

THE CHICKEN AND DOG POEM PROBLEM IN FOLK ACTIVITIES

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Abstract:

This study explores the transformation of the classical Chinese mathematical problem “*Chickens and Rabbits in the Same Cage*” into the Vietnamese version “*Chickens and Dogs*”, as reflected in Sino-Nom mathematical texts and modern educational materials. Based on an analysis of five Sino-Nom mathematical texts, the study identifies the Temporary Assumption Method as the central reasoning technique used across these versions. The findings reveal a gradual process of localization: early Vietnamese texts retained the original “*chicken and rabbit*” form, whereas later works replaced the rabbit with the dog, a more familiar and culturally resonant animal in Vietnamese daily life. By the mid-twentieth century, the problem had evolved into a mathematical poem, first recorded in *Mathematical Folk Songs* (1950), and it has continued to appear in mathematics education from primary to lower-secondary levels. The study shows that mathematical knowledge in Vietnam was not merely transmitted, but also reinterpreted within local cultural, linguistic, and educational contexts.

Keywords: Chicken and Dog poem, Sino-Nom mathematical texts, folk mathematics, mathematical riddles, mathematical games

1. Introduction

The problem “*Both chickens and dogs, tied together in a circle: thirty-six heads and one hundred legs. How many chickens and dogs are there?*” originated in China but is now familiar to Vietnamese students. In Vietnam, the problem entered everyday life, popular mathematics books, and educational websites in the form of mathematical verse, often recorded as mathematical riddles or folk mathematics.

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The Chicken and Dog Problem has a long history and continues to inspire mathematicians (see Nguyễn Đăng Phát, n.d.) and teachers who develop new and creative solutions, such as the Ô ăn quan method (Ngô Quốc Chung & Nguyễn Thị Hiền, 2023). Such approaches help students understand the problem more easily, even without much formal mathematical knowledge, and make the learning process more engaging.

This article reviews the history of the Chicken and Dog problem in Sino-Nom mathematical texts and Vietnamese folk life.

2. History

The origin of this problem can be found in the Sunzi Suanjing, a book written during the Jin dynasty in China (third-fifth centuries) (Sunzi, 2007). Volume 3 of the Sunzi Suanjing contains the following problem: “*Now there are chickens and rabbits in the same cage. There are 35 heads above and 94 feet below. How many chickens and rabbits are there?*”

Answer: 23 chickens and 12 rabbits.

Solution: Place the 35 heads above and the 94 legs below. Divide the number of legs by two to obtain 47. Subtract the number of heads from this result. In other words, divide the total number of legs, 94, by 2 to obtain 47, then subtract the number of heads, 35, to obtain the number of rabbits; the number of chickens follows naturally.

Comment: Sunzi may have been the first to propose the Provisional Assumption Method, also called the Temporary Assumption Method. Suppose that both chickens and rabbits have two legs. The half-leg count is then 47. Since rabbits actually have four legs, the difference $47 - 35 = 12$ gives the number of rabbits. We can then deduce that there are 23 chickens.

This problem was probably also mentioned in many other Chinese mathematical books. For example, the book *Tăng bổ toán pháp thống tông* (a copy of which is currently preserved in Vietnam; Trình Đại Vị, n.d.), supplemented from *Toán pháp thống tông* by Trình Đại Vị (China, first printed in 1592), restates the same problem with the same data. However, its solution is slightly different.

Solution: Double the total number of heads to obtain 70. Subtract 70 from the total number of legs; the remainder is 24. Divide this by 2 to obtain 12, the number of rabbits. Multiply 12 by 4 legs to obtain 48 rabbit legs. Subtract 48 from the total number of legs; the remainder is 46 chicken legs. Dividing this by 2 gives 23 chickens, which agrees with the answer.

Comment: This is also a form of the Temporary Assumption Method. Suppose that both chickens and rabbits have two legs. The assumed number of legs is then 70. Since rabbits have four legs, the extra $94 - 70 = 24$ legs belong to rabbits. From this we deduce that there are 12 rabbits and 23 chickens.

3. The Chicken and Dog Problem in Vietnamese Sino-Nom mathematical texts

We examined the following five Vietnamese Sino-Nom mathematical texts, written in Sino and Nom scripts, that include the “*chicken and dog*” problem.

