# Promoting Class Safety Benchmarking Evaluation Based on Pearson Correlation Analysis

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**Abstract:** With the proliferation of information technology, big data analysis has found wide applications in today's safety management. Based on a Pearson correlation analysis between the incidence of unsafe student behavior and the coverage of unsafe student behavior by class safety benchmarking evaluation, this study focuses on how to reduce the incidence of unsafe student behaviors by promoting class safety benchmarking evaluation. The results show that promoting class safety benchmarking evaluation improves the rate of supervision on unsafe student behaviors and significantly reduces the incidence of unsafe student behaviors.

**Keywords:** Class Safety Benchmarking Evaluation, Correlation Analysis, Unsafe Student Behavior.

## 1 INTRODUCTION

The safety of college students has become an urgent issue as higher vocational colleges expand their enrollment. According to some research，college students, who are active in thinking but relatively weak in awareness of safety precautions, sometimes conduct unsafe behaviors that are in violation of school disciplines, healthy lifestyles, ethics or even laws, and some of the unsafe behaviors lead to campus safety incidents such as negative public opinion events, accidental injuries, etc., seriously endangering campus security and stability as well as students healthy growth [2, 3, 8]. Therefore, reducing the incidence of unsafe student behaviors is a most important task for colleges.

In today's information age, big data has been widely used in safety management, with the basic function to figure out the laws for the incidence of unsafe behaviors from massive data, improve the safety supervision ability and effectively reduce unsafe behaviors [11]. In the study, the correlation between the incidence of unsafe student behaviors and the coverage of unsafe student behaviors by class benchmarking evaluation was evaluated, by retrieving big data on unsafe student behaviors from Campus B of D College for Pearson Correlation Coefficient Analysis. Based on the correlation analysis, the class safety benchmarking evaluation is promoted to improve the rate of supervision on unsafe student behaviors，with the goal of significantly reducing the incidence of unsafe student behaviors.

# 2 THEORETICAL BASIS FOR BENCHMARKING EVALUATION

As to how to reduce the incidence of unsafe student behaviors, scholars have conducted much research on the aspects of safety warning education, mental health services, safety management improvement, etc. [1, 4, 6]. While this study focuses on how to reduce the incidence of unsafe behaviors among students by improving the supervision of unsafe behaviors through correlation analysis-based class safety benchmarking evaluation.

Benchmarking, originating in the United States in the 1970s, can be defined as "the continuous process of analyzing the gap with best practice and taking measures to achieve fundamental improvement and innovation", and it has the essential feature in the pursuit of competitive advantage in modern knowledge management [9]. For optimizing benchmarking management, an important segment is implementing benchmarking evaluation to encourage the formation of shared responsibility [7]. In college, the class is the basic unit of safety management and class safety benchmarking is a process of promoting the class to keep a competitive state in safety management [5]. Similarly，for the smooth development of class safety benchmarking, a basic guarantee is promoting class safety benchmarking evaluation, by which the safety performance evaluation of each class member is integrated with the performance evaluation of the class as well as of the associated class cadres, with the aim of organizing the class members to form a community with shared responsibility. In this study, class safety benchmarking evaluation was promoted to reduce the incidence of unsafe student behaviors based on Pearson's correlation analysis between the incidence of unsafe student behaviors and the coverage of unsafe student behaviors by class safety benchmarking evaluation.

# 3 CORRELATION ANALYSIS

For this study, we took 32 classes of 1636 freshmen from Campus B of D College as the subjects and retrieved big data on their unsafe behaviors. Through surveys, tests and correlation analysis of big data, we calculated the current incidence of unsafe student behaviors, the coverage of unsafe student behaviors by class benchmarking evaluation and the Pearson correlation coefficient between the two.

## 3.1 Current incidence of unsafe student behaviors

The incidence of unsafe student behaviors, an indicator of the density of unsafe behaviors, is the ratio of the number of unsafe student behaviors to the total number of students in a given period. To ensure campus safety and stability as well as students' healthy growth, Campus B of D College proposed a requirement to reduce the incidence of unsafe behaviors among students to less than 6% by benchmarking against the historical best level of 5.83% and the current level of 5.97% of peer Campus A. By reviewing student unsafe behavior inspection records from October to December 2021, we calculated that the average monthly incidence of unsafe student behaviors was 9.71% with an interval of 9.53-9.83%, missing the target of 6%.

