



Research Article

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Analysis of students' satisfaction towards organic chemistry course in universities based on binary logistic regression

Yijun Zhang

College of Chemistry and Chemical Engineering, Henan Institute of Science and Technology, Xinxiang, China

ABSTRACT

The quality of course teaching is one of the key factors in evaluating teaching level, with students' satisfaction being the measure of teaching quality. An analysis of the students' satisfaction towards teaching helps teachers to improve their teaching skills and provides reference for teacher's skill training. With Organic Chemistry course in universities as the object of study, we have collected satisfaction data of 120 students through survey and thus established a Binary Logistic regression model, focusing on 5 aspects: teaching attitude, content of course, teaching management, teaching method, and experimental teaching. The factors affecting students' satisfaction towards Organic Chemistry course, in descending order of significance, are: linking theory with practice, experiment demonstration, inspiration in teaching, the accuracy of teaching contents, keeping new information up to date, giving prominence to the key points, the proficiency in teaching, flexibility of teaching method, organization of course, prepare lessons, experiment instructions. With improvements in these factors, the satisfaction of students will be greatly raised. The application of Binary Logistic regression model helps increase the accuracy of the results.

Keywords: Teaching, Satisfaction, Binary Logistic, Organic Chemistry

INTRODUCTION

Higher education in China has been rapidly developing in recent years. We have witnessed the overall improvement of the higher education system whereas there are some negative effects coming into being due to the enrollment expansion of colleges. The decline of teaching quality is one that draws most attention [1]. The teaching quality is correlated to many factors. With courses being the main source for students to attain knowledge, the quality of teaching directly influences the quality of education. Therefore, evaluation and analysis become crucial for improving the quality of teaching. In class, with the teachers being the subject of "teaching", the students "study", the satisfaction of students is apparently a direct reflection of the quality of teaching [2,3], widely recognized by educational administration department. Satisfaction evaluation applies in various fields such as tourism [4], marketing [5] and medicine [6]. It functions by analyzing the satisfaction data of customers towards their services, so as to improve the quality of service. There are many factors contributing to the students' satisfaction towards teaching, all of which cannot be ignored, though their influence may vary. The traditional way of evaluation is to conduct a satisfaction survey among the students and to statistically analyze the scores given, but with this method we cannot determine how each factor affects the degree of satisfaction. For example, analysis of means and variance helps determine how the influence of factors is distributed, but it does not show the degree of influence of each factor on the satisfaction towards teaching. The technology of data mining can thoroughly present the hidden connections between the survey results and each contributing factor, while the statistical analysis applied in processing and analyzing data or association rules helps improving the accuracy of the results. That's why quantitative method is so widely used in evaluating the teaching efficiency in recent years. Principle component analysis, factors analysis, AHP [7], fuzzy clustering [8], probabilistic neural network model [9] are all

applied as the tools of quantitative method, greatly enhancing the credibility of the results of evaluation.

Organic Chemistry course is one of the specialized core courses taught in university, and crucial for both theoretical study and application. Many experts have been conducting researches focusing on how to improve the quality of Organic Chemistry teaching. By researching and analyzing the data of students' satisfaction towards Organic Chemistry course, we have gained a more thorough understanding of the problems existing in teaching in class, which guides us to find the solutions. In research regarding satisfaction, Logistic regression model is one of the frequently applied methods, also one of the appropriate model in analyzing individual decision-making behaviors. Binary Logistic regression model is mainly used to analyze dichotomous dependent variable, with good application prospect in the satisfaction evaluation in Organic Chemistry course. Therefore, the purpose of this study is to establish a Binary Logistic regression model to discuss the factors effecting the students' satisfaction towards Organic Chemistry course in university, unveil the degree of influence of each factor, and provide guidance to improving the quality of teaching [10].

