“I Feel Like I’m Teaching in a Gladiator Ring”: Barriers and Benefits of Live Coding in Classroom Settings

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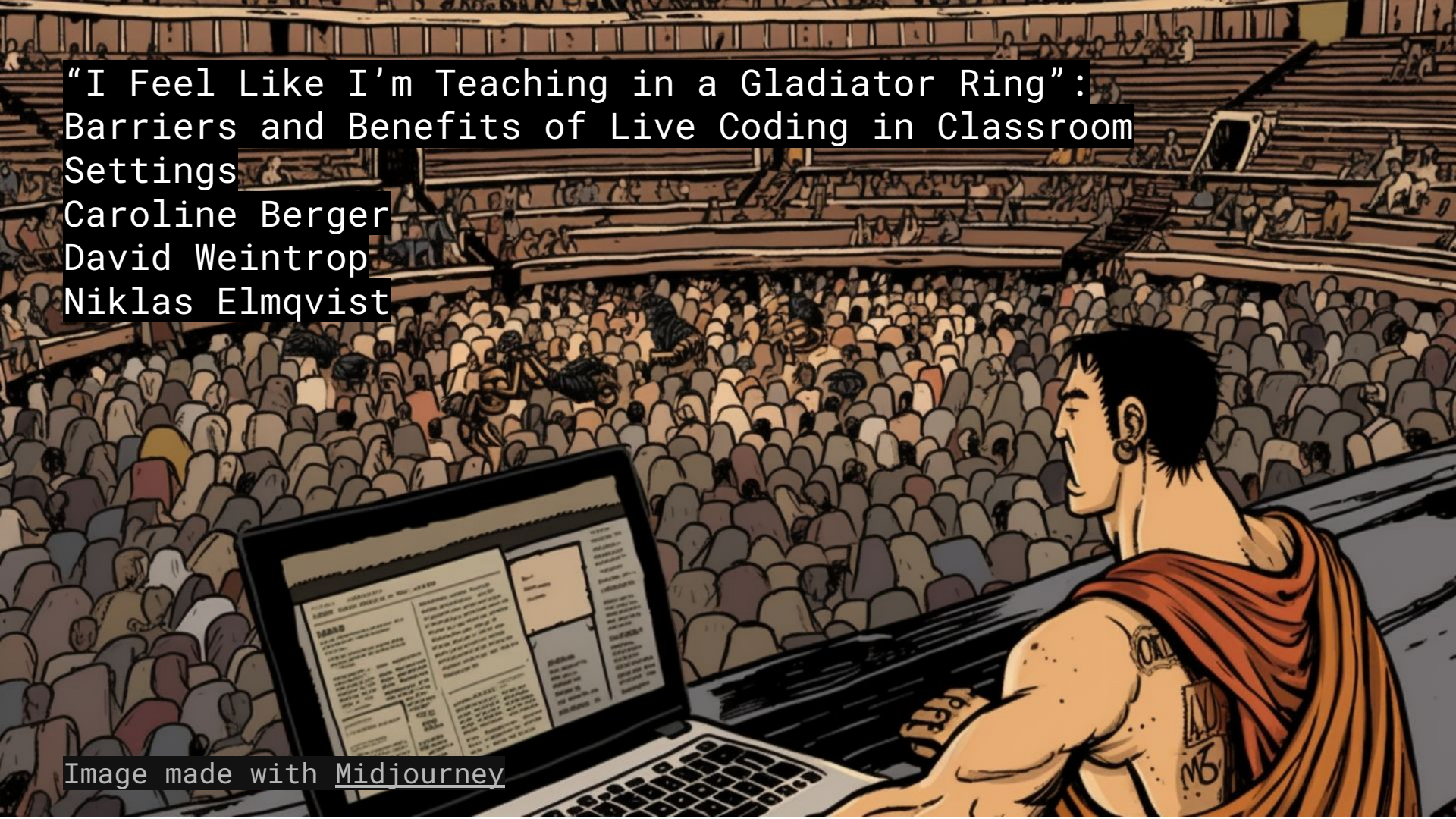
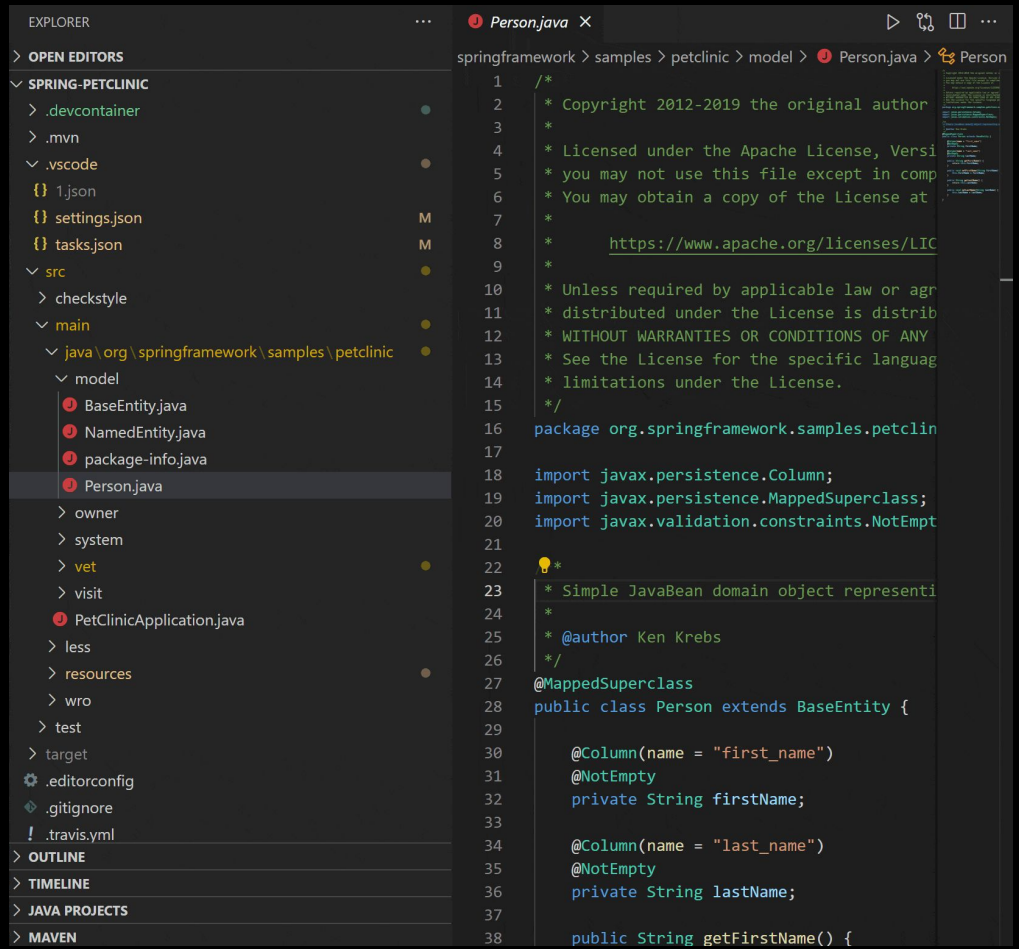


