

Developing the Concept of Multiply and Divide

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Introduction

The following looks at the difficulties basic numeracy students have in dealing with multiplication and leading from that, division. I am concentrating on multiplication as this best illustrates the problem. It is also the area where I have started to develop a way of addressing the problem. I feel that to start with I should make it clear the level of student with whom I am concerned. I work in Adult Basic Education departments of Further Education and Community Education in Bristol, England. The students I am looking at in this paper have very immediate numeracy needs, such as being able to handle money on a day to day basis more confidently. When they start they are generally able to count, add and by informal methods subtract numbers. They may have found means of tracking their money in broad terms, but very often cannot itemize and check all the details. The development of these skills, although it can involve time and hard work on the part of the student, are not, relatively speaking, too difficult to achieve.

Outline of Problem

Many basic numeracy students find the concepts of multiply and divide more difficult. We tend to teach the four rules one after the other as if they follow a logical order directly building on the previously learned skill. To some extent this is the case but not totally so. Just because a student can add and take away does not mean that they have all the skills or understand all the concepts that are needed to go on to multiply and divide.

To add follows on from counting. The need to do this on a simple level is all around. How many people want tea and how many want coffee in the group? The idea of adding these together to get to the total number in the group is something that can be seen. Going on from that, to take away is also something with which they are familiar - if five want tea and there are ten in the group then five from ten is five who want coffee. Using money gives lots of examples of the need in very practical terms to add and take away.

The step on from this to multiply and divide is not as smooth as it may seem to those of us who have mastered these ideas and use them regularly almost without thinking. How much will five teas cost if one costs 50p: $5 \times 5 = 25$ so 2.50 - no problem. The bill came to 2.50 for five of us so that is 5 into $25 = 5$ so 50p each.

The answer to this sort of sum can be arrived at by repeated addition or subtraction. And so many basic students carry on using these methods of arriving at the answer and not bothering with the multiply and divide. I will leave aside the question of whether they need to for the time being, (this would be a subject for another talk altogether), and

proceed on the basis that the student wants or needs, for whatever reason, to be able to do these things.

In working with a number of students at this level over the last five -six years I have found over and over that students revert back to repeated addition to work out practical sums when, for instance doing money problems, and resist using multiplication.

At first I thought that they resisted it because of the problem of learning their tables; they could not call to mind the answer quickly enough, so went back to the sure way of adding. However I started to find that even where students had tried and who for a short time managed to learn the times tables they still did not use this knowledge.

The other answer was that the students needed to try out multiplication in a range of practical settings. This is the way most tutors I have spoken to would proceed and is the way that the standard text books are laid out. Encouragement of this by way of simulated exercises or actual situations where they could use multiplication outside college did not help them significantly. Even if they made a special effort to try to use multiplication very often this would be checked by adding, showing a lack of confidence in the method.

One major problem was not resolved, they were still not sure of when to use the knowledge. I have gathered together work from various students who are able to mechanically work out a multiplication sum when they are given it as an exercise clearly labelled multiplication. These people have also been able to learn some times tables, if not all of them up to ten times.

When faced with a realistic situation where some addition, some subtraction, some multiplication and some division are used and they have to select the most appropriate they are confused as to what is required when. Students would often try the sum two or three different ways hoping one of them would be right. They would usually get so bogged down in this that they lost sight of what they were trying to achieve.

This led me to think that it is not the mechanics of the calculation that is confusing but the actual concept of multiplication (and division) that is not understood. I have been trying to find a reason which may explain the difficulties people have with both of them which may also help with the use and mechanics of dividing.

Materials that Address the Problem

When I tried to see if I could illustrate the difference between multiplication and division by using diagrams or some other graphic/tangible way of understanding what is happening I started to see another problem the students have.

I gave some students the following exercise:

You open a cupboard and find the following:

Tins of:

Baked Beans	Peas	Tomato soup
Baked Beans	Mushroom soup	Tomato soup
Peas	Mushroom soup	Baked beans
Peas	Mushroom soup	Tomato soup

You have to

1. Organise them into groups of similar things.
2. Count the number of groups
3. Count how many are in each group
4. Work out how many are there altogether

When I was making this up I thought I had maybe made it too simple, but thought that if I introduced it as a preliminary stage then the students may accept it. However what I found was that this was a more difficult exercise than I had expected and that the students had real trouble with the grouping of things. It was not something they did. I talked to them about doing this sort of thing at home - i.e. sorting out their kitchen cupboards and the like to count up what is there. They would count each set of tins separately and not try to group them in any way. They also said that whenever they tried to do this sort of thing they would get half way through and start forgetting the numbers and would have to start again. So this seemed to be something to develop.

I feel that patterning and maybe other related special skills are something that these student are not able to do, at least do well, and instinctively. I therefore developed the grouping idea. Exercises either written or practical where students are encouraged to group objects have started to show some benefits to the students. As yet though I have not developed an adequate range of materials to fully develop these skills.

One of the difficulties is trying to find things that an adult would be happy to use. Some find the use of counters and so on a bit childish, although in the right environment this can be incorporated into the classroom session. It seems that these people may well have missed out on some of the play that many of us did as children. It is with things such as building blocks and other maybe more boy-like toys that we develop these skills. This is an area I would like to explore more in the future.

In looking into this I have found little help from the standard text books; even ones which have a generally good practical approach to numeracy. The accreditation appropriate for this level of student does not encourage the development of these skills either. Counting in batches is one example from the Number-power scheme which touches on this but it is one small part of a unit. Although we may try to avoid teaching strictly in line with the requirements of the accreditation schemes it is a fact of life in most centres that tutors have to pay regard to their requirements and often are expected to tutor students to pass these courses. I am concerned that the lack of attention to the spacial/organising skills referred to here are being neglected, only to prevent the student going beyond the lowest levels of achievement.

In general these materials are all geared towards a numerical or mechanical understanding of multiplying and dividing. The spacial skills come later when students go on to measuring and geometry. But maybe some of these skills are needed at an earlier stage.

I have indicated the problems students have with their tables and using multiply and divide. Making the work relevant and showing practical examples has not necessarily helped to make the decisions about what to use any easier.

Conclusion

Although I have concentrated on these few students who may be a minority of those we see as tutors I feel that these points have a wider importance. Firstly because I am not convinced that all those who appear to understand multiply and divide and who have passed exams or gained accreditation which purports to show that they are able to do these things are actually able to go out and use these skills to make life easier for themselves. Often tutors take the mechanical knowledge to be an illustration of the student learning how to do them. They may have a mechanical skill that in given situations where the need to do them are clearly spelt out they can appear to apply them successfully.

Secondly even those who can do these things and can use multiply and divide at a simple level may not have all the resources they need to move on further with maths. At some point the understanding may break down or they will find it much more difficult to do other things - fractions and so on. These tasks may be made much easier if the patterning and spacial skills I have touched on can be more fully developed.

Altogether, encouragement gathered understood difference accreditation achievement resources. However they would usually count out money by grouping like coins together, probably because this is commonly seen being done by others. Very often the money would then be counted consecutively and the reason for grouping not actually used.

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