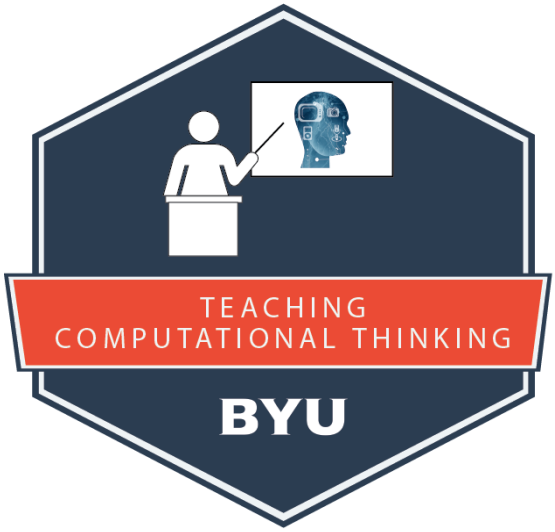

Teaching Computational Thinking

Badge Guide

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Badge Introduction

Computational Thinking (CT), considered by some to be a fundamental literacy of the 21st Century, is increasingly gaining traction with educational associations and school systems around the world. This badge certifies earners' ability to apply sound instructional strategies to integrate CT in their classrooms.

It is estimated that this badge will take approximately 2 hours to complete.

Recommended Prior Knowledge

This badge builds on the Understanding Computational Thinking (http://bit.ly/2llb60D) badge.

International Standards Alignment

ISTE Standards for Educators

- **Facilitator Standard 6c:** Create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems.

ISTE Standards for Students

- **Computational Thinking Standard 5:** Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions.

Intended Learning Outcomes

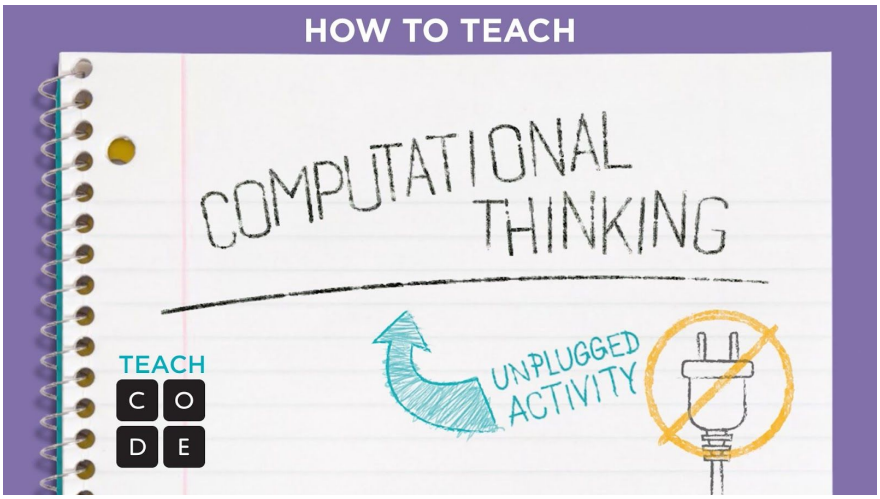
1. Facilitate student learning of computational thinking in effective and developmentally-appropriate ways.
2. Evaluate the effectiveness of classroom activities in which computational thinking principles are taught.

Acknowledgements

Some of the following content is adapted from Integrating Computational Thinking (Hunsaker, n.d.), a chapter in the open educational textbook K-12 Technology Integration published on Pressbooks. Special thanks to Peter Rich for invaluable insights and contributions.

Requirement 1: CT Pedagogy in your Teaching Domain

After learning about effective and developmentally-appropriate computational thinking integration, watch the following video and use the CT Teaching Rubric (on your submission form) to thoroughly evaluate the lesson.



