Original Research Article

Exploration of the practical path of ideological and political education in probability theory courses based on the case of Pu'er tea industry

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Abstract: This study focuses on the Pu'er tea industry in Yunnan and builds a teaching model that integrates probability theory, ideological education, and industrial practice. It designs typical applications such as stratified sampling, hypothesis testing, yield analysis, market regression, and Bayesian updating. The course follows a structured sequence of context introduction, value questioning, model explanation, code execution, task completion, and reflection. Based on a one-year study of 120 students, the experimental class performed significantly better than the control group in knowledge, values, and skills. The results show notable improvement in accuracy, ideological understanding, and report quality. The model offers a replicable path and evidence base for promoting localized and practical ideological education in science and engineering.
Keywords: probability theory course; Pu'er tea industry; ideological and political education in courses; three-line collaboration

1. Introduction

Ideological and political education in basic science and engineering courses is shifting from knowledge transmission to value shaping and practical application[1]. As a core stage of cultivating scientific spirit and rigorous thinking, these courses play a central role in advancing "three-dimensional education." Yunnan's Pu'er tea industry, rich in cultural and data resources, provides real-world cases for localized ideological integration[2]. Prior studies have explored the cultural, economic, gender, and entrepreneurial dimensions of Pu'er tea, while educational research has addressed course design and deep learning–based classroom optimization[3]. Building on this foundation, this study develops a "mathematics plus ideological and political education plus industry" model, constructing a three-dimensional teaching structure, case library, and evaluation system[4]. It offers theoretical and empirical support for localizing ideological and political education in science and engineering curricula.

2. Theoretical basis and path framework

The ideological and political education of courses is grounded in the "three-dimensional education" concept, promoting the integration of knowledge, values, and practical skills[5]. Supported by contextual learning, action learning, and outcomes-based education theories, this approach encourages real-world engagement, problem-solving, and outcome-oriented teaching[6]. Based on this, the institute developed a collaborative model integrating mathematical knowledge, ideological-political elements, and industrial practice[7]. The model combines key probability theory content with value themes like scientific spirit and

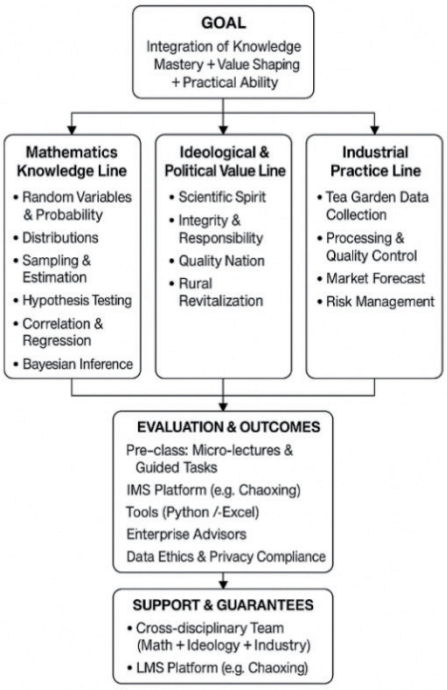

Figure 1. Overall block diagram.

integrity, and applies them to real data from the Pu'er tea industry[8]. A closed-loop teaching structure—Pre-class motivation, in-class guided learning, and post-class reflection—Ensures students achieve comprehensive growth in knowledge, values, and application[9].

3. Teaching implementation case analysis

3.1. Case group design

3.1.1. Quality assurance hypothesis testing

To assess whether a batch is qualified, the actual failure rate parameter is set to be p false, and the qualified benchmark adopted by the regulations is p_0 to conduct unilateral inspection.

$$H_0 : p \le p_0 \quad \text{vs.} \quad H_1 : p > p_0$$

When n samples are drawn, the number of defective products is X, and the composition ratio of the sample is $\hat{p} = X / n$ falseX. At α the significance level, the statistic is approximated by normal distribution.

$$z = \frac{\hat{p} - p_0}{\sqrt{p_0 (1 - p_0) / n}}$$

At H_0 that time $z > z_{1-\alpha}$, the implementation was rejected and batch inspection activities were carried out. The program presented an OC curve. In p the context of the real probability, the probability of acceptance

$$L(p) = \sum_{x=0}^{c} \binom{n}{x} p^x (1-p)^{n-x}$$

According to this standard, c this is the maximum tolerable number of unqualified products. Based on this, the risk definitions for consumers and producers $\alpha_c = 1 - L(p_0)$, as well as the risk definition for producers $\beta = L(p_1)$ (p_1 the inferior product boundary) are established. Relying on historical batch data and covariates such as environmental humidity, the z value, efficacy $1-\beta$ and OC curve are published simultaneously in the quality report to ensure the transparency of product quality and integrity information.

