Effect Evaluation of Organic Chemistry Teaching Based on Box-Behnken Model

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Abstract. Online and offline hybrid teaching is an important teaching means in the current reform of organic chemistry, and the comprehensive evaluation of the effect of information teaching is the basis of scientific and condensed curriculum reform results. On the basis of the single factor experiment, this paper adopted the response surface optimization method to investigate the proportion of information teaching, value of domestic demand of learning and value of influence of learning environment, the influence of those factors on the academic level of organic chemistry. The results showed that the conditions to achieve the best academic level of organic chemistry were: the proportion of information teaching for 0.5, value of domestic demand of learning 73, and value of influence of learning environment 52. Under the optimal conditions, the average academic of organic chemistry was 82.211.

Keywords: Organic chemistry · teaching effect · response surface method · information teaching

1 Introduction

Organic chemistry is an important professional basic course of pharmacy major and a key link in the training of pharmacy talents [7]. Under the reality of the rapid development of the education information age [3], to improve the quality of pharmacy personnel training, how to enter the blue ocean in the reform of the first-line curriculum is the primary topic [6]. In order to strengthen the innovation of course concept [4], course content and teaching method, and give full play to the demonstration and leading role of organic chemistry course, an organic chemistry gold course with high-level, innovative and challenging was strove to be created [1, 5].

Factors affecting the academic performance of organic chemistry included course teaching methods, learning motivation, and external influences such as class study style and social environment [9]. This paper intended to investigate the various factors of organic chemistry academic performance, the response surface model optimization, with organic chemistry academic performance as the response value, the online combination of information teaching methods, learning domestic demand and learning environment affect the academic performance of organic chemistry, and got the best information teaching mode of organic chemistry [2, 8].

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2 Experimental Sample Selection

In order to test the teaching effect of organic chemistry, a total of 500 pharmacy students in the same grade were selected. 500 students were investigated in the form of questionnaire, and the sample of organic chemistry, the proportion of information teaching, value of domestic demand of learning and value of influence of learning environment were obtained.

3 Analysis of the Factors Affecting the Academic of Organic Chemistry

3.1 Influence of the Proportion of Information Teaching on the Academic of Organic Chemistry

Statistics take the sample of different proportion of information teaching to calculate the corresponding average academic performance of organic chemistry. The proportion of information teaching was online teaching time accounting for the total teaching time, with 0.1, 0.3, 0.5, 0.7 and 0.9 respectively according to the actual situation. Samples with value of domestic demand 70 and value of influence of learning environment 50 were fixed, and the results were shown in Fig. 1.

As shown in the figure, with the gradual increase of the proportion of information teaching, the academic performance of organic chemistry showed an increasing trend, indicating that the use of information teaching means had a positive impact on the academic performance of organic chemistry.

However, when the proportion of information teaching means accounts for more than 0.5, the academic performance of organic chemistry showed a decreasing trend, which may be that the information teaching time was too long, the offline positive communication time between teachers and students was relatively reduced, and students' stronger independent learning ability was required. Therefore, the proportion of information teaching as 0.5 was the best value.

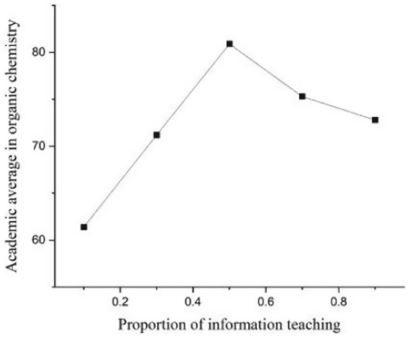


Fig. 1. Influence of proportion of information teaching on academic of organic chemistry

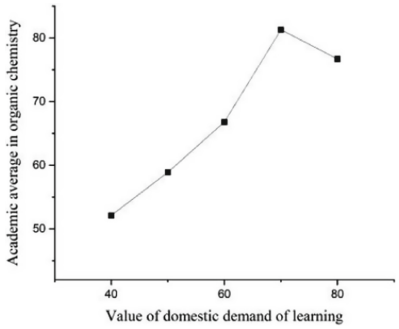


Fig. 2. Influence of value of domestic demand of learning on academic of organic chemistry

3.2 Influence of Value of Domestic Demand of Learning on the Academic of Organic Chemistry

The samples of different value of domestic demand of learning were counted, and the corresponding average academic performance of organic chemistry was calculated. According to the statistics, the learning domestic demand values were 40, 50, 60, 70 and 80 respectively. The sample where the proportion of information teaching 0.5 and the value of influence of learning environment 50 were fixed, and the results were shown in Fig. 2.

