The Dancing Alice Project: Computational and Embodied Arts Research in Middle School Education

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Rather than underline the fact that thinking can be abstracted and separated from corporeality, I am underlining the fact that thinking depends upon it.
(Sklar, 1994, p. 14).

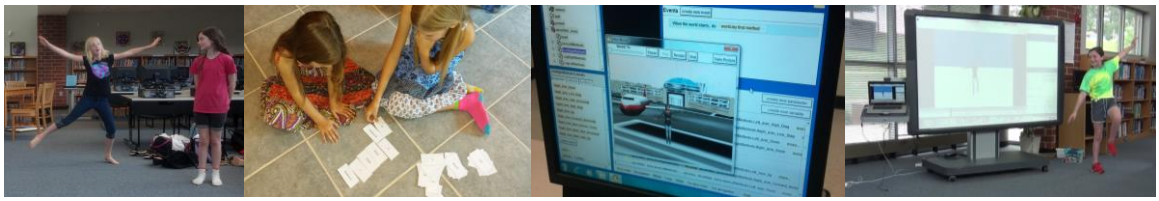


Figure 1. Image montage of the Dancing Alice Project. These images show an edited sequence of the project: beginning with dance choreography; programming sequence game; programming choreography onto a virtual character; and performing one's dance along with her programmed character.

We move to think. Dance and movement, in particular, as ways of knowing and being have tremendous cognitive-emotional power in teaching and learning (Hanna, 2008; Leonard & McShane-Hellenbrand, 2012). In the widely circulated and seemingly viral *Sir Ken Robinson TED Talks video* on how schools kill creativity, Robinson clearly makes this point as he tells the remarkable story of dancer, performer, director, and choreographer Gillian Lynne who is best known for choreographing the musicals *Cats* and the *Phantom of the Opera* (Robinson, 2006). When she was in elementary school in the 1930's, the school wrote to her parents claiming that she had a learning disorder because she could not concentrate and was constantly "fidgeting" in class. Once taken to see a specialist, the doctor told Gillian to wait in his office while he and her mother talked privately outside. Before he left, he turned on the radio. He then asked her mother to watch Gillian from the window. Gillian was up out of her chair immediately moving to the music. In a profound moment in his talk, Sir Ken Robinson quotes the doctor explaining, "Mrs. Lynne, Gillian isn't sick; she's a dancer."

At this moment, it is as though the audience suddenly gasps for air, kinesthetically responding to the revelation that arts educators know all too well: it was not that she was sick or not smart; as Sir Ken Robinson elucidates, "[She] needed to move to think." While making a strong statement in favor of dance and movement education in schools, the overall point supports his premise that schools can no longer afford to educate students in the same ways as they have traditionally done for centuries. In our current, ever-changing, global, digital, and environmentally-fragile age, schools and society need to privilege creativity and multiple ways of being intelligent in order to prepare students for this reality and unknown future (Partnership for the 21st Century, 2013; Buffington, 2013).

Although Sir Ken Robinson highlights the professional dance artist, who is the epitome of one who needs to move to think, in reality, we all move to think. One need not be a professional dancer to benefit from the creative process of moving, creating movement, and communicating through movement. Dance and movement cross multiple disciplines and industries: art, design, entertainment, tourism, business, and digital media. As collaboration, interactive technologies, and the sharing of information continually expand our notions of communication, digital media and computing are playing huge roles in this reality and have changed the way we think (Papert, 1993). With our current digital, global context, the U.S. Department of Labor (2005) has predicted an increase in demand for computer system analysts (29%), database administrators (37%), and software engineers (38%). The need for computational thinking and learning in schools is necessary. While computing and interacting with digital media are often categorized as disembodied (de Spain, 2000), the process of computing and digital media are inherently trans-disciplinary, merging ways of thinking beyond disciplinary boundaries, and embodied in terms of visual, auditory, kinesthetic, aesthetic, artistic,

and design elements involved. Since we move to think, and learning is syntonic, related to our own understandings of our selves, lives, and bodily ontologies, how can we better understand the role of the body in thinking and computing? How does one move to think when computing? How can embodied ways of inquiry help students engage in computational thinking?

The Dancing Alice Project, our pilot research study, drives our inquiry of computational thinking. In this research project, we have developed and piloted a method for blending dance and computer programming as a novel and embodied way to engage middle school children with computational thinking. Our goal is that students approach programming as an active, physical task, as they engage with the content they develop. In the Dancing Alice Project, we developed an environment on top of the current computer-programming platform called *Alice*, created by Carnegie Mellon, to introduce students to the computer programming language Java™. Alice has a drag and drop interface that enables students to program without having to learn the syntax that prevents many students from engaging with computer science.

