

A Case Study of the Integration of Culturally Relevant Computer Science: The Planning Practices of Elementary Teachers in a Research-Practice Partnership

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Abstract: An often overlooked but important component of understanding how to support teachers to enact computer science (CS) instruction is investigating how they plan CS activities. This study investigates how teachers in a research-practice partnership (RPP) report planning to integrate culturally relevant CS into their lessons. Teachers were interviewed about how they planned lessons to implement culturally relevant CS in their classrooms. Researchers analyzed the interviews using a framework of persistent challenges that teachers confront when planning and enacting instruction. Findings include that teachers were capable of anticipating and overcoming challenges of supporting students with basic technology skills. However, results also highlight that teachers planning CS instruction may need additional support to anticipate ways to assess student thinking, strategies for managing student behavior, and to develop and reach their personal goals for implementing culturally relevant CS lessons.

Introduction and background

State and national frameworks in the United States (e.g., Framework for P-12 Engineering Learning, 2020; Next Generation Science Standards, 2017) task teachers to offer equitable opportunities in computer science (CS) to their students (Madkins et al., 2019; Santo et al., 2019). CS provides students with empowering access to technology, positioning them to become future creators, innovators, and inventors (Wing, 2006). Through CS education, students engage in authentic problem solving, logical reasoning, and design skills that further enhance their abilities to meet the needs of a rapidly evolving technological society (e.g., K-12 Computer Science Framework, 2016). Further, current elementary students will likely be expected to have skills in computing when entering the job market, and CS-related jobs currently pay almost double that of other fields (U.S. Bureau of Labor Statistics, 2018).

However, as schools begin to adopt these frameworks, social justice issues arise in creating equitable computing experiences for all students (Margolis et al., 2015). Factors such as school accountability practices, teacher preparation programs and professional development (PD), lack of instructional resources, and restricted access to computing-related courses have historically limited access, recruitment, and retention of students in CS, especially for students from underrepresented backgrounds in STEM (Margolis et al., 2017). Prior research has shown that extended PD through research-practice partnerships (RPPs) can help teachers to overcome these factors as they learn how to teach CS skills (Jocius et al., 2019). RPPs are long-term partnerships in which teachers and researchers work together to focus on problems of practice and produce research based on analysis guided by practice (Coburn et al., 2016). For example, continued PD through an RPP can help teachers to have focused time and support to develop CS skills (Cateté et al., 2022), increase teachers' confidence in teaching with CS (Rich et al., 2021), and empower teachers with the agency to develop tools for their own classrooms (e.g., Christian et al., 2021). Yet elementary teachers may still not have experiences or strategies to draw upon their students' cultural assets within CS (e.g., Yadav et al., 2021) and may then need support designing accessible CS-integrated lesson plans (Jocius et al., 2023) that meet their school standards and fit the needs and interests of the students in their specific classrooms.

This paper reports on the work of an RPP that supports teachers to integrate culturally relevant CS activities in their classrooms (Lilly, Chiu et al., 2023). The RPP in this study aimed to provide pedagogical strategies for teachers to leverage students' cultural identities and resources (e.g., Madkins, 2019), drawing on concepts of culturally relevant teaching (CRT) such as academic success, cultural competence, and sociopolitical consciousness (e.g., Ladson-Billings, 1995). Our goal within the CS-focused RPP is to support elementary teachers to equitably teach CS within their culturally diverse classrooms by providing ongoing PD that is tailored to fit the specific needs of the teachers through strong practitioner involvement and commitment to continuous improvement of CS education (Bevan et al., 2019).

Framework

An often overlooked but important component of understanding how to support teachers to enact CS instruction is investigating how they plan CS lessons and tasks for their students. It is particularly important to examine elementary teachers' planning of culturally relevant CS instruction to provide equitable CS learning opportunities early in students' development (e.g., Lilly et al., 2024). The purpose of this study is to investigate how elementary teachers plan to integrate culturally relevant CS activities into their classrooms.