Image made with Midjourney

*“And then I’m teaching [...] in a classroom that feels like a **gladiatorial ring**. 200 seats in a wall up in front of me. And I have to lean back to see the top. And really the only constraint in that classroom is that it’s **terrifying**. It is the most terrifying experience I’ve ever had.”* — Participant 08 (Computer Science instructor)

Live coding is “the process of writing code live on a computer in front of students during class”

Selvaraj et al. Live coding: A review of the literature.ITiCSE '21.



GIF source Foojay.io

BACKGROUND

Image source Wikipedia

COGNITIVE APPRENTICESHIP

THEORETICAL FRAMEWORK

COGNITIVE APPRENTICESHIP

• Modeling: “teacher performs a task so students can observe”;
• Coaching: “teacher observes and facilitates while students perform a task”;
• Scaffolding: “teacher provides supports to help the student perform a task”;
• Articulation: “teacher encourages students to verbalize their knowledge and thinking”;
• Reflection: “teacher enables students to compare their performance with others”; and
• Exploration: “teacher invites students to pose and solve their own problems”.

Collins et al. Cognitive Apprenticeship American Educator. 1991.

THEORETICAL FRAMEWORK

Interview

2 instructors
7 teaching assistants
6 students

What makes live coding hard?

In an ideal world, how could tools support live coding?

