Transactions on Comparative Education (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/trance.2024.060402
ISSN 2523-5818 Vol. 6 Num. 4

A Study on the Penetration Strategies of Mathematical Culture in Calculus Classroom from the Perspective of Curriculum Ideology and Politics

Zhiying Hu

School of Information Engineering, Xi'an Fanyi University, Xi'an, Shaanxi, 710105, China

Keywords: Course Ideological and Political Education, Mathematical Culture, Calculus

Abstract: From the perspective of ideological and political education in the curriculum, we need to cultivate outstanding talents with comprehensive development in morality, intelligence, physical fitness, aesthetics, and labor. Emphasis should be placed on highlighting the supporting and leading role of basic disciplines, and mathematical cultural factors should be injected into mathematics classrooms. From the perspective of ideological and political education in the curriculum, this paper analyses the value of integrating mathematical culture into calculus classrooms. On this basis, further research was conducted on how to integrate the content of calculus courses into mathematical culture, that is, to explore mathematics. The general strategy of cultural infiltration is to transform the traditional knowledge-based education approach into a "trinity". The core teaching method of value shaping, ability cultivation, and knowledge imparting, with the ability as the core, greatly improves student's interest in learning.

1. Introduction

From the perspective of ideological and political education in the curriculum, in order to cultivate outstanding talents with comprehensive development in morality, intelligence, physical fitness, aesthetics, and labor, we need to highlight the supporting and leading role of basic disciplines. Mathematics is the method and theory [1] that people use to qualitatively grasp and quantitatively characterize the objective world, gradually abstract and summarize it, and widely apply it. Mathematics is a part of human culture. Simply put, mathematical culture refers to the ideas, spirit, methods, viewpoints, and their formation and development of mathematics [2]. While acknowledging the value of mathematical tools, we should also recognize their cultural value [3]. Calculus, as an important public basic course in the field of economics and management, is the key to solving professional problems and plays a crucial role in the quality of talent cultivation. As an important foundational course, calculus, in the eyes of students, is synonymous with cold and mechanical, dull and uninteresting numbers, symbols, and graphics. Calculus classrooms ignore the vivid cultural background and profound cultural connotations inherent in mathematics itself, overly emphasizing the memory and imitation of knowledge, and neglecting the cultivation and development of student personalities, resulting in mathematics, which originally belongs to the cultural category, gradually losing its cultural significance. Therefore, "making mathematics more

cultural and returning mathematics to its cultural essence" is a problem that we need to pay attention to, think about, and explore in mathematics education. Furthermore, by making students feel the charm of mathematics and increasing their interest in learning [4], it naturally improves the efficiency of calculus classrooms. Therefore, it is particularly necessary to conduct strategic and practical research on the infiltration of mathematical culture into calculus classrooms [5]. It is important to infuse mathematical culture into calculus teaching to enhance students' comprehensive literacy.

2. The Value of Integrating Mathematical Culture into Calculus Classrooms in Cultivating Human Thinking

The famous contemporary mathematician Ke Lang once pointed out that "calculus, or mathematical analysis, is one of the great achievements of human thought." This makes us know that the study of calculus not only includes its knowledge value, but more importantly, it plays an important role in cultivating human thinking patterns. For example: $1+\frac{1}{4}+\frac{1}{6}+\cdots\cdots=\frac{\pi}{6}$. The more items obtained, the higher the accuracy. For example, when the change in the independent variable Δx is very small, Δy is approximated by dy, that is, the idea of using straight lines to represent curves. The in-depth analysis of them has made people realize that we cannot use simple "dichotomy" to view things. To view the complex world, we need to grasp the essence of things, examine them from multiple aspects and angles, and enable people to view problems from a dynamic, dialectical, comprehensive, and systematic perspective in order to seek limits $\lim_{n\to\infty} sin\pi\left(\sqrt{n^2+1}\right)$. If we follow the general approach, it is difficult, but if we adopt the method of simplifying to complexity and transforming it into a formal form $\lim_{n\to\infty}(-1)^n sin\pi\left(\sqrt{n^2+1}-n\right)$, this problem is easy to obtain results. Understanding these mathematical thinking methods is beneficial for cultivating students' mathematical creativity.

3. Strategies for Infiltrating Mathematical Culture in Calculus Teaching

3.1 Infiltrating Mathematical Culture in the Introduction to Calculus Course

At the beginning of the class, it is necessary to attract students and enhance their interest and attention by explaining the historical period and significance of calculus in the development of mathematical history [6]. Secondly, there will be targeted and gradual infiltration from the following three aspects:

(1) It must be explained to students that calculus is one of the great achievements of human intelligence, and its status lies between natural and humanities sciences. The discovery of calculus triggered a great revolution in the history of mathematics. Since the emergence of analytic geometry and calculus, it has opened up the era of variable mathematics, and mathematics has begun to describe changes and motion. Calculus has changed the face of the entire mathematical world. Since Newton and Leibniz founded calculus in the 17th century, mathematics has achieved unprecedented prosperity in the following two hundred years.

(2) Calculus not only brought about significant changes in the discipline of mathematics itself, but also had a significant impact on other natural and engineering sciences. "Mathematics and physics do not separate schools" has a real meaning after calculus. Without calculus, modern physics, mechanics, and electricity cannot exist. At present, no one who has studied calculus can engage in scientific and technological work. In today's extensive economic activities, calculus has also become an essential tool, and it can be said that calculus is almost used in all fields.

