

Dancing Codes: Stories of Boys Exploring Computational Thinking Through Dance

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Abstract

We designed, developed, and researched a virtual and in-person curriculum for how to explore computational thinking using dance choreography, focused on engaging upper elementary and middle school girls. However, this paper explores our observations and interactions with our young participants who identified as boys through a series of vignettes. Here, we explore how the possibilities of how the intersectionality of gender and race, ethnicity, and sexuality converged, influencing the boys' embodied and narrated identities. By employing a design-based research approach and drawing upon a theoretical framework that integrates concepts from computational thinking, embodied cognition, and gender theory, the paper aims to question and challenge gendered assumptions and broaden participation in dance and computing. Our findings suggest that expanding definitions of dance and normalizing dance participation can be crucial in dismantling stereotypes and providing inclusive educational opportunities for all children.

Introduction

In their book *Data Feminism*, which challenges power, privilege, and gender binaries in data science, D'Ignazio and Klein (2020) echo Bardzell's (2010) call to designers that feminist human-centered computing must look to those pushed to the margins when thinking about design. To move towards equitable and inclusive design, we need to "demarginalize the 'margins'" (Dye et al., 2018, p. 489). When we began this research project in 2012, and throughout the next decade of data collection and analysis, we sought to do just that by designing and creating a dance-centered curriculum and virtual environment to support the development of computational thinking with 5th-8th grade girls, an underrepresented demographic in computer programming. However, as the project progressed, we unexpectedly attracted many boys who were overrepresented in computer programming but often marginalized in dance. The marginalization of boys in dance education is well-documented in the literature. Boys participating in dance have faced stereotypes, social stigma, and narrow definitions of masculinity that can discourage their involvement (Garcías de Ves & Beltran-Garrido, 2024; Polasek and Roper, 2011; Risner, 2002, 2009, 2014a; Risner & Watson, 2022). For example, boys and men frequently encounter negative stereotypes and assumptions about their sexuality in dance (Polasek and Roper, 2011; Rekoert, 2023). These experiences have often led to decreased participation and isolation among these dancers (Clegg et al., 2017, 2019). Further complicating this landscape is also the reality that leadership roles in dance, such as choreographers and artistic directors are still often held by men (Feltham & Ryan, 2020; Garcías de Ves & Beltran-Garrido, 2024; Van Dyke, 2017). Within dance contexts, gender binaries also persist with more "athletic" moves reserved for men and "graceful" moves for women. Yet, with that said, a deconstructing of gender and broadening of gender expression in dance is gaining momentum (Feltham & Ryan, 2020; Garcías de Ves & Beltran-Garrido, 2024; Risner & Watson, 2022) in the commercial media and social platforms with diverse representations of men-, women-, and non-binary-presenting people dancing in memes, videos, shows, and movies.

This paper explores our observations and interactions with our young participants who identified as boys through a series of vignettes, brief, illustrative case stories from our data collection. The vignettes serve as an interpretive and narrative means to share our findings, one with a rich qualitative research precedence, evoking Geertz's (1973) notion of "thick description," qualitative research interview narratives, and interpretation of "lived experiences" (Fanon, 1967; Langer, 2016). The specific vignettes were chosen and constructed to highlight a specific population of our participants, revealing the nuances of our interpretations and perceptions about their behaviors and explanations throughout the research process. Here, we explore how the possibilities of how the intersectionality of gender and race, ethnicity, and maybe sexuality converged, influencing the boys' embodied and narrated identities (Tan et al., 2013) as they navigated the intersection of dance and coding as communities of practice (Wenger, 1999). By investigating their experiences and our interactions with them, we aim to acknowledge and challenge gendered assumptions that complicate participation in dance and computer science. Our study draws upon a theoretical

framework that integrates concepts from computational thinking, embodied cognition, and gender theory. This framework allows us to examine the potential of dance and virtual environments in supporting computational thinking while challenging gendered assumptions and power dynamics. We employ a design-based research approach (Barab & Squire, 2004) to investigate these issues in real-world educational contexts.

The paper is structured as follows: First, we provide an overview of our theoretical framework and methods. Next, we present five vignettes that highlight the boys' experiences in our project, examining and questioning their negotiations of masculinity, stereotypes, and social norms. Finally, we discuss the implications of our findings and argue for the importance of expanding definitions of dance and normalizing dance within school settings to challenge gendered assumptions and broaden participation.

Theoretical Framework

This study draws upon a synthesis of theoretical perspectives to investigate the potential of dance and virtual environments to support computational thinking and challenge gender stereotypes. Our framework integrates key concepts from computational thinking, embodied cognition, and gender theory to provide a comprehensive lens to understand boys' experiences engaging in dance and coding.

