Spatial reasoning, estimation, drawings and representational skills are crucial elements in the teaching and learning of math among preschool children. These skills are highly correlated with the development of language and communication. Teachers can facilitate development of math-related skill by setting up engaging scenarios in which children can use and improve their communicative and representational abilities. The Village Game, an example of a mathematics education scenario conducted with a group of six 5-year-old children at a municipal preschool in Reggio Emilia, Italy, is organized into four main phases: (1) the construction of a village by a child (codifier); (2) a detailed description of this village by the codifier to another child (decodifier), who attempts to reconstruct the same village just from the codifier’s description; (3) a class discussion directly comparing the two villages; and (4) drawings of the first village from different points of view by all six children. In respect to the development of spatial and communicative competencies, the Village Game offers children the following opportunities:

- Organize objects (possible components of a village) in a space (table) and in relation to each other (in a microspace).
- Define spatial relations with verbal language and gestures by describing a constructed village to another child, who, without looking, must in turn create the “same” village.
- Assess individually, in pairs, and in groups the similarities and differences between the two created villages, expressing the spatial relationship between elements in the “microwpace” (village) and the “macrowpace” (the room where the construction of the villages takes place).
The distinction between macrospace and microspace is important in understanding the nuances of what is occurring for the child in the Village Game. The child exists and moves about in macrospace, while being external to microspace. At the same time the child can explore microspace visually and through manipulation.

Perception through sight in macrospace is not global and so it imposes the assumption of different points of view with consequent use of time (changes in perspectives due to movement are usually slow) of space and of memory (for comparison different perspectives). In microspace we often have the possibility of a relatively global vision from a single (or relatively few) points of view. As a consequence perception is instantaneous and in a relatively short time we have significant changes of perspective. (Bartolini Bussi, 1992, p. 67)

Two other activities of the Village Game include the following:

- Graphically representing some spatial relations by drawing one of the villages from different viewpoints, keeping in mind what can be seen rather than what is known.
- Evaluating and discussing the strategies identified for drawing to render the different viewpoints from which the village has been considered.

These processes of drawing, perceiving, and understanding pictures are important and contribute uniquely to the child’s experience of the Village Game. However as Stetsenko (1995, p. 151) has noted:

The process of drawing should not be treated as isolated from other mental abilities of the child. On the contrary, relating drawing to such processes as language (in both its oral and written form), gestures and symbolic play is equally important, since all these processes are aimed at an overarching task of mastering social semiotic ways of communicating. In fact, such an approach corresponds to Vygotsky’s dialectical claim that children’s development is a dynamic system of unitary but not uniform, integral but not homogeneous processes.

This “multimodal” aspect is an important feature of the Village Game. In this chapter we focus on how construction activity and language (oral, graphic, gestural) elicited by the Village Game support children specifically in exploring, conceptualizing, and representing spatial relations. We discuss the use of artifacts or manipulatives, the importance of group process, and role of the teacher as mediators. In particular we analyze the following:

- The function of semiotic mediation (Bartolini Bussi, 2007; Bartolini Bussi & Boni, Chapter 20, this volume) offered by artifacts set up by the teacher (the elements of the village) in the process of teaching–learning.
- Cognitive, relational, and communicative processes in individuals and groups.
- The mediating role of teachers (Bartolini Bussi, 1996).

The scenario used in the Village Game was inspired by a research program first conducted in Geneva in 1983 by the research team Groupe Mathématique du Service de la Recherche Pédagogique. This program, originated with a Piagetian approach, made use of not only symbolic elements (house, car, animals, etc.) but also nonstructured material
(wooden cubes, parallelepipeds, cylinders, etc.) and was meant to provide teachers with suggestions for teaching practice, without any theoretical framework. In the 1990s, the research group for teaching–learning mathematics in preschools and primary school at the University of Modena, coordinated by Bartolini Bussi, took up the experiment once more with significant modifications (Bartolini Bussi, 1992, 2007). The insights presented here benefit from earlier work (e.g., Arzarello & Robutti, 2008; Bartolini Bussi & Mariotti, 2008) and the educational process within the Reggio Emilia early childhood centers (Bruner, 1966; Edwards, Gandini, & Forman, 1995; Rinaldi, 2006). The work presented here began with an analysis of the “semiotic potential” (i.e., the potential to express the utilization schemes produced in the solution of a given task in mathematical terms, through semiotic activity of the involved objects) (see Bartolini Bussi & Boni, Chapter 20, this volume). Specifically, we investigated the exchanges between coder and decoder in the Village Game activity and teacher effectiveness in facilitating the fabrication, negotiation, and internalization of signs2 (e.g., gestural, linguistic, and graphic) that have spatial significance (Vygotsky, 1931/1978).3

Following the paradigm of the theory of didactical situations of Brousseau (1997), mostly inspired by Piaget’s works, the Village Game is primarily a didactical situation.4 In this communication game, knowledge is constructed within a social context as students attempt to solve a problem situation. In particular, validation of the solution comes not from an external, authoritative source (e.g., the teacher) but from the way the situation itself is structured and organized. Like every adidactical situation, the game is organized into an “action phase” (the construction of a village by the codifier), a “formulation phase” (description of the village by the codifier to the decodifier, who cannot see the codifier), and a “validation phase” (through direct comparison between the villages constructed by the codifier and the decodifier). In addition to this socioconstructivist structure, the game has a strong semiotic and sociocultural character that comes from the Modena group’s post-Vygotskyian5 revision (Bartolini Bussi & Boni, Chapter 20, this volume).

