

From 'a Teacher' to 'a Facilitator'

By Pradnya Kadam

While functioning as a mathematics teacher in a school, it is a necessity of education field that every teacher reflectson and rethinks about her own knowledge of 'mathematics and teaching of mathematics'. Like any other teacher inschools,I teachmathematics from'Mathematics textbooks' prescribed by the school to the school children. Most of time my teaching approach involves, 'telling or demonstrating concepts given in the text book' 'questioning', 'explaining doubts'. I always wanted my students to learn mathematics to enjoy it as a subject. I wanted them to love mathematics. I wanted them to evolve mathematics. It is not possible to achieve these goals, if we teach mathematical concepts only by methods of telling, demonstrating or by explaining. It is also required to go beyond the prescribed text book. Therefore while doing a project work (which was compulsory work of M.ED course), I took an opportunity to experiment 'constructivist approach' of teaching and learning on secondary school students. For the experiment,the mathematical topic chosen was 'Basic Geometrical Constructions' i.e. construction of the perpendicular bisector to a segment and the angle bisector to an angle.

At secondary school level children are taught Euclidean geometry. Though Euclidean geometry is about abstract concepts, it is applicable to our physical world. Therefore, while teaching geometry at a school level we take help of our experience of physical world. Hence, while teaching geometry to children it is important to seehow we are using these experiences.

While functioning as a school mathematics teacher most of the time my lesson plan would include activities that could give me expected learning outcome. I would have pre- defined learning outcomes. These learning outcomes were fixed behaviours/ responses of students to my planned teaching sequence. A lesson plan would include a particular fixed sequence which I used to carry out in the class with the intension and expectation that what was planned before the class would only happen in the class.

For the project work students of class five, six and seven were selected. I learnt/ understood required mathematical knowledge from the book, 'Geometry: Euclid and Beyond'by Hartshorneand school mathematics text books. Since I had no experience of teaching by constructivist approach and I had also not done enough reading/ study of 'constructivist approach of teaching and learning', to maximum extent I remained dependent on my guideDr.SatyawatiRawoolfor using/ understanding constructivist approach.

While observing various geometrical constructions, I noticed that all geometrical constructions are constructed by joining points of intersections of arcs drawn to get fixed points. These arcs are nothing but parts of circles. Hence it can be said that geometrical constructions are constructed by joining intersection points of circles. Therefore, I started observing 'the angle bisector of an angle and the perpendicular bisector to a segment' in the form of intersection of circles. For example, we can observe the perpendicular bisector to a segment in following ways.

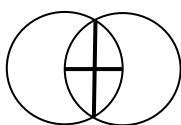


Figure 1

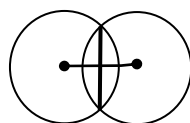


Figure 2

If two equal circles pass through the centers of each other as shown in the Figure 1 then by joining intersection points of two circles we get the perpendicular bisector to a segment formed by joining the centers of two circles.

If two equal circles do not pass through centers of each other and the centers are outside of intersection part of two circles as shown in Figure 2 then also a segment joining to intersection points of two circles is the perpendicular bisector to a segment joining the centers of those two circles.

If two intersecting circles are not equal, then a segment joining intersection points of two circles is only a perpendicular to a segment joining centers of two circles, but not the bisector of that segment as shown in Figure 3.

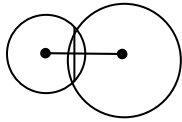


Figure 3

Form these observations, I thought, if children would be given experiences to observe these structures, then in future when they would have to construct a perpendicular bisector to a segment, they might relate construction methods to these structures and it would help them to visualize methods for construction of a perpendicular bisector to a segment.

From discussions with my guide on constructivist approach of teaching and learning, I understood that constructivism is about creating an atmosphere which is conducive for learning, where children develop or evolve their own knowledge of the content/ concept. Since children evolve their own knowledge with the help of a teacher, teacher's role in the class remains secondary. Instead of functioning as a teacher he/ she functions as a facilitator and provides scaffold in the form of cues, indirect examples, probing questions. The facilitator has to abandon direct instructions. I could also understand that for teaching by this approach, I could not have pre-defined objectives. For the lessons by this approach, 'plans' and 'objectives' evolve as children progress with the content. Hence, it was not possible to write structured lesson plans for the experiment before sessions.

