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## **An investigation of the mathematical elements of the Dai culture south-west Yunnan province, China**

### **Una investigación de los elementos matemáticos de la cultura Dai del suroccidente de la provincia Yunnan, China**

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#### **Abstract**

Dai ethnic mathematical culture is an important part of Dai ethnic culture. Mathematical elements show in their daily life. Through a research project of the Yunnan Dehong Dai people in southwest China, We collected the first-hand information, tried to do a small investigative study, and collected mathematics teaching resources that is useful to primary and secondary schools students on mathematics learning in this minority areas.

**Keyword:** Dai ethnic; Mathematical culture; Primary and secondary schools; Teaching resources.

#### **Resumen**

La cultura matemática de la etnia Dai es una parte importante de la cultura Dai. Los elementos matemáticos están presentes en su vida diaria. A través de un proyecto de investigación en la Etnia Dai de Yunnan al suroccidente de China, se recolectó información de primera mano, que puede ser usada como recursos para la enseñanza y el aprendizaje de las matemáticas por estudiantes de primaria y secundaria en esta población minoritaria.

**Palabras clave:** Etnia Dai; Cultura matemática; Escuelas de primaria y secundaria; Recursos para la enseñanza.

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## INTRODUCTION

Dai is an ethnic minority group with a long history. Since ancient times, the ancestors of the Dai have lived in southwestern China. Besides this, Dai is a cross-border ethnic groups, and the Burma Shan ( DAI ), the main ethnic group of Laos Yankee Group, Thailand 's ethnic Thai, India's Assam Hong Dai have a close relationship. Global Dai (Thai, Shan) total population 60.000.000 above.

Ethnic culture is often rich in mathematical culture, for example in construction, clothing, painting, measurement, astronomy, calendar, and religion. The difference in the geographical environment and historical development means different national cultures show different mathematical characteristics and makes them unique cultural phenomena with their own characteristics. These characteristics reflect the mathematics culture that develops along with the nation. In the Dai national culture, mathematics is an important part. Until recently, little research on Dai national mathematics culture had been done.

Therefore, we mounted a research project of the Yunnan Dehong Dai people, based on observation, documentation, and interviews. We had access to the Dai people's daily life, examined historical records and materials, visited elders and the Dehong Prefecture of Civil Dai Institute scholars and experts to collect the first-hand information, tried to do a small investigative study, and collected mathematics teaching resources from primary and secondary schools in this minority areas.

## DAI NATIONAL MATHEMATICAL CULTURE ELEMENTS

### Mathematical elements originating from the Dehong Dai language

#### - *The concept of number*

As with many other ethnic minorities that have their own number base and ordinal structure, Dai has its own pronunciation, corresponding symbols, and unique structure and rules. There is no word for zero in the Dai language.

- *Mathematical elements in Dehong Dai calculation*

<b>number</b>	1	2	3	4	5	6	7	8	9	10	20
<b>Dai pronunciation</b>	ləŋ <sup>33</sup>	səŋ <sup>35</sup>	sam <sup>35</sup>	si <sup>11</sup>	ha <sup>31</sup>	hok <sup>11</sup>	tset <sup>11</sup>	pət <sup>11</sup>	kăw <sup>31</sup>	sip <sup>35</sup>	sau <sup>53</sup>

(note: The traditional pronunciation has six tones. 33 said first voltage; 53 second; 11 third; 31 fourth, 43 fifth; 35 sixth tone. The above figures such as SAM<sup>35</sup>, expressed in reading "three", to read Dai Sixth)

Historically, the Dai used natural numbers to add and subtract in the process of daily life, but there were no symbolic representation of operations, they only used language. There is no multiplication in the Dai Language, multiplication is expressed as repeated addition. Sub-division is often used in distribution, and their method is unique, not directly using the division operation as we know it, but by reducing operations. For example, 10 bananas for 5 people, first step is one banana for each person, then repeat the step, so in the end everyone has two bananas. They did not give everyone two bananas directly. Grain distribution was similar to this, using the baskets, large baskets to small basket, until the end.

**The Methods and Tools of Measurement**

- *The unit of length*

The daily life of several commonly used unit of length

<b>Picture 1</b>	<b>Picture 2</b>	<b>Picture 3</b>	<b>Picture 4</b>	<b>Picture 5</b>	<b>Picture 6</b>
xo <sup>31</sup> xe <sup>31</sup>	liu <sup>43</sup>	xwp <sup>43</sup>	sək <sup>11</sup>	ʔok <sup>11</sup> ləŋ <sup>33</sup>	wa <sup>53</sup>



Picture1



Picture 2



Picture 3



Picture 4



Picture 5



Picture 6

Besides these, in the measurement of perimeter , the measurement object is embraced, the distance between the tip of the middle finger with both hands is called “kət<sup>11</sup>”.