EXPERIMENTAL SECTION

Object of Study

The teaching of Organic Chemistry course in Henan Institute of Science and Technology is selected. Questionnaire survey was conducted after Organic Chemistry lessons, with a total of 120 students investigated. All data were sorted, checked and input into computer. The SPSS11.0 software was used to analyze the data.

Method

Binary Logistic regression model is applied in this study. The rationale for this model is to establish a regression model based on a set of data collected through observation. The probabilistic relation between several independent variables and one particular value of a dependent variable is determined, thus simulating the varying pattern of the event of concern. There are only two values to be assigned to the dependent variable in Binary Logistic model, namely, 1 or 0, representing two probabilities of one decision-making. Suppose x_1, x_2, \dots, x_i represent the i factors affecting Y . In the process of statistical analysis of data, denote the probability of satisfaction as $P(Y=1)$, and the probability of dissatisfaction as $1-P(Y=0)$. The ratio of these two, $P/(1-P)$, is the odds, or preponderance. The odds bigger than 1 means the probability of satisfaction surpasses the probability of dissatisfaction, i.e. satisfaction is in preponderance. Denote the logarithm of the odds as $\ln[P/(1-P)]$, i.e. Logistic conversion of P recorded as $\text{logit}(P)$:

$$\text{logit}(P) = Y = \ln \frac{P}{1-P} = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_i x_i \quad (1)$$

$$P = \frac{\exp(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_i x_i)}{1 + \exp(\alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_i x_i)} \quad (2)$$

Where a is a constant term, representing the natural logarithm of odds when all the values of the independent variables are 0. β_i is the partial regression coefficient of this equation, representing the effect of variable x_i on Y . When its value is positive and statistically significant, it means that the value of Y increases with the increase of the explaining variable x_i . On the contrary, when the regression coefficient is negative, it means that Y decreases with the increase of x_i .

Selecting dependent variable

The dependent variable involved in this study is the students' satisfaction towards Organic Chemistry course, a qualitative dichotomous variable. If the result is "satisfaction", the dependent variable $Y=1$; if dissatisfaction, the dependent variable $Y=0$.

Selecting independent variables

All independent variables are dichotomous variables, classified by semantic differential technique. This technique was proposed by the American psychologist, Charles E. Osgood, used for studying people's affective responses to stimulus words or concepts. The two extremes of the attitude scale are usually two opposite adjectives, like honest and dishonest, strong and weak, important and unimportant. In semantic differential technique, however, the testees often tend to select answers in the middle of the scale, causing an inaccuracy in the results. Therefore, the factors are dichotomized to accurately reflect the attitude of tested students. By literature research and referring to the teaching evaluation index system of Henan Institution of Science and Technology, we establish an evaluation index system focusing on five aspects: teaching attitude, course content, teaching management, teaching method and experimental teaching. Treat the students' overall satisfaction towards Organic Chemistry course as the

dependent variable, and x_1 - x_{13} as independent variables (Table 1).

Table 1: Values and types of independent variables

Aspect	Independent variable	Code	Value	Type
Teaching attitude	Prepare lessons	x_1	Unsatisfied(0), satisfied(1)	Dichotomous
	The proficiency in teaching	x_2	Unsatisfied(0), satisfied(1)	Dichotomous
	The accuracy of teaching contents	x_3	Unsatisfied(0), satisfied(1)	Dichotomous
Content of course	Giving prominence to the key points	x_4	Unsatisfied(0), satisfied(1)	Dichotomous
	Linking theory with practice	x_5	Unsatisfied(0), satisfied(1)	Dichotomous
	Keeping new information up to date	x_6	Unsatisfied(0), satisfied(1)	Dichotomous
Teaching management	Organization of course	x_7	Unsatisfied(0), satisfied(1)	Dichotomous
	Time allocation	x_8	Unsatisfied(0), satisfied(1)	Dichotomous
	Inspiration in teaching	x_9	Unsatisfied(0), satisfied(1)	Dichotomous
Teaching method	Language expression	x_{10}	Unsatisfied(0), satisfied(1)	Dichotomous
	Flexibility of teaching method	x_{11}	Unsatisfied(0), satisfied(1)	Dichotomous
Experimental teaching	Experiment demonstration	x_{12}	Unsatisfied(0), satisfied(1)	Dichotomous
	Experiment instructions	x_{13}	Unsatisfied(0), satisfied(1)	Dichotomous

