Making Code Relevant to Students’ Lives

Kevin Buffardi & Richert Wang
Chico State       UCSB
Data Science

Business Analytics

Bio-Informatics
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

```cpp
#include <iostream>
using namespace std;

int main(){
    int temperature;
    cout << "How many degrees is it inside today? " ;
    cin >> temperature;
    while (temperature >= 75) {
        cout << temperature << endl;
        temperature--;
    }
    cout << "It is cool inside now, the AC is turning off. " << endl;
}
```
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:

```c++
int factorial(unsigned int n) {
    if (n == 0)
        return 1;
}
```

Feedback

<table>
<thead>
<tr>
<th>Result</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>✔️</td>
<td>factorial(0) -&gt; 1</td>
</tr>
<tr>
<td>🚫</td>
<td>factorial(3)</td>
</tr>
<tr>
<td></td>
<td>Expected:&lt;6&gt; but was:&lt;6357416&gt;</td>
</tr>
<tr>
<td>🚫</td>
<td>hidden test(s)</td>
</tr>
</tbody>
</table>

Check my answer  Reset

Practice a different C++ exercise
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](https://codewit.us) proof-of-concept

**CodeWorkout**

**X1182: Codewit Jessica: C++ Variables for Soccer Players**

Write a program that stores the following information about a soccer player in variables with the following identifiers and corresponding values:

- `shirtNum` has the player's jersey number, 4
- `lastName` has her last name, "Martinez"
- `inGame` says whether or not she is currently playing, or `true`
- `average` represents the points she scores per game, 1.52
- `grade` stores the letter grade of her performance, 'A'

The program should then display those variables values in a message following the template:

`The player's last name who has the number shirtNum has an average of average which allows her to have a grade of grade inGame`

**Your Answer:**

```c++
1 {
2   return 0;
3 }
```
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*
  \[\chi^2=17.037, \text{df}=2, p<.001^*\]

<table>
<thead>
<tr>
<th>Practice Less</th>
<th>Practice Same</th>
<th>Practice More</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Expected</strong></td>
<td>58%</td>
<td>11%</td>
</tr>
<tr>
<td><strong>Observed</strong></td>
<td>38%</td>
<td>27%</td>
</tr>
</tbody>
</table>
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