Central to our research is computational thinking (CT), a problem-solving approach that involves breaking down complex problems into smaller, more manageable parts, recognizing patterns, and developing algorithms to solve them (Wing, 2006). CT encompasses a set of concepts (e.g., sequences, loops, conditionals), practices (e.g., abstracting, modularizing, debugging), and perspectives (e.g., expressing, connecting, questioning) that are essential for understanding and creating computational artifacts (Brennan & Resnick, 2012). Within the context of this research, we view coding not merely as a technical skill but also as a form of creative expression and a medium for artistic exploration, as has been explored in other research contexts, including painting, sculptures, sewing, and fashion (Bevan et al., 2019; Buechley et al., 2008; Buechley & Eisenberg, 2008; Peppler, 2013; Peppler et al., 2020, 2022, 2023; Peppler & Wohlwend, 2018; Pinkard et al., 2017, 2020). Just as dance allows individuals to express themselves through movement, coding provides a platform for creative problem-solving (Çakır et al., 2021; Lee & Yi, 2021; Vongtathum et al., 2021; Woo & Falloon, 2022). By framing coding as a creative endeavor, we highlight the parallels between the expressive nature of dance and the imaginative possibilities of programming. By engaging students in creating computational artifacts through dance, we encourage them to explore the creative potential of coding while simultaneously developing their computational thinking skills.

Next, embodied cognition theories (Barsalou, 2008; Lakoff & Johnson, 1999) provide a framework for understanding how the physical experiences involved in dance can support the development of computational thinking (CT) skills. These theories emphasize the role of the

body in shaping cognitive processes, suggesting that the full-body movements and expressive gestures involved in dance may help concretize and communicate abstract CT concepts (Fofang et al., 2021; Kopcha & Ocak, 2019). For younger students who may lack the vocabulary to articulate computational ideas, the embodied nature of dance can make CT more tangible and shareable. By taking on an embodied perspective through dance, students can physically enact and work through computational concepts, similarly to how elementary students in Kopcha and Ocak's (2019) study used their bodies to take on the perspective of the robot they were programming. The interactive nature of dance, involving the interplay of mind-body and environment, aligns with the ecological psychology perspective (Heft, 2001) and suggests how dance enables a holistic engagement with CT ideas.

Our framework also considers the influence of gender expression and stereotypes on the participants' experiences. Both dance and coding are associated with complex and social-constructed notions of gendered tropes (D'ignazio & Klein, 2020; Lewis et al., 2016; Risner, 2009, 2014b; Risner & Watson, 2022). Specifically, “[dance] represents somewhat of a conundrum for masculinity; it offers the potential for reimagining identities and yet it also reflects historically and socioculturally rooted aspects of power and privilege” (Risner & Watson, 2022, p. 3). We view gender and the complexities of gender expression as socially constructed. Butler (1990/2006; 1993) discusses how gender identities are continually performed and reified through repeated social norms and beliefs. In the U.S. context of our work, although American gender norms have historically been rooted in heteronormativity, increasing awareness and representation of and by queer and LGBTQIA+ identities and cultures is palpable (Rekoert, 2023), particularly in the media and social platforms. By focusing on boys' experiences in dance, we aim to challenge the marginalization of boys in this field and the broader assumptions that position dance as feminized in US contexts (Oliver & Risner, 2017; Risner, 2009, 2014b).

Integrating these theoretical perspectives, our framework positions dance to support CT while challenging gender stereotypes and power dynamics in dance and computer science. This synthesis of theories guides our approach to investigating the potential of embodied, creative experiences to foster inclusive and equitable learning opportunities at the intersection of dance and coding.

Methods

Positionality

As researchers, our focus on dance as an entry point for this study is informed by our shared passion for dance and commitment to creating inclusive learning environments. Leonard's experiences as a dance artist, choreographer, and arts education professor have shaped her understanding of the transformative potential of dance education. As a White woman researcher, she recognizes the privileges and biases she brings to this work and strives to create inclusive and equitable research spaces. Daily's background in jazz, hip hop, and

African dance styles, her expertise in computing, and her identity as a Black woman researcher has inspired her to challenge dominant narratives about who can participate in dance and computer science. Together, our lived experiences and our roles as educators have motivated us to explore the intersection of dance and computational thinking to broaden participation and challenge stereotypes.

Throughout this project, we have been mindful of how our identities and experiences may influence our interactions with participants and our interpretations of the data. We have engaged in ongoing reflexivity and dialogue to interrogate our assumptions and biases and to ensure that we are centering the voices and experiences of our participants. By leveraging our diverse perspectives and expertise, we aim to create a collaborative and inclusive research environment that pushes the boundaries of dance and computing education.