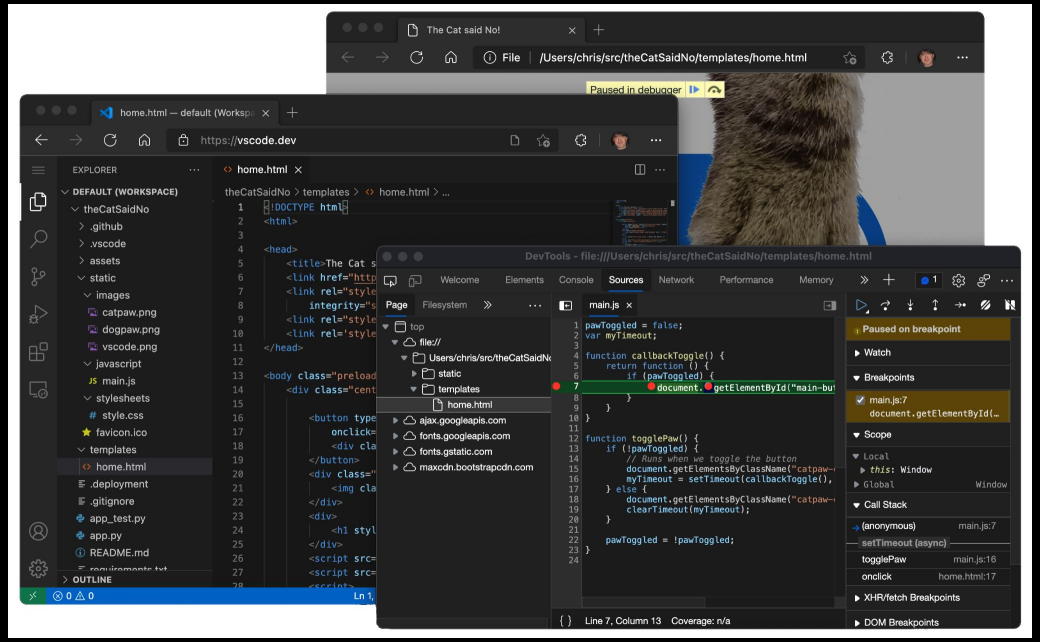
METHOD

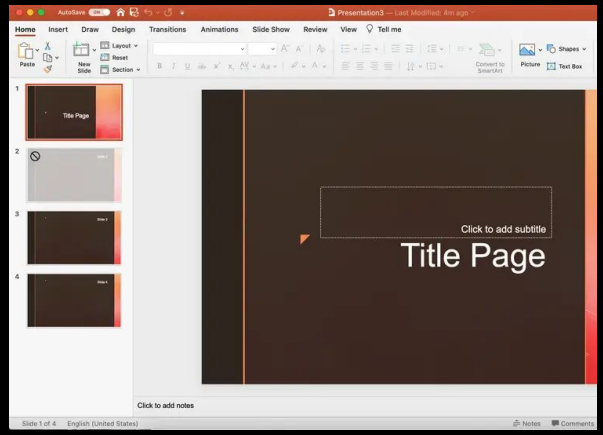
Teaching environment constraints

Image source Temple University

FINDINGS

Balancing act while trying to teach





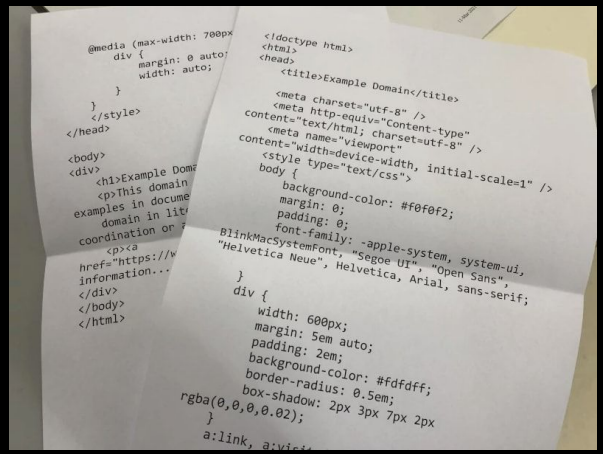
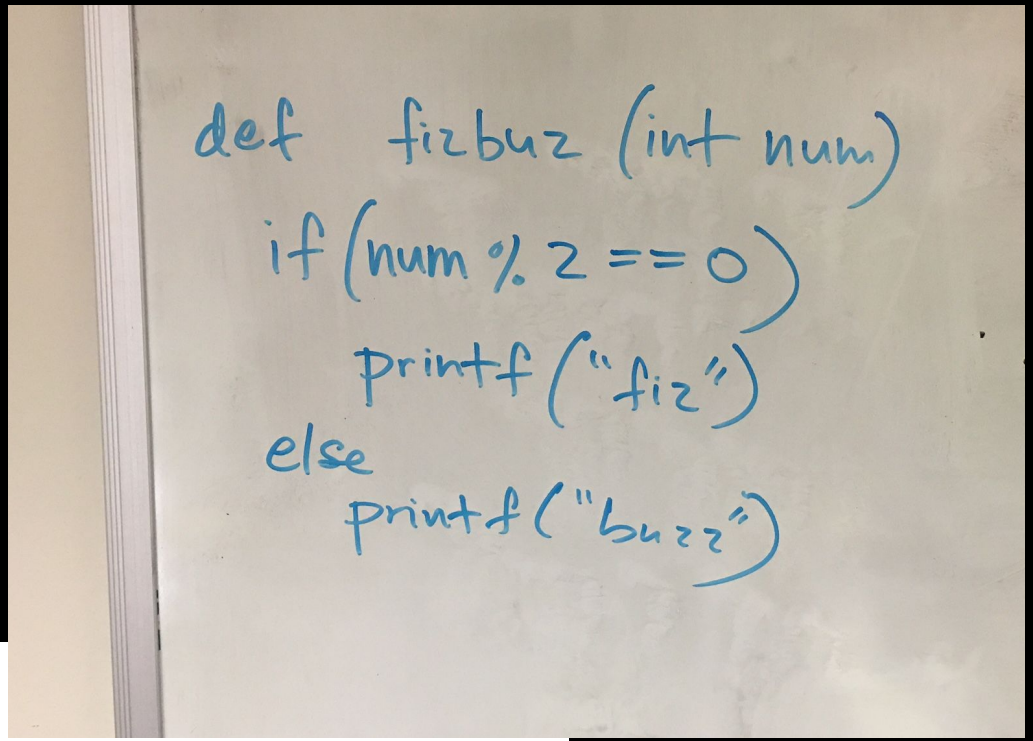


Image sources Visual Studio Code, Microsoft, Kevin van der Vleuten

FINDINGS

Live coding can be scary

If there's a spelling mistake [when white boarding], or if [a student coding on a whiteboard in front of the class] miss[es] a comma or something, no one cares… You do that on a computer, then it'll scream at you, and then there will be the red squiggly. - Participant 02 (Computer Science TA)




```
int main()
{
    cout << "Hello, World!" << endl
    return 0;
}
```

