

Research Article

Developing visual-spatial thinking in youth using sensorimotor experiences: Approaches from a Piagetian cognitive framework

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Shaping OurSpace was an urban planning project asking children to propose plans for a housing project phased for redevelopment. Our primary aim was building visual-spatial thinking. McCormack's (1988, 2011) hierarchical framework was used to operationalize visual-spatial thinking, and we believe that embodied cognition served as a vehicle for fostering visual-spatial thinking not only in rudimentary ways but also more conceptually. Thus, although our study did not depend on Piaget and Inhelder's (1956) developmental approach to spatial reasoning, their work provides theoretical insight that supports assumptions underlying our work. We highlight two areas of connection between Piaget and Inhelder's theory on spatial reasoning development and our methodology across the 2 phases of our project: 1) Piaget and Inhelder privilege sensorimotor experiences as the bases for spatial reasoning, and 2) Piaget and Inhelder argue that spatial reasoning occurs in 2 phases – via perception and via imagination and thought. We argue that Piaget and Inhelder's arguments about spatial reasoning remain decidedly relevant in understanding how to potentially facilitate this reasoning in children.

Keywords: Embodied cognition; Piagetian cognitive framework; Visual-spatial thinking; Spatial reasoning; Sensorimotor experiences

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1. Introduction

Shaping OurSpace was an interdisciplinary approach using urban geography geospatial activities and theatre. The program occurred over two phases-1) a 6-week summer program through Girls, Inc. located in the housing project and 2) an 8-week after-school program at a local elementary school near the housing community. Phase one included elementary and middle school aged girls completing urban planning geographical tasks and theatre activities. During phase two, elementary aged children from a local elementary school in close proximity to the housing project completed a theatrical performance to facilitate urban planning. We aimed to use this youth-centered community-planning project to leverage visual-spatial reasoning through embodied activities.

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Visual-spatial thinking is accomplished when one uses logical and creative mental processes to develop mental pictures or images for the purposes of solving problems, creating novel ideas, enhancing physical skills or pacifying tumultuous emotional states (McCormack, 2011). It is also hierarchical and builds from concrete to more abstract ways of thinking as delineated by four constructs. The first level is visual-spatial perception thinking and is characterized by the ability to create a mental bridge between real objects and drawings, photographs, or media images that represent the objects. The next two constructs build upon this first level and are characterized by the ability to memorize objects from mental images, visualize incomplete objects, and rotate dimensional objects. The final construct, creative visual-spatial thinking is the ability to create and imagine fantasy and alternate realities and process multiple mental images and perspectives at the same time (McCormack, 2011). The purpose of this study was to examine the facilitative role of embodied pedagogy for fostering visual-spatial thinking.

1.1. Embodied Cognition

Embodiment emphasizes the role of the body as integral to meaning-making not only in childhood but across the life span (Marshall, 2016). As such, sensorimotor experiences that are acquired through our bodily experiences and interactions with our surroundings are necessary for knowledge construction (Wellsby & Pexman, 2014). This notion is more broadly conceptualized as embodied cognition and can occur through kinesthetic or empathetic ways of thought. Kinesthetic thinking occurs through one's physical interactions within the space. Empathetic thinking is grounded in sensorimotor experiences allowing one to imagine him/herself in another's position (Henriksen, Good, Mishra, & the Deep Play Research Group, 2015).

Piaget was one of the first to argue for the centrality of the body to cognition (Marshall, 2016) and sought to show that cognition was "made (emphasis theirs) out of noncognitive processes" (Smith & Sheya, 2010, p. 2). Sensorimotor experiences serve as the basis for thinking because they support mental/symbolic representations of space. Piaget and Inhelder (1956) showed that a child's ability to visualize an object is dependent on internalizing tactile-kinesthetic experiences with the object. Movement, the senses, and perception are interconnected and this integration informs symbolic representations (Piaget & Inhelder, 1956). Smith and Sheya likewise argue that the sensorimotor system, of which action is a part, is complex and made up of subsystems that interconnect and dynamically interact as the "engine" of cognition, supporting higher-order abstract thinking.

Sensorimotor experiences are also central to the conception and awareness of space and the ability to manipulate objects for everyday and advanced spatial tasks. According to Piaget and Inhelder (1956), the development of spatial awareness relies on perceptual activities and imagination and thought. Perceptual activities are the actions that result in the definition of space. These physical actions give objects existence and location as they are manipulated, held, and observed. For example, Piaget and Inhelder (1956) describe haptic perception as a perceptual activity. Haptic perception is the ability to perceive objects by touch alone without a visual stimulus. As such, it allows for the transfer of tactile information into visual imagery (Concannon, 1970, p. 250) and is a gateway to imagination and thought. Not all objects can be perceived through direct sensorimotor experiences. Imagination and thought are needed to acquire knowledge from the unseen. In this way, imagination and thought "complete perceptual knowledge through references to objects not actually perceived" (p. 250). In sum, extractions are possible because of interactions with the tangible.