Kennedy (2016) proposed five persistent challenges that teachers confront when planning and enacting mathematics instruction: portraying the content, soliciting student participation, assessing student thinking, managing student behavior, and addressing teachers' own needs. Portraying the content includes teachers' judgment about how to represent content, including translating content from textbooks and standards documents (e.g., Bieda et al., 2020) through specific experiences for their students. Soliciting student participation is the ways in which teachers engage students and focus their attention on focal content and learning goals while also differentiating instruction and incorporating student choice (e.g., Dack et al., 2019). Assessing student thinking refers to understanding students' knowledge both short and long term and includes prior understandings as well as ways to support students to respond to one another to build accurate solutions together (Ding & Carlson, 2013). This can include informal assessment, for example through classroom discussions, or utilizing formalized classroom assessments and district and state tests to make instructional decisions in revising the order and scope of their lessons (e.g., Bieda et al., 2020). Managing student behavior means maintaining both a productive learning environment and the planned rigor of the instruction through proactive steps, such as introducing classroom routines and rules at the beginning of the school year (Weinstein & Mignano, 2006) as well as in-the-moment decisions, such as responding immediately to behaviors that may negatively affect the learning environment. Addressing teachers' own needs is how teachers must be consistent with their own philosophies, needs, and personalities while addressing the other four persistent challenges (e.g., Dack et al., 2019).

The ways in which teachers address and attempt to resolve each individual challenge in their planning practices has implications for their efforts to attend to the other planning challenges. Further, teachers need to develop adaptive expertise (e.g., Muson et al., 2021) such that they are able to constantly re-evaluate the ways in which they address these challenges in their planning practices to equitably support all of their students (e.g., Philip et al., 2019) as they move on to new topics and new groups of students (Kennedy, 2016).

This study extends the Kennedy (2016) framework from use with teachers' mathematics lesson planning to teachers' lesson planning that is focused on culturally relevant CS integrated into core content areas. This extension is particularly important when considering teachers' adaptive expertise with the integration of culturally relevant pedagogy, because persistent challenges are part of the reason that practices and strategies are created. For example, because we are aware of persistent challenges in planning mathematics lessons, specific planning strategies were suggested to support teachers to address these challenges. Thus, it is important to understand persistent challenges in integrating culturally relevant CS so that we can consider practices and strategies to support teachers to attend to these challenges. In particular, this paper addresses the research question: In what ways do the teachers' reported culturally relevant CS lesson planning practices address the five persistent challenges of teaching involving curriculum, student participation, student thinking, managing student behavior, and teachers' own needs?

Methods

This study uses an embedded, single case study methodology (Yin, 2018) to consider teachers' planning practices of culturally relevant CS lessons for their own classrooms within an RPP's PD. We chose to use a single case study methodology in order to describe how eight elementary teachers developed lesson plans to integrate culturally relevant CS for their own classrooms in a single, bounded context (Miles et al., 2020). Further, this enactment is a unique case (Yin, 2018) as the elementary teachers were part of, and had support from, an RPP focused on culturally relevant CS which is atypical for elementary teachers.

Setting and participants

The RPP included one school district, two public universities, and one statewide computer science nonprofit organization. The goal of the RPP was to provide ongoing PD for third, fourth, and fifth-grade teachers to create or adapt their own culturally relevant, CS-integrated lesson plans for their classrooms. Supporting the teachers through this process were five teacher-leaders, three researchers, and two non-profit leaders from the RPP. In this study, eight teachers were interviewed about culturally relevant CS lesson plans that they created with support from the RPP. Self-reported demographic data for the teachers is included in Table 1, below.

Table 1
Teachers' Self-Reported Demographic Data

Pseudonym	Undergraduate Degree	Master's Degree	Years Teaching	Gender	Race	Age
Mrs. Lavender	History	Education	1 - 3 years	Female	Black	35-55
Ms. Aquinas	Interdisciplinary Studies	/	3 - 10 years	Female	Black	22-35
Ms. Humble	English	Elementary Education; STEM	1 - 3 years	Female	Middle Eastern / White	22-35
Mrs. Allison	Political Science	Elementary Education	10+ years	Female	Black	35-55
Ms. Luther	Elementary Education	/	1 - 3 years	Female	Black	22-35
Mrs. Mattox	Elementary Education	/	1 - 3 years	Female	Black	35-55
Mrs. Vittitow	English	Elementary Education	1 - 3 years	Female	White	22-35
Mrs. Deans	Psychology	Teaching	1 - 3 years	Female	White	22-35