Context

We designed and developed a platform that we named Virtual Environment Interactions (VEnvI), shown in Figure 1, as a virtual environment that scaffolds the learning of computational concepts through the experience of creating dance choreography and drew inspiration from programming environments like Scratch, Alice, and Looking Glass (Conway et al., 1994; Dann et al., 2008; Kelleher et al., 2007; Kelleher & Pausch, 2007; Resnick et al., 2009). VEnvI utilizes a drag-and-drop interface to create sequences of dance moves while simultaneously allowing users to engage with and customize timing (speed), parallel actions (unison), loops (repetition), and conditional functions (If, then Boolean logic statements to create theme and variations) for a virtual character's dance choreography (Daily et al., 2014; 2015; 2016; Isaac et al., 2016; Leonard & Daily, 2013; Leonard et al., 2015; 2020; Lin et al., 2017; Parmar et al., 2016a; 2016b). Using motion capture of dancers with varying abilities and identities enhanced the look and flow of the character movements, making them more lifelike. Throughout our project, participants had the opportunity to choreograph dances in the physical world, calling upon similar movements to what is available in the VEnvI movement bank and then coding corresponding choreography on characters in the virtual world. Then they would perform the physical choreography alongside a projection of the virtual choreography. Since we define dance broadly as purposeful and aesthetically-motivated movement beyond utility, we endeavored to make dancing inclusive, utilizing pedestrian, athletic, social line dance, hip-hop, ballet, and/or contemporary movements, where all participants, no matter their prior dance experience, could choose from a diverse movement bank to use to program and choreograph. In future iterations, more diverse dance forms would ideally be represented, as well.

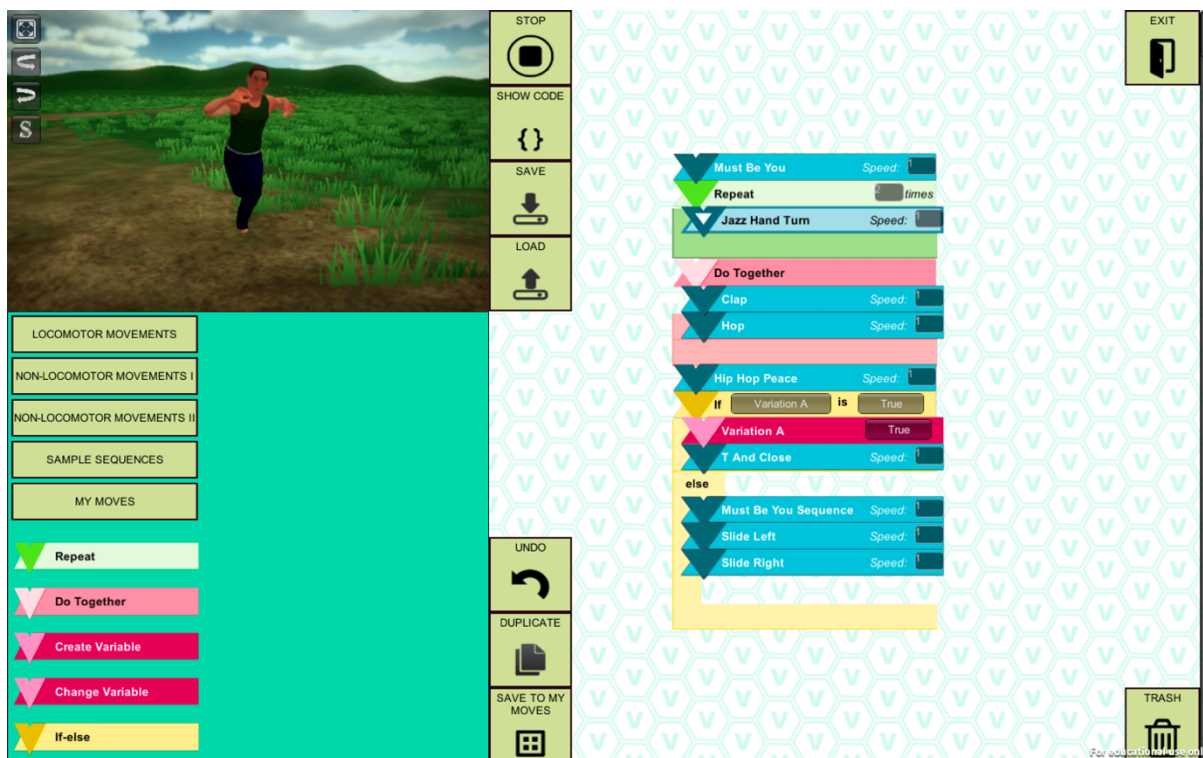


Figure 1. Screenshot of the VEnvI user interface. The virtual environment window shows the character at the top left, the move selection area and programming functions at the bottom left, and the drag-and-drop workspace area at the right. Users can choose a man or woman character, their skin, eye color, and clothing.