3.1.2. Output fluctuation and normal approximation

The feasibility of the implementation of the plan was investigated. X_i The distribution of daily fresh leaf harvesting was independent of each other. The expectation μ, variance σ^2 and central limit theorem showed that the approximation of the sample mean was:

$$\bar{X}_n = \frac{1}{n} \sum_{i=1}^{n} X_i \approx \mathsf{N}\left(\mu, \frac{\sigma^2}{n} \right)$$

For T the total planned amount within consecutive days Q, $S_T = \sum_{i=1}^{T} X_i$ the probability of total output reaching the target is:

$$\Pr(S_T \ge Q) = 1 - \Phi\left(\frac{Q - T\mu}{\sigma\sqrt{T}} \right)$$

Among them , this function $\Phi(\cdot)$ belongs to the category of standard normal distribution, and the process stability is examined and measured by bandwidth qualification rate:

$$\Pr(|X-\mu|\leq k\sigma)=2\Phi(k)-1$$

In the formula, k the value is the multiple of the allowable fluctuation. By (μ,σ) substituting the rolling forecast into the formula, the team manpower and transportation capacity can be configured under the established probability requirements of compliance.

3.2. Integrated team-based teaching and modular workflow for three-dimensional education implementation

To implement the three-dimensional teaching model, a team of mathematics teachers, ideological experts, and industry consultants collaborated on planning, case design, and teaching[10]. Each played a distinct role: math faculty taught core concepts, ideological experts led value discussions, and consultants provided real Pu'er tea data. A three-tier teaching system ensured support throughout, with the Super Star Platform managing learning progress. Teaching modules followed a unified process—Using real cases, guiding value discussion, explaining models, coding practice, and completing group tasks—Culminating in reports and reflections that connected technical learning with value development.

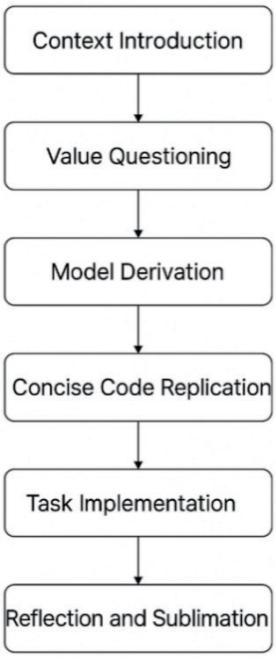

Figure 2. Teaching process.

4. Empirical research and effectiveness evaluation

4.1. Research design

This study was conducted in the Probability Theory and Mathematical Statistics course for two majors at a university in Yunnan, involving 120 students from two classes. The experimental class adopted an integrated model combining mathematics, ideological education, and industrial practice, while the control class used traditional teaching with exercises. Over one year, pre-tests, mid-term, and final assessments were conducted. Data included classroom engagement, assignment completion, test scores, ideological literacy, and practical outputs based on real Pu'er tea industry cases. With student consent, data were collected ethically and processed using outlier screening and imputation methods. Final analysis used t-tests, ANOVA, and structural equation modeling. Table 1 displays selected processed data samples.

4.2. Analysis methods

After data preprocessing, **Table 4-1** presents the core sample. The study evaluates knowledge, values, and practical skills using quantitative and qualitative methods. Paired t-tests and Cohen's d assess score changes, with Wilcoxon tests used when data lack normality. Repeated measures ANOVA analyzes the interaction between time and teaching model. Structural equation modeling (SEM) explores causal relationships among the three competencies, using test scores as observed variables and standard fit indices. Regression and canonical correlation assess how classroom behavior affects outcomes, while text mining of reflections reveals value and emotional shifts.

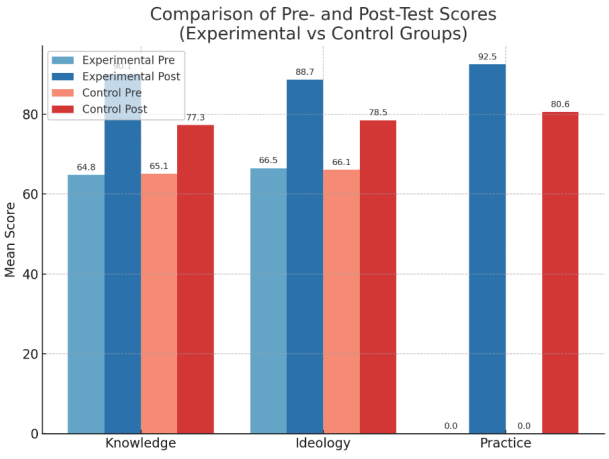

Figure 3. Comparison of pre- and post-test scores between the experimental class and the control class.