Video 1. Unplugged - Computational Thinking - Lesson in Action. Click, copy, or type this link into your browser to view: https://youtu.be/b4a7Ty1TpKU. ***Note:*** *This video is copyrighted by Code.org under a Standard YouTube License. It is therefore not included in the CC-BY license of the rest of this document.*

Note: *The specific criteria for evaluation are noted below in requirements 1.1-1.4.* ***Pay special attention to the instructions in parentheses to guide your evaluation.*** *Also, it is* ***strongly recommended*** *that you review the information below before attempting to fulfill this requirement.*

Requirement 1.1: CT Content

Criterion 1:

The teacher explicitly teaches specific CT skills, attitudes, and approaches. ***(Evaluator comments should note specific CT concepts being taught and where in the lesson these took place.)***

You should already be familiar with CT skills, attitudes, and approaches from completing the Understanding Computational Thinking (http://bit.ly/2Ilb60D) badge. If you need a refresher, you may find the following useful:

Components of Computational Thinking		
Skills	**Attitudes**	**Approaches**
• ***Decomposition***: Breaking down data, processes, or problems into smaller, manageable parts. • ***Pattern Recognition:*** Observing patterns, trends, and regularities in data. • ***Abstraction:*** Creating a visual model or simulation of a problem that incorporates only the most important details. • ***Algorithm Design:*** Developing the step by step instructions for solving this and similar problems. • ***Evaluation:*** Ensuring that your solution is a good one.	• ***Confident:*** Believing in one's own ability to solve problems. • ***Communicative:*** Willing and able to communicate effectively with others. • ***Flexible:*** Able to deal with change and open-ended problems.	• ***Tinkering:*** Experimenting and playing. • ***Creating:*** Designing and making. • ***Debugging:*** Finding and fixing errors. • ***Persevering:*** Keeping going. • **Collaborating:** Working together.

Table 1. Components of Computational Thinking

Requirement 1.2: Principles, Practices, and Strategies for Effective CT Integration

Criterion 2:

The teacher integrates sound pedagogical principles, best practices, and/or effective teaching strategies associated with effective integration of CT. ***(Evaluator comments should analyze specific strategies or principles demonstrated or not demonstrated by the teacher.)***

The following list represents a variety of pedagogical principles, best practices, and/or strategies that have been used and documented in the academic literature surrounding CT instruction. It is not necessarily a comprehensive list, but it can provide a good starting point for evaluating and planning CT-infused lessons. As you evaluate your

own and others' lessons, you may notice additional principles or strategies that seem to contribute to an effective learning experience. As you notice these, you may want to note them in your evaluation rubrics, and that is great! For now, use the following list as a foundation:

Effective CT Teaching Strategies
Adapted from Hunsaker (n.d.)

- **Modeling.** Teachers should set an example of learning by modeling their own understanding, learning, and progress in computational thinking. Especially in the early stages, they should also model the computational thinking process for students so they understand what the learning, reflection, and revision look like (Highfield, 2015).
- **Integrating.** Teachers should collaborate with other teachers to facilitate the completion of interdisciplinary culminating projects (Bers, Flannery, Kazakoff, and Sullivan, 2014).
- **Releasing Responsibility Gradually.** When teaching CT, educators should start with direct instruction, move to a simple guided activity, then issue an open-ended challenge or problem (Buss and Gamboa, 2017). Teachers should then continue to guide behavior, even while working/playing as a team (Highfield, 2015).
- **Encouraging.** Insofar as possible, teachers should provide "encouragement and problem-solving hints and tips," rather than outright answers (Buss and Gamboa, 2017).
- **Questioning.** Rather than providing answers directly, teachers should ask "probing questions" before, during, and after learning activities (Buss and Gamboa, 2017; See also Highfield, 2015). These questions should encourage students to reflect on their learning and might begin with phrases like the following (Buss and Gamboa, 2017):
    - "What if you were to…"
    - "How would you…"
    - "Have you considered…"

- **Fostering alternative problem-solving.** Teachers should promote alternative ways of modeling a problem (Buss and Gamboa, 2017), such as
    - Drawing out solutions on paper.
    - Discussing alternative solutions as teams.
    - Relating challenges to more familiar circumstances.
- **Using CT vocabulary across the curriculum** (Yadav, Mayfield, Zhou, Hambrusch, and Korb, 2014). This can reinforce students' understanding of the terms and help them see their applicability across the curriculum and in daily life. For example, a teacher might refer to a set of rules or procedures as an "algorithm"; invite students to create an "abstraction" of how they feel; or emphasize that you are practicing "pattern recognition" skills.

