Development & Implementation of a Course to Prepare K-12 Practitioners to Broaden Access to Computing

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Session Overview

I. BACKGROUND

II. DESIGN OF COURSE: 2018

III. IMPLEMENTATION: SPRING 2019

IV. EVALUATION

V. FINDINGS

VI. DESIGN IMPLICATIONS FOR NEXT COURSE ITERATION

VII. LIMITATIONS
I. Background

- Need for CT in K-12
- Challenges of Expanding CT for all K-12 Learners
- State Policy Context: Georgia
- In-service Instructional Technology Programs
Defining CT

Students that are computational thinkers “[develop] and [employ] strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions” (ISTE, 2016). Sub-elements of this standard include defining problems; thinking algorithmically; collecting, analyzing, and representing data; developing models to understand complexity; and creating and testing automated solutions (ISTE, 2016).
Need for “Leading CT” Course

As teacher educators, how are we preparing in-service educators to guide K-12 students as computational thinkers?
II. Design of Course:
2018
II. Objectives & Assignments

1. Define computational thinking.
   - Reading Journal, Parts 1 and 2
   - Discussion: Computational Thinking: Given foundational readings on CT, learners write a discussion post in response to one of four choices; and they respond to at least two peers.
II. Objectives & Assignments

2. Explain the traditional barriers to computing careers for females and minorities; and highlight strategies for overcoming them.

- Short Paper 1: Barriers to CS for Girls
- Short Paper 2: Barriers to CS for Students of Color
- Reading Journal, Parts 1 and 2
II. Objectives & Assignments

3. Identify resources (e.g., organizations, funds, people, events, curricula) for supporting learning of computational thinking in K-12 or informal learning contexts.

4. Explore professional learning networks, communities, or resources to support continued professional growth as an advocate of computational thinking for K-12-aged learners.

- Exploring & Curating
II. Objectives & Assignments

5. Analyze computing innovations in terms of their social, economic, and cultural impacts, both beneficial and harmful.
   • Discussion S3: Technology and the Evolution of Privacy:
   • Reading Journal, Parts 1 and 2 (see Objective 1)

6. Demonstrate effective planning for the instructional design, facilitation, and/or classroom management of computational thinking activities among students or teachers in K-12 or informal learning contexts.
   • Learning Plan (w/ Peer Review)
II. Objectives & Assignments

7. Given that computing is a way to express creativity, solve problems, enable communication, and foster innovation in a variety of fields and careers, defend a rationale for the importance of K-12 learners’ development of knowledge and skill in computational thinking.

• Portfolio Shell and Final Portfolio
• Discussion: How do you do, everybody?
• Crowdsourcing T-chart
• Discussion: Elevator Speech
• Discussion: Reflection & Looking Ahead
II. Objectives & Assignments

8. Create computational artifacts that demonstrate development of knowledge and skills related to decomposition, pattern recognition, abstraction, and/or algorithm design.

- Computational Activities in 3 Parts: Learners publish artifacts (e.g., screenshots, video walkthroughs, or embeddables) to their portfolio, including a brief description of each artifact, their evaluation of its quality, an estimate of the time it took. In addition, learners align their artifacts to one or more of the CT Vocabulary keywords from the CT Vocabulary and Progression Chart.
III. Implementation: Spring 2019

- 15-week graduate, online course
- Elective course for instructional technology and school library programs
- 20 K-12 participants (1 admin, 2 librarians, 17 teachers)
- 75% White; 25% Black
- 75% Female; 25% Male
- 9 Elementary, 5 Middle, 6 High School
IV. Evaluation

- Evaluation Questions
- Data Collection Instruments
- Data Analysis
V. Findings

Evaluation Question: How did learners perceive course experiences at midpoint and near-end?

○ Week 7 Feedback Survey (n=10)
○ Week 12 Feedback Survey (n=12)
## Participants’ Perceptions of Course at Week 7 and Week 12

<table>
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<tr>
<th>area</th>
<th>Week 7 (n=10)</th>
<th>Week 12 (n=12)</th>
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| **How Course is Going**   | Overwhelming (6)  
Going well (6)                                                                 | Going well (8)  
Overwhelming (4)                                                                 |
| **What You Like**         | Course Design & Organization (6)  
CT Activities (3)  
Policies (2)  
Readings (1)                                                                 | Readings (3)  
Course Design & Organization (2)  
Policies (2)                                                                 |
| **What You Dislike**      | CT Activities (5)  
Too Many Kinds of Activities (2)  
Course Design & Organization (1)                                                                 | Readings Intensity (4)  
CT Activities (4)  
Online Portfolio Development (1)                                                                 |
| **How Relevant or Not Relevant** | Relevant (9)  
Plans to Introduce into K-12 (3)  
Thinking Improved (1)  
Not Relevant (1)                                                                 | Relevant (10)  
Becoming More Relevant (1)  
Not Relevant (1)                                                                 |
V. Findings: Evolving Understanding of CT

“Some of the assignments my students already do are computational thinking activities. Now, I am understanding the why and importance behind developing these skills.” (Week 12)

“At first it was hard to see the relevance. It is becoming more clear and has increased my excitement and knowledge about CT.” (Week 12)
V. Findings: Evolving Understanding of CT

“At this point in the course, I feel much more comfortable and confident with the topic of computational thinking and computing. It was so new to me at the beginning of the course, I felt like I was treading water to stay on top of things. All the readings have been useful and guided me in the right direction to grasp the context of the course.” (Week 12)

“I have enjoyed the time spent learning to use the various applications available through the Computational Activities. I am gathering a great deal of experience I can use with my students.” (Week 7)
V. Findings: Understanding Barriers

“I have been very interested in seeing the inequalities in the access to computational thinking for female and students of color. I never realized this was such an issue and discrepancy for these students. It makes me want to step up and be an advocate for these students so they can have equal access to computing like other students.”
V. Findings: Dislikes

“I’m swamped”

<<This course was more work than three others combined.>> (paraphrased)

“I am used to finishing a month or more ahead of the end date of each semester.”

