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Research on the Implementation Strategy of Large Unit Teaching of High School Mathematics in Ethnic Areas—Taking Probability and Statistics as a Case Study

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Abstract: ***The Standards for Mathematics Curriculum for Ordinary High Schools (2017 Edition, Revised in 2020) [1] points out that it is necessary to develop students' core mathematical literacy. Under the guidance of this concept, large-unit teaching as a holistic teaching model has gradually attracted attention. Based on the actual situation of high school mathematics teaching in ethnic minority areas, this study selected the "Probability and Statistics" unit through the interpretation of the new curriculum standards, aiming to explore the implementation strategy of large-unit teaching suitable for the learning situation in ethnic minority areas, and provide a reference for high school mathematics teachers in ethnic minority areas to carry out teaching.***

Keywords: Large unit teaching, High school mathematics, Mathematics education.

1. Introduction

1.1 Research Background

In order to adapt to the development of the times, the country has put forward higher requirements for the comprehensive quality of the people and the cultivation of talents. Specifically, the new curriculum emphasizes that the high school stage is a critical period for cultivating students' core literacy and improving their comprehensive quality, and should help students adapt to the needs of future social life, higher education and career development. We need not only technical personnel, but also talents who lead the development of the times. Therefore, high school education, on the basis of moral education, needs to lead students to learn and think more deeply about the knowledge of the subject.

Among the five core knowledge modules of high school mathematics, "Probability and Statistics" focuses on cultivating students' mathematical abstraction, mathematical modeling, data analysis, logical reasoning and calculation ability, and its teaching value and core literacy cultivation significance are very prominent. Therefore, this study chooses the "Probability and Statistics" module as a case study, and at the same time pays attention to the teaching situation of ethnic schools. On the basis of theoretical research, it develops a large-unit teaching design, aiming to provide appropriate references for front-line teachers in ethnic schools.

Compared with other modules, the knowledge of "Probability and Statistics" focuses more on practical applications in terms of methods. For students in ethnic schools, this practicality often needs to be based on life experience and cultural background. If teachers choose to finish all courses in a short period of time, students will have less time to practice exercises, making it difficult to master the method of question analysis, which will ultimately affect test scores. This phenomenon of "catching up" may also be exacerbated in ethnic schools due to factors such as language conversion and basic differences. Based on this, teachers need to be familiar with the basic knowledge of probability and statistics in high school mathematics, use the large-unit teaching model, optimize and adjust the teaching content, scientifically allocate the proportion of class hours, and fully consider the cognitive characteristics and life experience of students in ethnic areas, so that students can deeply learn and think about probability and statistics knowledge and improve their core mathematical literacy.

1.2 Research Significance

1.2.1 Enriching large-unit teaching cases in ethnic education scenarios

At present, large-unit teaching research is mostly practiced in ordinary schools, and there is a lack of specific cases targeting the special learning conditions in ethnic regions, such as language diversity, cultural background differences, and cognitive habits. This study designed a large-unit teaching plan for "Probability and Statistics" through theoretical research, deeply integrated into the ethnic cultural context, and formed a theoretical experience that is both universal and ethnically appropriate.

1.2.2 Supporting the cultural adaptability of students' basic mathematical knowledge

Due to language barriers and differences in thinking patterns, it is difficult for ethnic students to form a systematic probability and statistics knowledge framework. This study integrates teaching content through large-unit teaching, reconstructs knowledge logic with ethnic culture as the link, and helps students establish a complete knowledge structure that is localized and transferable. This knowledge reorganization based on cultural identity can not only solve the cognitive gap problem of ethnic students, but also promote their in-depth understanding of the essence and ideas of mathematics and cultivate the basic literacy of mathematical modeling.

1.2.3 Promoting the professional development of cross-cultural teaching for teachers in ethnic minority areas

Teachers in ethnic minority areas generally face the dual challenges of insufficient cross-cultural teaching design capabilities and the inertia of traditional class-based teaching. This study provides an operational large-unit teaching framework to guide teachers to break through the current teaching limitations, master the overall teaching design and implementation skills based on ethnic learning conditions, help teachers reduce the burden of repeated explanations, make classes more efficient, and allow teachers to focus more on the personalized learning needs of ethnic minority students.