Embodied cognition further reaches out beyond the body to capture our social interactions (Teske, 2013; Marshall, 2016). Phenomenologists exploring empathy argue that empathy is intimately tied to embodiment. One theory addressing this connection indicates that empathy is immediate and based on "direct experiential access" (Gangopadhyay, 2014). Empathy is a way of knowing, with Ingerslev (2014) arguing that our bodies are "expressive units" that are immediately perceived and understood. We grow to understand others because embodied

cognition is situated within family relations, friendships, and other types of relationships with others – our innate abilities are coupled with a predisposition to learn to read specific cues. This capacity grows due to brushes with emotional contagion, theory of mind, and other social psychological processes (De Bruin, Strijbos, & Slors, 2014). Ingerslev argues that our innate ability and predisposition to empathize is due to our capacity (rather than the act) to pretend.

A second argument is that empathy is the product of being able to mirror the bodily experiences of another. In this case, the pathway to empathy is simulation or “enactive imagination” (Gangopadhyay, 2014). Slaby (2014) notes that empathy based on simulation does not account for the agency of the person one is trying to sit in the shoes of. Simulation, no matter how well intentioned, will require the person to reference themselves. Thus, the nature of one’s body limits the capacity to place one’s self in another’s shoes. So, our imagination must also be built with information about the person (or people) with whom we are seeking to understand (Mackenzie, & Scully, 2007).

Experimental studies offer some support for these arguments about empathy by showing how our motor system influences our capacity to empathize. For example, researchers exploring the mirror neuron system have shown that motor reaction for persons’ observing a painful experience in another’s hand (a pinprick) was more pronounced the more it seemed as if the painful experience occurred in peripersonal space (Mahayana, et al, 2014). Motor activity and empathy potentially commingle in perspective taking, with motor activity (i.e., observing another’s actions) potentially leading to cognitive (vs. emotional) empathy (Milston, Vanman, & Cunnington, 2012). Cummins, Piek and Dych (2005) showed that struggles in visual spatial processing and concomitant motor ability (i.e., developmental coordination disorder) indirectly impacts children’s capacity to socialize and empathize with others. In other words, children that struggle to play games or sports with others struggle to socialize with others, potentially because of diminished esteem and feelings of competence and struggles in decoding interpersonal cues.

1.2. Embodied Pedagogy

Building on these ideas, embodied pedagogy preferences the body and sensorimotor experiences as a mechanism for learning. In doing so, it accounts for knowledge gained through tangible experiences and interactions with objects as well as intangible experiences grounded in imagination and thought. Merleau-Ponty acknowledged that the body is “a lived experience structure in addition to a context for cognitive mechanisms” (Merleau Ponty, 1956 as cited in Francesconi & Tarozzi, 2012, p. 268). Some theorize that embodied pedagogy combines embodied teaching and learning (Dixon & Senior, 2011), highlighting the relational dynamic between the teacher and learner. As such, the interaction between teacher and student relies on an embodied experience. This experience is foremost grounded in our physical commonality- “we are all bodies” (Perry & Medina, 2011, p. 63). Further it is through the body that we relate to the world (Ellsworth, 2005). This body-centric perspective transfers to the teaching and learning dynamic. Estola and Elbaz-Luwisch (2003) recognize the teachers’ physical body, the physical work of teaching, and the duality of bodily perceptions between teachers and students. Further, teachers and students are “body conscious” (Probyn, 2004). The teacher-student relationship relies on the interpretation of body language and the messages and meaning embedded within these body interactions. As such, body language acts as a discursive practice in which the body speaks what the mouth does not (Moje, 2000).

In addition to ideas around the physicality of embodied teaching and learning, perceptions, emotions, and lived experiences are equally important (Ponty, 1968). The “affective encounters between bodies gives a shape to the pedagogical moment” (Dixon & Senior, 2011, p. 476). Further, “our bodies, feelings, relationships, and histories are pedagogical material...used in the processes of teaching and learning” (Dixon & Senior, p. 477). When considering physical and affective attributes of embodied pedagogy, Dixon and Senior demonstrate how both are realized within the teaching-learning dynamic. They also articulate how the role of self and other is critical to this

dynamic. The body “extends” in space, beyond the boundaries of the body, such that “connections are felt and seen by others” (p. 482). As such, recognition is given to the “embodied nature of pedagogy” (p. 483). In particular, bodily interactions (both physical and affective) between students and teachers are central for teaching and learning.