Because of limited space in this chapter, we present only examples organized around three in-depth foci. A more detailed study is in progress. In this chapter, the results are presented from a teacher’s perspective rather than that of a researcher’s. The first section of this chapter focuses on analysis of semiotic potential of the objects (artifacts) related to the features of the game. The second section briefly considers the relationships between language and spatial representation, demonstrating that learning of spatial representation categories, as has already been posited by various studies by Stetsenko in psychology (1995), is highly “multimodal,” with a systemic nature. In the final section we share observations on the crucial role of the teacher. We present and discuss protocols to support our conclusions.

**Experimental Context and the Semiotic Potential of the Artifact**

Creating the entire experiment, we placed particular attention on setting up contexts similar to children’s everyday experience using materials and spaces with which they were familiar, working in small groups and with durations of playing time similar to those in their everyday school life. The playful and familiar dimension meant that the level of enjoyment shown by the children was always high. After the pilot experiment, described in this chapter, the experience was repeated in many other schools, with simi-
lar results. The Village Game was described to a group of six participating children who, in turn, assumed the following roles:

- Codifier (the child who builds the village and then describes it to the decodifier).
- Decodifier (the child who listens and tries to implement the instructions from the codifier to duplicate the village, even asking questions).
- Observer (the child who silently observes the construction and description of the village and participates in the final collective discussion and comparison of the two villages).

The Game comprises a minimum of three and a maximum of six rounds, depending on how long each game lasts. Each game round included the construction of a village, description by the codifier and subsequent reconstruction by the decodifier, and revisitation/comparison by the whole group of the results obtained in terms of similarity–differences between the two villages. Together the children alternated taking the role of codifier and decodifier twice during games. Both meetings lasted about 2½ hours and were filmed with a video camera. The Village Game usually took place in the school atelier, or workshop (for a description, see Edwards et al., 1995), in which two square tables were placed so that the tabletop was completely and easily available to the child at arm’s length. Tables were placed side by side, facing the same direction, and separated by a movable screen. Each table had a chair at the head. To the side of the two tables, five chairs were set out for the observer children and the teacher (see Figure 22.4, on p. 506). The two children acting as codifier and decodifier sat on either side of the screen, and were each given two identical sets of nine objects whose nature and playful qualities lent themselves to the kind of symbolic narrative that is familiar to preschool-age children. The group included Andrea, Asia, Beatrice, Francesco, Gabriele, and Sharon, who worked together with one of the class teachers, Ilaria. The other adults involved, the teacher Erika, and the authors of this chapter took turns recording the game. The children ranged in age from 5 years, 4 months to 5 years, 11 months.

The choice of giving the children nine objects to build up the village conformed to precise spatial criteria and was inspired by research by Lurçat (1986), who reminds us that

> the child’s representation of space is constructed based on fixed objects taken as a reference and this very probably [is] before the constitution of a body schema detachable from her/his organism. … The appearance of language, with the formation of concepts, presupposes the possibility of scission of the body schema from the body in order to project it on objects as the start of individuation. Every object … structures the space surrounding it, appears as a centre of a geographical map whose polarities are the same ones as the body schema: top–bottom, left–right, front–back. (pp. 17–18)

Hence, when faced with an object, there are three main ways (and combinations of them) to project onto it one’s own body schema: by translation, rotation on a central axis, and reflection (symmetry). See Figure 22.1.

We can illustrate these different ways to refer to the position of an object by means of the example shown in Figure 22.2. The map in Figure 22.2 shows a child in front of a square table, where a very little village (a car and two trees) is set down. A football is on the floor, and the teacher is observing the child behind him or her.
Imagine that the child has to describe the position of an object in this village. The child can use the following reference systems:

- An **egocentric** reference system, in which the position of the object depends on the position of the child (“The car is in front of me”), that often implies the use of gestures (“The small tree is on that side”).
- An **intrinsic allocentric** reference system, in which localization is totally defined by spatial relationships within the village (“The small tree is behind the car”).

**FIGURE 22.1.** Scheme translated from Bartolini Bussi (2008, p. 131) based on Lurçat (1986).

**FIGURE 22.2.** Map of a child in front of a little village.
A situated allocentric reference system, in which the child considers some physical elements external to the village but present in the room (“The small tree is on the side of the football”).

A social allocentric system, in which, instead of the ball, the child refers to a person or an animal that is external to the village but present in the room (“The small tree is on the side of the teacher”).

A geocentric reference system, in which the child defines the position of an object in a very abstract way, related to the position of the earth (e.g., the cardinal points; “The car is facing North”). To use this kind of reference system the child needs a very high capacity for abstraction, which can be mobilized if children have been involved in other projects, for example, the observation of different positions of the sun during the day.

