Stanford
GRADUATE SCHOOL OF
EDUCATION

EDUC 261D | Spring 2020 | Thursdays 3:00-5:50

CURRICULUM & INSTRUCTION IN COMPUTATIONAL THINKING

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Overview

This course approaches computational thinking through the lens of teaching for social justice. We will examine how (and why) practitioners and schools can support students' engagement with computational thinking practices through interdisciplinary means. This course will develop students' understanding of computational thinking to engage in important ways with power, privilege, and identity. Utilizing computational thinking as an approach to problem solving empowers individuals to recognize the influences technology brings to our society and the impact it has on ethics and equity. The goals of this course are to:

- Describe the core practices of computational thinking and be able to use it as a way for K-12 students to access information, express their thinking, learning, and ideas, and increase their computational fluency.
- Develop technological and content knowledge in order to utilize these practices in your discipline.
- Understand how to choose appropriate learning environments for students to engage in computational thinking related activities with an emphasis on pedagogy.
- Empower practitioners to recognize opportunities where they may be able to engage an audience in utilizing computational thinking skills.

Acknowledgements

We acknowledge that Stanford University sits on the land of the Muwekma Ohlone people. We acknowledge the painful history of genocide and forced removal from this territory, and we honor and respect the many diverse Indigenous peoples still connected to the land on which we gather. We remember their continued connection to this region and we offer our respect to their Elders and to all Ohlone people of the past and present.

This course would not have been possible without the help of Moni Yupa, STEP class of 2018 who advocated for and tested out a trial version of this course. Additionally, Chris Proctor, PhD student in Learning Sciences and Technology Design who tirelessly worked with us to develop the syllabus. We also must acknowledge this course is available thanks to funding from the TELOS initiative at Stanford.

Expectations

What do we expect of you?

This course is designed to create a collegial culture in which we can all learn from one another. To that end, engaging with the texts, discussions, and activities in this class means being fully present. We expect you will come to class prepared to curiously engage with the content, actively challenge your own understandings, be willing to work through ambiguity, and be respectful of the diversity of experiences and identities of your colleagues.

There are 3 expectations we consider especially important

1) Participation- our collective engagement in class activities and discussions will facilitate your learning and others. Participation looks and sounds different for each learner and our goal is to provide a variety of opportunities for everyone to engage. We expect for you to mind your own airtime, and either step back to create space for others or step in to share your ideas.

2) Communication- Class starts promptly at 3pm and will end promptly at 5:50 (we will discuss our ideas with you around our remote class when we meet). We are aware of the commitments you have outside of our class and will do our best to communicate about the arc of the course so you can prioritize your time accordingly. We also appreciate the same. In the case of absence (for major illness or family emergency), email us before the session. If missing a class is unavoidable for other reasons, we will ask you to submit reflections on your readings. Additionally, we will be available 1 hour before every class or you can email us to set up a time to meet.

3) Digital Tools- we will be using digital tools in this class. For tools that are new to us, we ask you to explore with an open mind and a willingness to try it out. Additionally, when they are not central to our learning, we expect you to set them aside, this includes personal devices - please check in with family, friends, colleagues, and the internet at large during breaks.

What can you expect of us?

You can expect that we will work to get to know you as a student, but more importantly as a human. We will strive to create a collaborative and equitable learning environment where each of you feels comfortable sharing what you've learned, challenging other's ideas, and wrestling through your own uncertainties. We will work to build trust with you and amongst our community of learners. We will provide you continuous feedback and be available to meet with you when you need it. You can expect we will do a lot of hands-on activities, reflections, moving around and not a lot of lecturing. You can also expect us to be organized and communicative in order to support your learning.

Assessment

In full transparency, we do not find grades indicators of your learning. We also do not find grading, in the traditional sense, the best use of our time. You are all graduate students taking our class to learn, engage, and grow with the content. Our job as instructors, and your job as students, is to provide continuous feedback to support engagement with our course. If you are adhering to the above expectations and make sincere efforts to fully participate in assigned tasks during and outside of class, you can expect an A.

Activities

Reading We collated thoughtful and digestible amounts of reading each week. The readings will guide our learning for that class and in order to fully participate you need to have read. Each week we name our Essential Question(s) and learning goals and intend for them to act as guides for your reading. As there is so much rich content, we will always include supplemental readings for you to bookmark for the future, but these are not required.