The statistical data presented in Figure 3 indicate that the experimental class achieved significant growth

in knowledge acquisition, ideological and political literacy, and practical ability, with a clear interactive impact. This empirical data supports the effectiveness of the three-line collaborative teaching model.

4.3. Results

4.3.1. Knowledge dimension: Changes in correctness of core questions and performance on transfer questions

Using the three-line collaborative teaching model, students in the experimental class showed marked improvement in knowledge acquisition. Core questions focused on key topics like random variable distributions, sampling estimation, and hypothesis testing, while also assessing students' ability to apply Bayesian inference and regression to real Pu'er tea scenarios. As shown in **Table 3** and **Figure 4**, the average score on core questions rose from 63.5% to 89.1%, and transfer question scores increased from 57.5% to 84.6%. A paired t-test yielded a p-value below 0.001 and a large effect size ($d > 1$), confirming the intervention's significant impact on learning outcomes.

4.3.2. Ideological and political dimension: Pre- and post-test improvement rate (target ≥ 15%) and changes in key items

The ideological and political literacy assessment uses a four-dimensional scale with verified reliability, covering core categories such as scientific concepts, integrity and responsibility, product quality, and rural development. **Table 4** includes the scores and growth rates of the 8 students' ideological and political literacy tests before and after.

Looking at **Figure 5**, we can see that the overall average growth value is 27%, which exceeds the established target by 15 percentage points, and the indicators of each dimension ($p<0.001$).

4.3.3. Practical dimension: Industry analysis report compliance rate (target ≥ 80%) and expert evaluation key points

The core evaluation requirement of the practical dimension is that students must complete a comprehensive analysis report based on actual Pu'er tea data, covering sampling design, adjustment of quality inspection standards, and market regression forecasting. **Table 5** shows the practical assessment scores of eight students and whether they meet the standards.

As shown in **Figure 6**, the average score of the practical tasks was 91.0%, far exceeding the target and reaching over 80%. The experts' comments mainly involved three core aspects: ensuring the full picture of the data, the accuracy of the probability model, and the depth of value orientation. This argument was cited many times, and students have achieved a deep connection between course theory and industry needs.

5. Conclusion

Set in Yunnan's Pu'er tea industry, this study validates a three-dimensional model integrating probability theory, ideological education, and industrial practice. A year-long experiment shows significant gains over

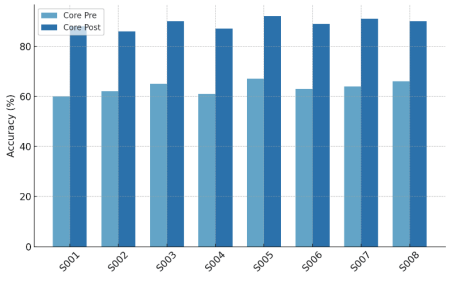

Figure 4. Comparison of the accuracy of core questions before and after the test.

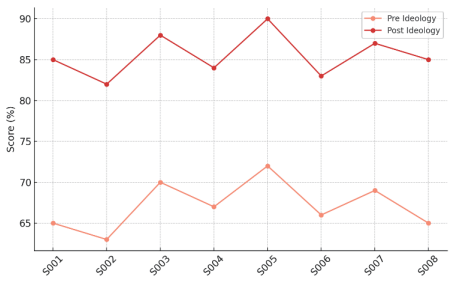

Figure 5. Changes in ideological and political literacy scores before and after test.

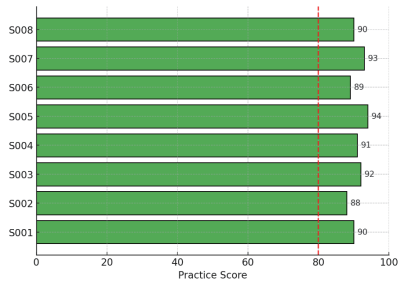

Figure 6. Comparison of the practice report score and the 80-point passing score.

controls in knowledge, values, and practical skills. The model is transferable; next steps scale regional cases, collaboration, and digital resources.

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