In the case of the use of an intrinsic allocentric reference system, there are many possible ways to define the position of an object. For instance, the child may not take into account the polarity of the objects and say:

1. “The big tree is behind the car,” projecting his or her body schema on the car by reflection. In a projection by reflection, the observer defines the position of an object in relation to him- or herself, as if it were reflected in a mirror.
2. “The big tree is in front of the car,” projecting his or her body schema on the car by translation. In a projection by translation, the observer defines the position of an object in relation to him- or herself as if the object has the same spatial positioning as the observer body.

Otherwise, the child may take into account the polarity of the objects and say:

3. “The small tree is on the right of the car,” projecting his or her body schema on the car by reflection or translation.
4. “The big tree is on the right of the car,” referring to the intrinsic polarity of the car and projecting his or her body schema on the car by rotation, as if he or she were the driver. In a projection by rotation, the observer defines the position of an object in relation to him- or herself, by identifying with it.
5. “The small tree is behind the car,” referring to the intrinsic polarity of the car and projecting his or her body schema on the car by rotation.

These are only examples to show the complexity of the task. There is no “right” or “wrong” way of describing the spatial situation. However, there are more and less effective ways for children to communicate meaning to each other.

One feature of an object (i.e., whether it has an intrinsic front and back) is especially useful in the spatial reasoning tasks in the Village Game. Objects with parts that are intrinsically described as front and back are called canonic. Those that do not are called noncanonic. Canonic objects have this quality because of some feature—direction of movement (e.g., the little car); the presence of organs of perception (e.g., animals, persons, figures, or dolls with human likeness), particularly visible faces (wardrobes, house, mirror, painting)—or because of their adaptation to the human body (e.g., a chair). Noncanonical objects, such as a stone, a tree, or a box, are objects without particularly privileged parts. For this reason their orientation or location can only be described pro-
visionally and in a way that requires us to take into account the perspective or position of the subject or viewer.

Canonical objects provided to children included the following:

- A “house” made of cardboard or other material of a sufficient size to totally or partially hide other elements of the village, and with front and back openings allowing the total or partial insertion inside the house of other village elements. The outer walls of the building were different in such a way as to pose the orientation’s problems for the children at different times in the game. The hypothesis underlying the use of the house is that it represents an element central to the village from not only a perceptive point of view but also an affective point of view. We thought that the house would be the first object positioned in the village, around which the children would organize various spatial relationships. The house allows a projection of one’s own body schema through both reflection and rotation.
- Two human figures (one male and one female): canonical and affective elements given prevalent polarity by the presence of organs of perception. Body schema can be identified with the figures through translation or by rotation.
- An animal: an affective and canonical element with prevalent polarity due to the presence of organs of perception and whose body schema can be identified both by translation and by rotation.
- A means of transportation: a canonical element with prevalent polarity due to the direction of movement and onto which it is possible to project body schema by reflection and by rotation.
- A chair: a canonical element with prevalent polarity because it is an object made for bodies, and it allows projection of body schema by means of translation, reflection, and rotation.
- A ladder: a canonical element with prevalent polarity (top–bottom) that is particularly easy to codify graphically as an isolated element but with increasing complexity in relation to others (e.g., a figure placed on the ladder). This element allows projection of body schema through translation and through reflection.

Noncanonical objects included:

- A low tree: an element that allows projection of body schema by translation and by reflection.
- A tall tree: an element that, because of its size, can obscure or allow only a partial view of another object, and that allows a projection of body schema by translation or by reflection (see Figure 22.3).

The artifact derived from the combination of all these elements can be used by the teacher as a tool of semiotic mediation in the process of teaching–learning appropriate spatial categories and signs. Using this artifact, the teacher can support students’ production of situated spatial signs. In addition, by using either spontaneously generated or appropriately provided pivot signs described by Bartolini Bussi and Boni (Chapter 20, this volume), the teacher can assist in the transition of signs connected to the world of the artifact toward mathematical signs used in the reference culture. Help is needed because geocentric reference systems, which are independent of the particular situation (e.g., not dependent on movable objects), and intrinsic allocentric reference systems, which are based on objects’ spatial features within a constrained context, are not always easily integrated.
Phases of the Game

Constructing and Dictating the Village

After the teacher has shown the materials to the children and invited them to comment on each element in the set, he or she proposes that a couple of children take turns constructing a village. The codifier first constructs a village, then “describes” it to his or her companion (the decodifier), who, by asking questions, tries to construct an identical village (Figure 22.4) using only the communication from the student codifier. The codifier is usually behind the decodifier.
Comparing the Villages

