Teaching Self-Paced, Blended, and Mastery-Based Computer Science Classes

BTTVC Presentation by Sarah Strong (she/her)
August 16, 2022
Overview

Who am I?

Why self-paced, blended, and mastery-based?

Why is this model great for teaching computer science?

What do students think of this model?

Pushback and criticism
Who am I?
I have been teaching computer science for \( N \) years, where
\[
\text{list(range}(N)\text{)} == [0, 1, 2, 3, 4].
\]

The school board I teach in is the value of `Integer.MAX_VALUE` in Java.

\[2^{31}: \text{Toronto} \quad 2^{31}-1: \text{Waterloo}\]
\[2^{63}: \text{Peel} \quad 2^{63}-1: \text{Halton}\]

My favourite course is the size of this set:
\[
\{1, 2, 2, 3, 4, 5, 5\}.
\]

4: ICS2O 5: ICS3U
6: ICS4U 7: TEJ3M

I teach all of the following languages are truthy in Python.

0: C 1: Python  "": Ruby
True: Java None: TypeScript
[0]: HTML & CSS & JavaScript

True or False: I am in my thirties.

The answer is equivalent to
\[(5 < 4) \; || \; (1 \leq 1)\]

True or False: I am a Replit certified educator.

The answer is equivalent to
\[\text{not}(1.0 - 1)\]

My favourite educational podcast is the colour yellow in hexadecimal.

#00FFFF: The Cult of Pedagogy
#FFFF00: Overthrowing Education
#FF00FF: Unprofessional Development
Why self-paced, blended, and mastery-based?
Modern Classrooms Project

Blended Instruction

Self-Paced Structure

Mastery-Based Grading

Students access new content from teacher-created videos

Students learn at their own paces within each unit of study

Students progress when they demonstrate mastery

Source: http://modernclassrooms.org
Self-Paced Learning
Why self-pace?

• Students take different amounts of time to process and learn the same information.

• Students face different barriers in life that affect their ability to learn.

• Self-pacing helps students develop resilience, motivation, confidence, and other important skills.
Different ways to implement self-pacing

Self-paced can be implemented in many ways:

- Self-paced lessons
- Self-paced weeks
- Self-paced units
- Self-paced semesters
How I implement self-pacing

• There are four units altogether, released one at a time.

• Each unit builds on each other. For example, mastery of unit 1 is needed to succeed in unit 2.

• Each unit ends with a unit project.

• The culminating task is a student conference.
How I implement self-pacing

- Students’ midterm marks are determined by how far along they get in Unit 1 and 2
- Students’ final term marks are determined by how far they get along they get in Units 1 to 4
- There is an additional Bonus Unit after Unit 4 for students aiming between 98 and 100
Pacing Trackers

Pacing trackers can be implemented in many ways:

• Show the progress through a lesson, unit, or course
• Can show all students or just an individual student
• Can be filled in by the teacher or student
• Can be public or private
## Example (ICS3U)

<table>
<thead>
<tr>
<th>Task</th>
<th>Location</th>
<th>Google Classroom</th>
<th>Repl.it</th>
<th>Both</th>
<th>Location</th>
<th>Google Classroom</th>
<th>Repl.it</th>
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<tbody>
<tr>
<td>Ethical Computer Use</td>
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<td>Exercise 25.6 - Unlucky Monkeys</td>
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<td>Exercise 26.7 - Text Analysis</td>
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<td>Project 2 - Human vs Bot</td>
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</tbody>
</table>

**Midterm Mark**

- 35-45
- 50-62
- 63-72
- 73-78
- 79-81

**Unit 1**

- 82-85
- 86-90
- 91-94
- 95-100

**Unit 2**

**Last Updated:** April 15, 8:00 AM

**Due:** Thursday, April 14 at 9 PM

**Colors:**
- Green: Complete
- Yellow: Keep Trying
- Orange: Missing
### Example (ICS2O)

#### UNIT 1

<table>
<thead>
<tr>
<th>Task</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1.1 – Official Computer Use</td>
<td>blackPenguin123</td>
</tr>
<tr>
<td>Task 1.2 – Password Protection</td>
<td>blueBird3574</td>
</tr>
<tr>
<td>Task 1.3 – Impact of Computers on Health (Part 1)</td>
<td>blueCrocodyl152</td>
</tr>
<tr>
<td>Task 1.4 – Impact of Computers on Health (Part 2)</td>
<td>blueDog666</td>
</tr>
<tr>
<td>Task 1.5 – Internet and Data Collection</td>
<td>blueJun221</td>
</tr>
<tr>
<td>Task 1.6 – Internet and Safety</td>
<td>bluePanda344</td>
</tr>
<tr>
<td>Task 1.7 – Emailing</td>
<td>blueTiger386</td>
</tr>
<tr>
<td>Task 1.8 – Online Safety and Responsibility</td>
<td>blueTaco9999</td>
</tr>
<tr>
<td>Task 1.9 – SQL Injection</td>
<td>greenLion435</td>
</tr>
<tr>
<td>Task 1.10 – SQL</td>
<td>greenPanda176</td>
</tr>
<tr>
<td>Task 1.11 – Night and Day</td>
<td>greenPlatypus489</td>
</tr>
<tr>
<td>Task 1.12 – Dynamic Circle</td>
<td>greyGraze316</td>
</tr>
<tr>
<td>Task 1.13 – GUI</td>
<td>greyRabbit888</td>
</tr>
<tr>
<td>Task 1.14 – CSS</td>
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<tr>
<td>Task 1.15 – AJAX</td>
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</tr>
<tr>
<td>Task 1.16 – CSS</td>
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</tr>
<tr>
<td>Task 1.17 – HTML</td>
<td>redCat123</td>
</tr>
<tr>
<td>Task 1.18 – HTML</td>
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#### UNIT 2

