Effects of a New Media Data Interaction System on Teaching Efficiency in Vocational Education

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Abstract—The new media data interaction system has profound influences on the teaching efficiency of vocational education. Therefore, its effects on the teaching efficiency of vocational education were analyzed in this study. The analysis was carried out from the perspective of the satisfaction of students with the application of the new media data interaction system in their vocational education and teaching practices. According to scale statistics and the multi-grade fuzzy satisfaction calculation model, results reveal that students are relatively satisfied with the services provided by the new media data interaction system and its effects on teaching efficiency, thereby indicating that such teaching mode can lead to good teaching efficiency. These students also have relatively positive attitudes toward teaching activities based on the new media data interaction system, and this teaching mode can improve their academic performance in vocational education, hence achieving good teaching efficiency. Students of classes that use the new media data interaction system also report higher learning efficiency compared with those students in classes that do not use this system.

Keywords—new media data, interaction system, vocational education teaching, satisfaction, learning efficiency

1 Introduction

With the progress in multimedia digital and *computer* technologies, the design and operation of a new media data interaction system have become increasingly mature. This system has become an important auxiliary tool in the teaching of all subjects in universities. Ideological education courses in universities are important subjects for developing the ideology of university students. Using the new media data interaction system to teach university students who are taking ideological education courses faces both opportunities and challenges [1]. The continuous emergence of these technologies enriches the teaching methods for vocational education in universities. Therefore, universities have to design appropriate countermeasures and understand the influence of new media data interaction on the ideology of university students [2]. Many researchers have investigated changes in the teaching of vocational education in universities. For instance, Hornecker et al. integrated new media technology and ideological education

teaching and obtained promising results. However, they only investigated integration in ideology and ignored the practical application effects of multimedia [3]. While Gong et al. attempted to innovate ideological education courses through new media, this method has strong theoretical properties, and very few studies have examined its practical application effects [4].

This study aims to investigate the influences of the new media data interaction system on the teaching efficiency of ideological education classes in universities. Through a statistical survey and practical comparative analysis of teaching efficiency, the effects of the new media data interaction system on ideological education teaching are explored.

2 Theoretical background and hypothesis development

The new media data interaction system was first used in teaching middle school students. At that time, China proposed the policy of "alleviating the burden" of students to cope with their excessive academic burdens. Middle schools not only have to improve the academic performance of students but should also avoid taking up much of their spare time. To this end, they used the new media data interaction system in their teaching activities, such as turnover classes and massive online open course teaching, and achieved outstanding results. Recently, an increasing number of universities applied the new media data interaction system in designing various teaching contents to maintain classroom teaching efficiency and realize modernized teaching and achieved a relatively good teaching efficiency [5]. Compared with the traditional teaching mode, the use of the new media data interaction system offers more advantages. For instance, teachers can interact with their students through the multimedia content in the system, whereas students can operate and learn classroom knowledge directly through the system. This teaching mode greatly promotes convenience in teaching and enriches the teaching methods adopted by learning institutions. Many scholars have therefore investigated the integration of the new media data interaction system into teaching activities and found that using this system can promote the learning interest and enthusiasm of students, hence improving their learning performance [6]. Some researchers show that using this system can improve the teaching efficiency of teachers to some extent and positively contribute to improving their classroom teaching level [7].

The new media data interaction system can present highly diversified multimedia data and enrich teaching contents to make them three-dimensional, hence improving the absorption of relevant knowledge by students. Using the new media data interaction system too much may reduce the attentiveness of students. However, using conventional teaching can help students deepen their understanding of various knowledge points and enhance their activeness in classes. On the basis of the above theories and analyses, some hypotheses are proposed in the present study.

- Hypothesis 1: vocational education teaching efficiency can be improved by integrating the new media data interaction system.
- Hypothesis 2: vocational education teaching can be improved by using the traditional teaching mode.
- Hypothesis 3: To acquire more knowledge, students may achieve a better effect by using the new media data interaction system, which can stimulate the multiple senses of students, improve their retention of relevant knowledge, and accelerate their knowledge comprehension.

