

Research and Practice of Integrating Ideological and Political Education Into Liberal Arts Mathematics Teaching

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This paper first analyses the reasons for the low effectiveness of ideological and political education in current liberal arts mathematics teaching, then puts forward the contents, methods, and approaches of integrating ideological and political education into liberal arts mathematics teaching, and finally finds out the matters needing attention of integrating ideological and political education into liberal arts mathematics teaching.

Keywords: liberal arts mathematics, contents of ideological and political education, methods of ideological and political education, approaches of ideological and political education

Introduction

In recent years, ideological and political theories teaching in all courses has become the key, hot spot and focus of close attention and in-depth research by universities and teachers in the teaching reform. However, the research and practice of integrating ideological and political education into liberal arts mathematics teaching is still in the exploratory stage.

Mathematics is not only a tool, but also a form of thinking; it is not only a language, but also a spirit; it is not only a science, but also a culture; it is not only a technology, but also an art; it is not only a form of knowledge, but also a form of literacy. The ability to apply mathematical concepts for quantitative thinking is an important indicator of measuring scientific and cultural qualities (Chen, Zhang, Duan, & Jin, 2019; Xiao & Wu, 2022). Mathematics education plays an irreplaceable and important role in general education, which is determined by the characteristics of mathematics itself. The cognitive activities of mathematics can cultivate the habit and quality of rational thinking. Mathematics believes in the quality of precision, organization, logic, analysis, and criticism. Therefore, by studying mathematics, students will unconsciously cultivate a meticulous and organized way of thinking, and establish a meticulous work style, professionalism, strong sense of responsibility, and a dedicated spirit of persistently pursuing truth. Moreover, mathematics not only develops people's logical thinking, but also enables them to do better in formulating plans, drafting documents, establishing social disciplines, and dealing with various problems, enabling them to make correct generalizations and judgments. In short, mathematics plays a core role in shaping human rational thinking and can make up for the shortcomings of China's cultural tradition in this regard. Mathematics and its application and the continuous development of

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mathematics education will make China's comprehensive national strength stronger, the quality of the people will generally reach a higher level, and the overall goal of Chinese path to modernization will be achieved faster. College mathematics plays a very important and irreplaceable role in cultivating the humanistic spirit of college students and improving their thinking quality, learning ability, application ability, and so on (Li & Yu, 2013).

Liberal arts mathematics is a public basic course for students majoring in English, law, communication, art, and other liberal arts majors in liberal arts colleges. It is a preparatory course for liberal arts students to understand science and scientific ideas, and plays an important role in the liberal arts education training system for liberal arts students. It mainly includes the core contents of calculus, linear algebra, probability and statistics, and differential equation, so that liberal arts students can master the basic knowledge, theory, and skills of these contents. Through the study of it, liberal arts students can learn scientific thinking methods and scientists' rigorous and diligent learning attitude, improve their logical reasoning ability, abstract thinking ability, spatial imagination ability, mathematical modeling ability, computing ability, ability to comprehensively use the knowledge learned to analyse and solve practical problems, improve their mathematical quality, scientific literacy, and comprehensive quality, develop good thinking habits, and lay the necessary mathematical foundation for learning follow-up courses and expanding knowledge. Although liberal arts students may rarely involve deeper mathematical knowledge in their future work, they can still use mathematical thinking to solve problems encountered in their work. For liberal arts students, the weak foundation in science and the lack of scientific thinking are serious problems. At present, the lack of quantification in humanities and social sciences such as economics, management, and sociology in China has led to a lag in the development of these disciplines, which are significantly different from the international level. Therefore, it is imperative and far-reaching to comprehensively improve the level of science education for liberal arts students. In fact, the science training of liberal arts students is mainly completed through the study of liberal arts mathematics (Li & Yu, 2013). The study of it plays an important role in the growth of liberal arts students. On the one hand, it is due to the irreplaceable role of mathematical thinking methods (including logical thinking, etc.) in their thinking and researching problems. On the other hand, in modern society, mathematics and its applications have made significant progress in promoting society compared to before.