Professional development through the RPP

Initially, the teachers created their lesson plans through a five-day, online summer PD workshop. The PD workshop was specifically designed by the RPP to focus on supporting teachers to integrate CS and explore how to integrate culturally relevant CS within their classrooms. The first three days of the summer PD were designed to introduce the teachers to CS, CRT, and CRT in CS. On the first day of the summer PD, the non-profit leaders and researchers modeled a CS lesson, gave an overview of the importance of culturally relevant computer science integration in elementary school, and introduced block-based programming. On the second day, the RPP helped teachers understand and develop cultural competence through the cultural proficiency continuum Q-sort activity and reflection (Cormier, 2021). Teachers also explored a database of CS lessons created by the RPP. Participants on day three had more hands-on experiences with both unplugged and block-based programming as well as learned about local CS pathway opportunities and the Algorithms and Programming strand of their state's standards of learning.

On day four, the PD shifted to focus on supporting the teachers as they brainstormed potential lessons for their classrooms and then collaborated to build out lesson sketches. These sketches were shorter versions of the teachers' typical lesson plans so that they could explore several lesson ideas. Additionally, participants also had the opportunity to think more deeply about the students that are in their classrooms and how their personal cultural competence can impact interactions with students. This day of PD included support for teachers to embed elements of cultural relevance in their lessons through cultural competence (maintaining students' cultural integrity during the teaching and learning process), cultural critique (helping students to recognize, understand, and critique current social inequities), conceptions of self and other (committing to the belief that all students can achieve), social relations (enhancing student-teacher and student-student relationships and collaborative learning opportunities), and conceptions of knowledge (scaffolding learning using artifacts endemic to students' racial and ethnic identities and local/global culture and history; Cormier, 2021).

For the fifth and final day of the summer PD, teachers had focused time to expand their lesson sketches into lesson plans and then received feedback from collaborative partners on their lessons. The main purpose of that day was to continue to support teachers to think about how they would implement their lesson within their own classroom. Before the PD ended, each teacher set an intention of what they wanted to do in the following monthly PD sessions to prepare to implement their lesson plan.

Throughout the summer and monthly PD sessions, the teachers were supported to utilize two tools that were co-designed by the researchers and teacher-leaders in the RPP the previous year (Lilly, Austin et al., 2023). These RPP tools were a CRT checklist and a lesson plan rubric (Figure 1).

Figure 1

The Teachers Were Supported in Their Lesson Planning by Culturally Relevant Lesson Planning Tools in the Form of the RPP's CRT Checklist (Left) and Lesson Plan Rubric (Right)

TABLE 2			
Culturally Relevant Teaching Checklist			
Prerequisites	Intent and Aim	Level of Agreement	
Cultural Competence	Does this lesson offer cultural knowledge relevant to your students' cultural identities, cultural knowledge, cultural experiences, and cultural/personal history? If yes, provide evidence below: If not, explain how you will address it using lesson modifications below.	Yes	No
Please provide supporting evidence or lesson modifications below:			
Teacher will...			
Students will...			
Cultural Critique	Does this lesson offer your students space and time to recognize, understand, and critique historical and current social inequities and their causes? If yes, provide evidence below: If not, explain how you will address it below.	Yes	No
Please provide supporting evidence or lesson modifications below:			
Teacher will...			
Students will...			
Theoretical Underpinnings	Intent and Aim	Level of Agreement	
Conceptions of Self and Other	Does this lesson offer opportunities for all your students (e.g., learning English as an additional language, neurodivergent) to demonstrate academic success (e.g., learning, academic growth)? If yes, provide evidence below: If not, explain how you will address it below.	Yes	No
Please provide supporting evidence or lesson modifications below:			
Teacher will...			
Students will...			