Interventions oriented within a body/world framework for learning is often utilized in education, however, interventions “acknowledging...the ability of the body to influence cognitions are few and far between” (Leitan & Chaffey, 2014, p. 7). While research acknowledges that embodied pedagogy is foremost grounded in the bodily interactions between teachers and students in educational spaces, embodied activities can also act as a scaffold for learning. And in contraposition to Piaget, early theorists assert that direct practice and training in perceptual tasks facilitates children’s perception (Gibson & Gibson, 1955; Zaporozhets, 1965).

1.3. Current Study

Our study did not depend on Piaget and Inhelder’s (1956) developmental approach to spatial reasoning. However, their work provides theoretical insight that supports assumptions underlying our work, namely that spatial reasoning can be facilitated through embodied pedagogy. Shaping OurSpace was developed for children that were familiar with the housing community phased for redevelopment. We wanted to help them feel connected to the changes being planned and to reimagine the new community, with this reimagination potentially informing the Housing Authority’s plans for redevelopment. Two approaches for building connection were used: neighborhood planning tasks were used to reimagine a new space and oral history interviews with community members of the housing community were used as the basis for a theatrical performance about the coming change.

2. Method

2.1. Research Design

We relied on the qualitative paradigm to examine how embodied activities aimed to scaffold visual-spatial thinking in the Shaping OurSpace program. Specifically, the role of interpretivism guided the way in which the work of Piaget and Inhelder (1956) was interpreted and applied to the data (Clark & Vealé, 2018). Interpretivism prioritizes the role of subjective perception and considers the experiences of researchers and their influence on the research process.

2.2. Setting

The Housing Authority of a mid-size southern city is preparing to demolish and rebuild a low-income housing complex into a mixed use and mixed income development. The new development would entail relocating current residents during reconstruction, with a percentage of these residents being able to return to the site in its new incarnation. Shaping OurSpace was a year-long interdisciplinary program that combined theatre and geographical tasks to facilitate student involvement in reimagining what this new community could look like. The program worked with two groups of students - 1) students participating in a Girls Inc. summer program (2012) located on the grounds of the housing complex and 2) students attending an elementary school approximately two miles from the housing complex in Spring 2013. In both groups were students who were very familiar with the housing community (either because they lived there or had friends and family that lived there) as well as students not as familiar. Students in the summer participated in six weeks of tasks and met for two hours once a week for 6 weeks. Students in the spring participated in a fine-arts after-school program and self-selected into Shaping OurSpace. We met for one hour once a week from January to March.

2.3. Shaping OurSpace Program

We sought to use the redevelopment of the BTW area as an “in context” basis for developing spatial reasoning tasks. The tasks for the Shaping OurSpace program were intended to help the

children feel connected to the changes being planned for the BTW and to reimagine the community. For the children participating in the summer camp, community planning included theatre (these tasks are described in the course of explaining the progression of the spring program) and geography activities. During this phase, the primary activity focused on geographical tasks rooted in movement within and around the housing community. The children in the program played under a prominent shade tree, walked the community and noted likes and dislikes, and annotated Google Earth images. They also produced individual cognitive, or mental, maps of their neighborhood; drew individual two-dimensional pictures of the BTW area; and engaged in group discussion of what makes a good neighborhood. The culminating activities for the summer camp children were development of three-dimensional plans using Legos, with Legos placed on Google Earth images of the BTW area and the presentation of several of these community redevelopment plans for a member from the Housing Authority.

The children participating in the spring program completed neighborhood planning tasks like annotating google maps and developing cognitive maps of their neighborhoods. However, the primary activity was a theatrical performance. To prepare for the performance, students in the spring program assisted in the development of and completed interviews with members from the BTW housing community about their experiences in their homes. These oral histories were transcribed and woven together into a script. The theatre educator took special care to have students say the words of the people they interviewed.

Students prepared for this play through theatre games and rehearsal of the play. Spatially-related theatrical games informed by Viola Spolin (1999) and Augusto Boal (1979) prepared the students for performance and were interwoven into blocking for the play. For example, in concentration games, students passed nonsense phrases, sounds, and/or motions randomly around the circle. The objective was to maintain focus, timing, and the correct phrase/order while passing energy from person to person. In spatial awareness games, students created scenes using every-day classroom objects to better explore the ways in which spatial relationships impact how we view an object. For example, in the game "Power of the Chair," students situated chairs in ways that showed power relationships. For example, one formation included forming a circle, with several chairs encircling a chair in the center, with the outside circle of chairs pointed at the central chair. In a second game students "Completed the Image" by joining a peer who had struck a pose by connecting to the pose (taking the hand of the student) and flowing into a pose that built around the starting pose. The play was performed before an audience of their peers, parents, and members from the Housing Authority.