## 3.2    Current coverage of unsafe student behaviors by class benchmarking evaluation

According to the current rules on the evaluation of unsafe student behavior enforced by Campus B, all unsafe behaviors are counted in the performance evaluation of individuals, but only seriously disciplinary unsafe behaviors, such as getting drunk and staying out late, are counted in the performance evaluation of the class and its associated cadres. We looked at the evaluation records from October to December 2021 and calculated that the coverage of unsafe behaviors by class safety benchmarking evaluation was 13.2% on Campus B, which is much lower than the 61.2% on peer Campus A, as shown in Table 1.

**Table 1:** Current coverage of unsafe student behaviors by class benchmarking evaluation

| Campus | Number of unsafe behaviors | Number of unsafe behaviors covered by benchmarking evaluation | Coverage of unsafe behaviors by benchmarking evaluation |
|---|---|---|---|
| Campus B | 477 | 63( in violation of disciplines that may lead to serious consequences) | 13.2% |
| Campus A | 281 | 172 （that may lead to serious consequences) | 61.2% |

We further examined the record of unsafe behavior supervision by student cadres under the current evaluation by taking as a sample the unsafe behavior of not measuring the temperature on time. As shown in Fig. 1 below, the average rate of supervision on non-punctual temperature measurements by associated class cadres was 51.2%, with an interval of 46.5-57.3%, failing to reach 80%, which is the eligible rate of supervision on unsafe conduct as specified in the cadre liability list.
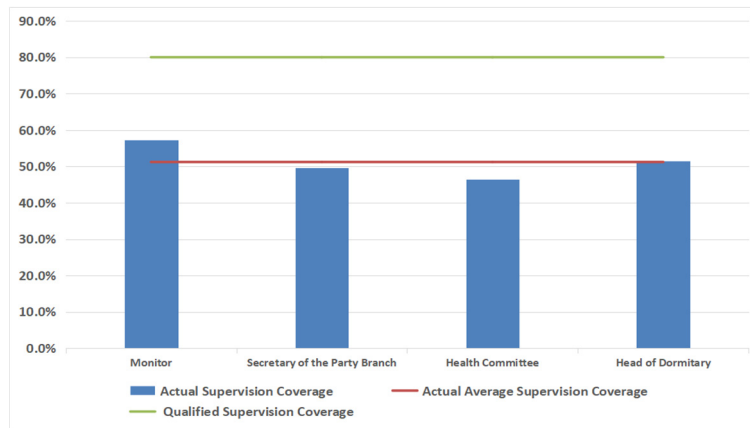


**Figure 1:**    Rate of supervision on unsafe behaviors by associated class cadres

In summary，currently the coverage of unsafe student behaviors by class benchmarking evaluation on Campus B is only 13.2%, much lower than 61.2% on peer Campus A. In this case, the rate of supervision on unsafe behavior by associated class cadres is lower than the value specified in the cadre liability list.

### 3.3 Correlation between the incidence of unsafe behaviors and the coverage of unsafe behaviors by class benchmarking evaluation

To further analyze the correlation between the incidence of unsafe behaviors and the coverage of unsafe behaviors by class benchmarking evaluation, we selected 32 classes and divided them into four experimental groups for the evaluation system transition test, controlling the other variables as much as possible. The groupings of the evaluation transition tests are listed in Table 2 below.

**Table 2:** Experimental groups for the evaluation transition test

| Groups | Classes | Coverage of unsafe behaviors by class benchmarking evaluation |
|--------|---------|----------------------------------------------------------------|
| Group 1 | Classes 1-8 | Only unsafe behaviors in serious violation of disciplines are covered. |
| Group 2 | Classes 9-16 | 2 common unsafe behaviors (not turning off the light on time and not measuring the temperature on time) are added. |
| Group 3 | Classes 17-24 | 4 common unsafe behaviors (not turning off the light on time, not measuring the temperature on time, irregular use of electricity and not cleaning up the dormitory as required) are added. |
| Group 4 | Classes 25-32 | All unsafe behaviors except accidental ones are covered. |