Teachers' Lesson Implementation Rubric/Checklist	
Instructions: This is a reflective activity for teachers. Not every question needs to be addressed as not every question is applicable to every lesson. This rubric is aligned with the Teachers' Lesson Planning Template and SEL Lesson Planning Template .	
Lesson Development Resources	Review the lesson plan for this activity and address the following questions.
Select one ▾	Did the teacher utilize the CRT Checklist in lesson planning?
Select one ▾	Did the teacher use their school template to build the lesson plan to include essential questions, objectives, SELs, etc. based on core content areas?
Select one ▾	Does the lesson include "I can" statements?
Standards of Learning (SOLs) / Essential Skills and Knowledge	Review the lesson's Computer Science Integration Authenticity and its alignment with core content standards and address the following questions.
Select one ▾	Is the CS integration authentic to this lesson?
Select one ▾	Does the CS integration enhance teacher practice?
Select one ▾	Does the CS integration enhance student experience?
Select one ▾	Is there authentic content integration (e.g. do the CS standards align with the content areas) of this lesson in a meaningful way?
Select one ▾	Do elements of the lesson plan/ curriculum/ materials help integrate CS with other content in a way that's also culturally responsive?
Select one ▾	Does the lesson align with the CS Standards for your grade level?
Select one ▾	Are the CS Lesson standards that we are looking at supporting the goals of this lesson?
Select one ▾	Does the lesson explain the application of the standard?
Opportunities for Cultural Responsiveness	Review the lesson's approach to culturally relevant teaching skills and if/how it engages all students in the lesson and activities and address the following questions. Remember not every lesson checks every component of the Culturally Relevant Teaching checklist.
Cultural Competence	
Select one ▾	Does this lesson offer cultural knowledge relevant to the students' identities and local/global culture and history?
Select one ▾	Does the lesson build background knowledge/a common starting point for all students to engage by providing opportunities for content-based vocabulary building?
Select one ▾	Does the lesson build background knowledge/a common starting point for all students to engage by providing a list of what background knowledge is required?
Cultural Critique	
Select one ▾	Does this lesson offer the students space and time to recognize, understand, and critique current social inequities and their causes?
Select one ▾	Does the lesson engage students by making real-world connections beyond the scope of the lesson?

The CRT checklist was designed to help the RPP teachers assess, modify, and align their CS content with the components of CRT and enhance student engagement and achievement, while the lesson plan rubric was meant to be a reflective activity for teachers to perform following lesson plan creation to prepare for implementation. It was explained to teachers that not every question on either tool needed to be addressed as not every question will apply to every lesson. Both tools were aligned with the lesson planning templates that teachers had access to as they began planning their lessons.

Following the summer PD, teachers workshopped their lesson plans through four monthly, online PD sessions (including one-hour after-school sessions and six-hour formal all-day Saturday PD sessions). This included teachers modeling their lessons for the RPP as well as applying the RPP's checklist and rubric to their lesson and then working in smaller breakout groups with other members of the RPP to discuss the changes that they would make. After each breakout session, the RPP joined back together to reflect upon the process and collaboratively offer suggestions for improvement as they finalized their lessons for implementation.

Data sources and analysis

Before implementation of their culturally relevant CS lessons, the eight teachers were each individually interviewed about the process that they went through to plan their lessons. Each interview followed an open-ended interview protocol, was approximately 30 minutes long, and was audio recorded and transcribed. The open-ended interview protocol was developed with feedback from the RPP and experts in CS education and was aligned with the Kennedy (2016) framework.

As part of the protocol, teachers were instructed that our discussion of planning was not limited to formal templates but included anything that they did to prepare for teaching the lesson. This could include any way that they organized their thoughts, asking a colleague a question or collaborating during the summer PD sessions, reviewing example lessons that the RPP provided, or going online to some Internet resources. Questions in the protocol prompted teachers to reflect on their decisions about which CS and core content skills to focus on, their use of culturally relevant tools (i.e., the CRT checklist and the lesson plan rubric), and, in line with the RPP's asset-based approach to CS, how they have tailored or customized the lesson to the students in their class as well as how the lesson may leverage and sustain their students' strengths. In terms of assessment, the protocol included questions about teachers' use of past assessments to inform the lesson, how they plan to assess targeted learning outcomes from the lesson, and how they plan to use assessments from the lesson to inform their future instruction.

