Varying your

Our previous article *Getting the balance right: The equals sign* presented activities which can be used to introduce children to translating and solving word problems using equations where the unknown is represented with a frame. The PSMC recommends such algebra work for third and fourth class pupils. Children in senior classes are expected to translate word problems into equations where the unknown is represented with a variable.

Variables are symbols (e.g. letters) that take the place of numbers or ranges of numbers. At primary school level, the main focus/use of variables is to represent an unknown quantity e.g. 5 + r = 30. Variables are also used to express rules e.g. A = L x W (area = length x width) and D = 2 X R (diameter is twice the radius). This article presents approaches which facilitate the meaningful introduction and consolidation of primary school children's understanding of variable (i.e. a letter/symbol that represents an unknown). Conceptual understanding of the concept of variable is fundamental to further study of algebra and is "necessary for the meaningful use of all advanced mathematics" (Schoenfeld and Arcavi, 1988: 420).

Language exploration

An introduction to the concept of variable can be launched by asking children what they think the word 'variable' means. If necessary prompt them "Does anybody know what it means to vary?" The expected response from pupils is that 'it changes'. If children are having difficulty provide examples e.g. "The weather varies and the speed of the car/bus varies on your way to school." Discuss everyday things that vary such as temperature, direction of the wind and the price of an item from shop to shop.

Variable wheel

The variable wheel provides a novel approach to introducing the concept of variable. A variable wheel is essentially two strips of paper, one with the letters of the alphabet on it and the other with numbers (1 – 26) on it (see figure 1a). The letter strip is wrapped around the number strip so that each letter aligns with a number. Start by having 'A' aligned with 1, 'B' aligned with 2, etc. (see figure 1a).

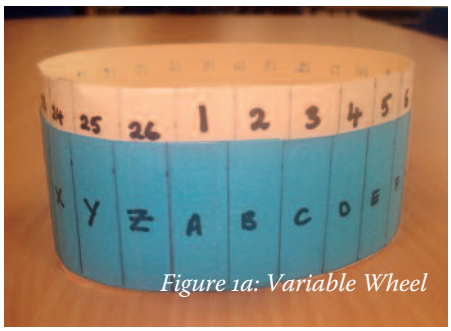


Figure 1a: Variable Wheel

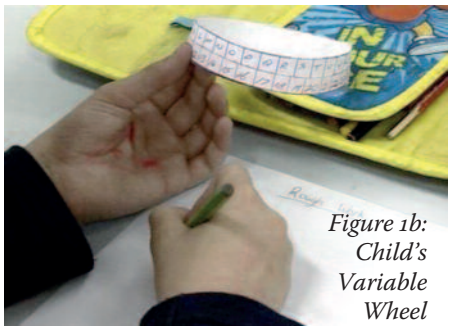


Figure 1b: Child's Variable Wheel

The variable wheel allows children explore the idea of a variable as a letter (symbol) that can stand for any number within the set of numbers (1-26) and also will allow children substitute numbers for variables (letters).While the teacher should demonstrate activities on a large variable wheel (see figure 1a), each child should have their own variable wheel (see figure 1b). The first activity children carry out with the variable wheel is to find the value of the letters in their name e.g. Amy is 39 because A=1, M=13 and Y=25. Before children do this they should predict who will have the highest/lowest name value in the class and justify their choice e.g. "Can anyone predict who might have the highest value name in the class?" "Why do you think that?" Such open-ended questions promote higher-order thinking and develop reasoning skills. Children should be given the opportunity to independently find the value of their names, using the variable wheel, and compare actual answers to predictions.

To develop children's concept of variable further, children should be asked if they think the results would be the same if they varied the values and worked backwards letting a = 26 and z =1? This is an important step as we want children to realise that a variable is a letter that can represent any number depending on the problem (i.e. a = 1 in one problem but a = 17 in another problem). Allow children to twist the variable wheel in a random fashion and come up with a new value for their name (see figure 2). From this, children should come to realise that any letter can represent any number (and vice versa) and that letters (i.e. variables) don't have to be set values. The children can be challenged to find the largest/lowest value for their name using the variable wheel.

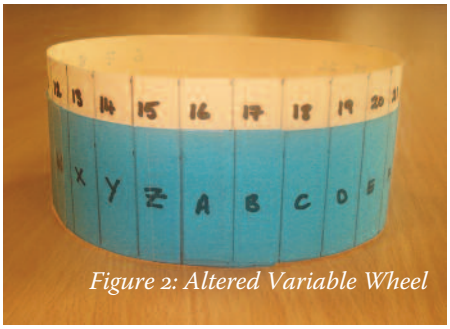


Figure 2: Altered Variable Wheel

approaches to teaching variables

Solving story problems using variables

Children's concept of variable can be developed through the use of relevant story problems. The use of story problems with different contexts (e.g. sport, games, clothes, food) will motivate pupils and support their understanding of the use of variable in creating and solving equations (number sentences). The key information from each story problem can be initially recorded on a table. Subsequently the information can be translated into an equation (with a variable) which can be solved.