As shown in the figure, with the gradual increase of domestic demand, the academic performance of organic chemistry showed an upward trend, indicating that students' learning needs and expectations were positively correlated with the academic performance of organic chemistry. However, when the learning domestic demand was too large, the academic performance of organic chemistry showed a downward trend, which may be due to the large learning domestic demand and students' high expectations for their study, which produces great learning pressure and psychological pressure, which was not conducive to improving their academic performance. Therefore, chosen the learning domestic demand value of 70 was the best value.

3.3 Influence of Value of Influence of Learning Environment on the Academic of Organic Chemistry

The average value of the academic performance of organic chemistry was calculated. According to the statistics, the influence values of value of influence of learning environment are 40, 50, 60, 70 and 80 respectively. Fixed selected samples with proportion of information teaching of 0.5 and value of domestic demand of learning of 70, and the results were shown in Fig. 3.

As shown in the figure, with the gradual increase of value of influence of learning environment, the academic performance of organic chemistry showed an upward trend, indicating that the external environment of study including class study style and family-social influence on the academic performance of organic chemistry was positively correlated. When value of influence of learning environment reached 50, the academic performance of organic chemistry was the best, and the academic performance after

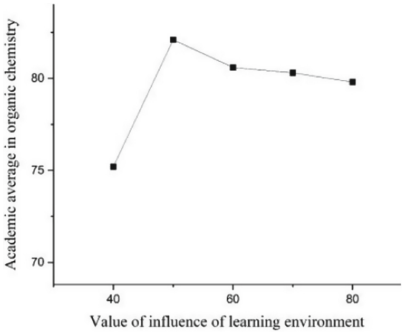


Fig. 3. Influence of value of influence of learning environment on academic of organic chemistry

exceeding the 50 was slightly reduced and became stably. Therefore, value of influence of learning environment 50 was chosen as the best value.

4 Response Analysis of Factors Affecting Academic Achievement in Organic Chemistry

According to the single-factor experimental results, with organic chemistry academic performance as the response value, chosen value of influence of learning environment(A),value of domestic demand of learning (B) and proportion of information teaching (C) as the independent variable, according to the Box-Behnken center combination principle, using Design-Expert 12.0 software design, response surface experimental factors and level in Table 1, response surface experiment design and results in Table 2, ANOVA analysis in Table 3.

Applying Design-Expert 12.0 software to fit the Table 2 to a multiple regression analysis, the regression equation was obtained.

$$\begin{aligned} Y &= 82.00 + 2.35 + 3.89B - 2.31C + 3.17AB \\ &+ 2.88AC - 2.35BC - 7.60A^2 - 7.93B^2 - 14.32C^2 \end{aligned} \tag{1}$$

From Table 3, the factor contribution of the three independent variables to the dependent variable was B > A > C, and the model F value was 1348.45 and P < 0.0001, indicating the significant correlation between the dependent variables and the independent variables. $R^2 = 0.9994$, with a signal-to-noise ratio of 26.746, much greater than 4, knowing that the model is very reliable. The misfit term P was 0.0638, greater than 0.05, indicating a nonsignificant misfit and a high degree of model fit.

Table 1. Response surface experimental factors and levels

Factor	Level		
	−1	0	1
A-value of influence of learning environment	40	50	60
B-value of domestic demand of learning	60	70	80
C-proportion of information teaching	0.3	0.5	0.7

Table 2. Response surface experiment design and results

Test Number	Value of influence of learning environment	Value of domestic demand of learning	Proportion of information teaching	Average academic of organic chemistry
1	−1	−1	0	63.2
2	1	−1	0	62.1
3	−1	1	0	64.5
4	1	1	0	76.1
5	−1	0	−1	58.4
6	1	0	−1	56.8
7	−1	0	1	57.6
8	1	0	1	67.5
9	0	−1	−1	51.3
10	0	1	−1	63.9
11	0	−1	1	60.3
12	0	1	1	63.5
13	0	0	0	82.1
14	0	0	0	81.6
15	0	0	0	82.1
16	0	0	0	82.1
17	0	0	0	82.1

