UNIT 17 UNDERSTANDING SHAPE, SIZE AND SPACE

Structure

17.1 INTRODUCTION

Children come to school with a lot of experience in dealing with shape, size, and space. The experiences in preschool and early primary grades need to be such that they help the child to organize their prior experiences and develop these concepts further. However, this is not the usual scenario. Development of these concepts is generally not emphasized as much in schools. However, as a teacher of pre-primary and early primary grades learners, you need to be aware of the following:

- What understanding and experiences about space, shape, and size do children already have when they come to the preschool or join the school in Grade 1?
- How do children begin to engage with concepts of shape, space, and size during their early years and how does their awareness and understanding of these concepts develop over the year?
- What can you do as a teacher to expand children's engagement with these concepts and keep them developing them further?

We have discussed these three aspects in two Units. This Unit will help you answer the first two questions mentioned above while the next Unit discusses the third question.

Objectives

After reading this Unit, you will be able to:

- describe the concepts related to space, size, and shape that children engage with and develop in the early years;
- explain how children develop these concepts;

- state the sequence in the emergence of these concepts with age (i.e., the developmental sequence); and
- know why we need to extend children's understanding of these concepts.

17.2 EMERGENCE OF CONCEPTS OF SPACE, SHAPE, AND SIZE DURING INFANCY AND TODDLERHOOD

The infant's earliest interventions in her spatial environment are through reaching out for objects, holding them, touching them, and moving them in different ways – rolling, pushing, pulling, banging, and sliding them. To move toward objects and places, crawling and walking are the ways used by the infant. All these actions involve the use of space and, in turn, help the infant in understanding the space around her, and the placement of objects in this space.

Can you think of some examples that show how children interact with objects and the space around them? Write your response in the space provided below.

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Gradually, as the infant starts developing language, her words reflect her increasing understanding of the space-related features of her physical environment. A three-year-old, and even a younger child, spontaneously uses words such as 'near-far', 'big-small', 'up-below', and 'in front of-behind' as she compares one object with another in terms of distance, size, height, position, etc. For example, the child says, "The ball is under the table." Or if you ask the child, "Give me the box near you", the child gives you the correct box. If we were sensitive to the development of children's thinking, we would be quite amazed at the concepts these very young children have acquired!

Infants put objects into containers and place things on top of each other. This shows that the young child understands how things are in relation to each other. These examples show how children through their interaction with the environment spontaneously acquire concepts of shape, space, and size. Of course, the child may have difficulty in explaining the meaning of terms related to size, shape, and space, but through her actions, it is clear that she understands and uses them correctly in her everyday context. The interesting point is that the young child develops these concepts without especially having been taught these formally. We, adults, do not quite appreciate how much the child already knows before the child begins to formally learn in school! Consider the following examples to understand what we mean.

Example 1

Nine-month-old Vishal has just learnt to crawl. He follows his mother wherever she goes. The mother, tired of having to be careful about him, finally makes him sit on the bed. Vishal cries and crawls almost up to the edge of the bed but does not get down from the bed.

Example 2

Two-year-old Hia is trying to grab the mobile phone placed on the table. Her hand does not reach up to the telephone; it is still a few inches away. Hia stands on her toes and now the mobile phone is in her hands! She turns around and gives her mother a joyous smile.

Example 3

Three-year-old Apurva's aunt tells her, "Oh wow! Your shoes are very nice! Can I have them?"Apurva replies, "No, they will not fit you. My shoes are small and your feet are big."

Example 4

Three-year-old Dheer is with his parents in a different city. His grandmother, talking to him over the telephone, tells him longingly, "I miss you. You come to me!" Dheer says, "How can I come? I am far." The grandmother replies jokingly, "You come through the telephone!" Dheer replies, "I can't…my head is big. It will get stuck in the telephone."

In each of the examples, can you identify the concepts children have understood? Think and then read our description further. Do you have some experiences of your own or do you recall some incidents that have been related to you which show children's understanding of shape, space, and size? Think and write your thoughts in the space given below, and then read further.

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In the first example, the child does not get down from the bed because he can make out that the bed and the floor are not at the same level. The child can make out that the bed is **higher than** the floor, and also **the depth** is more than the reach of his feet when getting down. Perceiving depth is an important space-related ability – it helps the child to be able to judge the distance between objects and himself correctly so that he does not bang into things. Research shows that infants as young as six months old can perceive depth.