3 Methodology

3.1 Teaching satisfaction analysis

The new media data interaction system was applied in teaching vocational education, and its effects on teaching efficiency were verified from the perspective of teaching satisfaction. The differences between practical and expected teaching efficiencies in the university context were then measured to understand the satisfaction of students with the teaching efficiency of vocational education. A lower difference between practical and expected teaching efficiencies corresponds to higher satisfaction of students [8]. Some research contents regarding the satisfaction of students with the teaching efficiency of vocational education after the adoption of the new media data interaction system are introduced as follows:

Compilation of scales. Following the related literature, this study reviewed various research opinions, analyzed the teaching characteristics of vocational education, and designed a scale for measuring the satisfaction of students with the teaching of vocational education based on the new media data interaction system. In the design process, the scale was modified several times by consulting relevant experts in the system and vocational education. A teaching satisfaction measurement scale comprising 35 questions and 7 dimensions of new media data interaction system was eventually designed. These seven dimensions include technological conditions, teaching level, teaching resource, interaction conditions, teaching efficiency, online-offline cooperation, and teaching design.

Research objects. The implementation of the scale depends on the survey platform. The respondents were university students who attended vocational education that used the new media data interaction system. The survey was conducted from May 7, 2021 to May 10, 2021. During this period, a total of 2,427 valid survey responses were collected. The platform stated that the respondents are not allowed to submit unless they finished answering all questions. Therefore, all the collected responses were deemed valid. The sample comprised 1442 males (59.42%) and 985 females (40.58%). Around 37.56%, 17.28%, and 45.16% of these students attended vocational education courses that used the new media data interaction system once, twice, and at least thrice, respectively. The respondents majored in humanities and social sciences, science, and engineering.

Model construction. The following multilevel fuzzy satisfaction calculation model was built using the intuitive fuzzy technique:

$$F = (\tilde{L}, \tilde{R}, \tilde{W}, \delta, G, X) \tag{1}$$

The parameter expressions and calculation methods in the model are as follows:

1. $\tilde{L}$ represents the system set and is mainly used to describe a satisfaction calculation index, where $\forall L \in \tilde{L}$ and $L = \{l_1, l_2, \cdots l_m\}$.
2. $\tilde{R}$ refers to the fuzzy satisfaction calculation matrix set, where $\forall R \in \tilde{R}$ and $R = \begin{bmatrix} r_{i1} & r_{i2} & r_{i3} \\ r_{i1} & r_{i2} & r_{i3} \\ \vdots & \vdots & \vdots \\ r_{i1} & r_{i2} & r_{i3} \end{bmatrix}$. This matrix set describes the calculation intuitive fuzzy number of a grade fuzzy satisfaction, where r_{i1} and r_{i2} denote the degree of membership and degree of hesitation of index *i*, respectively, and r_{i3} refers to the degree of non-membership of this index, $r_{i1} \in [0,1]$.
3. $\tilde{W}$ is the weight set, where $\forall W \in \tilde{W}$ and $W = (w_1, w_2, \cdots w_m)$. W is used to calculate weights, where w_i expresses the weights of index i in the calculation process. $w_{i1} \in [0,1]$. If $\sum_{i=1}^{m} w_i$ is not equal to 1, then normalization must be applied.
4. δ is used to describe the $\tilde{R}^m * \tilde{W} \to \tilde{R}$ relation, which is the fuzzy satisfaction calculation function. $\forall (R_1, \cdots R_m, W) \in \tilde{R}^m * \tilde{W}$, $\delta(R_1, \cdots R_m, W) = R'$ represents the fuzzy satisfaction synthesis process of a grade of fuzzy satisfaction calculation matrix $R_1, \cdots, R_m$ to the upper grade of fuzzy satisfaction calculation matrix R'.
5. G represents the n fuzzy satisfaction degrees stored in the fuzzy satisfaction set $G = [g_1, g_2, \cdots, g_n]^T$ through calculations. If the intuitive fuzzy number (a_i,b_i,c_i) is the ultimate fuzzy satisfaction results of evaluation content i, then the fuzzy satisfaction of this evaluation content is $g_i = \frac{a_i}{c_i}$.
6. $X = (x_1, x_2, \cdots, x_n)$ is used to calculate the fuzzy satisfaction ordering vector of n evaluation contents. This calculation is the descending order of G.

Model test. The new media data interaction system, teachers, and students were divided into three elements. Statistics on the satisfaction of students with their vocational education that use the new media data interaction system were collected. The satisfaction of students was used as the dependent variable, various factors were used as independent variables, and teaching quality was used as the mediated variable. Satisfaction with vocational education teaching based on the new media data interaction system was

evaluated by combining the above multilevel fuzzy satisfaction calculation model with various factors. The satisfaction relation structure is shown in Figure 1.