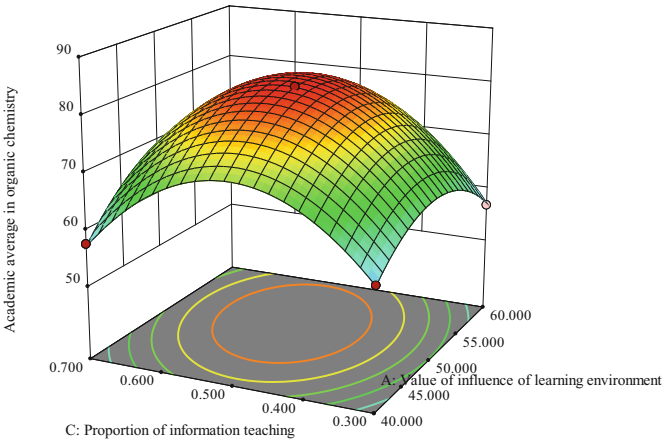
Table 3. Analysis of ANOVA

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	1816.07	9	201.79	1348.45	<0.0001	significant
A	44.18	1	44.18	295.24	<0.0001	
B	120.9	1	120.9	807.93	<0.0001	
C	42.78	1	42.78	285.89	<0.0001	
AB	40.32	1	40.32	269.46	<0.0001	
AC	33.06	1	33.06	220.94	<0.0001	
BC	22.09	1	22.09	147.62	<0.0001	
A^2	243.2	1	243.2	1625.2	<0.0001	
B^2	264.44	1	264.44	1767.17	<0.0001	
C^2	864.02	1	864.02	5773.91	<0.0001	
Residual	1.05	7	0.1496			
Lack of Fit	0.8475	3	0.2825	5.65	0.0638	not significant
Pure Error	0.2	4	0.05			
Cor Total	1817.12	16				

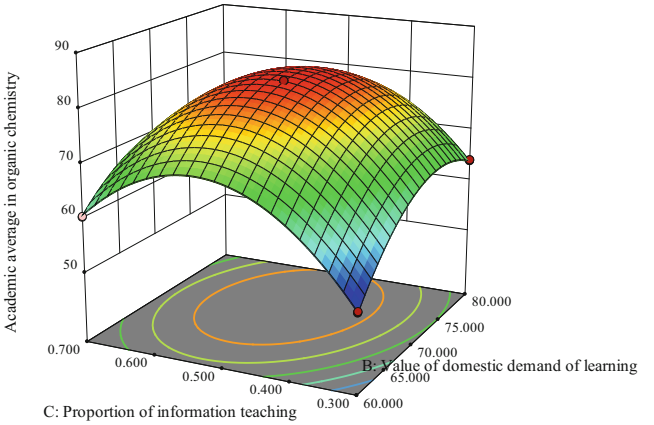
The results show that the proposed model can predict the academic level of organic chemistry quite well. In the first item of the model, A, B and C had significant effects on the academic level of organic chemistry. In the quadratic term of the model, A^2, B^2 and C^2 also affected the academic level of organic chemistry, indicating the non-simple linear relationship between the three independent variables. In the interaction terms, AB, BC and AC were very significantly different, indicating that there is a large mutual influence between the three independent variables.

After the analysis of the regression model equation, it was obtained that the best process for average academic of organic chemistry by value of influence of learning environment was 52.289, value of domestic demand of learning was 72.795, proportion of information teaching was 0.516, and average academic of organic chemistry under this condition could reach 82.904.

Considering the operability, the best condition was adjusted to that, value of influence of learning environment was 52, value of domestic demand of learning was 73, proportion of information teaching was 0.5, average academic of organic chemistry under this condition was 82.211 (Fig. 4).



(a)



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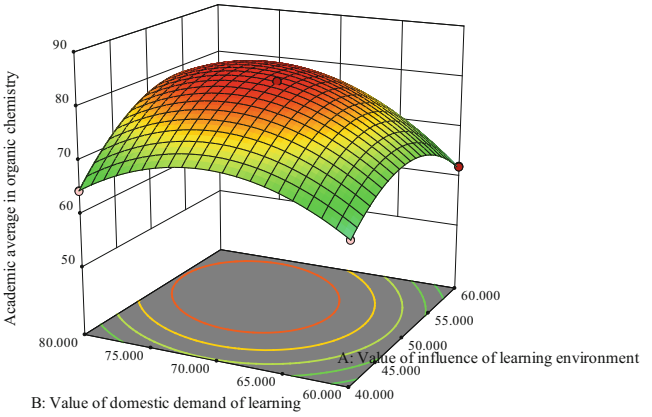

(c)

Fig. 4. Response surface diagrams

5 Research Conclusions

From the analysis results of the response surface model, value of influence of learning environment, value of domestic demand of learning and proportion of information teaching all had a significant influence on the academic performance of organic chemistry. Organic chemistry course adopted mixed online and offline teaching mode, which had significant advantages over traditional offline teaching in students' academic level. In offline classroom teaching, teachers mainly focused on key and difficult contents, and many teaching contents required students to use information teaching resources to learn in advance. Online autonomous learning needed more guidance, supervision and urging, and teachers could master the students' learning situation through the real-time data of online learning. Students' reasonable domestic demand for their own studies, a good class style of study, a harmonious family and social environment, would provide a good driving force for the study of organic chemistry, and laid a solid foundation for the subsequent study of professional courses.

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