Hia's example brings out that she can perceive when objects are **near and far** from her (in other words, how they are placed in space) and she can do something to solve her problem.

Apurva's and Dheer's example brings out the children's understanding of **relative size** – that objects are **bigger and smaller in comparison with each other.**

These examples reflect young children's understanding of space, shape, and size which grows and develops into complex concepts of geometry later on. As we said earlier, while children's actions show that they have this understanding, they may not be able to explain their understanding.

We adults, generally, do not pay attention to children's conversations and activities to find out what children know. However, if you make it a point to think about what is it that the child reveals about herself, and her understanding, through her activities and speech, you will get many examples where children during play and conversations with each other use concepts of space, size and shape such as 'above-below', 'near-far', 'big-small'.

17.2.1 When and How do Early Space, Shape, and Size-Related Concepts Emerge?

Through the examples shared above, we have seen that infants and young children have an understanding of space, shape, and size. Many researchers have tried to explore what kind of understanding children have regarding space, and how this develops. The most significant research in this regard has been done by Jean Piaget and In helder. They conducted numerous experiments to understand this dimension of the child's mental functioning. You have read about Piaget's theory of cognitive development in MCD-001. Here, we will discuss his theory with reference to the development concepts of space, shape, and size.

According to Piaget, the child begins to develop concepts related to space, shape, and size as early as 2-3 months of age. However, it is when the child is around 10-12 months of age that there is a significant development of spatial understanding because of three reasons:

- This is the time when the child develops coordination between her senses of vision and touch. Consequently, the child is better able to organize her movements and act upon objects.
- The child begins to be able to represent objects in her mind. In other words, the child can think of objects and recall them in her mind even when they are not present before her. As you know, this means that the child has developed object permanence.

Let us understand what we mean by these two points.

Concerning the first point, when the child discovers that her movements can affect objects, she makes such movements repeatedly. As the child becomes better at **holding, moving, pushing, and touching objects** in different ways, and as the **co-ordination between her eyes and hands improves** (i.e.,

between seeing and touching), she learns to differentiate between and analyze shapes and sizes of objects. At this time, her understanding of space, size, and shape improves rapidly. **Transferring** an object from one hand to another, **rotating** it in different directions, **touching** it, and **observing** it carefully, are very important activities that contribute to developing space, shape, and size-related concepts. **Repeated experiences** of touching and examining different objects help the child to rapidly develop a stable understanding of different sizes and shapes. In using their knowledge and displaying it, they have new experiences and make newer deductions and generalizations.

It will be easy for you to understand what we are saying if you observe a young child – around one year of age – playing with objects. This will give you an idea of how she tries to understand the size and shape of an object. For example, the child will pick up a toy car and explore it by turning it this way and that; if there are parts that protrude out, she will try to rotate them or pull them. If there is a piece that looks different from others, she would observe it even more carefully. She may try to slide the car or move it in some other way; maybe she would drop it or bang it a few times; she may try to roll it down the stairs or drop it from different heights.

When the child does all of this, we adults get disturbed that the child is not playing with the toy the way we think it should be played with. We may even get upset that the child is breaking a new toy that has been just bought for her! However, the child is playing and exploring the toy, in her own way. It is only through such investigation, exploration, and play with objects that the child develops concepts of shape, size, and space. **We need to understand a child's way of playing rather than telling her to play the way we think is appropriate.**

Concerning the second point, Piaget and his co-researchers explain that the child develops an understanding of the world around her through two processes:

a) The first process is developing an understanding of the environment **through direct contact with the objects** – that is by directly seeing, hearing, smelling, and touching, objects. This is called **understanding based on perception**. This process begins at birth, and gradually the child acquires knowledge in this way.

b) The second process is that of **visualization or mental representation.** This means that child can recall and see an object in her mind, even when the object is not present before her. This ability to be able to recall to one's mind an object which is not present before (in other words, visualizing the object) develops gradually through repeated experiences of actually seeing, hearing, handling, and exploring different objects. As the child examines an object using her various senses, she develops an idea about its shape, size, texture, weight, and appearance and she integrates all this information to form a picture of the object in her mind, so that finally she can bring all these features of the object to her mind even when the object is not present before her and can think of / visualize the object. For example, as she handles different types of balls,

she derives the features which are common to all balls so that when she hears the word 'ball', she can bring a picture of it to her mind, even though it is not present before her.

