Using Chess Symbols to Teach Arithmetic

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Background

Chess benefits children and this claim has been evident in hundreds of articles published (1) In the past, many chess puzzles have been published and Sam Loyd, the "Puzzle King", is an authentic American genius, famous as a composer of chess problems. The most recent mathematics and chess related book entitled Mathematics and Chess has 110 entertaining problems and solutions. (2) Almost all of these published puzzles, old and new, are related to the moves of chess pieces and the majority of them are considered difficult for most of elementary students to solve.

In 1995, after searching market for a suitable math and chess junior workbook with void, I decided to write one myself. I pioneered the idea of integrating chess symbols and their values into mathematical chess puzzles in my workbook entitled Mathematical Chess Puzzles for Juniors (3).

The fundamental difference between my mathematical chess puzzles and those traditionally published chess puzzles is that I integrated chess symbols and values into the arithmetic operations and this is the first time that children from pre-school to elementary school are able to work on mathematical chess puzzles at their ability level. Children not only learn chess, but also have the opportunities to explore the chess puzzles making use of the very basic chess knowledge.

To me, the idea of using of chess symbols and their values directly in the mathematical chess puzzles is a breakthrough that math and chess could be “truly” integrated. With the publication of my new workbook (4), the chess puzzles that students could work on are no longer limit to only traditional chess puzzles, I have created some mathematical chess puzzles that show the relationship between chess and mathematical concepts.

Purpose of this Article

The values of chess symbols I use in my workbook are the same as the ones used in the Teaching Manual published by the Canada Federation of Chess (5). Perhaps I did not have any explanations in any of my previous published workbooks on the reasons of using chess symbols, I have received some queries on why chess symbols are used in my workbook. A few typical questions are listed as follows:

(1) What more advantages could chess symbols have than using some animal figures?
(2) Why not just directly use variables names like x, y, z, …?

This article attempts to answer the above questions by analyzing the reasons primarily using my own observations and practical teaching experiences and feedback from my students.

Chess symbols have special meaningful values

English letters such as x, y, z, … are normally used to represent unknown numeric values. These unknown letters are also called variables and they normally do not have singly defined values. On the other hand, chess symbols each has definitely defined meaningful value and its value is related to each piece's strength in the chess game. Take a look at the following example.

Let $x = 1$, $y = 3$ then $x + y = 1 + 3 = 4$

In the above particular example, x is 1 and y is 3 but x does not always have to be 1 and y does not always have to be always 2.

If we use chess symbols in the above example, we get

♟ + ♗ = 4

The above pawn and bishop have specifically defined values 1 and 3 respectively and will not change their values just because the problem is different. In algebra, students would substitute x or y with different values when given values are changed. In other words, the values of x and y could be changed for different problems. To compare the substitution values for chess symbols and algebraic variables, we realize that there is a difference that is in chess symbols substitution, the substitution is intuitive for children since the values of chess symbols are pre-defined and meaningful to them.

The chess symbols used in my workbook and integrated with math puzzle problems are not necessarily viewed by children as "variables", these values have special meanings to children, they could easily relate much better between chess symbols and their relative values. To use animal figures or any other symbols such as x, y, z in mathematical chess puzzles would be less meaningful to children when compared to the use of chess symbols in math and chess integrated puzzles problems.

Chess Values Used

Each chess piece has been assigned a different value, for example, the following are values assigned to chess symbols and are used in my workbook.

