



Research on the Development and Utilization of Yunnan Minority Mathematical Culture Resources

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Abstract. The researcher selected several ethnic minorities in Yunnan Province, and through the study of their national architecture, clothing, crafts, festivals, folk customs, metrology, astronomy, calendar, religion, literature, etc., finally obtained the following results: first, collected some valuable first-hand ethnic cultural materials; The second is to excavate mathematical elements (i.e. mathematical cultural resources) from a large number of first-hand data; The third is the analysis of the relationship and difference between different ethnic minority mathematics cultures in Yunnan and mainstream mathematics.

Keywords: Theoremethnic minority · Mathematical culture · National mathematics · Mathematics education

1 Introduction

Yunnan Province, one of the 23 provinces in China, is located in the southwest region, between $21^{\circ} 8' - 29^{\circ} 15'$ north latitude and $97^{\circ} 31' - 106^{\circ} 11'$ east longitude. It is the province with the largest number of ethnic minorities in China. According to the statistics of the 2021 national population census. The population of ethnic minorities in Yunnan is 15.636 million, accounting for 33.12% of the total population of the province. There are 25 ethnic minorities with a population of more than 6000. The distribution of various ethnic groups is characterized by large mixed and small settlements, forming the characteristics of the coexistence of diverse ethnic cultures.

Every nation has its own culture, so it must have its own mathematical cultural resources. They are hidden in national architecture, clothing, crafts, festivals, folk customs, metrology, astronomy, calendar, religion, literature, etc., and have its unique existence value and historical significance.

The purpose of this project is to select several ethnic minorities unique to Yunnan Province as samples, excavate the mathematical cultural resources of ethnic minorities in Yunnan Province, and strive to make effective use of them to a certain extent.

2 Research Background

The research on the cultural level of national mathematics in the world originated around 1981. In his book “Mathematics as a Cultural System”, the American mathematician Wyld pointed out that mathematics as a culture, different cultural systems will produce different mathematics, and the typical culture of the nation, such as religion, philosophy, art, customs, and social environment, all play a restrictive role in the generation and development of mathematics. At the 10th and 11th International Conference on Mathematical Education (ICME), the issue of “national mathematics” was specifically discussed. Scholars studied national mathematics education from different perspectives, such as socio-culture.

Researchers believe that the integration of mathematics and culture should also be demonstrated in mathematics classroom. Brazilian mathematical historian Darbrossio regards national mathematics as a “method to track and analyze the generation, dissemination, diffusion and standardization of mathematical knowledge” in different cultural systems. Professor Klaus Graf of the Free University of Berlin, Germany, pointed out that the harmonious “voice” of culture, history, information, mathematics, education and other aspects should be played in every math class, so that mathematics and different aspects of culture in the math class can be organically integrated.

In recent years, the research on mathematical culture of ethnic minorities in China has made some fruitful achievements, mainly in the following aspects:

This paper studies the national mathematical culture from a theoretical perspective. For example, Zheng Yuxin pointed out theoretically that “national mathematics” has two different research directions, namely, the anthropological research on mathematics and the opposition and transformation between “daily mathematics” and “school mathematics”; Lu Chuanhan and Zhang Honglin discussed the connotation, characteristics, performance and significance of national mathematical culture.

Dig out the mathematical elements in the traditional life of ethnic minorities. Experts and scholars have excavated a large number of mathematical cultural resources from the architecture, clothing, crafts, festivals, folk customs, metrology, astronomy, calendar, religion, etc. of ethnic minorities. For example, ethnic cultural materials such as Tibetan games, Uygur costumes, Mongolian astronomical calendar, Miao silver ornaments, Dong Drum Tower, Shui language and characters, Dai architecture, etc. contain rich mathematical knowledge, ideas and methods.