Research Design

In-depth details of our research design and data collection have been published in both journals and conference proceedings (Daily et al., 2014; 2015; 2016; Isaac et al., 2016; Leonard & Daily, 2013; Leonard et al., 2015; 2020; Lin et al., 2017; Parmar et al., 2016a; 2016b). The overarching research question guiding this study was: *How does this transdisciplinary project at the intersection of dance and computer programming reify, challenge, and/or transform gendered norms, perspectives, and identities for our participants who identify as boys?* We employed a design-based research (DBR) approach (Barab & Squire, 2004) to investigate the potential of dance and virtual environments in supporting computational thinking and challenging gender stereotypes. DBR aligns with our research goals as it allows for iterative design, implementation, and analysis cycles in educational contexts. We aimed to develop a theoretically grounded and empirically tested VEnvI that integrates dance and coding. Our DBR process involved multiple iterations of design, implementation, and analysis. Findings from each iteration informed the refinement of VEnvI and the development of new features to support participants' engagement and learning. For example, insights from early iterations led to the inclusion of more diverse dance styles and

the addition of customizable character appearances to enhance participant autonomy and self-expression.

Participants

The studies involved 170 participants across six research contexts, with grade levels ranging from 5th to 9th grade. Most participants (n=113) self-identified as girls, while 57 identified as boys. The racial/ethnic breakdown of participants was 86 White, 36 African American, 9 Hispanic, 9 Multiracial, 8 Asian, and 2 Native American/American Indian. The duration of the programs varied, with some contexts meeting once or twice a week for several weeks, while others were all-day or multi-day camps. The contexts included both during-school and after-school programs, as well as university-sponsored summer camps.

Data Collection & Analysis

In each iteration, we would engage participants in a dance warm-up, an exploration of computer programming concepts using movement and the computer, as well as activities where participants choreographed dances physically and also programmed choreography for their virtual characters. We then collected a variety of data sources to capture participants' experiences and learning outcomes through: 1. Pre-/Post-Surveys: Participants completed surveys at the beginning and end of each iteration to assess their attitudes towards dance, coding, and identity as dancers and programmers; 2. Focus Group Interviews: Semi-structured interviews were conducted to explore participants' perceptions of the program, challenges faced, and collaborative processes; 3. Observations: Researchers observed participants' engagement and interactions during dance and coding activities, documenting field notes and reflections; 4. Artifacts: Participants' physical and virtual choreography and programming projects were collected as evidence of their creative processes and computational thinking skills. Qualitative data, including focus group transcripts, observation field notes, and artifacts, were analyzed using thematic analysis (Braun & Clarke, 2006).

We followed an iterative process of qualitative coding, categorizing, and identifying themes aligned with our research questions and theoretical framework. For this paper, after having coded the data as a whole for computational thinking concepts, practices, and perspectives and embodied ways of representing knowledge for other publications (Daily et al., 2014; 2015; 2016; Isaac et al., 2016; Leonard & Daily, 2013; Leonard et al., 2015; 2020; Lin et al., 2017; Parmar et al., 2016a; 2016b), we noticed gendered themes emerging from the data, particularly with some of the data from our participants who identified as boys. Therefore, the analysis for this paper followed one of focused coding (Saldaña, 2021) for gendered expressions and identities related to our boys and the perceived influences of intersectional identities on boys' experiences based on our interactions with them. We present five vignette narratives to share these experiences.

Vignettes

Vignette 1: "Dr. Edward"

Our first research iteration took place in an afterschool context at a school that houses an urban 4th- 5th grade and racially diverse neighbourhood school (housing most students receiving free and reduced lunch at the school) and the district's highly gifted 3rd- 8th grade and predominately White school. When designing VEnvI, we used an existing programming environment, Alice (Dann et al., 2008), to test our ideas about what a new environment must include. At the time, we could only create one character that could perform a small set of dance moves. We specifically chose to make the character a woman of color, and we dressed her in contemporary clothing: jeans, a tunic-style shirt with a synching belt at the waist, and colorful sneakers. We wanted the character to look familiar to the students. Since one of our goals within our project was to inspire young women of color and engage them in computer programming, we did not want to privilege White students using a White-appearing character as they are already highly visible and often used as default characters in the media.