Requirement 1.3: Developmental Appropriateness

Criterion 3:

The teacher integrates CT education in a developmentally-appropriate way for the students. ***(Evaluator comments should thoroughly explain why the lesson was developmentally-appropriate and/or which aspects of the lesson were not developmentally-appropriate.)***

There is a great deal of conversation about what is "developmentally-appropriate" technology integration in Early Childhood Education (PreK-2nd grade). A prime example is the 2012 joint position statement from the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center for Early Learning and Children's Media. The statement, Technology and Interactive Media as Tools in Early Childhood Programs Serving Children from Birth through Age 8, outlines several issues, guiding principles, and recommendations for early childhood educators seeking to appropriately integrate educational technology into their classrooms. ***If you are an early childhood educator, please read the above article and use it to inform your discussion of the developmental appropriateness of the lesson you evaluate.***

There is less discussion and fewer guidelines about what constitutes *developmentally-appropriate* tech integration in secondary or even upper elementary grade levels. However, many of the principles discussed in Early Education literature may be modified to apply to these situations. ***If you are an upper elementary or secondary educator, please review the guidelines and questions below and use your "professional judgment" (NAEYC and Fred Rogers, 2012) to determine how they might be adapted for use within your teaching domain.***

Developmentally-Appropriate Guidelines
Abridged from NAEYC and Fred Rogers, 2012.

1. "Above all, the use of technology tools and interactive media should not harm children."
2. "Developmentally appropriate practices must guide decisions about whether and when to integrate technology and interactive media into early childhood programs."
3. "Professional judgment is required to determine if and when a specific use of technology or media is age appropriate, individually appropriate, and culturally and linguistically appropriate."
4. "Developmentally appropriate teaching practices must always guide the selection of any classroom materials, including technology and interactive media."
5. "Appropriate use of technology and media depends on the age, developmental level, needs, interests, linguistic background, and abilities of each child."
6. "Effective uses of technology and media are active, hands-on, engaging, and empowering; give the child control; provide adaptive scaffolds to ease the accomplishment of tasks; and are used as one of many options to support children's learning."
7. "When used appropriately, technology and media can enhance children's cognitive and social abilities."
8. "Interactions with technology and media should be playful and support creativity, exploration, pretend play, active play, and outdoor activities."
9. "Technology tools can help educators make and strengthen home–school connections."

10. "Technology and media can enhance early childhood practice when integrated into the environment, curriculum, and daily routines."
11. "Assistive technology must be available as needed to provide equitable access for children with special needs."
12. "Technology tools can be effective for dual language learners by providing access to a family's home language and culture while supporting English language learning."
13. "Digital literacy is essential to guiding early childhood educators and parents in the selection, use, integration, and evaluation of technology and interactive media."
14. "Digital citizenship is an important part of digital literacy for young children."
15. "Early childhood educators need training, professional development opportunities, and examples of successful practice to develop the technology and media knowledge, skills, and experience needed to meet the expectations set forth in this statement."

You may also find the following guiding questions useful as you consider what is developmentally-appropriate in your classroom:

Checklist Questions for Developmentally-Appropriate Technology
(Direct quotes from Hirschy, 2015)

1. "Will using it influence more than one area of development (social, emotional, cognitive, or physical)?"
2. "Does it allow for varying levels of understanding and abilities in children?"
3. "Will its use build upon children's previous knowledge and enhance future growth and development?"
4. "Does the technology enhance other activities in the classroom and allow you to build on it to create greater understanding and growth?"
5. "Can it encourage active and creative play?"
6. "Will it allow children to use it together in social contexts?"
7. "Can it be adapted for children with special needs or for dual language learners?"
8. "Is it culturally appropriate?"
9. "Is it flexible enough to meet the needs of individual children and different learning styles?"

10. "Does it support children's independence, ability to complete tasks and confidence?"

Requirement 1.4: PIC-RAT Evaluation Model

Criterion 4:

How would you classify this lesson on the PIC-RAT matrix? Why? ***(Evaluator comments should provide adequate rationale for the placement.)***

The PIC-RAT evaluation model is a heuristic that facilitates the evaluation of any educational technology intervention. If you are not familiar with the PIC-RAT model, or if you need a refresher, please refer to the image below. (For additional information, please see Chapter 1: Effective Technology Integration in Royce Kimmons' open textbook K-12 Technology Integration [https://k12techintegration.pressbooks.com]).

