Notes from the Field: Teachers' Perceptions of Joyful Secondary Computing

Jayne Everson
foundry10
Seattle, WA, USA
jayne@foundry10.org

Rotem Landesman
Harvard Graduate School of Education
Cambridge, MA, USA
rotem_landesman@g.harvard.edu

Amy J. Ko
University of Washington
Seattle, WA, USA
ajko@uw.edu

Abstract

It is essential for student learning that classrooms are joyful. In this study, we asked *What secondary CS teachers think makes CS learning joyful?* and *How do teachers conceptualize joy in a CS classroom?* We found that teachers conceptualized joy in six distinct ways. Teachers need students' needs to be met to experience joy. Joy is found in community and relationships. Problem solving can be a joyful process. Joy can be found in the outcomes of the work. Relevant and meaningful curriculum designed for students' interests makes learning joyful. Finally, students find joy in taking ownership of their work. All of these align with feminist pedagogies. This work highlights the potential for practitioners to design computing courses and environments for joy, and for researchers to examine existing pedagogy and its influence on students' experiences and learning.

CCS Concepts

• **Social and professional topics** → **Computing education**.

Keywords

Joy, Secondary, Pedagogy

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1 Introduction

It's essential that classrooms are a good experience for students [12, 25, 26]. It's also important that the classroom is joyful for teachers so that teachers want to stay in the classroom.

Scholars are engaging in understanding joy in learning: giving talks [38] about joy, and designing pedagogy for joy [20]. There has been some research studying joy in CS. Sometimes instructors sought to design for their own joy [42]; others learned that not all formats of learning computing are joyful for all students [36]. Some work has designed curriculum intending to produce joy and found that it encouraged broader participation [2, 13, 14, 17, 27, 32]. And some work has designed for joy in computing for particular populations, for example, centering connection for elementary students [22]. But none of these studies have examined if these efforts produced joyful classrooms.

In spite of all we have learned about joy, no one has asked secondary CS instructors what their perceptions of a joyful CS classroom are. In this study, we sought to do that by asking: *What do secondary CS teachers think makes CS learning joyful? How do teachers conceptualize joy in a CS classroom?* We asked a workshop of teachers to design a joyful computing environment, and sent out design probes with CS teachers across the United States to hear about their experiences of joyful computing over the school year.

2 Related Work

2.1 Joyful Pedagogy

There is compelling prior work that joy should be a meaningful part of learning and a pedagogical goal. **Feminist Pedagogy** values the importance of embodiment and affect, allows learners to re-imagine themselves and the world [40], and also encourages learners to push against traditional educational spaces by creating new ones [43].

Sometimes prior work centers a particular instructor's joy. In one instance, a teacher centered joy in his classroom centering on 3 concepts: community, visibility, and agency, defining joy as "deserving of study and investigation as any other pursuit" [6]. A joyful pedagogy text argues for three factors: agency, community, and creativity, but again centers the teacher's joy [3]. In one study, researchers found the inclusion of culture and identity, multiple pathways for knowledge generation, acceptance and respect, collaboration, and meaningful approaches to teaching content were ways to promote joy in learning [34]. One argument for joy in higher education is that joy can be a radical subversive pedagogical act of defiance by resisting oppressive structures; it is relational and embodied (like humor) [15]. O'Hara et al. argue that we need to move beyond transactional education because trust is the foundation of joy [33].

Other prior work has examined joy in specific disciplines: in writing [31], in art [20], and in STEM [39] centering joy in the classroom and finding it useful for student engagement.

2.2 Joy in CS education

Often joy is declared because of instructor or curricular intent [2, 13, 14, 17, 27]. Joy was a motivation to design new programming languages [32] and to foster engagement in a first-year engineering course [30]. Sometimes instructors center their own joy in teaching [36, 42]. Other instructors designed for what they perceived



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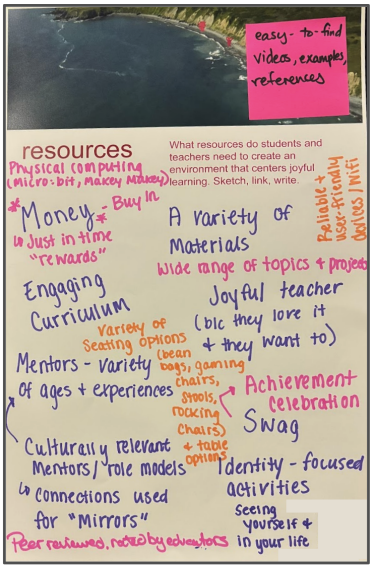


Figure 1: Poster from the resources small group written and collected at the workshop.

students should find joyful in online learning [8, 44]. Practitioners design for joy in particular populations, like elementary, Latine, or Black students [19, 22, 24].

