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Research Article

New 'Young Geographers': Children's Cognitive Development Wayfaring Through the City Replica Project

Annabelle Black Delfin[1*], **Wenjie Wang**[2]

[1]Research and Program Development, NM Center of Excellence for Early Childhood Education, Western New Mexico University, Silver City, New Mexico
[2]The Department of Early Childhood, NM Center of Excellence for Early Childhood Education, Western New Mexico University, Silver City, New Mexico
E-mail: blackdelfink@wnmu.edu

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Abstract: This paper examines how children relate an actual 3D environment to modular, loose parts in creating a 3D city replica with 2D embellishment. The main goals of the study were to examine children's creation of 3D replicas of immediate physical spaces in their educational setting and the cognitive development that is needed to support this type of play, as well as the cognitive benefits derived from engaging in symbolic 3D construction. Further, this paper explores children's 2D symbol use in the children's drawings and marks added to the surfaces of the loose parts during construction play. Framed by Vygotsky's sociocultural theory (1978), the qualitative research was conducted in a four-year-old classroom at a child development center in the southwest of the United States. Data was collected from photos, participants' narratives, and fieldwork and analyzed by the photovoice method through a developmental cognitive skills and abilities lens. We observed the interplay of the individual and society reflected in the children's understanding of their community's symbolic culture and approach to constructing a city replica. It was found that field trips of neighbourhood walks helped to establish children's perceptions of their community's symbolic culture before constructing the city model; further, children have dual representation abilities and can use their abstract reasoning skills in finalizing 3D constructions. Moreover, children used basic spatial skills, such as symbolic representation, position, location, perspective, scaling, direction, and navigation during the city replica 3D construction and in pretend play with the completed city replica product. Lastly, the seminal work of Mitchell (1991) is brought in to ground the results of the research project in the curriculum and pedagogy of early childhood.

***Keywords*:** sociocultural theory, early childhood education, cognitive development, symbolic representation, photovoice, loose parts, spatial skills

1. Introduction

As one of the significant developmental areas, young children's cognitive development has long been studied, particularly regarding symbolic representation and abstract reasoning. When children begin to understand and use symbols, this is a developmental indication that the child is expanding concrete thought and experience to include abstraction. Comprehending symbols, artifacts, and cultural significance is a step to symbolizing and understanding language, culture, and literacy. Children's development and learning emerge through multiple interactions with the

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world, including teachers' facilitation, parents/family members' guidance, peers' influence, and the community's support (Vygotsky, 1978). At the same time, early childhood teachers can design play experiences that are fun and engaging, introducing meaningful contexts and promoting higher-order cognitive processes, such as imagining, problem-solving, and abstract reasoning (Hutt et al., 2022). Early childhood curriculum provides exposure to learning environments and experiences that can foster development. The goal is not to 'speed up' development, it is to provide exposure- without which, development (of the same skill or ability) could come later. The advantage of exposing children to learning environments and experiences is that exposure builds a foundation of learning which further facilitates learning as the child grows and develops. As such, this research examined children's exposure to a curriculum and construction process of a city replica project, which is part of a larger study seeking a deeper understanding of how preliterate children discern meaning from symbols. We look at how a class of four-year-old children utilized emerging cognitive skills and abilities in the process of relating their real community environment to a 3D modular model using loose parts (i.e. small, paper-covered boxes) in creating a 3D city replica with 2D embellishment.

As early childhood researchers, our approach is from a developmental perspective, where education is informed by and informs development in the early years. This approach is central to a Vygotskian sociocultural framework that acknowledges the mutually influencing interaction of physical growth and development and the socio-cultural discourses in which the child emerges (Vygotsky, 1978). As such, often in the early childhood field the approach to understanding and fostering children's development is through early childhood curriculum design (Krogh & Morehouse, 2020; Mercer, 2018; Stacey, 2018). A great deal of developmental information can be ascertained about children when they engage in meaningful and well-designed play experiences (Vygotsky, 2016). We especially wanted to know what cognitive skills were utilized and expanded by children's engagement in the city replica project, while at the same time designing a curriculum that evokes developing cognitive skills. This paper has two specific objectives: (1) to examine children's engagement and interaction in a project designed to elicit specific cognitive and spatial skills and (2) to provide early childhood practitioners and educator preparation programs in higher education with examples and supporting evidence of the effectiveness of emergent curriculum based in a sociocultural framework.

2. Theoretical framework

Sociocultural theory has been utilized as the lens through which both the data was analyzed and the curriculum was designed. This theory, first proposed by Vygotsky (1978), is widely accepted within early childhood education due to its compatibility as a learning theory with the developmental perspective. Unlike education for older children which focuses on academic content, early childhood education focuses on the growth, development, and learning of children. Sociocultural theory asserts that children's growth, development and learning are always influenced by interactions with others, and thus, also, by and with the culture within which the child emerges (Vygotsky, 1978).

One of the main tenets of sociocultural theory that is found in early childhood curriculum design is the idea of the 'more knowledgeable other' and the 'zone of proximal development'. These ideas appear in early childhood curriculum design first as the teacher or researcher ('more knowledgeable other') identifying what a child can do and designing learning environments and play experiences that include activities or interactions that are just beyond what the child can do. This space between what the child can do and can do with the help of a more knowledgeable other is called the 'zone of proximal development'. As children are exposed to learning environments and play experiences that are intentionally within their zone of proximal development, they close the gap between what they can do alone and what they can do with the interaction of another person, acquiring skills and abilities as they grow over time. Thus, the zone of proximal development is always changing as the child grows (Vygotsky, 1978).

Early childhood curriculum design incorporates many sociocultural theoretical premises with the focus on child development. This theoretical framework is used here as we examine the cognitive development that occurs when children interact with each other and their teachers in the city replica project. Woven throughout the literature review is a reference to Vygotsky's (1978) sociocultural theory where we observe the interplay of the individual and society reflected in the children's understanding of their community's symbolic culture and approach to constructing a replica of their city.

