Curriculum for a Comprehensive Satewide In-Service CS Teacher Training Program

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Sarah Diesburg
University of Northern Iowa
sarah.diesburg@uni.edu

J. Ben Schafer
University of Northern Iowa
ben.schafer@uni.edu

Briana Morrison
University of Virginia
bbmorrison@virginia.edu

UNI / University of Northern Iowa.

CSEd@*UNI*

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Building on Previous Work

- In 2018 Iowa launched a series of new K-12 CS laws
  - Provided for CS Endorsements at both the elementary and secondary levels
  - Required districts to develop a plan for offering CS courses across K-12 curriculum
- 2018-2020 NSF CSForAll:RPP small-size/pilot grant, $300,000 over 2 years
- 2023-2026 NSF CSForAll:RPP medium-size grant, $1,000,000 over 3 years

Our Program

- Five graduate courses
- Participants earn one or both of Iowa's CS Endorsements (K-8 and 5-12)

| Course Sequence (3 credits each) |
| --- |
| Foundational Concepts of Computer Science |
| Fundamentals of Programming |
| Teaching and Learning of Programming |
| Computer Science Methods |
| Data Structures and Algorithms |

In-Service Teachers

- 18 month, cohort-based program

- Hybrid of asynchronous online course work with "monthly" face-to-face Community of Practice events

  - CoP Events hosted by partner facilitators at locations around the state
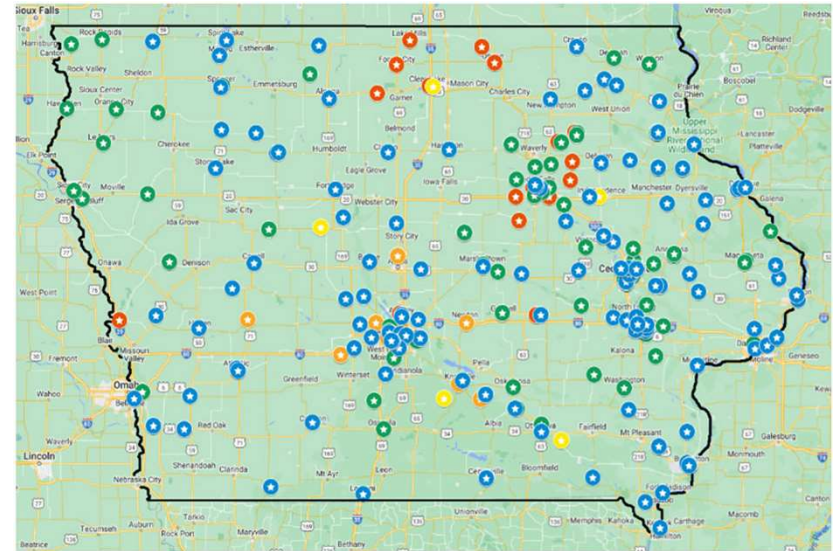
- Cohort '23 (green pins) : 88 teachers, 3 partner sites
- Cohort '24 (blue pins): 132 teachers, 7 partner sites

Curriculum

Curricular Design Process

1. ***Educator-based:*** Our audience consists of trained educators and our program is designed with objectives and learning activities appropriate for this audience.
2. ***Standards-based:*** Our program is designed around specific outcomes and standards from the CSTA K-12 Standards for students and the CSTA Standards for CS Teachers.
3. ***Peer/cohort-based:*** Our program is designed with an emphasis on participant collaboration and developing active communities of practice.

Our Curriculum and Course Outcomes

- We began by identifying the learning outcomes and the standards to which those outcomes are connected
    - o Understanding by Design (UBD)
- Full detail for all 5 courses in the paper and project website
    - o Includes sample syllabi and fine-grained learning outcomes evaluations
- Foundational Concepts of CS

Foundational Concepts of CS

- FCCS provides knowledge of the breadth of computing, excluding programming
- The textbook used is "Computer Science: An Overview" by Brookshear and Brylow , supplemented by faculty videos

Course-Wide Outcomes	
0.1	Analyze and discuss common social and ethical considerations of real-world applications.
Module 1: Data Representation	
1.1	Recognize that the fundamental building blocks of computers are logic gates and, given their inputs, be able to determine the output of a simple collection of gates.
1.2	Apply an understanding of how computers represent various types of values (e.g. bits, bytes, binary, hexadecimal, encodings, storage units).
1.3	Recognize common errors (e.g. overflow and truncation).