1.2.4 Responding to policy demands for high-quality development of education in ethnic minority areas

The new curriculum emphasizes "discipline education" and "cultural inheritance", and education in ethnic minority areas needs to implement the goal of "forging a strong sense of community for the Chinese nation". This study naturally infiltrates cultural confidence education in the imparting of knowledge through the teaching of probability and statistics, provides a paradigm for exploring the coordinated advancement of "mathematical core literacy" and "Chinese nation community education", and helps the connotation-oriented development of high school education in ethnic minority areas.

2. Review of Related Literature

2.1 Current Status of Research on Large Unit Teaching at Home and Abroad

2.1.1 Current status of foreign research

The concept of "large unit teaching" originated from the "New Education Movement" in Europe and the United States in the late 19th century. Its advocates regarded the content and activities of learning as an organic whole, but the textbook compilers ignored this point and arranged the courses according to the traditional method, resulting in the problem that the knowledge obtained by students was fragmented and lacked systematization, thus limiting the long-term development of students. For this reason, De Kleri proposed the concept of "unit as a whole", that is, to arrange the scattered knowledge into a unit in order, and then set up another unit, adjust the content according to the theme of this unit, and complete the teaching of this unit within a period of time. Subsequently, Dewey believed that "unit teaching" had a high promotion value, so his disciple Kilpatrick proposed the specific implementation method of "unit teaching". He also advocated abolishing textbooks, abolishing subject divisions, breaking the routine, and letting students learn by themselves. Only in this way can the rationality and feasibility of "unit teaching" be reflected, which is an important sign of the development of "unit teaching" [2].

1960s, Bloom proposed the concept of "mastery learning" and, based on this theory, further refined and clarified the teaching objectives and evaluated the teaching effect through testing. At this time, the unit design that promotes teaching through evaluation was first proposed [3]. In the 1990s, Frazee and Rudnitz et al. proposed the "holistic teaching method". They believed that the ultimate goal of unit teaching is to promote the formation of the subject's cognitive structure. The significance of this teaching method is to help students acquire deeper knowledge [4].

Since then, the system of unit teaching theory has gradually improved and matured, attracting attention and extensive research from all walks of life, which has provided strong ideological and theoretical support for the future development of mathematics unit teaching.

2.1.2 Current status of domestic research

Based on the review of relevant data, we can draw the following conclusions: Unit teaching is not an educational method that was proposed after the new curriculum standards were introduced. It was introduced in the 19th century and was already used in China in the early 20th century. Professor Cui Yunheng of East China Normal University has expounded on the student-centered orientation in many papers on large unit teaching, allowing teachers to stand higher, start with big tasks, aim at learning, conduct real evaluation, and conduct self-reflection and management after learning [5].

From the existing literature, we can see that large-unit teaching design can effectively improve teachers' professional teaching level. Teachers have a high degree of recognition of large-unit teaching. However, ordinary mathematics front-line teachers are already very busy in their daily teaching work and it is difficult for them to spare time and energy to carry out large-unit teaching design. In addition, when carrying out the actual work of large-unit teaching, the preliminary work to be done puts higher standards and requirements on teachers. For example, while mastering the curriculum standards, examination guidelines, and teaching methods, it is also necessary to have an in-depth understanding of the content system of the course. In order to understand some high school knowledge thoroughly, it is also necessary to master certain advanced mathematics knowledge. At the same time, it is also necessary to be familiar with the types of questions. Only in this way can we accurately grasp the key points and difficulties of the course to design teaching. Domestic teacher Ren Nianbing discussed the problem of "meso-level teaching design - between single class design and subject course design" from the following aspects and proposed countermeasures: determine the content of the unit by the logical connection within mathematics; analyze the core literacy by using the basic paradigm of mathematics learning; adjust the relationship between units and class hours by analyzing the position of mathematics knowledge in the system [6].

2.2 Current Status of Research on Probability and Statistics Teaching at Home and Abroad

2.2.1 Current status of foreign research

Statisticians Arcavi and Isoda [7] proposed that the teaching of statistics and probability should focus on practical exploration, promote the improvement of students' thinking ability through experiments, and also pay attention to students'

understanding of probability. In the initial stage of learning probability knowledge, students are prone to make mistakes in understanding related concepts. Bagni. T [8] conducted a test on middle school students to investigate the procedural skills necessary for students to solve descriptive statistics problems and possible misconceptions. The results showed that students were unable to distinguish between easily confused related concepts. In the teaching process, teachers should also pay attention to the mastery of probability ideas. Liu. Y. & Thompson [9] conducted a survey on the mastery of probability ideas of middle school mathematics teachers. The results showed that only one-third of the teachers had obvious random ideas, and the other teachers still held uncertain mathematical concepts when dealing with probability and other related issues.