 (king) = 0 point

 (pawn) = 1 point

 (knight) = 3 points

 (bishop) = 3 points

 (rook) = 5 points

 (queen) = 9 points

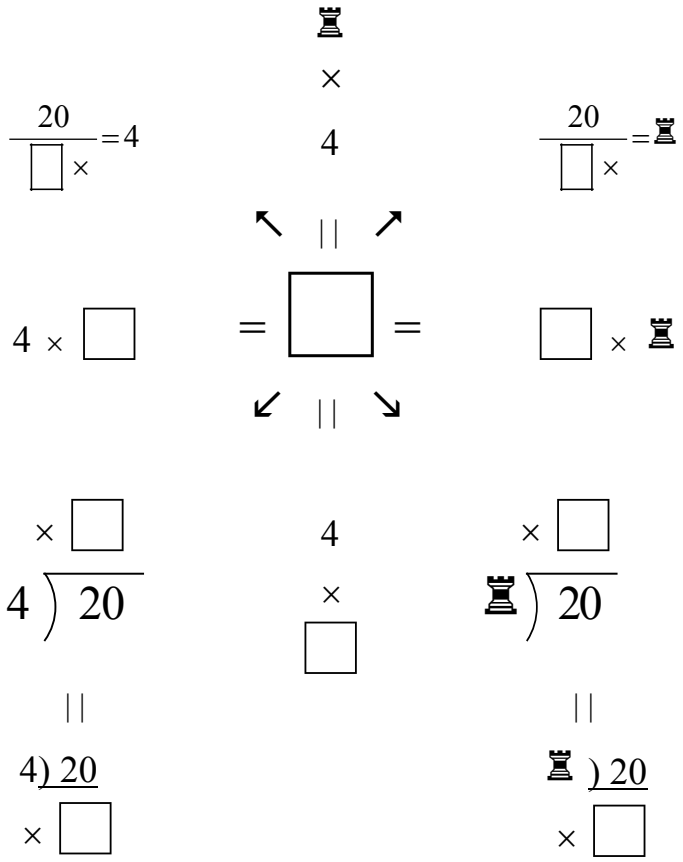
My experience of using chess symbols in teaching arithmetic operations is very positive. Elementary students who have not learned variables but have worked on my worksheets using chess symbols have absorbed the concept of algebraic variables or substitution in a natural and intuitive way. There is no need to explain the concept of variable other than mention the values of chess pieces, for example,

 + 5 = _____

To get the answer I would only have to remind students the value of  . The reason why students seem to be able to learn the concepts of substitution even in grade 1 or 2 is because students could relate the numerical value of each chess piece to its actual strength of each piece which is very meaningful to them and also it is fun to work out the problems using the knowledge of chess. The symbols of other objects will not be as meaningful as chess symbols.

The following is another example how chess and math is integrated. Parents like the idea of having their children to think in an extra step to get the value of ♜ before they could get the answer. A simple one step multiplication problem is changed to 2-step problem and involves a bit more thinking to acquire the answer.

Example 1



Chess values are much like monetary values. When chess or money figures are seen by children, they both represent some pre-defined meaningful values.

Example 2

Fill in different number of chess pieces to come up with each total.

Number of ♟	Number of ♘	Number of ♖	Total points
1	1	1	9
3	2	0	9
0	3	0	9
☐	☐	☐	10
☐	☐	☐	10
☐	☐	☐	11
☐	☐	☐	12
☐	☐	☐	13
☐	☐	☐	14
☐	☐	☐	15

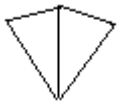
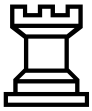
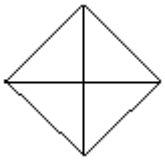
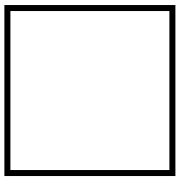
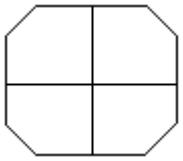
Chess symbols have meaningful moves

The other reason of using chess symbols in mathematical chess puzzles is the chess symbols themselves representing movements and coincidently some of the directions of movements resemble some arithmetic operators, for example rook can move up and down and left right and thus its trace of capable moves looks like a + sign.

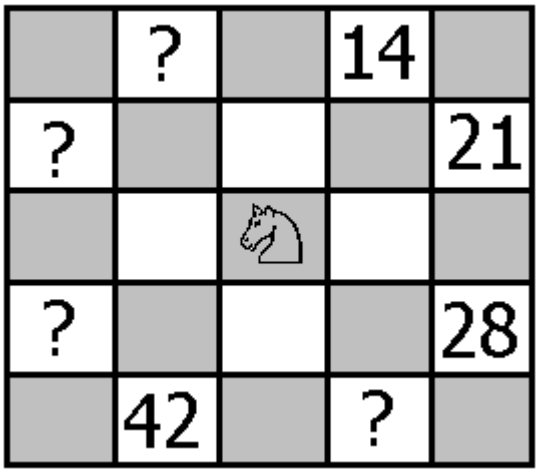
Each chess symbol has a specially defined direction of move and these directions of moves are "imbedded" with each piece. I have taken the advantage of chess pieces moves and defined them as follows:

Addition/Subtraction = Rook (Could also be queen or king)
Multiplication = Bishop (Could be also be queen or king)
Division = King (Opposition of 2 kings)

Example 1. The following is a puzzle that requires the knowledge of chess moves.