At the same time since children selected for the experiment did not have any experience of such an environment of learning till then, it was required to give them gradual experience of learning in this way. Hence we decided to conduct cycles of learning. We decided to conduct 'open and exploratory' activities for the first cycle of learning which would not challenge them much but would help them to get adjusted with new environment of learning.

For the first session of this experiment, I planned an activity with circular objects. It was decided to ask students to observe various relationships between circular objects in 'the space' and on 'a plane'. For the session it was assumed that children knew meaning of the terms 'the space' and 'a plane' and the word 'relationship'.

In the beginning of the session, I distributed circular bangles, CDs and circular cut-outs of papers to the children. To begin with the activity, I instructed them to see various relationships between two circular objects in the space and in a plane (here I was not supposed to give any direct instructions to the children, I could not exhibit my role as a facilitator instead I behaved like a teacher). Many children asked a meaning of phrase 'relationships between two objects'. I explained them that, it means to see how two objects are related. Some children asked meaning of the term 'the space'. I explained that, "objects those have only length and breadth are called as two dimensional objects. These two dimensional objects can lie on a surface i.e. plane and surface is called as 'a plane'. Objects like compass box, bench, notebook has length, breadth and height, hence we need to keep them in our surrounding, and they can't completely lie only on a surface. Hence our surrounding is called as 'the space'". Class five children did not understand meaning of the words 'length' and 'breadth'. Class seven children explained meanings of the terms 'length' and 'breadth'.

with an example of a box. By pointing at the longest side of a compass box they showed the length of a box and by pointing at width they showed breadth. In this way the whole session turned into a question answer session and again I took main role in the class. I failed to keep my role secondary.

While children were handling circular objects, most of the children selected circular objects of equal size. They were given complete freedom to observe whatever they could observe while handling objects in any way. I asked them to draw their observations on a paper, if they wanted. Children started observing circular objects. They started holding them in hands in various positions, they also started rotating bangles. Some girls wore bangles. But, for a long time children remained confused about the activity. For the whole session they went on thinking about what was actually being taught to them.

In this process the teacher needs to have lot of patience so that during learning process if learners ask for the help the facilitator can provide the help by asking probing questions to learners instead of telling the answer directly. To ask probing questions and to create processes in which learners can generate their own knowledge the facilitator needs to be very creative.

Though content knowledge is secondary in constructivist learning process then also the facilitator should have detail and correct knowledge of content. Without detail and correct knowledge of content, learning processes are useless. Even though the teacher assumes some behavior from students it is required that the teacher prepares for various possibilities that can occur while conducting an activity.

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In the second session of this experiment children were given a worksheet containing two equal size intersecting circles. They were instructed to draw anything that they feel inside the circle.



Figure 4.

While planning for the lesson it was assumed that the children would identify the specific relation between two objects that the two circles are equal and they pass through centers of each other. It was also assumed that the children would draw diagrams like an equilateral triangle, two equilateral triangles, a rhombus or an isosceles triangle or two isosceles triangles as follows:

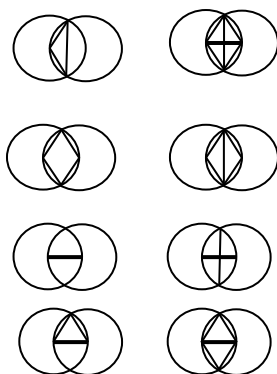


Figure 5

In the beginning of this session, I asked children to observe the figure given in the worksheet and drew any kind of drawing inside the figure. They were given complete freedom to draw anything (according to the constructive approach of learning). I also instructed them to observe their drawing and write their different observations on a separate sheet of paper.

I assumed children would also observe these diagrams only. And hence they would indirectly observe a perpendicular bisector to a segment. While doing the activity many children identified intersection part of two circles as 'rugby ball shape' and outside part of intersection as 'moon shape'.

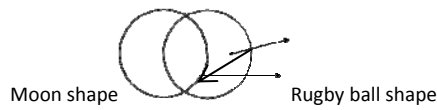


Figure 6

Many children identified that two circles pass through centres of each other. For class five children the term 'centre' was unknown. A class seven child explained its meaning as 'a middle point'. Most of the children started drawing any figure inside the circles. These diagrams did not match to diagrams that I had anticipated. I started getting panic in the class. I had never guessed that on instructing 'draw anything inside the figure' children could draw in the part of figure which is not intersection of the two circles. Since there was some intention behind assigning this activity which was not getting fulfilled because of children's this response, I became upset in the class. One child drew 'equilateral' in the given figure of circles.