3.1. *Ý Trai toán pháp nhất đắc lục [A Record of What Ý Trai Understood Correctly in Methods of Computation] by Nguyễn Hữu Thận (Nguyễn Hữu Thận, 1829, Book 6)*

The problem: *Thiết hữu kê thỏ đồng lung, dẫn tri đầu cộng tam thập lục, túc cộng nhất bách, vấn kê thỏ các kỷ hà?*

Translation: Suppose there are chickens and rabbits locked in the same cage. The total number of heads is 36 and the total number of legs is 100. How many chickens and rabbits are there?

Solution (Nguyễn Hữu Thận, 1829, Book 6): Subtract the number of legs of a two-legged chicken from that of a four-legged rabbit; the difference is 2. To find the number of rabbits first, multiply the two legs of a chicken by the total number of heads, 36, to obtain 72 legs. Subtract this from the actual total, 100, leaving 28 extra legs. Dividing these extra legs by 2 gives 14 rabbits. Once the number of rabbits is known, the number of chickens follows.

To find the number of chickens first, multiply the four legs of a rabbit by the total number of heads, 36, obtaining 144 legs. Subtract the actual total of 100 legs; the difference is 44 legs. Dividing 44 by 2 gives 22 chickens. Once the number of chickens is known, the number of rabbits follows.

This method uses the assumed number of chickens to find the number of rabbits. If all 36 animals are temporarily assumed to be chickens, the corresponding number of legs is 72. Since the actual total is 100, there are 28 extra legs. Each rabbit contributes 2 extra legs beyond the assumed two, so dividing 28 by 2 gives 14 rabbits. The method of using the number of rabbits to find the number of chickens follows the same logic and requires no further explanation.

Comment: Nguyễn Hữu Thận also solved the problem using the Temporary Assumption Method. Suppose that both chickens and rabbits have two legs. The assumed total is then 72 legs. Since rabbits have four legs, the remaining 28 legs yield 14 rabbits. From this we can deduce that there are 22 chickens.

3.2. *Cửu chương lập thành toán pháp [Ready-made Computational Methods of the Nine Chapters] (Phạm Hữu Chung, 1713, p. 71b)*

The problem: *Kim hữu kê thỏ, tổng tam thập lục đầu, túc nhất bách. Vấn kê nhược can, thỏ nhược can?*

Translation: Now there are chickens and rabbits, with thirty-six heads and one hundred legs. How many chickens and how many rabbits?

Answer: There are 22 chickens and 14 rabbits.

Method: Place the number of heads above. Below it, place the number of legs divided by two. Then subtract the upper number from the lower number to obtain the number of rabbits. Subtract this result from the total number of heads to obtain the number of chickens.

3.3. *Lập thành toán pháp [Ready-made Computational Methods] (Lập thành toán pháp, n.d., p. 21b)*

Chicken and rabbit calculation (page 21b): There are chickens and rabbits in the same cage. There are 81 heads above and 190 legs below. How many chickens and rabbits are there?

Answer: There are 67 chickens and 14 rabbits.

Method: Place the number of heads above. Below it, place the number of legs divided by two. Then subtract the upper number from the lower number to obtain the number of rabbits. Subtract this result from the total number of heads to obtain the number of chickens.

Comment: *Cửu chương lập thành toán pháp* and *Lập thành toán pháp* also use the Temporary Assumption Method. For example, in *Lập thành toán pháp*, suppose that both chickens and rabbits have two legs. Then half of the total number of legs is $190 : 2 = 95$. Since rabbits have four legs, the difference $95 - 81 = 14$ gives the number of rabbits. From this we can deduce that there are 67 chickens.

3.4. *Bút toán chỉ nam [The Mathematical Guide] (Nguyễn Cần, 1909)*

Question: The total number of chickens and dogs is 36, with 100 legs. How many chickens and dogs are there?

Answer: There are 22 chickens and 14 dogs.

The calculation is as follows: First, add the two legs of a chicken and the four legs of a dog to obtain 6 legs, whose average is 3 legs. Multiplying 36 by 3 gives 108. Subtracting the actual total, 100, leaves a deficit of 8. Next, subtract the two legs of a chicken from the four legs of a dog to obtain 2, and divide the deficit 8 by this difference to obtain 4. Half of 36 is 18. Subtracting 4 from 18 gives 14 dogs, while adding 4 to 18 gives 22 chickens.

3.5. *Thống tông toán pháp [Counting Methods of Interrelated Origins] (Tạ Hữu Thường, n.d.)*

Chicken and Dog Problem

Question: If chickens and dogs are tied together in a circle, 36 animals have 100 legs. How many chickens and dogs are there?