However, all the participants wanted to customize the character: to make her look more like them, give her different clothes, and change her racial appearance or hair. We explained that since we were working on designing our program, we were only able to make one character at this time. This ended most requests to change the character's appearance, with one exception. Our lone boy participant in this iteration—let us call him "Taye"—continually asked if he could change the character to a boy, and every day, he would express how he wanted more boys to participate in our project.

In addition, it was not uncommon for him to come and dance next to the person leading the dance activities. While we usually led dance activities by facing the group and having the kids mirror us, on most days, Taye would dance right next to us. That could have made it easier for him to follow the sequences. However, we also hypothesize that being the only boy and one of three African American-identifying participants (with the other six identifying as White) and one of four students from the neighborhood school played a role in Taye's behavior during this project. While we do not know about how Taye identifies in terms of his sexuality, we acknowledge that heteronormative and heterosexist narratives permeate assumptions surrounding dance and who dances (Risner, 2009; 2014b); therefore, the intersectionality of sexuality and gender are inherently interwoven in dance. These identities are not mutually exclusive and highlight potential multidimensional influences on Taye's experiences as a dancer.

One day, Taye created an alter ego named "Dr. Edward" (Leonard & Daily, 2013). It is important to note that we referred to ourselves as Drs. throughout the sessions. We used our first names with Dr. in front to make it easy to remember, but also because, as professors and scholars, we wanted to model that distinction and aspiration for the kids. Dr. Edward wore a handmade mustache, goatee, and hat cut from white computer paper and talked in a mature, deep voice. Sometimes, Dr. Edward would say nonsensical things, but other times, he would

talk about what he would do differently in the program, recommending that we make the character into a man. He also explained that more boys had initially signed up for the program, one of whom was named "Joe Swanson," but "Joe dropped out" because "it was too girly...there were too many girls."

So, what was going on with the arrival of Dr. Edward? By creating Dr. Edward, Taye had transformed himself into a character that reflected his desire for a gender-matched peer to interact with and to build some 'coded' camaraderie with (Risner, 2007). However, we also needed to recognize other factors. His choice to place "Dr." at the front of this alter-ego's name, provided this character with an authoritative, hyper-masculine voice and look, intrigued us. Did Dr. Edward reaffirm his masculine, heteronormative status and elevate his status within the group? Tan et al. (2013) distinguishes between two types of acts of identifying: narrated identities (telling of who one is/might be) and embodied identities (actions to show who one is/might be). Dr. Edward may have been a manifestation of the possible struggle between Taye's narrated and embodied identities. In many ways, we saw Taye was also 'coding' the character of Dr. Edward, taking control in a way that he could not within the program, programming a masculine character and colleague imbued with perceived privileged identities.

Vignette 2: Now, "I Am a Dancer."

During a one-week, university-sponsored, fee-based summer camp with need-based scholarships available, it was clear that all eleven participants (eight boys and three girls) were excellent students academically and were interested in computer science in some way; however, not all were as interested in dance. At the beginning of the camp, a White-identifying boy named "Oliver," continually remarked that he did not like dancing and did not want to dance. His responses on the pre-survey correlated with this. During our first warm-ups and dance activities, he had this embarrassed smile, often laughing at himself. However, Oliver became increasingly engrossed throughout the week and enthusiastic about his choreography. By the end of the week, he was one of the participants who consistently volunteered to demonstrate their choreography. When allowed to program and then optionally choreograph a dance battle, Oliver was part of the only duo to organize their battle as humans versus virtual characters—Oliver and their partner, African American-identifying "Jacob," danced alongside a projection of the characters, performing tricks (handstands, cartwheels, flips, and "the worm"). The other students programmed virtual characters to battle against each other in the virtual space only. When Oliver and Jacob performed their battle, Oliver asked to have his performance filmed using his phone so that he could text it to his mom and show her that he was "now a dancer."

We were sure we had positively impacted Oliver's confidence as a performer and newly discovered identity as a dancer. However, when we looked at his post-survey that he filled out *after* his dance battle, *after* texting his mom his dance video, and *after* announcing to everyone in the room that he was "now a dancer," there was no change. He still did not

identify as a dancer or choreographer. Moreover, no change in anyone's response to that item was changed from pre- to post-biographical survey. Only two of the nine students saw themselves as dancers or choreographers on both pre-/post-surveys.

We felt disheartened. While this iteration was only a week, we observed excitement about dancing. We wonder if the groups' responses reflected more considerable societal pressures and assumptions about dance and what it means to be competent in dance since the majority did not have much prior dance experience and came to camp more for the coding aspect. Learning as the process of identifying as a part of a community of practice, such as in dance, involves gauging one's *regime of competence*—the continuously evolving yet also negotiated set of criteria that define a community and an individual's competency in participating in that community (Wenger, 1999). Furthermore, the act of identifying within a community involves both sharing and performing how one identifies. Maybe Oliver did not feel competent enough dancing to narrate his identity (Tan et al., 2013) as a dancer, even though he was beginning to embody an identity as a dancer.

