Making Code Relevant to Students' Lives

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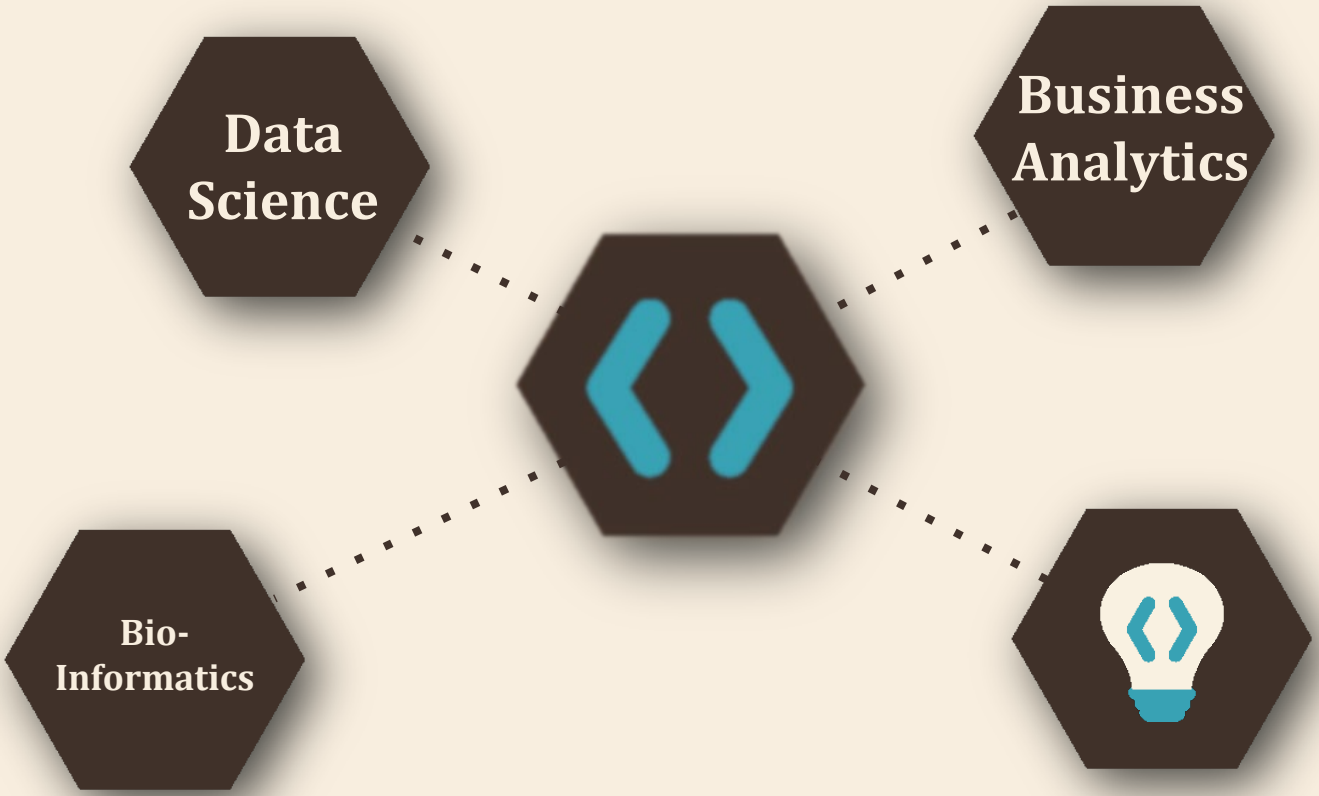

Data Science
Business Analytics
Bio-Informatics

Coding courses do not reflect California's **diversity**

Advanced Placement Computer Science A course:

- 31% **Girls** (of 49% overall enrollment)
- 29% **Latino/a/é** (of 54%)
- 2% **Black** (of 5%)

via CSforCA

Coding course content reflects conventional applications

Common assignments

- Games
- Puzzles
- Robotics
- Microcontrollers
- Media Computation

But what are students **interested** in?

Surveyed introductory coding students…

What are your hobbies and interests?

Of those hobbies and interests, which do you believe can be relevant to Computer Science or programming?

Surveyed introductory coding students…

- **What are your hobbies and interests?**
- **Of those hobbies and interests, which do you believe can be relevant to Computer Science or programming?**

Two semesters (n=198):

- Gender
  Majority: 154 Male (78%),
  Minority: 41 Female (21%), 1 Non-binary (<1%),
  Excluded: 1 Prefer not to say (<1%), 1 no response (<1%)

- Race
  Majority: 119 White and/or Asian (60%),
  Minority: 77 (39%) One or more identified:
  American Indian or Alaska Native, Black or African American, Hispanic or Latin American, Native Hawaiian and Pacific Islander, Other
  Excluded: 2 no response (1%)

Interests using *Grounded Theory* thematic analysis:

- **Games** - video games, tabletop games, puzzles, etc
- **Reading** - reading any sort of literature
- **Arts and Crafts** - drawing, knitting, etc.
- **Music, Film, and audio/video** - consuming, creating, or editing music, movies, etc.
- **Athletics** - sports and fitness activities, either watching or participating
- **Science, Technology, Engineering, and Math (STEM)** - specific fields (e.g. Biology, Statistics, etc), building computers, and electronics
- **Other academic disciplines (non-STEM)** - any fields not traditionally identified as STEM
- **Socializing** - time or activities with friends and family
- **Sleep and relaxation** - all forms of resting
- **Animals** - interacting or taking care of pets, livestock, or other animals
- **Culinary** - cooking, eating, and drinking
- **Fashion and cosmetics** - makeup, clothes, accessories; studying, shopping, or wearing
- **Nature and outdoors** - camping, fishing, and other outdoor activities that concentrate on nature
- **Travel** - vacations, road trips, domestic and international exploration
- **Automotive** - driving, fixing, and customizing any automobiles

