:50
post-survey	15		2:50-3:05
Lunch + assessment review	45		3:00-3:45
			4:00 end

Equipment to Bring

For each room:

- Laptop + charger
- dongle
- Extra laptops
- 2 whiteboard markers + eraser
- Cell phone
- Paper for sign-in sheet (name, UW Net ID) + clipboard
- Snacks
- Water bottles
- Print outs
    - curriculum x N (num participants)
    - Mental rotations assessment
    - Assessment x N
    - protocol
- Clipboard with some paper
    - Pens: 3 blue, 3 black
- Sticky notes

Equipment to have students bring

- Water bottle
- Pen (not pencil)
- medication
- Laptop (+ charger if needed)
    - Can borrow from STLP and UW Libraries

Room Access:

Reference #xxxxxx.

If the classroom or building is locked please contact- Building Services at 206-685-1900 or for afterhours/evenings and weekends please call 206-685-1411. For access to the classroom equipment, or additional equipment needs please contact- Classroom Technology & Events at 206-221-5000; Options 9 for after hours.

Room Set-Up

- Chairs: For small groups, move any unneeded chair out of first row so participants can move in and out easily. Space remaining chairs out so participants have space to move papers around.
- Board:
    - Write "Programming Curriculum Study" on board up top
    - Write name on board and email.
    - Write Agenda for day (new line for each item below)
        - introduce study
        - Pre-survey
        - Instruction
        - Break
        - Assessment
        - Post-survey
        - lunch
- Place 1 black pen, water bottle for each participant.
- Lay out curriculum and assessment somewhere (at least partially) out of sight
- Set up snacks on table to side. Ensure trash can nearby.
- Open laptop
    - Plug in charger
    - Open Slack
    - Mute laptop
    - Open Drive folder Cyberlearning/quadrant_study
    - Open notes document
        - notes: benji
        - notes: dastyni (updated link)
- Once everything is set up, send other researcher a Slack message saying you're ready (or you need help)

Arrival (10:00-10:10)

Students will arrive.
As they do, **WRITE DOWN**:

- name,
- course they heard about study from (INFO 101, INFO 200, INFO 201)

Have all students sit at table set up in front.

With free time, instructors should get to know students (year, major, what got them curious about learning to code). Get to know students. Encourage students to meet each other.

Ask students: "The study should wrap up some time around 3PM, certainly by 3:30PM. Do you have anything scheduled immediately after this study that would require you to leave at a certain time?"

WRITE DOWN

- what student's motivations for participating in study, learning to code are (if they share it)

If everyone has arrived and people are no longer interacting, you can start at 10:05.

Introduce study (10:10 - 10:15)

Overview:

- Thank them for coming.
- Who researchers are (name, researcher)
- Objective of study: To evaluate a new curriculum for programming.
- Questions?

#TODO: Before you begin script, Slack at other instructor to let them know you are about to begin.

Script (Be high energy!):

1. "Let's go ahead and get started. Thank you all for coming today!"
2. "I'm <NAME>, a PhD student in the University of Washington Information School working with Professor Andy Ko. I've spent the past many years researching and also teaching introductory programming. "
3. "Today, you will be helping my research team and me evaluate a new curriculum to teach programming."
4. "The data we collect today is for research purposes only. Nothing you do today will directly affect your grades in any of your courses and your personal information will never be shared publicly. Are there any questions about the study objective or the use of your data?"
5. "I've written on the board an agenda for the day. You will soon begin a pre-survey to learn more about you. I will then provide you some more instructions about how you will use the

curriculum and then you will spend most of your time working with the curriculum. We'll then have a break and get your lunch orders. After the break, you'll take an assessment to measure what you know. We'll then have you take a post-survey, provide you lunch. After lunch, you are welcome to hang out and you can use me as a resource to help you with anything programming related. This could be helping you run code on your laptop or help you understand how programming can support your major or career interests. I'd encourage you to stay for that."

6. "That's an overview of the day. I'll provide you more information about the curriculum and the assessment later. Are there any questions about the agenda that I can answer?"