Teachers were also asked to share specific aspects of planning that they felt successful with, how their strengths and prior knowledge and experiences supported their planning and anticipated strengths in implementing the lesson, and the ways in which preparing or implementing the lesson may be helpful when considering their goals for themselves and their students with culturally relevant CS for the year. Teachers were also asked if they faced any particular challenges in planning the lesson (e.g., integrating CS into the core content as they planned, integrating CRT into the lesson, understanding technical aspects of CS) or if they anticipated any challenges in implementing the lesson (e.g., solving technical issues as students logged into Scratch, offering adequate time for the lesson within the school day, supporting all students' needs) and how they resolved, or additional support that they may need to resolve, these challenges. More broadly, teachers were asked what, if any, additional support from the RPP they would like before or during the implementation of their lesson.

Two researchers worked together to create a codebook based on Kennedy's (2016) persistent challenges to deductively code (Miles et al., 2020) the transcripts of the audio-recorded interviews. Codes included each of the five persistent challenges. For these codes, the two researchers achieved inter-rater reliability above 80% over 20% of the data and reached consensus on any disagreement. The researchers then looked across coded statements for patterns and wrote analytic memos. After being shared with the participants through member checking to ensure accuracy and a representation of their experiences, the analytic memos then became the basis of the findings below.

Results

We provide here findings by type of persistent challenge. We also present teachers' suggestions for how RPPs can support teachers to overcome these challenges.

Portraying the content

Teachers reported feeling capable of anticipating and overcoming challenges of supporting students with basic technology skills (i.e., logging on to the computer) and pacing of CS activities. However, teachers stated that they need additional support to anticipate other challenges such as how to give instructions to students so that they meet goals without activities becoming teacher-led as well as how to support students with different needs in CS. For example, Mrs. Mattox said, "Just being knowledgeable on the content. And just being prepared ahead of time and knowing what things that kids might not know before you start the lesson so that you can emphasize those things." Similarly, Mrs. Allison said, "I know how to help students on an [individualized education plan] when they're struggling with fractions. But how do I plan to meet their needs on Scratch?" In these quotes, and throughout the interview, the teachers spoke of the importance of having support prior to implementation in both the CS content and pedagogical strategies. When working with a less familiar content area, the teachers felt that they may need continued support to understand the content, to be able to portray the content to all of their students, to know what students may not have prior knowledge about, or have access to knowledge about the common student misconceptions that they may not be able to predict in CS as they would in content areas that they have taught more often.

Soliciting student participation

Despite learning about how to make connections to students and leverage students' cultural identities and resources within CS activities, most teachers reported feeling unsure about how to solicit student participation or specific strategies that they would include in their planning. However, they were hopeful that students would be interested in the CS aspect of a lesson. For example, Mrs. Lavender said, "Especially kids like they spend so much time on computers, I think if it's presented like a game then they're going to be fine."

Teachers also reported their beliefs that access to integrated CS lessons can help students who may struggle with core content skills. One such teacher, Ms. Luther, also included a strategy for supporting student participation:

Two days before I actually implement my lesson, I'll introduce Scratch to them and let them play around. So that way, by the time we do the lesson, they will be comfortable with using Scratch in the lesson, or creating their own Scratch for the reading part of it. The reading that we're doing is a fifth-grade level reading. I do have some students below, but I think that with it being so interactive and including the digital piece that it will help them be more intrigued to do the reading lesson that day.

In this example, Ms. Luther uses a strategy of supporting her students to become familiar and comfortable with the technology (i.e., Scratch) prior to the lesson. In her interview, she continued to discuss how she believed that students being comfortable with the CS skills may then help them to also feel more comfortable with the core content skills.

Assessing student thinking

Teachers reported that they did not have formalized strategies in place in their lesson plans to assess student thinking about CS or the core content area in either a formative or summative way. Additionally, their lesson planning did not typically build on prior assessment of CS skills, and they were not planning on making future instructional decisions based on student outcomes from their lessons.

Some teachers considered the importance of assessing students. For example, Ms. Aquinas said, “If they don’t do well, or they don’t include the parts that they need to then, of course, we always use our data to make the next lesson better, or to incorporate spiral reviews.” But the teacher reported that she had not planned for assessments to gather this data for her CS lesson.

Three teachers based their decisions about how to integrate CS on prior assessments from core content areas. These teachers suggested that some students may not be able to engage in specific CS activities. For example, Ms. Humble reported that she had a benchmark for the content area that she could review. Based on this benchmark, she would be able to see who had mastered the core content-specific skills or may need additional support with the core content. This teacher reported that, “For students who are struggling, I’ll need to drop back down ... what we are doing is at a higher level. I can snip things out and focus on a base level.” However, students who struggled with the core content may have still been successful with the CS.