2.2.2 Current status of domestic research

At present, the research on probability and statistics in middle schools mainly includes: teaching methods of probability and statistics, the current status of probability and statistics teaching and the problems involved, the historical and cultural nature of probability and statistics content, the comparison of new and old versions of textbooks, and the comparison of domestic and foreign textbooks. Wang Suoping theoretically explained the starting point of probability and statistics teaching and pointed out some principles, teaching suggestions and thinking methods that should be paid attention to in the teaching process [10]; Wang Liang inspired students' learning enthusiasm from the context [11]; Liu Yisong explored the teaching of probability and statistics from the perspective of mathematical models as a core quality [12]; Liu Xiao started from the perspective of mathematical operations [13] and proposed the principles of teaching and teaching [14]; Chen Ying started from the perspective of probability and statistics and took the example of Marilyn to explore the cultural connotation of probability and statistics [15]. Wang Lian, through her own teaching reflection, came up with several teaching opinions, that is, it is necessary to attach importance to the understanding of random phenomena and their concepts. In fact, most teachers have a vague understanding of probability [16]. In his survey, Wang Shuang found that teachers' understanding of probability and statistics was insufficient [17]. Bian Jianlei believes that many teachers have many deficiencies in their understanding of the requirements of the new curriculum standards, random thinking, statistical investigation thinking, statistical description thinking, and statistical reasoning thinking [18]. The papers by Li Yong, Zhang Shumei, Liu Wenhui, Zhang Jianyue and others also show that even mathematics teachers in key middle schools have great deficiencies in their understanding of probability and statistics [19].

Through domestic and foreign research and analysis, large-unit teaching design has achieved certain results in both theory and practice. Its systematic and holistic advantages make it an important way to cultivate students' core literacy. Although China's large-unit teaching design started late, driven by the core literacy education concept, more and more experts and scholars are actively carrying out localized exploration. The current research focus is to develop a complete and scientific framework process for large-unit teaching design based on China's educational reality, so as to promote the all-round development of students and promote the progress of China's education.

2.2.3 Current status of domestic research on ethnic mathematics education

Ethnomathematics is an academic concept that emerged around the 1980s and has gradually become an important interdisciplinary subject in international mathematics and mathematics education research. Its core connotation refers to the mathematical thinking paradigm and systematic practical knowledge formed by a specific cultural group in long-term social practice. Specifically, ethnic mathematics is reflected in the non-systematic application of mathematical knowledge and skills by ethnic minority groups in production and life practices, and this application is often culturally unconscious. Due to differences in cultural practices, ethnic mathematics of different ethnic groups shows significant cultural specificity, and related mathematical thinking is usually implicit in specific cultural contexts.

The development of mathematics education in ethnic minority areas is deeply restricted by their unique customs, religious beliefs, language systems and regional environment. In addition, the family education model, students' own cognitive characteristics, teachers' professional qualities and the overall teaching atmosphere of the school are also key variables affecting the quality of mathematics education. In order to effectively promote the progress of mathematics education in ethnic minority areas, we should take the mathematics curriculum standards as a guide, fully combine the regional cultural characteristics, and systematically develop localized teaching resources. At the same time, we must vigorously improve the comprehensive ability of mathematics teachers in ethnic minority areas so that they can skillfully use information technology to implement new curriculum teaching.

3. Analysis of the Teaching of Probability and Statistics Unit

3.1 Analysis of the Requirements of the New Curriculum Standards

According to the requirements of the General High School Mathematics Curriculum Standards (2017 Edition, Revised in 2020) [1], the probability teaching of the compulsory course should enable students to understand the basic concepts of probability, including sample points, sample space, events and the relationship between events, and focus on cultivating students' ability to use mathematical methods to analyze random problems. In combination with the situation in ethnic regions, teaching can guide students to conduct mathematical abstraction from familiar scenes of their own ethnic life, such as traditional festivals and random phenomena in agricultural and animal husbandry production, and understand the nature of random events. The elective course focuses on improving students' probability calculation ability, including using the principle of permutations and combinations to solve classical probability models, mastering basic formulas such as conditional probability and total probability, understanding the distribution characteristics and numerical characteristics of special random variables, and being able to use them to

solve practical problems. This process effectively promotes the development of students' core literacy such as mathematical abstraction, modeling, calculation and reasoning.