Reflecting We believe committing to a weekly reflection practice is one of the best ways to authentically learn and track your growth as a learner. Documenting your learning and reflecting on your growth helps us assess our teaching and also allows for you to see your developing ideas in real time. Each week you will have two reflections, a Reading Reflection and an Application Reflection. The reflections can be done in either a Google Slides deck or a Google Sites page that you will link in Canvas. The design and organization is up to you - each response should be about 500 words and can include other artifacts of learning (photos, videos, links, etc) . Some weeks we may ask you to respond to others' reflections in an effort to push our ideas further.

Reading Reflection: The reading reflection questions are on the syllabus in the Course Roadmap. You are to respond to the prompts before that week's class. Reflections should be updated no later than 2:30pm on Thursdays.

Application Reflection: Following each class you will then add a reflective response to a question we pose about the class activities. We will post this question on the syllabus at the end of each class but the intention is for you to reflect on how the activities and discussions experienced in class inform your understandings of the reading and your thinking about the content.

Designing You will be working in pairs on a Design Project that showcases your engagement with and understanding of computational thinking. The projects are due on Class 9, June 4th. Beginning in Class 3, we will dedicate a majority of the second half of class to working with your partner on the project.

Support Services

This COVID-19 pandemic is a stressful time for us all (your instructors included). We are all balancing new routines, new stresses, and constant uncertainty. These can be barriers to learning. In addition, you may experience a range of other challenges that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. Stanford is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available.
https://vaden.stanford.edu/caps-and-wellness/counseling-and-psychological-services-caps

Accessibility

If there is anything you need in order to make the classroom space or course content more accessible to you as a learner, let us know, regardless of any diagnosis or formally documented accommodations you may or may not have.

Students with Documented Disabilities

Students who may need academic accommodations based on the impact of a disability must initiate the request with the Office of Accessible Education (OAE). Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. Professional staff will evaluate the request with required documentation, recommend reasonable accommodations, and prepare an Accommodation Letter for faculty dated in the current quarter in which the request is being made. Students should contact the OAE as soon as possible since timely notice is needed to coordinate accommodations. The OAE is located at 563 Salvatierra Walk; phone: 723- 1066; web site http://studentaffairs.stanford.edu/oae.

Honor Code

1. The Honor Code is an undertaking of the students, individually and collectively:
    a. that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;
    b. that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.
2. The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.
3. While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work.

Violations of the Honor Code

Examples of conduct that have been regarded as being in violation of the Honor Code include:

- Copying from another's examination paper or allowing another to copy from one's own paper
- Unpermitted collaboration
- Plagiarism
- Representing as one's own work the work of another

Course RoadMap

Online Learning Guide

A quick guide with instructions, norms, and expectations from us about online learning and working together in a digital space.

Class Playlist on Spotify

As we work, explore, and tinker in class we will play this playlist as our background music. Add songs to the playlist - the more songs the better!

Launchpad

Where we will link the agenda, slides, lesson plans, and other materials from class. Check this prior to each class to also know what materials you need to have with you for class.

Class 1 | April 9th **Essential Question**: To what extent does the practice of computational thinking empower people to recognize the impact technology has on society and its influence on ethics and equity?		
Learning Goals: Develop an understanding of computational thinking Understand the various approaches to defining computational thinking Evaluate the prevalence and impact of digital media on the lives of adolescents. Consider the inequitable effects of identities and stereotypes around computing. **PCK**: Creating inclusive computing cultures	**Readings:** Syllabus Wing, J. M. (2006). Computational thinking. Communications of the ACM, (pgs 33-35) Pea & Grover (2013) Computational Thinking in K–12: A Review of the State of the Field (pgs 38-43) Denning (2017) Remaining trouble spots with computational thinking. (pgs 1-7) **For A Deeper Dive in the Future:** boyd (2014) It's complicated: The social lives of networked teens Margolis, et al. (2008) Stuck in the shallow end: education, race, and computing.	**Reading Reflection**: Where have you witnessed or experienced inequities in the culture of technology? How are you defining computational thinking? Where is it's place in your work spaces? **Application Reflection:** Where do you see connections between computational thinking and your content area and daily life? Where might you already be doing CT in your daily life or instruction that requires you to use CT to solve problems?

Class 2 | April 16th

Essential Question: How do we identify applicable data and patterns for use in models and systems? Are the algorithms created void of human bias?