By referring to the records of safety inspection, unsafe behavior supervision and benchmarking evaluation of 32 classes in March, we calculated the coverage of unsafe behaviors by class safety benchmarking evaluation, the rate of supervision on unsafe behaviors by class cadres and the incidence of unsafe behaviors. As shown in Fig. 2, the coverage of unsafe behavior by class safety benchmarking evaluation, positively correlated with the rate of supervision on unsafe behaviors by class cadres, is negatively correlated with the incidence of unsafe behaviors.
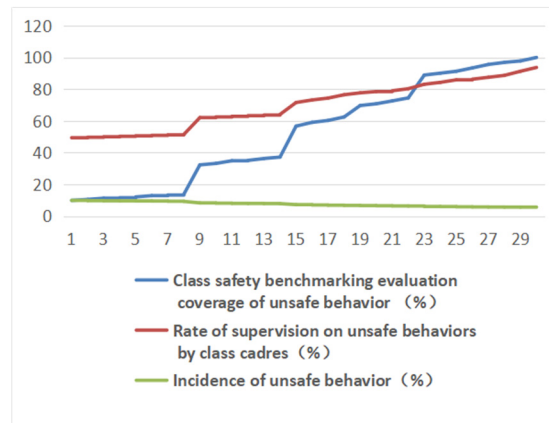


**Figure 2:** Results of evaluation transition test

The Pearson Correlation Coefficient Calculator was used to calculate the correlation coefficient between the coverage of unsafe behavior by Class benchmarking evaluation and the incidence of unsafe behaviors for each class of the 4 groups in March. As can be seen from the XY scatter plot in Fig. 3, R has a value of -0.9652 and $R^2$ has a value of 0.9316, suggesting a strong negative

correlation between the coverage of unsafe behaviors by class benchmarking evaluation and the incidence of unsafe behaviors.
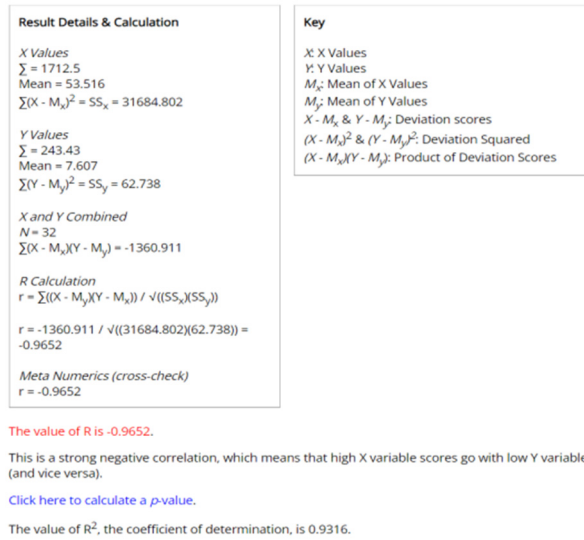
**Result Details & Calculation**

*X Values*
$\sum = 1712.5$
Mean = 53.516
$\sum(X - M_x)^2 = SS_x = 31684.802$

*Y Values*
$\sum = 243.43$
Mean = 7.607
$\sum(Y - M_y)^2 = SS_y = 62.738$

*X and Y Combined*
$N = 32$
$\sum(X - M_x)(Y - M_y) = -1360.911$

*R Calculation*
$r = \sum((X - M_y)(Y - M_x)) / \sqrt{((SS_x)(SS_y))}$

$r = -1360.911 / \sqrt{((31684.802)(62.738))} = -0.9652$

*Meta Numerics (cross-check)*
$r = -0.9652$

**Key**

*X*: X Values
*Y*: Y Values
$M_x$: Mean of X Values
$M_y$: Mean of Y Values
$X - M_x$ & $Y - M_y$: Deviation scores
$(X - M_x)^2$ & $(Y - M_y)^2$: Deviation Squared
$(X - M_x)(Y - M_y)$: Product of Deviation Scores

The value of R is -0.9652.

This is a strong negative correlation, which means that high X variable scores go with low Y variable scores (and vice versa).

Click here to calculate a *p*-value.

The value of $R^2$, the coefficient of determination, is 0.9316.