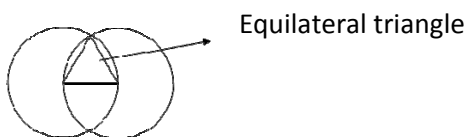


Figure 7

As this diagram was according to my expectations, I praised the child (here I should not have praised him because according to this activity every child's diagram was correct and children were supposed to explore their own ideas). My praise had adverse effect on behaviour of other children of the class; they guessed that the teacher wanted to teach us about an equilateral triangle hence she had praised that child. For rest of the session all the children drew only an equilateral triangle inside the circle. I became more and more upset because children did not draw other diagrams that I had anticipated.

Therefore for the third session, I decided to give the following worksheet.

WOEKSHEET 2

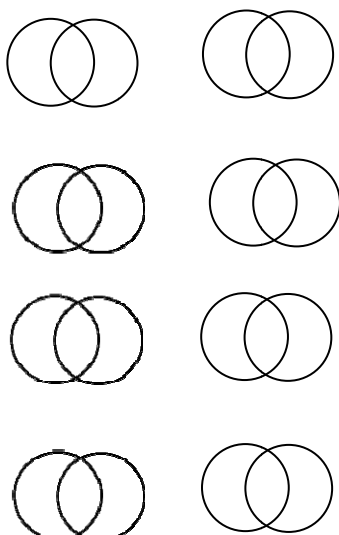


Figure 8

This time children were strictly instructed to draw only inside intersection of two circles and I had strong confidence that they would draw only eight figures that I had anticipated. Children were also instructed to write their observations on the same worksheet. It was also instructed to identify the drawn geometrical objects and give them geometrical name. By this time I had prepared myself for probing questions which I would have asked if children would draw the expected diagrams.

When children were given the worksheet they drew many different shapes inside intersection of two circles. This time drawing was only limited to the intersection part of the two circles. Following are few examples of drawings drawn by students of class five

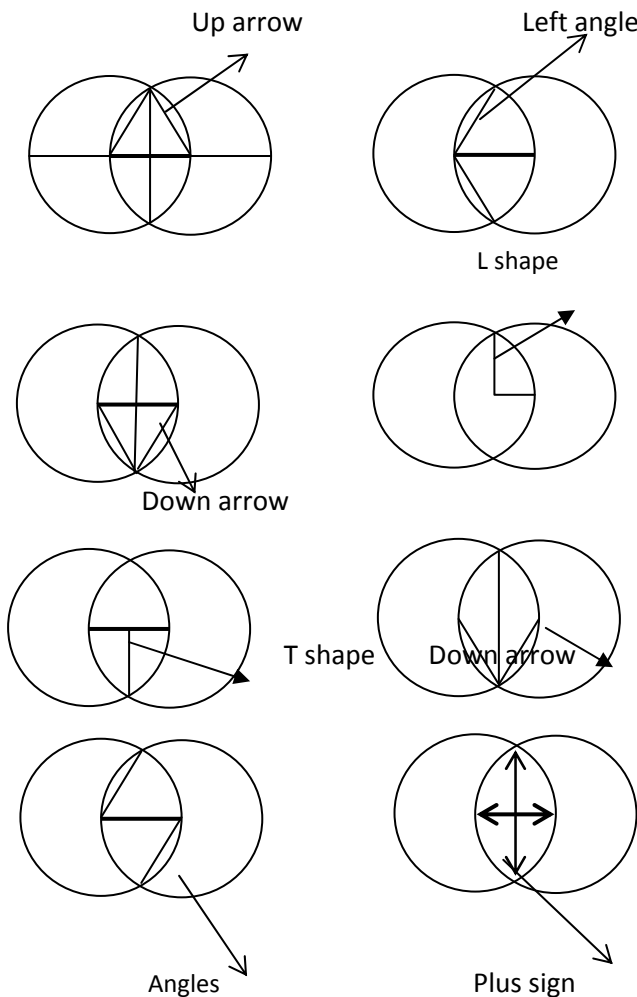


Figure 9

Some class five students drew rhombus inside the intersection. When they were asked for the name of the figure they named it. They called it 'kite', 'diamond' and 'kajukatri'. Some children also did free hand drawing inside the intersection of two circles. Class six children drew following diagrams:

