Vishnupad Temple Rangoli as a Potential Stimulus for Geometrical Thinking

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Abstract

Rangoli(s) is an integral part of decorating sanctums in Hindu temples, especially during worship hours. In this paper, we present a case of using rangolis of Vishnupad temple (located in Gaya, India) as a stimulus for geometrical thinking among students. Each evening, the foot print of Lord Vishnu is decorated with a unique rangoli. It not only depicts artwork of the priests, but also highlights the geometrical and mathematical creativity associated with it.

Introduction

Rangoli(s) or *Rangolee* refers to an Indian art of decorating the floor with colourful designs (involving different shapes and patterns) [4]. In this context, we discuss the Vishnupad rangoli which is drawn every evening in a famous Hindu temple of Lord Vishnu, located in Gaya (Bihar), one of the holy-pilgrimage cities in India. We also reside in the same city; thus, we came across these rangolis through local newspapers and images shared by our friends. What caught our attention was that unique rangolis are drawn every evening. We got interested in these rangolis for the last two years, and tried to explore the mathematical context in this event. We collected 196 pictures of these rangolis (personally shared by the priests and rangoli creators to us) and interacted with some middle grade students (from the same city) to explore how these rangolis can serve as a stimulus for geometrical thinking.

Vishnupad Rangoli

"*Vishnu*" refers to one of the supreme trinity gods in Hinduism, and "*Pada*" means step as well as foot, so *Vishnupad* literally means foot of lord Vishnu. The event of worshipping and decorating the sanctum of lord Vishnu's footprint with colourful rangolis is popularly known as Vishnupad "*Shringar*" (decoration). These rangolis draw a lot of footfalls because of its auspicious and religious connection. Each evening the footprint area is decorated with unique designs, while the whole temple floor is decorated on special occasions like festivals or on a full moon night (*Purnima*). The footprint (approximately 11 inches long) is surrounded by an octagonal (each edge 22.5 inches long approximately) boundary of metal. The space between the footprint and edges of the octagon is used for rangoli (Figure 1).

Figure 1: *Visnhupad rangoli made up of different materials embedding different shapes (Picture and artwork credit: Baldev, Vijay Gayab and other priests of Vishnupad temple)*

Often, eco-friendly products like flowers, fruits, dry-fruits, sweets (such as parallelogram or rhombus shaped *kaju-katli*, spherical *ladoos,* circular *peda* etc.), petals, leaves are used to fill up the space in different

patterns and colour combinations. Thus, it also works as a mathematical task (estimation) for the priests to calculate the weight of dry fruits (often around 1.25 kg), number of fruits of different sizes, packets of colors required to decorate and fill up this space involving multiple geometrical shapes (which change every day). A few samples (Figures 1-4) of the rangoli artwork are presented in the text. A separate collection of some rangolis is available here [3].

Geometrical Thinking

This section presents highlights of an interaction with a group of middle grade students (of the same city) involved in two tasks (phases) with rangolis. We printed a collection of 196 rangolis on A4 size papers (12 pictures on a paper, each picture was labelled numerically) and invited students (S) in two groups (4 and10 students) for joining a task to solve first author's (KG) *confusion*, and then we moved to another task (grouping activity). Few excerpts from the smaller group have been highlighted in the context of Van Hiele levels of geometrical thinking [2].

Figure 2: *A rangoli with flowers*

Figure 3: *Lotus shaped rangoli*

Task 1: Help me find the best Rangoli!

"*What is the best?*", can be a subjective task for students. So, the term 'best' was intentionally used to generate multiple views and interpretation from students.

KG: *Mai bahut confuse hoon. Kya aaplog sabse badhiyan rangoli dhoondhne me meri madad karoge?* (Students, I am confused. Can you help me find the best Rangoli among these?)

Students started looking at all these pictures one by one and after few minutes of discussion among each other the following conversation takes place.

S1: *Sir ye dekhiye* (Figure 2). *Isme to* '*tribhuj*' *hai, isme* '*varg*' *hai, isme ek* '*vrit*' *bhi hai*. (Sir, this one, it has triangles, squares and a circle also) (Van-Hiele level: Level 0 (Visualisation); Level 1(Analysis/Description))

KG: *Nahi, yaahan vrit to nahi hai.* (No, there is no circle here.)

S1: *Hai, ye to gol jaisa hai* (Circle is there. It is like a round shape) (Level 0: Visualisation)

One student referred to the curved garland around the footprint as '*vrit*', though it appears more elliptical than circular. Possibly, these students haven't come across the term ellipse in their mathematics syllabus so far. S1 couldn't name the shape as an ellipse but tried to relate it with a more familiar shape with round attributes (circle). (Level 0: Visualisation)

KG: *To aapko lagta hai jis rangoli me saare aakriti hain, wo hi best hai* (So, do you consider that rangoli the best one which embeds all the different shapes within it?)

S (all): Hmm! (Silence surrounds when asked why do they think so.)

The search for different familiar shapes in these rangolis by students reflects their ability to decide the best rangoli based on the number of different shapes rather than greater number of a particular shape. It can be an indicator of these student's potential of assessing creative artwork based on flexibility rather than fluency (components of divergent thinking and creativity).

KG: Okay! which one do you like the most? Which one do you want a print out for yourself?