2.4. Participants

While students participated in the embodied activities through the Shaping OurSpace program, this article focuses on the perceptions of the instructors leading the endeavor and their decisions that aimed to foster visual-spatial thinking through embodied activities. As such, the participants included the theatre and geography university faculty who developed and facilitated the program. At the time of the study, the theatre professor (Dr. Brent) had been a faculty member for six years and the geography professor (Dr. Rowland)¹ had been a faculty member for seven years. Both are Caucasian females living and working within a 10-mile radius of the housing community.

2.5. Data Collection

The data included semi-structured interviews with the theatre and geography professors facilitating the program and transcripts from recordings of the theatre professor during the play rehearsal. The interviews lasted approximately one-hour and were later transcribed. The interview data included questions that asked how the professors envisioned and planned activities in ways that connected space, the body, and the discipline (i.e., geography or theatre) as well as the intentionality of eliciting visual-spatial thinking through the embodied activities. Prior to data collection, the study was approved by the Institutional Review Board.

2.6. Data Analysis

This study was situated within a naturalistic, interpretive stance with the primary goal of understanding the meaning placed on phenomena (Lincoln & Denzin, 1994). In this case, we sought to understand the planning and application of embodied activities for an urban redevelopment project that aimed to foster visual-spatial thinking in children. According to Crabtree and Miller (1992), qualitative data analysis falls along a continuum from pre-figure technical analysis to emergent intuitive analysis. The former is a “tightly structured” approach where categories are determined prior to data collection. The latter is much less structured and relies on the researchers’ “interpretive and intuitive capacities.” Along the continuum is template analysis. Here, the researcher applies predetermined codes to the data, but these codes can be added to or changed during the analysis process. This research relied on template analysis such that codes were determined based on prior research in addition to emerging from the data.

First, we searched the corpus of data to determine how the embodied tasks served as perceptual activities that aimed to foster imagination and thought (Piaget & Inhelder, 1956). This pre-determined theme was further examined to understand the nuanced role that the activities played to foster imagination and thought for different types of tasks (geography and theatre).

For the geography tasks, the roles included *sensorimotor experiences* and *scaffolds*. Emergent codes were determined to capture the types of activities used to scaffold learning or engage students in sensorimotor experience for the purpose of engaging imagination and thought. Imagination and thought were scaffolded using *questioning* and *group interaction*. Further, sensorimotor experiences included *primary* and *secondary activities* that were either tangible with the purpose of informing/correcting perception (primary) or dependent (secondary) on the primary activities to engage students in less tangible, but applied opportunities to engage imagination and thought (See Table 1).

For the theatre tasks, *sensorimotor experiences* acted as scaffolds with the goal of supporting imagination and thought. The emergent codes included primary and secondary activities. Similar to the *primary* geography tasks, tangible activities were coded. These tasks aimed to build perceptions about the feelings of the community residents experiencing the change in their neighborhood. The *secondary* activities, served to help the children embody the feelings and experiences of the affected community in order to reflect those thoughts and images to an audience during the culminating play.

The semi-structured interviews were transcribed, and then the researchers applied descriptive coding and in vivo coding (Saldaña, 2009) while reading the interview data and field observation notes. During the data analysis, the researchers noted specific reasons as to whether students were either satisfied or not satisfied with the flipped classroom model. To identify the possible reasons, each student’s interview data, open-ended answers, and common themes across the data were compared. Peer reviews occurred when the data and themes were shared with other graduate researchers.

2.6.1. Trustworthiness

According to Shenton, (2004) trustworthiness aims to establish “qualitative validity.” One component of trustworthiness is credibility. Similar to internal validity for the quantitative research paradigm, credibility addresses the congruency of the findings with respect to reality. While there are several approaches for establishing credibility, the researchers relied on a collaborative approach to coding to make determinations regarding the meaning and interpretation of the findings. As such, codes were discussed and revised until consensus was reached. In this way, the researchers used inter-coder agreement throughout the process to maintain credible findings (Creswell & Plano-Clark, 2011; Saldaña, 2016).

Table 1.