(3) Calculus has also had a profound impact on the entire human culture. As long as we study the changes of things, we need to use calculus, so calculus also permeates humanities and social sciences, using it to describe and study things with regularity. Philosophy pays particular attention to calculus because it has given philosophy many inspirations. It not only affects philosophical methods, but also influences worldviews.

3.2 Infiltrate Mathematical Culture When Explaining Concepts to Deepen Understanding of Dull Concepts

The formation process of many mathematical concepts itself has a certain humanistic background. By tracing and shaping concepts, on the one hand, it can stimulate students' enthusiasm for learning mathematics and feel the rich historical and cultural heritage contained in mathematical concepts; On the other hand, it can also enable students to appreciate the arduous and persistent spirit of mathematical pioneers in the field of mathematics to explore truth. In the teaching process, these humanistic materials should be fully utilized to provide timely humanistic education to students. For example, limit is the foundation of calculus and the most important concept in calculus. In order to enable students to understand the concept of "infinite convergence", the famous quote from *Zhuangzi Tianxia Pian* is quoted: "A hammer of one foot is gradually halved, and will never be exhausted", allowing students to experience the extreme thinking of ancient China.

3.3 Infiltrating Mathematical Culture in Proving Axiomatic Formulas

Mathematical theorems and formulas are the crystallization of mathematician's thinking for thousands of years, the concentrated embodiment of mathematical knowledge and ideas, and the basic content of people's learning of mathematics. The emergence and development of each theorem and formula may contain a history of mathematical development. Therefore, introducing the history of mathematical development when explaining formulas or theorems is more beneficial for students to deeply understand the connotation of theorems and formulas. For example, when studying the Newton Leibniz formula in calculus, introduce why this formula is named after both and the controversy that occurred at that time, in order to attract students to deepen their understanding of the formula.

3.4 Infiltrating Mathematical Culture in Application Exploration

The value of mathematical culture lies not only in the knowledge itself, but also in its application value. From this perspective, the teaching of mathematical applications is the best point of combining mathematical disciplines with mathematical culture. For example, when teaching calculus courses to students majoring in economics and management, it is necessary to talk about the application of derivatives in economics. At this point, the relationship between economics and mathematics can be appropriately introduced. The true close connection between mathematics and economics began in the mid-19th century, when modern mathematics had already developed extensively. In the mid-19th century, Wallace and Jevens proposed the economics of marginal utility theory, which is actually the "derivative" in mathematics. From then on, the connection between mathematics and economics became increasingly close. For example, when discussing the concept of economic functions, it is easy for students to understand that the demand function is generally a subtractive function. Why is it sometimes in linear form, sometimes in quadratic curve form, and sometimes in exponential form? Obviously, the reality is bound to be different. At this point, you can point out the establishment of mathematical models for economic phenomena and establish functional relationships to lay the foundation for the application of mathematics. Other disciplines

are not only increasingly using mathematics, but also promoting its further development.

4. Conclusion

In short, from the perspective of ideological and political education in the curriculum, integrating mathematical culture into the teaching process of calculus, enables students to understand the richness of mathematical knowledge, the ingenuity of mathematical methods, the vastness of mathematical thinking, and the beauty of mathematical thinking, fundamentally changing the goal of learning mathematics, thus allowing culture to infiltrate children's hearts and inspire their wisdom. Improve teaching methods, enhance students' core competitiveness, and cultivate high-quality applied talents for society [7]. Under the comprehensive educational concept of taking "cultivating virtue and nurturing talents" as the fundamental task of education, we must go hand in hand with ideological and political theory courses [8] throughout the entire process and form a synergistic effect. Integrating mathematical culture into calculus teaching, making reasonable use of tedious basic mathematical knowledge such as theorems, formulas, and concepts, and unleashing the charm of mathematical culture, enables students to understand the origin and development of mathematical knowledge while enriching their emotional experience of mathematical knowledge. This allows mathematical knowledge to reflect the light of human will and wisdom, allowing students to better understand and master mathematical knowledge while being moved and happy. Through interpreting mathematical works, students can perceive the harmony of mathematics and appreciate its beauty.

Acknowledgements

This work was supported by the 2023 Education and Teaching Reform Research Project of Xi'an Fanyi University (J23B09).

References

[1] Tian Yuan. Strategies for Integrating Mathematical Culture into Higher Mathematics Teaching. Journal of Anshan Normal University, 2021, (4): 12-15
[2] Luo Liying. Let Mathematics Culture Bloom in Mathematics Teaching. Education Science Forum, 2021, (09): 22-25
[3] Yu Hang. The Value and Application of Mathematical Culture in Higher Education Mathematics Teaching. Industry and Technology Forum, 2021, (19): 190-191
[4] Li Xin, Siqin Qimuge. Exploration of teaching strategies to improve students' ability to solve mathematical cultural background problems. Journal of Chifeng University (Natural Science Edition), 2021, (37): 106-107
[5] Lin Weimin. A Discussion on Classroom Teaching Strategies for the Infiltration of Mathematical Culture. Friends of Mathematics, 2021, (33): 36
[6] Wang Yumei, Yu Zhuo. Effective ways and methods of integrating mathematical culture into higher mathematics teaching. Journal of Jilin University of Education, 2022, (01): 103-106
[7] Cui Yan, Wu Juan. Exploring Strategies for Integrating Course Ideology into Higher Mathematics Teaching. Journal of Anhui Electronic Information Vocational and Technical College, 2021, (5): 65-68
[8] Liu Fujian. Teaching Strategies for Higher Mathematics Based on the Cultivation of Applied Talents. China Science and Technology Journal, 2010, (13): 162-164