<table>
<thead>
<tr>
<th>Task</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 2.1 – Browsers and Search Engines</td>
<td>blackPenguin123</td>
</tr>
<tr>
<td>Task 2.2 – Operating Systems</td>
<td>blueBird3574</td>
</tr>
<tr>
<td>Task 2.3 – Hosting</td>
<td>blueCrocodyl152</td>
</tr>
<tr>
<td>Task 2.4 – Chaining</td>
<td>blueDog666</td>
</tr>
<tr>
<td>Task 2.5 – Find and Replace</td>
<td>blueJun221</td>
</tr>
<tr>
<td>Task 2.6 – Net and Folder Organization</td>
<td>bluePanda344</td>
</tr>
<tr>
<td>Task 2.7 – Email</td>
<td>blueTiger386</td>
</tr>
<tr>
<td>Task 2.8 – Email Organization</td>
<td>blueTaco9999</td>
</tr>
<tr>
<td>Task 2.9 – Power User</td>
<td>greenLion435</td>
</tr>
<tr>
<td>Task 2.10 – Power</td>
<td>greenPanda176</td>
</tr>
<tr>
<td>Task 2.11 – Power</td>
<td>greenPlatypus489</td>
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<tr>
<td>Task 2.12 – Power</td>
<td>greyGraze316</td>
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<tr>
<td>Task 2.13 – Power</td>
<td>greyRabbit888</td>
</tr>
<tr>
<td>Task 2.14 – Power</td>
<td>lavenderCatz002</td>
</tr>
<tr>
<td>Task 2.15 – Power</td>
<td>purplePanda246</td>
</tr>
<tr>
<td>Task 2.16 – Power</td>
<td>purpleRat123</td>
</tr>
<tr>
<td>Task 2.17 – Power</td>
<td>redCat123</td>
</tr>
<tr>
<td>Task 2.18 – Power</td>
<td>redDog101</td>
</tr>
</tbody>
</table>

#### Midterm Info

- **Due Date:** Thursday, April 14 at 2:05 PM
- **Green:** Complete
- **Yellow:** Keep Trying
- **Orange:** Missing

#### Final Info

- **All Units**
- **Midterm Info**
- **Final Info**
What questions do you have so far?
Blended Learning
Why blended learning?

In order to implement self-pacing effectively, live lectures must be removed.

Live lectures can be replaced with video lessons and small group instruction.
Making videos

There are plenty of options for videos:

- **Screencast videos**
- **Recordings of lectures**
- **Recordings of document camera presentations**
Why videos?

Lots of reasons!

- Students who are absent have a fair shot at catching up
- Students who get help at home can share the videos with their helpers
Why videos?

- Students can rewind, rewatch, pause, speed up/down, turn on subtitles etc.

- Videos are straight to the point whereas lectures tend to be long and have tangents and disruptions

- It frees up my time so I can spend more time helping students.
Why videos?

• Students who have poor vision or hearing can see/hear videos clearer than lectures.

• Students who have trouble focusing during live lectures (e.g. students with ADHD) don’t have to endure them.

• Multi-language learners can turn on auto-translated subtitles
Why videos?

- In case of unexpected distance learning days, there are very few changes to the plan
- It makes it easy for substitute/supply teachers
Making effective videos

Tips for making videos:

• Keep videos shorter than 6 minutes
• Speak at a fast pace using conversational language
• Don’t over-edit – mistakes improve engagement
Making effective videos

Tips for making videos:

• Make videos reusable – don’t mention lesson numbers and other things that might change during the video

• Upload videos to YouTube so that students can turn on auto-generated subtitles
Example

String Operators and Special Characters (Unit 1, Lesson 2.1)
Example

**Link to video.**

**String Operators**

We've seen that the `+` operator can be used for string concatenation.

The lines below print "butterfly".

```python
print("butterfly")  # prints "butterfly"
print("butter" + "fly")  # also prints "butterfly"
```

We can also use the `*` operator for string multiplication.