3. Literature review

In looking at how preliterate children discern meaning from symbols, many areas of study have been researched with regard to processes of cognitive development. This includes children's symbolic representational abilities and skills, both receptive and expressive, which involve the awareness of relationships between a symbol (or representation) and its referent (Uttal et al., 2008). Symbols can occur in many forms; auditorily as spoken words or sounds (Wang & Black Delfin, 2023), visually as written words or images in two dimensions (2D) (Uttal & Yuan, 2014), and kinesthetically as a model or replica in three dimensions (3D) (DeLoache, 1989). Symbols can occur as concrete representations, such as a miniature toy horse or a doll house, as well as occurring as an abstraction, such as the metaphor of the colors red meaning 'stop' and green meaning 'go' (Uttal et al., 2009). Mitchell (1991) explains symbolic representation as an "expression of relations through images (symbols), which sometimes actually intensifies the recaptured experience or object by pruning it of all except the essential" (p. 26).

This paper examines how children comprehend and utilize symbols and symbolic representation to relate an actual 3D environment to modular, loose parts in creating a 3D city replica with 2D embellishment. As such, the literature focus includes research that concerns children's creation of 3D replicas of immediate physical spaces in their educational setting and the cognitive development that is needed to support this type of play, as well as the cognitive benefits derived from engaging in symbolic 3D construction. Further, this paper draws from the literature that explores children's 2D symbol use in supporting examination of the children's drawings and marks added to the surfaces of the loose parts during construction play. Lastly, the seminal work of Mitchell (1991) is brought in to ground the results of the research project in curriculum and pedagogy of early childhood.

3.1 *Mental representations underlie symbol/referent relationship*

Cognitive abilities that bring about the comprehension of symbolic representation have been studied, including (comprehension of) scale (Huttenlocher et al., 1999; Ware et al., 2010), perspective (Ebersbach et al., 2011), spatial skills (Frick & Newcombe, 2012; Casey, et al., 2008; Jo & Bednarz, 2014; Möhring, et al., 2021), and dual representation (DeLoache, 2004). Much research has been conducted on children's interaction, use and comprehension of auditory or 'linguistic symbols', also known as words, sounds and other vocalizations, (DeLoache, 1995, p. 66), in language learning and 2D symbols, such as images, text, logos, and maps in literacy learning. Further, there has been inquiry into children's interactions with scale models and 3D symbolic representations (DeLoache, 1989; 2000; Uttal & Sheehan, 2014). Accordingly, a child's comprehension of scale, perspective, and spatial relations would occur, according to Vygotsky (1978) in the qualitative transformation between elementary cognitive processes 'which are of biological origin' and higher mental processes which emerge from 'a sociocultural origin' (p. 46). Comprehension of dual representation would be seen by Vygotsky (1978) as fully situated in higher mental functions due to the social understanding of sign and signifier. Higher mental functions appear in the ability to form mental representations.

A mental representation involves the ability to form a (mental) 'visualization' of both concrete and abstract concepts and their relations. Carlston (2010) believes the ability underlies the human memory system. A simple mental representation may start as a memory, such as remembering a physical space like a kitchen. As children grow, cognitive abilities to build, hold and cognitively manipulate mental representations are strengthened and expanded, going beyond recalling how a physical space was actually arranged. In this example, the memory could become a mental representation, a 'mediated memory', when the child manipulates the visualization, such as mentally 'rearranging the furnishings' in the same kitchen space. Vygotsky (1978) draws a distinction between 'non-mediated' memory, which is 'very close to perception… characterized by a quality of immediacy' and determined by stimulation from the environment (p. 38), and 'mediated memory', which implies higher mental functions due to a 'self-generated stimulation', that is, a mental representation (p. 39).

Mental representations are generated as ideas, schemas, plans, designs, and even understanding of systems. They involve apprehension of items or components and their interconnections or relations within the whole, exist on multiple levels of processing, and involve mapping mental imagery onto physical referents. Children's play that involves mental representations is symbolic. As Vygotsky (2016) states, 'Play is understood to be symbolic' (p. 9) requiring 'rules stemming from the imaginary situation' (p. 10), also known as a mental representation that will govern the play episode. Complex pretend play requires a mental representation of the storyline, characters, social norms, etc. Construction with loose parts, especially at scale with adherence to the referent, also requires mental representation to design, plan, construct, and align as a model to reality (Ho et al., 2022).

Geometric abilities such as isolating one part of a 3D mental representation, mentally changing perspective/orientation to the representation, or rotating the 3D mental representation have been identified as cognitive developmental milestones (Ocal & Halmatov, 2021) where a child's abilities have been found to be linked to the amount of spatial language to which the child is exposed (Levine et al., 2012). As a child gets older, the ability to hold and manipulate mental representations about abstractions or abstract relationships improves 'with the help of speech' as the child 'acquires the capacity to be both the subject and object of their own behavior' (Vygotsky, 1978, p. 26).

3.2 *Inter-related loose parts and pretend play*

In 1934, a book was published by the founder of Bank Street College of Education, Mitchell (1991), which outlined a different approach to teaching children about symbolic representation, 2D and 3D depictions, and the wider interaction with one's environment involving scale, perspective, and spatial reasoning. The book, *Young Geographers: How They Explore the World and How They Map the World*, was a slim volume that established an early link between the environment, symbols, and wayfaring between 2D and 3D perspectives. Mitchell (1991) determined this was at the heart of geography and that children could engage in geographic learning even in early childhood. Following environmental exposure, such as trips around the neighborhood, Mitchell advocated for a classroom setting where children have access to materials that facilitate reliving the experiences through "play which is constructive and leads through progressive stages of relationship-thinking" (p. 16). To Mitchell, the learning materials were important to facilitate, what Vygotsky (1978) would call, the interiorization of the outdoor experiences. Mitchell supported the use of inter-related loose parts, explaining, "This kind of play needs free or raw materials which can take the impress of the user. The best of all adaptable materials seems to be blocks which are cut in multiples of a given unity" (p. 16). Constructive play with loose parts allows children to design and build 3D representations. The term 'loose parts' refers to learning materials that usually appear in sparse 3D geometric forms, can be stacked or attached in some way to connect parts, and occur in various scales to a child-sized body. Loose parts are meant to be manipulated and assembled as physical objects in space (Sear, 2016). The provision of loose parts in a classroom or outdoor area is known to promote cognitive development through the interaction of the concrete, physical loose-part units, and the abstract, i.e., the child's mental representation of the design idea. The nature of building with loose parts is fluid and open-ended, inherently incorporating problem-solving, organization, knowledge of physical laws (i.e., the effect of gravity and balance), and relational thinking (Trinanda & Yaswinda, 2022). Mitchell summarizes by saying, "Some sort of free material, comparable to blocks, is necessary through which children may express their geographic thinking. Dramatic play [then] becomes more and more important" (1991, p. 18).