While the dance opportunities offered Oliver a seemingly unique experience, we can see how conditions for stereotypical expressions of heteronormative masculinity also came into play (Clegg et al., 2017), with the majority of participants in this iteration being boys who often took on leadership and assertive roles that dominated conversations (Clegg et al., 2019), eagerly volunteering to show their work and competing to find "bugs" in the program (Leonard, Daily, Jörg, & Babu, 2020). With the opportunity to program and choreograph the dance battle, conditions may have become ripe for displays of hyper-masculine notions of competition, aggressiveness, and power (Risner & Watson, 2022; Wellard, 2006). Interestingly, Oliver and Jacob included "tricks" since we did not include those moves in VEnvI, nor our dance activities. It is possible that Oliver's interest in dance stemmed from the opportunity to perform masculinity in that way, like sports contexts and classes "where social activity is established upon principles such as competition, winning and overcoming opponents" (Wellard, 2006, p. 109). Whatever the intersectional social norms at play, there was a clear disconnect between what we observed and what was said during the activities, versus how Oliver identified and described himself on paper.

Vignette 3: "I Have Taken a Dance Class."

With space for 16 students in an after-school iteration, we had ten boys and six girls volunteer to participate. On the pre-survey, we were pleasantly surprised to find that out of the ten boys, eight said they enjoyed dance, ranging from a little to a great deal, spending about 1-4 hours dancing per week in Physical Education class, extracurriculars, alongside video games/media interactions, and during family activities. Four boys stated they had attended a formal dance program or class, and two expressed that they saw themselves as dancers.

Interestingly, while filling out the pre-surveys, one of these boys, "Sage," raised his hand. One of our graduate assistants working on the project went over to help him. He whispered something to her, and they talked briefly before she left him to finish the survey. Later, she shared that Sage had whispered that he was having trouble answering the question about if he had ever participated in a dance class. After quickly looking around, seemingly to see if any of his peers sitting nearby (all boys) were listening, Sage explained that he had taken dance classes before but was unsure if he *should* answer "yes." When we looked at the pre-surveys, Sage answered "yes" because he had taken a hip-hop dance class and thought he was "all right" at dancing. However, he noted that he did not see himself as a dancer because "I am not very interested in [dance]." Then, in the post-survey, Sage said he "strongly disagreed" with the statement, "I am a dancer." However, he said he would participate in our project again because it was fun.

Sage's participation throughout the program was stellar—actively engaged, visibly having fun, and creatively problem-solving choreographic and programmatic challenges. We cannot be sure of why Sage was apprehensive about acknowledging that he had taken dance classes before his "looking around" at his peers to see who was listening or could see his answers seems to align with the "prevailing social stigma—including narrow definitions of masculinity, heterosexist justifications for boys in dance, and internalized homophobia" (Risner, 2009, p. 43). Even more, competing intersectional cultural and racial identities may also have come into play with his apprehension. Sage identified as Asian in a school where most students identified as White. Might it have been more socially acceptable to dance in his home life? Risner (2009) acknowledges, "Although dancing in many cultures has been and continues to be viewed as an appropriate...[masculinity] activity, the Western European cultural paradigm situates dance as primarily a...[feminine] art form and has since the eighteenth century" (p. 24). Again, Sage's narrated and embodied identities seemed in conflict (Tan et al., 2013).

Vignette 4: Maintaining and Challenging the Status Quo.

During the same iteration as our vignette with Sage, we had the opportunity to compare our research data responses and program engagement between the boys and girls. We found no difference between the learning outcomes of the boys and girls on the pre-/post-computational tests. Both had a statistically significant score increase when tested on knowledge and application of computational thinking concepts. However, when looking at our other data, we noticed some variance between boys' and girls' sharing, practice, and performance patterns and how they described their engagement processes during the interviews.

For example, in the pre-survey, Sage noted that he was "not very interested in dance." Seven (out of ten) of the boys also noted negative feelings about dance in the pre-surveys. They explained that they do not identify as dancers or choreographers because:

[I] can't dance.
Embarrassment
I'm not a good dancer.
I dislike dancing.
Because it is not my favorite thing.
I suck.
I'm not very interested in it.

The other two boys noted that they did see themselves as dancers or choreographers because:

I can breakdance.
I see myself as a dancer because I've been dancing all my life, and when I'm older, I want to be a professional dancer and singer because I'm good at both of those.

