METALS
Masters of Educational Technology & Applied Learning Science

Introductory Computer Science

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Educational Goals, Instruction, and Assessment

BIG IDEAS

Participation & Making:
Ground abstract concepts in students' experience of making programs that use these tools to create simple animation effects.

Observation & Worked Examples:
Show students both how to implement the tools learned in the course, and when they can be useful by demonstrating common, simple use-cases.

Authenticity & Motivation:
Empower students to make things that interest them by using programming tools to solve real problems in the context of their own projects.

Belonging & Norms:
Encourage inquisitiveness and welcome failure by having students reflect at the end of each class, and by modeling how to deal with failure and challenge.

Triangulation & Validity
Give multiple opportunities for students to practice and demonstrate competence in all knowledge and skills.

CONTACT

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OVERVIEW AND CONTEXT

Domain – Introductory Computer Science

Importance – CS is difficult and off-putting
…but also creative and empowering

Learners – Suburban 10-12th Graders

Timing – 5 Days over the summer

Setting – Private tutoring facility
with ten students in each class

Developmental Levels
- Computer use, algebraic literacy (Alg 1), seminar skills

Dispositions
- Course is opt-in ⟶ Most should be interested

Learner Differences
- Varied visualization and abstraction skills
- Varied Grit
- Varied Metacognition

ASSESSMENT DESIGN

Spiral Review/Practice
Worked example of everything so far, then students implement their own variation

Isolated Implementation
Worked example of new concept, then students implement their own variation

Integrated Implementation
Develop computer game throughout week, Add new feature with today's concept

Surveys
Assessing Dispositions and Metacognition: Self-Identify challenges, interest, opportunities for improvement, attitude towards failure; defining good code

GOAL SPECIFICATION

Fundamental Purpose
Foster interest in Computer Science
- All other goals are secondary & serve this purpose

Cognitive Knowledge & Skills
Programming tools & techniques: What, When, How

Metacognition
Students will understand their own capabilities, what challenges them, and how to evaluate & improve their work. Students will seek to improve themselves and learn from their mistakes.

Cognitive Goals

Knowledge	Skills	Dispositions
Variables	Drawing Shapes	Interest
Conditionals	Positioning with Variables	Curiosity
User Input	Conditionals in Animation	Grit
Lists	User Input	
Loops	Drawing with For-Loops	
Functions & Classes (advanced only)	Defining Classes and Functions (advanced only)	

Metacognitive Goals

Knowledge	Skills	Dispositions
Awareness of Own Abilities	Self-Assessing Work Quality	Self-Improvement
Recognizing Challenges	Feature Design	Dispositional Awareness
	Refactoring	

INSTRUCTIONAL DESIGN

Structure of Each Class

Spiral Review & Practice of all previous material

Conceptual Overview of New Concept

Isolated Implementation of New Concept

Integrated Implementation:
Incorporate new concept into project with new feature

End of Class Survey:
What is [today's topic] and how is it useful? What was hard today? What was cool? What do you want to make? How could your program be refactored?

Course Schedule

Day 1	Day 2	Day 3	Day 4	Day 5
Drawing	Variables	Conditionals	User Input	Lists & Loops

EVALUATION RESEARCH

Evaluating Impact
Worked examples vs participatory practice. In the Spiral Review and Practice as well as Isolated Implementation, half the students will see a worked example demonstrating how and why to implement the relevant tools, and will then *practice by creating their own variation*. The other half of students will receive an *additional worked example*. This will facilitate evaluation of the efficacy of practice vs observation.

Evaluating Implementation
Has every student been assessed on all three performance tasks for each day's topic? Is every point assigned justified with a simple note of what the student did to deserve the mark?

REFERENCES

1. Schwartz, D. L., Tsang, J. M., & Blair, K. P. (2016). The ABCs of how we learn: 26 scientifically proven approaches, how they work, and when to use them. New York, NY: W.W. Norton & Company.
2. Wiggins, G. P., & McTighe, J. (2008). Understanding by design. Alexandria, VA: Association for Supervision and Curriculum Development.