RESULTS AND DISCUSSION

We use a forced entry strategy to estimate the model with the SPSS software. The comprehensive test on the model coefficients shows a significant regression equation. The observed value of likelihood ratio chi-square is 127,710, probability p 0.000, which proves that this model is applicable in this case. The value of -2 Log likelihood is 32.968, which shows that this model has a good fit. The value of Nagelkerke R^2 is 0.888, which means that this model has a good fit. The overall prediction accuracy of the regression model is 95.9%, which is increased by 2.4%, compared to 93.6% in step 0. This means that this model works appropriately in prediction.

Table 2 shows the output of the logistic regression analysis, including the partial regression coefficient β , the standard deviation estimated according to the regression coefficient S.E., the statistical quantity estimated according to the regression coefficient Wald the significance level factor Sig. and the odds ratio Exp(B). Wald is used for null hypothesis significance testing in the logistic regression equation, with coefficient being 0, in order to judge whether a variable should be incorporated into the model. In this study, the significance level is set as 0.15. When the probability P corresponding to the explaining variable Wald is lower than the given significance level, we conclude that the regression coefficient of this explaining variable differs markedly from 0, thus should be retained in this equation. Otherwise it will be excluded from the equation. In the result of the odds ratio Exp(B), if we take x_i as the dichotomous variable, Exp(B) then represents the odds ratio of $x_i = 1$ to $x_i = 0$, all other things being equal. If x_i is a polytomous variable, Exp(B) represents the ratio of this category to reference category with all other things being equal. In this equation, an odds ratio bigger than 1 indicates that the independent variable has a positive effect on the probability of occurrence, whereas an odds ratio smaller than 1 indicates the opposite; an odds ratio equal to 1 indicates that the independent variable does not affect the probability at all.

Table 2: Variables in the equation

	β	S.E.	Wald	Sig.	Exp(B)
x_1	2.128	1.220	3.044	0.081	8.400
x_2	2.765	1.628	2.885	0.089	15.887
x_3	3.007	1.563	3.702	0.054	20.229
x_4	2.849	1.499	3.611	0.057	17.267
x_5	4.288	1.655	6.712	0.010	72.821
x_6	2.886	1.426	4.097	0.043	17.929
x_7	2.422	1.281	3.575	0.059	11.263
x_8	0.463	1.069	0.188	0.665	1.589
x_9	3.190	1.421	5.039	0.025	24.294
x_{10}	0.474	1.304	0.132	0.716	1.606
x_{11}	2.610	1.189	4.820	0.028	13.596
x_{12}	3.655	1.473	6.158	0.013	38.666
x_{13}	1.975	1.266	2.433	0.119	7.205
Constant	-17.568	5.076	11.980	0.001	0.000

The influence of teaching attitude upon satisfaction towards teaching

It is shown that thoughtfulness in course preparing and proficiency in teaching both improve satisfaction towards teaching. The odds ratios reach 8.4 and 15.9 respectively, showing that it is crucial for teachers to be well prepared and deliver proficient teaching in class to improve satisfaction of their students. Preparation is the premise of teaching. Teachers finish this process before class, but their preparation directly affects the outcome of their teaching. Teachers need to follow the syllabus and refer to the characteristics of the subject to prepare and organize

their course contents, e.g. to analyze and select useful contents from textbooks. Meanwhile, teachers need to be familiar with their students' cognitive pattern, way of thinking and ability to study, so as to choose the most effective way of expression to guarantee students' learning efficiency. Proficiency in teaching is the representation of a teacher's attitude towards teaching, which helps the students to concentrate and improve learning efficiency.