S2,3,4: *Ye wala* (This one) (Figure 3).

K: *Kyon* (Why)?

S2,3,4: *Isme Lotus flower hai n* (*rashtriya pushp*) *aur ye simple hai aur* '*Barabar*' *bhi hai* (It looks like a lotus flower (the national flower of India), and it looks simple, and appears 'equal'). (Level 2: Abstraction/Informal deduction)

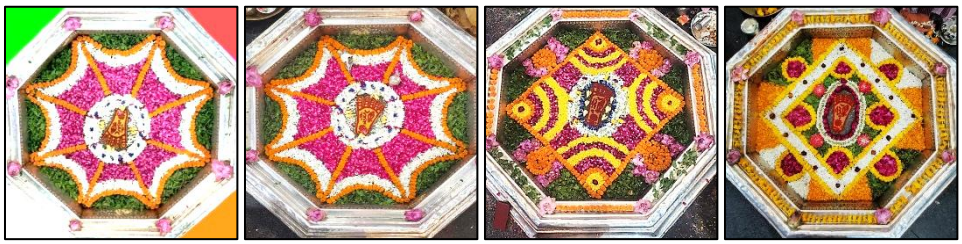
It is evident that they wanted to indicate 'symmetry' or 'mirror symmetry' aspect of this rangoli (Figure 3) with a colloquial term 'barabar' (equality), but didn't have a more sophisticated vocabulary to explain it. Their choice of a geometrical figure (Figure 3) also appears influenced by social and cultural context [8].

Task 2: Clubbing similar appearing rangolis as a pair

KG: Students, don't you think some of the images appear similar?

S(all): Yes sir! (they took time to look at some of the images)

When students compared some rangolis while looking for similarities among those, different pairs emerged for discussion.



(a) **(b)** **(c)** **(d)**

Figure 4: *Similar looking rangolis: (a, b) star rangoli (c, d) tilted square rangoli*

Two Cases Involving Counter Arguments among Students

Case 1: The same rangoli (image) got printed twice (Figure 4a and 4b)

The same image got printed twice due to author's mistake. Luckily, the second image (Figure 4b) was a rotation of the first image and it sparked a discussion

S1: *Mil gaya! yah dono same hai* (Got it. These two are same (Figures 4a and 4b)). (Level 0: Visualisation)

S2: *Nahi nahi…same nahi hai…isme panja ulta hai…ghum gaya hai dekho* (No, these are not same...the foot is reverse in it (Figure 4a) …see, it has rotated). (Level 1: Analysis/Description)

While S1 looks at these pictures and the symmetry of the structure makes it appear invariant, S2 observes the pictures minutely to figure out the effect of rotational symmetry. (Level 2: Abstraction/Informal deduction (establishes the relation between both situations))

Case 2: Tilted square within the octagon (Figure 4c and 4d)

S3: *Inme varg hai* (Both figures have square)

S1: *Nahi nahi…varg kaise hai?..yah to tedha hai* (No, no…. how is there a square?...this is tilted) (Level 0: Visualisation)

S3: *To kya agar tedha hai to varg nahi kahleyga kya…isko idhar se ghuma ke dekho* (So what 'if' it is tilted? Won't you call/consider it (Figure 4c) a square? Look by moving the figure like this (uses hand gestures)) (Level 2: Abstraction/Informal deduction)

S1: *Haan! aur isme shanku bhi hai* (Yes…and there are cones also here (Figure 4c))

Since, the square within octagon (Figure 4c) has been drawn by joining the mid-points of alternate edges of the octagon, it doesn't provide a straight view of square (often depicted in textbooks) but appears tilted. S1 couldn't identify this transformation, consequently sees the quadrants on this quadrilateral in conical form. (Level 0: Visualisation)

There were also instances where S1 referred to rectangles as squares in some rangolis, which were immediately differentiated by S2 and others. S1 is an active participant but S1 needs more exposure to

geometrical shapes to let her explore, sort and classify, and enhance her thinking to level 1 and 2 on relevant occasions. In fact, only few excerpts from the activity have been presented here. As the discussion moved forward by looking at a greater number of rangolis, we could see that students (especially in the larger group) used terms like *ardhvrit* (half-circle), *vakr* (arc), *pratichhedan* (intersection), *rekha* and *rekhakhand* (line and line-segment) for different rangolis. Students also clubbed some images as star variants and circular variants (popular aesthetical preferences for geometrical designs described by Eysenck [1]). It brings out the richness and possibility of these rangolis to promote geometrical discourse among students when coupled with some meaningful tasks. A task integrating these rangolis can be also be developed in the context of Van Hiele model of geometrical thinking.

Conclusion

Several documents and position papers talk about humanizing experiences and maximizing learning in the mathematics classroom through contextual and culturally centered mathematics [5,6,7,8]. The specialty of Vishnupad rangoli is that different rangolis are made every evening (without repetition), providing ample number of images for the learners to play with. The combination of several rangolis provided an opportunity to create tasks to compare several images based on their geometrical differences and similarities. These rangolis (depicting different types of symmetries like mirror reflection, rotation, D_n, C_n etc.) are also a treat for the eyes, especially for group theory enthusiasts. We believe that using these rangolis as a pedagogical tool can provide a scope for geometrical thinking among students, as these also provide a regional as well as cultural context to get engaged with.

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