Prior work centering Black joy in computing environments by Ivey et al. advocates for abolitionist teaching practices in secondary CS courses by centering the voices of Black educators to center Black joy [19]. Additionally, Jones and Melo call for more critical conversation in CS education by imagining alternative visions of CS that center student joy and liberation [21].

McNutt et al. found that these creative coding instructors were designing for joy and found that competence was required to experience certain types of technical joy[29]. Additionally, prior work has also examined best practices that incorporate community and increase student retention and enjoyment of the subject of computing. Pair programming found increased persistence, retention, and enjoyment in students [28, 37]. Chavez shared the battle against course creep and deadlines improved outcomes in a data structures course [4]. There is some work examining student's perspective of joy in CS, which found that feminist pedagogies like relationships, autonomy, and meaningful work underpinned the relationships students had with CS [10]. What this range of work in CS education shows is that instructors are designing courses in the hopes that students find the same joy in computing that they themselves have, but there is a dearth of research examining teachers' perceptions of joyful CS.

3 Methods

For this study, we conducted a workshop of CS teachers in conversation at an annual conference for K-12 CS teachers and distributed design probes to CS teachers before thematically analyzing the data. We selected these forms of data because they offer two perspectives from teachers: the workshop in conversation over the summer, and



Figure 2: Design probes distributed to teachers.

the design probes in reflection during the school year while they were teaching.

3.1 Data Collection

In order to triangulate, we collected multiple forms of qualitative data for this study.

3.1.1 Workshop. In a one-hour session titled "Dreaming of Joyful CS Classrooms" at a national K-12 CS teacher conference, we tasked teachers to engage in speculative design, a method where participants dream of futures that are preferable in all that is possible [9, 23]. To do this, teachers broke up into five small groups and designed for architecture, pedagogy, curriculum, resources, as well as an open category. In these groups, they discussed the environment that created a joyful CS classroom on a new island. Attendees had sticky notes and topic posters on each table to write on. Figure 1 shows an example of a completed poster. Once teachers had completed their posters, the session had a large-group discussion. The first author recorded this conversation after gaining consent from all attendees.

3.1.2 Design Probes. The first author distributed 105 design probes to CS teachers and educators. Figure 2 shows a design probe, which contained a summary of recent CS education research, 3 pre-stamped postcards, art supplies, and an explanation of this study. The first author collected 72 emails when handing out design probes. Each of the postcards had a prompt and a time to return the postcard. The prompts were *"What makes learning CS joyful?"*, *"What makes learning computing joyful?"*, and *"What makes learning computing joyful?"* The first author emailed a reminder that corresponded with the postcards' prompts (beginning of the school year, October, and December). The email contained that month's prompt and a link to an anonymous Google form for a digital response option. In total, participants mailed back 4 postcards and provided 3 digital responses for the first prompt, 3 postcards and 4 digital responses for the second prompt, and 3 postcards and 5 digital responses for the final prompt. For the final prompt, the research team also asked participants if they would like a cup of coffee "on us" for their time. Five teachers provided their emails and received a $10 electronic gift card.

3.2 Participants

We did not collect demographic data from our participants. In the workshop and when handing out the design probes, we asked if participants were teaching CS in K-12, and used that as the inclusion criteria for this study. Several people declined to accept design probes because they did not identify as CS teachers.

3.3 Analysis

Guided by Braun and Clarke's process for thematic analysis [5, 35], we first familiarized ourselves with all the sources of data reading them multiple times both in raw format and then in spreadsheets. We each kept reflexive journals to capture our thoughts and experiences with joyful computing and our thoughts about the data throughout the entire analysis process. We then came together in analysis meetings to make a list of things we observed through our familiarization process. We created an initial list of themes we noticed in the data. We then coded all data with these initial themes. We again examined all data and collapsed overlapping themes. We arrived at six final themes: *teachers need students' needs to be met to experience joy, problem solving is a joyful process, joy can be found in the outcomes, relevant and meaningful curriculum designed for students' interests makes learning joyful,* and *students find joy by taking ownership*. The first author verified all themes across all data sources.