Thus, the process of repeatedly playing and engaging with (or we can say exploring) objects helps the child to develop a picture of the objects in her mind so that she develops the ability to recall an object in her mind even though it is not present before her. When the child can do this, her understanding of shape, size, and space grows rapidly as she does not have to depend on the object to be present before her to think of its shape and size. However, to be able to reach this stage, the child has to have many experiences of handling actual objects.

How would we know that a child has developed the ability to visualize/represent objects in her mind? Recall what you have read about cognitive development Course 1. The difference is visible – if you think of your interactions with an infant of around 8 months of age and with a child who is about one and a half years old. If you start playing with a doll with the eight-month-old child, and then hide the doll and start playing with a new attractive object, it is unlikely that the child will insist on playing with the doll. However, an 18-month-old child will not accept the change of toy so easily and will insist you bring the doll back. The older child is therefore able to mentally represent the doll and knows that the doll exists even though she cannot see it and therefore does not accept your statement, "The doll has gone away." In fact, the child may begin to search for the doll if she is really enjoying the play with it. As you know, Piaget gave the specific name 'object permanence' to this ability. You have read in MCD-001 that this ability to understand that objects continue to exist even when they are not present before one's eyes is called object permanence. **Object permanence is an important space-related concept that emerges during infancy.** It means understanding that objects continue to occupy space even though they are not visible to us.

Check Your Progress Exercise 1

1) Give an example wherein the child shows an understanding of the following:

   a) near and far

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   b) bigger and smaller

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17.3 EMERGENCE OF SPACE-RELATED CONCEPTS DURING PRESCHOOL YEARS

The child, by the age of three, can compare objects in terms of distance (far-near) and size (big-small). She can make choices and make decisions based on these comparisons. For example, she can select the bigger piece of cake; when asked to pick an object near her, she can pick the correct one. During preschool years, the child's understanding of space, shape, and size expands further. **Four important abilities related to the understanding of shape, space, and size, emerged during this period**. These are:

a) The ability to take another's perspective

b) The ability to conserve

c) The ability to classify

d) The ability to seriate

You have read about Piaget's experiments and the emergence of these abilities during the preschool years in Unit 12 (concerned with Cognitive Development) of Block 3 of MCD-001. You may also remember that Unit 16 of MCD-002 also describes a variety of activities that foster these abilities and develop and strengthen children's conceptual understanding of shape, size, and space. In the next Unit, you will read about more activities related to the concepts that can be carried out in Grades 1 and 2.

In this Section, we will describe how these abilities are related to the understanding of space, shape, and size. We will not describe Piaget's experiments in detail here but simply give the salient points so that you can recall the experiments and connect how these above abilities are related to developing an understanding of space, shape, and size.

Let us start with children's ability to look at objects or situations from another person's perspective.

17.3.1 Taking Another Person's Perspective

According to Piaget, preschool children do not realize that different people would have different perspectives and capabilities and so may not look at and perceive situations and objects in the same way as them. Children of preschool age see everything from their perspective and from their own frame of reference. They believe that other people also look at and understand events and activities in the same manner as they do. For example, according to Piaget, if a girl closes her eyes and is not able to see an object, then she believes that other people in the room are also not able to see that object. Piaget has called this quality of a child's thought 'egocentrism'. He stated that pre-primary learners cannot understand that another person can look at the same thing and not see exactly what the child is seeing.

You will remember reading in Course 1 (MCD-001), Unit 12 about the experiment Piaget carried out with the three-dimensional model of three hills where the children are asked to pick up the photograph that shows how a hill appears to a doll placed on a chair in a different position from that of the

child's. The experiment is based on the ability to visualize (mentally think of) space from different angles.

Based on this experiment, Piaget proposed that:

- Children younger than four years of age do not have any understanding regarding perspectives; they do not realize that the same thing can appear different when viewed from different positions in space.
- Five-year-olds believe that the doll sees the hill just as they do; in other words, they believe that others see things just as they do.
- By seven years of age, children begin to understand that the doll would have a different view of the hills but cannot identify the correct view from the photographs.
- Only by the time children are around nine years of age, do they understand that the view of another person would be different and they begin to recognize/understand what this may be – in the experiment, at this stage, children identify the correct photograph which shows how the hill looks to the doll.