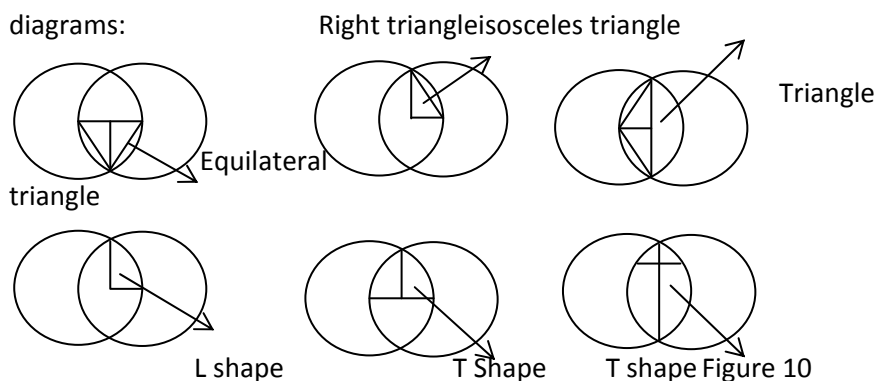


Figure 10

Some class seven students drew following figures:

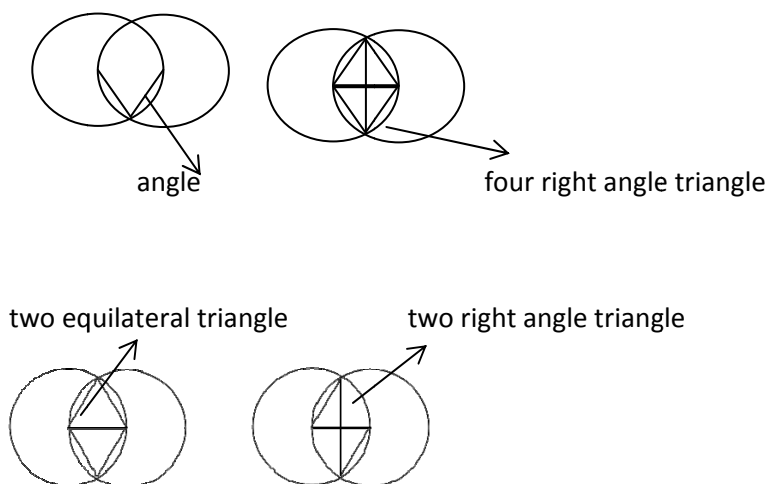


Figure 11

In this session also children's response was not according to my anticipation. But by this time I was settled for my expectations about children's responses. As writing reflective writing of my own work and experiences in the class was part of my experiment, these reflective writings and my discussions with the guide helped me to maintain my emotional balance and confidence. I started learning role of a constructivist facilitator.

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For the next session children were given following worksheet.

WORKSHEET 3

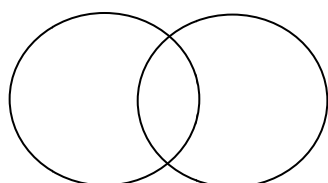


Figure 11

Again children were instructed to identify the relation between the two circles and to draw whatever they want inside the figure. I did not force them to draw any particular figure inside the two circles. They were also told to name the figure as well as the activity.

For informal discussion with the children I had planned (if the figures would be geometrical) to ask about properties of drawn geometrical figures, and make them check those properties with geometrical instruments. It was also planned to motivate children to compare this particular relation between the two circles with the relation given in the previous worksheets and observe what changes occur in drawings because of two different conditions.

When this worksheet was distributed all children could easily identify the relation between the two circles easily. They also compared it with their previous worksheet. Most of the children drew following

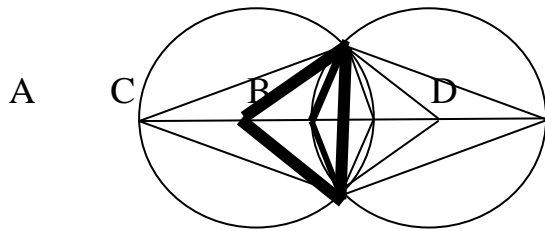


Figure 12

Class seven students identified the triangle in dark as an isosceles triangle. When I asked for the reason they reasoned that the triangles have two sides equal because they are radii of equal circles and the third side (line joining intersection part of two circles) is unequal. Other group of children measured length of sides of the triangles to conclude that it was an isosceles triangle. Some children drew diameters AB and CD. They concluded, since the diameters in the middle of triangle hence sides on both the sides of triangle are equal.

