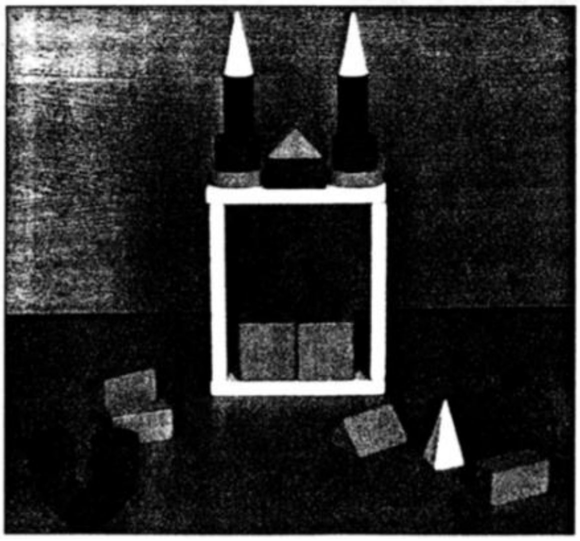
Playing and Learning with Poleidoblocs

Julia Anghileri and **Sarah Baron** explore a resource which might be lying unused at the back of one of your cupboards.



Poleidoblocs are the coloured building bricks introduced by Dr Margaret Lowenfeld some 55 years ago, yet still sustain their popularity in many primary school classrooms. Many of the aims and opportunities for mathematics learning outlined by Dr Margaret Lowenfeld herself are as valuable as they ever were. Mathematical understanding of relationships in sorting, balancing and measuring, as well as of the characteristics of structures and 3-D shapes, appear to relate well to many requirements of the National Curriculum.

We are often led to believe that children today are influenced by the technology boom to a point where they require external stimulation and spurn 'old fashioned' fun. However, recent experiences have shown that opening a box of Poleidoblocs can be instantly fascinating and the children we have observed have all shown sustained enthusiasm for their use. Through analysing children's responses it is possible to see a progression in the skills and understanding demonstrated within their individual constructions. When free play is followed by teacher intervention it may be helpful to teachers to know potential stages in the development of mathematical ideas, so that appropriate teaching may take place.

Thinking Through Play

The instant attraction of the blocks themselves appears to stimulate, not just random building, but thoughtful construction for children from the age of two upwards, and older children carefully select pieces for their geometric properties.

'*Poleidoblocs are made of wood that is pleasant to handle, presented in colours that are attractive and also in their distribution provide clues to the interrelations of the blocks. In these characterisitcs they satisfy a child's inherent tendency to savour an experience with several sense at the same time.' [1]*

The bricks do not constitute a random set, but, involve equivalencies in shape, size, area and volume that facilitate development in the understanding of many relationships that are the scaffolding upon which mathematics is built.

We know that when children are actively involved in constructing their own mathematical understanding, this involves many sensual experiences including touching and seeing the results of their own actions. Margaret Lowenfeld recommended initially a period of free play to provide tactile experiences and opportunities for exploration. This was in recognition of the fundamental ways in which children learn.

'We are yet at an early stage in our knowledge of the thinking potentialities' of young children. We do not yet know what elements of the process of mathematical understanding can arise spontaneously within them or what kinds of mathematical work they are able to conceive of and to carry out for themselves. We do not know much about the interaction between creative ideas, executive ability and cognitive comprehension. Watching children with Poleidoblocs brings new information on all these points' [1].

It is surprising how pertinent these comments are nearly 25 years later, as we continue to strive to provide the best learning environment and the most effective activities to promote mathematical thinking. The activities children engage in when working with Poleidoblocs (for playing with Poleidoblocs is thoughtful work) reflect the requirements of the National Curriculum, not only *Shape, space and measures,* but also in *Using and applying* where teachers may plan to observe, join in discussion or question during individual or group constructions. Pupils may be encouraged to explore patterns and relationships.

Early experiences

For children of all ages from two upwards, building towers appears to be the automatic response when the box is opened. Some of the youngest children we observed were building with the bricks that were nearest at hand until their structures became unstable and fell. They did not appear able to predict the fall, or to be put off they would start again‘ and build different structures that varied considerably in their design. As young children experiment with different pieces, they get instant feedback about the success of their strategies for building towers, and refine their approaches to match their aims building. Already they are beginning to experience the reversibility that typifies mathematical relationships.

The first refinement we have noticed in children’s constructions is the selection of similar pieces: children begin to look for particular bricks, identifying similarities in shape, size and colour. Patterns begin to be evident as the bricks are matched by the thoughtful constructor.

Matching similar shapes appears to lead to the careful alignment of vertical edges when towers are built, so that the structure becomes more stable. The stability is also helped by the selection of larger bricks for use near the base of a structure.