Pre-survey (10:15 - 10:25)

Overview:

- Individually take pre-survey on computer. Put away laptops when done.
- Write pre-survey URL on whiteboard: **tiny.cc/cs1-pre**

Script:

1. "Let's move onto a survey to find out more about you all."
2. "Knowing about your motivations and prior experiences related to programming is critical to our data analysis, so please provide thoughtful responses."
3. "The survey is accessible via a link I'm about to write on the board. Please take out your laptops now, open up a browser, and write down the link I'm about to write down on the board."
4. **#TODO**: write URL on whiteboard: **tiny.cc/cs1-pre**
5. "The link to the pre-survey is on the board. Go ahead and start working on that. Put away your laptops after you finish the survey."
6. **#TODO**: If student needs a laptop, provide spare. If multiple need laptops, have one of them use their phone.
7. **#TODO**: start timer for 10 minutes
8. **#TODO**: Slack at other instructor to let them know pre-survey began
9. **#TODO**: after 5 minutes, walk around and see where people are. They should be at or past section 4 of 7 (free response questions). If they are not, you may need to allow an extra 3 minutes.
10. **#TODO**: after 8 minutes, ask "You still have time, but when you finish the survey go ahead and put away your laptop so I know you're done."
11. **#TODO**: Erase pre-survey URL from board.
12. **#TODO**: after 10 minutes if laptops still out: "Go ahead and wrap up over the next minute or two."
13. #TODO: After 10-13 minutes: "Ok please make sure you've submitted the survey and close your laptop and we'll move on to the learning part!"

Instructions: curriculum (10:25-10:30)

Overview:

- Explain that study is to judge teaching materials, not participants
- Curriculum objective, how to approach instruction
- Explain role of researcher
- Metacognitive prompts
- Experimental condition only: explain quadrant of skills

Script: Curriculum objective

1. "Great so in a few minutes we'll get started with the learning from the curriculum. This will consist of working through a packet of paper with instruction to read and practice problems to work through. Your goal will be to learn as much as you can to perform well on an assessment to measure your knowledge."
2. “While you work on the packet, I’ll be here taking notes, typing to communicate with another researcher, updating the time you have left and writing it on the board, and helping to answer your questions.”
3. "I want to emphasize that we are here to judge the teaching materials, not you. If you are confused or something is difficult, that's the curriculum's fault, not yours!"
4. "One way to make this learning more effective is to ask questions. If you're unsure about anything, just ask!"

Metacognition:

1. So the practice problems in the curriculum may ask you to explain your plan for solving a problem or explain the code you write. These prompts are about understanding your *metacognition*.
2. *"Metacognition* is the awareness and understanding of one's own thought processes. It is a critical part to learning."
3. "To help you make the most out of practice, we'll provide you with metacognitive prompts as you practice reading and writing code. So when you write code, we may ask you to plan out your code beforehand or write comments next to each line of code afterwards. Research suggests that metacognitive prompts like these will help you make the most out of your learning."
4. PLANNING: "For some practice problems, we'll ask you to describe a step-by-step plan that describes the code you will write. This plan should be detailed enough for a stranger to look at it and follow along with your thought process when you are coding."
5. In example, say my task was to give change to a customer when they paid with a $20 bill for an item that costed $3.59.
    a. Subtract 3.59 from 20 to calculate the change due to the customer
    b. Get $10 bills until the amount of change is less than $10 bills. Then I'll repeat for $5, and then $1 bills
    c. After the change due is less than $1, I'll repeat the process with quarters, dimes, nickels, and then pennies.
    d. Finally, I'll give the customer the change
6. To summarize, please put effort into the metacognitive prompts (comment your code, plan your code). This information is critical to help us understand your thought process and will help you better learn the material!
7. Are there any questions?
8. This information will appear on one of the first pages in the instructional material.

EXPERIMENTAL ONLY: Script: explaining quadrant of skills.
(Control: Skip this and move on to "Script: Curriculum instructions")

- Programming is an ability made up of many skills. We're going to have you practice 4 of these skills…

Script: Curriculum instructions

1. #TODO: Get 1 packet and place on table so participants can see it.
2. "Now let me tell you more about the curriculum packet. I admit, the stack of pages seems a bit large but it's single-sided and the font is large and we've designed the curriculum so it should be approachable and it has a nice balance of instruction to read and problems to practice."
3. “For our study to be successful we ask you to work only from this packet. So that means no outside sources like accessing your laptop of phone to look things up for instance.”
4. "You'll read through each page and some will require you to work through a practice problem. The solutions are provided in the packet as well."

