Crafting Technology-Enhanced Educational Videos for Visual Learners



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Teaching Challenges in My Discipline

Frustrated Student: I attended classes but:



Failed to:

- Follow <u>lectures</u>
 - Large class size restricting pauses and interactions
 - Distracted by copying notes
 - Missing instructor's *remarks*
 - Unable to *review* later
- Complete experiential exercises
 - Lectures focusing on theories
 - Lack of technical pre-requisites

Contributions of this Paper



- My approach contributes towards *inclusive teaching*: Maintaining a learning environment to facilitate students with <u>diverse</u> (e.g., cultural, language) *backgrounds*, learning *modalities/styles*, and *cognitive abilities* to grow intellectually.
 - <u>Chen-Wei Wang</u>. Creating Tutorial Materials as Lecture Supplements by Integrating Drawing Tablet and Video Capturing/Sharing. In 8th Computer Science Education Research Conference (CSERC), pp. 1 – 8. ACM, 2019.
 - <u>Chen-Wei Wang</u>. Integrating Drawing Tablet and Video Capturing/Sharing to Facilitate Student Learning. In ACM Global Computing Education Conference (CompEd), pp. 150 – 156. ACM, 2019.
- Two major updates are reported in this paper:
 - My approach has been adopted, <u>seamlessly</u>, in the design and delivery of *online courses* between Winter'20 and Winter'22.
 - In Summer'21, I proposed, designed, and have delivered instances of a service course that is meant to transfer my proven teaching approach to colleagues in various academic disciplines across the university.

An Example Lecture



- My approach (for in-person & remote deliveries) comprises:
 - 1. Preparation
 - 2. Setup
 - 3. Delivery
 - 4. Sharing

[time consuming; creative] [routine]

- [choreographic]
 - [routine]
- Before we dive into <u>how</u> they should be implemented, let's first see <u>what</u> a lesson is like by implementing them.
- The subject chosen is one that's challenging for first-year CS and engineering students:

Object-Oriented Programming in Java

Example Lecture: Background



Recall:

BMI (Body Mass Index) = $\frac{weight(kg)}{height(meter)^2}$

Example Lecture: Class Model



Consider the following *model* of a person:

```
public class Person {
 /* Attributes */
 double weight: /* kilograms */
 double height: /* meters */
 /* Constructor */
 Person (double weight, double height) {
  this.weight = weight;
  this.height = height;
 /* Accessor/Getter: Body Mass Index */
 double getBMI()
   double bmi = this.weight / (this.height * this.height);
   return bmi;
 /* Mutator/Setter: Change of Weight */
 void gainWeight(double amount) {
   this.weight = this.weight + amount;
```

Example Lecture: Console Tester



What are the *console outputs* produced by the following test?

```
public class PersonTester {
 public static void main(String[] args) {
   Person alan = new Person(72, 1.72);
   Person tom = new Person(65, 1.81);
   System.out.print("Alan's BMI: ");
   System.out.printf("%.2f\n", alan.getBMI());
   System.out.print("Tom's BMI: ");
   System.out.printf("%.2f\n", tom.getBMI());
   alan = tom;
   alan.gainWeight(3);
   System.out.println("==== After Alan gained 3 kgs =====");
   System.out.print("Alan's BMI: ");
   System.out.printf("%.2f\n", alan.getBMI());
   System.out.print("Tom's BMI: ");
   System.out.printf("%.2f\n", tom.getBMI());
```

1

2



Running PersonTester, here's the console output:

```
Alan's BMI: 24.34
Tom's BMI: 19.84
===== After Alan gained 3 kgs =====
Alan's BMI: 20.76
Tom's BMI: 20.76
```





Questions?