Image sources
David Neely, Weber State University

FINDINGS

Treasure hunt for errors

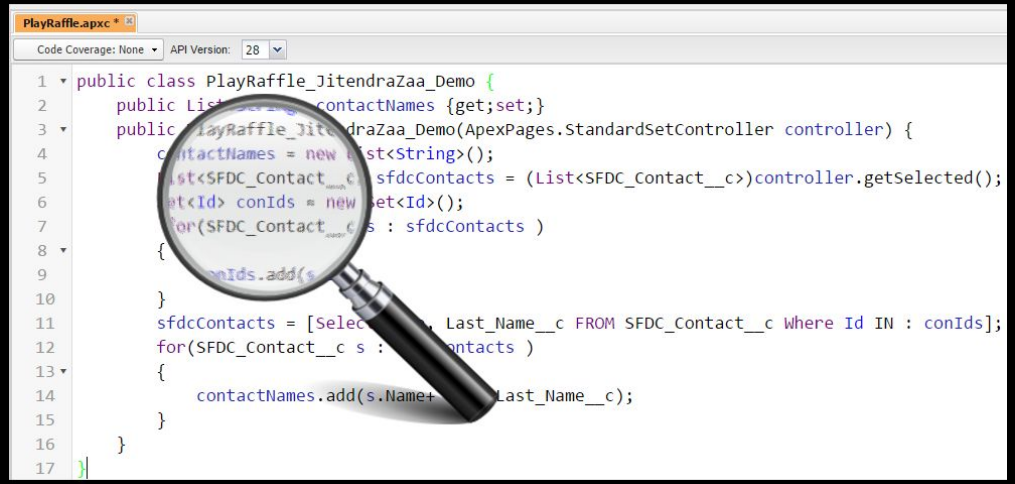


Image source
Jitendra Zaa

Oh, the students love to find the problems as I code them. I kind of built this open atmosphere with a lot of debugging being a big focus of the course and encourage the students as I'm typing and we're seeing what's going on if they see something that's wrong, a lot of times they'll say aloud. Otherwise, it's the process... I built in errors in the code to see a lot of the problems that they may stumble across as they code. - Participant 11 (Computer Science Instructor)

FINDINGS

Scaffolds: use wisely

It’s usually better when they start from zero with some example. I’ve seen some professors or where if they’re finishing some project and half of it is already done. And then they start from there, the professor already has the half of it in their mind, but this might be the first time ever a student is seeing it. And yeah, I’ve had that experience and being completely lost. And then you have to go back afterwards and see the half that they started with, understand that first, and then mentally replay the lecture and then it makes sense but it’s a little bit of work. - Participant 02 (Computer Science Teaching Assistant)