**Figure 3:** Correlation coefficient between the coverage of unsafe behaviors by class benchmarking evaluation and the incidence of unsafe behaviors

In addition, as shown in the XY scatter plot in Fig. 4 below, the incidence of unsafe behaviors is no longer decreased significantly when the coverage of unsafe behavior by class benchmarking evaluation rises above 90%.
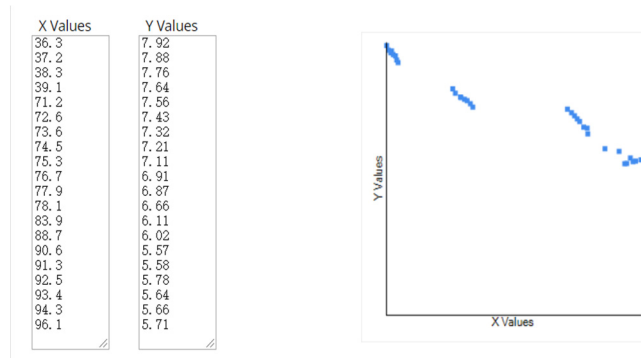
| X Values | Y Values |
|---|---|
| 36. 3 | 7. 92 |
| 37. 2 | 7. 88 |
| 38. 3 | 7. 76 |
| 39. 1 | 7. 64 |
| 71. 2 | 7. 56 |
| 72. 6 | 7. 43 |
| 73. 6 | 7. 32 |
| 74. 5 | 7. 21 |
| 75. 3 | 7. 11 |
| 76. 7 | 6. 91 |
| 77. 9 | 6. 87 |
| 78. 1 | 6. 66 |
| 83. 9 | 6. 11 |
| 88. 7 | 6. 02 |
| 90. 6 | 5. 57 |
| 91. 3 | 5. 58 |
| 92. 5 | 5. 78 |
| 93. 4 | 5. 64 |
| 94. 3 | 5. 66 |
| 96. 1 | 5. 71 |

**Figure 4:** The XY scatter plot of the coverage of unsafe behaviors by Class benchmarking evaluation and the incidence of unsafe behaviors

# 4 COUNTERMEASURES TO PROMOTE CLASS BENCHMARKING EVALUATION

Based on the above correlation analysis, classroom benchmarking evaluation is promoted to reduce the incidence of unsafe student behaviors to less than 6%, by increasing the coverage of unsafe behaviors by class benchmarking evaluation to 90% and the rate of supervision on unsafe behaviors by associated class cadres to 80%.

## 4.1 Formulating rules for class safety benchmarking evaluation

Taking the selection of excellent classes as an opportunity, we formulate rules for class benchmarking evaluation with a combination of rewards and penalties, as shown in Fig. 5 below. With multiple-evaluation of the relevant individuals, the associated student cadres and the class in two ways of "reward and penalty" for unsafe behaviors, the rules are formulated to build a new safety management ecology in which mutual supervision coexists with mutual achievement.
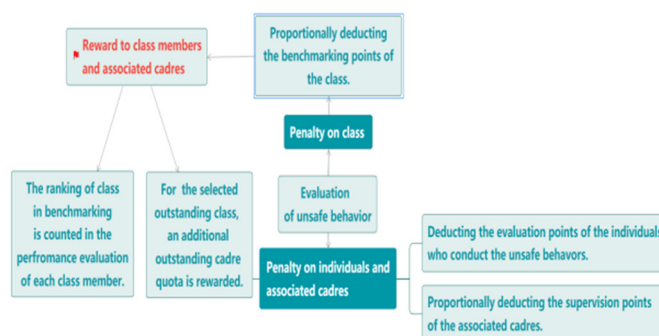


**Figure 5:** Rules for class benchmarking evaluation

## 4.2 Designing procedures for class benchmarking evaluation

Referring to the management process of students' monthly comprehensive quality evaluation, we designed the procedures of "daily inspection publicity, weekly summary notification, monthly statistical score deduction, and periodical evaluation and reward" for class benchmarking evaluation.

## 4.3 Promoting the implementation of class benchmarking evaluation

First, at the beginning of April, the rules for class benchmarking evaluation were released for all classes, thereby motivating the students to strive for excellence. Next, the class benchmarking evaluation was performed, and each unsafe behavior was also factored into the performance evaluation of the class cadres proportionally, as well as into the selection of good classes. Finally, the ranking of each class in the class benchmarking was computed inversely proportional to the evaluation of each class member. In addition, an additional quota of

outstanding cadres was given to the selected elite classes to inspire a sense of collective honor and responsibility, as well as vigor in supervision over unsafe behavior.