Later Research

You also know that after Piaget presented his results, many other experiments have also been done by other researchers to find out when is it that the child begins to see things from another's perspective. Some experiments have led to the same conclusions as Piaget's while others have shown that preschoolers can take another's perspective in certain situations. You would remember the experiment from Unit 12 of MCD-001 wherein the preschoolers are required to hide the doll where the policemen cannot see it and they do so successfully.

In fact, it would be interesting for you to carry out the doll and mountain experiment with children in your neighbourhood or class and see what you find. Try out the following experiments as well.

Experiment 1: Sit in front of the child and give her a picture card. Then tell her to show the picture to you.

Experiment 2: Sit in front of the child and ask her to show you her fingernails.

What were the conclusions of your Experiment 1? It is possible that some children held the picture card in a way that the picture was facing you while others held it in a way that the picture was facing them. We can say that the first group of children can take another's perspective – they could understand which side the picture should face for a person sitting on the opposite side for the person to see it. They understood how the picture would appear from another angle or another point in space. The children in the second group do not realize that the picture has to be held differently for the person who is sitting opposite them to be able to see it – they cannot take another's perspective.

Similarly, in Experiment 2, some children may put forward their hands with their palms facing down so that their fingernails are facing the person sitting opposite them. Others may hold their hand with palms facing up and the fingers folded towards them so that the fingernails are facing them.

What do such contrasting responses of children to the doll and mountain experiment, the picture-card experiment, and fingernail experiment tell us about preschool children's ability to take on another person's perspective and regarding the child's egocentrism? Write down your answer and then read the description that follows.

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From the above discussion, we can conclude that whether or not the child can take another person's perspective depends upon the situation. Children can take another person's perspective when:

- The situation presented to them is familiar and meaningful to them.
- When the children clearly understand what is expected of them.

This means that the child's previous experiences, the nature of the task, and how the present task is presented to them are crucial in determining whether the child will show the ability to take another's perspective. There are individual differences as well and it is not as if preschool children are egocentric altogether. They can understand another person's perspective in some situations but as compared to older children, they remain more connected to their own perspective. The ability to take different and multiple perspectives is an ability that continuously evolves when we are adults.

The Importance of Taking Another Person's Perspective for Mathematics Learning

Why is it important for a mathematics teacher to recognize the extent to which the children in her class can appreciate other people's perspectives? How does the ability to take on another person's perspective influence the learning of mathematical concepts, especially those related to space, shape, and size? Let's find out!

a) Being able to understand or see things from another person's perspective helps the child to think of the various possibilities in a particular situation. Thinking of possibilities also implies thinking of things that are not present right there – gradually, this helps to develop the ability for abstract thinking and the ability to visualize, including visualizing transformations of shapes, which is an essential part of geometry. Thinking of possibilities and being able to think in abstract terms grows as we use it more.

b) When a child can take different perspectives, this means that the child can visualize objects from different angles and different points in space.

This means being able to visualize transformations as well including changes when additional constructions are made in a shape. This ability is also required for grasping complex concepts of geometry later.

For example, a cylinder viewed from the top looks like a flat disc or a coin, and from the side, it looks different. A cuboidal box will look different from different sides and angles and so will other shapes and objects. Even a sphere and a cube can look different from different sides. We have to integrate these different perspective representations of an object in our mind and interpret them to be the same object. The ability to recognize the essential shape by visualizing how it would appear from another view is important for the generalization of the idea of that shape.

c) The ability to take on another's perspective is important for maintaining and developing social relationships. Social interaction, conversation, and communication depend on being able to understand the point of view of others. The learning of mathematics requires social interaction, conversation, and communication.

17.3.2 The Ability to Conserve

You know that 'conservation' means the ability to understand that the quantity or amount of a certain substance remains the same and does not change, even if its shape is changed or it is transferred from one container to another, so long as nothing is added or taken out from it. You have read about in Unit 12 of MCD-001 at length. While this seems very obvious to adults, Piaget found that it is not so for young children. Preschoolers find it difficult to conserve. You would remember reading about three experiments carried out related to conservation.

- The first experiment is the one in which children had to think whether the amount of clay changed if the ball of clay was flattened – conservation of mass.
- The second experiment is the one in which children had to think whether the amount of water changed when it was poured into a wider glass – conservation of volume.
- The third experiment is the one in which sticks of equal length were shown to the children and they were asked to think whether a stick became longer because it was pushed forward as compared to the other stick – conservation of length.