Interests, comparing minoritized students to majority

Games

Gender majority (n=104, **68%**) vs **minority** (n=15, **36%**), $\chi 2=5.50$, df=1, **p<.05***
Racial majority (n=76, 64%) vs minority (n=43, 56%). No sig. diff. (p=.48)

STEM

Gender majority (n=55, **36%**) vs **minority** (n=6, **14%**), $\chi 2=4.87$,df=1, **p<.05***
Racial majority (n=42, 35%) vs minority (n=19, 25%). No sig. diff. (p=.19)

Music/film/audio/visuals

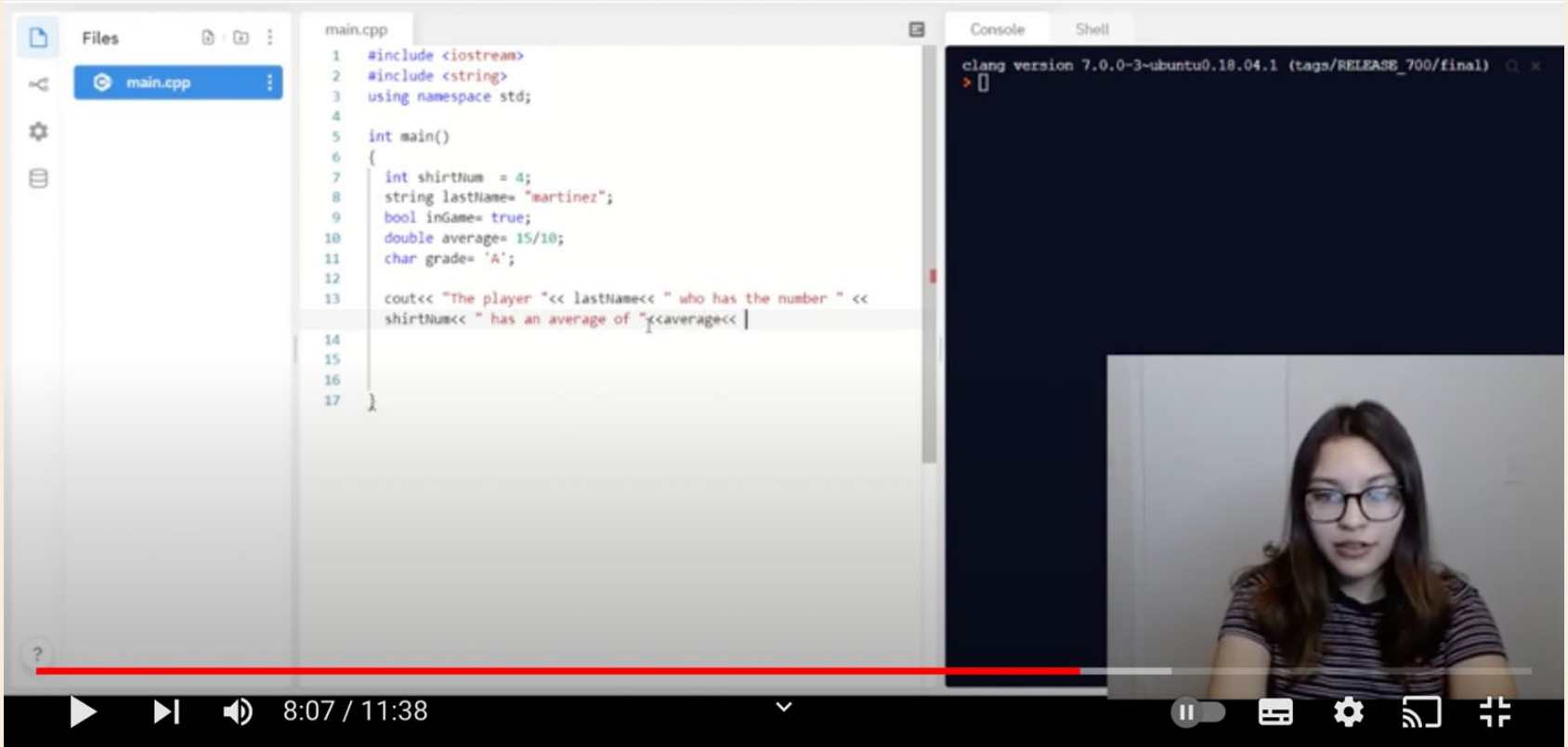
Gender majority (n=51, 33%) vs minority (n=16, 38%). No sig. diff. (p=.62)
Racial majority (n=37, 31%) vs minority (n=30, 39%). No sig. diff. (p=.36)

