Analysis of influencing factors and teaching reform of nuclear professional English based on logistic regression

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Abstract. Nuclear professional English course can help students of nuclear energy engineering major to understand the corresponding course content accurately and effectively while learning and researching frontier topics. This course has an important guiding role for their future development. This experiment obtained a series of data from students who had completed the course by questionnaire survey, and logistic regression algorithm was used to analyse the influencing factors of professional English test, then obtained the P value. The significant relationship between the independent variable and the dependent variable can be seen from the P value, thus reflecting the problems existing in the current course. The odds ratio (OR value) value of 0.030 is the biggest influence on the passing rate of the examination factor. In the questionnaire survey on the distribution of students' intention, 96.25% of the students hope to have a new teaching mode, while 38.10% of the students do not take the initiative to read English books.

1. Introduction
In October 2019, the Ministry of Education issued the opinions on deepening undergraduate education and teaching reform and comprehensively improving the quality of personnel training, which mentioned comprehensively improving the quality of curriculum construction and deepening the reform of innovation and Entrepreneurship Education [1]. As an interdisciplinary course combining English with nuclear specialty, nuclear professional English has its unique professional connotation. It focuses more on the expression of nuclear terms, the study of professional vocabulary, syntax and structural model, and emphasizes the English expression in the professional field. On the one hand, the amount of nuclear power engineering in China and even in the world is huge. Up to now, China has built 11 nuclear power units with 9.1 million kilowatts, and is building 14 nuclear power units with 15.12 million kilowatts. It needs to build another 55 to 70 million kilowatts of nuclear power. That is to say, from 2009 to 2020, it needs to start construction of another 55 to 70 nuclear power units with 1 million kilowatts. Considering that the construction period of nuclear power is about 5 years, it is necessary to start about 5 units each year to ensure the completion of this goal. In order to achieve this goal, China needs a large number of nuclear energy professionals [2]. On the other hand, in the teaching process of cultivating nuclear energy
professionals, learning English is the key to better learning nuclear power knowledge. China's nuclear energy engineering is in line with the world. At present, the top technologies of nuclear energy are in European and American countries. Many nuclear energy technologies need to be obtained from abroad. Only by learning professional English can we better adapt to and learn the relevant knowledge of nuclear energy engineering. At the same time, nuclear enterprises send a group of outstanding talents to study advanced nuclear technology in European and American countries every year, which reflects the importance of learning professional English well.

Juanfang Xi proposed that the construction of a professional teaching team can not only provide guarantee for professional English teaching, but also provide higher quality teaching services for students, create a better learning environment for students, and let them obtain happiness and satisfaction in learning [3]. Xia Wang thinks that there is a big difference between professional English and public basic English, so it can’t use the way of teaching public basic English to carry out professional English teaching, let alone arrange teachers to preside over the teaching work [4]. Erxi Zhao and Xiaofang Liu encourage to strengthen English learning work, organize English corner, class group English support activities, etc., through the development of these activities, to pave the way for students to better participate in nuclear power English [2]. Fei Li and others used the method of participatory learning and action (PLA) to investigate the nuclear professional English by questionnaire, and got the result that the pass rate of the test paper increased from 95% to 100%, with an average increase of 5 points. The significant improvement of overall performance reflects the effectiveness of participatory learning. Therefore, it is proved that PLA teaching method can improve the academic performance [5]. They all used different methods to put forward various methods and suggestions on education reform from different aspects. However, they did not use specific mathematical models and principles to find the problems in the current teaching system of nuclear professional English, and they did not put forward the corresponding suggestions and methods to carry out the teaching reform.

In view of the above research, there is no literature using the logistic regression principle to explore the education reform of nuclear professional English. Therefore, this paper uses the logistic regression principle to explore the many influencing factors of nuclear professional English, which is of great significance for promoting the development of nuclear professional English and improving the learning effect of students.

2. Principle
Logistic model adopts logical probability distribution function, assuming that random variables obey logical probability distribution, the Formula is as follows:

$$L(P) = \ln \frac{P_i}{1-P_i} = \beta_0 + \beta_1 X_1 + \ldots + \beta_i X_i + \varepsilon_i$$

(1)

Where, $P_i$ is the probability of students passing the nuclear professional English examination, $1-P_i$ is the probability of students failing to pass the nuclear professional English, $\frac{P_i}{1-P_i}$ is the probability of students passing the nuclear professional English, $\beta_0$ is the constant term, $\beta_i$ is the regression coefficient of the i-th independent variable, $X_i$ is the i-th influencing factor affecting students to pass the nuclear professional English, $\beta_1, \beta_2, \beta_3, \beta_4$ is the regression coefficient, is the random disturbance term.

Binary logistic regression model can reduce the variation of independent variables and improve the accuracy of linear regression model. Therefore, the binary logistic regression model is used to predict the factors influencing students' passing nuclear professional English. The formula is as follows:
Where, $X$ is the independent variable, $Y$ is the category of the dependent variable, and $\theta$ is the parameter to be determined by the model. This model is used to explain the probability of taking 1 or 0 of the model result under specific factors. See the experimental design for variables and their assignment.