Table of Codes and Themes for the Geography and Theatre Activities

Primary Theme	Code	Sub-Code
Perceptual Activities	Sensorimotor Experiences	Primary Activities
		Secondary Activities
	Scaffolds *	Questioning *
		Group Interaction*
	Grounding**	Games to promote empowerment/teamwork**
		Performance drill**

Note: *These codes apply only to the geography activities. **These codes only apply to the theatre activities

3. Results

We would like to highlight two areas of connection between Piaget and Inhelder's (1956) theory on spatial reasoning development and our pedagogy across the 2 phases of our project: 1) they privilege sensorimotor experiences as the bases for spatial reasoning, and 2) they argue that spatial reasoning occurs in 2 phases – via perception and via imagination and thought.

3.1. Geography Tasks

The geography embodied activities were guided by two approaches for using imagination and thought. These activities were more self-focused and concrete, meaning that the students were asked to engage in tangible activities that intended to build to more abstract ways of thinking about the neighborhood space. The culminating activity for the geography embodied exercises was a reimagined neighborhood using Google images and Legos and a presentation to a representative from the Housing Authority. In order to evolve towards this culminating activity, the professors relied on scaffolding and sensorimotor experiences to engage students' use of imagination and thought for the spatial task of creating the neighborhood plan.

3.1.1. Scaffolding

The teachers in the program scaffolded student thinking through questioning and group interactions, using questioning and group interactions to inform or correct students' perceptions about their neighborhood. The use of questioning and group interactions played an essential role for helping students to reimagine the BTW housing community, so we consider these scaffolds perceptual activity tasks.

Questioning. Throughout the program, the geography professor helped students process their understanding of the neighborhood and surrounding community through questioning. For example, the professor asked students to think about their city as they walked around their neighborhood and made annotations to the Google map. Dr. Rowland explained,

"The conversation we were working towards is what would be a really good neighborhood, or how would we like to see this neighborhood if we were imagining that way. So, developing an understanding of their sense of the city by saying, "Okay, what are important landmarks?" and then getting them to annotate on the Google map, "What do you like?"

Questioning students to think about their likes and dislikes of their neighborhood transferred to the culminating activity. Dr. Rowland described, "I was just asking them to think about their own spaces and what they did and didn't do and what they liked about it and what they didn't like." "You know, several of the girls did not like dogs that were unattended. Then when we were talking about space in the Lego project, I would say, "Well, what about dogs? What should we do about that?" I was just trying to just reflect back what they said."

According to Bruner (1986) and Vygotsky (1978), discourse between students and teachers scaffold student learning. Further, when teachers question beyond a triadic approach (e.g., closed ended initiation question to gauge knowledge, low cognitive level student response, and teacher assessment of learning), meaning-making is facilitated. While the triadic approach may have a purpose as an initial scaffold, Wells (1993) proposed the notion of guiding students' development of ideas and concepts by building on their responses. In this example, Dr. Rowland used questioning as building blocks. She described, "You are scaffolding cuz (because) you are asking people to think about their neighborhoods, to think critically about their neighborhoods, and then think about the neighborhoods they'd like to see." As such, she drew upon the girls' lived experience in their neighborhood and sought to help them think more deeply about their experiences in order to formulate solutions that might aid in the redevelopment of the neighborhood space.

Group Interaction. Group interaction was also important for scaffolding learning and helping students to plan the new neighborhood. Throughout the program, students worked together to discuss and complete tasks. In the culminating activity, students worked in heterogeneous groups of varying ages and re-envisioned their community. Dr. Rowland stated, "We were also creating a sense of the girls working together as like a microcosm, right? That did work really nicely I think in that last day. [W]e thought together about the three blocks and then we broke it down and then we came back together and drew it." She further acknowledged, "[W]hen I saw them working together, they worked in group of threes for that, I had—from that, I had a much better sense of what they understood about their neighborhoods, how extensive their understanding was..."

While working in groups seemed meaningful, Dr. Rowland also acknowledged that working together did not mean that every student was able to make sense of the neighborhood space. Further, not every student was able to participate fully, but she believed that the experience was still meaningful. She stated, "Although some people didn't get everything, their ideas and the way they worked together because there was enough of that team interaction, it was really—it was good."

In addition to scaffolds used to support the students spatial reasoning about the BTW neighborhood, sensorimotor experiences also served to engage imagination and thought. The geography activities included primary and secondary sensorimotor experiences as perceptual activities, with primary experiences supporting and being informed by secondary experiences. Primary sensorimotor experiences were tangible activities that aimed to inform and correct perceptions and included walking in the neighborhood and students' prior experiences in the BTW area. In addition, the girls had general experiences with home, play, and safety that also served as a tangible experience that they could support imagination and thought.