Throughout the process, we resolved all disagreements through discussion [16]. For example, the initial theme of *students finding joy by taking ownership* was separate from *relevant and meaningful curriculum designed for students' interests makes learning joyful*, and ultimately decided to keep them independent because *Relevant and meaningful curriculum designed for students' interests makes learning joyful* was about what teachers needed to provide, and *students finding joy by taking ownership* was about students' power to do what they wanted in the classroom. We decided to collapse the initial theme of *tangible learning* and concluded it should be part of *relevant and meaningful curriculum designed for students' interests makes learning joyful.* We also debated whether *empower* should be its own theme but decided to collapse it into *students finding joy by taking ownership* because students took initiative when they realized the power CS offered.

4 Results

In this study we identified 6 ways K-12 teachers found joy in computing,

4.1 Teachers need students' needs to be met to experience joy

Teachers dreamed of and shared stories where each individual student's needs were met. Many teachers in the workshop highlighted how important accessibility was. In their ideal CS classrooms, they wanted to teach using programming languages that were accessible for all students. Teachers mentioned Wordplay [1] and Quorum [2] and asked for all curriculum to be *"natural language inclusive"*. In designing the island, accessibility was an assumption. The teachers designed the entire island to be *"Total access- whole island is like a giant accessible robot map"* where everyone was able to get everywhere and no one was excluded.

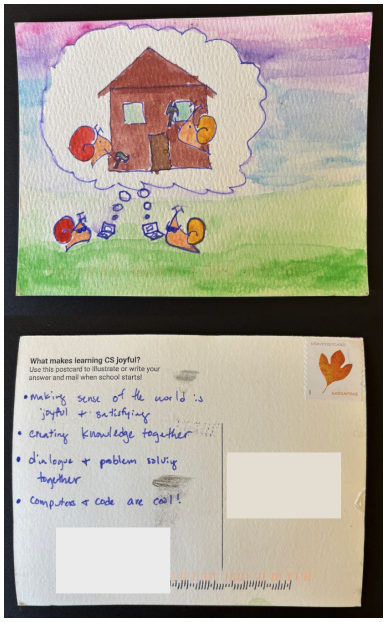


Figure 3: This postcard is an example of the postcards teachers mailed. They used the art tools to illustrate their thoughts and also often included a few sentences or short notes.

Also, while designing ideal educational environments in the workshop, teachers expressed a desire for things that required resources like *"smaller classes"* and curriculum. Teachers noted the types of curriculum they needed: curriculum that covered a *"wide range of topics + projects"*. They also asked for *"curriculum [that] is inclusive and adaptive to the needs of all learners"*, was *""peer reviewed, rated by educators,"* and had *"flexible starting points for students (block or text-based)."*

Additionally, in the workshop, teachers wrote of a need for physical resources like *"wifi"* (Figure 1, and wrote that *"each student has a device w/ fun, alternative flexible seating options"*. Air conditioning came up surprisingly often. AC was required, not just for student and teacher comfort, but as one teacher in the workshop discussion mentioned, *"A working air conditioner. not always there. not always there. It's been a big problem in my school recently."* and another teacher shared in response, *"the computers die because they overheat too."*

4.2 Joy is found in community and relationships

Community, collaboration, and relationships came up as an important component of joy in each of the data sources. A teacher wrote on postcard 3 how joyful it was to be *"creating knowledge together"* and to, *"dialogue and problem solv[e] together"*, as seen in Figure 3. Another teacher noted the importance of collaboration and relationships between peers when they wrote:

[1] https://wordplay.dev/
[2] https://quorumlanguage.com/

"When my students started their own discussions about the work and quickly responded to their peers, it brought joy to me because my students were enjoying the lesson." -Postcard

In the workshop discussion, another teacher shared how they worked to make sure they were *"incorporating like a healthy amount of like social interaction.* and then went on to describe how they felt like they were going against the flow.

"I feel like I what I've seen like a mistake that like CS teachers kind of make sometimes. like making like, you know, you focus on like the computer part of things, but you don't really focus on like that peer to peer interaction, which is like that's such like a variable, like joyful experience" -workshop discussion

They viewed peer interaction as an important part of learning computing and making it joyful.

