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A Research on the Strategy of Integrating PBL with Curriculum Ideological and Political Elements – Taking College Mathematics as an Example

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Abstract: Taking college mathematics as an example, a questionnaire was designed for college mathematics teachers and students to fully comprehend the teaching situation. This paper mainly discusses the problems existing in the teaching of college mathematics and proposes the strategy of integrating PBL with curriculum ideological and political elements in college mathematics, so as to change the teaching process and improve the teaching quality.

Keywords: College mathematics; PBL; Curriculum ideological and political elements

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1. Introduction

College mathematics is highly abstract and discrete, which makes it difficult for students to learn. Due to the lack of visual and intuitive understanding and the grasp of concept formation, method, and theoretical reasoning, the traditional teaching methods need to be reformed. In view of this situation, a questionnaire was designed for college mathematics teachers and students. The results of the survey revealed that students feel that college mathematics is difficult, and that the classroom environment is too depressing; in addition, students have low learning enthusiasm and motivation. Due to the limited class hours and umpteen tasks, teachers shift their focus to theoretical knowledge in class; hence, there is a lack of knowledge application and interaction between teachers and students. Teachers must change their teaching methods from the traditional direct teaching method to the PBL teaching method and give full play to their leading positions in class. In this way, concrete problems can be transformed into abstract mathematical concepts. PBL, as a teaching method proposed by Barrows HS [1], is student-centered and begins with questions. In classroom teaching, teachers create a situation to stimulate interest by using questions, encourage students to explore the reasons behind the problem, guide students to learn new content with existing knowledge and methods, as well as give full play to students' initiative and creativity.

In recent years, curriculum ideological and political reform has become a topic of interest in education and teaching reform and achieved fruitful results in theoretical research and practice. Integrating PBL with curriculum ideological and political elements will encourage students to explore further, and at the same time, reveal the deep thoughts of motivation through problem mining. In the process of raising and answering questions, the critical spirit and teamwork spirit should be emphasized, in order to help students experience the emotions, thoughts, and values that they want to convey, thus achieving better educational outcomes. Many scholars have conducted studies on it. For instance, Huang Jun, who proposed the

application of problem-orientated teaching method to the ideological and political teaching of organic chemistry in colleges and universities [2]; Zhang Ping, who proposed the "3W" ideological and political teaching method based on problems while taking the architecture course as an example [3]; and Shi Peng, who took the microbiology course as an example to propose a problem-oriented curriculum ideological and political teaching design based on COVID-19 [4]. At present, there are numerous studies on the effective path of ideological and political education in college mathematics [5-7], but further exploration is needed to determine how to integrate PBL with curriculum ideological and political elements and apply it to college mathematics teaching. In this modern educational environment, students are expected to collaborate, think critically, jointly develop innovative projects, and answer complex questions. In order to achieve the goal, it is necessary to fully mobilize students' learning initiative, stimulate their interest in learning, and cultivate their innovative spirit as well as their ability to cooperate. In this paper, the strategy of integrating PBL with curriculum ideological and political elements in college mathematics is put forward to promote the teaching of college mathematics and improve the educational effect.

2. The strategy of integrating PBL with curriculum ideological and political elements

First of all, teachers need to enhance their ideological and political awareness and establish the concept of curriculum ideology and politics with personal quality and spiritual outlook to influence students, so that they will form correct values and outlook on life.

Secondly, in PBL, problems are taken as the starting point of learning, so the selection of cases is particularly important when PBL is being integrated with curriculum ideological and political elements. A good case should not only satisfy the realization of teaching objectives, but also conducive to the implementation of curriculum ideology and politics. This requires teachers to dig deeper into curriculum knowledge and combine it with professional, scientific, humanistic, and open questions [8], in order to arouse the enthusiasm of students in learning mathematics, nurture their creativity, and cultivate students who have the spirit of hard work and will continue to pursue the truth and ideal, as well as bear hardships. Finally, teachers should include ideological and political contents in the answers and expand them layer by layer so that in the process of solving problems, implicit ideological and political education and value shaping can be realized.

3. Typical cases of integrating PBL with curriculum ideological and political elements in college mathematics

The idea that "mathematics comes from life, in life, for life" is fully embodied by teachers who use middle school math problems or practical problems to introduce students to math, translate life experience into math knowledge, and then turn math into life experience for students to actively practice. This drives students to develop interest in learning mathematics and grow fond of mathematics, as well as helps them discover new mathematical concepts. Using a variety of cases and incorporating practical application cases into teaching, those seemingly boring mathematical concepts may become more interesting. This would also address students' doubts about the use of mathematics and point out the direction for follow-up studies. Taking college mathematics as an example, four cases will be discussed in this paper.

(1) Case 1: The concept and calculation of extreme value

Using a video, explain to the students why manhole covers are designed to be round, while liquid cups, buckets, and other items are cylindrical. Based on the circumference of the plane graph, concluding that the area of a circle is the largest, students can use the extreme value and the best value of thought to solve problems, while reaping the most rewards with minimal effort. By solving practical mathematical problems in daily life, it is possible to cultivate students' creativity and critical thinking.