The specific experimental process of logistic regression analysis is shown in Figure 1.

$$p(y = 1 | x, \theta) = \frac{e^{\theta x}}{1 + e^{\theta x}}$$  \hspace{1cm} (2)

$$p(y = 0 | x, \theta) = \frac{1}{1 + e^{\theta x}}$$  \hspace{1cm} (3)

**Figure 1.** Logistic regression flow chart.

3. Experimental design

3.1. Questionnaire design and content
This experiment adopts the form of questionnaire survey, designs a questionnaire for the class of nuclear professional English course in the school of nuclear technology and automation engineering of Chengdu University of Technology, and takes the students who have completed the course as the object to conduct a self-administered anonymous survey. 90 questionnaires were distributed and 82 questionnaires were returned. In order to eliminate the interference of extreme questionnaires, two invalid questionnaires were eliminated, and the effective questionnaire rate is 97.56%, which met the requirement that under the 95% confidence level, the sampling error is less than 5% of the required sample size.

3.2. Assignment of questionnaire
The independent variable and dependent variable related indicators are: curriculum arrangement (X₁), job completion (X₂), review of examination (X₃), attention in class(X₄), reading English books (X₅), passing of CET-4 (X₆), discussion and communication (X₇), utilization of campus resources (X₈), online learning (X₉), and passing of nuclear professional English examination (Y).

| Table 1. Assignment of each influencing factor and output value. |
|---------------------------------------------------------------|
| Influence factor                                           | Variable name | Assignment                          |
| Curriculum arrangement                                      | X₁            | Reasonable=1; Unreasonable =0        |
| Job completion                                              | X₂            | Complete=1; Uncomplete=0             |
| Review of examination                                       | X₃            | Complete=1; Uncomplete=0             |
| Attention in class                                          | X₄            | Serious=1; Not serious=0             |
| Reading English books                                       | X₅            | Complete=1; Uncomplete=0             |
| Passing of CET-4                                            | X₆            | Pass=1; Failed=0                     |
| Discussion and communication                                | X₇            | Active=1; Unactive=0                 |
| Utilization of campus resources                             | X₈            | Frequently=1; Seldomly=0             |
| Online learning                                             | X₉            | Frequently=1; Seldomly=0             |
| Passing of nuclear professional English examination         | Y             | Pass=1; Failed=0                     |

4. Discussion and analysis

4.1. Single factor analysis
SPSS software is used to conduct chi square test on single factor [7]. When the results are significantly related to dependent variables, logistic regression analysis is conducted. The results of single factor analysis are shown in Table.2

| Table 2. Single factor chi square test results. |
|-----------------------------------------------|
| Influence factor                              | X²       | P value |
| Curriculum arrangement                        | 14.359   | 0.000   |
| Job completion                                | 0.011    | 0.918   |
| Review of examination                         | 22.217   | 0.000   |
| Attention in class                            | 6.055    | 0.014   |
X$^2$ is Pearson $X^2$ value, which is used to calculate $P$ value. When $P < 0.05$, it has statistical significance. From Figure 2, it can be seen that the curriculum arrangement, job completion, review of examination, attention in class, passing of CET-4 and online learning have significant influence on whether students pass nuclear professional English examination.

![Figure 2. P value results of single factor chi square analysis.](image)

### 4.2. Binary logistic regression analysis

Binary logistic regression analysis is performed on the five significant influencing variables obtained in Section 4.1. Firstly, the overall validity of the model is analyzed. It can be seen from Table 2 that the original hypothesis of the model test here is: whether the independent variable is put into the two cases, the quality of the model is the same. Here, the $P$ value is less than 0.05, so it shows that the original hypothesis is rejected, that is to say, the independent variables put in during the construction of the model are effective, and the model construction is meaningful. According to the reliability and validity analysis, Cronbach $\alpha$ coefficient is 0.637, KMO value is 0.710, which are all greater than 0.6, which indicated that the research data have a good reliability and validity by using binary logistic regression analysis, and the results obtained by the following binary logistic regression analysis are true and reliable. The significant dependent variables from Table 2 are analyzed by binary logistic regression, and the results are shown in Table 3.

| Influence factor             | OR value | $P$ value |
|-----------------------------|----------|-----------|
| Curriculum arrangement      | 0.000    | 0.964     |

![Table 3. Binary logistic regression analysis of significant influencing factors.](image)
Figure 3. P value results of binary logistic regression analysis.

It can be seen from Table.3 and Figure.3 that the P value of review of examination and online learning is less than 0.05, so the independent variable has a significant impact on the dependent variable. The odds ratio (OR value) of examination review situation is 0.030, which means that the change (decrease) range of Y is 0.030 times, and the OR value of online learning situation is 0.022, which means that the change (decrease) range of Y is 0.022 times for each unit of online learning. Therefore, in contrast, the examination review has a greater impact on nuclear professional English. Therefore, according to the analysis results of influencing factors, the following reform measures can be put forward:

(1) Strengthen students’ education and correct their learning attitude. According to the data in Table.3, the OR value of examination review is 0.030, which is the most important independent variable. Review before examination can help students consolidate the knowledge of the whole course. Therefore, it is suggested that at the end of teaching, students’ education should be strengthened, the importance of examination review should be emphasized, learning groups should be organized to help and supervise each other, teachers should spend more time on defense, students should spend more time on reviewing and preparing for exams, so as to create a tense atmosphere for examination.