In the implementation process of the ideological and political theories teaching in liberal arts mathematics, the fundamental purpose of the teaching is to enable students to not only learn the necessary basic knowledge and skills of higher mathematics, but also understand the basic thinking methods and spiritual essence of mathematical science; and is to provide students with both formal logic and abstract thinking training, as well as the influence of dialectical thinking and humanistic spirit. The students will continue to be helped and guided in their work, study, and life by the spirit of mathematical science, as well as the basic thinking methods for analysing and solving problems, even if they forget some specific mathematical theorems and formulas in the future. The contents of liberal arts mathematics and the development history of higher mathematics contain rich philosophical ideas and ideological and political education resources, which have rich humanistic value and important educational functions. They can cultivate students to form dialectical philosophical thinking, scientific spirit of seeking truth from facts, and a national sentiment serving the country with science and technology. As a science course, teachers often focus on mastering concepts, cultivating computational abilities and so on in the teaching process of liberal arts mathematics. Liberal arts mathematics is aimed at teaching liberal arts students, who generally have low mathematical thinking abilities. When teachers teach theory, many students have

difficulty understanding them. If teachers introduce appropriate ideological and political elements through certain knowledge points during the teaching process, it can not only increase the fun of the course, improve students' learning initiative, and enable students to master the course knowledge points in a more relaxed environment, but also enrich the content of ideological and political education, and enable the integration of the two. Moreover, the integration of ideological and political education into liberal arts mathematics will have an impact on the comprehensive development of liberal arts students. Therefore, it is meaningful the research and practice of integrating ideological and political education into liberal arts mathematics teaching.

In the literature on the integration of ideological and political education in liberal arts mathematics teaching, the research of Li and Yu (2013) involved the infiltration of mathematical culture in liberal arts mathematics teaching; Chen et al. (2019) explored the idea of ideological and political theories teaching in liberal arts mathematics course based on teaching situation in the current higher education, and analysed and explored the specific implementation methods of ideological and political theories teaching in liberal arts mathematics; Xiao and Wu (2022) studied the significance of ideological and political theories teaching in all courses and the current situation of liberal arts mathematics course and used the two teaching cases of derivatives and differentials in liberal arts mathematics course to integrate ideological and political education into the teaching by introducing appropriate examples and current political news. The literature mainly studies the significance, contents, methods, cases, approaches, and matters needing attention of integrating ideological and political education into liberal arts mathematics teaching. It does not comprehensively analyse the true reasons for the low effectiveness of ideological and political education in current liberal arts mathematics teaching. On the basis of careful and comprehensive analysis of the true reasons, there is a little literature about the contents, methods, approaches, and matters needing attention of the integration. In practice, since the establishment of liberal arts mathematics course, liberal arts mathematics teaching lacks the integration of ideological and political education, and the effectiveness of the integration is not high. Therefore, it is not enough the research and practice of integrating ideological and political education into liberal arts mathematics teaching.

This paper first carefully analyses the reasons for the low effectiveness of ideological and political education in the current liberal arts mathematics teaching, then on the basis, puts forward the contents, methods, and approaches of integrating ideological and political education into liberal arts mathematics teaching, and finally finds out the matters needing attention of the integration.

The Reasons for the Low Effectiveness of Ideological and Political Education in Current Liberal Arts Mathematics Teaching

It is a major project to integrate ideological and political education into liberal arts mathematics teaching. Although certain results have been achieved, the effectiveness is still not high. The main reasons for the low effectiveness are the following three aspects.

Liberal Arts Mathematics and Liberal Arts Students Have Their Own Characteristics

Because liberal arts mathematics has strict logic and high abstraction, it is independent of ideology, and lacks the effective combination points of explicit ideology and politics; because liberal arts mathematics is difficult, and its teaching content is diverse and involves a wide range, as well as the number of liberal arts students is large, involving a wide range of majors, and greatly influenced by liberal arts mathematics, but the class hours are very limited, teachers often find it difficult to take into account the ideological and political

education; the traditional teaching of liberal arts mathematics either teaches too much technical content such as argumentation, reasoning, and calculation, or mainly focuses on storytelling or conceptual teaching, which also leads to unsatisfactory integration into ideological and political education.

The Syllabus Is Too General, the Contents of the Course Are Outdated, and the Methods Are Not Effective Enough

At present, the syllabus of liberal arts mathematics in most Chinese colleges and universities is highly generalized, and there is no detailed integration into ideological and political education. The contents of integration do not fit well with students' life reality and focus of attention, and are not attractive and infectious enough. In the current ideological and political education in colleges and universities, there still exist the methods of preaching and the practice of "quick mobilization", and liberal arts students are in a passive state of acceptance. On the other hand, due to lack of understanding, excavation, and design, and other reasons, the situation of "hard copy after cutting and splicing" often occurs.