The ultimate goal of this pilot study was for students to create an animated character that would be projected onto a large screen and with whom the students would be able to perform. In this way, the animated character is body syntonic (Papert, 1993) in that understanding a dancer is related with learners' understanding of their own bodies. Our main hypotheses for this research were that 1) the combination of dance and programming will open pathways to broaden participation in computing, and 2) that body syntonicity will enable young learners to bootstrap their intuitive knowledge in order to learn programming concepts. We found that all the students engaged in a variety of embodied ways throughout the pilot. In other words, all of the students moved, used movement, and called upon their bodies to think through computer programming. Furthermore, their most insightful and engaged experiences in dance and computer programming

occurred when the knowledge that they were exploring and creating was body, ego, or culturally syntonic, related to their knowledge of their bodies, self, and cultural experiences (Papert, 1993). They were moving to think in syntonic, relational ways. In this paper, we present this pilot project, a theoretical framework guiding our inquiry, and a sampling of our initial findings. However, just as our need to move to think, this project also needs to move. This paper presents findings from the first phase of this work. The analysis of our data, our theorizing, redesigning of the pilot, and the development of continuing research is ongoing. This is only the beginning…

Merging Dance and Computer Programming: The Pilot Project and the School

I would just love to be a part of the Dancing Alice project because the program mixes the main parts of my life, which I am extremely passionate about. Computer programming and dance are second and third languages to me. Computer programming and coding look like rocket science to lots of people, but to me it somehow makes all the sense in the world. And dance just fascinates me and is a large part of my life. It just puts me into a state of awe simply understanding and being able to express how I feel and tell stories without even speaking. I many not take dance classes or computer programming classes but either way, without them, I'd just be lost. Without either of these things, especially dance, life would be dull and predictable and one who lies in a world like that is one I pity. I feel as if participating in the Dancing Alice program would be so great and amazing that there aren't even works strong enough to describe the happiness and gratefulness I would feel.

(5th grade student)

The juxtaposition of dance and programming is a natural fit in that, in dance choreography, there exists a similar process of sequencing steps or moves and organizing them compositionally, through repetition, unison, contrast, canon, changing levels, speed, and facings, etc. In many ways, computer programming is very much like the compositional process of choreographing a dance. The importance of computational thinking, a combination of concepts (e.g., sequencing, events, conditionals) and practices (e.g., iteration, modularization, debugging) from the world of computing are important for careers inside and outside of computer science (Brennan & Resnick, 2012; Lee et al., 2011). Examples of computational concepts the students

utilized include: sequencing—identifying a particular order of steps for a task, event—a response to something that occurs. While practices include: iteration—repeating a procedure until a desired goal is reached, modularization—taking smaller parts and putting them together to form something larger, and debugging—finding and fixing mistakes. In many ways, the practice of computer programming is very much like the compositional process of choreographing a dance where small pieces are integrated into a larger whole (modularization) and body positions are incorporated and changed slightly to create something new (remixing and reusing). Furthermore, the students learned these basic programming skills and strategies through the artistic and choreographic process, merging these two compositional skills.

As mentioned above, we utilized the Alice programming environment as a part of this pilot. Currently, in order for a character to move in any kind of dance-like fashion, there are a lot of commands necessary. The necessity of multiple commands for a simple move is not ideal for creating a full dance. Therefore, we first developed a set of primitives, basic methods within Alice to support basic dance moves (e.g., arm, foot, and head positions). For example, students could chose move the “left arm” from “down,” a neutral position with the character’s hands at her side to “horizontal,” a position with her arm perpendicular to the body in an outstretched horizontal position. In order to do so, the student would have to drag and drop the command “do together” into the workspace. Then, the student would drag and drop “left arm down” followed by “left arm horizontal” into the workspace to achieve this action (Figure 2). Therefore, we scaffolded the student’s learning in such a way so that there was not a complete disconnection between the programming language and actual movements themselves.