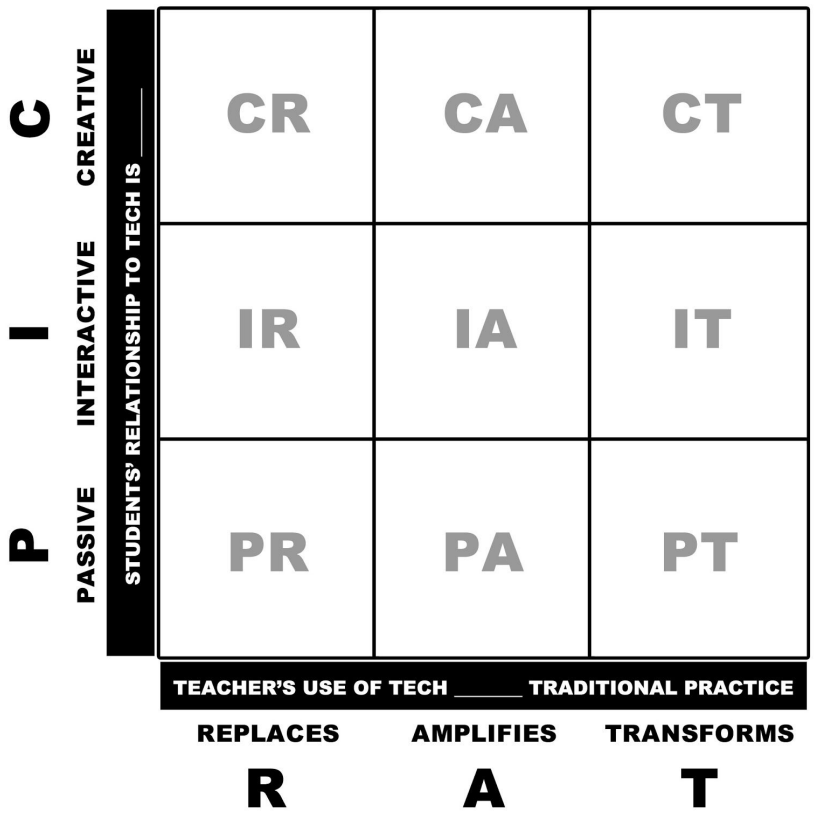


Image 1. PIC-RAT Matrix. Image by Royce Kimmons, CC-BY license.

Requirement 2: CT Lesson Plan

*Create a lesson plan for your classroom/teaching domain that explicitly integrates principles and vocabulary of computational thinking in an effective and developmentally-appropriate way. You will self-evaluate this lesson plan based on the **CT Integration Rubric** on your submission form. Your badge reviewer will use the same criteria to evaluate your work. Include your lesson plan on your submission form.*

***Note:** The CT Integration Rubric is a slightly modified version of the CT Teaching Rubric you already used in requirement 1.*

For this requirement, use any lesson plan format/template you are familiar and comfortable with. Before you begin, review the **CT Integration Rubric** in requirement 3 of the badge submission form so you know what is expected. Your self-evaluation in requirement 3 will be your chance to justify your instructional decisions in the lesson plan.

Requirement 3: Lesson Plan Self-Evaluation

*Use the **CT Integration Rubric** (on your submission form) to thoroughly evaluate your lesson plan. Your reviewer will also evaluate your lesson plan based on this rubric.*

Note:** The specific criteria for evaluation are noted below in requirements 3.1-3.4.* ***Pay special attention to the instructions in parentheses to guide your evaluation.

Integration vs. Teaching

Most requirements for this rubric are the same as they are for requirement 1. However, this rubric differs from the CT Teaching rubric in that the first criterion requires you to *integrate* CT into other subject areas, rather than simply teach the principles. As you are preparing your lesson plan, consider how to explicitly relate and connect the skills, attitudes, and approaches of computational thinking to other subject areas within your teaching domain. For ideas, it may be useful to reference the Integrating Computational Thinking (http://bit.ly/2k1UXzr) chapter in this online K-12 Integration Textbook (https://k12techintegration.pressbooks.com).

References

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NAEYC, & Fred Rogers Center for early Learning and Children's Media. (2012). *Technology and interactive media as tools in early childhood programs serving children from birth through age 8.* Retrieved from https://www.naeyc.org/sites/default/files/globally-shared/downloads/PDFs/resources/topics/PS_technology_WEB.pdf