(2) Enrich online learning methods and encourage online learning. From the logistic regression analysis of significant influencing factors in Table.3, it can be seen that the P value of online learning on the dependent variable is 0.008, indicating that it has a significant impact on the dependent variable, and the OR value reaches 0.022, indicating that it has an impact on the dependent variable. Therefore, online learning should be added to enable students to have more channels for learning. During the epidemic period, many online learning platforms were produced and used. Most students studied and communicated through the Internet, which affected the relationship between online learning factors and test passing rate. However, with the return of offline courses to normal teaching, some online learning platforms have not been used. Therefore, nuclear professional English courses should continue to use online learning software, such as Rain Class, MOOC, etc., which are highly involved and attractive to students, both inside and outside the classroom, and encourage students to actively participate in the process, so as to improve learning efficiency.

4.3. Questionnaire survey of students’ intention distribution
According to the results of the analysis, a follow-up questionnaire survey was conducted in this experiment.

Q1: The current professional English course is boring or useless. 11.25% of the students strongly agree with this statement, and 11.25% of the students agree with it. Therefore, 22.5% of the students still think that the current course is boring and useless. Therefore, there are some problems in the teaching methods of nuclear professional English, and corresponding measures should be taken to improve them.

Q2: Lively and relaxed teaching course is helpful for learning professional English. 66.25% of the students strongly agree with this statement, and 30% of the students agree with it. Therefore, a lively and relaxed teaching course is helpful to the learning of professional English.

Q3: It's helpful to discuss and communicate in professional English in class. 57.5% of the students strongly agree with this statement, while 35% of the students agree with it. This shows that the discussion and communication through professional English is effective and helpful to students' learning.

Q4: The process of teachers' PPT combined with blackboard writing is helpful for learning. 98.75% of the students think that the teacher's way is helpful for learning, so they can continue to use this way of teaching.

Q5: Hoping there are more innovative ways to teach in class. 96.25% of the students hope to arrange more innovative teaching methods in the classroom, so it can add some measures in this regard.

Q6: Whether the students inititatively read nuclear English books when the teacher don’t ask to do. Among the students who are not asked by teacher, 61.1% of the students are willing to read nuclear English books actively, and 38.9% of the students are not willing to take the initiative to read. It can be seen that students are less involved in nuclear related English books, so relevant measures should be taken to improve students' reading.

Figure 4. Distribution of intention of Q1-Q5 middle school school students.

It can be concluded from the survey results in Figure.4 that the nuclear professional English should keep reasonable curriculum arrangement, and adds relaxed and creative teaching. In single factor analysis, the P value of reasonable curriculum arrangement and dependent variable is 0.000, which indicates that it has significant influence on whether or not to pass the examination. In the 80 valid questionnaires, 95% of the students think that the curriculum arrangement is reasonable, so the current curriculum arrangement should be continued. However, in the teaching process, 22.5% of the students thought the course is boring. At the same time, 96.25% of the students think that the lively and relaxed course is helpful for learning, and 96.25% of the students want to have a more innovative teaching method. Therefore, some trend elements can be added to the class or some ways to make students more relaxed, such as increasing the number of times to show English learning videos about nuclear power.
engineering, organizing oral English PK competition in class, Rap competition in professional English terms, etc., so as to attract students to participate in classroom activities, and improve their concentration in class, so as to improve the pass rate and academic performance of the examination.

38.1% of the students in Q6 will not take the initiative to read nuclear English books, which reflects that there is still a big problem in the reading amount of nuclear English books among the students of this major. There are less class hours in English for nuclear professional English, so English reading is indispensable for the study of this course. Therefore, teachers of English for nuclear professional English should encourage students to actively read English books, recommend excellent English books for nuclear energy, and arrange reading time after class. Adequate English reading can increase students' vocabulary and strengthen their sense of English language, which can improve their English ability.

5. Conclusions
Binary logistic regression is used to analyze the influence of various factors on whether students passed nuclear professional English. According to the judgment result of \( P \) value < 0.05, we can see that curriculum arrangement, review of examination, attention in class, passing of CET-4 and online learning are related to test passing. The OR values of Online learning and review of examination respectively are 0.022 and 0.030 to influence the degree of change through nuclear professional English. Therefore, by enriching students' online learning methods and increasing students' learning atmosphere before the examination, the passing rate of the examination can be improved. Binary logistic regression analysis has almost no restrictions on explanatory variables. Although binary logistic regression is mainly used to predict a certain variable, it is concluded that \( P \) value directly reflects the influence relationship between independent variable and dependent variable, while OR value of reflects the influence degree of independent variable on dependent variable, which plays an important role in analysis teaching system. For the influencing factors after analysis, it can put forward targeted reform measures to improve the teaching quality.

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