3.1.2. Primary Activities

Walking the neighborhood helped to shape and refine students' understanding about the familiar community space. In this example of a primary activity, we see that the Geography teacher, Dr. Rowland led the girls in a walk around their neighborhood. This walk was a tangible sensorimotor experience that helped the girls become more aware of the space. Dr. Rowland recognized it as such. In this statement, she discussed how the walk around the neighborhood was beneficial for helping the girls to identify places on the Google map and identify them as spaces that they liked or didn't like. She shared, "Yeah. I understood that there were some shared likes and dislikes from that, and then we could sort of move into, "All right, what are the things that you really like about this neighborhood?" That was also our walk too, and that shaped things somewhat cuz we talked about—we walked by the library, we walked by the old school building. Almost all of the kids—we spent a little bit of time talking about that...what its history was."

The girls also applied their prior experiences with the neighborhood, their associated feelings and the physical interaction with the space to the reimagined community. One of the spaces that the girls enjoyed was a tree near the Girls' Inc. community building. The girls talked, wrote, and

drew pictures about the tree. Dr. Rowland recalled, "I mean the specificity of that place was amazing.... I didn't realize until looking back at their images and sitting there every afternoon just... how important that enormous tree was that they played under. It didn't really strike me till I started seeing it in the images...and then shade becomes incredibly important when they can plan that complete three blocks. They look to those trees; they planned...the child's play space under those trees."

In addition to the girls' tree play space, their general experiences with playing in parks transferred to the reimagined community. Dr. Rowland shared, "It was great to see how, although they might live in one neighborhood, that they had some—you know, a decent understanding of other spaces. When we finally came to the plan and working on the plan, that they were bringing some of the ideas that they've seen in these other spaces, especially ----- Park. I think—I thought it was pretty remarkable how a number of the ideas that they must've picked up and understood about that park were coming into the neighborhood."

These tangible primary activities aimed to provide opportunities for the girls to use their lived experiences to foster a more in-depth sense of the space around them. In doing so, they engaged in perceptual tasks that were grounded in purposeful embodied activities.

3.1. Theatre Tasks

In contrast to the geography embodied tasks, wherein the planning exercises may have served to support empathy, preparation for the play required students engage empathy from the outset, as the children were encouraged to understand the mind of another (Gangopadhyay, 2014) or to proverbially walk in the shoes of another (De Bruin, et al., 2014) and to not lean as heavily on the self as a referent. The primary activities were sensorimotor experiences that were more abstract and intended to scaffold developing connection to world of the play, with sensorimotor experiences encompassing the text and the transitions, or blocking, of the play. Importantly then, the students in the play carried out the oral history interviews that served as the words of the play. The theatre professor made sure to give students words they themselves said or words of members of community members that they had interviewed.

Secondary activities supported the primary activities, in particular, embodying the text of the play. Imagination and thought as pretending (Ingerslev, 2014) served as the basis for understanding the feelings of people that would be subject to the change in the neighborhood. Performers of all sorts are convincing to the degree they are connected to the world they are creating, so performance is more than the recitation of words. Instead, performance involves capturing mindset and emotion, with a performer coached to find the emotion within themselves. To do this effectively, a performer must overcome nerves, unpack the meaning behind the words, and be comfortable in their own skin. One type of sensorimotor experiences was "grounding," or connecting students to the world they were creating within the play. Grounding is "a very physical thing....a lot of times, students, when they approach a play, it's just about how you say the lines....[I]t's hard to get students to connect words to their bodies. I think it's because we spend so much time on intellectual ideas, and then kinesthetic things are separate. We don't put them together. So we've got this really weird mind/body split thing going on that students, they don't really think about words and emotions as being in their bodies. ...So that's why grounding becomes really important, being connected to the environment that you're in"

The students were asked to give voice to feelings that could be attached to change occurring, with emotions encompassing hopefulness, fear due to displacement, disorientation, caution, and potential frustration/powerlessness, as the redevelopment was not really the choice of the members of the community. Sensorimotor experiences, as grounding, scaffolded the ability to imagine someone else's feelings about the outcomes of neighborhood redevelopment, particularly when one is subject to the redevelopment plans constructed by others.

Grounding occurred in 2 ways: through games that encouraged a sense of empowerment and through performance drill. Theatre games were important sensorimotor experiences because they

served to center the students in their bodies. Empowerment, as a sensory experience, was a precondition for performance drill. Preparing for a performance before others can be both stressful as well as tedious, and students have to want to be there. The students were also encouraged to begin to develop a sense of the images being created for an audience in the course of performing for an audience. So, the young actors must be empowered to listen to themselves and to "own" the stage. Likewise, teamwork as a foundation for performance cannot occur without buy-in of the performer:

We expected them to have attention, to give attention to things, to be focused when it was time to focus. That became sort of their ethic. Then, also, there was a lot of – I think we asked them what they thought needed to happen. So because they were part of, not just creating things every step of the way, but also responding to it critically, like what do we need to do better or what's missing or that sort of thing. I'll never forget when A-----said, "Love." She's like, "There's no love."