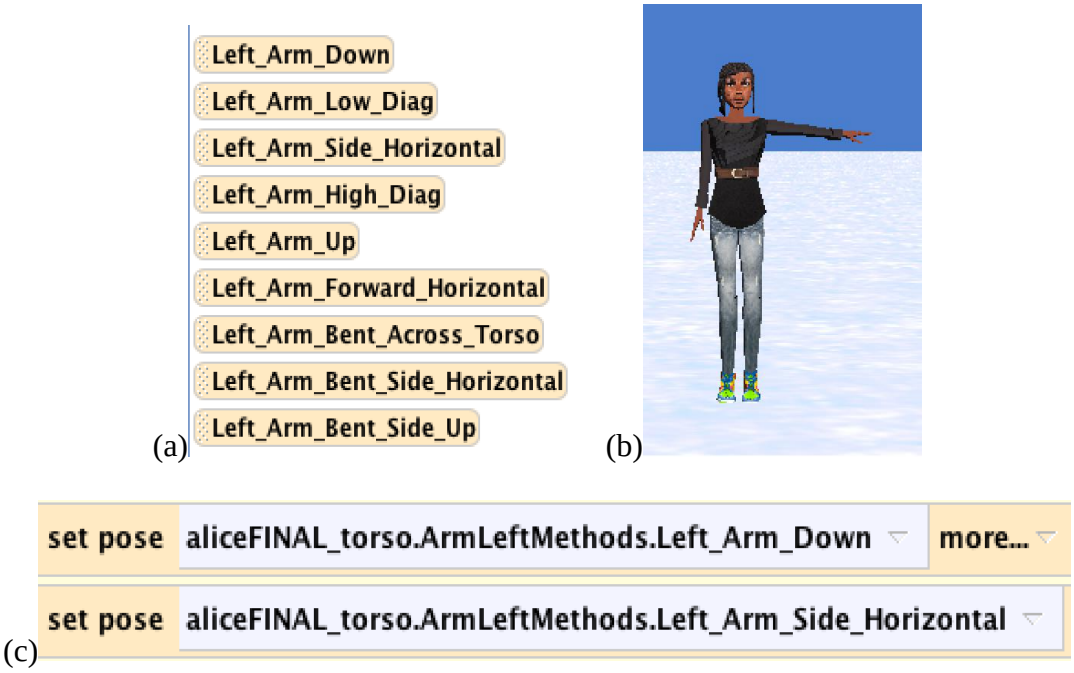


Figure 2. Screenshots from Alice. (a) Different commands that can be selected for the left arm. (b) Alice character moving left arm to horizontal positions. (c) Commands used to achieve character's position.

Once we developed the dance primitives, we began a five-week pilot with 9 students (8 female and 1 male; grades 5 and 6; 6 White and 3 African American) as an after school program at a middle school in a small urban community: twice per week, for two hours (ten sessions total). The school is a unique and diverse educational environment, where a percentage of the students come from the school district's top 1% of students, according to the state testing procedures, 29% are minority, and 20% are eligible for free and reduced lunch.

Each week, students met with instructors learning basic dance curriculum involving the elements of dance (body, space, time, energy) and dance choreography (theme & variation, repetition, unison, cannon) and basic computer programming commands in Alice (do together, loop, wait, if, then). The activities in the virtual world consistently mirrored the activities in the physical world, with all activities enabling opportunities for scaffolding student understanding of

computational concepts, practices, and perspectives as well as building community in the learning environment. We began each session with a physical dance warm-up to focus the students' energy and to condition their bodies for dance explorations. First, we worked with the students to learn a popular hip hop line dance, the *Cha Cha Slide*, that involves simple, repetitive dance steps: stepping to the side, two-foot jumps, a basic salsa cha cha move, etc. After learning this choreography, the students began to explore the Alice platform to recreate the Cha Cha Slide on their virtual character.

Once they felt competent with the movement capabilities of the character, we moved into choreographing an individual eight-count dance phrase and exploring the concept of theme and variation in dance with these phrases: how can one vary a move through using different body parts, levels, and timing? Finally, the students replicated this dance choreography in Alice on their characters. However, the students were given the choice to replicate the dance exactly, to create a variation or to add onto their original choreography. Once they programmed the choreography onto the character, they were given the opportunity to perform physically alongside their character as it was projected onto a screen, creating a physical-virtual duet (Figure 1, 4, & 5). The project culminated in an informal showing of the students' projects and performances for family and friends on the last day.

Throughout the ten sessions, serving as both the researchers and the instructors, we collected the data as participant-observers (Tedlock, 2008). We collected data on the students' experiences through observations, photographic and video footage of dance and programming sessions, a collection of student work, post-program student interviews, and pre- and post-assessment questionnaires. The videotaped interviews asked the students to discuss their experiences, what they enjoyed, what challenged them, and if and how they see relationships

between computing and dance. The pre- and post-assessment questionnaires examined the students' interests in and outside of school, their experiences with computers and gaming, and their knowledge of dance and choreography.

Thinking About Learning: The Theoretical Framing For the Pilot Project

What an individual can learn, and how [one] learns it, depends on what models [one] has available.

(Papert, 1993, p. 120)

Our main theoretical framing for our hypotheses is guided by Papert (1993) and his conceptualization of the psychological construct of syntonic learning—learning that is relatable to the learner in terms of self, culture, and one's body. To begin his influential and provocative book, *Mindstorms: Children, Computers, and Powerful Ideas,* Seymour Papert (1993) writes,

> *In most contemporary educational situations where children come into contact with computers the computer is used to put children through their paces, to provide exercises of an appropriate level of difficulty, to provide feedback, and to dispense information. The computer is programming the child (p. 19).*

However, within the LOGO environment, the first "child-friendly" computer programming language primarily used in mathematical instruction, around which Papert centers his discussion of children and computers, this relationship is reversed. With LOGO, the child is the programmer, deciding and controlling how the computer should "think." In doing so, Papert contends that the child becomes an epistemologist, exploring her own thinking in this process. In other words, LOGO as a tool for thought exemplifies the Piagetian perspective that children are "active builders of their own intellectual structures" (p. 19).

Utilizing their existing knowledge and experience along with the surrounding cultural, material, and intellectual context to think and learn (Gruber & Vonèche, 1977), students' learning is syntonic, meaning that new knowledge is compatible with one's own feelings and understandings of body, mind/self, and cultural/social context. According to Papert, through syntonic learning children are able to more effectively learn and understand mathematical concepts because of their active engagement in the construction of and the syntonic associations with this knowledge. Thus, the LOGO turtle can be seen as an "object-to-think-with," in other words, a tangible tool for thought. However, Papert argues that LOGO is not "a panacea for all educational problems" but rather serves as an illustrative model for future educational tools and possibilities, lying at "an intersection of cultural presence, embedded knowledge, and the possibility for personal identification" (p. 11).