For younger children the triangular prism may cause problems because of its sloping edges and attempts to build on top of it indicate little understanding of the need for a level base. This is also seen when there is an attempt to build on top of the cones and pyramids. We have seen some children repeatedly attempting to build onto the sloping edges, twisting and turning their shapes until the ‘offending’ piece is finally discarded in favour of another with a horizontal surface. These early experiences begin to focus on the differences there may be in flat surfaces, where some are horizontal or vertical and can more easily be incorporated into buildings while others are flat but sloping.

Later there is clear understanding of the different characteristics of the ‘pointed’ shapes as structures are finished with a ‘roof’ (triangular prism) or decorative finishes are added using the cones and pyramids. Young children learn to select and reject the different bricks, basing their decisions on their growing experience of the geometric properties of the shapes and the way they relate to ‘real world’ experiences.

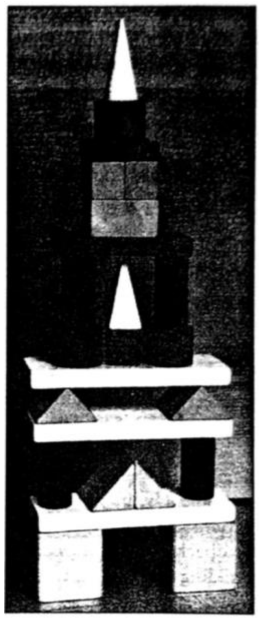
It appears that while they are playing with the shapes, children are reflecting on the results of their efforts and are refining their approaches. Lowenfeld [1] refers to a report about Poleidoblocs in the journal Educational research by J. D. Williams which notes that

‘ - they satisfy a child’s inherent tendency to savour an experience with several senses at the same time. — they give a child the opportunity to test himself out, to compare what he makes with them with what his fellows do, and when he succeeds, to savour the satisfaction provided by achievement. – it is this satisfaction: and pleasure and excitement that achievement of a desired representation or of a good pattern gives the Child. who makes it, that generates zest for a closer contact and more intimate understanding of the materials that he has been using. This must can well unlock the door of comprehension of mathematical law— there are children who grow slowly and need a longer period of ‘playing with’ the materials of study; there are children auger to learn, who scorn ‘play’ and want to work hard at acquiring new knowledge. Both can find what they need in work with Poleidoblocs.’

Balancing

As well as building taller and taller structures, children start to experiment with balance. Here, considerable variation is evident in children of the same age and while some reception age children Will be pleased with half a dozen bricks carefully balanced, others will construct high towers incorporating many geometric characteristics. Where larger pieces are placed onto smaller pieces and cylinders are used as ‘columns’, it becomes important to place each additional piece centrally or to counterbalance one piece with another of similar dimensions. Some children begin to balance the slats on their narrow faces and the thin cylinders on their curved faces and signal their satisfaction in achieving a difficult balancing objective. Children also begin to show some appreciation of pieces with the same height or pieces that can be put together in order to match other heights. A significant stage of development appears to be the understanding that balance can be achieved using any of the surfaces and, in particular, a triangular prism may be stood on its end to give a horizontal base so that it can be incorporated in ‘tower’ structure. This piece is then the same height as several other pieces in the set and ideas of measurement begin to be seen, either through sequencing and pattern making or through the use of symmetrical ‘pillars’ to support a structure. Ideas of sameness may extend to pieces of the ‘same height’ or ‘same length’ and matching of heights or lengths starts to be included in the children’s mathematical thinking. Sometimes an opening is incorporated into an individual’s construction and careful selection is needed for appropriate pieces to fill the gaps. Equivalence in shape, she and function can be explored using individual pieces or combinations.

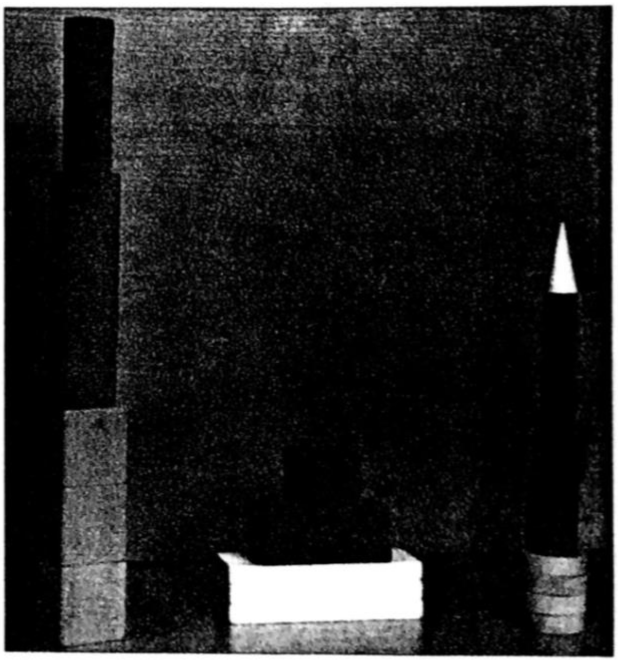
Ideas of symmetry and sequencing



When children match for sameness, parallel and identical portions appear to develop spontaneously in their; constructions and teachers may observe this as evidence of a developing understanding of symmetry. The long slat appears to encourage parallel building at either end as well as careful balancing centrally, and cylinders and long cuboids are used as support pillars in symmetrical building. Such ideas of symmetry begins; to be evident in some four- and five-year- olds, who are getting aesthetic pleasure from their appreciation of patterns. At this stage, teacher interaction may help children to clarify emerging ideas and to put their thinking into words.

