# ANOVA Model for the Effectiveness of Blended Teaching Model

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Abstract: Based on information technology and guided by innovative teaching concepts, the blended teaching mode combines online network learning and offline classroom learning, making students the main body of teaching. Is this king of teaching model effective? This paper proposes an ANOVA model for analyzing the effectiveness of the blended teaching model, introduces the formulae and methods for parameter estimation and hypothesis testing, and presents a linear model for evaluating the effectiveness of blended learning. The conclusion that blended teaching mode has a significant effect on test scores was drawn.

## 1 INTRODUCTION

In the age of information technology, the change of teaching paradigm is unstoppable. In order to achieve deeper reform in education, we need to deeply integrate information technology with education. The main direction of development is the implementation of blended teaching, which is an organic combination of "online independent learning" and "face-to-face teacher teaching" (He 2014)

Taking Comprehensive English course as an example, this paper conducts an ANOVA on blended teaching to test the significance of its effect on English performance and to provide theoretical support for the wide application of the blended teaching model.

## 2 BLENDED TEACHING MODEL

The blended teaching mode supported by information technology breaks the one-way integration of traditional information technology and classroom teaching, and builds a smart teaching platform against the background of information technology, so as to achieve precise guidance for teaching, including clear sorting of teaching objectives and overall design of teaching process, with the core goal of cultivating students' independent learning ability and higher-order thinking(Mathur, R. & Oliver, L. 2007). It integrates online and offline teaching methods, actively integrates "cooperation" and "discussion" teaching design, realizes teaching and learning as one, learning and doing as one, and uses real-time monitoring and multi-dimensional evaluation to maximize the formation of a clear understanding of blended learning. (Bloom 1978)

As can be seen from Table 1, the mastery of knowledge in the blended teaching mode supported by information technology is mainly completed before and during class. Before class, through independent learning, learners understand and criticize the acquired information, integrate it with existing knowledge, and construct the knowledge system independently; during class, through classroom teaching activities, the knowledge learned before class is transferred and applied, and the construction of the knowledge system is improved from classroom activities. (Macdonald 2006) Capacity development is reflected in the whole blended learning process, and learners use resources to study independently before class, which helps to develop independent learning ability. During the class, collaborative inquiry activities, online discussions and post-class question and answer sessions help to improve communication and collaboration skills. Learning is a process from problem identification to problem solving (Merrill M D, 2002), and the "learner-centered" teaching model is conducive to the development of problem solving skills. The entire blended learning process is focused on the emotional experience of the learners, trying to give full play to their motivation and create a positive learn-



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ing environment. (Macdonald, C 1991) Evaluation feedback is used throughout the whole blended learning process, combining process evaluation and summative evaluation, integrating intra-group, inter-group and teacher evaluation, and multi-faceted evaluation methods (Lipponen, L. 2002).

In order to compare the teaching effects of blended teaching mode and traditional classroom teaching, the author selected two administrative classes of the second year of computer science majors in a university in eastern Guangdong for the teaching experiment. The experimental group was Class 1 of Grade 20 with 41 students, and the control group was Class 2 of Grade 20 with 43 students. 84 students did not differ much in their overall level and ability. The control group adopted the traditional classroom teaching method, while the experimental group adopted the blended learning mode supported by information technology, dividing the teaching process into three parts: before, during and after the class. (Hofmann 2001)

Table 1 Blended teaching mode

| | | | |
|---|---|---|---|
| **Teaching Preparation** | **Analysis of the learning situation** | | |
| | **Network Resource Selection** | | |
| | **Instructional Design** | | |
| **Teaching Design** | **Before Class** | **Self-directed Learning** | **Web-based learning resources** |
| | | **Group assignment** | **Group study and discussion** |
| | **During Class** | **Pre-learning feedback** | **Review key points and answer questions** |
| | | **Share and exchange** | **Personalized analysis of key points** |
| | | **Presentation of results** | **Communication, discussion and inter-group evaluation** |
| | | **Class Summary** | **Wrap-up Reflection** |
| | **After Class** | **Assignment** | **Reinforcement of learning content** |
| | | **Discussion** | **Online Question and Answer** |
| **Teaching evaluation** | **Formative evaluation** + | | **Summative evaluation** |
| | Online self-directed learning performance | | Unit Test |
| | Teamwork | | Results Show |
| | Classroom Discussion | | Assignment grades |

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# 3 ANALYSIS OF VARIANCE MODEL

For some products in production life, there are many factors that affect their evaluation index. To know which factors have an impact on the product, we need to conduct tests and analyze them according to the test results to find out the factors that have a significant effect is called ANOVA.

## 3.1 Example

Let the English scores of the students of the m classes participating in the experiment be *x* and the general examination scores of the first semester final examination be *y*. Where *Xij* denotes the English scores of the *j*th student in class *i* and *Yij* denotes the general examination scores of the *j*th student in class *i* in the first semester final examination, *(i=1,2,---, m; j=1,2,---n)*. The effectiveness of the blended teaching model is evaluated for m teaching classes.