After a child has described the village (codifier) to a friend (decodifier), the screen separating them is taken down and the whole group enters into an exchange discussion about the two villages created (see Figure 22.5). Ideally, the outcome is not someone winning or losing, but an interpretation of a shared learning endeavor. In fact, group evaluation is not limited to counting how many objects are “mistaken” or “correct” but involves “how” oral communication between the codifier and decodifier takes place. The role of the teacher at this point becomes fundamental for guiding the process of validation: supporting the children’s expression, reciprocal listening, and memory of expressions used in speech by the codifier and the questions asked by the decodifier. Annotation, mirroring, and paraphrasing (Bartolini Bussi, 1998a) of speech terms and gestures used by the children are important. In this way, in fact, the teacher is able to create the conditions in order to explore constructed personal meanings to foster the production, sharing, and negotiation of situated signs of a spatial nature, which are significant for the child, and to graft the mathematical signs onto the situated signs (see Bartolini Bussi & Boni, Chapter 20, this volume), which is the long-term objective of this learning–teaching process.7

Drawing the Village from a Specific Point of View

After the group discussion, a village is reconstructed on a large table. The children sit around the table on different sides, and are asked to comment, then draw what they see from their specific points of view (see Figure 22.6). Nothing can be taken for granted in this operation at the preschool age. In fact, it means separating ourselves from what we know exists and taking into account only the things we see, which, in some cases, may not be the most characteristic part of the figure or object (as happens with a person’s profile or an animal’s front or back).8

FIGURE 22.5. Second phase of the game: Comparing the villages.
Individual and Group Evaluation of Drawings

After drawing the village from their individual points of view, the children take turns to recount their own drawing to the others, to answer questions, and to observe and comment on other children’s drawings (see Figure 22.7). This individual and group rereading of their own drawings and those by others encourages the children to explore more deeply the signs of a spatial, oral, and graphic nature that have already been introduced, thus allowing them to establish new and more vast semiotic connections (Bar-tolini Bussi, 1993, 1996). Making explicit their personally constructed meanings, and their ways of graphically representing them, facilitates children’s distancing themselves from their productions and helps them to become more conscious of their own thinking and to discover possible alternative strategies for representation.9

The experiment described in this chapter had a further stage. In fact, the children were asked to move from the microspace of the village constructed on the table to the
macro-space of the school playground. The analysis resulting from this phase of the experiment is still in progress. In this chapter we limit ourselves to the first part of the experiment (excluding the macro-space stage in the school playground).

**Analysis of the Semiotic Potential of the Artifact Actually Exploited**

After the experiments, we analyzed what features of the various objects (previously discussed) were really used in the children’s processes of locating the objects in space, which reference systems children used more frequently in relation to the different objects, and whether, based on Lurçat’s classification, there was decentralization and, if so, what types of projection of body schema the children used in relating to the various objects.

We observed that, relative to different potential modalities for projection, the children showed a differential ability. They were able to decentralize their points of view relative to front–back orientation (at least for some of the objects), thus localizing one object relative to another using the objects’ own polarity. On the contrary, this was not true for lateralization. In the case of left–right orientation of the various objects, the children usually adopted an **egocentric** or **intrinsic allocentric** reference, mainly with reference to the house. In the following section, we summarize what we observed for each object in the village.

**The House**

The house was the first element to be positioned by all the children. This observation is perfectly consonant with all experiments carried out previously. The house polarizes the space in the sense of inducing an initial **allocentric** reference system, in relation to which all other objects are organized and located successively. Some of the house’s features, specifically, a door, windows, and a large door that the children interpreted as a garage, proved to be particularly useful in the clear identification of front and back. The house aided the use of **egocentric** reference systems and **intrinsic allocentric** reference systems, with projection of the body schema by reflection and not by translation (e.g., 295. Andrea: Francesco, I put the house on the right [indicating the right side with his hand] or 787. Asia: [pointing with hands and arms joined] I put the house turned to the left).

**The Automobile**

The position of the car was usually described using **intrinsic allocentric** reference systems. The decision to use an **allocentric** reference system, although not exclusive, is supported by the obvious possible connection between car and garage, which offers an “easy” solution to the spatial problem (e.g., 162. Francesco: And I put a car inside the garage).

**The Horse**

There was a growing awareness of this object’s semiotic potential. Initially the horse was considered globally but later reference was made to its polarity (presence of a differentiated front and back). This generated a great increase in the number of sentences...
for a more precise localization/positioning. On both days, there was a prevalent use of intrinsic allocentric reference systems (e.g., 176. Francesco: After I put the horse on the left side of the house) and social allocentric reference systems (e.g., 344. Gabriele: What about the horse’s nose? On Erika’s side?). 345. Francesco: No, no, on Erika’s side; 346. Gabriele: On Ilaria’s?; 347. Francesco: Yes, on Ilaria’s side! And later 352. Francesco: And I put the little tree close to the horse; 353. Gabriele: But where? Against the wall or ... or on the other side?; 354. Francesco: No, near to the horse in front of its nose [Francesco repeatedly brings his cupped hands close to his own face]. 355. Gabriele: Done it!).