Teachers also shared that their relationships with students were an important part of a joyful CS experience. A teacher wrote on a curriculum design poster that it was important to have good curriculum so that they could *" focus on relationships, extra support."* In another example a teacher responded to the postcard prompt digitally, writing that joy in computing came from *"The ability to create things and connect with students through that creativity."*

In the workshop discussion, a teacher mentioned how it was important to connect to the broader community so that students were *"doing feels purposeful and it might like solve something bigger, it can connect to the world."* They mentioned that it did not need to be world-changing work, it just needed to be purposeful and that *"sometimes it's just silly."* In the workshop posters, teachers wrote about another way to connect to community by creating learning environments that were *"multi-generational"* and that students had *"relationships with mentors"* who were *"culturally relevant"* and *"role models"* (see Figure 1. It was important that students had the opportunity to connect to older students and people working in industry so that they could *"see it to be it."* Another teacher figured out a way to do that by inviting students back to their classroom:

"[A]lumni that I've taught come back and talk to a group of students about their journey in CS. What are they doing now, and how did they get there? It's delightful, as I get to connect with old students and also inspire new ones." -November digital postcard

Teachers also mentioned that they needed community too, in order to become better teachers. They found it important to connect and found value and joy in *"Meeting fellow CS teachers and learning new things. Now really excited for this project!"* at the summer conference. Another teacher shared in a beginning-of-the-year-postcard:

"All the CS teachers are coming together at the beginning of school is always fun! We had a teacher share about 'six bricks' for teaching K + 1 about teaching computation thinking. We <3 it!!" -postcard

4.3 Problem solving can be a joyful process

Many teachers shared that the process of working on CS was joyful because CS was like a puzzle. A teacher wrote on a digital postcard that they found CS joyful when students were able to *"Discover the Joy in Computing – where logic meets creativity, and every problem is a puzzle waiting to be solved!"* In another digital postcard, a teacher shared:

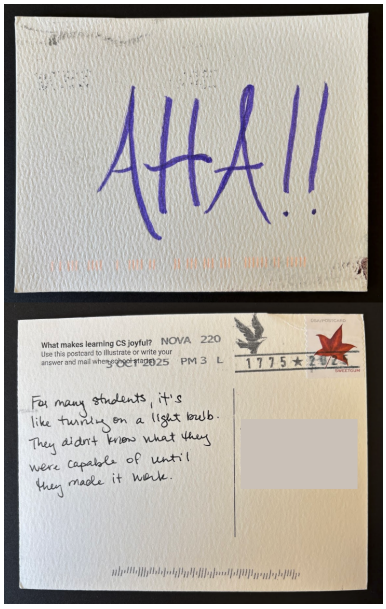


Figure 4: This postcard shares a teacher's perception of the AHA! moment as a joyful outcome of studying CS.

"I am joyful when I see others solve problems they are encountering because I notice satisfaction and gained confidence through the time invested to find a solution. Through computer science, students, teachers, and others are able to solve problems." -October digital postcard

Another teacher wrote in December in a digital postcard that they noticed the way CS classes created opportunities for students to unlock the tool of CS and experience joy while experiencing, *"the magic of transformation, like turning abstract problems into functional solutions, or finding your passion for problem-solving and helping people."*

Teachers noted conditions that were required for joyful problem solving. Workshop teachers wrote on the pedagogy poster that their ideal computing environments were ones where *"group problem-solving that doesn't feel like 'groupwork'"*, and *"use[d] real-world problems"*. In another example, a teacher emphasized that problem-solving was joyful when there wasn't pressure to solve the puzzle, writing on a digital postcard: *"When students get something to work! When they can solve a fun puzzle. When the pressure of time and grades is taken away."*

Teachers often emphasized that the hard work of problem solving was in service of the moment when you finally figured something out. One teacher wrote on a digital postcard: *"There are so many different ways to solve a problem and it is very exciting and satisfying to solve a problem you've been working on!"* and another teacher wrote on a digital postcard that it was joyful to watch when students were *"solving interesting problems, getting something to work, [and taking] opportunities to be silly."*

4.4 Joy can be found in the outcomes

Many teachers shared they experienced or witnessed joy in the outcomes of projects, for example, when students got code to work particularly after a period of struggle or frustration. They often referred to it as an *"Aha moment!"* as seen in Figure 4, or when students understood something as a *"'lights-on' as joy"* moment. Teachers also mentioned the importance of reflection and taking the time to celebrate students' success. Teachers wrote on the pedagogy poster from the workshop that it was important to create *"lots of opportunities to share successes"* and incorporate *"frequent celebrations."* In the workshop discussion, a teacher shared:

> *"once [students have] gone through it. Like creating those moments to celebrate, that's the struggle itself. In getting through that, is the celebration." - workshop discussion*

And another teacher responded with the importance of highlighting successes publicly, sharing:

> *"I feel like making that celebration social and like across the whole community so that it is public. They're being publicly recognized, they feel like they're a part of that classroom of that community, of the CS space and they can see themselves in it a bit more, too." -workshop discussion*

This teacher shared that celebrating students' success publicly entangled positive CS identities. Another teacher noted in a digital postcard:

> *"Watching students create a digital product and find 'joy' in their accomplishment. I've had students who 'don't like coding,' who are very proud of the work they have done."*

Regardless of students' perceived relationship with CS, teachers noted they were able to find joy by seeing the output of their work.