Similar to concrete play with loose parts, dramatic or pretend play promotes the cognitive development of higher mental functions (Vygotsky, 1978). Pretend play requires an understanding of social norms and concepts of time. Pretend play relies on intramentalization (i.e., internalized social knowledge) that emerges as an external voice of the character in the pretend play, as well as inner speech, which serves to organize the pretend play within the child. Vygotsky (1978, p. 96) states, 'It is here that the child learns to act in a cognitive, rather than an externally, visual realm by relying on internal tendencies and motives and the incentives supplied by external things'. In this way, inner speech acts as the mediator of decontextualized words, as a mental representation that gives order and structure, in this case, to a pretend play episode or construction project with loose parts (Wertsch, 1985).

3.3 *Children and perception of scale*

For many years, it has been widely understood that scaling is a developmental cognitive achievement that does not usually emerge until late childhood. Piaget and Inhelder (1967) argued that perception of scale necessitates proportional reasoning abilities. This requires a child to have knowledge of units (i.e., measurement of some sort), to construct and mentally hold two fractions that represent unitized distance, and to solve for an unknown variable in the ratio. Piaget argued that cognitively a child could not engage in this type of proportional reasoning until at least the age of 11 or 12 (Piaget & Inhelder, 1967).

Huttenlocher et al. (1999) argue that scaling does not require proportional reasoning. Younger children employ different ways to perceive the relationship between a symbol and referent and differences in scale. In scaling tasks with three and four year olds, it was found that perceptions of scale were demonstrated with tasks that involved enclosed spaces. The researchers posited that the boundaries of the enclosed space (i.e., walls in a room or sides on a sandbox) provided the parameters of the scale relationship "if the location is coded by relating visible distances to one another rather than by imposing unit measures, the coding will directly preserve the relation between those distances" (Huttenlocher et al., 1999, p. 397). By situating tasks in enclosed spaces, three and four year old children demonstrated success with comprehending scale between a 2D representation applied to 3D physical space "because the coding of location in enclosed spaces preserves information about location in a form that is directly applicable to similarly shaped spaces regardless of size" (Huttenlocher et al., 1999, p. 397).

Vygotsky (1978) would account for this by pointing out that children are always already negotiating between the concrete (material world) and the abstract (relational world). The example provided by Huttenlocker et al. (1999) demonstrates this to be so. Unlike the Piagetian viewpoint, which relies on children's learned algebraic abilities, this explanation includes important concrete parameters that afford a child's abstract reasoning of scale.

3.4 *Symbols can have multiple meanings: dual representation*

To understand symbols, making the leap from symbol to referent requires that children develop dual representation. Dual representation is the ability to comprehend the meaning of the object and the meaning of the object *as a symbol* (such as a 2D image or a 3D model). This cognitive ability arises from mentally representing the object in different ways; as an actual object, as a symbol for the object, and, even, as a symbol of a symbol (DeLoache, 2000). Children under three usually do not have this cognitive ability yet. They have difficulty comprehending when an object is a symbolic representation of another object. For example, if a child is shown a printed photograph of a cracker and told, 'this is a cracker'. The child under two may reach for what they perceive to be a material cracker. A child a bit older may perceive the printed photograph as paper but not make the connection between the photo on the paper and an actual cracker. A child older than three may see that the photograph *represents* a cracker (DeLoache et al., 2003).

Research has found that children under two and a half tend to focus on (3D) object properties, especially if they are given access to physically manipulate the object, and this can make it more difficult for them to perceive the object as a symbol or abstraction (Uttal et al., 2009). It seems the act of actually touching the object decreases young children's abilities to make the connection to which the object refers. When the object's physical properties are diminished, or access is restricted, children's abilities to discern the symbolic relationship are increased (DeLoache, 1989).

For a child to understand dual symbolic purposes effectively, at the simplest level, the child must be able to "mentally perceive the object, its referent, and the relationship between the two" (DeLoache, 2004, p. 69). Often, symbolic meaning is grounded in social or cultural knowledge. Being able to perceive the symbol/referent relationship usually requires some amount of sociocultural exposure, which in turn serves to drive cognitive development (Vygotsky, 1978).

4. Methodology

Analysis of this city replica project recognizes that multiple frameworks came together in the enactment of the project, such as, incorporating cognitive skills requiring expression in both 3D and 2D symbolic representation, discursive analysis of dialogue and stories told in the interaction of construction, and spatial knowledge for 3D construction. This research has been analyzed using the photovoice method of the city replica project, which was one part of the participatory action research study, Treasure Map Experience (TME). The photovoice method emerged in the 1990s as a way to combine images and narrative to understand issues from multiple perspectives (Wang & Burris, 1997). The photovoice can be understood as a way to analyze data collected in the form of participants' lived experiences and voices for meaning in relation to identified 'lenses' or areas of research inquiry (Goopy & Lloyd, 2005; Schell et al., 2009). As a visual method, many photos were taken which recorded children's learning progress (i.e. their engagement in the process of creating a city model) and the result (the replica of the city). The voices, comprised of the stories and dialogue that children and teachers shared when engaged in the project, were collected, categorized, coded and analyzed. Through this narrative method, the voices and photos traced children's perspectives and understanding of symbolic learning reflecting teachers' teaching strategies in facilitating children's learning experience. The project was grounded in the community, connecting families' engagement in children's development and growth and highlighting the community's culture and histories that influence children's learning on a macro level. Together, images and voices from children, teachers, family members, researchers, and the community combined to describe this unique and collective research work and bridge gaps between learning, teaching, community culture and resources, and research (Nykiforuk et al., 2011; Wang & Burris, 1997).

