Coding Expediently: A Computationally Situated Epistemic Game

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INTRODUCTION

Computationally integrated physics learning helps educators…

- Facilitate learning physics.
- Provide another representation/means of engagement.
- Train students in industry-relevant skills.

Delivering computational activities requires teaching new technical practices. We consider these practices as **epistemic games**.

An epistemic game[1] is a set of rules and strategies that guides and limits what knowledge is appropriate for a learner to use when solving a problem. An epistemic game has…

- An **epistemic form** (what the game looks like).
- A **knowledge base** (resources needed for the game).
- **Entry and exit conditions** (signals when to start and end the game).
- **Moves** (steps taken during the game).

CODING EXPEDIENTLY

We describe an epistemic game called **Coding Expediently**.

- **Epistemic form**: A code that can be developed in multiple ways toward a goal.
- **Knowledge base**: Syntax and ability to predict "what the code would do" with given changes.
- **Entry condition**: Multiple paths toward the goal.
- **Exit condition**: Accomplishing the goal.
- **Moves**: Identify paths, evaluate the time/workload for each, follow path, confirm goal is accomplished.

For example, one can Code Expediently in the following activity by taking a copy-paste-modify path.

```
1  FirstTerm = 1
2  print( '1 term' ) # The first term.
3  print( FirstTerm )
4
5  SecondTerm = 1/1
6  print( '2 terms' ) # The first two terms.
7  print( FirstTerm + SecondTerm )
8
9  ThirdTerm = 1/(2*1)
10 print( '3 terms' ) # The first three terms.
11 print( FirstTerm + SecondTerm + ThirdTerm )
12
13 # You'll add code starting in Line 14.
14
```

4. Checkpoint: Add another term.

In the code cell above, copy and paste Lines 9-11 into Line 14. In your new copy, **modify** the code to calculate `FourthTerm` and add `FourthTerm` to the `print` command. How close is your new approximation for e to the actual value of 2.71828182846?

Figure 1 Tutorial activity from our interviews.

We describe Coding Expediently as an epistemic game that students might play to minimize time or keystrokes while coding.

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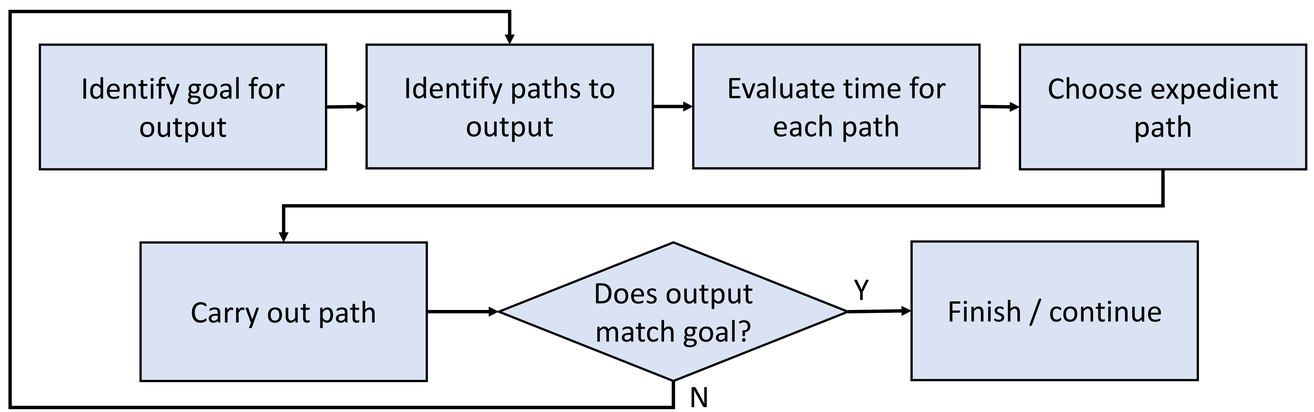
Figure 2 The Coding Expediently epistemic game.



INTERVIEWS

We observed Coding Expediently in think-aloud interviews[2]. Students narrated their thinking while completing an introductory Python tutorial in a Jupyter notebook[3,4] designed to present students with a series of minimally working programs[5-8]. We video-recorded the students with a camcorder and screen-captured their work through OBS[9]. The prompt in Figure 1 asks students to approximate e by adding the fourth term to a Taylor series already set up.

One could Code Expediently by using a copy-paste-modify path, or one could type new lines manually. We observe two students who took each approach.

- **Meghan (non-Python coding experience and math up to Calculus II) engaged in Coding Expediently using copy-paste-modify**: "So I'm just modifying it so that it calculates the fourth term… I'm just like copying and pasting the next two lines and then I'm just changing it to four terms."
- **Vance (no coding experience and math up to Calculus III) is aware of the expedient option but chooses not to**: "I could just copy and paste. But why would I do that when I can make it all fresh?"
- **Vance's longer approach seems to make room for a different game**: "I'm going to screw this up to investigate what the limits are. So I'm going to opt to see if there is a variation in the capitalization. I'm not going to capitalize the word term there. I just want to know if something as simple as a capitalization error is going to essentially flub me up. So if it's case sensitive, I have to be very particular about finding out."

NEXT QUESTIONS

- How do students learn to Code Expediently?
- What other game is Vance playing?
- What other computationally situated games can we observe students playing?

References

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