Jackie's Approach: To Infinity and Beyond



- Slides with <u>all</u> points revealed at once (with <u>no</u> animation) Students (*visual learners*) easily get *lost* and *demotivated*.
- 2. Slides with <u>well-planed</u> animations of texts and images
 - Fixed orders of animation do not respond well to the class dynamics (e.g., questions covered in later slides, detailed clarifications)
 - Ineffective for walking through case studies

(as it's not how students would solve them problems on their own)

3. (Animated) slides with Occasional & Lightweight Annotations

- Minimal & causal additions to bullet points and examples
- Still *incomplete* walkthrough on how problems are *solved from scratch*
- Annotations are scattered around slides

(vs. focused & dedicated notes of illustrations)

4. *My approach goes beyond all these*!



My approach was adopted in various modes of delivery (MOD):

MOD \ Semester	F17	W18	F18	W19	F19	W20	F20	W21	F21	W22
In-Person, Synchronous (LIVE LECTURES)										
Online, Synchronous (MODERATED Q & A)										
Asynchronous (PRE-RECORDED LECTURES)										
Asynchronous (TUTORIAL VIDEOS)										

Jackie's Approach: Applicable to You?



- Lectures/Tutorials focus on *detailed*, *visual* illustrations on <u>concrete</u> examples, replacing the blackboard/whiteboard with a *drawing tablet*.
- I have taught 2,700+ CS and SE students from (18 instances of) seven EECS courses, from first- to fourth-year.
- I have created:
 - 500+ *lecture* videos [synchronous & asynchronous]
 - 150+ hours of *tutorial* videos
- I have adopted this approach for teaching <u>all</u> my courses:
- 1. **EECS1021** Object Oriented Programming from Sensors to Actuators [W19] 2. EECS1022 Programming for Mobile Computing [W18, W21] 3. EECS2030 Advanced Object Oriented Programming [F17, F18, F19, F21, F22] 4. EECS2011 Fundamentals of Data Strutures [W22 5. EECS3311 Software Design [F17, F18, W19, F19, W20, F20] **EECS3342** System Specification and Refinement [W22] 6. 7. EECS4302 Compilers and Interpreters [W20, F22] As long as there's something you want to teach, my approach is applicable! I even use this approach to give research talks.

Jackie's Approach: Four Phases



1. PREPARATION

- Most time consuming, yet most critical
- Clarify what examples/concepts you wish to demo in details.
- Create starter pages: EXTENSIBLE & REUSABLE. [Examples]

2. SETUP

- Application 1: In-Person lectures/reviews • Application 2: Remote lectures/tutorials
- [wireless microphone] [studio microphone]

[mirrored to your computer]

3. DELIVERY

- Presentation [e.g., powerpoint, PDF] [e.g., Eclipse]
- Programming Tool
- Drawing Tablet (e.g., iPad)

4. SHARING

- As the subject expert, *insights/remarks* made while you demonstrate are the most valuable for your students.
- *Record* the entire delivery and *share* it with students (or even 0 those in the public).



Jackie's Approach: Visual Summary



Reflections



- Using a *drawing tablet*, replacing the blackboard/whiteboard, helps student *comprehension*, <u>despite formats</u>.
- Yet, *student engagement* remains a challenge:
 - Pre-recorded lectures: Clarity, Completeness vs. Procrastination
 - Q&A sessions: Optional (*attendance*) vs. Mandatory (*workload*)

Resources



• A compact tutorial session:

https://www.eecs.yorku.ca/~jackie/research/talks.html

• Explore more examples of adopting the approach:

• Lectures:

https://www.eecs.yorku.ca/~jackie/teaching/lectures

• Tutorials:

https://www.eecs.yorku.ca/~jackie/teaching/tutorials

• Starter Pages and Annotations:

https://www.eecs.yorku.ca/~jackie/teaching/iPad

- Read more about the approach:
 - <u>Chen-Wei Wang</u>. Creating Tutorial Materials as Lecture Supplements by Integrating Drawing Tablet and Video Capturing/Sharing. In 8th Computer Science Education Research Conference (CSERC), pp. 1 – 8. ACM, 2019. [PAPER]
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Jackie's Approach: Four Phases

Jackie's Approach: Visual Summary

Reflections

Resources

Teaching Challenge: Large Classes



Teaching Challenge: Large Classes