4.1 *Research design*

As previously mentioned, this photovoice product of the city replica emerged from a larger project based on children's learning of map symbols. Specifically, teachers introduced children to how to read maps with various activities such as reading books about maps, checking travel locations on maps and globes, pretending to play about travelling around the world, creating passports and visas, etc. As part of the Treasure Map Experience (TME) curriculum unit, alongside those activities that were conducted, teachers and children made several field trips of neighborhood walks. The research site was located in a historic downtown area of a city in the southwestern United States. The children's neighborhood walks traversed the blocks surrounding their school, which included multiple public spaces and municipal/state institutional buildings, streets, a parking garage, houses, offices, shops, and museums. Children created a replica of the familiar city blocks surrounding their school using recycled materials and loose parts, with natural exposure to the community environment and culture, as well as intentional discussions of the community features and neighborhood cultures, see Figures 1 and 2. In other words, the city replica project was a process of children's comprehension and usage of symbols. Using the photovoice method, this research recorded and analyzed children's mental representations, use of symbols, discernment of meaning from symbols, and creation of new meaning from symbols.

Figure 1. Recycled boxes were wrapped with brown paper at the beginning of the project

Figure 2. Boxes as loose parts in mid-construction

4.2 *Participants*

This study involved two teachers and 12 children. All of the children were 4 years old during the data collection phase, except one who was 3 years and 10 months at the time. The oldest child turned five during the last week of the study. The participants were from multiple cultural backgrounds and represented a wide range of diversity. The two teachers had differing years of teaching experience but demonstrated great collaboration and insightful understanding of children's development, learning, and growth. The lead teacher had been a preschool teacher for many years, known for her expertise in emergent curriculum design. The assistant teacher was apprenticing with the lead teacher while she completed her early childhood coursework. The teachers were bilingual (English and Spanish). All of the children spoke English and class was conducted mostly in English with some Spanish. The research took a semester, about five months, and was conducted in a child development center in northern New Mexico. The researchers obtained teacher consent and parental consent for children's participation in this research project, and the research was approved by a university Institutional Review Board.

4.3 *Data collection*

Data was collected from the classroom, the community, and the neighborhood using the photovoice method. Numerous photos were taken by teachers and researchers, which focused on the city replica process and result. The process centered on neighborhood walks, project material preparation, and the creation of the city model. As researchers followed the children and the teachers, voices were also documented via field notes, observations and member checks from the classroom and the community. For example, children's explanations, discussions, talking points, dialogues, teachers' and family members' communications, and teachers' reflections about the city replica were tracked. Researchers also sought clarification by asking the children and teachers open-ended, spatial-oriented questions, (i.e., 'What do you mean by bird view? Tell me more'). Jo and Bednarz (2014) emphasize that learning occurs when "teachers possess critical eyes to select, design, and use effective questions to facilitate students' spatial thinking" (p. 310). The result was a replica of the city blocks surrounding and including the children's school documented through photos, video, and other recorded interactions with the children.

Table 1. Cognitive skills and abilities

Cognitive skills and abilities	
• Mental representations/conceptualizing spatial relations	• Scale
• Symbol/referent relationship	• Direction & orientation
• Use of existing symbols (such as, a stop sign)	• Conversion of 3D symbols to 2D symbols • Conversion of 2D symbols to 3D symbols
• Generation of new symbols (such as, a ristra)	• Perspective ◦ 'Bird's eye view' ◦ 'Ground view'
• Dual representation	• Abstract thinking

4.4 *Data analysis*

We followed four steps for analyzing data collected from the photovoice method. The researchers conducted a thematic analysis of initial rounds of photos and recorded stories and dialogue to identify themes in relation to the identified lens of 'Cognitive Skills and Abilities' (see Table 1). As part of the larger research project we had identified cognitive skills pertaining to symbolic representation for which we would be looking during the city replica project. These identified areas of cognitive development became one of the 'lens' through which we looked at the photos and voices for evidence of children's acquisition of these skills and abilities (Table 1). When we saw or heard evidence supporting children's acquisition or use of these identified cognitive skills and abilities, these photos/voices were coded for the identified skill/ability.

The second step was a photovoice analysis based on the participants' interpretations, which involved a member check review of numerous photos with teachers and children. The photos, especially with the children, would serve as a prompt to a question such as, "Tell me about this photo of the veterinary clinic that you built" or with the teachers, "How do you think the city replica project is going? Can you give me some examples where you have noted the children making connections between the real neighborhood and the replica that they are building?" These informal conversations that occurred during the preparation and construction phases of the project became further data to be analyzed. This, too, was then thematically analyzed in relation to the lens of cognitive skills and abilities specified in Table 1.

The third step was cross-comparison between the researchers' and participants' interpretations. Specifically, we first reviewed visual images and selected and categorized images. Then we re-examined different image categories with these interpretations and cross-checked with the participants as to their interpretations. It is worth noting that the interpretations were critical as children and teachers helped us (researchers) understand their perspectives of the symbolic world. An example of this occurred during a member check as a child pointed to a photo of his 'veterinary clinic' and said, "Look, I stacked two boxes for my veterinary clinic- just like the one where we take our cats. There's an upstairs!" The photo had been coded by the researchers as possible examples of Symbol/Referent Relationship and Scale. The child's statement about using two boxes to construct a two-story replica because the actual clinic he was representing has two stories verified the researcher's coding, but also added coding for Mental Representations/ Conceptualizing Spatial Relations and Abstract Thinking.