*- The daily life of several commonly use distance unit*

When walking, <b>one step</b>	The distance Person who can just hear the cow crying	The distance Person who can very hardly see the cow
tin <sup>33</sup>	tso <sup>33</sup> ɲo <sup>53</sup> həŋ <sup>43</sup>	ta <sup>33</sup> tək <sup>43</sup> hən <sup>53</sup> xai <sup>53</sup>

*- Unit of Weight*

When weighing grain (or rice) in weight, then "bucket", "basket" and "litre" [**means L,or 1000ml**] is used as the unit of measurement, they correspond to 25kg; 15kg; and 1.5kg respectively. The unit of weight used in Dai are : fun<sup>31</sup>, the<sup>31</sup>, həŋ<sup>33</sup>, tsoi<sup>43</sup>etc. 10 fun<sup>31</sup>=1 the<sup>31</sup>, 10 the<sup>31</sup>=1 həŋ<sup>33</sup>, 40 həŋ<sup>33</sup>=1 tsoi<sup>43</sup>, 1 tsoi<sup>43</sup> is equivalent to 3.33...jin (Chinese Han people’about weight unit). After the year of 1950, for ease of use,, take 1 tsoi<sup>43</sup>as 3jin(1.5kg.).1 tsoi<sup>43</sup>=30 həŋ<sup>33</sup>, həŋ<sup>33</sup> is equivalent to **liang** that Han people name it ; the<sup>31</sup> is equivalent to **qian** that Han people name, 10 həŋ<sup>33</sup>is also called sin<sup>11</sup> in Dai, it is equivalent to **jin**.

*- Units of Area*

There is no standard unit of area in Dai language. Land is used to sow rice seeds, and thus a basket of a species of rice may be used as measurement. "1 Lo species" will plant a certain amount of arable land, approximately 3.5 acres to each basket.

### - *Unit of Volume*

There is also no standard volume measurement. The Dai people, in addition to the introduced national, scientific units, have a unique measurement method that is not very precise, but which is commonly used. for instance, “jɔp<sup>35</sup>”, this means that three fingers can hold ; “kǎm<sup>33</sup>”, this means that one hand can hold ; “kɔp<sup>11</sup>”, this means that two hands can hold ; “swɯ<sup>31</sup>”, i.e.L, A bamboo drum volume, About 1.5 kg. of water. “tu<sup>53</sup>”, namely Tu, 10 L for a Tu ; “taŋ<sup>33</sup>”, Tang, 2 Tu for 1 Tang ; “tso<sup>53</sup>”, Chuo, , 10 Tang for a Chuo.



### **The dai calendar**

#### - *The Dai Li mathematical knowledge*

Dai Li is the Buddhist calendar, where 1181 is the same as 637AD. Each year is divided into three parts: *winter* (January to April), *heat* (from May to August), and *rain* (September-December).

#### - *Directions*

In the Dai Language, East and West are determined by where the sun to rises and falls. North and South are determined from the East and West" orientations.

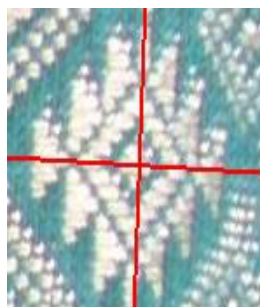
**The binary system number**

Dai in the long-term production and life to use several binary system. Binary (used in volume, length units ), decimal, hexadecimal twelve ( used in calendar ), three hex and forty hex (used in weight unit ), which the decimal is widely used.

**Geometry**

*- Geometric dress patterns*

In the Dai styled dress or embroidery, there are many elegant and beautiful patterns. They use straight lines, lines, parallel lines, triangles, squares, diamonds, rectangles, and other shapes to constitute a decorative geometry. Many examples of central symmetry, axial symmetry and the periodicity principle exist.



*Dai construction of geometric patterns*

Geometric patterns can be seen in Dai styled buildings: bamboo houses; pagoda; windows and doors; and wall decorations. These geometric patterns include: circles, squares, diamonds, rectangles, polygons, parallel lines and so on.





Dai Architectural forms, both internal and external, use symmetry as far as possible. Such symmetry reflects the Dai life philosophy, so that the mathematical elements become a symbol of the Dai culture.



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***Geometry in the appliances of daily life***

Dai appliances used in daily life show rich geometrical elements, commonly they are cylindrical, round conical, rectangular, have embedded parallel lines, regular polygons and so on.



## CONCLUSIONS

Through our investigation, we conclude the following:

- (1) Dai 's on geometry knowledge mainly come from the production and life . Commonly used geometry such as Triangle, four angle shape, square, circular,sphere, cylinder, cube, etc. have their own pronunciations. The Dai can only conduct a simple practical estimation and can not give the accurate interpretation of the graphic nature ,there is no any calculation formula in calculation.
- (2) The mathematical elements in Dai culture have special features and social significance.
- (3) The mathematical elements of Dai culture also reflect the inclusive nature of mathematics, expressing the Dai peoples' yearning for a better life.

## SUGGESTIONS

Nowadays people are often more concerned about the mathematics in new technology or modern economic activity, but minority students' experience about mathematics in daily life can be useful resources.

Suggestion 1: By providing students with innovative learning materials, we can help students better understand their cultural background, and hence enhance their self-confidence, learn to respect human and culture, and facilitate their adaptation to a multi-cultural environment.

Suggestion 2: In mathematics education for minority cultures, the mathematics of those minority areas should be a part.

Suggestion 3: Minority students can be shown that many of the limitations of "everyday mathematics" can be overcome by "school mathematics". Using "everyday mathematics" as the starting point may resolve ethnic students' difficulties, and implementing the new curriculum should be further explored using the context of these students' reality.

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