The Assessment and Evaluation System Suitable for Ideological and Political Theories Teaching in Liberal Arts Mathematics Has Not Been Established

Most colleges and universities pay more attention to implementing the idea and process of ideological and political theories teaching in the course, and do not do enough to track and evaluate the implementation effect, failing to design a scientific assessment method, evaluation index, and feedback system.

The Contents, Methods, and Approaches of Integrating Ideological and Political Education Into Liberal Arts Mathematics Teaching

Based on a careful and comprehensive analysis of the reasons for the low effectiveness of ideological and political education in current liberal arts mathematics teaching, the contents, methods, and approaches of integrating ideological and political education into liberal arts mathematics teaching are proposed in the following.

Excavate the Ideological and Political Education Resources of Liberal Arts Mathematics, and Pay Attention to the Enlightenment of Mathematical Culture, Especially the Development History of Mathematics, in Ideological and Political Education

We need to enable liberal arts students to understand the background and development of some contents in liberal arts mathematics. It can not only stimulate students' learning enthusiasm but also benefit them in the future adding mathematical culture to liberal arts mathematics teaching. Through the infiltration of mathematical culture, liberal arts students can understand the inevitable laws of the emergence, growth, and development of mathematics, understand how mathematicians understand the objective world from a mathematical perspective, and understand that the development of mathematics is closely related to human culture. Emphasizing the teaching of mathematical culture and allowing students to appreciate the cultural value of mathematics will reflect the teaching objectives of mathematics at a higher level, improve students' mathematical literacy, and enable them to experience the beauty of mathematics. For example, when facing students majoring in economics, we can help them understand that the work of many Nobel laureates in economics is closely related to mathematics. In addition, during the teaching process, it is necessary to guide students to learn based on their understanding, rather than mechanically instilling or forcing them to memorize. We need to enable liberal arts students to master the thinking methods of understanding mathematics; only in this way can we truly achieve general education for

students. Moreover, in the teaching process, we should prioritize improving the mathematical literacy of liberal arts students before the goal of knowledge and skills. In the setting of mathematical teaching objectives, it is necessary to highlight ideological content, integrate the content of mathematical culture into mathematical knowledge and skills, and improve students' mathematical cultural literacy through careful design, careful arrangement, and long-term adherence.

We can introduce mathematical methodology in the introduction to help students understand the logical thinking of mathematics and mathematical thinking methods, and apply mathematical thinking methods to thinking about humanistic issues. We should strive to naturally introduce the basic concepts of liberal arts mathematics from various perspectives, helping students not only understand the origins of those abstract concepts, but also understand the relationship between mathematics and other disciplines and reality. When talking about the concepts of real number and limit, we can introduce them from historical development. When talking about the concept of function, it can be introduced the law of children's receptivity changing over time in psychology. When discussing ladder function, the relationship between Engel's coefficient and affluence can be used as an example. When talking about the concept of derivative, the origin of derivative, tangent, and velocity can be introduced. When talking about the concept of definite integral, we can use the area of a curved trapezoid and the acting of variable force to introduce it. When discussing functions, we can introduce mathematical model methods, mathematical paradoxes, and the mathematicians Archimedes and Euler. When discussing limits, we can introduce the dialectical thought contained in limits, mathematical thinking, and ancient Chinese mathematician Zu Chongzi, and also guide liberal arts students to transfer mathematical language to the research of humanities and social sciences. When discussing derivatives, we can introduce the dialectical thought contained in derivatives, the mathematical abstractions in mathematical thinking methods, and the mathematician Newton. We can also use the essence of derivatives to introduce ideological and political elements such as national pride and the superiority of the socialist system. When talking the application of derivatives, it can be introduced that the description of the mean value theorem reflects people's general cognitive laws: from low to high, from simple to complex, from special to general, and it can also be introduced mathematical construction methods in mathematical thinking methods and the mathematician Fermat. When discussing differentiations, ideological and political elements can be introduced as follows: Differentiation is actually an approximation of the amount of change in a function at a certain point, taking the opportunity to remind students not to underestimate the impact of the high-order infinitesimal obtained by the change in the function minus the differentiation. In addition, the subtle high-order infinitesimal also constantly tells us to be rigorous in our academic pursuits. When discussing indefinite integral, we can introduce the dialectical thought of contradiction transformation in the process of calculating indefinite integral, and also introduce the inversion method of relational mapping in the mathematical thinking methods and the mathematician Leibniz. When discussing definite integral, we can introduce the law of unity of opposites, the law of quantitative and qualitative change, and the law of negation of negation in the process of calculating definite integral, and we can also introduce Li Shanlan, a mathematician of the Qing Dynasty in China. When discussing the outline of binary calculus, we can introduce the creation of mathematical thinking methods, as well as French mathematician Descartes and Chinese mathematician Hua Luogeng. When talking about an overview of linear algebra, we can introduce linear algebra deals with the mathematical problems of linear relations, as well as the mathematical aesthetic methods in mathematical thinking methods and the mathematical prince Gauss. When discussing the preliminary aspects of