It was often this step, that occurred with teachers and children as we looked and discussed photos or the actual replica in progress, where the conversations with the participants would confirm or deny evidence of the children's demonstration of the identified cognitive skills and abilities. Children's and teacher's voices assisted us in avoiding assumptions and misinterpretations, minimized our biases, ensured children's and teachers' sharing, and reminded us that children can have their own perspectives on symbols. For example, our analysis included some images taken from the community during the neighborhood walks focusing on community symbolic culture; some images were taken from the classroom during the preparation of the city replica emphasizing loose parts; some images were taken during children's construction process of creating the city model with 2D and 3D symbolic representations; and some images were taken after the city replica project with a completed product and narratives.

During the last step in the process, cross-comparison occurred as we compared three sets of voices from children, teachers, and researchers and looked closely at the differences and similarities in comprehending symbols and symbolic products. Themes emerged and converged. After that, we identified the relationships between various themes and provided reasons for the emergence of the identified themes. The analysis coalesced into four major themes, explained in the following section.

5. Findings and discussion

Analysis of the data yielded four themes that could be traced across participants and the identified areas of cognitive skills and abilities. Responses are organized from the following four perspectives: 1) neighborhood walks establish children's understanding of community symbolic culture in constructing the city model; 2) children's dual representation ability and abstract thinking are reflected in their 2D embellishments and symbol generation during city model construction; 3) children applied basic spatial skills, including position, location, perspective, scaling, direction, and navigation when constructing a 3D city model; and 4) The neighborhood walks, construction of the replica and pretend to play with the replica converge in supporting children's understanding of the spaces.

5.1 *Children's understanding of community symbolic culture: neighborhood walks*

One of the beginning steps of the city replica project involved neighborhood walks which connected the community's symbolic culture and children's symbolic comprehension. Teachers conducted several neighborhood walks and guided children in recognizing symbols and featuring cultural elements in the community. Neighborhood walks provided authentic social interactions between children and their neighbors- accessing important community cultural resources, such as colors, shapes, artwork, architecture, languages, heritages, music, and many more. Children experienced the community's symbolic culture from different senses. As noted by Mitchell (1991), "Trips, therefore, become the basis of the curriculum in the younger years" (p. 13). The environmental exposure of the neighborhood walks, the "trips", referred to by Mitchell, are central to the development of other parts of the curriculum. In reference to a child's experience of the neighborhood walks she goes on to say,

> "If the trips are planned with reference to the functioning of the community around him, and if the schoolroom furnishes him with proper tools for play, his play will evolve and spontaneously take on the aspects of human geography, and his floor play with blocks and bench-made products will show true beginnings of map-making" (p. 13).

Figures 3 and 4 were taken during the neighborhood walks. As can be seen in Figure 3, one teacher guided children who stepped down the stairs, and adobe houses, streetlights, and ristras can be seen behind the children. In Figure 2, the teacher and the children stopped at a stop sign. The children lined up, watched, and listened to the teacher's explanation of the stop sign as a symbol in their neighborhood.

Figure 3. Neighborhood walk and the community symbolic culture

The symbols of the community significantly shaped children's understanding of the city replica project. As each culture presents unique symbolic representations based on history, economics, language, and other developments, the first step for children to understand community culture is to note and make sense of the symbols present in the community. This makes it crucial for teachers and researchers to consider the importance of community and cultural connectedness in efforts to enhance children's symbolic development, as 1) culture is delivered by symbols, and symbols reflect culture (Wertsch, 1985); 2) children's abstract thinking is developed based on concrete details (Cunningham, 2022); 3) children's spatial abilities (higher order mental functions) are grounded in their actual physical experiences (Vygotsky, 1978); and 4) culture is dynamic, symbolically coded, and can be further potentially developed and produced by young children (next generations) (Swidler, 1986). Children paid attention to and gradually incorporated the unique cultural values, traditions, and related factors into their city replica project by intentionally pointing out different community symbolic cultural elements, such as ristras, adobe architecture, murals, etc.

Further, Mitchell (1991) points out that exposure to the community and surrounding environment also provides exposure to the outdoors, wayfaring the actual terrain of traversed ground while on a neighborhood walk, "trips of this type will gradually build up a conception of the fundamental conditioning earth forces, such as tides and currents, wind and weather, elevation, island and harbor, and the main work activities which have resulted" (p. 15) in the community. Environmental exposure to the terrain, the landscape features, as well as to the community's symbolic culture is the necessary first step of Mitchell's (1991) curricular approach. More examples are analyzed in the following sections.

Figure 4. Neighborhood walk and the stop sign explanation

5.2 *Children's 2D comprehension: dual representation and abstract thinking*

The first important theme from the data set is that children can make an abstraction of a 3D object and represent it as a 2D image, reflecting children's dual representation capability and abstract thinking ability. For example, Figure 5 shows a real ristra, a three-dimensional, decorative item made from local red chiles from the community, taken during the children's neighborhood walk. Figure 6 shows a child's drawing of the ristra, a two-dimensional image spontaneously drawn to add embellishment and information to a 'building' replica during the children's city model creation in the classroom. Even though young children perceive their world initially in a concrete way, they are still able to develop abstract thinking patterns that allow them to perceive beyond the "here and now"; in other words, thinking and process of thinking can be based on or far away from "the last moment". As can be seen, Figure 5 was from the community, while Figure 6 was taken in the classroom where the real ristra does not exist.

Figure 5. Ristras from the community during the neighborhood walk

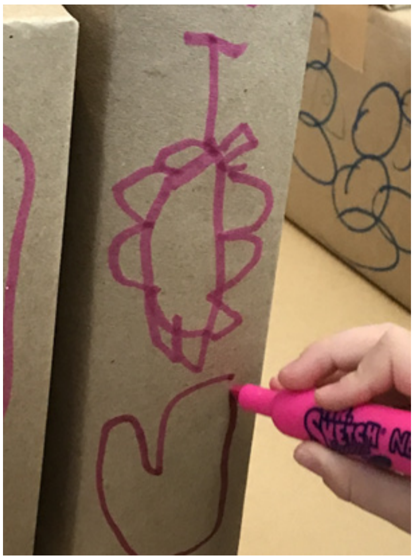

Figure 6. A ristra from a child's drawing during the city model creation in the classroom

Starting from here, different from concrete thinking, which is closely connected to objects and experiences and is direct and explicit, the development of abstract thinking requires children's dual representation ability. Comprehension of dual representation involves an understanding that symbolic artifacts always have a concrete and an abstract nature, existing as real objects and also as symbols (DeLoache, 2000). To cognitively grasp this, children must mentally 'represent the concrete entity itself and at the same time, its abstract relation to its referent' (2000, p. 330).