Learning Goals:	**Readings:**	**Reading Reflection:**
Analyze the relationship between programming and computational thinking, and related pedagogical tradeoffs. Understand algorithms as more than a problem-solving mechanism; rather a political/historical project in what computers do, that maintains humanity. Discuss how we use data to recognize patterns and answer questions in context. Understand how computers can help collect or create new kinds of data and the potential implications the interpretations may have on communities. **PCK**: Working with data to think through the language of computation	Noble, Safiya (2018) Algorithms of Oppression (pgs 1-14) The New Jim Code? Race and Discriminatory Design (26 minute podcast or read transcript) An Algorithm That Grants Freedom or Gives It Away, NYTimes (1-6) Teaching Students to Wrangle 'Big Data', Education Week (1-4) **For A Deeper Dive in the Future:** Benjamin, Ruha (2019) Race After Technology: Abolitionist Tools for the New Jim Code Watch The Great Hack Christin, Angèle (2017). Algorithms in practice: Comparing web journalism and criminal justice. (pgs 1-14) Norman (1999) Affordance, conventions, and design. (pgs 38–43) Taylor & Hall (2013) Counter-Mapping the Neighborhood on Bicycles: Mobilizing Youth to Reimagine the City. (pgs 65-76)	How has your definition of computational thinking evolved? Does engaging with computational models support your understanding of the ethical implications of technology? Why or why not? **Application Reflection:** What do we understand about systems and the algorithm within that system? What are the impacts when things are changed? What are the implications on human bias?

Class 3 | April 23rd

Essential Question: How do we identify a problem and build models that address the problem?

Learning Goals:	**Readings:**	**Reading Reflection:**
Understand systems and using decomposition as a computational thinking practice Process of data-collection, analysis, interpretation, and communication, and its role in various disciplines	Yadav (2016) Computational Thinking for All: Pedagogical Approaches to Embedding 21st Century Problem Solving in K-12 Classrooms (1-4) Case (2014) Parable of the polygons: A playable post on the shape of	What are the implications for learning in bringing real world problem solving using computational models into learning spaces? How might computational thinking practices and tools elevate students'

Use computational models to understand systems, both from the perspective of the computational agent and the impact it has on emerging behavior. **PCK**: Using computers as tools for thinking and creating	society. Ito, et al. (2020) The Connected Learning Research Network: Reflections on a Decade of Engaged Scholarship. (pg 4-7, 37-43) Berland,M., Lee, V.R. (2011) Collaborative strategic board games as a site for distributed Computational thinking (65-71, 78-80) **For A Deeper Dive in the Future:** Mitchell (2009). Unsimple truths: Science, complexity, and policy. Victor (2011). Explorable explanations. Noonoo (edSurge article) Playing Games Can Build 21st Century Skills-Research Explains How	problem solving skills? **Application Reflection:** After completing your prototype, what computational agents or tools might be used to solve the problem? What needs to be considered when developing computational tools to ensure systemic inequities and racist structures are not perpetuated?

Class 4 | April 30th

Essential Question: How do we know we are using the appropriate tools to elevate the learning experience and deepen students knowledge?

Learning Goals:	**Readings:**	**Reading Reflection:**
Explore interdisciplinary applications of computational thinking. Analysis of task and affordances in selecting educational technologies. Evaluate pedagogical considerations of teaching with technology **PCK**: Selecting appropriate tools for integrating computational thinking practices.	Brennan & Resnick (2012) New frameworks for studying and assessing the development of computational thinking (1-11, and choose 1 assessment approach to read). Hamilton, M., Clarke-Midura, J., Shumway, J.F. et al. An Emerging Technology Report on Computational Toys in Early Childhood (1-12) Barr & Stephenson (2011) Bringing computational thinking to K-12: what is involved and what is the role of the computer science education community? (48-54) **For a Future Deep Dive:**	How are you differentiating between computational thinking concepts and practices? What is the added value to students learning in utilizing these practices? In creating learning environments to support these practices, how do you select an appropriate technology tool in service of equitable student learning? **Application Reflection:** **(add to this reading reflection prompt now that you have had our in class experience)** In creating learning environments to support these practices, how do you select an appropriate technology tool in service of equitable student learning?

	Bowles, N (2019). The Digital Gap Between Rich and Poor Kids is Not What We Expected Maloney, et al. (2010) The Scratch Programming Language and Environment. Proctor & Garcia (2019). Student voices in the digital hubbub. Shumway et al (2019) Coding Toys in Kindergarten Triple E framework	

Class 5 | May 7th

Essential Question: What is the value of making/tinkering and student agency in learning and where does it fit within computational thinking?