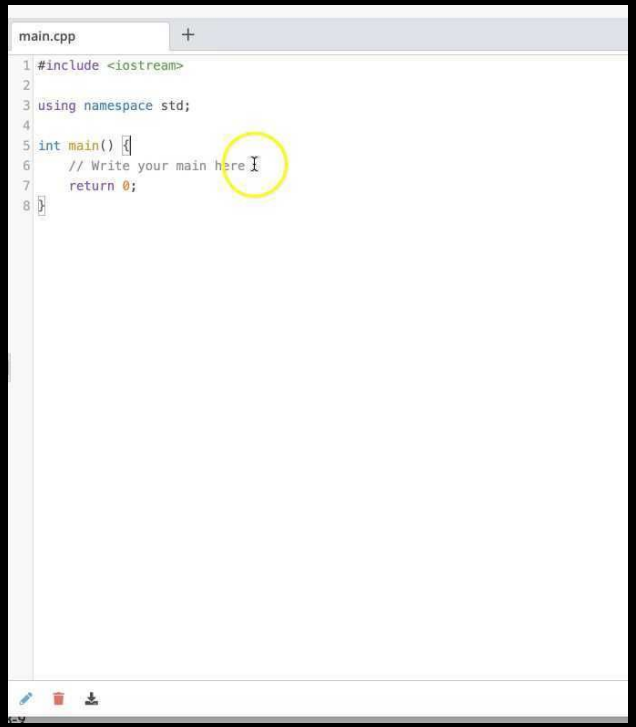


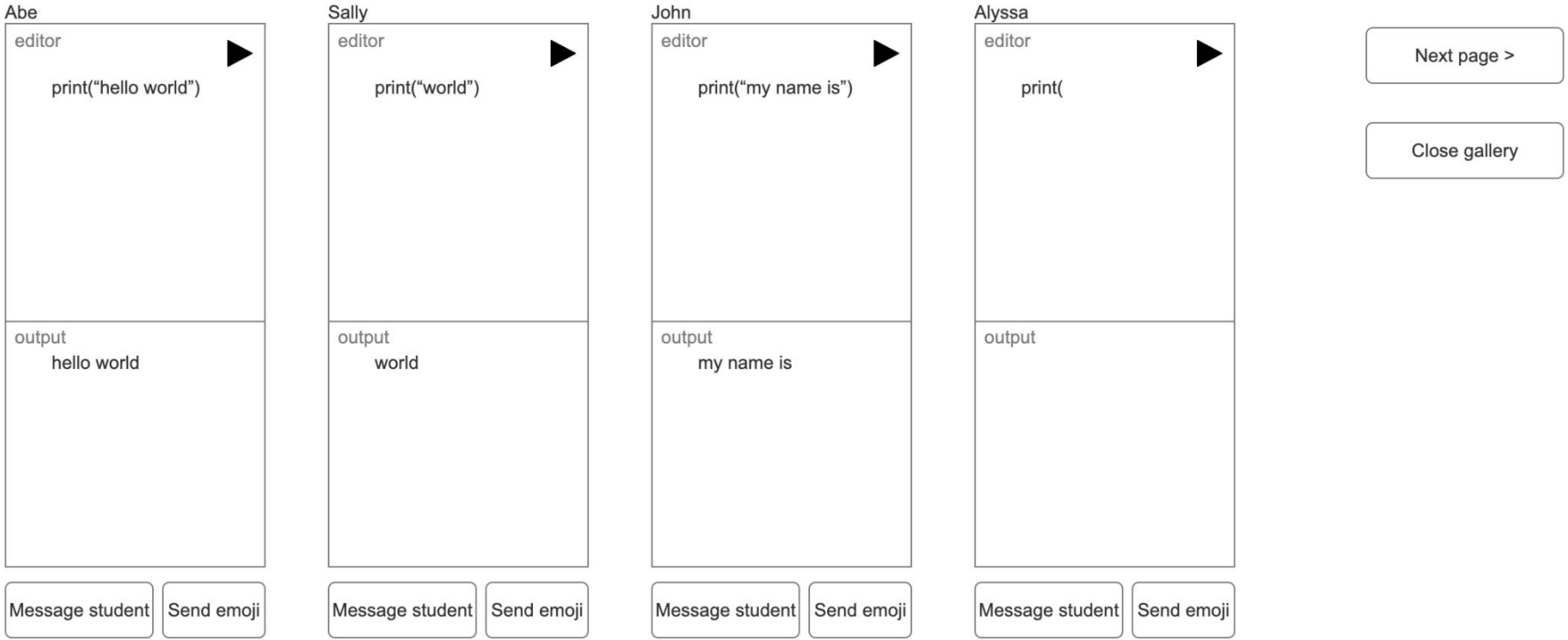
Image source LBD Community College

Computers optional

Image sources ZDNET, UCSB

DESIGN GUIDELINES

Peeking into student editors



DESIGN GUIDELINES

Design Guideline	Cognitive Apprenticeship Stage	Type of Live Coding
Personal computers optional	Modeling	Instructor-led
Directing attention	Modeling	Instructor-led
Many keyboards, one digital space	Coaching, Scaffolding	Student-instructor collaborative
Errors as signals of student progress	Coaching, Scaffolding	Student-led
Peeking into student editors	Coaching, Scaffolding	Student-led