Based on his experiments, Piaget concluded that:

- Four to five-year-old children are unable to conserve.
- Slightly older children – six to seven years old can conserve in some situations, but not in all of them. They have started developing this concept.
- Children begin to conserve consistently between eight to ten years of age.

Conduct Piaget's experiments with some children in your locality and note down your results. Are they the same as Piaget's?

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You will remember from your reading of Unit 12 of MCD-001 that a child is not able to conserve for three reasons:

a) The child cannot mentally undo an act – she cannot roll the flat ball of clay in her mind into a round ball again. She cannot reverse her thought. And so loses the link between the ball of clay and the flattened clay. The ball of clay and the flattened clay become two different objects for her.

b) The child focuses on one aspect ignoring all others – in the case of the clay, the child only focuses on the fact the flat piece has a larger width as compared to the ball; she ignores that it is thinner. The child centers her thinking on one visible aspect of the situation.

c) The child is dominated by what she sees and not by the logic of the situation. The flat piece of clay looks bigger, so the child reasons that it must be bigger.

Later Research

As in the case of taking another's perspective, studies done by researchers after Piaget have shown that children do conserve very well in situations that are relevant and familiar to them. For example, children belonging to potter families daily mould clay into vessels of different shapes. These children can conserve the amount of clay easily without being in doubt. They will not agree that the amount of clay changes when the clay is moulded into the shape of a vessel. However, if the child has no experience in making vessels out of clay, then she might fail to conserve in Piaget's clay experiment. Likewise, if a five-year-old child has the experience of pouring water from one bucket to another regularly, then she would not believe that the amount of water changes in the process of transferring water from a container of one shape to another. This suggests that appropriately designed tasks and experiences can help children develop the ability to conserve.

How is the ability to conserve related to the development of mathematical concepts of shape, size, and space?

a) Being able to conserve means understanding the link between:

- Space and shape – different shapes may occupy different spaces but their mass (amount) may be identical; so a ball of clay whether flat or round has the same amount (mass) of clay.
- Space and size –a change in the space occupied by objects does not change the size of objects. So, a stick when pushed a bit forward as compared to the other does not become longer.
- Space and number – a change in the arrangement of objects, does not change the number of objects. Being able to conserve is the basic ability required for being able to count – if we were to be dominated

by what we see, then we would never be able to verify by counting that the number of stones remains the same whether they are put together in a pile or spread out on the floor.

b) Being able to conserve helps the child to develop the ability to think logically and to develop reversibility of thought. This will enable the child to think about situations in the mind, without actually carrying out an action. This will help her to deal with day-to-day situations, involving space, shape, and size. For example, the child will be able to mentally think that if she moves a chair to a particular corner, she will get more space to play. The child will be able to mentally estimate whether a certain amount of milk fits into a certain bottle and if a certain number of pencils would fit into a particular box.

c) When you give the child opportunities to learn to conserve, you also help the child to focus on various aspects of a situation (de-center), and to verify what she sees by thinking logically about it (not being dominated by perception). Conversations with the child about what she is doing and asking her to reason out her choices would help her observe and explore more carefully.

Check Your Progress Exercise 2

1) Which of the following statements is NOT true about the relationship between the ability to conserve and the mathematical concepts of shape, size, and space?

   a) A change in the arrangement of objects, does not change the number of objects.

   b) Objects that look similar occupy the same space.

   c) A change in the space occupied by objects does not change the size of objects.

   d) Different objects may occupy different spaces but their mass (amount) may be identical.

2) Based on what you have read, explain why the ability to conserve is important for:

   i) Estimating and measuring length

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   ii) Estimating and measuring capacity

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17.3.3 The Ability to Classify

'Classification' means putting together or grouping objects based on a common property. 'Matching' means keeping similar/ identical objects together. You would remember from Unit 12 of MCD-001 about Piaget's experiment where children were given three different shapes (cut-outs of one-fourth part of a circle, oblong, and triangle) of three different colours– red, blue, and yellow. The children were asked to keep similar things together. The expectation was that children should take both the shape and colour into consideration and make specific groups – thus oblongs of red colour in one group, oblongs of yellow in another, oblongs of blue in the third group, then three groups triangles and then three groups of one-fourth part of circle. You have read this experiment in Unit 12 of Block 3 on Cognitive Development in MCD-001. Can you recall what Piaget found? He found that:

- Most two and three-year-olds did not give any consideration to the shape or colour of the pieces that they were picking and did not make any groups based on these criteria. They would pick up the shapes and make a design – like arranging them in a line, circle, or the shape of a house. Piaget concluded that 2 and 3-year-olds cannot classify.
- Four to six year old began to use the criteria of colour and shape while arranging objects in categories. However, the criteria for classification did not remain consistent throughout the process. The child began to categorize based on shape and started putting all the oblongs together. But in between, she noticed the colour of the oblong and changed her criteria of selection to colour. A little later she may change the criterion to another colour or shape. Piaget stated that children cannot classify because they are dominated by what they see and also because of their inability to consider more than one aspect of the pieces at one time –i.e., they are not able to consider shape and colour together.
- Almost all children of six years of age could select one criterion for making categories and retain it throughout. If they selected colour as a criterion for categorization, then they put together all the pieces of that colour, be they oblongs or triangles. Then they shifted to the next colour.
- Once children reach the concrete-operational stage, i.e., seven years and above, they can perform more complex levels of classification. At this stage, they can classify using both the criteria of colour and shape. For example, initially, the child sorts out the pieces based on their shape so she makes three categories oblong, circles, and triangles. Now because every shape is also of three different colours, she distributes all the oblongs in three categories of different colours.

Later Research

Like in the case of Piaget's other experiments, later researchers do not agree with all the conclusions drawn by him. They state that Piaget's experiments are too difficult, and are not related to the child's everyday experiences; children do not find them relevant and meaningful and so do not perform these correctly. You would remember reading the example in Unit 12 of

MCD-001, when a researcher gave picture cards of animals, food, and furniture to some three-year-old children. Children were then shown a puppet and told that the puppet liked food and they were then asked to sort out the cards that the puppet would like. The children could sort out all the food cards. When asked, they could also categorize all the cards of furniture together. According to this experiment, if the context and the classification criterion (a) are clear and meaningful for the child, then they can categorize successfully.

Actually, in day-to-day situations, you can observe children making categories at different levels of complexity. They sort out fruits from vegetables, red beads from blue ones, balls from other kinds of toys, small balls from bigger balls, marbles of different colours, and so on.

How is the ability to classify related to the development of mathematical concepts?

a) When children classify based on the shape and size of objects, they develop these concepts.

b) Often doing classification means finding out a common property among objects that look quite different from each other. This involves thinking logically, identifying a property that is common among different-looking objects, and selecting/ choosing between objects based on this property. When a child understands classification, she understands that the same set of objects can be classified (put into groups) in various ways depending upon the property that one has chosen for making the groups.

17.3.4 The Ability to Seriate

Another way to find and establish a relation between objects is the ability to arrange them in an increasing or decreasing order based on some constant property such as size, length, or weight. This process of arrangement is called 'seriation'.

You would recall from the reading of Unit 12 of MCD-001 that based on his experiment where children were asked to arrange ten sticks of different lengths in an increasing or decreasing order of size, Piaget concluded that preschoolers cannot seriate. Most children could arrange three sticks in the correct order but then started making mistakes thereafter. His experiments showed that children were able to arrange all 10 sticks in the correct order after they entered the concrete-operational stage. Can you recall from your reading of Unit 12 of MCD-001 the mistakes that preschoolers made while seriating and why they made these mistakes?

Later researchers made simple changes in the experiments and found that three and four-year-old children can seriate four sticks in the correct order.

Why is the ability to seriate important for the learning of mathematics?

a) Seriation is a basic ability to develop the concept of numbers and the ability to count. The child needs to understand that counting numbers from a series – each successive number is one more than the other.

b) Seriation activities can be planned using any property – such as length, height, thickness, colour, weight, area, number, texture – (smoothness/ roughness). When children carry out these activities it helps in developing these concepts.

17.4 LANGUAGE AND SPATIAL CONCEPTS

Language is a critical aspect to keep in mind while communicating about space-related concepts.