The obvious polarities indicated by the presence of the horse’s nose and tail functioned as elements for organizing space. This took place with the children not only at the time of construction/dictation but also, and above all, at the group discussion of the drawings.11

**The Male and Female Characters**

Out of 109 statements for localizing/positioning the human figures, only three statements used an egocentric reference system. Most of the reference systems used were intrinsic allocentric and connected to front–back polarity. This showed that children are capable of decentering and projection of their body schema relative to front and back (e.g., 568. Andrea: ... with her face at the window). In other cases, the characters were localized in relation to other elements created for the body, such as the chair or the ladder (e.g., 562. Beatrice: But the little woman ... the lady ... I put her ... sitting ... on a chair or 317. Andrea: The builder goes up the ladder). The children also seemed less willing to accept approximation when defining the position of human elements compared to other types of elements within the village. This led to multiple specifications and questions, and allowed the children to discover the effectiveness of these communication strategies.

**The Vegetation Elements**

There are two trees in the set of objects, one tall and one short, that for the most part were positioned by children using an intrinsic allocentric reference system (e.g., 602. Andrea: The big tree is close to the horse, with its tail touching the tree) or a social allocentric reference system (e.g., 794. Asia: “And then the big tree turned toward the right which is facing just where Erika is). More than the other elements, and probably because of their noncanonical nature, they seem to raise the question of defined distances for the children, with general qualifiers (e.g., 593. Andrea: Yes ... but a little bit far ... and a little bit near! or 595. Beatrice: Medium, do you mean? and 596. Andrea: Yes. A bit medium). The left–right spatial relationship was also often brought into play in positioning the trees and was provisionally resolved by children using a generalized “near to” that, however, the children themselves who sought more precise spatial terms began to consider insufficient (e.g., 162. Francesco: ... then on the other side of the house on the right I put its trees or 592. Beatrice: Is it toward the light table?). In conclusion, we can affirm that, in general, the part of the semiotic potential inherent in the artifact was actualized. However, much potential remains to be more deeply explored, probably by changing the available variables (introducing also a car the human characters may enter, etc.).
Language, Drawing, Gesture: The Need for a Multimodal Approach

In this section, we wish to draw attention to a fundamental aspect of the research project. As we have already said, the hypothesis, inspired by Vygotsky’s theory, that runs through the entire experiment is that the process of conceptualization of space is multimodal. Therefore, it is not possible to deal with the issues of children’s cognitive processes connected to space without, at the same time, considering all the different systems of spatial signs they utilize. From this perspective, the drawing should not be treated as a separate area of competence. Together with the other sign systems, it contributes to our understanding of the cognitive development of the child. As Stetsenko strongly emphasized (1995), this development is a single dynamic, although it is not necessarily uniform and homogeneous. From the point of view of teaching practice, then, we need to organize activities that mobilize and bring together in various ways the different sign systems. For this reason the sequence of the Village Game includes acting, comparing, drawing, and discussing the drawings. On the other hand, from the point of view of analysis of cognitive processes, it is necessary to consider the child in his or her entirety and complexity, including affective issues. Therefore, we did not limit ourselves to analyzing only the child’s linguistic ability. We also collected evidence (not detailed here) of the importance of the narrative aspects (i.e., to describe the village by telling a story) that were not mobilized in similar tasks concerning nonstructured materials.

The case of Gabriele, in contrast with that of Beatrice, is illuminating in this respect. At the end of the second day of the experiment, in the phase of drawing from one’s own point of view (see Figure 22.8), Gabriele produced the drawing shown in Figure 22.9. The horse’s position represented a significant problem for Gabriele. During the execution of the game, in which he acted as decodifier, Gabriele held a lengthy discussion with the codifier Francesco to understand where Francesco had situated the horse. Gabriele expressed very well the way the horse’s position could be communicated, starting from essential elements, such as head and tail (see discussion 431–445).

When he made his drawing, Gabriele first drew the horse and represented it, starting from exactly those elements that were most visible from his viewpoint: the rear

**FIGURE 22.8.** Gabriele’s point of view.
of the horse and the tail. Consistent with this, in the phase where he talked about his
drawing, he said:

801. **Gabriele:** I can see [the horse’s] bottom and the tail and so I drew its bottom
and tail!

Gabriele, who was the youngest child, carried out his task effectively, with extremely
schematic lines (almost symbolic), in contrast to his companions, who were much more
preoccupied with life-like details in their drawings. For Gabriele, the issue of represent-
ing the elements of the village from his own viewpoint appeared to be the main prior-
ity. If we limited ourselves to this case, then we might infer a linear consequentiality
between oral language and graphic language, as if the drawing were nothing other than
a translation of what had been said, or as if the drawing posed no difficulties other than
those of manual and executive skills.

The case of Beatrice demonstrates a more complex purpose of the drawing. In fact,
in the discussion phase preceding the phase of drawing from her individual viewpoint
(which also took place on the second day) Beatrice seemed to express her concept of
point of view clearly and confidently:

675. **Teacher:** ... and what does “point of view” mean in your opinion?
676. **Beatrice:** That we try to draw what we can see ... them.
677. **Teacher:** (writing) We try and draw what we can see ourselves. ... What
do you mean, Bea? Explain it to me properly so that so you can let Gabriele,
who is playing, understand as well.
678. **Beatrice:** That a person is ... a point. ... It’s Andrea who can see some-
thing.
679. **Teacher:** A person is in a point that sees something.
680. **Beatrice:** That in another point sees a different thing, and in another point
a different thing from the thing in other point.
681. **Teacher:** For example, what are the points here?
682. **Beatrice:** I can see half the car (*pointing with her right-hand forefinger*), the horse, the little man, and the lady who is there on the chair . . .