Context: Sport

Sports problem 1: There were 76 points scored altogether in a rugby match. Ireland scored 40 points. How many points did France score?

The information from the story problem can be recorded on a simple table by the teacher and children. We can say to children "As we do not know how many points France scored we can use a letter/variable to represent the points France scored." Ask children to give suggestions e.g. "What letter might we use as the variable in this problem for France?" A suggestion might be F. Write this on the table. The next step is to transfer the information from the table and write an equation using the selected variable i.e. 40 + F = 76. Ask children to solve this (F = 36) (see figure 3).

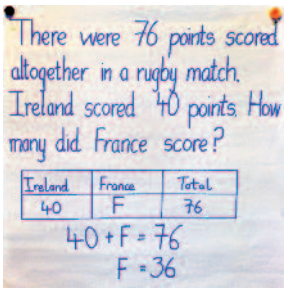


Figure 3: Poster for Sports Problem 1. (Story Problem ➔ Table ➔ equation)

Next we can present a similar but more challenging problem.

Sports Problem 2:

In the matches played so far in the 6 Nations Rugby Ireland, Italy and France have scored 186 points altogether. Ireland has scored 78 points and Italy has scored 63 points. How many points has France scored?

Allow children to fill in a table again, choosing the variable to represent France. Write an equation to represent the story i.e. 78 + 63 + F = 186. In this problem F = 45. Compare the two problems in class. In the first problem F = 36 and in the second problem F = 45. It is important that children realise that the value of the variable (i.e. 'F' in this case) can change depending on the problem. Ask children if we used K/Z/etc. as our variable for France would we get the same answer. Discuss.

Creating story problems

After lots of work solving problems using variables, children can work, in pairs or individually, to create their own story problems that will require a variable to solve them. To motivate pupils tell them that their story problems will be placed in envelopes and given to another group to solve. Model the process of writing a story problem to the class and provide clear directions. One way of modelling how to create a story problem is to collect information/data from the class itself and fill in a pre-prepared chart (see figure 4).

There are ☐ children in a class.
They have to choose their favourite juice from a choice of three juices.
☐ like orange juice.
☐ like apple juice.
How many like cranberry juice?

Figure 4: Creating a Story Problem: Data Collection Template

Take a class survey to complete the pre-prepared chart. This approach will make the problem relevant to the children and facilitates linkage with the data strand. Provide children with the opportunity to create their own story problems, which require a variable to solve. Figures 5 and 6 are examples of story problems created by pupils we worked with in a Limerick City primary school.

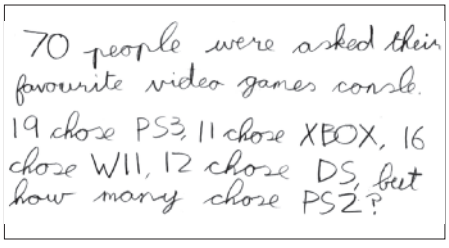


Figure 5: Story Problem created by pupils (video game consols)

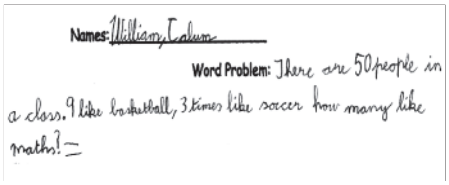
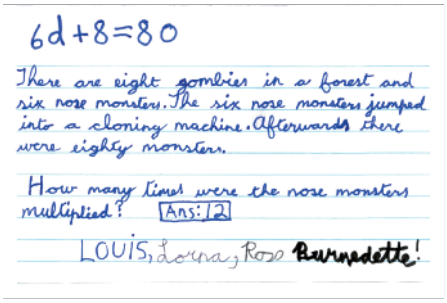


Figure 6: Story Problem created by pupils (preferred activities from a choice of basketball, soccer and mathematics)

Translating equations into story problems

Once children solve and create story problems using variables, one possible extension activity is to ask pupils to work in groups to write a story problem that represents a given equation. This requires flexible reasoning on the part of pupils. Such an activity also provides challenge and supports differentiation for more able children. Simple to more complex equations can be presented to groups. In many cases, teachers are amazed by the pupil response in terms of its complexity, originality and creativity (see figure 7).

Figure 7: Story problem developed by a group of pupils in response to an equation
Equation: 6d + 8 = 80



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Note: *The ideas in this article serve as a starting point for teachers who seek to develop pupils' understanding of the concept of variable. These activities may be modified to meet the needs of your class group and can be used over several days. Contexts that are appropriate to the interests of your class should be used.*

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