The solution: Consider the heads and reduce the legs. First take the 100 legs as the given total and divide by 2 to obtain 50. Subtract 36 from 50 to obtain 14 dogs, then subtract 14 from 36 to obtain 22 chickens.

To check the result, take 14 dogs with 4 legs each, giving 56 legs, and 22 chickens with 2 legs each, giving 44 legs. Together they make 100 legs.

Answer: 14 dogs, 22 chickens.

Bird and Rabbit Problem

Transliteration:

Birds and rabbits in the same cage do not know the number

Thirty-six heads in the middle of the cage

Seeing that there are one hundred legs

How many birds and how many rabbits are there?

Answer: 22 birds; 14 rabbits.

Solution: Take the total of 36 heads and multiply it by 4 legs to obtain 144 legs. Subtract 100; the remainder is 44 legs. Dividing 44 by 2 gives 22 birds. Subtracting 22 from the total number of heads leaves 14 rabbits.

Comment: This is also the chicken and dog problem mentioned above, with chicken and dog replaced by bird and rabbit. The solution, however, is slightly different.

This example shows a shift in language: in the same book, the pair “*chicken and rabbit*” is transformed into “*bird and rabbit*” or “*chicken and dog*”.

3.6. General comments on the system of “chicken and dog” problems in Vietnamese Sino-Nom mathematical texts

First, although the presentations differ slightly, all the books are based on the Temporary Assumption Method. The solution in *Bút toán chỉ nam* is different, but in our opinion it is less clear and more difficult to explain than the solution in *Ý Trai toán pháp nhất đắc lục*, even though *Bút toán chỉ nam* was written 80 years later.

Second, in three older Vietnamese books - *Ý Trai toán pháp nhất đắc lục*, *Cửu chương lập thành toán pháp*, and *Lập thành toán pháp* - the problem is still stated in the “*chicken and rabbit*” form, as in Chinese mathematical books. Tạ Hữu Thường and Nguyễn Cẩn may have been among the first to state the problem in the “*chicken and dog*” form, making it more suitable for Vietnamese readers, for whom dogs were more familiar than rabbits. However, the problem was still presented in prose.

Finally, this transformation raises an intriguing question: which work first rendered the “*chicken and dog*” problem into verse? This question not only marks a shift in literary form but also reflects how mathematical reasoning continued to evolve within Vietnamese linguistic and cultural expression, an issue that invites further investigation.

4. The Chicken and Dog mathematical poem in Vietnamese folk life

The Chicken and Dog poem has become part of Vietnamese folk life through mathematical verse, riddles, and singing exchanges. Two versions of this problem are presented below.

Version 1. According to Lương An (1986), in the past, in the Bình Trị Thiên region, boys and girls often gathered to sing and challenge each other with poetic mathematical riddles. The following is a chicken-and-rabbit riddle in verse.

The girl sings a riddle:

I have been busy with housework for a long time

I hear that you have been studying hard.

“That chicken and that rabbit in a cage

Eighty-three birds

Two hundred and eighteen legs.”

Please count how many chickens and rabbits

How can we earn our parents’ food, clothes, and education?

The boy sings back:

Twenty-six rabbits, fifty-seven chickens

What difficulty is there that I can't figure out

Let me tell you about earning our parents’ food, clothes, and education!

Solution (in equation language): Let x be the number of chickens. Then the number of rabbits is $83 - x$. According to the problem, $2x + 4(83 - x) = 218$, so $x = 57$. Therefore, there are 57 chickens and 26 rabbits.

Comment: The young men of earlier times were probably guided by Confucian scholars in solving this problem through the Temporary Assumption Method. The problem may have been adapted from Chinese mathematical books by Vietnamese Confucian scholars, which would explain why it retains the “*chicken and rabbit*” form. It may therefore be inferred that this puzzle circulated among the people from the eighteenth to nineteenth centuries. The numbers 83 animals and 218 legs were also probably a new creation by a mathematically trained Vietnamese Confucian scholar in the Bình Trị Thiên region, perhaps Nguyễn Hữu Thận (Lương An, 1986). We do not know of any Chinese or Vietnamese mathematical book that uses these data. Further research may reveal other versions of this problem whose numerical data changed through singing exchanges.

Version 2. According to Triều Nguyên (2016), the following problem was popular in singing sessions in the coastal Hải Phòng area.

The girl sings:

A bunch of chickens and dogs tied together

Thirty-six heads and one hundred legs.

Please calculate so you don't make a mistake

How many of each kind of dog and chicken are there?