5. "An important thing to note that is after you work on a page, write your initials in the bottom right of the page so we know you read that page. You'll see space in the bottom right of each page for that."
6. "So to recap, you'll have a total of 2.5 hours to work through this curriculum. We won't continue to the assessment until after time is up. If you finish it early, I encourage you to review anything you weren't sure about, and it would be helpful to us if you could mark the areas that you thought were hard or confusing. If you have a question, just blurt it out and we'll help you with it. Please pace yourself and take breaks! You're free to get up, walk around, get snacks as needed."
7. "Are there any questions?"
8. #TODO: Answer questions
9. "Ok. I'll keep time for you all on the whiteboard and make periodic announcements. I'll pass out the curriculums and you may begin!"
10. #TODO: distribute curriculums
11. #TODO: Start time.
12. #TODO: On board, write
    a. "TIME REMAINING" with box beneath it. In box, write "2 hrs 30 minutes"
    b. "ASK QUESTIONS ANY TIME BY JUST SPEAKING UP."
    c. "WHEN FINISHED, ORGANIZE PAGES BY PAGE NUMBER."
13. #TODO: Slack at other instructor to inform them you are beginning instruction

Work on curriculum (10:35-1:05)

Overview

- Answer questions, take notes
- Keep track of time
    - Remind students to take breaks
- Participants can get up, walk around, get snacks, take breaks
    - Cannot consult external resources, use laptops, etc.
    - If finish early, encouraged to review materials
- Take notes
- Periodically check in with other instructor (see what they are observing, what data may be interesting)

Script: Facilitating question answering

1. When question asked, instructor gets clipboard with paper, gets up and sits in empty chair at island of tables.
2. To answer question, reference part of curriculum (try to avoid explanation unless question is out of scope of curriculum)
3. **#TODO**: Record data on question:
    a. who asked it
    b. What initial question was
    c. Question refinement process

    d. Who answered
    e. How answered

Script: Updating time

1. Update time remaining on board. After update, announce "you have <TIME REMAINING> remaining"
    a. 2 hr, 1 hr 30 min, 1 hr, 45 min, 30 min, 15 min, 10 min, 5 min

Script: Wrapping up (when time is up or after every student has stopped looking at packet for at least 5 minutes)

1. #TODO: Slack at other instructor informing them you are about to wrap up
2. #TODO: Benji creates online Jimmy John's order and sends Dastyni sign-up link.
3. "Let's go ahead and wrap up. Take a minute to go ahead and organize your pages by page number and put them in a stack and I can collect them."

Break (1:05-1:15)

Script

1. "Go ahead and take 10 minutes to take a break. I encourage you all to get up, walk around, and get a snack."
2. "I will also be taking your Jimmy John's orders, so some time during your break come by and order from my laptop. You all definitely deserve it!"
3. #TODO: As participants come up, ask them how they are doing and what they thought of the curriculum. Record notes on perceived motivation or fatigue levels, thoughts on curriculum for each student.
4. #TODO: Erase from board the number in time remaining box, rules, and finish early instructions.
5. #TODO: collect curriculum packets and ensure pages are ordered and stacked. Clip pages of each packet together and set aside.
6. #TODO: restructure tables so students are no longer looking at each other (see figure)

7. #TODO (With 2 minutes remaining): make sure everyone is back in the room

Buffer Task

Script:

1. "Just to wake everyone's brains up, we're going to do a quick little mental rotation game."
2. "I'll pass out the instructions and then explain what's happening."
3. "So at the top of page 1, you'll see a row of 5 figures. All these figures are pictures of the same object at different angles."
4. "In the row of 2 figures below, you'll see that this figure is different."
5. "This task is about identifying which figures are pictures of the *same* object at different angles.
6. "At the bottom row of 5 figures, look at the leftmost figure. Now **2** out of 4 of the remaining figures are pictures of that leftmost figure at different angles. Go ahead and figure out which 2 they are and put an X in the 2 boxes you select"
   (wait for people to do task)
7. "What boxes did people select?" (1st and 3rd are correct answers)
8. "So to recap, this task is about looking at the figure on the left side and then figuring out 2 out of the remaining 4 figures are pictures of the leftmost figure at different angles."
9. "Are there any questions?"
10. "Go ahead and flip this page over and practice 3 more times."
11. (Wait 1 min for them to practice.)
12. "Ok so now I'm going to pass out a sheet with figures printed on front and back. I'll put 3 minutes on the clock and we'll see how many rows you can get through!"
13. Pass out sheets and start time.
    (wait 3 minutes)