In all of the experiences of joy, teachers only mentioned the outcome of grades as a thing they needed to decouple grades and stress from CS for students to experience joy. Two posters from the workshop, the curriculum and pedagogy posters, mentioned that it was important there were *"no grades, just milestones"* and that they wanted work that was interesting enough to rise above the ever-present student questions *"is this graded?"* and *"is it good enough?"* Another teacher shared in a digital postcard that students should not have, *"too much homework so they can focus on ideas and not feel stressed and bogged down."*

4.5 Relevant and meaningful curriculum designed for students' interests makes learning joyful

In all of the sources of data, teachers noted that it was important for curriculum to be designed for students. They described this using phrases like *"engaging," "relevant," "real world projects"* and *"meaningful."* Teachers noted that when students were engaged, they focused on learning and learning was joyful. In postcard 5, a teacher wrote: *"Learning is joyful when all your students are participating and learning.* Additionally, a teacher in the workshop shared the importance of:

> *"finding engaging vehicles to deliver content through, like a storytelling or like through games, like stuff that's like really meets like students where they're at and like kind of just like allows them to like immerse themselves in content." -workshop discussion*

Other teachers highlighted the importance of designing classrooms and curriculum to reflect individual students' interests and knowledge. For example, in the pedagogy poster, one teacher wrote, *"student grouping by interest and competency level not by age."* And in the workshop discussion we saw how when students' interests were reflected in the projects they were doing, they were engaged:

> *"Not just cultural significance, but social impact or even environmental impact. So, where I live in Florida. We do a lot of projects that are related to things like climate change and things like that, but because that's something that people directly relate to and students tend to be more engaged in those." -workshop discussion*

Physical computing was one way teachers found joy and engagement. A teacher wrote *"Joy is a great connection for students in learning and especially when we bring in physical computin!"* in a digital postcard. Other teachers mentioned tools they used, like the micro:bit [3]. The physical nature of some of these tools offered a concrete way for students to understand and see their own learning.

Teachers also mentioned the importance of including identity and intersectionality when designing for students' computing joy. In the workshop a teacher mentioned, *"Students engaging something that's more real world, and applicable or [for students] if it has some sort of cultural significance"* and another participant responded sharing, *"So for our identity, we kind of hit intersectionality"* which matched with what was written on the resource poster: *"Identity-focused activities seeing yourself in your life."* Teachers thought that students experienced joy when they saw themselves in their work.

Teachers also emphasized the importance of providing flexibility and freedom to students. For example, in the workshop discussion, a teacher reflected on how important flexibility was:

> *"I realized almost everything that I kept going back to was about flexibility of like the flexible seated, flexible starting point. A variety of ways to access information." -workshop discussion*

4.6 Students find joy by taking ownership

We saw in the previous section that teachers worked hard to provide curriculum designed for students that offered students choice, in the hopes that students would take initiative, make choices, and unleash the power of CS and experience joy. In the workshop, teachers envisioned that students would take initiative by designing and building the transportation on the entire (speculative) educational island. In their design, students were using the power of CS to create a space that was joyful, inclusive, and accessible. One workshop attendee shared this dream in the discussion:

> *"Basically the entire island has to be fully accessible, and not constrained to the classrooms. So there will be a transportation system built by the students... We've got an indoor classroom, full outdoor classroom. Then you have the island, of course, so this takes robotics to different levels." -workshop discussion*

Occasionally, teachers also shared that they viewed themselves as learners and students of CS, taking initiative by finding new ways to use CS. For example, in postcard 10, a teacher shared:

[3] https://microbit.org/

"I love when I can take something I learn and find new ways to use it. Not sure why I love it more in CS than realizing I probably do it a lot in other areas. Just more joyful in CS." -postcard 10