Learning Goals: Experience making and inquiry activities to think about integration in interdisciplinary ways Identify opportunities for student ownership in solving real world problems **PCK**: Building student agency	**Readings:** Brennan K. (2015) Beyond technocentrism: Supporting constructionism in the classroom. (289–296) Barron, B, & Darling-Hammond, L. (2011). Teaching for Meaningful Learning: A Review of Research on Inquiry-Based and Cooperative Learning. Edutopia (1-15) **Future Deep Dives:** Papert (1980). Mindstorms: Children, computers, and powerful ideas. Blikstein, P. (2013). Digital Fabrication and 'Making' in Education: The Democratization of Invention. In J. Walter-Herrmann & C. Büching (Eds.), FabLabs: Of Machines, Makers and Inventors. Bielefeld: Transcript Publishers (1-19) Brennan, K. (2015). Beyond Right or Wrong: Challenges of Including Creative Design Activities in the Classroom. Journal of Technology and Teacher Education, 279-299.	**Reading Reflection:** What would a constructionist classroom look and sound like? What are your experiences as a student or teacher with that type of space? **Application Reflection:** How did you engage with the metacognitive process? (How were you thinking about your thinking)? What feelings did you experience as you make and tinker? What resonates with you about this?

	Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. Educational Psychologist, 41, 75-86.	

Class 6 | May 14th

Essential Question: How do we use computational thinking to leverage learning?

Learning Goals: Recognize opportunities where computational thinking practices can be enacted in learning settings. Differentiate between the variety of computational thinking activities and understand the range of entry points from computer less activities to programming. **PCK**: Integrating computational thinking into the curriculum	**Readings:** Kafai & Burke (2013) The social turn in K-12 programming: moving from computational thinking to computational participation. (pgs 603-608) Weintrop, et al. (2006) Defining Computational Thinking for Mathematics and Science Classrooms (pgs 130 -132 "Computational Thinking in K-12 Education", pgs 134-143 "The Computational Thinking in Mathematics and Sciences Practices Taxonomy") Lee, V.R., Recker, M. Paper Circuits: A Tangible, Low Threshold, Low Cost Entry to Computational Thinking (1-7) **Future Deep Dives:** Bers, M., González-González, M., Belen Armas Torres, M. (2019). Coding as a playground: Promoting positive learning experiences in childhood classrooms. Rich, Yadav, and Schwarz (2019) Computational Thinking, Mathematics, and Science: Elementary Teachers' Perspectives on Integration	**Reading Reflection:** Would you consider computational thinking a necessary literacy for students to develop? Explain. **Application Reflection:** How do we use computational thinking to leverage learning?

Class 7 | May 21st

Essential Question: How is computational thinking used to address issues of equity?

Learning Goals:

Discuss with community organizations how they are addressing problems of equity through computational thinking

Understand what ways different organizations are supporting the growth of student identity in computational spaces

Evaluate ways practitioners can create partnerships with community organizations

PCK: Utilize community partnerships in curriculum

Readings:

Pinkard, N., Martin, C. K., & Erete, S. (2019). Equitable Approaches: Opportunities for Computational Thinking with Emphasis on Creative Production and Connections to Community. Interactive Learning Environments, 1-15.

Santo, R The Right Tool for the Job: Deciding on Tech, Tools and Materials in Informal Digital Learning

Future Deep Dives:

Margolis, J (2003) Unlocking the Clubhouse

Reading Reflection:

How are organizations supporting school efforts to integrate computational thinking? Where are the inequities in their work? What about their work provides more equitable experiences for students?

Application Reflection:
What resonated with you from today's panel discussion?

Class 8 | May 28th

Essential Question: What is the future of computer science in K-12? How does computational thinking inform this movement?

Learning Goals:

Describe the current state of computer science pathways

Define the benefits and challenges of integrating computer science into K12 settings

PCK: Integrating computer science into core curriculum

Readings:
Margolis & Goode (2011) Exploring Computer Science: A Case Study of School Reform (1-15).

Proctor & Blikstein (2019). Defining and designing computer science education in a k-12 public school district (314-319)

Johnson, S (2019) Computer Science Now More Than an Elective for University of California Admissions. EdSurge Article

Future Deep Dives:
Windom, J (2019) Computer Science Goes Beyond Engineering Disciplines - Article & Podcast

Papini, et al. (2017) Preparing and Supporting Industry Professionals as Volunteer High School Computer Science Co-Instructors (441-446)

Gaskins (2016) How Art & Dance Are

Reading Reflection:

How do you differentiate computational thinking from computer science? What is their relationship?

Application Reflection:
How has your thinking evolved from the first class? What is your stance about CT in K12 settings?

	Making Computer Science Culturally Relevant (edSurge article) Bell, Witten, & Fellows (1998). Computer Science Unplugged.	

Class 9 | June 4th **Essential Question**: How have we applied our understanding of computational thinking to our design projects?		
Learning Goals: Understand the various ways our peers have applied to computational thinking to their context Experience a variety of applications of computational thinking	**No Readings**	**Applying Computational Thinking | Projects Due**

Class 10 | June 11th **Class Celebration and Feedback**		
	No Readings	