DESIGN GUIDELINES

Teaching environment

Support from other teachers

Mindset shift

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IMPLICATIONS

Images sources OSU, UMD

Backup slides

Related work

- Improv helps instructors to flip between their editor and slides (Chen & Guo, Improv: Teaching programming at scale via live coding, 2019)
- VizProg displays students' progress towards a solution (Zhang et al., Vizprog: Identifying misunderstandings by visualizing students' coding progress, 2023)
- Overcode analyzes student submissions (Glassman et al., Overcode: Visualizing variation in student solutions to programming problems at scale, 2015)
- Codeopticon has a gallery view for tutoring purposes (Guo,Codeopticon: Real-time, one-to-many human tutoring for computer programming, 2015)

Future work

- Validate proposed design guidelines
- Research live coding tools in informal learning environments like hobbyist communities
- Explore analog systems of engagement like clickers

Limitations

- Work might not translate to other education settings and geographic contexts
- Data completeness - Half of P04’s interview was lost due to technical issues

Participants

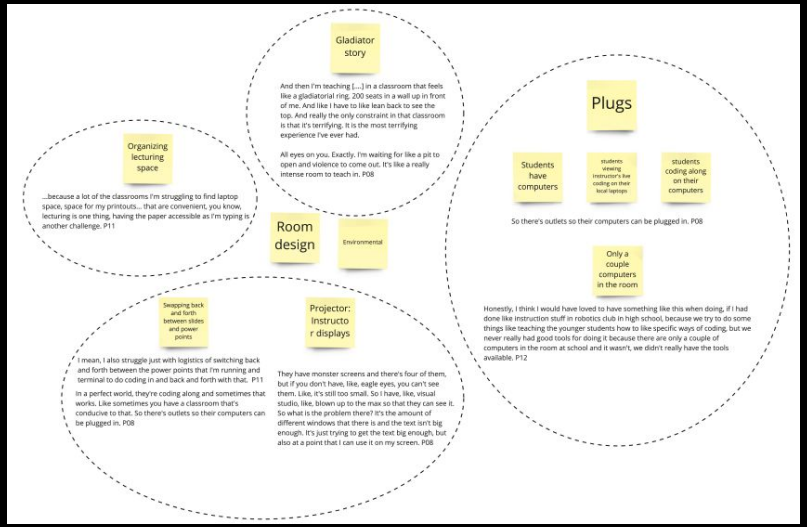
2 instructors
7 teaching assistants
6 students