Hired students with unique perspectives to offer

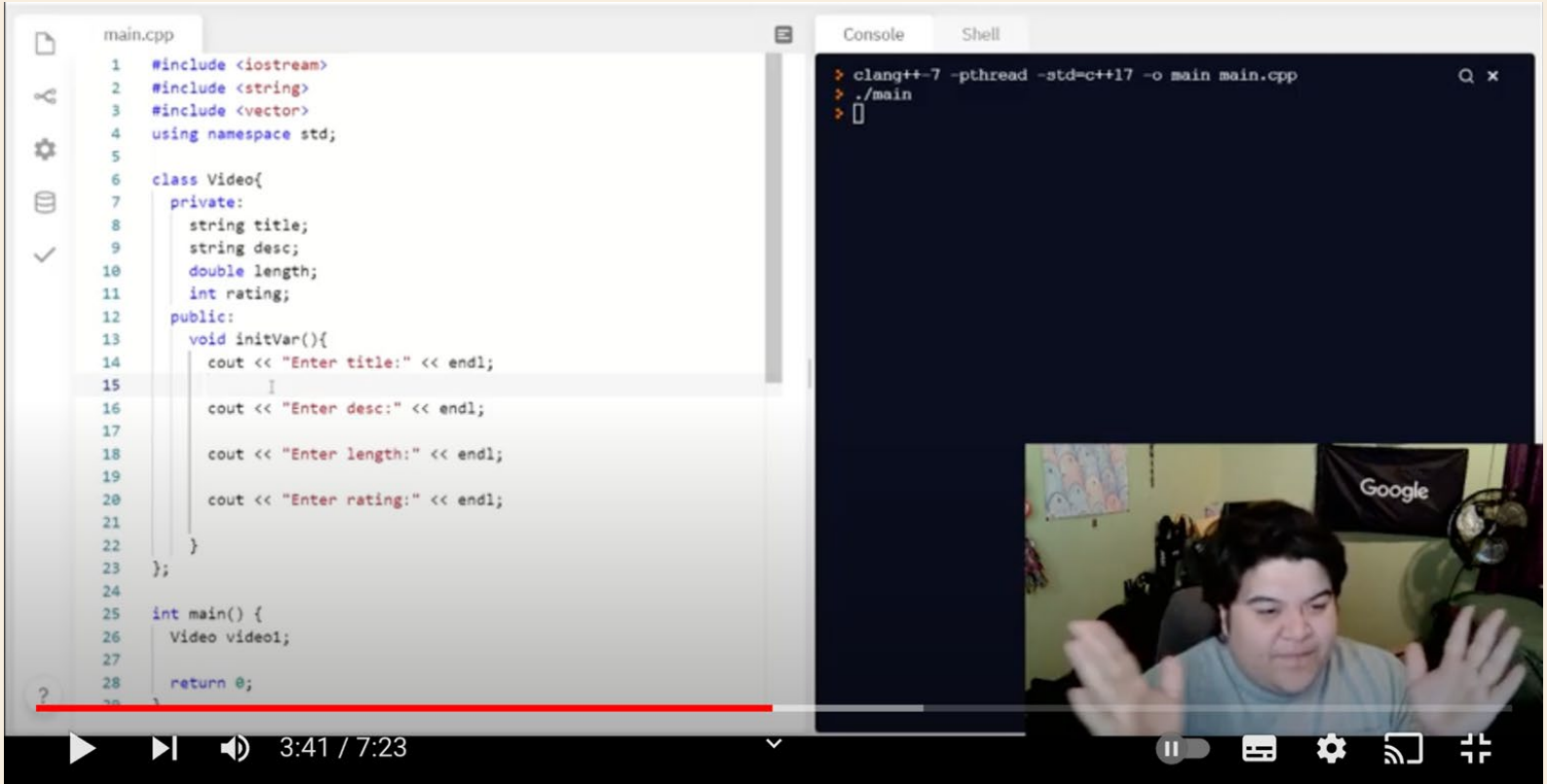
Instructions:

Record videos that demonstrate C++ concepts in ways that are relevant to *your* life

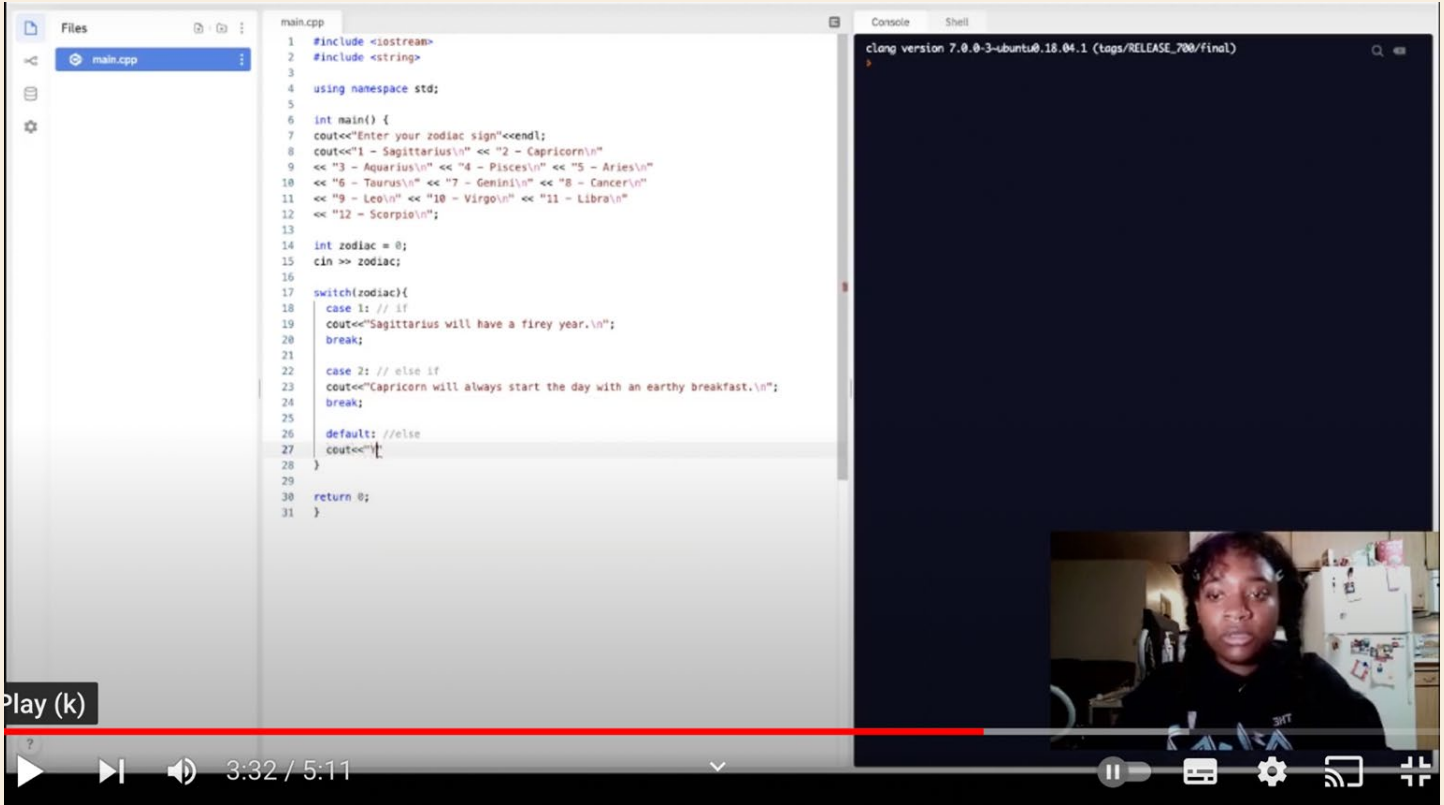
Jessica: Manage soccer player info with variables