probability and statistics, it is possible to introduce probability and statistics deal with the problems of inevitability contained in contingency, as well as the observations and experiments in mathematical thinking methods and the scientist Pascal. When discussing differential equations, we can introduce the Lagrange constant transformation method is the contradiction transformation one, and we can also introduce the mathematical reasoning and proof in mathematical thinking methods and the mathematician Lagrange.

Enable Liberal Arts Students to Have a New Understanding of Mathematics Courses and Eliminate Their Fear; Utilize Various Teaching Methods to Fully Stimulate Their Learning Interest, Deeply Apply Case Teaching Methods, and Highlight the Training of Mathematical Thinking

In order to eliminate the fear of mathematics among liberal arts students and transform them from passive learning to active learning, first of all, we need to make liberal arts students deeply realize the important role of mathematics for them and demonstrate the usefulness of mathematics. For example, when teaching mathematics to foreign language majors, it is mentioned that translating in negotiations requires logical reasoning skills, which can be acquired through learning mathematics. Secondly, we need to make students appreciate the beauty of mathematics. Combining mathematics with music, people have found that sound is the superposition of several simple sine functions, and the volume, tone, and timbre are related to the amplitude, frequency, and shape of the function. The fusion of various elements forms a beautiful and pleasant melody, which is called the “composite wave”. Digital music should be designed according to this principle. Combining mathematics with painting, geometry is very useful in painting. When studying Leonardo da Vinci’s famous paintings, people have discovered the existence of the golden section in mathematics from multiple perspectives. Combining mathematics with language, mathematical linguistics was formed. Combining mathematics with history, econometric historiography was formed. Combining mathematics and economics, mathematical economics was formed. Mathematics has been applied in various disciplines, fully reflecting the importance and beauty of mathematics (Chen et al., 2019).

By adopting exploratory, heuristic, and interactive teaching methods, combined with our lectures, we can more effectively integrate ideological and political elements into liberal arts mathematics teaching. We need to combine with practical needs and use targeted methods such as case analysis, situational teaching, emotional cultivation, model demonstration, reasoning and persuasion, moral practice, and other methods to fully stimulate the learning interest of liberal arts students. Many contents of liberal arts mathematics stem from solving practical problems and are themselves vivid examples. In the process of using case teaching method to teach these contents, students not only learned each mathematical knowledge point, but also experienced the thinking mode of extracting problems from reality, establishing mathematical models, and using mathematical knowledge to solve problems. In addition to designing the basic knowledge points of the teaching contents into cases, we can also explore various mathematical problems from politics, economy, life, and work, and design some typical cases. Further targeting the different characteristics of various humanities majors, design some examples with relevant professional backgrounds as cases to organize teaching. Through these rich cases, students’ enthusiasm for learning is fully stimulated, making it easier for them to deeply understand and master the contents taught. We should fully grasp the first liberal arts mathematics course for liberal arts students after entering university. By introducing the touching stories of various mathematical talents, we can touch the hearts of liberal arts students, encourage them to follow these elites as examples, study hard, and lay a solid foundation for future service to the motherland.

Integrate Ideological and Political Education Elements Into the Syllabus of Liberal Arts Mathematics and Deeply Excavate the Ideological and Political Resources in the Course

Based on the characteristics of liberal arts mathematics course, the value, spirit, and thought behind the knowledge can be excavated and integrated into the syllabus, and the ideological and political education elements can be integrated into the teaching objectives, teaching contents, and teaching strategies. Set up the curriculum teaching objectives with ideological and political education as the core, combining knowledge teaching with value guiding.