One aspect of *students taking ownership* was that students recognized they had autonomy and then took advantage of the choices teachers provided. They would demonstrate that autonomy by exploring in unexpected directions, or completing work what was required for class. A teacher wrote about this in a digital postcard: *"In CS, we used Microbits for the first time ever and I had a student go above and beyond and code Tetris which we all downloaded and played!"* In the second example this teacher gave, students were using their free time and taking ownership of their CS learning by choosing to return and work on their own projects: *"My classroom is a safe place for students to come when they have free time throughout the day and build, invent and explore"*

Creativity was another way *students took ownership.* This teacher was thrilled at the way students were combining their own interests, teaching each other, and demonstrating their knowledge:

"My students are making apps... The assignment was to teach someone else about a topic that you know more about than anyone in the class...Tomorrow in class we'll do a 'show and tell' looking at all the finished projects. It is so fun to see everyone support each other!" -digital postcard

Students were not just taking ownership, they were also building community and helping each other.

Finally, teachers mentioned the word *"empower"* or *"powerful"* as part of joyful CS. They shared examples of students realizing the things they could use computing to do. In a digital postcard a teacher wrote:

"The biggest joy in Computer Science is when you finally feel like you have actual power over technology... when you finally figure out that one misplaced semicolon or fix the logic on that one loop, and everything runs exactly the way it's supposed to...it totally makes the hours of frustration worth it... But the absolute best part is getting to work on projects you actually care about, like building a tool for your school club or a dumb little game just for you. That freedom to create something truly personal is the ultimate win." -digital postcard

For this teacher, it was powerful when students were able to use their computing skills to do things outside of the classroom.

5 Discussion

In this study, we identified 6 ways K-12 teachers found joy in both teaching computing and learning computing themselves. These enactments of joy contrast with prior works' findings of students' perceptions of broader computing education experiences. Joyful computing meant that students were working in *community* versus working alone [41]. Students experienced joy when creating things using *curriculum that was interesting and meaningful* versus doing work that was mathy and boring [11]. Additionally, teachers identified joyful computing when students were supporting each other, which is contrary to the defensive and fear-filled climates often found in computing classrooms [1].

Moreover, teachers shared that when they valued individual students, they observed joyful computing. For example, when teachers recognized that students do not all approach the classroom with the same experiences, needs, or backgrounds, they were able to *ensure students' needs were met* and *teach a curriculum that is relevant, meaningful, and designed for student interests.* This aligns with prior work calling for relevant and meaningful curriculum so that instruction is inclusive[7].

Feminist pedagogy asserts that relationships, community, autonomy, and valuing an individual's experiences demonstrate care and are important parts of education [10, 18, 40, 43]. The findings from this work align with feminist pedagogy. Teachers observed joy when students were *learning in community* by building relationships with peers and with their teachers: highlighting the importance of relationships. Students also found joy by *taking ownership of their learning*, which demonstrates the importance of autonomy. Additionally, teachers shared that when *students' needs were met*, for example, a comfortable environment (e.g. air conditioning), or *relevant and meaningful curriculum*, or physical computing, all elements of an embodied experience, students found joy. This aligns with the need to value an individual's embodied experience as part of feminist pedagogy [18, 40, 43].

There are several limitations with this work. We asked if our participants were teachers but did not select for specific age groups or settings. The number of teachers who were able to respond during the school year influenced our response rate and the range of data. Additionally, our lived experiences as authors influence our interpretation of this work. If another group of teachers responded to these prompts, or other researchers conducted this analysis, they may identify different or additional elements of joyful computing. Additional work is needed to understand what joyful computing is for instructors of different ages, including elementary, middle, secondary, and university. Research is also needed to understand how joy presents in different educational settings, e.g., informal contexts. Nonetheless, this work highlights the potential for practitioners to design computing courses and environments for joy, and the need for researchers to examine assumptions about existing pedagogy and how it influences students' experiences and learning.

To design for joy, the feminist principles found as results in this work are important to incorporate into CS learning environments [10]. The nature of CS lends itself to joy: if we design for joy, rather than design against it. It is a field that opens doors for students to have the autonomy and choice to create things they care about; CS education gives students tools to build with. By combining feminist pedagogy with CS education, we can envision better, more inclusive learning for students and teachers alike. As feminist pedagogy encourages joy in the learning process [18] and CS offers the flexibility for students to incorporate their own interests and passions into their learning, the two together allow students to find joy and meaning in this work. If educators design computing using feminist pedagogies, students learn computing and learn joyfully.

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