In linking dance and computer programming, the Dancing Alice Project creates an opportunity for students to create what Papert calls an "educational object," in this case, a physical-virtual duet that students "think with" and through to explore knowledge in new ways, just as with LOGO and mathematical concepts. Here the act of dancing and choreographing, in addition to the act of programming a dancing character, act as external representation of knowledge. While constructing knowledge through dance and with computers remain fundamentally different experiences, the cognitive process of making connections on multiple levels allows learning and knowledge construction to happen in both instances in what Papert argues are more organic, associative ways as opposed to conventional, rote methods that require students to memorize information in a manner disassociated from their lives. Therefore, through syntonic learning, new knowledge is connected with existing knowledge and previous experiences. In this way, syntonic learning allows students to develop the mathetic strategy,

relating to Piaget's theory of assimilation, of solving problems by looking at something one already knows first, then taking this new knowledge and making it one's own (Gruber & Vonèche, 1977; Papert, 1993; Siegler & Aibali, 2005). For example, our students first learned the Cha Cha Slide and then reconstructed it through a different media through computer programming.

This project "recasts" dance and computing knowledge, transforming it into creative, artistic, digital expression. Moreover, exemplifying mathetic learning—knowledge about learning—this project is working to change how students think about the dance and computing material so it is not just about remembering and repeating it. In this sense, these experiences create the possibility of "setting up new neurological paths," an idea relating to Piaget's theory of assimilation of old knowledge into newly constructed knowledge since new neural pathways begin to be formed when acquiring and storing new knowledge or experiences and become strengthened with usage, increasing the likelihood of long-term connections and memory (Papert, 1993; Gruber & Vonèche, 1977).

Papert (1993) categorizes syntonic learning in three ways: body, ego, and cultural syntonicity. Body syntonicity is the idea that understanding an object's objectives, behaviors, and rules of operation can be related to the understanding of a learner's own body. Since the programmable Alice character is modeled after a person and moves similarly, the character and the act of programming the character are body syntonic. The second category, ego syntonicity, relates to knowledge that is compatible with the students' "sense of themselves as people with intentions, goals, desires, likes, and dislikes" (p. 63). Finally, cultural syntonicity, relates to the students' own social and cultural experiences.

Constructing Meaning Through Relationships: Initial Pilot Project Findings

You can't think seriously about thinking without thinking about thinking about something.
(Papert, 1993, p. 10)

Along with expanding their knowledge and utilization of computational thinking concepts and practices and basic dance technique and choreography, the students demonstrated interest in computing and dance. Throughout the ten sessions, all the students exhibited complex engagement with programming concepts and dance in a variety of ways. Interestingly, the most profound engagements that we observed had two things in common. First, they were embodied in some way. In varied ways, all the students engaged visually and kinesthetically through computing to understand movement and moving to understand computing. Secondly, all of these experiences were constructed in meaningful ways that directly related to the student, his/her experiences and identity. Whatever the task, the concept being worked on, or the knowledge being explored, the students had what we viewed to be the most profound engagements with these experiences when they were able to construct and reconstruct the knowledge to make sense in terms of themselves.

It is important to note two things here. One, we see learning as the process of constructing knowledge, broadly defined as the information, skills, and understandings that one acquires through experiences. Two, what we are identifying as highly engaged experiences and profound moments are from our research and educational perspectives. These are instances in which we viewed significant meaning making, a breakthrough, a change, a challenge, or an epiphany in the students' thinking. Moreover, these profound moments and engaged experiences where the students were using embodied thinking to construct and reconstruct knowledge were done in syntonic ways.

To clarify how we define knowledge, we focused on the knowledge related to dance and computer programming. With respect to the former, we are referring to technical movement skills, such as increased coordination and ability to recognize, replicate, and create dance sequences and patterns. In addition, artistic and aesthetic knowledge, such as kinesthetic awareness and abilities to execute and explore of dance elements (body, space, time, effort/shape) are included. For the latter, computational thinking knowledge, which, in its essence, is utilizing creativity to solve problems was the focus. Computational thinking includes concepts, practices, and perspectives. Concepts focus on what the student is learning, namely loops, sequences, conditional, operators, and aspects of logical reasoning skills, while practices include iterating, reusing, remixing, abstracting, modularizing, testing and debugging. Finally, perspectives are formed by students seeing computation as something that can be used for self-expression, the social aspects of engaging, equipping and educating others, and seeing a connection between technologies that surround them and their ability to negotiate the world.

Again, Piaget calls the merging of new knowledge with old knowledge, assimilation. In other words, this process is one of constructing knowledge as students are actively working on acquiring and transforming this knowledge (Papert, 1993). This process is simultaneously a re-construction of knowledge since students do not learn or live in a vacuum. This theory of knowledge construction assumes that any knowledge that they receive inevitably interacts with previous knowledge and experiences in their thinking.