Regarding statistics, the new curriculum aims to cultivate students' ability to use basic statistical methods to make scientific decisions on problems in daily life, cultivate students' core literacy in data analysis, and experience statistical thinking and inductive inference. Basic concepts include the characteristics and calculations of data characteristics such as population, sample, mean, median, mode, percentile, range, variance, and standard deviation. Teaching should encourage students to collect and analyze data reflecting the life, culture, and economy of their own ethnic group, such as family income and expenditure, students' preferences for different ethnic cultural activities, sales data of local specialty products, and students' physical health data, and understand the significance and applicability of different characteristic values in describing the unique data set of this community. Basic methods include ways to obtain data, sampling methods, estimating totals with samples, and organizing data with appropriate charts. Finally, make inferences and decisions through reasonable analysis and description of the data. Understand and use correlation coefficients to analyze the correlation of data, understand and master the univariate linear regression model, and perform independence tests on 2×2 contingency tables.

3.2 Teaching Objectives of Probability and Statistics Unit

Use reverse thinking to analyze the knowledge that students have mastered. The purpose of the probability and statistics unit teaching is to enable students to have the statistical thinking of inferring the whole from the sample, and to cultivate their ability to use probability methods to solve practical uncertain problems. Especially in ethnic areas, our goal is to guide them to be based on life and rooted in culture, so that after studying the basic problems, students can start from reality, choose reasonable investigation methods, and collect corresponding data information for statistics. Finally, complete the inference through data processing. Therefore, the teaching objectives of the probability and statistics unit are:

1) Through the complete statistical reasoning process, students can understand that the evaluation criteria of probability statistics are relative, and can choose appropriate survey methods and effectively organize data charts when solving practical problems in the region;

2) Master the principles of stratified sampling and random sampling, be able to choose the best sampling plan according to the situation, extract the most representative sample, and cultivate abstract thinking;

3) Be proficient in using probability distribution histograms and fan charts, understand the advantages and disadvantages of different graphs to present data, and be able to clearly analyze the data characteristics of ethnic culture, regional economy or social livelihood in real life;

4) Be able to correctly judge and calculate the mode, median, frequency, variance, etc. of a group of data through the frequency distribution histogram, analyze these data characteristics, and cultivate mathematical literacy in data analysis;

5) Learn to use independence tests to analyze the correlation between data, and accurately calculate and interpret the probabilistic significance of the test results;

6) Understand the correlation analysis method, including the interpretation of scatter plots, the relevant formula and corresponding range of coefficient r, the calculation of r value, and the application of quantitative and qualitative analysis;

7) Master the linear regression equation and be able to calculate the coefficients of the linear regression equation. From the perspective of calculating the coefficients of the linear regression equation using the least squares method, transform the nonlinear regression equation into the linear regression equation, and experience the solution of complex problems through this transformation;

8) Understand the statistical significance of the coefficient of determination and several methods to judge the quality of a regression model, such as the residual sum of squares and residual plot.

3.3 Teaching Strategies for Probability and Statistics Unit

3.3.1 Understand the teaching materials as a whole and reorganize the unit content

The advantage of large-unit teaching design is that teachers have the autonomy to reorganize teaching content in combination with the specific context of ethnic schools. In other words, teachers are no longer bound by the arrangement of traditional textbooks, and can freely combine teaching content and play a leading role. Therefore, in this large-unit teaching of "Probability and Statistics", based on the analysis of textbook content and curriculum standards, we not only disrupt the order of textbooks, but also focus on closely linking abstract statistical concepts with the living world and cultural background of students in ethnic areas. Such teaching content will be more in line with the physical and mental development characteristics of the students being taught, thereby lowering the cognitive threshold for understanding complex concepts and stimulating the intrinsic motivation for learning. However, while this brings convenience to teachers, it also puts forward higher-level requirements and challenges for teachers' teaching concepts and teaching levels. This requires teachers to be able to transform textbook content into learning materials and activities with ethnic characteristics and regional specificity, and to master the textbooks with ease.