These two boys maintained confident, positive attitudes towards the dancing throughout the sessions, acting as leaders during dance activities, but at times, it seemed as though they had to speak up for dance since the other eight boys often dominated conversations. The six girls noted positive feelings about dance, aligning with the prevalence and normalization of women's participation in dance (Clegg et al., 2019; Risner, 2007). Five identified as dancers and choreographers, and one explained that she likes to dance but does not take classes and, therefore, did not identify as a dancer.

During this iteration, we also conducted gender-based focus groups since our initial research focused on girls' computer programming participation. We asked the same questions in the boy and girl focus groups: "How would you describe this program to a friend?" "What was your favorite part?" "What was most challenging?" We also asked them to describe their process of programming and choreographing with a partner. Then, we asked them what they would focus on if they had more time to work on their projects. Most of the boys talked about their projects in terms of the action and props available in the program to add to their dance scenes.¹ For example, there was a lengthy discussion in which one pair explained, "We had a limo crash into stuff, and in the end, he ran me over, and the buffalo or bison ran him over. And then the fire truck killed the bison. Then the random UFO that had gone up in the air crashed into the fire truck." Even though the girls' and boys' groups and one mixed-gender group used props and non-dance actions along with dance movements, the emphasis during the boys' interview was on the peripheral, non-dance action. In contrast, the focus from the girls' interview appeared to be more on the individual moves, such as "trying to get [the characters] to disappear and reappear" or "we're trying to make it do a handstand first, or at least get it to that lunge." These observations are somewhat in keeping with research on how boys and girls design digital games in which girls tended to create games with narratives

¹ In this iteration, Alice was used. Alice allows for many other characters besides the dancing character, which allows for more story development. Our platform, VEnvI, does not utilize props, scenes, or other characters besides the dancing character.

compared to the games created by the boys, which resembled commercial games that contained more stereotypically masculine undertones of violence and action (Kafai et al., 2016).

Participants exhibited engagement in a variety of ways within their gender groups. Although one group of boys talked more about the action and one group programmed a narrative with violent, adventurous themes, even one of the girl groups ended their programming performance with a UFO entering and landing on all the dancing characters and making them disappear. At other times, the kids' engagement countered and resisted gendered stereotypes. During the boys' interview, we asked them how they might describe this program to a friend. "Gene," of the boys who identified as a dancer and noted that he wants to be a professional dancer, adamantly voiced, "I have one more thing, to be honest; I would describe this program to be very exciting and emotional with dancing and acting programs with a lot of emotion and activity..." Here, Gene focused on the emotional aspects of expressing oneself through dance, explicitly challenging hyper-masculine stereotypes. He did so in front of several peers, who mainly did not identify as dancers and tended to dominate conversations. One of the girls, "Misty," called attention to the notion that computer programming is often seen, stereotypically, as an activity for boys. However, for her, dance and sports were for everyone, so our program merging programming and choreography was more inclusive from a gender perspective. She explained that,

...girls don't think that they can program because they think that they're just girls. It's a stereotype, sort of. Adding a dancing element and adding sports maybe could help girls and some boys start liking programming. Some people think that some girls, some boys, think that programming is just for geeks. It's not. It's actually fun..."

In this way, she advocated for broadening perceptions and debunking gendered and other identity stereotypes in dance and programming. Misty's and Gene's commentary possibly hints at changes for this next generation of dancers.

In this sense, these students highlight one of our project's hallmarks: accessing dance from a broad perspective. Since the movements we used included pedestrian, social line dance, hip-hop, and classical dance (ballet, contemporary) styles, all students could choose from a diverse movement bank. In their choreography and performances, most of the movement was more pedestrian and gestural (walking, clapping, simple jumps and turns), with hints of classic dance moves and other actions that the platform afforded them, such as disappearing and adding props, scenery, and animal characters. This diversity of possibilities and the autonomy to make creative choices allowed them to engage in varied forms of choreographed movement in alignment with their interests.

Vignette 5: When Dance Class is the Norm...

One iteration took place in an elementary public arts magnet school where students attended art, music, drama, physical education, and dance classes every week. Having the time to incorporate cross-curricular connections, we used the parts of the cell as a theme, per the

request of the 5th-grade teacher team, for the dances that the students would choreograph physically and program virtually. To support this work, we built a warm-up that included a movement choir poem about cells, cell membranes, nuclei, cytoplasm, and vacuoles that we would perform daily. Then, in pairs, students created and performed physical-virtual dances representing a cell's parts. All pairs were homogeneously gendered by student choice (Daily et al., 2015).