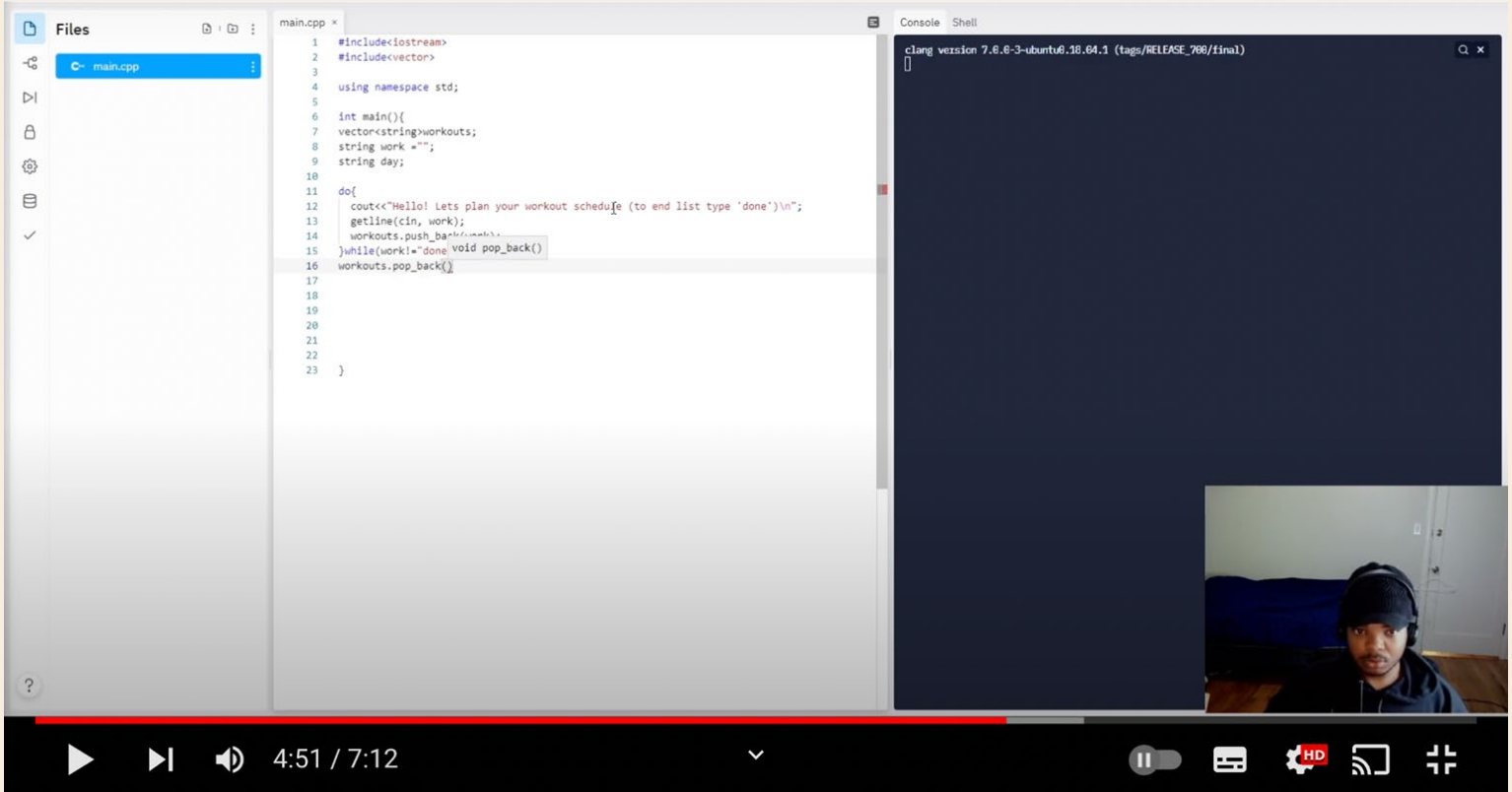
Juan: Detail videos with classes



Destiny: Write horoscopes with switch statements