Some attempts and discussions have been made on the integration of minority mathematics cultural resources and school curriculum. For example, in the preparation of textbooks, Professor Dai Qin of Inner Mongolia Normal University has made in-depth research; Professor Song Naiqing of Southwest University has prepared a series of primary school mathematics textbooks containing a large number of mathematical culture elements. In terms of teaching technology, it proposes that information technology can help teachers better present and infiltrate minority mathematics culture in classroom teaching; In the aspect of classroom teaching, Professor Luo Yongchao of Guizhou Kaili University discussed the application of score in the Dong Drum Tower, combining score teaching with the Dong Drum Tower culture; Professor Zhou Changjun of Dehong Normal College combines the mathematical elements in Dehong Dai costumes with teaching.

However, the existing research also has some deficiencies: ① The exploitation of ethnic minority mathematical culture resources in Yunnan is not enough. In addition to Professor Zhou Changjun of Dehong Teachers College who has done a long-term systematic research on Dai mathematical culture in Yunnan, there is little systematic development of other ethnic minority mathematical culture in Yunnan; ② The research on the relationship between mathematical cultures of different nationalities is insufficient: few people pay attention to the connection and difference of mathematical cultures of different nationalities, which has important practical significance for multicultural mathematical education in multi-ethnic areas; ③ The research on the practical application of minority mathematics culture to classroom teaching and the corresponding teacher training strategies needs to be deepened; ④ The research methods are still empirical qualitative methods, while quantitative methods and empirical research are few.

3 Research Process

3.1 Sample Selection

This study selected the Bai, Naxi, Pumi and Yi ethnic groups with unique characteristics in Yunnan Province as samples.

The Bai nationality is a minority with a long history and culture in China. As early as 4000 years ago, the ancestors of the Bai nationality created a splendid national culture in their work. The Bai culture with a long history has been continuously inherited and developed during the development of the Bai people for thousands of years, forming a Bai culture with its own characteristics. Dali is a multi-ethnic place, with 13 ethnic minorities including the Bai nationality. As the 15th largest ethnic minority in China, the Bai nationality mainly lives in Dali, Yunnan Province. Dali Bai nationality mainly refers to the farming people living between Cangshan and Erhai. At the end of 2015, the minority population of Dali Bai Autonomous Prefecture was 1.8583 million, of which the Bai population was 1.2179 million, accounting for 65.4%. After the washing of history, Dali Bai nationality has formed a unique national culture, which contains many mathematical culture and mathematical elements.

Naxi is an ancient nationality. Scholars who study the history of Naxi generally believe that Naxi is the descendant of ancient Qiang people. “Moer” and “Moshu” are homonyms of the Naxi appellation recorded in the Han literature. Today, the Naxi ethnic group is mainly distributed in Lijiang, in the northwest of Yunnan Province. Lijiang is located in the Jinsha River region, hence its name. A few are distributed in Sichuan, Guizhou and Tibet near Yunnan Province, with a current population of more than 300000. Naxi nationality is one of the ethnic minorities with a long history and culture in China. It has its own language and characters, and its unique religion, scriptures, festivals, characters, language and clothing. Dongba scriptures and Dongba hieroglyphs are famous both at home and abroad. Dongba scripture is a Naxi scripture recorded in the native language, which is recognized as a national cultural heritage in the world. It is also a valuable material for studying Naxi language, architectural culture, production and living customs, and relations with other nationalities. It has been listed as “Memory Heritage”.

The Pumi nationality is one of the nationalities with a long history and ancient culture in China. “Xifan”, “Peimi” and other names were once used by the Pumi nationality. Today, the Pumi nationality is one of the nationalities with a long history and ancient culture in China. Lanping County in Nujiang Prefecture of Yunnan Province, Ninglang County in Lijiang City, Yulong County and Weixi County in Diqing Prefecture are the main settlements. The rest are distributed in Yunxian, Fengqing, Zhongdian and Muli, Yanyuan, Jiulong and other counties in Sichuan Province., They live together with the local ethnic groups, with a population of about 40000. They have their own language and characters, and their unique religion, scriptures, festivals, characters, and languages, among which the Korean scriptures are very famous.