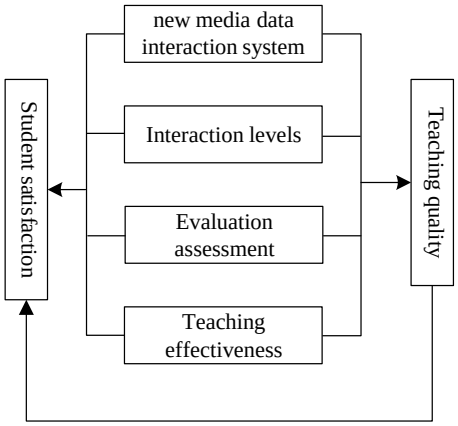

Fig. 1. Satisfaction relation structure

The model content was fitted and tested using the maximum likelihood method, and a chi-square value of 2599.719 was obtained. Meanwhile, the chi-square value was 0.098, which was far higher than the critical value of 0.05. The degree of freedom (DOF) of the model was 424, which conformed to the super-cognitive level standard. Meanwhile, the absolute fitting index of the model conformed to the standards, whereas the relative fitting index was below the critical value. Therefore, the model needs further verification.

3.2 Analysis of vocational education teaching practices

Using pre-and post-test methods based on different groups, this section analyzes the responses of students after attending the classes based on the new media data interaction system. Two university classes were invited to participate in the experimental study. Group A was a vocational education teaching that uses the new media data interaction system, whereas group B was a class that uses the ordinary teaching mode. Before the experimental study, statistics on the learning styles of students have collected to pre-test their learning adaptation. On the basis of these statistics, the academic performance and learning efficiency of each student were acquired. The attitudes of students toward the new teaching mode were understood using the statistics for Group A. The performances of students in the vocational education courses during the previous semester (before the implementation of the new teaching mode) were also investigated. The experimental period lasted for a whole semester, and the above statistical processes were carried out again after one semester. Post-test statistics on the learning achievements, learning efficacy, and changes in the attitude and psychology of the two groups to the new media data interaction system were summarized after the experiment. Table 1 presents the detailed experimental designs.

Table 1. Design of experimental stages

Test tags	Group A	Group B
Pre-test	Test of learning style	-
	Test of students' attitude toward new media data interaction system	-
	Test of learning self-efficacy	Test of learning self-efficacy
	Test of learning achievement	Test of learning achievement
Post-test	Test of students' attitude toward new media data interaction system	-
	Test of learning self-efficacy	Test of learning self-efficacy
	Test of learning achievement	Test of learning achievement

In the pre-test, statistics on the learning styles of the students were collected. The learning style scale was sent to the students, with each scale containing 12 questions and each question having 4 possible answers. Each answer had a corresponding score. The total scores for different branches corresponding to Options 1 to 4 of different learning styles reflect "concrete experience (CE)," "reflection observation (RO)," "abstract content (AC)," and "active experience (AE)." These results represent different learning stages of the learning experience modes. The differences between each pair of results reflect the scores of different style dimensions, and quadrants were formed using the numerical values across different dimensions [9,10]. The detailed division results are listed as follows:

1. If AC-CE≤7 and AE-RO≤6, then it is divided into the divergence learning style.
2. If AC-CE≤7 and AE-RO≥6, then it is divided into modulating learning style.
3. If AC-CE≥8 and AE-RO≥7, then it is divided into aggregating learning style.
4. If AC-CE≥8 and AE-RO≤6, then it is divided into assimilating learning style.

According to the statistical scores of each learning style, the learning styles of different students were obtained. Learning style is not directly related to the academic performance of students but serves as an auxiliary tool for investigating their learning conditions.

The teaching process was divided into three stages. Stage 1 lasted for a week, during which the teachers familiarized themselves with the new media data interaction system. Stage 2 was the practical teaching stage, which crossed over the entire teaching period. Stage 3 was the teaching summary stage, which took place during the last week of the semester [11].

4 Results analysis

4.1 Analysis of teaching satisfaction data

Factor analysis was performed using SPSS v.19 before the empirical analysis. Bartlett's spherical test and a sample adaptation test (Kaiser-Meyer-Olkin, KMO) were applied during the adaptation and sample sufficiency tests in factor analysis [12]. A KMO

value of no lower than 0.65 and a squared Bartlett's value of nearly 37385.915 were obtained, both of which conform to the analysis demands.

The factor number was judged according to the cumulative contributions of principal components and factor characteristic roots. During factor judgment, the interpretability of factor characteristic roots needs to be determined. The designed scale included 35 questions covering 7 dimensions. The total variance was computed via orthogonal rotation by using the maximum variance method. Results show that the first three-factor characteristic roots conform to the test requirements (>1). Only the fourth-factor characteristic root was below 1, but its cumulative variance contribution rate is increased to above 75%. Therefore, this factor was deemed interpretable. Following the factor analysis, the number of dimensions of the scale was reduced from seven to four.

