How do previous coding experiences influence undergraduate physics students?

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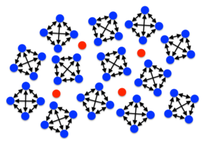
Context & Methods

Electricity and Magnetism Projects and Practices in Physics (EMP-Cubed)

- Flipped classroom
- Group work
- Requires work on computational problems
  - visually model physics concepts
  - minimally working code



- Semi-Structured interviews
- Three students
  - enrolled in EMP-Cubed
  - had previous "coding" experiences

Research Questions

- How do students with previous coding experiences take up the computational physics practices in EMP-Cubed?
- How they will make meaning of these computation-within-physics experiences?

Conceptual Framework

- Framework relates communities of practice theory to a science identity framework

Identity factors

Performance

belief in ability to perform required tasks

Competence

belief in ability to understand material

Recognition

perceptions of students' coding abilities, held both by themselves and their peers

Interest

student's desire to learn or engage in a given practice

"[EMP-Cubed]'s not technically programming because it's not like you're **starting from scratch.** You have to manipulate a couple lines..."

``I don't really feel EMP-Cubed is coding itself because **I don't really learn anything**...for CSE 201, I learned coding."

Students' Definitions of Coding

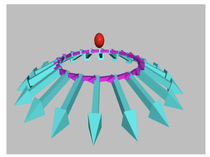
When the students are **learning** coding concepts by engaging in an activity that requires a lot of **time** and **creativity**, they consider it "coding."

```
## Scene Setup
scene = display(width=1000, height = 1000)

## Parameters
ec = 1.6e-19
k = 9e9

## Objects
cloud = sphere(pos=vec(0,3500,0), color=color.white, radius=100)
ground = box(pos = vec(0,0,0), width=5000, length=5000, height=0.1, color=vec(1,0.7,0.2))
HQ = box(pos = vec(-250,100,0), width = 10, length=10, height=200, color=color.green)
detector = box(pos = vec(0,30,0), width = 5, length=5, height=3, color = color.white)

E = vec(0,0,0)
field = arrow(pos=detector.pos, axis = E, color = color.yellow)
```



Is this activity coding?

Student learns coding concepts
Activity requires a lot of time
Start from scratch / minimal scaffolding

Yes → Used **previous coding identity** to make sense of activity

No → Developed **new coding identity** to make sense of activity

Development of New Coding Identity

Student indicators of success

Previous Coding Experience

``Why do I say [I was successful]? I **learned a lot** of stuff for coding. I got a **good grade** in the class too. I feel like I'm **better at coding** in general after taking that class."

``Every time I finally **finished my project** I felt so good about myself...I **felt smart** and capable... The combination of **liking what you're doing** and feeling that it's useful makes you feel like you're more successful...and I **did really well on the exams.**"

Performance | Competence | Interest

EMP-Cubed

``Usually I feel successful when I **understand everything** before the end of the class... I find myself understanding if I can **finish the project.**"

``I think if you **understand the concepts** fairly well within the duration of the class period [then you are successful]... and if you forget it after a month, that's whatever... This is from a stats major who doesn't use physics and **I'm just filling requirements.**"

Recognition as a coder within EMP-Cubed

Students were **not recognized** as "coders" within their previous coding experiences which were all computer science classes. Most students in these classes were learning new coding concepts together.

Students could potentially engage in expertlike behaviors in the computation community from additional outside computational experience, but this was **not observed** in our study.

``I do get excited when they're like `It's a coding day' because this is **my strength** and I get to practice and work in **my true major**. And I also feel a little bit more confident, especially when people are like `Oh my God I don't know how to code, **I'm gonna lean on you.**'"

``I think during coding days I was...one of the main people **moving ideas along**, just because I was going to go for a computer science minor, so **I kind of know what I'm doing**...it's like who knows how to code... do it and then **explain it** to everybody else."

Implications & Future Work

- Students without previous computational experience might...
  - feel incapable in their initial exposure to coding
  - develop negative coding identities
- Students perceived EMP-Cubed coding activities as physics practices
  - Future work could explore the perceptions of students with no computational experiences

Contact

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