Yi is the sixth largest ethnic minority in China. The national language is Yi, belonging to the Yi branch of the Tibetan-Burmese language group of the Sino-Tibetan language family. There are six dialects in the north, the east, the south, the southeast, the west and the middle, including five sub-dialects and 25 local languages. The Yi culture contains a large number of mathematical elements and certain mathematical values. We use the literature research method and field survey method to analyze and integrate the mathematical elements in the Yi culture, and combine them with the primary school mathematics textbooks to design teaching cases to integrate the Yi mathematics culture into the primary school classroom teaching. On the one hand, we should permeate the national mathematics culture in mathematics classroom teaching and give full play to the inheritance function of national mathematics culture; On the other hand, it provides materials and methods for creating characteristic mathematics classroom teaching and stimulates students’ interest in learning mathematics.

3.2 Methodology

Literature research method: widely collect data related to the subject through database methods such as China Academic Journals Network Publishing General Database, China Excellent Master’s Thesis Full-text Database, etc., and summarize them to provide theoretical support and methodological guidance for the research and writing of this paper.

Field survey method: after consulting some literature materials about the introduction of Yunnan ethnic minority culture, residential buildings and clothing in the literature research method, we learned about Yunnan ethnic minority residential clothing through field survey, combined with the actual situation and theoretical knowledge, and took some of the most representative physical pictures. Understand and sort out the contents of folk houses and clothing in order to explore the mathematical elements contained. When encountering incomprehensible residential and clothing content, ask the older villagers, listen patiently and collect information.

Interview method: Interview outline: ① Instructors’ understanding and attitude towards integrating national mathematical culture into the classroom. ② What are the main methods of integrating Yi culture into classroom teaching? ③ What are the difficulties in classroom teaching. In order to ensure the accuracy of the interview results, the teachers in class were interviewed in a natural state. After the interview, they were recorded and sorted out in time.



Fig. 1. Bai headwear in Dali, Yunnan

4 Research Results

4.1 Mathematical Culture of Bai Nationality

Dali Bai nationality has a long history and unique culture, and clothing is a mirror of its national culture. From ancient times to modern civilization, the clothing of the Bai nationality has also improved with the change of the times. It is different in each era, but it is the crystallization of the people's wisdom, making it gradually develop into a distinctive Bai nationality clothing culture. The observation and research of Dali clothing will find that it contains rich mathematical elements.

The Bai people have given special meanings to numbers, such as Dali Bai headdress (Fig. 1). Bai girls wear blue, purple or black square headscarf with a length of one Chi and two Cun, which symbolizes twelve months of a year. There are three Zhang and six Chi of red headrope on the outside, which symbolizes three hundred and sixty days of a year.

The zhang, chi and Cun in the above units are traditional Chinese units of length. One zhang has ten Chi, one Chi has ten Cun, and three Cun are equivalent to one Chi, so one Cun is about 3.333 cm, one Chi is about 33.33 cm, and one Zhang is about 3.333 m [1].

4.2 Mathematical Culture of Naxi Nationality

Lijiang is the largest settlement of the Naxi people. Wooden houses are the traditional form of all-timbered housing of the Naxi people [2]. In the high and cold mountains, there are still a small number of well-dried wooden houses, which are made of logs and are flush in length (generally 2 zhang 7 feet or 9 m). The diameter of the large end of the logs is about 1 foot (0.33 m). The diameter of the small end of the logs must be more than 4 and a half inches (0.15 m). The two ends are cut out and the ends are embedded to form the walls on all sides. Then set up purlins, lay wood shingles, press stones, and plaster cow dung or mud on the gap between the wall logs to avoid the wind and cold. The study found that the wooden corrugated houses showed rich mathematical culture in material selection and assembly (Fig. 2).