I was like, that is not what I expected you to say, but I am so gonna go with that because that's really sort of really – it's coming from a very intuitive place. I'm not even sure I know what she meant by that, but we used that from then on. I think that that was a way of validating their role and validating how they saw themselves. At least, that was the intention. I never really wanted to, if they brought something up, I never wanted to say, well, no. I wanted to somehow incorporate it into what we were doing so they felt like I had contributed to this. I am cool [laughs]. You know? I think they did. I think that that was – I think that's partly why they had such ownership.

Here students were asked to use imaginary cars as transition to another scene. Notice the teacher's encouragement to the students to decenter themselves and see the performance as an audience member might:

Teacher 1:We have a transition. Get to your car quickly. We're taking our cars to our places, right?

Teacher 1: Look at your semicircle. A-----, can you bring that one in just a little bit more? This one needs to go out just a little bit more. Awesome. Perfect. Then where are you? Good. Remember, no sound. Good job. Who starts us off?

Repeating a performance multiple times, or performance drill, were important sensorimotor experiences because this practice helped students feel comfortable by calming nerves. Performance drill also facilitated problem solving, with problem solving encompassing reflecting on the performance to make corrections to better embody characters of the play:

Teacher 1: Alright, we're gonna do this one again. The reason I wanna do it again is I want us to go back to the Columbian hypnosis. There's been something in here that I've been thinking about for a couple times that we've been doing it. You know how sometimes when you have one line, like – I dunno – it's rough over there. It's a really short line. I wonder how you would feel if, instead of walking all the way down front, if you just stood up and said it. You just stood up and said, "It's rough over there," and then sat down. There are a few places where that could happen, maybe even the library line. You could just stand and say it, except say it to the audience instead of saying it to A---- and T-----. Does that make sense? Do you know why I'm asking you to do that? Do you have any ideas why I might be asking?

We also like this excerpt because it manifests the professionalism of the preparation for the play. The students were held to similar standards of excellence as older students the theatre teacher directed. The environment was playful but also serious, with the students understanding they were charged with the important task of making this performance the best they could. They were routinely involved in performing and problem solving, and students grew in their willingness to own the stage and thus their performance. And even in play, there was purpose,

with theatre games utilized to not only help the students stay grounded in the performance but also model sensory experiences that they should carry with them into performance.

4. Discussion

In this study, differential sensori-experiences across the two phases of this project potentially informed the children's imagination about what the housing community was and what it could be. Relatedly then, sensorimotor experiences may have served as the linchpin between "that which signifies and that which is signified". According to Piaget and Inhelder (1956), one's ability to visualize an object is dependent on internalizing tactile-kinesthetic experiences with the object. Differential sensori-experiences potentially informed the children's imagination about what the housing community was and what it could be.

With the first group of children, the perception of the housing community was likely informed by the tactile, concrete experiences of the geographic tasks. The students were building to the complex spatial task of neighborhood planning through scaffolding and sensorimotor experiences that were aimed at helping them understand the space they were planning. As such, the target of imagining (re-presentation) was for the neighborhood plan (outcome). Perceptual activities were grounded in the self or self-centered, and the students were encouraged to "extend out" to imagine how people could live in this space. They had to take on the perspective of people who would live in the neighborhood as they designed the new space.

For the second group of children, a symbolic space created via a theatrical performance potentially informed perception of the housing community. Students were engaged in re-presenting the feelings of the people subject to redevelopment, with the fodder for this re-presentation comprised of the world created by the interviewees and the symbolic spaces created via the play. Perceptual activities were largely abstract, with "grounding" necessary to help the students stay connected to their bodies as well as the purpose of their work, and the children were asked to decenter themselves to be better understand and reflect the feelings of those subject to displacement.