Relating to the body: Students' body syntonic experiences

Perspectives of embodiment view cognition as "[depending] on the kinds of experiences from having a body with a particular and motor capacities that are inseparably linked and that together form the matrix within which memory, emotion, language, and all other aspects of life

are meshed" (Thelen et al 2001). Since the students were working with the medium of dance, the body was inevitably involved. Moreover, we chose to utilize dance as a means of engaging students in computing because of the opportunity of the body syntonic relationship of the students and the character in Alice. However, we noted that the range of body syntonic learning was varied and diverse. Students worked through various embodied strategies. One of the most common embodied thinking strategies was moving one's body to help build one's Alice character. Many of the students would actively move, either in their chairs at their computer (Figure 3) or would stand up to make sure they were composing their choreography correctly onto the character. It was not uncommon for one student in particular to gesture repeatedly as she was programming in order to remember the moves that she had choreographed in the dance session. Another student was having difficulty visualizing what body parts she needed to use to create a particular move and got up out of her chair to physically perform the move to problem solve.

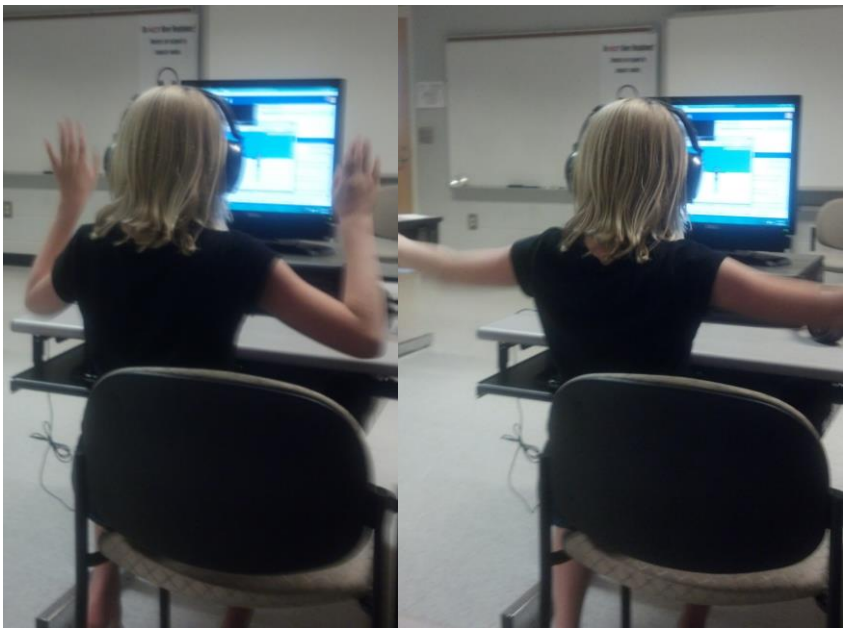


Figure 3. Student dancing to program in Alice. In both images a student is performing moves from her choreography to help her program her dance character.

Yet, we were surprised to find that not all the students needed to physically perform as they programmed, nor did they request or need someone else to physically model for them. Only when working during the dance portion of the session on physically moving and choreographing did these students require the instructor to model choreography, to repeat movements, or to dance with them to help them to remember dance vocabulary. When it came to computing, the students relied mostly on themselves to model physical moves. However, a couple of students remarked that it might have helped to watch someone perform their choreography in order to help them program the moves onto their character during the post-project interviews.

There were two instances in which students asked one of the instructors to demonstrate a move while they were computing. However, when asked later during the interviews if they had asked others to model moves with computing, the students did not mention these instances. Once, a student asked us how to perform a move from the Charleston that she wanted to use. Another student did not ask us to model a move but was struggling to remember in what direction he had choreographed a certain move to performed, and one of the instructors demonstrated his choreography so he could see it and then decide which direction to have the character turn.

That same student also did something unique from the rest of the students. While other students would revise their dance on the screen, tweaking their choreography as they programmed, this student programmed is character and then taught himself the choreography by playing the dance repeatedly. Thus, his embodied thinking took on a very different form. This student did choreograph an eight-count phrase like the others, but he struggled to replicate it in his body. He would create a move physically and then seemed to continually change it or forget what he had done when asked to repeat or demonstrate it. When it came time to program the

students' choreography, his did not have a complete phrase to work with. However, he took what he had and began to choreograph through programming the character. Therefore, his body syntonic thinking took on a very visual form first. It was as though he needed to see the choreography in order to physically learn it.