Children need to deconstruct and transform complex concepts and ideas into generalized abstractions without being tied to specific examples, experiences, objects, environments, etc. It is one type of higher-order thinking skill because children must absorb, process, retrieve, and use information later. Taking the ristra as an example, from viewing ristras, observing their colors, shapes, and length, listening to the teachers' introductions, and thinking about why the ristra is a cultural artifact and why it appears in the community, children need to process all this information and reconnect it when they employ the (2D, abstract) symbol in the city model, for instance, where to display the ristra, size, and color of the ristra, and so forth.

Similarly, across the street from the children's school is a very large sculpture of a dog, known simply as the "Big Dog" to the children (Kennell, 2011). The children encounter this sculpture and physically interact with it on their neighborhood walks. Figures 7 and 8 demonstrate children's dual representation ability and transformative capability from viewing a concrete object, a dog sculpture, to creating an abstract image, a dog picture. The child must form a mental representation of the essential features of the 3D dog statue, such as color, shape, and location, in order to represent the "Big Dog" as a 2D image or symbol. The essential features from the mental representation are transformed into generalized abstractions, which are preserved in the image.

Further, abstract thinking and dual representation require children to think more deeply to make generalizations and classify their experiences without completely relying on immediate, concrete facts. Children can use their imagination as they think in general without concrete details in front of them. According to Cunningham (2022), abstract thinking can be used in different aspects of daily life, such as using metaphors and/or analogies, comparing patterns and relationships among objects, experiences, and events, and creating based on available information and thoughts. In the city replica project, for example, children understood that ristras are cultural symbols in northern New Mexico. Another example occurred when children began to refer to the "Big Dog" statue that is located across from their school as a symbol of their city. Figure 9 shows children's perception of their city, state, country, continent, and planet, and as can be seen, the "Big Dog" has been used as a symbol of the city.

Figure 7. The dog statue from the community during the neighborhood walk (Kennell, 2011)

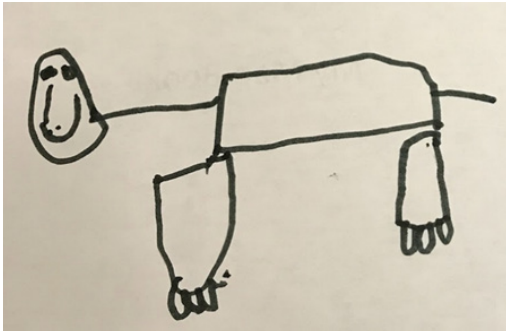

Figure 8. A dog image from a child's drawing during the city model creation in the classroom

Figure 9. The "Big Dog" is a symbol of the city

5.3 *Children's 3D comprehension: basic spatial skills*

The critical processes in the construction of the city replica project involved how to organize city/community objects onto a floor plan in the classroom and how different objects are related. To solve these problems, children needed to rely on spatial abilities. With teachers' assistance, children used their perceptions of basic spatial skills, such as location, position, perspective, scaling, direction, and navigation, demonstrating three-dimensional understanding.

5.3.1 *Black tape: position, location, and perspective*

Children use their basic spatial skills frequently in their everyday lives, especially at this age, as they become familiar with their surroundings. For example, how to find their homes, schools, favorite restaurants, playgrounds, etc. Most often, children still need to learn basic spatial ideas and relations with adult help. With the city replica project, it was challenging at the beginning when teachers asked children to build the city model with the materials provided. Children seemed confused about the objectives of the project, what the city model meant, and where to start.

To assist children, teachers used a black tape and placed it on the replica foundation with an explanation of how the black tape indicates the city streets in the neighborhood surrounding their school building. This initial action played a critical role in beginning the replica as it provided a point of reference that oriented the whole project, allowing the children to move forward in creating the other features in the environment, such as the scale models of the buildings and laying out the city blocks in all directions around their school. Specifically, the black tape was the children's first reference to simple position and location. For example, the street is in the middle, the church is on the left side of the street, and the convention center is on the right side of the street. The black tape also references two different perspectives, the bird-eye view and the ground view. For instance, if a child stands next to the city replica, the child can see the entire city from a bird-eye view, and if a child pretends to 'drive' a toy car on the black tape (streets), the child can see the street, church, the convention center, etc. from a ground view, and the child can see how they look alike and look differently from where she/he stands. The third reference of the black tape is the direction. Children use dual representation and imagination skills to become aware of their surroundings and think about where they are going. With the space divided by streets, they know where they are in space and how to move from one location to another. In familiar places such as the church, the convention center, the dog statue, stop signs, etc., they know the dog statue is next to the stop sign, but it is far from the church.

The streets, both actual streets of the neighborhood and the 'streets' indicated by black tape in the city replica, seemed to provide the boundaries to which Huttenlocher et al. (1999) refer in their research demonstrating that three and four year old children can comprehend scale between a 3D physical space and a 3D representation when boundaries are supplied and identified. Figures 10 and 11 show how the black tape divided city streets and provided the above three references, the position and location, perspective, and direction in commencing the city model.

Figure 10. Black tapes divide city streets

Figure 11. City streets outline positions, locations, perspectives, and directions

Figure 12. Creating parking lots

5.3.2 *Parking lot and the dog sculpture: spatial scaling*

As one of the basic spatial skills, spatial scaling refers to children's ability to transform information between the actual spaces/sizes and the designed spaces/sizes. Figures 12 and 13 show teachers and children creating parking spaces so toy cars can be driven through the city and parked in the right place. Children used shapes to reconstruct new shapes in building the parking lot. As can be seen in Figure 12, eight rectangles of the same size created eight parking spaces.

