Answer to the Kongfu Fingers Game

The question was, in the previous chapter, how do we use our two hands to represent the numbers from 0 all the way to 99?

The 'place values' now come into play. If we do not have the concept of place values, then all we can do with our two hands is to represent the numbers from 0 to 10. However, if we 1) let our right hand have the place value of 1, and the left hand have the place value of 10, and 2) let our thumbs to represent the number '5' (the same way as the Chinese abacus works), won't we able to use our two hands to represent the numbers from 0 all the way through 99 now? The following pictures will show why.


Figure 1: 0 X 10 = 0


Figure 2: 0 X 1 = 0


Figure 3: 1 X 10 = 10


Figure 4: 1 X 1 = 1

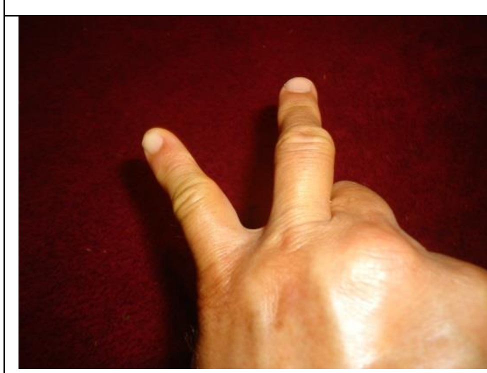
Figure 5: 2 X 10 = 20

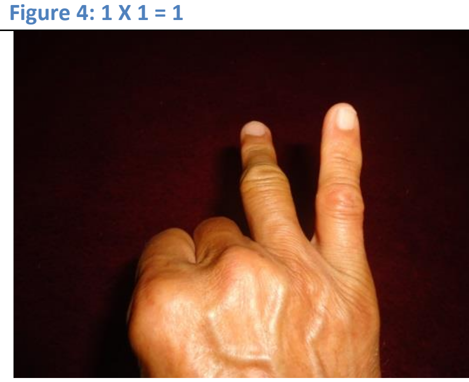
Figure 6: 2 X 1 = 2

Figure 7: 3 X 10 = 30

Figure 8: 3 X 1 = 3

Figure 9: 4 X 10 = 40

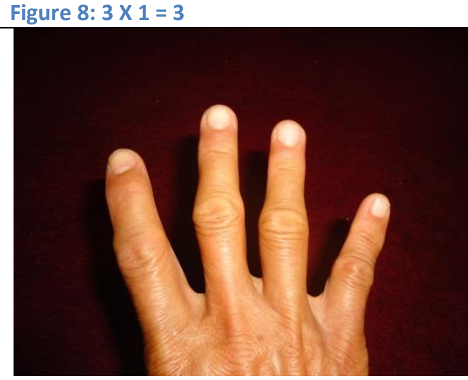

Figure 10: 4 X 1 = 4

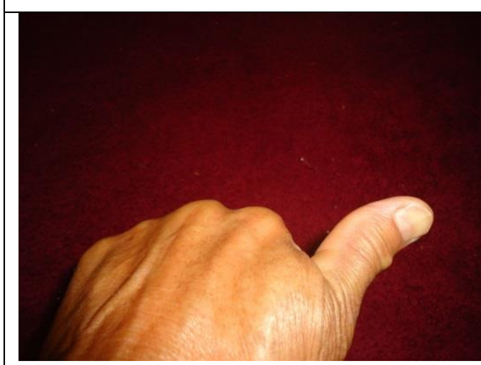

Figure 11: 5 X 10 = 50

Figure 12: 5 X 1 = 5

Figure 13: 6 X 10 = 60

Figure 14: 6 X 1 = 6


Figure 15: 7 X 10 = 70

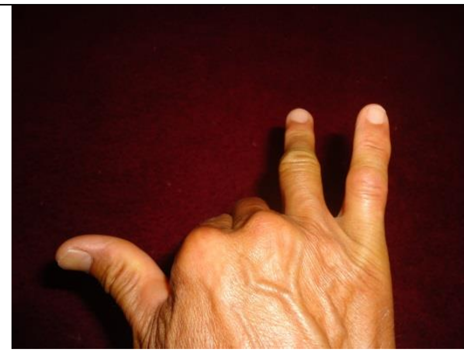
Figure 16: 7 X 1 = 7

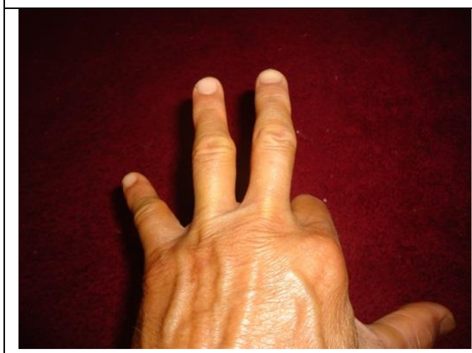
Figure 17: 8 X 10 = 80

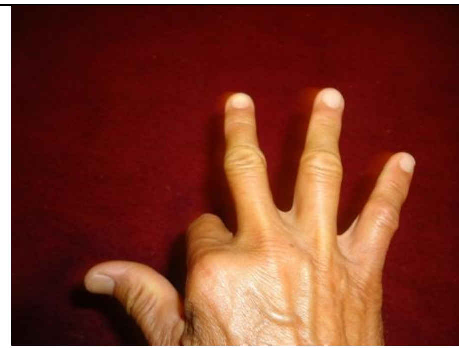
Figure 18: 8 X 1 = 8

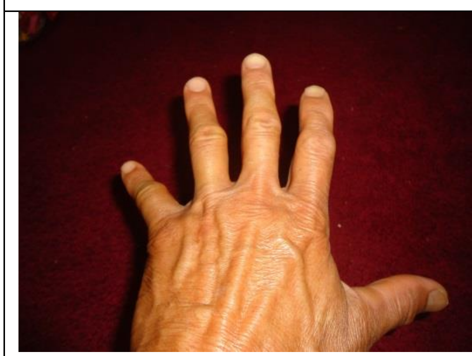
Figure 19: 9 X 10 = 90

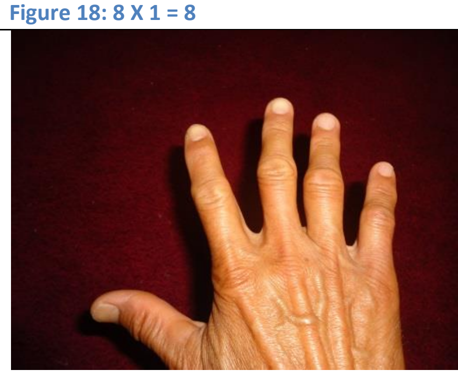
Figure 20: 9 X 1 = 9

With the place values in mind, we will be able to represent the numbers from 0 all the way through 99, as the above pictures have just shown us. Name any number and combine your two hands to represent it.

Now, another challenge: We have four students come to the board, and let their two hands represent different place values. What will be the smallest and the largest numbers they can represent with their hands? And, will they be able to represent any number between these two extremes? (**The answers are 0 and 99,999,999. Try to figure out why on your own. And, of course, they will.**) It will be easier if they stand shoulder to shoulder with their backs facing the class and stretch their hands and fingers upward.

If the class like even more challenges, let another student volunteer to go to the board to represent the positive or negative sign (with any gestures). Now, what will be the largest number and the smallest?

Conclusions

I have mentioned that the purpose of my encouraging the students to use the abacus is not for it to take the place of a calculator. Nor is it my focus for it to compete with a calculator. On the contrary, my purpose is for them (an abacus and a calculator) to complement each other, for the reasons as follows:

Calculators have become so easy to use and so powerful that students can obtain the results they need without having to understand the basic mathematic rules and operations. All they need to do is to punch the buttons. However, when they are facing more advanced mathematical topics, they are immediately frustrated because they did not build up the fundamental knowledge they now need.

An abacus can train the students in these areas through hands-on, step-by-step, operations.

I also mentioned that along the way, we would build the set of rules that we need to take care of how to determine the sign (positive or negative) of the result and also how to take care of the moving of the decimal point.

The rules to determine the positive or negative nature of the result are as follows:

A positive number plus another positive number.	The result is positive.