Several things may be going on in this instance. First, a strong correlation between observation and having physical knowledge of what is being observed aids in learning. Research in cognitive neurology has found a link in brain activity between learning a dance by doing and learning a dance by observing (Grafton & Cross, 2008). Moreover, research has shown that physical practice in dance, along with observation of a model performing the dance to be learned is more beneficial for the dancer's learning than physically performing it alone (Badets et al., 2006; Blandin et al., 1999; Grafton & Cross, 2008). Therefore, this student may have needed both the physical and visual knowledge in order to merge the two into a digital representational form. Also, this process of observing and physically doing may have been needed since the act of creating the dance was more of a kinesthetic and aesthetic experience and the act of programming involved more logical-mathematical skills since he was pieces commands together to create code. What they have in common are spatial-reasoning skills. And this student needed a strategy to convert his physical understanding of the body in space to the digital on-screen space.

In addition, some students were also using the "native" Alice methods, to create motions not in our dance vocabulary data bank. The motions typically created with these methods were not (typically) humanly possible (i.e., floating in the air and flipping upside down repeatedly). While these choices did not relate to the body as being a replication of the human body, they related to the students' imaginations, creative potential, and a desire to perform virtually in ways that they could not physically perform in person. Often the students would just play with the

character's capabilities, making her dance upside down or detaching her appendages for fun. Yet, all of the students ended up choreographing and programming possible human moves, with one exception.

One student, through the process of trying to program the character to step to the side, accidentally detached the character's legs. However, she realized that she liked the aesthetic of the move and asked if she could keep it in the dance. The instructor gave her the OK because this signaled a profound moment in which this student was taking creative license with her work and making an aesthetic decision; however, the instructor cautioned that when performing with the character that the audience might not know if this choice was intentional or not (Figure 4).

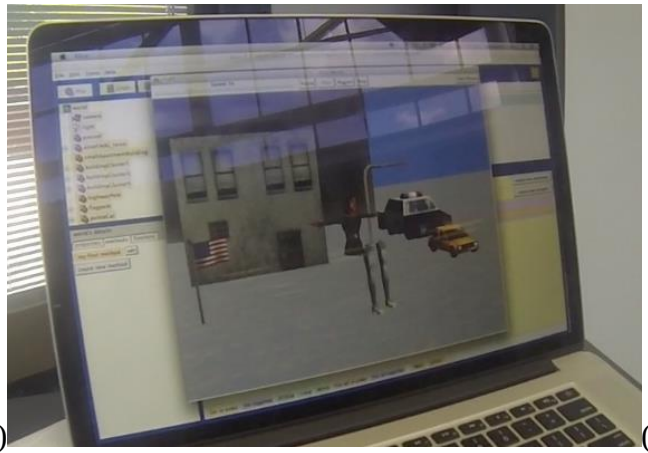
(a)  (b) 

Figure 4. Using humanly impossible moves. (a) Image of student's final Alice programming choreography where she detaches the character's legs. (b) Image of student practicing her snap and swing hips move with her Alice character.

Therefore, from a performance standpoint, she advised the student to make sure that when the student danced alongside the character, to make her choreography clearly coordinate or showcase the humanly impossible move so that she communicated visually to the audience that this was planned. The instructor gave a few suggestions, such as pausing to make a "Vanna White"-inspired gesture to highlight the detached legs, making them seem comical or doing a similarly silly movement physically alongside the detached legs so that the audience could cue

into the conscious choreographic choice. The student thought for a while and then said, “Ok, I have an idea!” A little while later, she had the brilliant idea to snap and swing her hips while her character’s legs detached on screen. During the performance, the audience immediately responded positively, laughing and “ooooh-ing and aaaah-ing” over her choreographic choice. While this example provides a different embodied experience, it demonstrates how the students related to the character in body syntonic ways and were able to creatively manipulate their character to reflect their understandings of how the human body works and can communicate in performative ways.

Relating to one’s self: Students’ ego syntonic experiences

We also noted that the students’ experiences during in the Dancing Alice Project often centered on a desire to make the Alice character look more like themselves or to replicate aspects of themselves within their choreography. Therefore, their individual projects were ego syntonic since they related to the students’ identity, desires, and interests. Most notably, the students immediately wanted to change the characteristics of the dancer to be male, to change her clothes, to change her ethnicity, and to change her body, often replicating their own identifying characteristics. Since we were only able to create one character in our platform, we made a specific choice to make her a woman of color dressed in contemporary clothing: jeans, tunic style shirt with synching belt at the waist, and colorful sneakers. We wanted the character to look familiar to the students, and since one of our future goals is to target young women of color and engage them in the field of computing, we did not want to privilege white students since they often are privileged visibly in the media.

However, interestingly, all the students asked if they could change something about her. Some wanted to change her hair or her clothes. A couple of the white students asked if they

could change her skin color, hinting that they wanted their character to look like them. Then our one male student wanted to change the character into a male. While they were unable to customize the character at this time, it would have been interesting to see what changes the students would have made if they had been given the option. Would they have continued to make similar choices, creating an avatar similar to himself or herself, so-to-speak or might have constructed a completely different character from themselves?