Together, the eight rectangles consist of a larger rectangle representing the parking lot. Figure 13 shows toy cars parked in the parking lot, and each of them has the same space/size for parking. In the process of creating the parking lot, children learned to take shapes apart and use shapes to construct other shapes. In this case, a big rectangle is created by eight small rectangles sized in relation to the toy cars, the size of the 'streets' and surrounding 'buildings'. The analysis of how the parking lot should be created fostered children's analysis of shapes, a part of spatial scaling, i.e. preserving the shape and adjusting the size to scale.

Figure 13. Parking cars

Figures 7 and 14 also show the transformation using spatial scaling from the real dog statue to the city model dog statue. Even though the accurate spatial scaling ratio is not reflected via the city replica project (i.e., actual building 1 : 30 model building), the general concept of investigating spatial reasoning strategies is reflected. For example, in children's and teachers' conversations and discussions, we learned that the dog statue is one of the important community symbols, and children love to use the "Big Dog" as a landmark to refer to location and direction. In order to transform the real dog statue into the city model, children needed to mentally represent the "Big Dog" and shrink or expand spatial information in the sense of zooming in or out of the dog and further, internally transform scaling information. During this transformation, spatial comparison and analysis occurred. For example, the real dog statue is smaller than the church but bigger than the stop sign. As a result, the city model dog should also be smaller than the church model but bigger than the stop sign model. Even so, while there was some discussion during construction regarding the scale of the stop sign in relation to the 'dog statue', the children decided to include a pre-made stop sign from another building set, even though it did not fit the scale of the replica (see Figure 14).

Similarly, to create other buildings, children must understand that the different sizes of the buildings represent the differences between real-life-sized buildings. For instance, a convention center's height differs from a shopping center's. Many of these scaling issues sparked discussion between the children and the teachers as the replica was being constructed, causing children to consider the consistency of scale when choosing to use the pre-made stop sign or in constructing their 'buildings'.

Figure 14. The city model dog statue

Additionally, the children's use of the "Big Dog" as a symbol reveals that the children in this study have attained dual representational abilities. According to Deloache (2000), the children's perception of the "Big Dog" can be seen here as occurring on (at least) three symbolic levels. The concrete level is the physical interaction with the dog statue, which has a swing under its belly (see Figure 7). On neighborhood walks, the children routinely stop to sit on the swing. Even as they are swinging on the two-story dog sculpture, they know that the sculpture is a symbol of a dog- not a real dog. Understanding that the statue is a symbol of a dog is the beginning of abstract understanding, i.e., seeing the physical item, the sculpture, as a symbol.

Later, back in the classroom, the children created a small-scale model of the "Big Dog" to place in the city replica, demonstrating the ability to "mentally represent multiple facets of its dual reality" (Deloache, 2000, p. 330) by making a (3D) symbol *of a (3D) symbol*. Further, several children transformed the 3D symbol of the "Big Dog" into a 2D representation that they drew in artwork and other activities voicing that the 2D image of the "Big Dog" not only symbolized a statue that symbolized a dog and a landmark that they used to spatially locate their school in the downtown area, but also as a generalized 2D symbol that stood for the entire city in their artwork. As Deloache (2000) points out, these multiple mental representations can exist in a single symbolic entity, and the children's ability to comprehend this, to form, hold, manipulate, and reproduce multiple mental representations regarding one symbolic item demonstrates that they have cognitively acquired dual representational ability.

Figure 15. The city model dog statue

5.3.3 *Features and details: direction and navigation*

Following the previous findings, as children created different buildings and used various landmarks to locate objects, they also featured many details to differentiate model buildings and navigate directions. Navigation skills assisted children in understanding the relationships among buildings and familiarizing themselves with various routes in the community and surroundings. They imagined navigating streets, buildings, and parking lots from different paths. For example, to navigate from the convention center to the shopping center, children learned that there could be multiple routes to a destination, as well as the bi-directional routes of coming and going. Thus, children utilized three-dimensional symbols in how they purposefully constructed buildings by adding features and details such as walls, air conditioner units on the roofs, a steeple on the church, road signs, traffic lights, etc. Figure 15 shows the ‘one way’ road sign that is added to help navigate the direction. Figures 16 and 17 display two different types of church windows. One is with circled glass windows, and another is with squares and plants on two sides, which differentiated features of the churches and further guided directions.

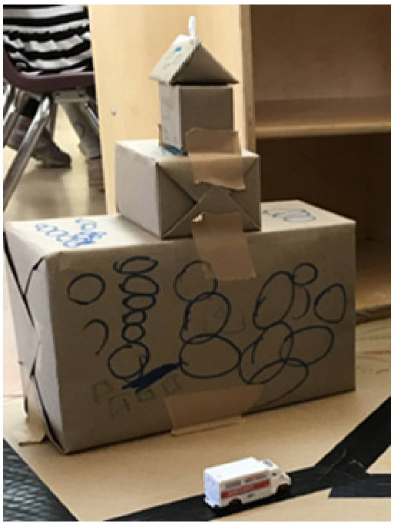

Figure 16. One type of church window with circles

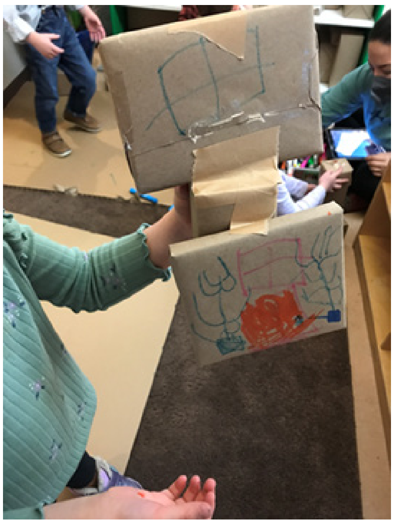

Figure 17. Another type of church window with squares and plants

5.4 *Pretend play and environmental exploration: extramental social exposure to intramental interiorization*

During the construction of the city replica project and after it was done, children began to engage in pretend play with the replica. For example, pretending to drive a toy car and one car asks another for directions. Conversations such as, "Can you please let me know where the nearby parking lot is? You need to take turns at the third stop sign, and the parking lot is next to the playground" which was recorded. The transformation from the internal understanding of physical space and spatial relations to external expressions using social norms with language and conversational tones reflects children's higher-order thinking skills and cognitive development. It was through the crucial step of pretend play with the replica that children's learning about scale, perspective, spatial relations, direction, and navigation became internalized. The act of 'using' the spaces of the city replica in pretend play seemed to cause an intramental interiorization of the extramental information. Different from the interaction of constructing the replica, playing with the replica introduced a new kind of interaction and understanding of the spaces created in the replica that mirrored the actual spaces of the neighborhood. Vygotsky and Luria (1993) identified these steps- from extramental social exposure to intramental interiorization- as central to all human learning and especially important for symbolic understanding which is grounded in social worlds.