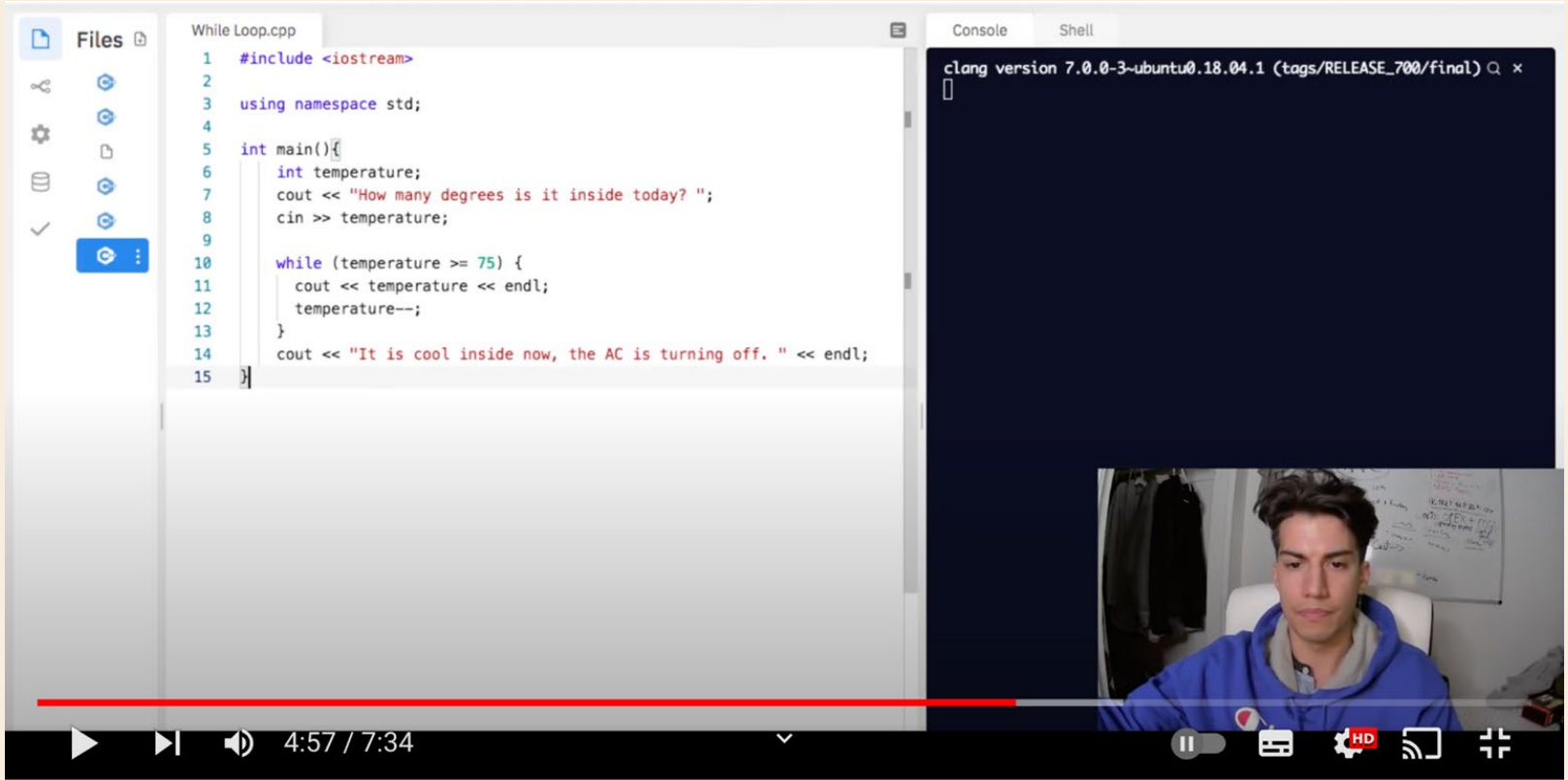


Phinease: Plan workout routine with vectors

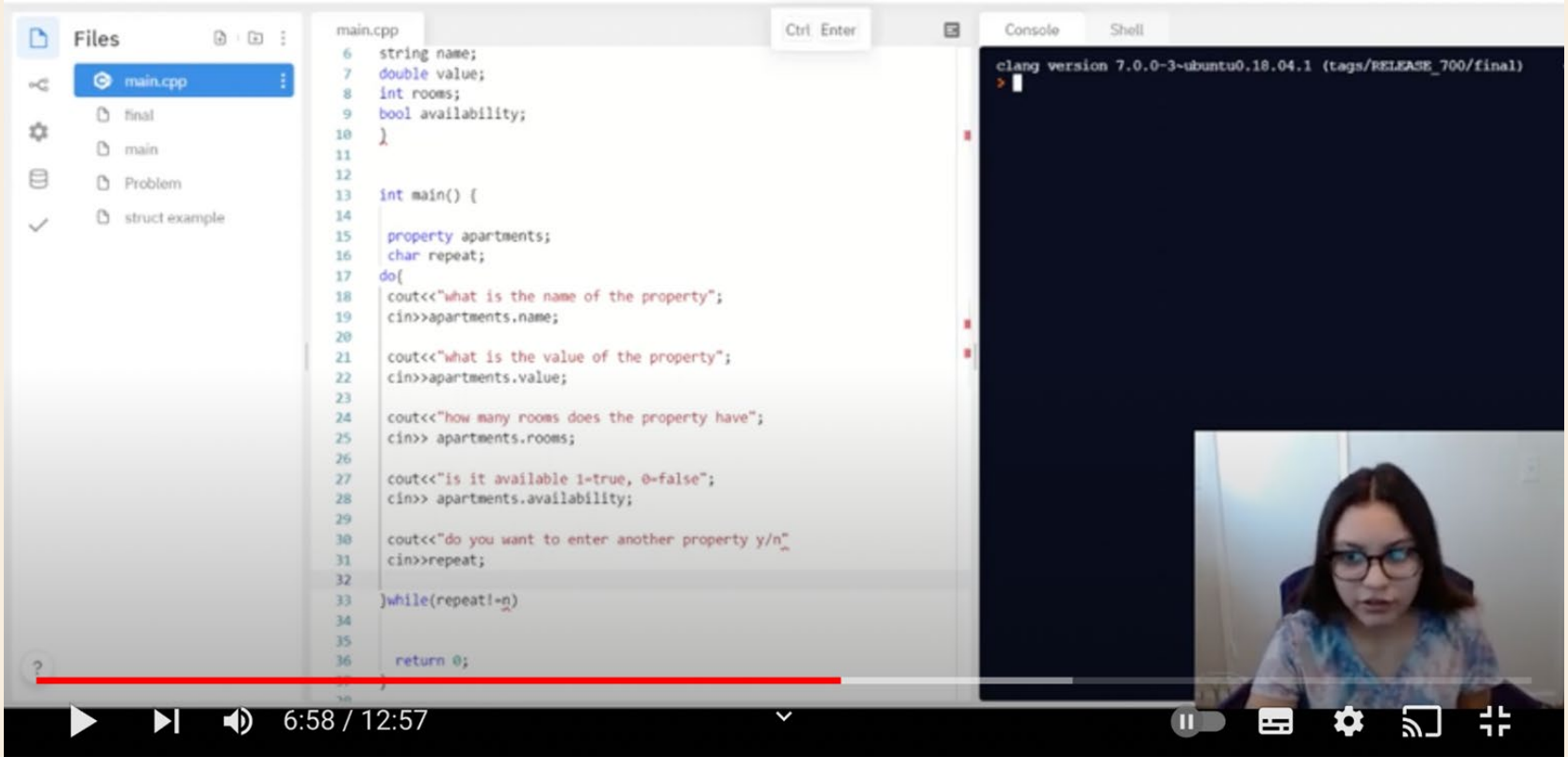


Popular topic: “Adulting”