Either way, we made it clear that, at this point, since this was merely a pilot project, we were only able to make one character. This put an end to most of the discussion about changing the character, with one exception. Our lone male participant would occasionally talk about his desire to have a male character and also to have more males participating in the project. One day, he did something about this: he created an alter ego named Dr. Edward. We suspect the arrival of Dr. Edward had much to do with this student's desire for male camaraderie during the project and another male perspective. Interesting to note, was his choice to place "Dr." at the front, providing this character with an authoritative voice, in the same way that the instructors asked to be called our first names with Dr. in front. This student as Dr. Edward made a mustache and goatee and wore a hat and talked in a mature male voice about his thoughts for the program. Often times, talking nonsense, and other times, he would talk about what he would do differently in the program or would suggest making the character into a male. While this example does not directly relate to dance or computer programming, it relates as an ego syntonic example of his interactions. He creatively transformed himself to reflect his personal desires, maybe some insecurities, and to express himself in a way that he maybe felt he could not as himself. In some ways, it was as though he was taking control over the act of creating a character in a way that he could not within the program.

Another student was not confident in her dancing abilities, did not feel comfortable coming up with her own choreography, and had difficulty working individually on programming her character exhibited ego syntonic knowledge construction in her choice of dance. One of the instructors saw that she was struggling to come up with an idea for her dance and asked her what dances she has seen or done before. Immediately, this student remembered a Charleston-inspired dance that she had been taught by her teacher in school. Feeling confident about the moves since she had already knew them and practiced them in class; she decided to replicate that known choreography. She eventually realized that she had to alter the dance moves because the Alice character was not as flexible and graceful to perform the Charleston exactly; therefore, in the end, this student was able to make choreographic and programming decisions, exhibiting a true reconstruction of knowledge. Once she had the opportunity to work with something familiar, her demeanor changed to excitement and her willingness to participate increased. It is as though the ego syntonic choice made all the difference in her experience.

Relating culturally: Students' culturally syntonic experiences

In all of these instances, the students were making their experiences with the programming and choreography relevant to themselves, and they were establishing some sort of embodied relationship with the character that they recognized socially and culturally in order to understand and engage with it. Our choice to make the character appear as she did in contemporary clothes and to respond racially to a diverse audience of student participants were choices made within a culturally syntonic frame. The dance moves and choreography that we chose, along with the music that we used were also culturally syntonic to the students' lives. We began with a dance that they knew or had seen before, the Cha Cha Slide. We then based our dance session choreography after basic dance technique and contemporary and hip-hop dance

vocabulary, making it relevant to the students and their interests. Therefore, we focused our dance session on dance as an applied art: dance as a form of inquiry and exploration versus dance as a fine art form that privileges technical dance skill. While some students had prior dance training, dance in this instance was meant to engage all ability and technical levels. At the same time; however, we did emphasize the nurturing of dance compositional skills, assuming that to create a dance one does not necessarily need to be a proficient, technical dancer, that all can engage with the creative compositional process of dance choreography from a range of ability levels (Leonard & McShane-Hellenbrand, 2012). Likewise, the students responded in culturally syntonic ways, as well. Their dance moves reflected the dance vocabulary that we presented and also continued the contemporary and hip hop-inspired qualities. In addition, the students were able to choose their own music for their physical-virtual duet. They were given the option to choose music from our dance session playlist that included Stevie Wonder, Michael Jackson, Daft Punk, and the Black Eyed Peas. Some did choose to use this music, while others chose music of their own to reflect their own aesthetic tastes, but all choices were contemporary and pop culture-influenced, including Cold Play, Taylor Swift, Beyoncé, and Mariah Carey.

One student chose to choreograph to Taylor Swift and explained that this was a song that would be heard at a party and remarked, “They have parties in the city.” She thus chose to add elements to the background screen environment in which the Alice character performed that reflected a cityscape that one might see in a music video (Figure 4). She made a point to note that, while Taylor Swift usually sings country songs, this particular song that she chose was more of a pop song so she did not want the scene to look too “country.” The experience and how she was constructing knowledge became more meaningful when it was syntonic, related to her interests and cultural experience.

Speaking of timing: Private versus Public Performances

Since this was a pilot, we knew revisions to our strategy would be required. In our findings, there was a bit of an anomaly. Although all students highly ranked the activities on their surveys, and spoke very highly of the program during their interviews, of all of the participants, only one expressed interest on the written survey to participate again. There are a number of things that could have contributed to this including the fact that the program was during the last weeks of school (with the final program occurring on the very last day of school). While this may have had some impact, we wonder if the performance aspect of the project could have made students hesitant. During the final program, only four of the students were willing to

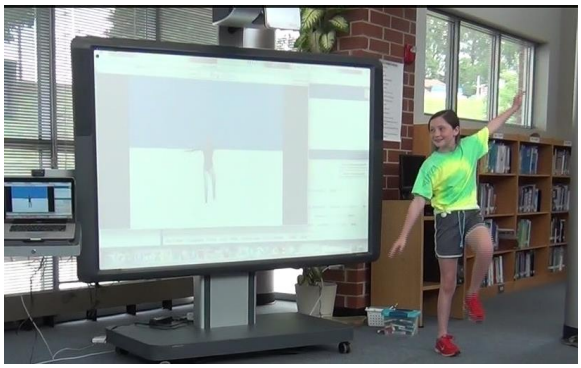


Figure 5. Image of student performing. This student is performing her choreography as her character's dance plays on the screen.

actually perform with the character (Figure 5). The rest preferred to stand next to the character and smile or point. Even though all of them had been willing to dance to create the character and practice with the character prior to this, the mood changed with an audience present. In the future, we may ask students to create the partner for a more experienced dancer or maybe even a professional dancer. They would still go through the process of learning that we have set forth; however, they may not have the same reservations about performing towards the end. There is truly a difference between using dance as a form of inquiry and dance as a form of performance.