The boy replies:

Counting it to be fourteen dogs

And the chickens are exactly twenty-two.

Comment 1: The phrase “*tied in a circle*” in the modern mathematical poem may have originated from a similar phrase in Tạ Hữu Thường and then been adapted into this song.

Comment 2: There may be no cage large enough to hold 35, 36, or 81 rabbits and chickens together. Therefore, the word “*cage*” (*lồng*) here should perhaps be understood as an animal pen (*chuồng*), as some later Vietnamese books wrote. Although the statement of the problem is somewhat unrealistic, it has been accepted and transmitted for about 2,000 years. This illustrates the generality and abstraction of mathematics.

5. The transformation of the Chicken and Dog Problem in modern Vietnamese mathematical literature

5.1. From classical mathematical writings to the first modern poetic version

The poem “*Both Chicken and Dog*”, in the form of a modern mathematical poem, probably first appeared in Đào Trọng Dự’s Mathematical Folk Songs (1950).

After the poem, the book presents the problem and its solution in French by establishing the following system of equations.

Let t be the number of chickens and u be the number of dogs. According to the problem, we have $t + u = 36$ and $2t + 4u = 100$. Therefore, the number of dogs is 14 and the number of chickens is 22.

We have not found any Vietnamese document older than Đào Trọng Dự’s Mathematical Folk Songs (1950) that records this mathematical poem problem.

An online article states that this mathematical poem problem was also circulated among students in Huế at that time.

5.2. The Chicken and Dog problem in contemporary Vietnamese education

The Chicken and Dog problem has become familiar in current books, newspapers, and teaching materials. It is often solved by the Temporary Assumption Method for Grade 5 students and by algebraic methods, such as equations or systems of equations, for lower-secondary students.

Both the algebraic method and the Temporary Assumption Method are general approaches that can be used to solve many other problems.

In Ngô Quốc Chung and Nguyễn Thị Hiền (2023), the proposed solution is, in our opinion, original and effective, especially for second- and third-grade students who have not yet learned the Temporary Assumption Method used in Grade 5. Based on the idea of the game Ô ăn quan, the authors propose solving the Chicken and Dog problem by arranging 100 pebbles into 36

boxes. First, place 2 pebbles in each of the 36 boxes, making 72 pebbles. The remaining 28 pebbles are then placed two by two into 14 boxes. Finally, there are 14 boxes containing 4 pebbles each, representing four-legged dogs, and 22 boxes containing 2 pebbles each, representing two-legged chickens.

The Ô ăn quan method can be applied to many other problems. The article by Ngô Quốc Chung and Nguyễn Thị Hiền (2023) won first prize in the 2022 Hoàng Tụy Mathematics Lecture and Writing Contest.

There are also many programs on educational websites, written in different programming languages such as Pascal and C, that solve the Chicken and Dog problem. In our opinion, however, these programs may obscure the mathematical beauty of the problem.

The authors of this article prefer the arithmetic solution, namely the Temporary Assumption Method, to the algebraic solution based on equations. In our opinion, the Temporary Assumption Method not only allows the Chicken and Dog problem to be taught to fourth- and fifth-grade students, who do not yet know how to set up and solve equations, but also helps students think actively and calculate quickly. In the past, during singing exchanges, Vietnamese boys probably had to calculate quickly to give an answer by this method, because the Confucian scholars who composed these mathematical poem problems did not use the language of modern equations. The mathematical poem problem “*Both Chicken and Dog*” therefore remains valuable in extracurricular classroom activities and youth collective activities.

6. Conclusion

Through cultural exchange and transformation, including the exchange and transformation of mathematical culture, Vietnamese scholars and communities absorbed the Chinese “*chicken and rabbit*” mathematical poem problem, transformed it, and introduced it into daily life as the “*Chicken and Dog*” mathematical poem problem, a version closer to Vietnamese experience.

This adaptation demonstrates both the localization of mathematical thought and the cultural creativity of Vietnamese scholars. From Sino-Nom manuscripts to folk songs, from arithmetic reasoning to algebraic formalism, the Chicken and Dog problem has evolved over centuries as a symbol of how mathematics intertwines with everyday life, language, and identity.

Even today, the problem continues to be taught from grade 5 to grade 9, not merely as an exercise in calculation, but as a living bridge between traditional wisdom and modern pedagogy.

Remark: This is an extended version of the Vietnamese articles by Tạ Duy Phương et al. (2018, 2019). English translations of book titles follow Volkov (2016).

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