Figure 18 shows the finished city replica project where children and teachers used the established city model as an ongoing site for daily pretend play. As mentioned before, toy cars and small human figures were introduced to the finished replica, sparking much spontaneous dramatic play that included a great deal of communication about navigating through the city replica to different familiar locations.

Figure 18. The final product of the city replica project

After the city replica project, teachers also provided home assignments for neighborhood walks. The teachers created maps, invited parents/family members to facilitate children's (home) neighborhood walks with constructions of the maps, and asked parents/family members and children to return their completed maps to the class. As a result, parents/family members participated in the children's learning, and each child had a map of her/his neighborhood. Figures 19 and 20 are children's examples from the home assignment of creating maps and conducting neighborhood walks.

The collective exploration of home and neighborhood, the shared observations of community symbolic culture, the interactions between children, parents/family members, and the surrounding environment, the mutual understanding of creating symbols of the map, and the joint discoveries in class about symbols highlight the growth and achievement from this project. The neighborhood walks and pretend play with the constructed replica both serve the same purpose of interiorizing the understanding of the spaces on differing scales within the individual children. When the children walk in the actual environment, this exposure is taken in as embodied knowledge at the scale of the actual buildings and the child's body. As a child engages in pretend play with the same space in the city replica, the child likewise has an abstracted embodied experience when they 'operate' cars and human figures at the smaller scale. Experiencing the walks in the real space and returning to the classroom to play in the replica space is a deliberate aspect of this curriculum, intended to provide exposure in two different spatial scales. We observed that curriculum such as this that engages the child's social world of teachers' facilitation, family involvement, and interactive play with peers cannot be separated in advancing children's symbolic development and cognitive ability, and further, as pointed out by Vygotsky (1978), curricula designed to include the child's social world can drive cognitive development. With the established city model, unlimited potential and possibilities can be further continued in enhancing young children's symbolic comprehension.

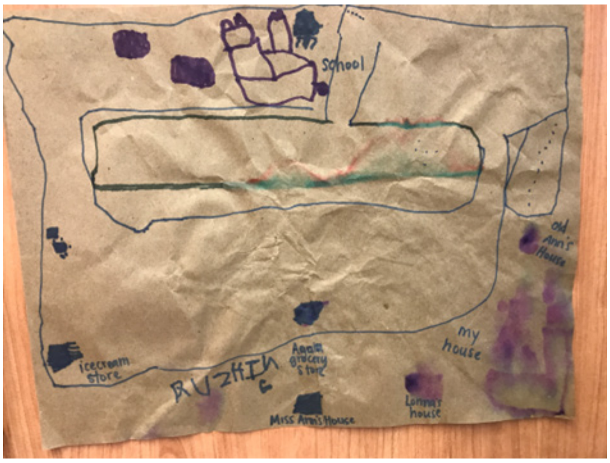

Figure 19. A map example from the home/family assignment

Figure 20. Another map example from the home/family assignment

6. Conclusion

In supporting children's symbolic development and learning, especially in exploring how children solve various problems using dual representation, abstract reasoning, and spatial skills, such as location, position, perspective, scaling, direction, and navigation, we have demonstrated the unique experience of using the city replica project with the involvement of teachers, parents/family members, and natural community surroundings. The children's performance and progress demonstrated their abilities of symbol comprehension, high-order thinking skills of community symbolic culture transformation, and higher mental functions of symbol imagination, creation, and usage. As Mitchell (1991) wrote long ago, still holds true today,

> "When children have been on trips exploring the immediate environment and return to classrooms equipped with free or adaptable materials-blocks, a type of play develops which is really human geography on a young level. Discussions by the children reveal and develop relationship-thinking. And in the floor play, with blocks, the beginning of maps can be seen" (p. 17).

Further, the city replica project served as an example of an emergent curriculum that is developed based on children's interests, strengths, and experiences for early childhood education practitioners and higher education teacher education preparation programs. Grounded sociocultural theory, the project connected children's past knowledge and lived experiences with the current community's symbolic culture and offered multiple interactions between the children, teachers, family members, and researchers. The city-sociocultural environment influenced children's cognitive development and learning; in turn, the replica reflected the children's sociocultural functions and how they reconstructed those functions and produced new sociocultural functions.

Lastly, the research journey shows the importance of teachers-children-families' collaboration in promoting children's cognitive development. The photovoice method afforded us the opportunity to capture vivid learning moments with valuable voices from each party: children, teachers, parents/family members, and ourselves. As both participants and researchers, we advanced our research skills. Moving forward with children's cognitive development studies, we highly encourage practitioners to apply, modify, and implement city replicas and neighborhood walks and strongly recommend the photovoice method in collecting and analyzing data, with the hope of discovering new findings in advancing teaching strategies, research methods, and types of collaborations. Like Mitchell's (1991) "Young Geographers", the children in this study engaged in "essentially a creative activity, the product of first-hand observation expressed through free materials" (p. 17) in the construction of the city replica. Thus, this project served as a curricular vehicle delivering opportunities for children to engage in a play-based activity that afforded many specific cognitive skills involving symbolic representation, spatial relations and abstraction. The new "young geographers" mirror those of early Bank Street College as they expanded their cognitive capacities and acquired symbolic representational skills through the city replica project.

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Conflict of interest

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