Foundational Concepts of CS (cont)

Module 2: Hardware, Data Manipulation, and OS	
2.1	Apply understanding of a CPU's instruction set and the instruction cycle to various scenarios.
2.2	Identify hardware components of a computer and describe their relationship and interaction.
2.3	Explain the process whereby a computer's CPU can be connected to or communicate with a variety of external (peripheral) devices.
2.4	Apply an understanding of computer memory/storage to a variety of situations.
2.5	Apply understanding of the role and functioning of operating systems to a variety of situations.

Foundational Concepts of CS (cont)

Module 3: Networks and Databases	
3.1	Explain how a network consists of several autonomous systems communicating through established protocols.
3.2	Explain how the Internet consists of multiple networks connected through packet switching.
3.3	Describe how the Web is an example protocol used on the Internet that displays web pages in a client-server model.
3.4	Explain how cybersecurity is an important concern for networks and the software that is built on them.
3.5	Recognize fundamental knowledge of the role, structure, and characteristics of database systems.

Foundational Concepts of CS (cont)

Module 4: Artificial Intelligence	
4.1	Differentiate between the concepts of machine reasoning/behavior and human reasoning/behavior.
4.2	Identify common vocabulary concerning artificial intelligence.
4.3	Identify challenges with artificial intelligence concerning images and language processing.

Mapping to CSTA Standards

- CSTA K-12 Computer Science Standards

  - Define the skills and key CS knowledge that students should have at various checkpoints along their K-12 journey

  - Divided into different grade bands

  - We concentrate on level 2 (roughly middle school) and 3A (roughly high school/typical student) for the grades 5-12 state endorsement

- CSTA Standards for CS Teachers

  - Establish robust benchmarks for teachers who prepare students to meet CS learning outcomes/standards

  - Serve as guideposts or benchmarks that teachers can use to guide their improvement

CSTA Computer Science Standards

- Full tables are in the paper detailing concept, standard, status, and class covered

  o Status is met, progressing, unmet

- The "Unmet" standards fall into three intentional categories:

  1. Lack of physical computing/devices

  2. Lack of data science emphasis

  3. Lack of ongoing software development projects

CSTA Teacher Standards

Full set of the CSTA Teacher Standards are addressed in our program, whether in one class, multiple classes, or program wide.

Concept	Standard	Class Covered
CS Knowledge & Skills	1a	TLP
	1b,1c,1f	FCCS
	1d	FOP
	1d,1e	DSA
Equity and Inclusion	2a,2b,2c,	TLP
	2a,2b,2c,2d,2e	Methods
Professional Growth and Identity	3c,3d,3e	TLP
	3a,3d,3e	Methods
	3b,3f	Program-Wide
Instructional Design	4c,4d,4e	TLP
	4a,4b,4c,4d,4f,4g	Methods
Classroom Practice	5b,5c	TLP
	5c	Methods
	5a,5d,5e,5f	Program-Wide

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Evaluation and Feeback

- Educator-based
  - *"Prior to this course, I was able to explain how to do the coding activities, but I couldn't explain why we were doing it that way or why it was important."*

- Standards-based
  - *"Taking a deep dive into the standards helped clarify how to structure a class."*
  - *"Taking an inventory of where I am at on teaching the standards. I feel confident that I can continue this self-reflection strategy and update it as I grow in my teaching."*

Evaluation and Feeback

- Peer/cohort-based

    o *"I thoroughly enjoy the CoP time and meeting with others who are in the trenches."*

    o *"Keep using CoPs. It's really reaffirming when we get together in person to share how the course is going."*

    o *"The hands-on activities at the CoP are the best part."*

Questions?

- See our website for more information

Thank you!

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