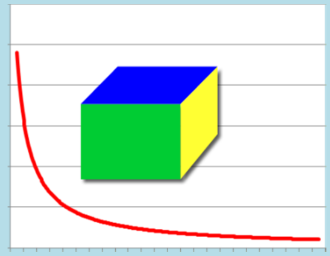
Playing with products



By Mike Ollerton 15 April 2015

INTRODUCTION

When a friend wrote a tweet about the value of play in education I just could not stop myself writing about the value of playing with mathematics per se and playing with products in particular.

MATHEMATICAL CONTENT

- Products
- Factors
- Co-ordinates
- Graphs
- Square-roots
- Area
- Perimeter
- Volume
- Surface area

APPLICABILITY

KS2 – KS4

The following set of ideas arose from a tweet I read about the importance of play as a powerful learning mechanism:

Amity Goss @AmityGoss via @AlisonMPeacock - Play is learning!
http://www.communityplaythings.co.uk/learning-library/blog/2015/april/encouraging-empathy-through-imaginative-play

I responded as follows:

Tweet 1
@AmityGoss @AlisonMPeacock play is a fundamental part of learning mathematics; playing with numbers and shapes; seeing how they fit together

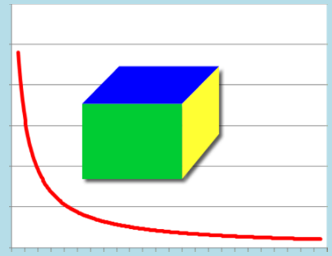
Tweet 2
We can play with percentages, Pythagoras, place value, prime numbers polynomials, products and concepts that don't begin with 'p' as well

Tweet 3
We can play with Pythagoras - what happens with non right-angled triangles, with or without obtuse angled triangles - play leads to depth

The first line from a Leonard Cohen song (Famous Blue Raincoat) reads:
“It’s four in the morning…”

Having awoken early and being unable to find further sleep I decided to download what was on my mind. This was to collect together some ideas based upon: “Playing with products”.

Playing with products



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For what my thoughts are worth, here they are; based upon ideas which are typical of teaching through enquiry; upon the types of questions I would ask (used to ask) of my learners in my classrooms. There is a key issue here about not seeking to prescribe how to teach but instead to offer ideas which can be adapted by other teachers and used according to the different classrooms they teach in. The root of effective teaching is about knowing our learners, deciding when to intervene and when to stand back; when or how to answer a question or when and how to question an answer; so many delicate balances to be considered.

In my practice I would use part 1 (below) as a whole class introduction. Parts 2 to 6 would then be offered not to the whole class but to individuals, pairs, small groups of learners who, I perceived, were ready to move on to more complex aspects of the problem; ready to engage in extension tasks.

Because, as a HoD, I taught in all-attainment groups, I believed it was important for learners to write about what they have understood within the main units of work upon which the schemes of work were organised. This effectively meant producing portfolios or journals, which I have written about more extensively at:
http://www.mikeollerton.com/pubs/Journal%20writing.pdf

Okay on with the mathematics and the questions I constructed:

Playing with products and partner pairs

1 Find pairs of whole numbers whose product is 24

- How many different pairs can you find ?
- Are you sure you have found them all ?
- Can you explain why you are sure you have found them all ?

We can call these product partner pairs.

2 Write each product partner pairs as pairs of co-ordinate; plot them on a graph

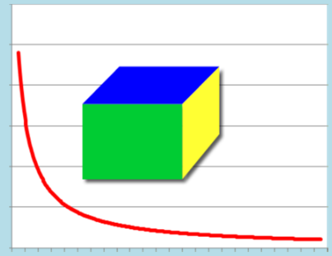
- What do you notice about the shape of the graph ?
- What happens if we allow partner pairs which do not need to be whole numbers for a product of 24 ?

For example if one of the pairs of numbers is 10, what would its partner be ?

3 If we know the partner for 10, what would the partner for 5 be ?

- What would the partner for 2.5 be ?
- What would the partner for 1.25 be ?
- Check each of your answers with a calculator

Playing with products



4 Plot these new partner pairs on your earlier graph

- Can you find the partner pair where both numbers are the same ?
- Plot this partner pair on your graph
- What do you notice about this partner pair ?

5 Turn your product partner pairs (for 24) into the dimensions of rectangles

- Calculate the areas of each of your rectangles
- Calculate the perimeter of each rectangle
- What do you notice about the different perimeters ?
- What is the smallest perimeter you can find ?

6 Suppose we now consider partner trios instead of partner pairs. So for 24 one partner trio could be 2, 2 and 6 because 2x2x6 = 24.

- Find all possible partner trios beginning with whole numbers only
- As before it is important to try to explain why you think you have found all possible solutions.
- Turn each set of three numbers into the dimensions of cuboids
- What is the volume of each cuboid ?
- What is the surface area of each cuboid
- If we allow partner trios which do not have to be whole numbers try to find which trio will produce the cuboid with the minimum surface area.

Choose a different starting product value, such as 20 or 30 or 32 and repeat each of the above steps 1 to 6

There are several key pedagogic issues and these are:

- Access and extension
- Enquiry as a powerful approach to learning
- The interconnectedness of concepts. In the above we have: products and factors, co-ordinates and graphs, square roots, area, perimeter, volume and surface area.
- Working algebraically is not far away if questions about generalising minimum perimeter for any area A and minimum surface area for any cuboid with volume V.