Consequently, access to empathy might have differed based on the nature of the sensori-experiences. We feel the children in the summer might have accessed empathy via the physicality of the geographical tasks the children completed. Shum (2014) contends that our corporality coupled with movement revealing alternate facets of the same object allows for our ability to imagine the world as experienced by another. One knows there is physicality beyond one's sight because, when we, say, move from the front of a building to the back, we know at the back we are not seeing the front and vice versa. We do not have to engage this thought experiment every time we try to believe in something we cannot see because we have physically engaged in the act of moving and seeing a different facet at each place of movement. So, our imagination is prerequisite to understanding that there is a unique experience to the "Other" just as there is a unique experience to the self. Understanding oneself because there is an "other" allows us to see that we all inherently interrelated. Reality is thus co-created, with empathy serving as the pathway to that co-created reality

The children in the spring might have accessed empathy via pretense about the feelings of people who would be most impacted by the planned neighborhood change. Ingerslev (2014) argues that empathy is based on our capacity to pretend, in particular, one must be able to take on a double perspective – the understanding that the same situation could be experienced in more than one way. If one has experienced understanding that the same experience can be perceived in different ways, then one has the precondition to be able to empathize with others. De Bruin, et al. (2014) add that the innate skill of seeing body cues in others (i.e., facial movement, eye direction, body movements, etc.) eventually becomes embedded in social contexts. As we begin interacting with each other in a "world-involving way," the body cues we come to hone in on in understanding emotions in people are due to situated understanding. Situatedness informs and influences our capacity to grow to understand the feelings of others, and we are inclined to center

on how and why something is occurring. De Bruin, et al. (2014) further note that our understanding of others is based on how well we can construct a back story and pull together a working narrative. The narrative is delimited by what one knows about the person one is striving to understand, and it is informed by imagination. Our imagination is informed by stories in our books, movies, songs, a sense of history, theatre, newspapers, other forms of nonfiction, things that happen to people we care about and or otherwise know (De Bruin, et al., 2014). Imagination, in this case, might have also been informed by the words of the play the children performed.

Potentially tapping empathy is especially noteworthy and augments the aim of our project. Thus, and as a potential contribution to Piaget and Inhelder's (1956) argument about spatial reasoning, sensorimotor experiences coupled with perception, thought and imagination may serve as embodied experiences that contribute to one's ability to empathize with others.

5. Conclusion

Educators do not often use embodiment as a touchstone in teaching, but there is a developing body of literature that exhorts bringing the body back into the classroom (Forgasz & McDonough, 2017). In the course of explaining how to structure similar experiences for other children, the theatre professor noted the following:

I would tell them [teachers] that they would need to create a series of exercises that allowed the student to first become more keenly aware of their own ability to focus. It might not be self-aware, in the sense that they know what they're doing, but something that would allow them to place their focus and their attention first... They need to develop that skill... ..Understanding that they need to be able to direct their attention, energy, to a certain place, kind of innately gives them a better sense of their own selves.... Then, they would need to structure it so that the next exercises would be exercises in which they are asked to shift their attention more. They need to have some awareness outside of their body, not a lot.... Then I would ask them to add to that team-building skills because in a play, even if you're just working with one other person, you're a team and you're creating the story and the action and the images with the team. So they need to understand that whatever they do is not just about them, that it's really connecting to that team.

While embodiment acknowledges the centrality of the body and sensorimotor experiences for cognition, embodied pedagogy bridges the body and mind to make learning possible (Nguyen & Larson, 2015). There are several good practices for intentionally building embodied classroom spaces. Firstly, the facilitation of the experience is paramount. Embodied pedagogy is an intense educational experience in part because it asks students to make themselves vulnerable before others. Some students might be inclined to resist (Forgasz & McDonough, 2017). Thus, better experiences require student consent (Butterwick & Selman, 2012; Forgasz & McDonough, 2017), and the facilitator respects and is mindful/attends to the emotional work that might occur (Butterwick & Selman, 2012).

The facilitator must also intentionally scaffold embodied pedagogy by "learning to speak the language of the body" (Forgasz & McDonough, 2017, p. 63). Forgasz and McDonough argue that when we use our bodies to learn, we feel and see our way into new understanding. A facilitator calls forward this way of knowing by foregrounding the body as a pathway to learning. For example, classrooms are inherently embodied spaces that capture and reflect back factual as well as emotional knowledge (Alerby, Hagström, & Westman, 2014). Intentionally leaning into this epistemological stance enhances speaking the language of the body. In this study, we used the language of the body by asking students to draw home, note likes and dislikes while walking the neighborhood, and reflecting on places of play. These embodied spaces served as inspiration for community plans and as the subtext for the theatre performance.

We believe that the body was pivotal to helping the children engage in visual-spatial thinking. Developing embodied activities that relied on kinesthetic experiences and that may have encouraged empathy were rooted in understanding this innate way of attaining knowledge. Piaget

and Inhelder's (1956)'s arguments about spatial reasoning remain decidedly relevant in understanding how to facilitate this reasoning in children.

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