They require different skill sets and have a very different focus. If performance is the goal, then more time and energy needs to be spent on the performance process of rehearsing and the act of performing. Alternatively, moving forward, we can focus mainly on dance and the choreographic process as a form of inquiry and a means to engage with programming a dancer.

Putting It Into Perspective: The Significance and Future of the Dancing Alice Project

> *[We need to work] at educating them broadly, at equipping them to use their visual acuity, design sensibility, and experience as makers to solve the problems—alone or in collaboration with others—that the next generation of creative professionals may be called on to solve. These will be complex problems that cross the boundaries of traditional disciplines, methodologies, and skill sets.*
>
> (Buffington, 2013)

Computational and creative thinking skills are valuable for understanding and problem solving in a wide range of contexts in and beyond the field of computer science and the arts and can support students in being competitive in the global innovation economy. By opening up pathways for entry through the arts, we work to ensure that students can participate and explore in sophisticated, creative, and higher order thinking projects that introduce them to computing fields. Here, dance opens up pathways for students who might not typically be interested in computing, allowing for interdisciplinary, embodied engagement, broadening their perspectives on dance and computing.

This pilot research project provides the foundation for a larger research study geared towards promoting and examining the use of grounded embodied pedagogy as a way of building computational thinking in a virtual environment with girls. In the next phase of our research, entitled, Dancing in Virtual Environments (DIVE), we will pioneer the design, development, and testing of a virtual environment and associated curriculum for blending dance and programming

as a novel and embodied way to engage 5th and 6th grade girls with computational thinking. Specifically, we aim to:

1. Develop a desktop-based virtual environment in which students must program a 3-dimensional character that they can later perform with. This environment builds on previous successes of similar programming environments but did not utilize grounded embodied pedagogy.
2. Conduct iterative design experiments to answer the following research questions: How does an embodiment-centered curriculum support the development of computational thinking? How does an embodiment-centered curriculum support interest in STEAM (science, technology, engineering, arts, mathematics) fields?
3. Capitalize on the results of these experiments to iteratively refine the virtual environment and curricular materials.

Throughout this ongoing and longitudinal project, we plan to develop and assess curricular interventions that can contribute to our knowledge of effective teaching and learning of computing for girls. During Phase I, we completed our initial pilot study, the Dancing Alice Project. Knowing the limitations of Alice, we seek to design a more realistic and dynamic platform. Using the data findings from the pilot, we are now beginning the design and development of our unique virtual platform. This newly designed platform will enable users to create choreography based on previously motion captured dance clips, using a 14-camera Vicon optical motion capture system that allows us to accurately record the subtleties of a dancer's movements. Based on the motions of small markers attached to the dancer's body, we compute the associated joint rotations and transfer the results to a virtual character. These characters will then be utilized in our virtual environment and will be adaptable characters that the users can

design in terms of appearance, sex, and aesthetics, knowing that this was an important desire of our pilot participants.

This research is timely in our creative, digital, computing age, and also provides innovative research possibilities for how we can study how we teach our students and how students can learn and engage in sophisticated and embodied ways. In presenting this project and our initial findings, we advocate for more meaningful and effective tools for learning in schools that appropriately and innovatively respond to the reality and inevitability of our digital, virtual age. We believe that learning should be syntonic in the form of simulations and representations of the world in which students live and within which they construct their realities and can apply knowledge versus simply being given disassociated strategies that do not make knowledge relevant (Shaffer, 2006). Thus, what could be more relevant that working with one's most valuable tool: one's body? While students engage in a variety of socially accepted bodily practices outside of school and in their home communities in dance, athletics, and music, the body is often absent, ignored, or taught to be silenced in schools. Often only valued for its cognitive development potential for young students, dance seems to disappear after kindergarten and early elementary grade school (Dils, 2007). However, dance has tremendous pedagogical, emotional, cognitive, social, artistic, cultural, and kinesthetic power in teaching and learning (Leonard & McShane-Hellenbrand, 2012; Hanna, 2008, Gadsen, 2009). This work seeks to build on that potential and to utilize its power in education to promote and inspire unique and syntonically integrated learning simulations, expanding students' artistic and creative experiences in meaningful and embodied ways in school. In addition, sharing this work in the inaugural issue of *Voke* also communicates that the art education world is diverse and continually needs to be pushed in terms of its inter- and trans-disciplinary potential and connections. We see

this world as plural and responsive to multiple arts forms that inform the visual, including dance.

We move to think, and we move our thinking to expand our learning possibilities.

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