In communication, many confusions arise due to language. For example, you may have noticed that people can use the terms 'above' and 'below' fairly well but there is usually some confusion in the usage of the terms 'right' and 'left'. Instead, people often use their hands and indicate 'this side' or 'that side'. Or when reversing the bus, instead of using the words 'right' and 'left', we use the words 'conductor side' and 'driver side'. Why do we get confused and why do we use the term 'conductor side' and 'driver side'? The reason is obvious and has to do with perspective. For a person facing you, the person's right and left are opposite to yours. Thus, confusion does arise when you use the words 'right' and 'left'. On the other hand, the term 'conductor side' and 'driver side' is invariant for each bus and there is no chance of confusion. Therefore, it is important to be careful about the language we use with pre-primary and early primary learners. It is also important to give them opportunities to express themselves and formulate their conceptions and talk about these. Giving children opportunities to use the terms related to space is a critical aspect of developing these abilities and deepening them.

One may wonder whether while carrying out activities with children and introducing concepts, we should use words and categories with which the child is familiar or should new words and categories be introduced to them. Whenever children learn new concepts, including space-related concepts, and integrate them with their earlier knowledge, their ability to think logically sharpens. Developing logical thinking abilities also involves more specific and appropriate usage of words. During our day-to-day talk, we are often not so careful about the use of words because it probably does not make a difference. For example, we use the word 'round' to describe a bangle, a ball as well as a coin or a *chappati*. The context clarifies the meaning and the way we are using the word. But when dealing with mathematical concepts, we need to be more specific. All the above-mentioned objects are different categories. The ball is a sphere, the bangle a circle and the coin is a disk. Helping children develop spatial concepts requires care in the use of language and the use of appropriate words to communicate specific ideas.

To summarize, till now we have discussed that very young children hold concepts related to space, and they have some understanding of sizes, shapes, and spaces; and the process through which this understanding develops. Gradually, children will develop more complex space-related concepts such as those of area, volume, length, etc. You will read related activities to enhance space-related understanding among children in the next Unit.

Check Your Progress Exercise 3

1) Why should paper cut-outs and drawings not be the first choice of educators to introduce space – related concepts to children?

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2) Mention some properties based on which a child can seriate.

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17.5 SUMMING UP

Children develop a basic understanding of shape, space, and size during the early childhood years. When an infant reaches for objects, holds these, rolls, crawls, and walks, these actions help the infant understand the space around her and the objects in this space. Gradually, as the infant starts developing language, her words reflect her increasing understanding of the space-related features of her physical environment. A three-year-old and even a younger child, spontaneously uses words such as 'near-far', 'big-small', 'up-below', 'before- after', etc. This shows that the young child understands whether things are far or near to something (the concept of distance, which is about space) whether they are big or small in relation to one another (concept of size), and so on.

During preschool years, four important abilities, which are directly related to the understanding of shape, space, and size, emerge. These are:

- The ability to take another's perspective
- The ability to conserve
- The ability to seriate
- The ability to classify

Activities related to matching, classifying, and seriating objects help in developing concepts of shape and size. Learning about these concepts is meaningful for young children if the educator uses real objects and materials. Hence, in the beginning the use of objects and materials should be emphasized instead of two- dimensional shapes in the form of paper cut-outs and drawings while teaching about these concepts.

17.6 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress Exercise 1

1) a) the child says that her grandmother lives farther than her friend

   b) the child asks for a bigger piece of cake

Check Your Progress Exercise 2

1) b

2) i) The ability to conserve is important for estimating and measuring length as the child is then able to understand that the length of a thing would remain the same irrespective of whether she rolls or folds the object or measures it using different ways. Suppose she wants to estimate/measure the length of a string. She should be able to conserve the length of the string and realize that it would be the same whether if she rolls up the string on a reel or measures its length by using an inch tape or ruler.

   ii) The ability to conserve is also important for estimating and measuring capacity because the child is then able to understand that the capacity of different-shaped vessels can be the same. Suppose, you show a child two bottles of 1-litre capacity but of different shapes and ask the child to tell whether the two bottles are of the same capacity or not. Then the child should be able to understand by pouring water from one bottle to another that the capacity of the two bottles is the same irrespective of their shape and size.

Check Your Progress Exercise 3

1) Paper cut-outs and drawings are two-dimensional representations of a variety of shapes that exist in the environment. Learning about shapes is more meaningful for children if the educator uses real objects and materials. Learning the names of the standard shapes is no indicator that the child has an understanding of the concept of shape. Children would learn the names of shapes in any case as a consequence of handling different objects and materials during play activities. When the focus becomes learning the names of shapes only, it is then that the educator's approach becomes restricted.

2) length, thickness, weight.

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