The factors were named according to the information characteristics. The four major factors were named as follows:

1. New media data interaction system services, which has a high loading and is related to the technological level of the new media data interaction system, new media source, teaching content, and teaching level of teachers based on the system. New media data contents are presented to the students through the new media data interaction system. This factor intuitively reflects the satisfaction of students with their ideological education teaching classes based on the new media data interaction system and was hence named as such [12].
2. Interaction level, which mainly influences the evaluation results for the data interaction function of multimedia and the design of the interaction module in the system. This factor was named as such given its high association with the interaction factors.
3. Evaluation, which is related to satisfaction of students with their homework, scores, and exam planning after finishing ideological education classes based on the new media data interaction system. This factor was named as such given its high association with assessment [13].
4. Teaching efficiency, which covers all the other questions, is related to the satisfaction of students with the teaching efficiency of their ideological education classes based on the new media data interaction system, the online-offline teaching coordination degree, and the services of the system [14].

The reliability test aims to verify the confidence level of the survey questions based on their stability and consistency [15]. The reliability of the survey questions can be divided into internal and external reliabilities. Internal reliability checks for internal consistency among similar questions, whereas external reliability measures the consistency of the evaluation results for a certain respondent across different periods. The reliability test yields the α coefficient of the four factors and the entire questionnaire. This coefficient should exceed 0.90 to validate the good effect of the survey questions. Table 2 presents the α coefficients of all factors and the entire questionnaire.

As shown in Table 2, the α coefficients of all factors exceed 0.90, indicating their high reliability.

Table 2. Reliability test results

Factor name	Number of questions	α coefficient
New media data interaction system services	12	0.964
Interaction level	8	0.939
Evaluation	9	0.942
Teaching efficiency	6	0.967
Overall	35	0.967

The path coefficient between the satisfaction of students and teaching quality was 0.78. The interaction level usually does not have a direct influence on the satisfaction of students but can reflect the effect of satisfaction through teaching quality. The new media data interaction system services and teaching efficiency both can directly influence teaching quality. These variables have path coefficients of 0.66 and 0.63, respectively. Both teaching efficiency and new media data interaction system services are of high concern in vocational education course teaching given that they are the two primary influencing factors of teaching quality. Specifically, using the new media data interaction system directly promotes the learning enthusiasm of students and significantly influences both teaching quality and the satisfaction of students.

All factors in this study are key factors that are directly related to teaching quality. These independent variables affect the satisfaction of students through the mediated variable. The evaluation also has a great influence on teaching quality, hence suggesting that evaluation influences the satisfaction of students through teaching quality. In this case, evaluation can be used to verify the learning effect of students, and the evaluation results can reflect the acceptance of a particular teaching mode by students. Academic performance also influences the satisfaction of students with vocational education teaching based on the new media data interaction system.

Interaction level is a key factor that does not directly influence the satisfaction of students. The interaction level is mainly reflected by the usage of the new media data interaction system and the practical teaching efficiency of teachers. In this process, teachers take the dominant role, and the new media data interaction system serves as their assistant. All students participate in the class, and an online-offline coordinated interaction is realized. Such teaching mode helps students develop fair, objective, scientific, and critical learning attitudes. In vocational education courses that are based on the new media data interaction system, students can acquire new cognitions and strengthen their ideological recognitions in the new era.

4.2 Data statistical analysis

A total of 98 students in 2 groups participated in the experimental study, and 89 valid responses were collected. The learning styles of these two groups were determined based on the calculations and statistical data (Table 3).

Table 3. Statistical results for learning styles

Group Gender		A		B		Total / people
		Male	***Female***	***Male***	***Female***	
Learning styles	Diverging	12	8	11	10	41
	Modulating	3	7	3	8	21
	Aggregating	3	2	2	4	11
	Assimilating	3	9	2	2	16
Total / people		21	26	18	24	89

As shown in Table 3, diverging is the major learning style of the participating students. The respondents demonstrated consistent learning styles during the pre-test.

The attitudes of students toward vocational education teaching based on the new media data interaction system were determined based on scale statistics. In this section, the extraction factors include the contribution and motivation for the new media data interaction study, perceived effectiveness, and perceived negative effect, whereas the relevant questions are related to the applications of the new media data interaction system. The above extraction factors test the learning contribution, teaching efficiency, and negative influences of the new media data interaction system. The scale reliability was calculated by SPSS prediction data and the α coefficient exceeded 0.90, thereby the high reliability of the scale. A total of 45 and 46 valid scales were collected from the pre-and post-tests, respectively. Table 4 presents the T-test results for the pre-and post-test samples of Group A.