683. **Teacher:** But?

684. **Beatrice:** I can’t see it . . . and then I see the tree.

685. **Gabriele:** And the car . . .

686. **Teacher:** And can you see the car properly?

687. **Beatrice:** No, so-so.

688. **Teacher:** So-so. . . . What can you see of the car?

689. **Beatrice:** (*bringing the palms of her hand to within 5 cm of each other*) Half of it.

690. **Teacher:** Half . . . so what do you have to . . . [what] can you draw?

691. **Beatrice:** Half!

After this dialogue, we might have expected a “correct” drawing, or a drawing consistent with what Beatrice stated. Instead, at the time of drawing (even though the teacher clearly stated and repeated the request that she draw only from her own point of view), Beatrice could not resist representing the most significant side of the house, the front, and all the other elements of the village (see Figure 22.10). She did this even though her point of view was of the side of the house (see Figure 22.11). At the end of the drawing, in the discussion phase, she explained her choices in the following way:

971. **Beatrice:** Even though I couldn’t see it, I thought hard and I tried to draw it without seeing.

Evidently, in Beatrice’s case there is not a consequential linearity between what she said and what she drew. All the same, to interpret behavior of this kind, as Freeman (1980) has already shown, it is not enough to put forward the argument of Piaget and Inhelder

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FIGURE 22.10. Beatrice’s drawing.
(1967) that a child represents everything he or she knows in a drawing. Actually, among the things Beatrice knows, although still only in an embryonic form, is what drawing from a certain point of view means. In 1980, Freeman had already proposed analyzing infant drawings in terms of problem solving (i.e., tasks involving the mobilization of a multiplicity of abilities). This view does not conflict with our Vygotskian perspective because it aims to take into account the complexity of the drawing activity and considers this activity in relation to the rest of the subject’s abilities. In a sense, spatial thinking is what enables the child to work with images he or she has constructed from personal experiences enacted in physical space, but then manages to transform [sometimes] only in his or her mind (Yakimanskaya, 1991). In the past (and also stemming from Piaget’s studies) drawings have often, and sometimes naively, been used as indicators of a child’s spatial competence. It was mistakenly thought that the better a child’s spatial competence, the better his or her competence in drawing, both for the creation of a photorealistic drawing and the ability to organize the page spatially. In fact, to speak of a child’s “spatial competence” means to have different abilities in mind. As Stetsenko (1995) reminds us, the performance we observe must instead be considered as a mixture of competence and of understanding the task, which do not emerge separately as givens. They are built up in a dialectic relationship between action and communication on intra- and interpersonal levels.

The Teacher’s Role

In the Vygotskian framework in which this experiment was created, special attention was always paid to the function of the teacher (Bartolini Bussi, 1998b; Falcade, 2006). Apart from managing the teaching contract (Brousseau, 1997), the teacher is also of fundamental importance in guiding and supporting the process of semiotic mediation (see Bartolini Bussi & Boni, Chapter 20, in this volume). Rather than a detailed analysis of the teacher’s role, we present some points for reflection.
First and foremost, we observe that a fundamental part of the teacher’s mediating function is helping with a cooperative and selective reconstruction of the situation (e.g., see 432 and 434 in the following dialogue), that is a shared reconstruction in which the fundamental elements of the activity are highlighted according to the objectives of the teaching project. In particular, through questions of the type, “and what does … mean in your opinion?” (675), the teacher helps to make explicit and to share the different personal meanings constructed during the course of the activity. Reconstructing and revisiting the activity helps children to generate signs, share them, and negotiate them, thus potentially internalizing them.

Generally, signs generated during a collective discussion *orchestrated* by the teacher (Bartolini Bussi, 1998a) are for the most part situated signs (i.e., directly connected to the activity with the artifact). However, given the deeply educational nature of the proposed activity, these signs have an implicit but strong connection with the mathematical signs of the reference culture. Starting from these situated signs, then introducing new signs or using *pivot signs*, the teacher establishes relationships with the mathematical or culturally pertinent signs that are the objective of her teaching.

Another of the teacher’s fundamental roles is to guide the phases of validation and highlight elements that are significantly conflictual. In the phase of comparing the villages, after Francesco’s “description” to Gabriele, the teacher helps them to focus on the origin of the wrong location of the horse chosen by Gabriele, due to his improper use of an egocentric reference system by the codifier Francesco:

431. **GABRIELE:** Oh, because he said … Francie said the nose is where I am!

432. **TEACHER:** It’s true. He said the horse’s nose is where you were … but instead? … but I could see Francie. … He was gesturing, he was doing gestures. … Francie, what were you doing when you were placing the horse? (Mimes the gestures Francie made with his hands.)