Managing student behavior

Teachers did not mention ways that they had planned to manage student behavior within their culturally relevant CS lessons. For example, the only mention of managing student behavior across the teachers was Mrs. Vittitow who said:

Having classroom management on the computer is definitely something that I feel I have gotten a lot better at this year, so I feel like I can definitely use that to my advantage to make sure that the students stay on task and aren’t drifting and going to other sites while they should be doing this.

Otherwise, teachers did not discuss planning strategies or making instructional decisions to manage student behavior.

Addressing teachers’ own needs

Teachers reported that they needed support to develop and reach their personal goals for implementing culturally relevant CS lessons. For example, teachers were aware of the RPP’s goals, but they struggled to consider their own goals or how to reach them. Ms. Aquinas initially stated that she “... [hasn’t] even thought about it, really, like what my main end goal is. Because for a lot of my students, CS is not like even a career and CS is not something that is on their mind.” Later in the interview, the teacher followed up this response saying, “So I think it’s mainly just, my goal would be, I guess for them to feel comfortable in exploring their own interests related to CS, and that they know they can pursue something in CS.” Similarly, Mrs. Deans responded that she did not have specific goals but then later in the interview spoke of her goal for students to find personal joy in CS by purposefully embedding elements of CRT in her lesson plans. These examples show how teachers may not have had the space to previously think about their goals within the RPP related to student interest in CS.

Discussion

Results highlight the strengths that teachers brought to planning culturally relevant CS lessons aligned with the five persistent challenges of teaching (Kennedy, 2016). Findings offer insight into elementary teachers’ pedagogical reasoning when trying to integrate CS into their instruction. As such, this paper complements prior research that focuses on specific strategies for culturally relevant CS teaching (Bredder et al., 2024; Lilly et al., 2024) and contributes towards understanding how to help teachers develop adaptive expertise for integrating CS into their instruction (e.g., Munson et al., 2021). Overall, teachers focused on integrating CS in their responses, with little explicit mention of culturally relevant pedagogical strategies emphasized by the PD and follow-up with the RPP. We discuss the specific findings and offer implications below.

Findings revealed that teachers reported feeling generally confident about portraying the content, or integrating CS into their lessons, which aligns with other research that suggests that these kinds of learning experiences can help teachers feel confident with CS concepts (e.g., Rich et al., 2021). However, teachers also noted that they did not feel as confident teaching CS as teaching other content areas and struggled when planning to adapt the content to the needs of their students, such as students with individualized education plans. Findings indicate that, although the PD focused on strategies and supports for asset-based approaches to CS instruction, teachers still did not feel confident when trying to plan specific lessons for their particular students. Given that integrating CS was completely novel for these teachers, it is not surprising that they may not be as confident in

customizing instruction to leverage and sustain students' assets, especially those with disabilities. A first step might be planning and implementing CS in their classrooms. Once they have an idea of how an integrated CS lesson can be orchestrated in their classroom, teachers can start to plan more specifically for their particular students. Ongoing cycles of teachers implementing their planned CS lessons and reflecting upon their practice with the help of the RPP may shed light on any changes in teachers' confidence and understanding and provide more information about how to support teachers to portray the content in ways that build upon the strengths, and meet the needs, of their individual students.

Similarly, despite anticipating student interest, most teachers felt unsure about how to plan to solicit student participation in ways that leverage students' cultural identities. Teachers mostly spoke on general terms about strategies for the whole group. Again, cycles of implementation with specific reflection about strategies to build upon students' cultural identities may help teachers develop these skills. Another potential avenue could involve opportunities to co-teach or observe a more experienced CS teacher, as well as providing explicit stems or prompts within the checklist along with the exemplar lessons to help teachers build on students' cultural identities.

Some teachers mentioned that for struggling students they would need to "drop down" a level. Despite an emphasis on setting high standards for students, and providing many examples of how to empower students to be the experts in CS in their classrooms (e.g., even if teachers don't understand how to debug a problem, students may be able to solve it), this could be a sentiment that the rigor would need to be lowered. The PD could be more explicit that prior achievement does not affect ability in CS or that prior assessments can guide where students may need support but should not be a gatekeeper for students to engage in CS (i.e., Santo et al., 2019).