Filling in □ by a chess piece	Geometric shapes
	
	
	
	

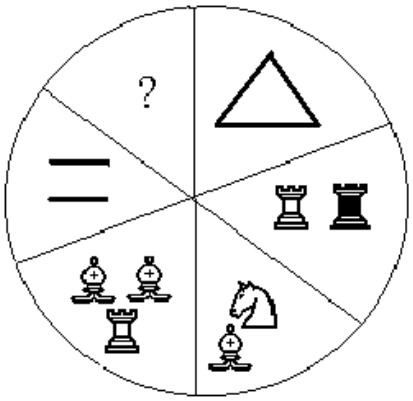
Example 2. Use chess symbol moves to solve the following puzzle.



Example 3. Use chess symbol moves to solve the following puzzle.

If 2 ♖ 3 = 5 then 2 ♗ 3 is = _____

Example 4. Use chess symbol moves to solve the following puzzle.



Summary

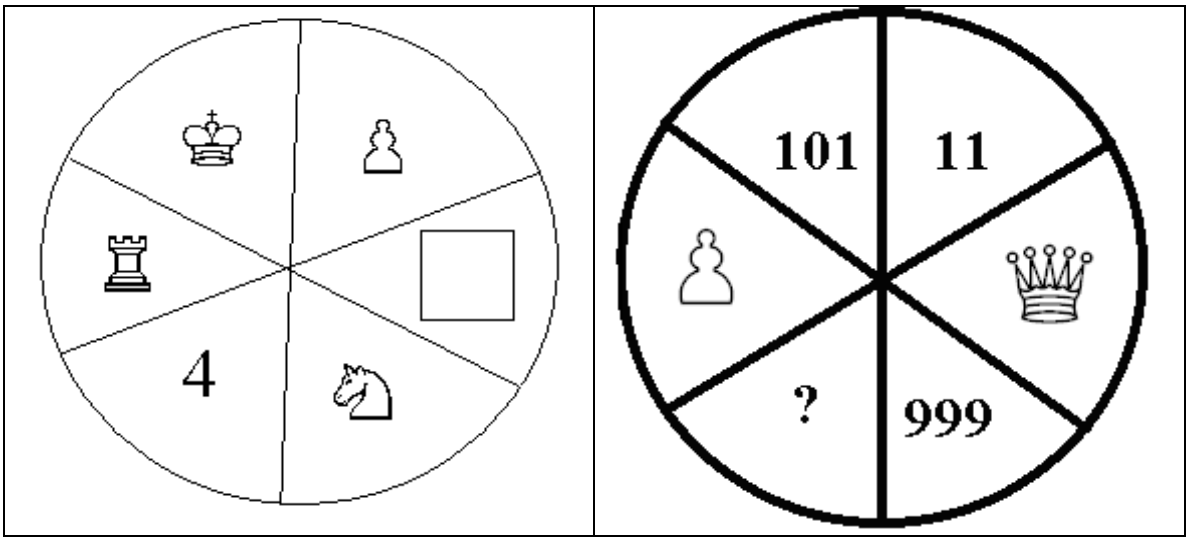
I have found the idea of using chess symbols very helpful for elementary students – elementary students do not know they are actually learning the concepts of variables by using chess symbols in arithmetic equations.

The most interesting in using chess symbols is that the chess symbols themselves not only possess pre-defined values but also have the implied meaning of movements and these two special characters allow me to create some very interesting mathematical puzzles with pizzazz.

By using chess symbols, a simple one-step arithmetic problem could become a multi-step problem, as this result, chess symbols and values offer children more opportunities to work on another type of questions which could simulate children's brain cell and improve their problem-solving ability. So the benefits of working on these types of problems is double edged- improve chess knowledge and also mathematical problem-solving ability.

The mathematical chess puzzles created by me are not just mechanically substituted numbers with chess symbols. Many mathematical chess puzzles created also involve pattern, sequence, geometry, set theory, and logic etc. In other words, the integration is very diversified and also involves multi-direction visualization. I would give the following two examples to conclude this article.

Example Find values to replace? or fill in □.



Reference

(1) Teacher's Guide: Research and benefits of chess compiled by Dr. Robert Ferguson. Details see below http://www.quadcitychess.com/benefits_of_chess.html
(2) Mathematics and Chess, by Miodrag Petkovic, Dover Publications, Inc. Mineola, New York, 1997
(3) Mathematical Chess Puzzles for Juniors, Frank Ho and Andrew Ho, ISBN 0-9683967-0-4, 1997
(4) Magic Chess and Math Puzzles, ISBN 0-9683967-9-8, Frank Ho 2005.
(5) Chess Teaching Manual, IM Tom O'Donnell. From the Chess Federation of Canada.