We saw no apparent differences between the boys and the girls in their interactions or the data collected during this iteration. All were engaged throughout both the dance and programming aspects of the program. Since dance was the norm for all students as a part of their curriculum every week, this experience of dancing and dancing in school normalized how dance in our project was perceived and enacted. While some of the students in this class also took dance classes as an extracurricular activity, and this was evident in their dancing, there was a baseline of dance knowledge across students. Dance composition, watching and analyzing dance using the elements of dance, and learning about diverse dance styles and traditions were routine for them. Additionally, it was clear that the students were often given autonomy and were confident in their compositional tasks to make creative choices, which we worked on following and nurturing in our project.

For example, the students' choreography and programming were varied and individually creative: some were more balletic, lyrical, and technical (often by those students who took dance as an extracurricular class). Many utilized creative movement styles and gestures, while others had an intentional robotic or athletic quality, depending on the student's interests. While some students expressed that they enjoyed dancing more than others, gendered codes of conduct, stereotypes, and assumptions about dance or who should or should not dance did not weigh heavily in this context. It was assumed that dance was for everyone, and participating in it was the norm. Unlike most public schools in the United States, this school offers dance as part of its curriculum. Although each state has PK-12 dance standards in place and 35 states certify dance teachers, the most recent reports from the National Center for Educational Statistics (Parsad, B., & Spiegelman, 2012) note that only 3-4% of elementary schools offer dance and drama/theater instruction. It makes one wonder what might happen to assumptions surrounding dance and who dances if dance was offered more extensively in schools.

Conclusions

We initially sought to broaden participation in computer programming for girls, yet we found through dance choreography that boys were also given opportunities to dance. However, it was clear that social norms and constructed identities related to the possible intersectionalities of gender and race, ethnicity, and/or sexuality were at play in our young participants' embodied and narrated identities and behaviors. While we cannot know for sure exactly what influenced these participants' choices, we observed and heard evidence of the socially constructed and complex web of performing gender in the context of dance and computer

programming. How they performed their identities as an imaginary, gendered character, how they chose to speak their identity as a dancer and not in writing, whether they questioned if they “should” admit to dancing, or in the ways that they expressed themselves in gendered ways revealed socially constructed norms and behaviors related to gender and influenced by identity intersectionalities.

Many boys said they participated in our project because they wanted to program. However, they also were able to dance as a part of it. Therefore, another layer of intersectionality comes into play for some since their identity as programmers possibly supported their entry into a world in which they might not have admittedly taken part before. Challenging long-held notions of who is a dancer by expanding how dance and related activities, like programming, can be defined and used in these transdisciplinary ways, especially by normalizing dance within school settings, might welcome more boys to dance, support those who dance, dismantle long-held binary notions of gender, and help young people engage in diverse pursuits, and confidently identify within these communities of practice in the future.

We acknowledge that we cannot make large generalizations and claims with our small sample populations for each iteration. However, small case studies like these can provide insight for educators since what we experienced most applies to classroom contexts (Stake, 1995). Providing tools to allow students to engage in various ways, giving them autonomy, especially in how they represented their knowledge in their choreography and programming, supported creativity and well-being (Nordin-Bates, 2020). This autonomy encouraged the boys' engagement across all our iterations. There was no model dance genre or technique that they had to emulate. Allowing for autonomy in dance and normalizing dance in schools can be a powerful call to educators and researchers in education. Additionally, if we expand this project, we endeavor to be more inclusive by not targeting gendered participation and expanding possibilities for educational opportunities for all children. For example, we would program VEnvI to include more inclusive, non-binary character choices versus just a man and woman character.

On the path to breaking down norms in programming, somewhere along the way, thanks to the boys who participated, we realized we also were working to ‘decodify’ dance as a gendered act. In this way, VEnvI works to respond to the call that “[we] need play environments that support children’s versatility in expressing themselves—open to unbounded limits of the imagination rather than confined by boundaries of gender stereotypes” (Kafai, 1998, p. 110). Dance has great potential to explore ways in which hegemonic masculinity and heteronormative binaries continue to function and to challenge those norms through the participation and experiences of diverse participants in dance because of its own complex relationships with gendered expression and its creative capacity as an embodied art form. In alignment with the VEnvI projects’ research findings and these vignettes, almost two decades ago Risner (2007) suggested that dance education may play a crucial role in “disrupting dominant cultural assumptions about acceptable ways of moving

for...[men] and to challenge cultural stereotypes about...dancers [who identify as men] and non-heterosexual modes of sexuality” (p. 144). Providing access to dance education opportunities in school contexts could “ensure that all children have access to dance as a part of a “comprehensive education” (Cone & Cone, 2011, p. 28)” (Leonard et al., 2014) and allow for more inclusive beliefs and strategies in dance practice. By exploring and sharing these vignettes, we seek to add to the literature and expand how dance and programming are defined, broadening opportunities for boys and *all children*.

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