3.3.2 Reset unit goals and implement core competencies

In actual teaching, when teachers design teaching before class, they usually design teaching content according to the order of the textbook arrangement and the class hours, focusing on the key and difficult points of the class. It is easy to ignore the connection between the previous and subsequent knowledge points, making it difficult for students to build a complete

knowledge framework and mind map. This is a typical "knowledge-based" teaching. This fragmented approach not only hinders the deepening of teachers' teaching level, but also is not conducive to the cultivation of students' core mathematical literacy. Especially in ethnic areas, when the teaching content does not match the cultural background and life experience familiar to students, the teaching effect will be greatly reduced. Therefore, in the teaching of the "Probability and Statistics" part of high school, the traditional knowledge-based teaching should be abandoned, and the "Probability and Statistics" content of high school in the textbook should be deeply understood. Using system theory, this part of knowledge is linked to form a whole, and the overall large unit goals are re-formulated, so that students can form the knowledge they have learned into a whole, so as to better implement the core literacy.

3.3.3 Pay attention to the teaching process and optimize the unit

In traditional classrooms, teachers only know how to impart knowledge in a one-way manner, ignoring the subjectivity and initiative of students. Moreover, the knowledge they teach is fragmented and unsystematic, and they prepare for each lesson. Large-unit teaching abandons the traditional teaching method and requires teachers to integrate knowledge points based on the cognitive characteristics and cultural background of ethnic students before class, so that the connection between the previous class and the next class, and between learning and learning, is closer and more coherent. Large-unit teaching abandons the traditional way of equal distribution of class hours. Instead, it first builds a systematic large-unit knowledge system based on the actual situation of ethnic regions, and then allocates class hours based on the cultural relevance, practical application value and difficulty of students' understanding of knowledge points. When designing large-unit teaching, teachers can get rid of the shackles of traditional textbook class hours, break the restrictions, and focus more on planning the entire large-unit teaching, the coherence of knowledge points, and the actual learning situation of students, so as to have a more systematic control of teaching. Because of this, large-unit teaching puts higher demands on teachers' teaching ability. Only when teachers consider all details carefully and improve their own teaching level. In this way, the teaching process of the large unit will be smoother, and the teaching design of the large unit will be successful and efficient. Therefore, in this study, the goal of the high school "Probability and Statistics" large unit is taken as the guide, closely combined with the learning situation of ethnic schools, and the knowledge is designed in a coherent and systematic way. The main position of students is firmly implemented, and situations are created. By creating real situations derived from the life, culture, and regional development of the ethnic group, the series of questions drives students' independent learning, promotes the application of knowledge and knowledge transfer, and finally cultivates their ability to use statistical thinking to solve practical problems around them, serving the development of ethnic regions and cultural inheritance.

3.3.4 Develop diversified evaluation to promote teaching reflection

The evaluation of large-unit teaching will pay more attention to whether it is accurate and effective than traditional teaching. The teaching objectives of large units are the direction indicators, and the evaluation objectives should be guided by the teaching objectives and focus on the completion of teaching. The large-unit teaching design pays more attention to promoting learning through evaluation. The teaching implementation of this class is diagnosed through post-class evaluation, and the teaching design is continuously optimized and improved according to the evaluation results, so as to better help students connect the relationship between knowledge points, deepen their impressions and build their own knowledge framework. Therefore, the evaluation methods of large-unit teaching are mainly process evaluation and summative evaluation. In the context of ethnic schools, the process evaluation of this study is reflected in the following aspects: students fill in daily learning record cards after each class. In addition to the routine mastery of the situation, difficult points and classroom performance reflections, students are especially encouraged to record in combination with their own ethnic culture and life examples, so that the evaluation data can more truly reflect the cognitive characteristics of ethnic students and the learning experience in the cultural context, and provide a basis for teachers to accurately grasp the learning situation and adjust the subsequent teaching strategies that incorporate local cases. After all the lessons of the "Probability and Statistics" unit are completed, a summative evaluation will be conducted, that is, students will be tested on the "Probability and Statistics" unit to help teachers understand the implementation of teaching and the implementation of core mathematical literacy, so as to promote teaching reflection.

4. Conclusion

In summary, the teaching of probability and statistics in high school is not only the foundation for students to learn advanced mathematics, but also the cornerstone of their future development. However, it is difficult for students living in a multicultural background to thoroughly master these mathematical concepts, which requires them to have a wide range of basic knowledge and overcome cultural cognitive differences. Therefore, in the teaching process, teachers should set appropriate teaching goals based on students' life experience and actual cognitive level, gradually introduce the concept of probability and statistics, and enable students to gradually understand the essence of probability and statistics by constantly connecting with their cultural context.

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