Some class five children drew following figure:

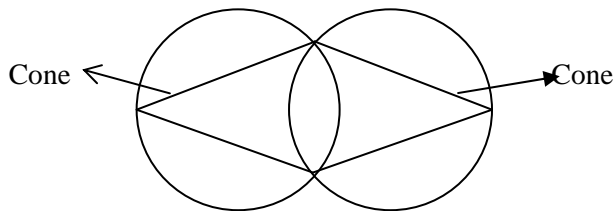
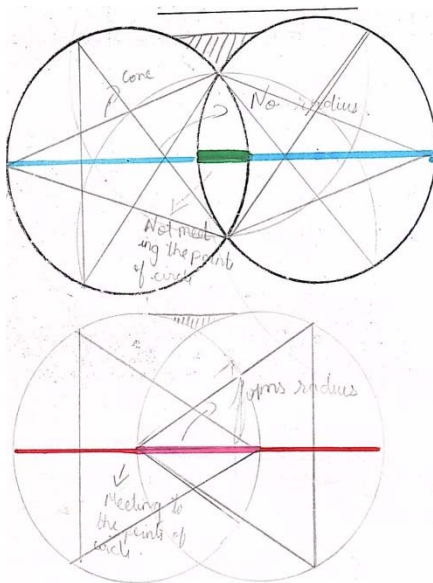


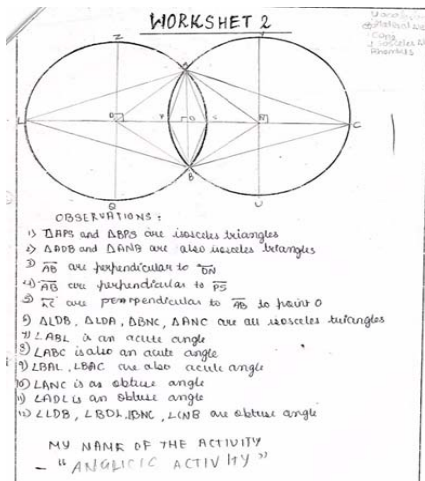
Figure 13

One of the a class five child drew the following figure.

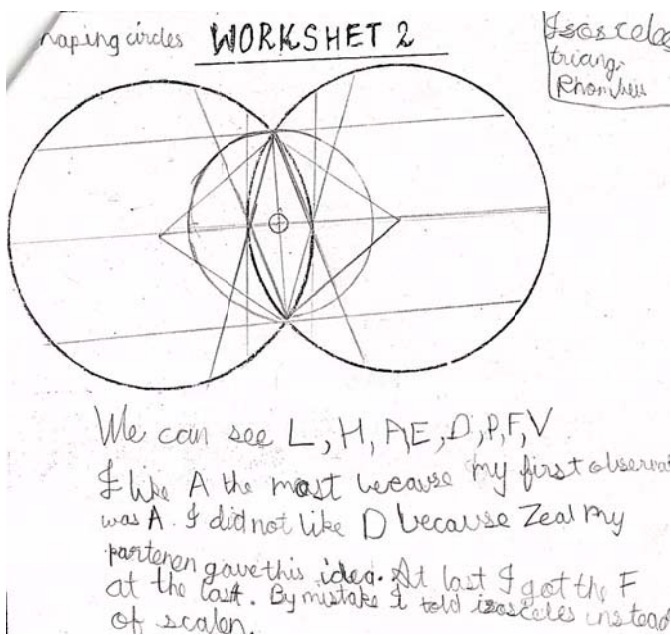


To compare two specific conditions of circles the child drew the previous condition on the same worksheet and drew radii to find the difference between the radii of two conditions of circles. She gave name to the activity as 'Pictography on circles'. She explained that we are doing drawing of pictures in circles hence she gave the name 'Pictography on circles'.

A class seven child drew following figure:



A class five child drew following figure:



He explained that he first drew an equilateral triangle, from that he got an idea to draw 'A'. Then he started drawing other lines and searching for other alphabets.

All children according to their understanding started taking responsibility of their learning. By this time I also settled with my expectations from children. I understood that when as a teacher I give some instructions to the children not necessarily they take the same meaning of it. The meaning that they develop for given instructions is according to their age, background, and experiences from surrounding till then. The experiences that a teacher gives them in the class are opportunities for children to develop new meaning for given instructions or activities. Therefore it is important that a facilitator remains patient while children perform any activity in the class and tries to understand child's existing knowledge, and tries to build new experiences based on it and environment of learning which will take them to expected goal.