Results also highlight that teachers planning CS instruction may need additional support to anticipate ways to assess student thinking, strategies for managing student behavior, and to develop and reach personal goals for implementing culturally relevant CS lessons. Findings align with other research describing limited examples of CS assessment that would be available to teachers (i.e., Yadav et al., 2016) as well as less of a focus on assessment and classroom management within the PD. One implication is that teachers need help to build assessment tools appropriate for their own lessons. For example, the RPP can support these teachers by developing and modeling assessments for CS skills and knowledge as well as supporting the teachers in creating and customizing existing assessment tools for their lessons. This can contribute to the building of a database of CS assessment tools. Teachers may also be encouraged to consider their own strategies and those from prior research (i.e., managing student behavior; Datnow et al., 2023) for overcoming these persistent challenges in other content areas and apply them when integrating CS.

Implications of this work include our suggestions for ways in which PD can support teachers new to CS to anticipate both persistent challenges that have been identified in prior research in mathematics education (i.e., Kennedy, 2016; Lilly et al., 2022) and persistent challenges that may be unique to CS education. In this way, CS PD can leverage the pedagogical knowledge and skills that teachers commonly use in other subject areas in the context of CS. For example, the teachers discussed needing support in portraying the content to predict common student misconceptions or creating assessments to understand student thinking for CS. Supporting teachers to approach lesson planning for CS as they would a more familiar content area (i.e., introduce the lesson with a story, develop an exit ticket) may be a way to also increase teachers' comfort and self-efficacy in CS by feeling that they are able to utilize familiar teaching protocols and tools in this new content area.

Further, CS PD can provide space for teachers to discuss and recognize their own, personal goals for planning and implementing culturally relevant CS instruction and then support the teachers in reaching their goals. Empowering teachers to develop, reflect upon their progress, and reach their personal goals in implementing culturally relevant CS instruction is important to increase teachers' self-efficacy, promote changes for future implementation, and help build a community to support elementary teachers integrating CS into their classrooms.

Limitations

This study applied Kennedy's (2016) framework, which was developed for mathematics education, to CS education. A limitation to this application could be that teacher interviews were rarely coded for two of the persistent challenges: managing student behavior and addressing teachers' own needs. However, we propose that instead these findings show that teachers may need more support in considering managing student behavior and addressing teachers' own needs when planning CS.

Another possible limitation is that this study only considers the reported planning practices of eight teachers. Of these eight teachers, six were novice teachers with less than three years of teaching experience and only one teacher had a degree in a STEM field. Our findings may then not generalize to a larger population of elementary teachers. However, we still feel that it is important to share our participants' experiences because both novice teachers and teachers without backgrounds in CS or STEM degrees are being tasked with integrating CS

within their classrooms. As only three percent of elementary teachers in the United States have a degree in a STEM discipline (Plumley, 2019), we feel that it is important to highlight the experiences of the elementary teachers in our study. Future studies should consider how persistent challenges in CS may be anticipated and attended to differently with novice, early career, and expert teachers with different degrees and prior experiences.

Conclusions

As teachers in the United States are tasked with offering equitable opportunities in CS, it is important to consider the practices of elementary teachers as they plan lessons that integrate CS. By utilizing, and extending, the Kennedy (2016) framework with CS and core content areas, this study's investigation of the challenges that elementary teachers in an RPP identify as they plan culturally relevant CS lessons furthers our understanding of how to support teachers to enact culturally relevant CS instruction. Integrating CS within an RPP is unique in the way that RPP members can provide ongoing support for teachers to overcome persistent challenges, allow them to be involved in the iterative process, and support them to develop more complex curricula as they learn more CS skills. Our findings demonstrate both the ways that teachers are capable of anticipating and overcoming challenges as well as the need for future research to consider ways to leverage teachers' expertise with the goal of supporting them to assess student thinking, to utilize strategies for managing student behavior, and to develop and reach their personal goals for implementing culturally relevant CS lessons. This work is important to understand what teachers perceive as persistent challenges to then support elementary teachers to provide their students with equitable access to learn CS.

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