The line below prints "hahaha".

```python
print("ha" * 3)  # prints "hahaha"
```

**Special Characters**

In order to put any of the following special characters in a string, you need to put the escape character `\` (backslash) in front of them.
### Unit 1

<table>
<thead>
<tr>
<th>TITLE</th>
<th>DUE DATE</th>
<th>SUBMISSIONS</th>
<th>PUBLISHED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise 1.1 – Welcome</td>
<td>—</td>
<td>View submissions 32 of 31 started 29 of 31 submitted</td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td>Exercise 1.2 – ASCII Cat</td>
<td>—</td>
<td>View submissions 29 of 31 started 29 of 31 submitted</td>
<td><img src="image" alt=" " /></td>
</tr>
<tr>
<td>Exercise 1.3 – Exact Change</td>
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<td>View submissions 29 of 31 started 29 of 31 submitted</td>
<td><img src="image" alt=" " /></td>
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<td>Exercise 1.4 – Leap Year</td>
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<td><img src="image" alt=" " /></td>
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<tr>
<td>Exercise 1.5 – Input Checker</td>
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<td>View submissions 29 of 31 started 29 of 31 submitted</td>
<td><img src="image" alt=" " /></td>
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<tr>
<td>Exercise 1.6 – Number Pyramids</td>
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<td>View submissions 29 of 31 started 29 of 31 submitted</td>
<td><img src="image" alt=" " /></td>
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<tr>
<td>Exercise 1.7 – Odd Powers of Three</td>
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<td>View submissions 28 of 31 started 27 of 31 submitted</td>
<td><img src="image" alt=" " /></td>
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<td>Project 1 – Solo Game</td>
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<td>View submissions 29 of 31 started 27 of 31 submitted</td>
<td><img src="image" alt=" " /></td>
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</tbody>
</table>
What questions do you have so far?
Mastery-Based Learning
Mastery-Based Grading

Mastery-based grading means students are given a mastery status instead of a percentage or level. Students don't move onto new material until they have demonstrated mastery of the pre-requisite material.

Demonstrating mastery is crucial for:

- Retention
- Building confidence
- Focusing on learning, not grades
Mastery versus gradeless/ungrading

mastery-based grading  gradeless/ungrading

me
How I implement mastery-based grading

All exercises on Replit are either:
• not started
• in progress
• complete (mastered)

Students move on to the next task when they have completed the previous ones.
How I implement mastery-based grading

All exercises on Replit have criteria for mastery, such as:

• passing all the I/O or unit tests
• including relevant and helpful line comments
• following conventions
• including custom tests
• declaring their sources
Example

Before Starting This Task

It's recommended that you begin this task if you have already submitted Exercise 1.1. It's okay if you are waiting for it to be marked.

Choose between watching all the videos or reading all of the notes.

- String Operators and Special Characters (video note)
- Multi-Line Strings (video note)
- The Console (video note)

Requirements to Pass

1. Get all input/output tests to pass.
2. Answer the questions in sources.md.
3. Click Submit in the top-right corner.

If you submit this task without meeting these criteria, you will be asked to redo it and resubmit it.

Instructions

Create a program that prints the following cat.

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Do not use raw strings (e.g. `\` or `\`). You must use at least one escape
Example

---

in this course, getting help from online sources is okay as long as you cite them and indicate which lines of code you copied. Each project file has a file history that can be used to easily determine excessive copy/pasting.

* Lying about your sources (e.g. saying you didn’t get help when you actually did) can lead to disciplinary actions.

---

Answer the questions below before submitting this task.

1. Did you use any online sources aside from the assigned videos and notes? (Yes/No)

   → No

2a. If you answered 'Yes' to Question 1, indicate which lines of code you copy/pasted.

   →

2b. Did you have any help from anyone aside from the teacher? (Yes/No)

   → No

2c. If you answered 'Yes' to Question 2, indicate who helped you (e.g. a classmate, a relative, a tutor, etc.).

   →

3a. If you answered 'Yes' to Question 2, indicate how each person helped
What questions do you have so far?
What do students think?
What did you most enjoy about this course?

• It's very relaxing and stress is kept at a low
• Meeting new people in this class who I have not met before
• Being able to socialize and work with the people around me
• Not having quizzes and tests
• Miss Strong is always there to help
• The fact that you can do the work whenever you want
• Making games and playing games
• The final projects at the end of each unit
What did you least enjoy about this course?

• Too much freedom... it took me a while to get used to it
• Everyone is loud
• Coding is hard
• The videos were nice but I would have preferred live lessons
• Sometimes I finished my work too early and got bored
• Sometimes the notes had typos and I got confused
Pushback and Criticism
Common criticism from admin, educators, and parents

- This isn't real teaching
- Students didn't sign up for online learning
- There's too much screen time
- Students are not developmentally ready for self-pacing
- Won't students just skip class?
- Mastery grading causes mark inflation
As educators our goal should be to be independence facilitators.

Kelly Rogers, Psy.S., BCBA
What questions do you have left?