Deeply excavate the ideological and political resources in liberal arts mathematics course, integrate the resources into the teaching objectives and contents of the corresponding chapters and sections, and formulate the specific ways and methods of teaching activities. In combination with practical problems, deeply excavate the cases that are suitable for the course, closely related to practical life, and easy to be understood by liberal arts students, and carry out case teaching to make liberal arts students realize the importance of learning the course and help them identify and establish correct values.

The Matters Needing Attention of Integrating Ideological and Political Education Into Liberal Arts Mathematics Teaching

Based on the research and practice in the first two sections, the following three matters needing attention of integrating ideological and political education into liberal arts mathematics teaching are found.

Follow the Laws of Ideological and Political Education Work, Imparting Knowledge and Educating People, and the Growth of Liberal Arts Students, and Improve the Attraction and Acceptance of Ideological and Political Theories Teaching in the Course

We should follow the laws of ideological and political education work; the integration of ideological and political education in liberal arts mathematics teaching must be combined with the educational goals, environment, and reality, and keep up with the times. We should follow the laws of imparting knowledge and educating people, improve professional quality, ideological and political cultivation, professional ethics and ideological and political education level of teachers, and guide teachers to adhere to the unity of imparting knowledge and educating people, the unity of words and deeds, the unity of focusing on research and paying attention to society, and the unity of academic freedom and academic norms. We should follow the growth laws of liberal arts students and pay attention to building their knowledge system, shaping their values, and cultivating their emotional psychology.

Teachers should actively care about politics, strengthen political theory learning, continuously improve political literacy, and strive to become disseminators of advanced culture. Teachers should enhance moral education abilities and recognize that ideological and political education will not only not affect the teaching of professional knowledge of liberal arts mathematics, but also enhance the ideological and humanistic nature of teaching and deepen the connotation of teaching. Teachers also should strive to organically combine the knowledge, theory, and ideology of teaching contents with the acceptability of teaching methods, and continuously enhance the attraction and appeal of ideological and political education.

Integrate Ideological and Political Education Into Liberal Arts Mathematics Teaching Based on the Characteristics of Liberal Arts Mathematics and Liberal Arts Students

Teachers should not spend too much time on ideological and political education during the teaching process, while neglecting the teaching of the course itself. Firstly, the content of ideological and political education in

liberal arts mathematics teaching should be targeted while also adapting to the psychology of liberal arts students. Secondly, teachers should not superficially associate teaching contents with ideological and political education ones in their teaching.

The interests and professional contents of liberal arts students are fundamentally different from those of science and engineering students, so the teaching of liberal arts mathematics should be different from that of science and engineering mathematics. For example, we cannot excessively teach technical contents such as argumentation, reasoning, and calculation. However, thinking training and the deeper understanding of mathematical applications must be based on necessary mathematical contents and training as a carrier, and teaching completely in a story or idea style will not meet the requirements. Liberal arts mathematics course should reduce requirements in terms of difficulty and depth, weaken skills, broaden knowledge, enable students to appreciate the essence of multiple branches of mathematics, improve rational thinking ability, cultivate students' modern mathematical awareness, show students the enormous power of mathematics in practical applications, enable them to learn to appreciate mathematical culture, and improve mathematical aesthetic ability, and interest in learning mathematics.

Improve Teachers' Consciousness and Ability of Ideological and Political Theories Teaching in Liberal Arts Mathematics; Strengthen Process Assessment, Focus on Quality Assessment, and Reform the Evaluation Ways of the Course

We should implement the plan to improve teachers' consciousness and ability of ideological and political theories teaching in liberal arts mathematics, and make solid progress by holding special training of ideological and political theories teaching in the course.

The assessment and evaluation methods of the courses reflect the teaching ideas of the courses, and are the important measure and means to urge students to study seriously and consolidate their learning achievements. There should be both incentives and constraints for liberal arts students. The assessment ways should be changed and the process assessment should be strict to allow students to spend more time on learning and achieve more effective learning. The assessment ways should promote the improvement of practical ability, comprehensive quality, and innovative ability of students on the basis of emphasizing the learning of basic knowledge and the cultivation of basic logical thinking ability. In the teaching of liberal arts mathematics, the process assessment should be emphasized through classroom quizzes, case assignments, submitting course papers, and so on, with the main purpose of comprehensive mathematical literacy assessment. An appropriate curriculum evaluation system should be established.

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