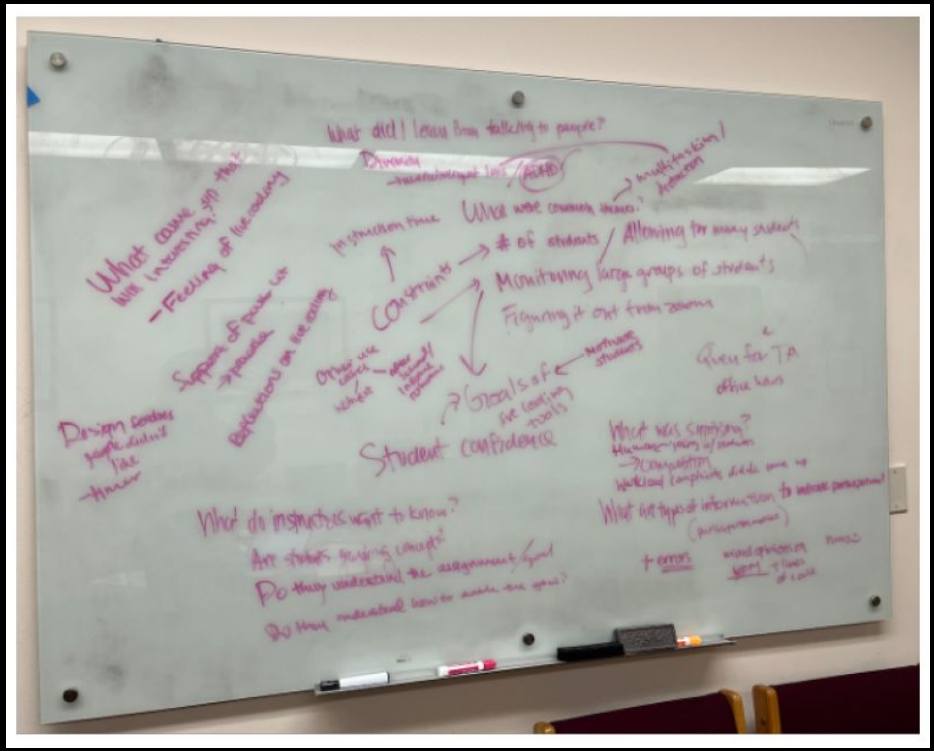
13 men
1 woman
1 non-binary person

#	Role	Setting	Age	Gender	Education
P01	Teaching Assistant	Online	26-35	Man	B.Sc. CS; M.Sc. CS; Ph.D. Info. Sci. student
P02	Teaching Assistant	In-Person	18-25	Non-Binary	B.Sc. CS student
P03	Student	In-Person	18-25	Man	B.Sc. CS, Math student
P04	Student	In-Person	18-25	Man	B.A. Psychology; M.Sc. HCI student
P05	Student	In-Person	26-35	Man	B.Eng. CS, Eng.; M.Sc. HCI student
P06	Teaching Assistant	In-Person	18-25	Man	B.Sc. CS student
P07	Teaching Assistant	In-Person	26-35	Man	BSc. CS; MSc. CS; Ph.D. HCI student
P08	Instructor	In-Person	36-45	Man	M.Sc. Info. Sys.
P09	Student	In-Person	18-25	Man	B.Sc. CS student
P10	Student	In-Person	18-25	Man	B.Sc. CS; M.Sc. HCI student
P11	Instructor	In-Person	45+	Man	B.Sc. Chemistry; Ph.D Info. Sci. student
P12	Teaching Assistant	In-Person	18-25	Man	B.Sc. CS student
P13	Student	In-Person	18-25	Man	B.Sc. CS, Robotics student
P14	Teaching Assistant	Online	18-25	Woman	B.Sc. Math, CS; Ph.D. CS, CS Ed. student
P15	Teaching Assistant	In-Person	26-35	Man	B.A. Design; Ph.D. Info. Sci. student

Data analysis

Reflexive thematic analysis
Significant statements





Coding Process

Code	Note	Quote
Description	Live coding as a performance	*"It's like live performance. It's really hard to practice it enough that you know that it's going to work, but also have that kind of ability to take student suggestions and potentially go in a direction that you haven't tested and might not work out."* (P08)
Barrier	Fear of messing up	*"Part of it is the pressure of just being in front of an audience. And you sort of, I mean, naturally you don't want to mess up. And so thinking of that gives you some sort of, I guess, anxiety, but I guess for me over time at first I was definitely like nervous since it was my first time doing anything like that. But I think in my experience, I got less nervous and much more comfortable. But yeah, I think the main thing is definitely just the anxiety of messing up so badly for students."* (P06)
Benefit	On-the-fly nature of live coding	*"I'm doing some example, then it's easier to change stuff on the fly and then surprise students."* (P02)
Design opportunity	Gallery camera view	*"Okay, these students got it these students didn't. I would love to have a second screen that had, you know, the small kind of security camera view where I had every student desktop and be able to see that they're all on their own."* (P11)