A positive number plus a negative number. (Or, a negative number plus a positive number)(**Addition is a commutative operation.**)	Determine by looking at the absolute value of the numbers. If the absolute value of the positive number is larger, then the result is positive. If the absolute value of the negative number is larger, then the result is negative.
A negative number plus another negative number.	The result is negative.
A positive number minus another positive number.	If the former is larger, the result is positive. If the former is smaller, the result is negative.
A positive number minus a negative number.	The result is positive. It is the same as the positive number plus the absolute value of the negative number.
A negative number minus a positive number.	The result is negative.
A negative number minus another negative number.	It is the same as adding the absolute value of the second number. If this absolute value is larger than the absolute value of the first number, then the result is positive. If this absolute value is smaller than the absolute value of the first number, then the result is negative.
A positive number times another positive number.	The result is positive.
A positive number times a negative number. (Or, a negative number times a positive number.)(**Multiplication is a commutative operation.**)	The result is negative.
A negative number times another negative number.	The result is positive.
A positive number divided by another positive number.	The result is positive.
A positive number divided by a negative number.	The result is negative.
A negative number divided by a positive number.	The result is negative.
A negative number divided by another negative number.	The result is positive.

The rules for moving the decimal point are as follows:

For addition and subtraction	Line up the decimal point in the numbers to be operated on. Look at the arrangement of the colors of the beads so you can designate the place value for each of them to your best advantage.
For multiplication	If, during a calculation, you have moved the decimal point to the right for easier operations, always move it backward however many places you have moved it to the right accumulatively.
For division	Treat the dividend the same way as a number in multiplication. On the other hand, if you have moved the decimal point in the divisor to the right in an operation, then you have divided more that many times by 10. So, in the end, you need to move the decimal point to the right by that many places to return to the result’s correct value[1].

These two sets of rules apply to any arithmetic calculation. They are not there only when one uses an abacus. In other words, when you operate an abacus, you are training yourself in these rules also.

As mentioned in the beginning chapter, there is a way for the Texas abacus to designate the positive or negative sign of a number. Utilize it by all means. By looking at the numbers to be operated on, including their signs, the user can determine the positive or negative nature of the end result already even before any other calculation begins.

With these and what we covered in previous chapters, students will be able to confidently operate an abacus. And through the process, slowly but surely, they will understand and become familiar with the basic mathematic rules and operations, which will, in their turn, pave the way for the students to go further and further in mathematics with clarity, precision, and confidence.

[1] **The behavior of the divisor is the opposite that of the dividend.**