The worship of numbers 7 and 9 in Dongba culture originates from men's nine and women's seven. When building the ridge at the top of the mountain, the triangular ridge



Fig. 2. Naxi wooden room in Lijiang, Yunnan

is mainly used. The stability of the triangle can directly bear the load of the roof. There is a component in the middle called Zhongtoumu, which means to ride the house. The Zhongtoumu is stable at the top of the hill and stamped outside the ridge. It rides two gables under the slot. The middle toumu of the left gable rides nine ridges, and the right one rides seven ridges. It is purely Dongba culture. The culture of men, nine women and seven ridges is reflected in the building of the wooden house. The assembly technology of the whole wood structure wooden room is called “Xilin Jianghan Tamper”. In ancient times, the measuring tools were limited. The material selection of the wooden room was almost estimated by the carpenter, and the estimation tool was a five-foot pole. Due to the diameter of the wood, the size of the pure wood corrugated room varies according to the number of corrugated wood. There are 12 corrugated wood and 22 corrugated wood. Generally speaking, the conventional corrugated wood is 18, with a height of 8 feet 2 (2.72 m), a depth of 1 feet 5 (5 m), a depth of 2 feet 6 (8.6 m), and a building area of about $49 m^2$.

4.3 Mathematical Culture of Pumi Nationality

The Pumi nationality is a hardworking nation, and is very good at weaving. As an important carrier of the Pumi culture, handmade textiles are mainly used to make bedding, satchels, clothing and other daily necessities.

There are many symmetrical figures reflecting the Pumi culture in the Pumi textiles [3]. For example, the textiles in Fig. 3 are composed of triangles, straight lines, rhombus, parallelograms, etc. [4]. The top two triangles form parallelograms, which are then translated in turn. There are large rhombus in the picture, three small rhombus in the large rhombus, and a parallelogram at the bottom, with hourglass like figure lying flat in the middle. In general, it is an axisymmetric figure, and the axis of symmetry is vertical. These symmetrical figures reflect the beauty of mathematics.



Fig. 3. Pumi textile pattern in Nujiang, Yunnan

4.4 Mathematical Culture of Yi Nationality

The ten month solar calendar of the Yi people is the glorious achievement of their ancestors. The provisions of the Yi solar calendar on the month and year are different from our current calendar. In our calendar today, the year is divided into 12 months, while the solar calendar divides the year into 10 months. In the current calendar, the month is divided into big month and small month, with 31 days of big month and 30 days of small month, while the Yi solar calendar stipulates that each month has 36 days, regardless of big and small months. The same point is that there are 365 days in a year.

There are still many mathematical cultures excavated through research. Here we will take “Teaching design of “axisymmetric figure” in primary school based on Yi nationality mathematics culture” as an example to introduce an application of minority mathematical culture.

1. Situational teaching: recognize the axisymmetric figure.
2. Teaching fragments: create teaching scenes.
 - (1) Please observe some pictures of your nationality (teacher shows some pictures of Yi students in their daily life).
 - (2) Carefully observe these headwear and clothing, and then share with the teacher. What do you observe?

This case captures the characteristics of students’ thinking through the Yi nationality’s mathematical elements: “concrete image thinking is the main, and gradually transits to the slow growth process of abstract logic thinking”. Children in low school age have strong curiosity, and familiar things can attract their attention, as shown in Fig. 4. The teacher presented many pictures and videos involving local minority costumes, embroidery, silver ornaments, etc. and organized students to observe. It not only consolidates the knowledge learned, but also enables students to realize the connection between mathematics and life, knowing that mathematics comes from life and is applied to life, and the beauty of mathematics is everywhere. Teachers organically link various mathematical elements in the curriculum resources of national culture with classroom teaching and teaching materials, so that students in ethnic areas can feel their own national or local national culture in specific practical activities, and truly implement the “people-oriented” teaching concept. At the same time, it also allows students to experience the



Fig. 4. Mathematics in Yi people's life

beauty of mathematics and the fun in the process of mathematics learning, which is of great significance to the cultivation of interest in mathematics learning.

5 Conclusion

Yunnan is rich in mathematical cultural resources of ethnic minorities. If it can be deeply explored and fully utilized, it will be of great help to the inheritance of ethnic culture and the mathematical education in universities, middle schools and primary schools.

Acknowledgment. The author would like to thank the referees for their very helpful and detail comments, which have significantly improved the presentation of this paper.

Supported by The Ministry of Education humanities and social science research project “Research on the development and utilization of mathematical cultural resources of ethnic minorities in Yunnan”: 18XJC880006.

Supported by Talent introduction and scientific research start-up fund project WYUAS: 2022RCKY0001.

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