(2) Case 2: Solution for the system of linear equations

Taking the massive flood in Shanxi in 2021 as an example, with collapsed houses and landslides, 2,110 rescue boats, 400 generators, and 800 diesel pumps were in urgent need at that time. Hebei, Henan, Shanxi, and Nei Mongol supported and delivered rescue supplies. A rescue vehicle can be equipped with equipment as those stated in **Table 1**.

Table 1. Equipment in a rescue vehicle

Equipment\ Province	**Hebei**	**Henan**	**Shanxi**	**Nei Mongol**
Rescue boat (platform)	10	90	50	60
Generator (platform)	20	0	0	40
Diesel pump (platform)	20	0	10	80

Question: How do you transport materials more reasonably?

Solution: Assuming that Hebei, Henan, Shaanxi, and Nei Mongol sent a rescue vehicle each, x_1, x_2, x_3, and x_4.

$$\begin{cases} 10x_1 + 90x_2 + 50x_3 + 60x_4 = 2110 \\ 20x_1 + 40x_4 = 400 \\ 20x_1 + 10x_3 + 80x_4 = 800 \end{cases}$$

$$(A \mid b) = \begin{pmatrix} 10 & 90 & 60 & 50 & 2110 \\ 20 & 0 & 0 & 40 & 400 \\ 20 & 0 & 10 & 80 & 800 \end{pmatrix} \sim \begin{pmatrix} 1 & 0 & 0 & 2 & 20 \\ 0 & 1 & 0 & -\frac{16}{9} & -1 \\ 0 & 0 & 1 & 4 & 40 \end{pmatrix}$$

$$\Rightarrow \begin{cases} x_1 = -2x_4 + 20 \\ x_2 = \frac{16}{9}x_4 - 1 \\ x_3 = -4x_4 + 40 \end{cases}$$

$$\Rightarrow x_1 = 2, x_2 = 15, x_3 = 4, x_4 = 9.$$

The linear equations can be solved. The optimal scheme is when Hebei, Henan, Shaanxi, and Nei Mongol send 2, 15, 4, and 9 rescue vehicles, respectively.

Through vivid examples, students should be told of how love is demonstrated through disasters, that every significant disaster that strikes a party is supported by eight other parties, and that great love has the power to overcome all natural disasters, so as to stimulate their patriotism and achieve the educational effect of ideological and political education.

(3) Case 3: Independent events

Question: If the probability of a cold virus in a person's respiratory tract is 0.002, find the probability of a cold virus in 1,500 people in a movie theater.

Solution: A_i represents the event of the "i-th person with a cold virus"; assuming that each person with a cold virus is independent of the other, then the sought probability is

$$P = 1 - P\left(\bar{A}_1\right)P\left(\bar{A}_2\right)\cdots P\left(\bar{A}_{1500}\right)$$

$$= 1 - (1 - 0.002)^{1500} \approx 0.95$$

While it is unlikely for each individual to carry a cold virus, the likelihood of the cold virus in the air increases with more people. This reminds everyone that epidemic prevention is a serious issue, and everyone is required to adhere by the epidemic prevention standards. It is similar to the present COVID-19 situation across the nation. It also helps students to develop a correct understanding of the epidemic, disseminate scientific knowledge about epidemic prevention, and take preventive and protective measures, so as to achieve the educational goal of ideological and political education.

(4) Case 4: The limit of number sequence [9]

Question: Xiao Wang borrows A_0 yuan from the bank and invests in a business. The annual compound interest rate is r. How much should he repay after t years?

Solution: If it is settled once a year, it will be settled once in t year, and the amount of repayment after t years is $A_t = A_0(1+r)^t$.

Question: If the settlement times are unlimited in one year, how much is the repayment amount after t years?

Solution: If there are n settlement times a year, the interest rate is $\frac{r}{n}$. nt is the settlement times in t year, and the amount of repayment after t years is $A_t = A_0\left(1+\frac{r}{n}\right)^{nt}$.

After introducing the concept of limit in the lesson with the problem and practical word problem being solved, students will come to understand that Xiao Wang would have to pay a significant sum of money after t years. This knowledge would prompt students to avoid taking out campus loans and practice self-control and rational consumption instead.

In the teaching process, PBL cases are taken as the carrier to design and excavate ideological and political elements in college mathematics and guide students to solve problems with ideological and political thinking. By giving full play to the advantages of PBL, it promotes creative thinking among students and encourages them to make bold explorations in teaching activities. Students should be guided to investigate and solve real, complex problems, realize the organic unity of theoretical learning and knowledge application, as well as truly achieve the integration of learning and practice, so as to improve the effect of ideological and political education and promote the growth of students.

4. Conclusion

As a teaching method, PBL, also known as problem-based learning, is the key to creating real and complex problem situations and giving students sufficient time and space for activities. It allows students to achieve independent learning and improves students' problem-solving skills in the real problem environment through group cooperation, independent inquiry, and other processes. In the problem guidance process, students, through continuous practice, reflection, and re-practice, have to cooperate with others, review old knowledge, and learn new knowledge. In a real and meaningful classroom environment, the implementation of PBL helps students master profound theoretical knowledge, while developing creativity, critical thinking skills, and communication skills.

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Disclosure statement

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