The influence of course contents upon satisfaction towards teaching

The accuracy of teaching contents, linking theory with practice and keeping new information up to date, all affect students' satisfaction towards teaching significantly. In class, it is very important for the teacher to grasp the content of the course. The contents of course are the materials and information dynamically generated from the interaction between teacher and students, serving the purpose of promoting learning. The contents of course closely follow the textbook, based on which new materials should be supplemented. Linking theory with practice is the most effective way of improving students' satisfaction towards teaching, with an odds ratio as high as 72.82, which means that the students are eager to apply the theoretical knowledge on real life practice. This poses a higher demand on teachers to improve their practical skills, which requires universities to start collaboration with enterprises or hold training sessions. In class, teachers should concentrate on the key points of the course and dedicate more time and efforts to make sure that all students comprehend the content in depths. Besides, as some materials in textbook are out of date, teachers should add a lot more new information into their teaching, especial new materials, advanced techniques or the latest methods applied in the process of production.

The influence of teaching management upon satisfaction towards teaching

Among two factors in teaching management, organization of course more greatly affects students' learning, with an odds ratio of 11.26. Organization of course determines the status and pattern of interaction between teacher and students in class. By establishing a harmonious yet orderly teaching and learning atmosphere in class, teachers can greatly improve the effect of their teaching. The Sig. value of time allotment reaches as low as 0.665. Therefore time allotment is not necessarily relate to satisfaction. The reason is that the pace or the progress of teaching is under the control of the teachers, and the students have no way of knowing in advance.

The influence of teaching method upon satisfaction towards teaching

Thought inspiring and flexibility in teaching are qualities that greatly help teachers to improve their students' satisfaction towards teaching, with odds ratios of 24.29 and 13.6 respectively. In fact, flexibility in teaching is closely related to though inspiring. Teachers should guide their students to take the initiative in learning and to obtain an effective way of learning, in accordance to the objective laws of learning. Students prefer teachers who are able to use different approaches in teaching, because these teachers can properly handle the relation between teaching and learning.

The Sig. value between language expression is 0.716, thus these two are considered irrelevant. It is because one of the fundamental requirements for a teacher is to pass the National Proficiency Test of Putonghua and reach the excellence level. The normative commitment requires teachers to conduct their teaching in Mandarin. In reality, most teachers teach in Mandarin, and only a few mingle Mandarin with local dialects. But as long as the students understand, it does not affect satisfaction.

The influence of experimental teaching upon satisfaction towards teaching

Experiments are critical in Organic Chemistry course, and experimental teaching fully embodies teacher's skill in action oriented methodology. The students would use certain equipments and materials to create some changes in the experimental subjects by controlling the experimental conditions. The students will attain new knowledge or confirm learnt knowledge by observing the results of experiment. Experimental teaching is of utmost importance for Organic Chemistry course, as it helps students to develop skills from practice. The teacher's accuracy in demonstrating an experiment is very important to foster a good habit of conducting researches in students. What students are concerned is whether their teacher is able to discover and correct their mistakes in experimental procedures.

CONCLUSION

With the help of Binary Logistic regression analysis, this paper discusses the connections between the students' satisfaction towards Organic Chemistry course and the teacher's teaching attitude, the contents of course, teaching management, teaching method and experimental teaching, thus providing guidelines for improve Organic Chemistry teaching.

The factors affecting students' satisfaction towards Organic Chemistry teaching, in descending order of significance, are: linking theory with practice, experiment demonstration, inspiration in teaching, the accuracy of

teaching contents, Keeping new information up to date, Giving prominence to the key points, the proficiency in teaching, flexibility of teaching method, organization of course, prepare lessons, experiment instructions. With these factors improved, an increase in the satisfaction of students is expected.

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