14. "And that's time! What'd people think of that?"
15. "Write your name at the top of the sheets and then I'll collect them."
    (collect sheets)

Instructions: assessment (1:20-1:30)

Overview:

- Objective of assessment
- Describe how they should explain steps they took and why that's important
- Example of describing steps
- Assessment logistics

Script:

1. "So we will now move on to the assessment. The objective here is to measure what you learned and try to understand your thought process. This time we are asking you to work alone, so you are free to ask me questions if you are confused about the instructions, but we won't be doing group questions anymore."
2. "It is important to understand that this assessment is NOT meant to judge YOU. It's meant to measure what you know and how well our materials taught you. Do your best, but don't feel bad if you can't figure something out. Again that's our fault for not teaching it well. And that's what we are here to figure out!"
3. "We would like you to first review all questions first and then answer the ones you feel are the easiest questions first. If you feel like you're stuck, feel free to move onto the next question. You can always go back and try to finish it later. The goal is to have each question answered to the best of your ability."
4. "The assessment consists of 7 questions covering the material you just learned. After each question, we'll ask you a few questions on what you thought of first when solving problem, what about the problem you found difficult, and we'll ask you to rate the difficulty of it. These prompts are critical in our data collection because it helps us understand your thought process, so please be as detailed as you can."
5. "You will have about 1 hour to complete the assessment. If you need more time, we can certainly give it to you. Please be sure to try to answer each question as well as the follow-up questions for the questions."
6. "If you can't remember something during the assessment or got confused while trying to answer one of the questions, We encourage you jot a note about it, maybe at the bottom of the page, letting us know. That can be really helpful."
7. "Any last questions?"
8. #TODO: Answer any questions
9. "Ok I'll pass out the assessments and then you may begin."
10. #TODO: pass out instructions.

Assessment (1:30-2:30)

Script

1. #TODO: Set timer for 60 minutes
2. #TODO: Write "60 min" in the time remaining box
3. #TODO: Slack other instructor and inform them that you started assessment
4. #TODO: Update time remaining box at 45, 30, 15, 10, 5, 3, 1 min and announce time remaining at each update.
5. #TODO: with 15 minutes remaining: walk around and see how far students are. May need to budget more time. If you need to, Slack at other instructor to confirm this change.
6. #TODO: After time expires: "That is time. Go ahead and finish your last thoughts and put your pens down."

Post-survey (2:30-2:45)

Script:

1. "Great job completing that assessment! We will look them over and can provide you feedback if you want. Now as we wait for lunch to arrive, please go ahead and take out your laptops and fill out a post-survey. I'll write a link onto the board now."
2. #TODO: Write link to post-survey on board: tiny.cc/cs1post
3. "The survey will take you about 10-15 minutes and by then lunch will have arrived."
4. #TODO: replace pens with different color pens
5. #TODO: move desks back to original "island" formation with a chair for you to sit at too
6. TODO after everyone finishes: "Go ahead and put your laptops away so you don't get food on them."

Lunch, Open Time (2:45-3:45)

Script:

1. TODO: replace black pens with blue pens
2. "As we are eating lunch, we want to give you all an opportunity to ask questions and check your work on the assessment. I will pass back the assessments and you can look through them and ask me questions. Feel free to fix your answers."
3. "We want to be able to tell the difference between what your originally wrote and what you changed, so I replaced your pens with blue ones so we know you wrote that after the assessment ended. And please don't completely cross anything out!"
4. "Does that make sense? Are there any questions?"
5. "Ok. I'll pass back the assessments, curriculum, and lunch!"
6. #TODO: distribute assessments, lunch. Sit with students with laptop and/or clipboard for taking notes about questions, what they talked about

7. #TODO: note which students are reviewing their assessments, which question, what resources they are consulting (curriculum, others)
8. #TODO: feel free to ask questions to better understand what they are doing. Try to avoid pointing them in a direction.

Feel free to run their code on Python Tutor with them.

As students walk out, thank them and tell them if they expressed interest, we'll contact them about potential follow-up opportunities.