## 3.2 Analysis of Variance Model

*Xij* is closely related to *Yij*, and there are two factors here, one is the teacher, which is a qualitative factor and is called the variance variable. The second is *Xij*, which is a quantitative variable called covariate.

$$y_{ij} = \mu + \alpha_i + \gamma x_{ij} + \varepsilon_{ij}, (i=1,2,\ldots, m; j=1,2,\ldots, n_i)$$

where α is the effectiveness of class i and satisfies ∑_(i=1)^m▒〖αi=0〗, εij is the random error, and γ is the regression coefficient.

### 3.3 Parameter Estimation of the Model

The least squares estimation (LSE) of the unknown parameters in (1) is $\hat{\mu} = \bar{\gamma}$, $\alpha_i = \bar{\gamma}_i - \bar{\gamma}, \hat{\gamma} = \frac{S_{yxW}}{S_{xxW}}$

### 3.4 Hypothesis Testing of the Model

Now let's test whether there is a significant difference in teaching effectiveness α_i among m teaching classes in model (1), and only when there is a significant difference in teaching effectiveness among m teaching classes, the evaluation of teaching effectiveness is carried out. The hypothesis test of model (1) is noted as.:

Test the statistic of H_0:α_i=0,(i=1,2,...,m)

$F = \frac{R_A/(m-1)}{R_W/(n-m-1)} \sim F(m-1, n-m-1)$,

For the convenience of calculation, the data are presented in the form of Table 2 for data analysis

Table 2 Test table for the analysis of covariance model

| Source of variance | Modified Sum of Squares | Correction of degrees of freedom | Mean Square | F ratio | Threshold | Significance |
|---|---|---|---|---|---|---|
| between classes | $R_A = R_r - R_W$ | $m-1$ | $V_A = \frac{R_A}{m-1}$ | $F_A = \frac{V_A}{V_W}$ | $F_\alpha = (m-1, n-m-1)$ | |
| In Class | $R_W = S_{yyw} - \frac{S^2_{xyw}}{S_{txw}}$ | $n-m-1$ | $V_w = \frac{R_w}{n-m-1}$ | | | |
| Total | $R_T = S_{yyT} - \frac{S^2_{xyT}}{S_{txT}}$ | $n-2$ | | | | |

Of which $n = \sum_{i=1}^{m} n_i$, $\bar{x}_i = \frac{1}{n_i}\sum_{j=1}^{n_i} x_{ij}$, $\bar{y}_i = \frac{1}{n_i}\sum_{j=1}^{n_i} y_{ij}$, $\bar{x} = \frac{1}{n}\sum_{i=1}^{m}\sum_{j=1}^{n_i} x_{ij}$,

$\bar{y} = \frac{1}{n}\sum_{i=1}^{m}\sum_{j=1}^{n_i} y_{ij}$, $S_{xxi} = \sum_{j=1}^{n_i}(x_{ij} - \bar{x}_i)^2$, $S_{yyi} = \sum_{j=1}^{n_i}(y_{ij} - \bar{y}_i)^2$,

$S_{xyi} = \sum_{j=1}^{n_i}(x_{ij} - \bar{x}_i)(y_{ij} - \bar{y}_i)$, $S_{xxT} = \sum_{i=1}^{m}\sum_{j=1}^{n_i}(x_{ij} - \bar{x})^2$,

$S_{yyT} = \sum_{i=1}^{m}\sum_{j=1}^{n_i}(y_{ij} - \bar{y})^2$, $S_{xyT} = \sum_{i=1}^{m}\sum_{j=1}^{n_i}(x_{ij} - \bar{x}_i)(y_{ij} - \bar{y}_i)$,

$S_{xxw} = \sum_{i=1}^{m} S_{xxi}$, $S_{yyw} = \sum_{i=1}^{m} S_{yyi}$, $S_{xyw} = \sum_{i=1}^{m} S_{xyi}$,

### 3.5 Linear Model for Effectiveness of Blended Instruction

When there is a significant difference in α_i, the linear model for evaluating teaching effectiveness is constructed using the regression parameter γ in model (1), and because there is an effect of the covariate x_ij, the covariates need to be taken at the same level at the same time, that is, the mean of the English Advanced Placement scores of each class $(y_i)^-$ minus $\gamma\hat{} = (x_i)^- - x^-$, that is, the estimated value of the regression coefficient γ in (2) to remove. The linear model (Yang Wenli 1998) of the effectiveness of blended instruction after ranking the mean scores after the effect of achievement x is

$\overline{x_i'} = \bar{y}_i - \hat{\gamma}(\bar{x}_i - \bar{x})$, $(\hat{\gamma} = \frac{S_{xyw}}{S_{xxw}}, i = 1, \ldots, m)$

## 4 CONCLUSION

The constructivist view of knowledge suggests that effective teaching and learning emphasizes the timeliness and output effectiveness of instruction. Teachers use both theoretical foundations to bring intelligent technology into teaching and learning, achieving a higher level of integration between information technology and classroom teaching (Oliver, M., & Trigwell, K.2005).

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Of course, there is still much room for improvement in the blended learning model, and teachers should gradually explore teaching strategies that are appropriate to it, and students should also enhance their sense of autonomy and collaboration.

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