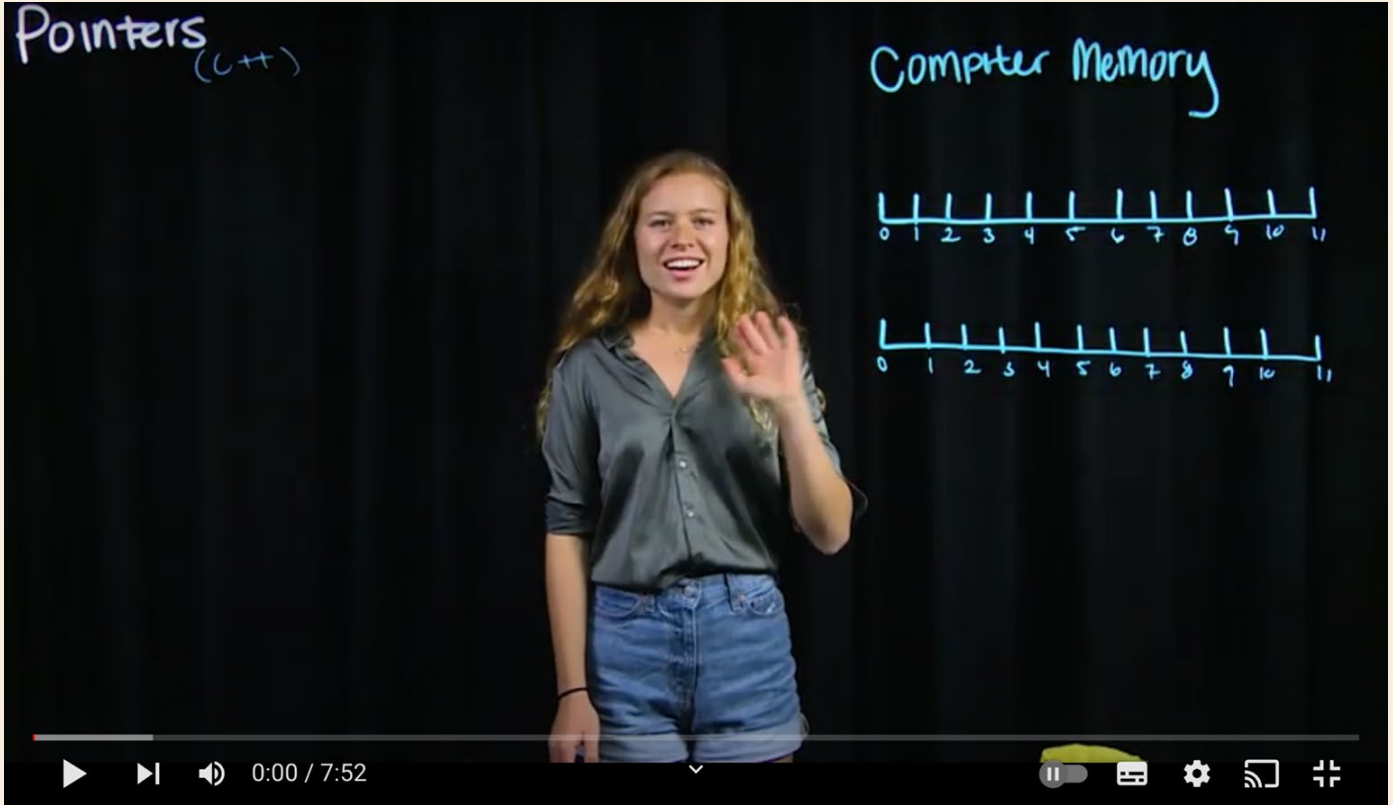
Jason: Energy-saving thermostat with while loops



Jessica: Apartment hunting with structs



Andrea: Keeping recipes with pointers



Created problems on corresponding concepts

CodeWorkout

- **Hands-on** coding exercises in the web browser
- Automated **testing and feedback**
- “Workouts” of **related exercises**

X538: Factorial C++

Write a function in C++ called 'factorial' that will take a positive integer as input and returns its factorial. In math, a factorial is the product of all positive integers less than or equal to a given positive integer. If the integer is zero, the factorial is 1. For example, calling `factorial(3);` should calculate 3x2x1 and return 6.

Examples:

```
factorial(0) -> 1

factorial(3) -> 6
```

Your Answer:

```
1  int factorial(unsigned int n)
2  {
3      if( n == 0 )
4          return 1;
5  }
6
```