433. **FRANCESCO:** I was here, Gabriele. (*Sits down in his place.*) Gabriele, I was here …

434. **TEACHER:** So then? … What does that mean then … if you were there?

435. **FRANCESCO:** (*standing up and going to sit nearby the decodifier’s chair*) I could see … I could see you … even though there was a screen and I was behind it … after I could see you on this side.

436. **TEACHER:** What could you have said otherwise, Francie? Instead of saying “the nose is near where you were,” was there another way … just a minute … another word?

437. **GABRIELE:** (*sitting down in his place*) You said the nose was near where I was, not …

438. **FRANCESCO:** Oh, I could see you from here. (*Goes back to his place.*)

439. **TEACHER:** Francie, could you have given him some other help … in your opinion?

440. **ANDREA:** (*Says something but it can’t be understood.*)

441. **TEACHER:** (*to Andrea*) Just a minute.
442. **Gabriele:** You should have said the tail was where (*with his right hand, pointing to himself*) ... where I am!

443. **Teacher:** Should you have said the tail was where I am ... or rather, Asia? (*to Asia, who seems to have suggested something*).

444. **Asia:** He could have said that “the face turned toward the light table (*stretching her left arm to point to the light table in front of the two game tables*) and the tail turned toward Gabriele”!

445. **Teacher:** What could he have taken? Could he have thought about all the things there are around this space?!

Observe how the teacher, by not only using questions (434, 436, 439) but also gestures that mirror the child’s gestures (439), helps Francesco to reconstruct the situation and to become aware of the origin of his mistake. In particular, by redefining and narrowing Francesco’s task (439), she helps him to explore other communicative strategies and adopt a more pertinent reference system. Furthermore, the teacher knowingly orchestrates the other children’s interventions: She asks Andrea to be silent (441), while giving value to Asia’s intervention (443) when she suggests adopting a *situated allocentric* reference system shared by everyone. To finish, she generalizes Asia’s intervention (445) by calling attention to the existence of spatial elements other than people (444). In this way, she helps the children to understand the efficacy of different reference systems.

The *social allocentric* reference systems, like the one adopted by Gabriele (442, 444), are more comprehensible but more fragile (because of the high mobility of people) compared to *situated allocentric* reference systems.

As Bartolini Bussi (1988a) has observed, this communication strategy of *generalizing*, together with *particularization*, makes it possible for the teacher on the one hand to extend an affirmation’s dominion of pertinence (thus helping the process of abstraction and expansion) and on the other to go back to the context of the activity, when a too-general statement is vulnerable to not being fully understood or taken in by the children. Through other opportune communication strategies, such as *mirroring* (432, 443) and *paraphrasing* (Bartolini Bussi, 1998a), the teacher institutionalizes or “relaunches” the discussion and helps to establish connections. In the paragraph relating to the dialogue with Beatrice about what it means to draw from a certain viewpoint, still through *mirroring* (677, 679), the teacher temporarily ratifies the child’s statement, thus reassuring her of the direction in which she is going and aiding deeper exploration of what has been outlined.

**Conclusion**

Analysis of the experiment proposed in this chapter is far from having been concluded. However, results already obtained are extremely rich and have suggested repetition of the same experiment with other children in other schools, in Reggio Emilia and elsewhere. We have seen how the experiment presents vast semiotic potential and allows for mobilization of multiple reference systems, providing an opportunity for generating, utilizing and reinvesting diverse signs of a spatial nature in various contexts (microspace, macrospace) and various semiotic systems (gestural, graphic, and linguistic).
We did not report other results of the research in this chapter, but the Village Game proved very effective in dealing with the challenges related to reference systems and coordination of spatial perspective. These are related to problems of decentration, on which Piaget himself was the first to work (see the celebrated Three Mountains Task), and to several interpretations about development of children’s spatial competencies in terms of a linear, step-by-step process. The data gathered, even if they concern a very small group, allowed us to refute an overly simplistic view espousing a linear development of children’s spatial competencies from an egocentric reference system to an absolute, objective reference system. As already demonstrated in established studies (Pontecorvo & Pontecorvo, 1986), it can be observed that the choice of reference system does not appear to be connected so much to cognitive development of the subject as to the type of task. Therefore, these are not depending on cognitive development competencies but are “domain-specific” competencies (i.e., deeply connected to the type of situation and context in which they are mobilized) (Karmiloff-Smith, 1992). From our point of view, the concept of “reference system,” on the one hand, is a tool allowing access to cognitive processes of a spatial nature in an individual and, on the other hand, given its centrality and versatility in not just mathematics, is a fundamental object of teaching–learning in primary schools. In particular, we believe that the construction of representations of spatial categories should be one of the fundamental objectives of early childhood education. From an educational point of view, the situation provides a significant learning context. From a research point of view, it provides a possibility for further exploration of links between not only gesture and language but also language and drawing in processes of spatial conceptualization. Furthermore, from a social implications point of view, it can be efficiently reinvested in teachers’ professional improvement during inservice training, using the vast collection of videotaped sessions as training tools. The situation is also robust, having been transposed several times both in preschool and primary school contexts, and also outside the Reggio Emilia institution, by both teachers and prospective teachers during school apprenticeship.