Through experimenting with pieces in various orientations the children will become aware of symmetries and differences. A cube is the same, whichever face it is sat upon, and always provides a firm base; cylinders may be turned to sit on either of their flat surfaces but will roll and fall when balanced on the curved face. The children’s awareness of curved faces and the sloping faces of the triangular prism appear to involve tactile experiences as they handle and contemplate the shapes. Again, it is appropriate for teachers to encourage the children to observe the shapes and their behaviour carefully. Teachers may also begin to introduce mathematical vocabulary like curved, flat, cube and square.

A different type of pattern appears when children use the different-sized cubes in the set in sequence (from largest to smallest); the ‘sameness’ of the three different-sized cylinders does not appear to be appreciated until much later, when the characteristics of each cylinder are focused upon and possibly verbalised. Children also create patterns by alternating identical pieces and patterns of colours may also emerge.



Again these ideas are reflected in the writing of J. D. Williams; Educational research which is referred to by Lowenfeld [1].

‘The material are constructed so that fundamental mathematical relationships are represented as simply as possible".

The material provides; opportunities for children to learn for themselves by manipulation, using the tactile and kinaesthetic as well as the visual sense. The discovery comes first through spontaneous play. The principles are grasped first in concrete form, and only later symbolised. The aesthetic pleasure enjoyed by adult mathematicians is paralleled by the pleasure experienced by the child in building concrete structures that reflect mathematical relations. This kind of pleasure motivates interest in mathematics.’

Teachers’ interactions with Children

At every stage, it is fruitful if the children are encouraged to talk about their ideas, ‘to explain their thinking to support the development of their reasoning’ and to ‘discuss their work, responding to and asking mathematical questions’ [2] Questions such as “Why is it difficult to balance the cylinder on its edge?” will encourage children to find words to talk about what they can see and children may use the words they hear their teachers use. Children hearing appropriate mathematical vocabulary (for example, sloping and curved as well as cubes, cones and pyramids) will adopt such vocabulary just as they develop everyday speech by copying and incorporating new words where they find a use for them.

Here is Lowenfeld quoting JD. Williams again [1]:

> [1]: 'Differences between child and child, and between child and, teacher in manner both of conceptualisation; and learning, constitute a serious obstacle to class teaching. From his pupils' free construction with the materials, the teacher is able to gain a direct insight into their styles and stages of thought' and 'It is possible to devise tests of the degree to which true understanding of mathematical; concepts has been achieved'.

Teachers' observations are an integral part of the implementation of the National Curriculum and activities involving Poleidoblocs may be structured to assess progress and to develop pupils' understanding in a manner which appeals to children of different ages and at different stages. But it is the pleasure in setting and achieving their own goals that perhaps furnishes the most important feature of the children's work a with Poleidoblocs. Every new box of Poleidoblocs comes with a booklet [3] that includes Dr Margaret Lowenfeld's own introduction to the blocks in which she notes that:

'The impact of Poleidoblocs on a school is not confined to mathematics. It is the initiation of the children, even very young, into the life of effort and joy in effort, and in their excitement of actual gaining of their goals.'

In the booklet she wrote for Infant teachers, Lowenfeld [1] claimed that:

'Psychology, the children working with Poleidoblocs and have gained two essential experiences which and stand them in good stead for the whole of their school life'. They and have found that they themselves, acting from their own initiative, can do things with school objects that win the teachers' interest. They and have found that their own intimacy with these blocks deepens as they use them, and new aspects of them appear. They have learned to look at objects closely and to find that in so doing the object has new things to ‘tell’ them about itself.’

Although somewhat romantically expressed these insights remain most valuable for effective mathematics learning. In the present climate, when school budgets are constrained by finance and many schools already have at least one set of Poleidoblocs, it is perhaps time to reflect on their optimum use to encourage an enthusiasm for studying mathematical relationships that can involve originality, creativity and aesthetic pleasure.

References

1. Margaret Lowenfeld and Ville Andersen: Poleidoblocs in the infant school, 1963 Mathematics in the National Curriculum, London, HMSO, 1995 (Key stage 1, p. 2)
2. Ville Anderson, Robert Thornhill and Marjorie Smith’s booklet accompanies *Lowenfeld Poleidoblocs* which are marketed by NES Arnold, Nottingham.

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