Check my answer! Reset

Practice a different C++ exercise

Feedback

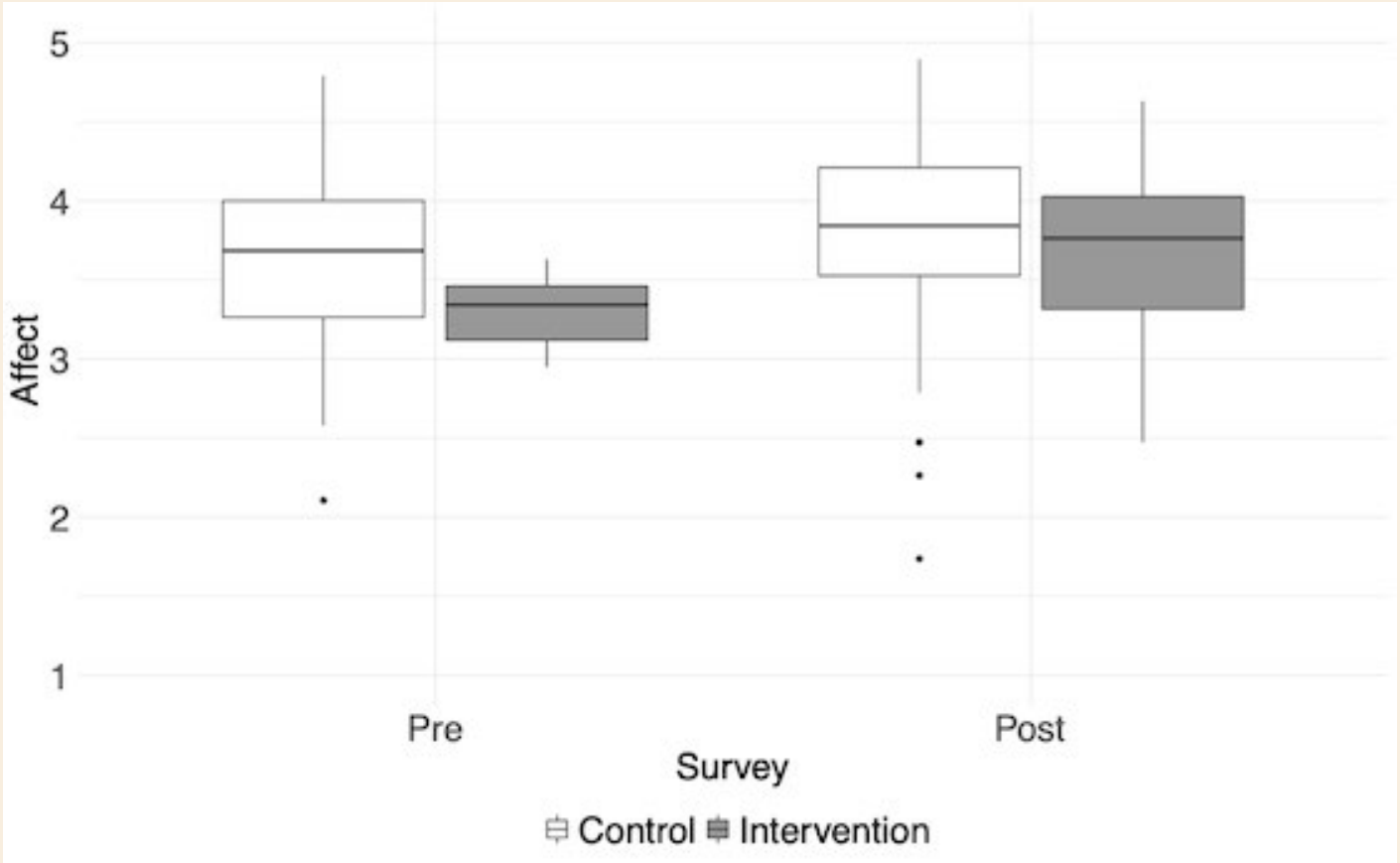
Result	Behavior
✓	factorial(0) -> 1
−	factorial(3) *Expected:<6> but was:<6357416>*
−	hidden test(s)

Initial adoption of videos and exercises at Chico State

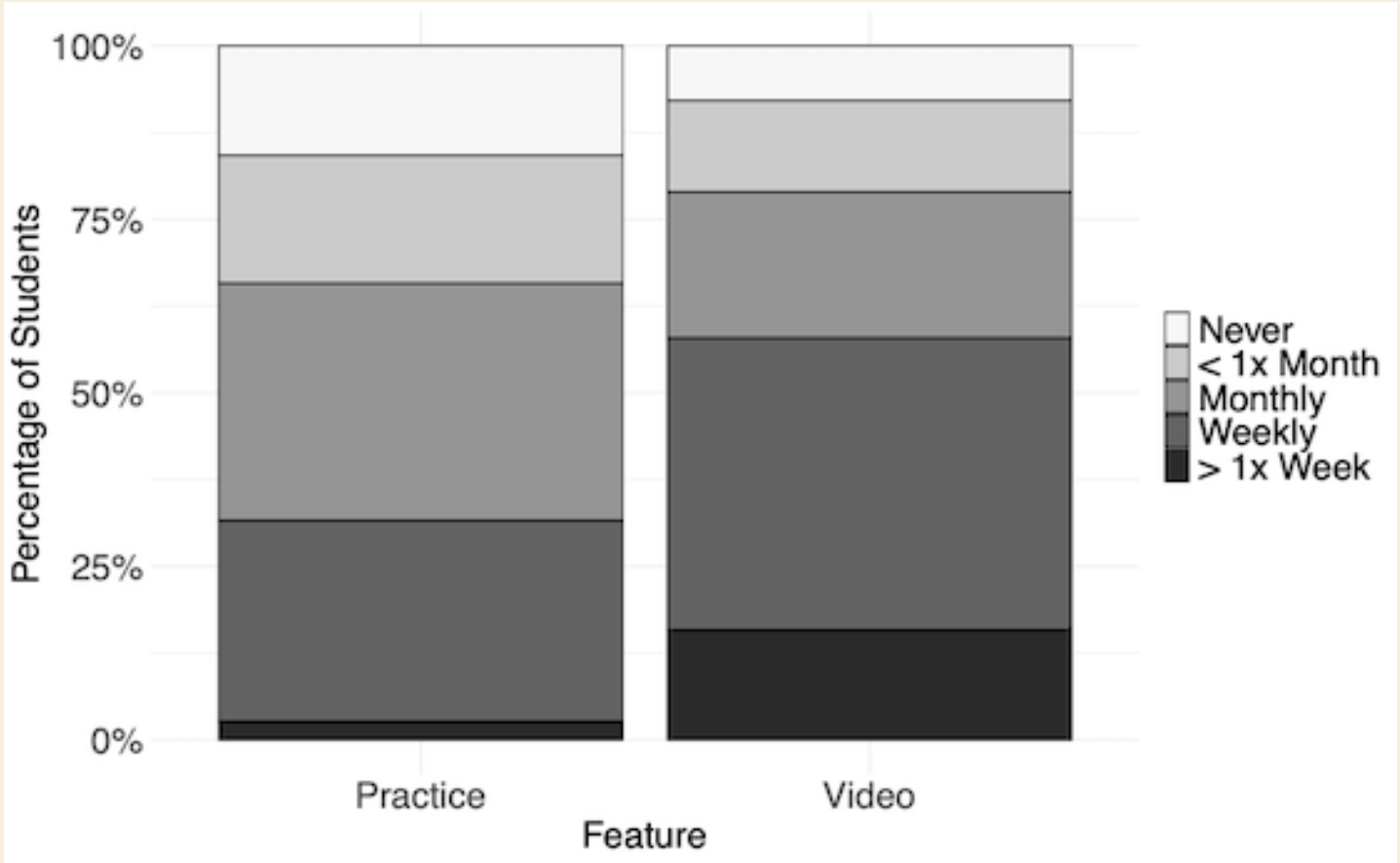
Pre/Post surveys on **affective outcomes** (belonging, self-efficacy, etc) and **confidence in C++ skills**