The situation opens up various possibilities. For example, the difficulty in quantifying relative distances between the various objects in the village, manifested in many of the children’s interventions, suggests that we should work on new educational journeys to approach issues connected with either measuring or estimating distances. On the other hand, the transition from a 3D situation to its 2D representation, which is not straightforward, posed for the children the interesting problem of perspective drawing. From this point of view, it would be interesting to construct an activity using digital photo cameras for quick comparison of children’s own drawings. Finally, it could be advantageous to set up a transition to the macrospace of the school playground. In fact, when we carried out such an evolution of the game in our experiment, it showed a lot of potential. For example, we could observe how drawing in this new dimension contributed to further clarification of what it means to observe and to draw from a certain viewpoint, and led some children to become aware and to evaluate their own personal implicit reference system, as well as supported the explicit and negotiated adoption of a shared reference system, which is a first step toward the idea of an absolute reference system.

The situation described in this chapter also shows indirectly the robustness of the theoretical framework (previously used only in primary school) in which the reference system was developed and analyzed, and contributes to clarifying processes connected with using an artifact as an instrument for semiotic mediation on the part of the
teacher. The theoretical framework proved to be easily accessible to teachers, as well, and improved their ability put the theoretical concepts into practice.

Notes

1. According to the Vygotskian perspective, by “artifact” we mean a particular object with its intrinsic characteristics, designed and realized for purpose of accomplishing a particular task.

2. Vygotsky distinguishes between the mediation of technical tools and that of psychological tools (signs, tools of semiotic mediation). Both are part of the cultural heritage of human-kind, and were produced and used by human beings, evolving over the centuries but maintaining their functions. Although clearly distinguished, “signs and tools” are assumed by Vygotsky (1931/1978, p. 53) in the same category of mediators. As for their function, the difference between signs and tools rests on “the different way that they orient the human behaviour” (Vygotsky, 1931/1978, p. 54). The tool’s function is externally oriented; it is to serve as the conductor of human activity aimed at mastering nature. The sign’s function is internally oriented; it is a means of internal activity aimed to master oneself.

3. For applications at the elementary school level, see www5.indire.it:8080/set/set_linguaggi/ul/o/lingomat/pres.html.

4. In his text Theory of Didactical Situations in Mathematics, Brousseau (1997) states the following:

   The modern conception of teaching therefore requires the teacher to provoke the expected adaptation in her students by a judicious choice of “problems” that she puts before them. These problems … must make the students act, speak, think and evolve by their own motivation. … The student knows very well that the problem was chosen to help her to acquire a new piece of knowledge, but she must also know that this knowledge is entirely justified by the internal logic of the situation and she can construct it without appealing to didactical reasoning. Not only can she do it, but she must do it because she will have truly acquire this knowledge only when she is able to put it to use by herself in situations which she will come across outside any teaching context and in the absence of any intentional direction. Such a situation is called an adidactical situation. … This situation or problem chosen by the teacher is an essential part of the broader situation in which the teacher seeks to devolve to the student an adidactical situation which provides her with the most independent and most fruitful interaction possible. … She is thus involved in a game with the system of interaction of the student with the problems she gives her. This game, or broader situation, is the didactical situation. (pp. 30–31)

5. We can consider the Modena group’s approach to be post-Vygotskian because of the reference not only to Vygotsky but also to other post-Vygotskian authors, such as Luria, Leonti’ev, Stetsenko, and so forth.

6. Because of the post-Vygotskian vision of this chapter, it is not possible to separate the production of signs and the process of conceptualization accompanying it. Our view, then, like Vygotsky’s (1934/1986), is that to speak of sign construction is the same as speaking of meaning construction.

7. Each game lasted about 5–7 minutes. Our experiment examined, in 2 days, nine rounds of games in which all the children played both codifier and decodifier. The nine episodes of comparison, one for each game, lasted an average of 5 minutes.

8. In the 2 experiment days, the two drawing sessions from individual points of view lasted about 20 minutes each.

9. This phase of the experiment lasted from 5 to 10 minutes for each child. Because all six children were present both days, the total length of this phase was 100 minutes.
10. In reality these two systems (egocentric and allocentric with projection by reflection) are not distinguishable in the case of the house. In fact, when we say, “I placed the house facing right,” this can mean “I placed the house with the facade turned toward the right of the person positioning it” (egocentric) or “I placed the house with the facade turned toward the house’s right-hand side” (allocentric with projection by reflection).

11. One part of an episode related to a group discussion of the horse’s position is covered in more detail later (430–444).

12. Figure 22.4 shows Gabriele, the decodifier, in front of Francesco, the codifier.

13. To characterize/define the position of an object, it’s important for children to learn not only to use egocentric spatial reference systems but also to mobilize multiple points of view (“decentration”).

14. This step-by-step interpretation, at least in Italy, is a widespread misconception shared at preprimary and primary levels by most teachers, who transpose it in a normative sequential approach to the teaching–learning of spatial competence.

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