“The amount of work. No offense, but it’s overkill compared to my other courses.”
VI. Design Implications for Next Iteration
1: Reduce Information

“The readings, while relevant, have been a little overwhelming as far as amount.”

“During the course, we receive so much interesting information, but if there is anything that I dislike about the course is that I feel that there is too much reading materials.”

"The course is finally at a point that allows me to focus and utilize the information that I have learned through the reading and activities and there is a lot of reading..."
1: Reduce Information

- Learners Overwhelmed Around Computational Activities and Readings/Reading Journals
- Better Integration of Concepts
- Reduction or Removal of Extension/Enrichment Readings (44)
- Remove Visual Noise
- Communicate the Learning Priorities
2. “A Lot of Balls in the Air”

“I am not used to having so many activities within a course.”

“It often seems like there are ‘a lot of balls in the air’ .... reading journal, discussions, computational activities log, etc.... But, I'm honestly not sure anything should be removed because it is all valuable. But, I often am not sure on where to begin and how to prioritize my time.”

- Problem: Quantity and diversity of projects
- Solutions: Reduction of assignment load; Removing Societal Issues Related to Computing Assignment (Obj. 5); and better treatment of issues through the course introductory videos.
3. Remove Open-endedness and Choice from Computational Activities

“I am facing some challenges with the computational activities, but I am learning and having fun in the process.”

"I wish there was a little bit more support with the computational activities. I struggled badly with the first set. I was particularly lost with Scratch. I watched 20-25 tutorial videos from them, but I still struggled with the basic functionality. I consider myself pretty savvy with stuff like that, so I was especially frustrated that I didn't feel successful even after trying so hard."
3. Remove Open-endedness and Choice from Computational Activities

- Clearly specify the activities for novices to the domain of CS (Clark & Mayer, 2011)
- Two approaches:
  - Require all learners to complete computational projects that provide experience in elementary (K-5), middle (6-8), and high school levels (9-12); or
  - Require learners to “specialize” in the level they choose.
- Allow advanced learners to design their own learning, but provide a way to both demonstrate their prior knowledge and for them to express their unique learning plan.
4. Confront Misconceptions and Naive Understandings of CT and CS

<<This course feels like the Georgia CS Endorsement.>> (Paraphrased)

- Show them the depth and breadth of CS.
- CS as more than programming.
- Help learners to understand CT-related pathways for professional learning beyond this course
5. Build in Content-specific Applications of CT

“Teaching students to learn out of the box is the biggest skill that is relevant [in this course], but coding has no place in my classroom at this point. If there is a program that brings coding to math, then it will fit better.”

- Math teacher had a hard time seeing relevance of CT to her classes
- Reveals opportunity to better connect CT activities to teachers’ content areas
- How?
6. Make More Time for Leadership Activities

“At this point in time not very relevant, because students are not using coding in my school. This has been used in the past, but the students were not enjoying it. I could see this being useful if there was a way to allow for coding and math work at the same time for me.”

- Have learners develop a more explicit plan for action
  - Given a template; and
  - Given an example.
7. Continue Using the Web Portfolio

- Authoring in Google Sites challenged several learners
  - Embedding documents
  - Sharing privileges
8. Aligning to the ISTE CT Standards for Educators

- ISTE Standards for Students (2016) and ISTE Standards for Coaches (2011) used
- ISTE CT Standards for Educators (2018) issued after course was designed
- Align course objectives and potentially expand course in new directions or create a second course
9. From Checklists to Rubrics

“Evaluation methods were fair. There was a lot of work in this class, but as long as expectations were followed, I did well.”

- Used binary checklists of project expectations combined with open-ended feedback and opportunity to revise.
- The result is that most learners succeed, and the data don’t reveal much to aid in more nuanced understandings.
- Improvement: Convert Checklists into Specific Rubrics
VII. Limitations

- Data collection design included on course evaluation at the end. Viewed as better to be impartial and didn’t want to over-burden students in a course that had become a heavy load. However, due to advising, several non-K12 students were in course. They may have answered final course eval. Need to include a short summative feedback survey.
- The learners were 20 Georgia teachers and school librarians. It would be interesting to see course with different audience in different formats like summer PD.
- OER at [https://tinyurl.com/yywp4peg](https://tinyurl.com/yywp4peg)
VIII. Looking Ahead, What Motivates Me

(1)

“Coding and CS are things that I have been wanting to dive into since my school is so heavy in STEM. But it has intimidated me so I've just picked other areas of STEM to focus on. This course has forced me to take the time to look at coding and CS and see how I can fit it into my 3rd grade classroom.”

“As a media specialist, I believe this is very relevant and useful. I plan to start next school year offering teachers/classes CT lessons. I will also plan an Hour of Code during each semester. I have so many resources to back up my lessons in case my administration or teachers do not want to participate.”
“This class made me realize that there is much more that I can do in the area of computational thinking and making computer science more accessible for all students.”
Questions or Comments?
References

References


References