- Control (n=161) from semesters with weekly readings
- Intervention (n=55) with supplementary material

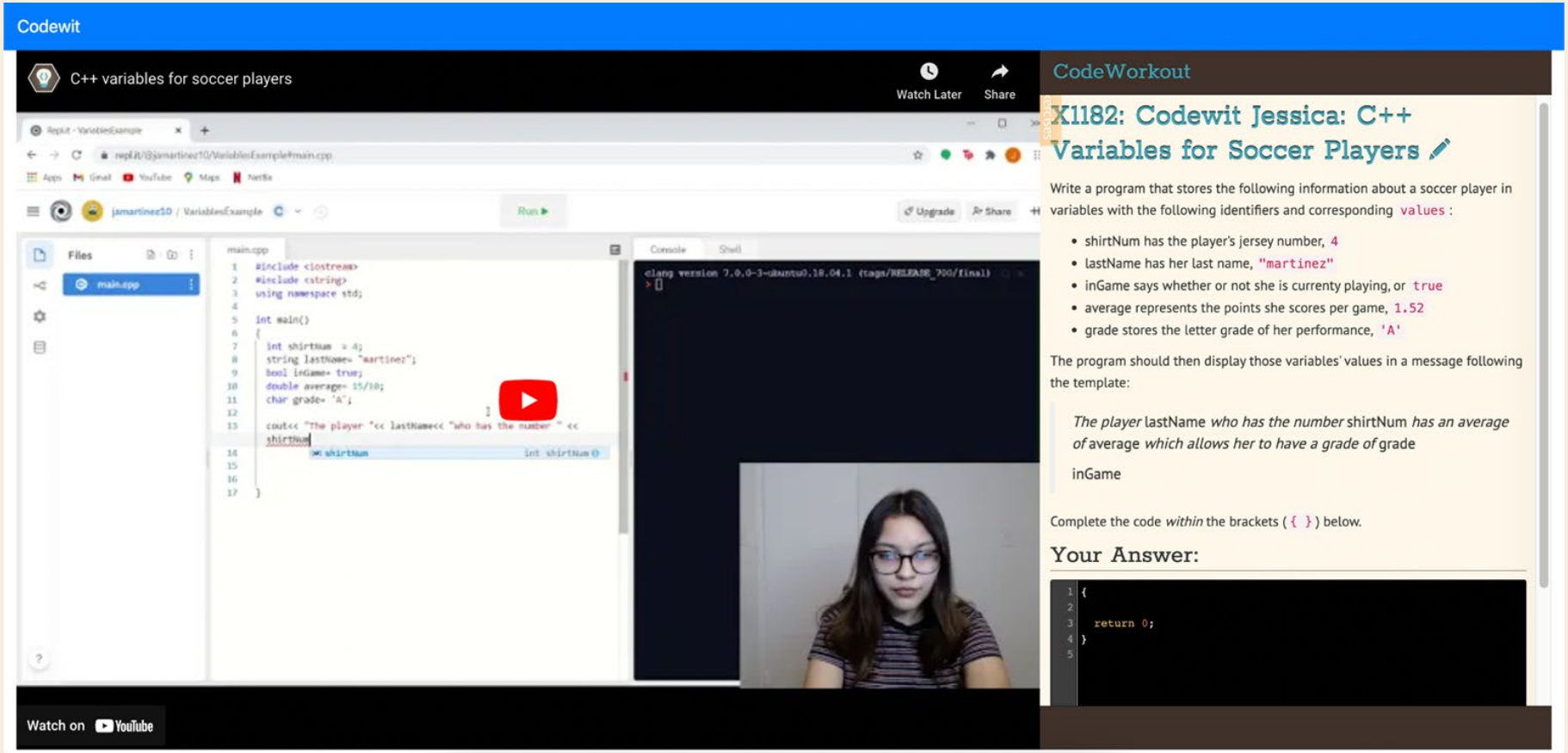
Significant greater gains in **affective outcomes** (p<.05*)



Less **practice** than **video watching**



Developed Codewit.us proof-of-concept



Piloted proof-of-concept at **UCSB**

Codewit.us offered as optional material in addition to eTextbook

- End-of-quarter survey for formative feedback
- Observed frequency of practice *as well as* video watching
- Compared to study with separate practice, video
  - Increased likelihood of practicing *at least as often*

$\chi 2=17.037$, df=2, **p<.001***

	Practice Less	Practice Same	Practice More
Expected	**58%**	**11%**	**31%**
Observed	**38%**	**27%**	**36%**

Moving forward

- **Codewit.us** experiment as required assignments
- Additional videos, upgraded recordings
- Extended development for **Codewit.us**
  - Improved design and user experience
  - Learning Management System integration
  - More programming languages
- Scaling larger, broader