Table 4. T-test results for the independent samples

Factor content		Contribution and motivation of new media data interaction learning	Perceived effectiveness	Perceived negative effect
Pre-test (n=45)	Mean	3.76	3.74	2.65
	SD	0.79	0.72	0.79
Post-test (n=45)	Mean	2.48	3.53	2.62
	SD	0.85	0.77	0.88
Significance level		0.107	0.149	0.863

Table 4 shows that the first two factors have relatively high means, which suggests that students believe that using the new media data interaction system in vocational education course teaching is conducive to improving teaching efficiency. However, the perceived negative effect also obtained a high mean, thereby indicating that some technical problems may hinder the application of the system. Although these problems can be offset through the teaching activities of teachers, they can still influence teaching quality to some extent. The means of all factors in the post-test were lower than those in the pre-test. However, no significant difference was observed between the pre-and post-test results, indicating that most students accept the application effect of the new media data interaction system in vocational education course teaching.

This section checks for significant differences in the self-efficacy scores between Groups A and B in the pre-and post-tests. Data from the academic pressure and self-efficacy scales were analyzed using SPSS. A total of 42 and 43 valid scales were collected in the pre-and post-tests, respectively. Table 5 presents the T-test results for the pre-and post-test samples.

Table 5. T-test results for the pre-and post-test samples

Stages and groups		Self-efficacy	Academic pressure
Pre-test	Mean of Group A	3.31	3.69
	Variance of Group A	0.67	0.59
	Mean of Group B	3.24	3.41
	Variance of Group B	0.69	0.75
	T	0.64	2.41
	Df	85	85
	P	0.608	0.035*
Post-test	Mean of Group A	3.27	3.49
	SD of Group A	0.75	0.21
	Mean of Group B	3.05	3.36
	SD of Group B	0.78	0.21
	T	2.34	0.93
	Df	80	80
	P	0.038*	0.448

Notes: $^{*}p<0.05$.

Table 5 shows that the academic pressure felt by Group A is significantly higher than that felt by Group B in the pre-test ($p<0.05$). These pre-test results suggest that before using the new media data interaction system, Group A faced higher academic pressure than Group B, but a small difference was observed between these groups in terms of self-efficacy. In the post-test, the academic pressure faced by Group A declined significantly, whereas its self-efficacy significantly increased, thereby suggesting that the new media data interaction system significantly increases the self-efficacy and relieves the academic pressure of Group A.

For each teaching mode, different learning styles exert varying influences on the learning achievements of students in vocational education courses. A T-test was performed to check whether learning style significantly influences the learning achievements of the two groups. Table 6 presents the results.

Table 6 shows that although the students in Group A have different learning styles, their post-test learning achievements are higher than their pre-test achievements, thereby suggesting that using the new media data interaction system in vocational education course teaching positively affects learning achievements.

Table 6. Statistical results for learning achievements under different learning styles-test results for the pre-and post-test samples

Learning style	**Diverging**		**Modulating**		**Aggregating**		**Assimilating**	
Groups	Group A	Group B	Group A	Group B	Group A	Group B	Group A	Group B
Number of respond-ents	20	21	10	11	5	6	12	4
Pre-test mean	45.69	41.37	53.87	56.26	48.44	51.24	46.15	51.19
Pre-test SD	9.36	13.76	14.73	20.29	5.62	11.69	13.16	15.84
Post-test mean	58.29	49.48	57.58	51.06	57.67	55.98	57.74	46.94
Post-test SD	11.58	8.94	8.65	5.84	5.47	15.87	6.72	6.76
Adjusted mean	57.85	48.32	58.57	53.42	57.68	56.28	57.38	47.44
Adjusted SD	1.88	1.88	2.35	2.39	4.74	4.10	2.32	3.55

5 Conclusions

This study investigates the influences of the new media data interaction system on the teaching efficiency of vocational education. The new media data interaction system not only increases the satisfaction of students to vocational education teaching but also effectively improves their learning effect. The survey and comparative analysis reveal that the academic performances of students in vocational education courses are significantly improved after the use of the new media data interaction system. Moreover, those students who attend the vocational education based on the new media data interaction system demonstrate higher learning enthusiasm and self-efficacy compared with other students.

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