## 4.4    Driving the improvement in benchmarking evaluation

Class benchmarking evaluation is not a short-term behavior, but "a dynamic management process of continuous improvement" [10]. In order to continuously improve the class benchmarking evaluation, we timely assess the impact of class benchmarking evaluation. First, we conducted an online collection of student proposals for class benchmarking evaluation. For example, we actively responded to student voices by awarding each student who has never engaged in unsafe behavior an additional 1 point. Second, we accumulated and solidified the experience to assess the system by classifying the benchmarking evaluation cases. Third, based on a survey of student attitudes towards evaluation, we formulated improvement plans and continuously improve the class benchmarking evaluation, forming a closed loop of benchmarking, summarization and upgrading.

# 5    RESULTS OF CLASS BENCHMARKING EVALUATION

Class benchmarking evaluation was conducted from April to June. Then, by referring to the records of safety evaluation and conducting questionnaire surveys, we counted the coverage of unsafe behaviors by class benchmarking evaluation, the rate of supervision for unsafe behavior by associated class cadres and the incidence of unsafe behaviors, to check the implementation effect of class benchmarking evaluation.

## 5.1    Coverage of unsafe behaviors by class benchmarking evaluation

According to the safety evaluation record, 273 out of 282 unsafe behaviors conducted by individual students from April to June, with the exception of  9 accidental unsafe behaviors, were counted proportionally in the performance evaluation of student cadres, as well as in the selection of excellent classes. The coverage of unsafe behaviors by class safety benchmarking evaluation reached 96.8%, above the target of 90%.  At the same time, the ranking of each class in the class benchmarking was computed conversely to the performance evaluation of each class member proportionally. In addition, for each of the top 10 selected outstanding classes, an additional outstanding cadre quota was awarded to the class cadre committee.

## 5.2    Rate of supervision on unsafe behavior by class cadres

We selected the unsafe behavior of "not measuring temperature on time" which is easy to be recorded as the sample and investigated the rate of supervision on unsafe behaviors by class cadres before and after the implementation of "multiple two-way" evaluation, as shown in Fig. 6 below. After the implementation of class benchmarking evaluation, the average rate of supervision on unsafe behavior by class cadres reached 94.8%, which is above the target value of 80%.
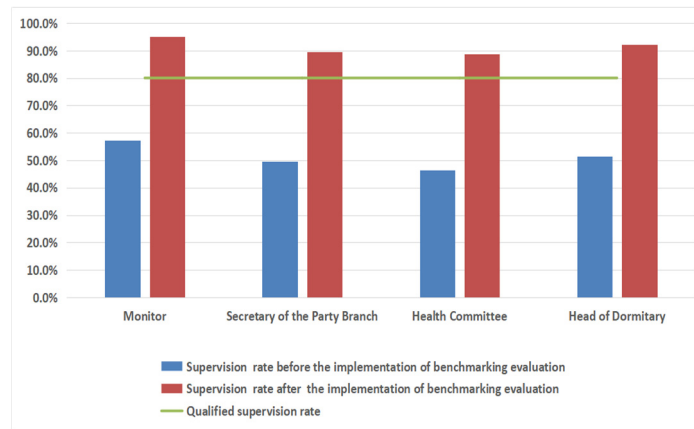
**Figure 6:** Rate of supervision on unsafe behaviors by class cadres before and after the implementation of class benchmarking evaluation

## 5.3 Incidence of unsafe behaviors

The implementation of class benchmarking evaluations was completed in July 2021 and continued from August to December 2021. Based on the normalized safety inspection data for October to December 2021, the incidence of unsafe behaviors among students decreased to 5.63%, below the target value of 6%. By comparing the number of unsafe behaviors for October to December 2021 with those for October to December 2020, it can be seen that the number of serious unsafe behaviors decreased from 48 to 11, and the number of safety emergencies such as accidental injuries decreased from 4 to 2, which decreased by 336% and 100% respectively.

## 6 CONCLUSIONS

It has been shown that by promoting class benchmarking evaluation, the incidence of unsafe behaviors fell below the target value of 6% and the rate of supervision on unsafe behaviors by class cadres rose above 80%. This study preliminarily explores how to reduce students' unsafe behaviors through benchmarking evaluation, which has reference significance for higher vocational colleges creating a safety management situation in which the students are encouraged to grow into high-quality skilled talents by enhancing their awareness of safety, sense of responsibility and spirit of teamwork. But how to optimize the safety benchmarking evaluation index system to better leverage the role of benchmarking evaluation in improving students' safety literacy remains a topic for further research.

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