Teaching Behavior Profiles of Higher Vocational Teachers in Blended Environments and Their Impact on Students' Course Satisfaction: A Latent Profile Analysis

Yue Tian, Xiage Liu*, Xin Yao
Xianyang Polytechnic Institute, Xi'an, Shaanxi, China
**Corresponding Author*

Abstract: Blended learning is a concrete practice that is instrumental in the digital transformation of education. This practice is characterized by autonomy and ubiquity, and it serves as a key pathway to promoting high-quality development in vocational education. A cross-sectional analysis of teaching behaviors reveals that blended learning centers on the frequency of teacher-student interaction, categorized into general interaction, low interaction, and active interaction. Furthermore, the blended learning semester plan and the duration of online and offline learning have been demonstrated to influence course satisfaction. In order to enhance the quality of blended learning in vocational education, it is essential to make efforts to strengthen teacher-student interaction and improve student course satisfaction.

Keywords: Vocational Higher Vocational Teachers; Blended Learning; Teaching Behavior; Course Satisfaction

1. Introduction

The "Educational Power Construction Planning Outline (2024-2035)" has established the deep integration of information technology and education as an important strategic direction for educational reform in the new era. The policy has guided the implementation of blended learning, an innovative practice model in digital education reform, which has emerged as a pivotal catalyst for enhancing the quality of higher vocational education. Blended learning, by constructing a three-dimensional learning space that integrates "online" and "offline," not only breaks through the time and space limitations of traditional classroom teaching but also promotes a deep transformation of the educational paradigm from "teacher-centered" to "learner-centered." Research indicates that this pedagogical model possesses substantial flexibility characteristics, empowering students to autonomously configure their learning processes in accordance with their distinct cognitive attributes and learning progression. Concurrently, its customized attributes can efficaciously address the diverse learning requirements of students, thereby providing a pragmatic approach to actualizing the educational principle of "teaching according to individual aptitude [1]."

In the context of a comprehensive strategy aimed at enhancing the nation's educational system, the systematic implementation of blended learning methodologies is poised to exert a substantial impact on the enhancement of vocational education quality. Contemporary students, often referred to as "digital natives," have been raised in the digital age, which has endowed them with a natural aptitude for embracing digitalization, informatization, and intelligentization [2, 3]. This innate disposition provides a robust foundation for the integration of blended learning methodologies, aligning with the demands of talent cultivation in the contemporary era. By leveraging digitalization to enhance students' autonomous learning and innovative thinking abilities, it integrates online and offline teaching resources to create a multi-dimensional learning space for students. The integration of technology in the educational sector has led to the emergence of a novel pedagogical approach known as blended learning. This approach has been found to be an effective strategy for promoting innovation in the realm of vocational education, thereby enhancing the competencies of students. The initiative provides technical assistance for the development of a lifelong learning system, thereby facilitating learning that transcends conventional time and space limitations and attains both universal and customized development. However, the efficacy of blended

learning is contingent upon the appropriateness of teachers' pedagogical practices. Teachers' behaviors serve as the primary determinants of the implementation effect of blended learning, given their role as the designers, guides, and evaluators of teaching activities. In order to address these challenges, it is essential to employ a systematic approach to the design of teaching content, both online and offline, to ensure the effective utilization of digital teaching tools. Furthermore, the provision of timely feedback and the optimization of teaching strategies through data analysis are crucial for enhancing the efficacy of learning processes. The quality of these teaching behaviors has been demonstrated to directly affect students' learning experiences, knowledge construction outcomes, and ability development levels. Consequently, within the paradigm of blended learning, the optimization of teaching behaviors by educators is paramount to ensure the efficacy of instruction and to capitalize on the benefits inherent to this pedagogical approach.

2. Research Theory and Hypothesis

2.1 The Theory of Pedagogical Existence

Teaching Presence is one of the core components of the Community of Inquiry (CoI) framework. Randy Garrison, Terry Anderson, and Walter Archer proposed and developed the CoI model to describe and optimize students' educational experiences in online learning environments. The model encompasses two distinct categories: Teaching Presence and Cognitive Presence, along with Social Presence. Teaching Presence is defined as the fundamental role and responsibilities of teachers in online learning environments. These responsibilities include course design and organization, promotion of dialogue, and direct guidance.[4] Teaching Presence has been demonstrated to facilitate meaningful and valuable learning guidance for students engaged in online learning, thereby contributing to the success of such educational endeavors. In this study, Teaching Presence is defined as online course design and organization, promoting online student discourse and understanding, and guidance, including the assessment and feedback provided by course teachers to online students [5].Research has demonstrated that pedagogical presence plays a significant role in enhancing students' satisfaction with online learning, their perceived learning outcomes, sense of belonging and community, cognitive presence, and social presence [6,7].Teachers are the main body in establishing and maintaining online courses. A comprehensive analysis of teachers' pedagogical practices in a blended learning environment, coupled with an examination of the pivotal role of pedagogical presence, can furnish scientific and effective guidance for students' blended learning.

2.2 Analysis of Higher Vocational Teachers' Teaching Behaviors in Blended Learning Environments

In the research on the teaching behaviors of vocational Higher Vocational Teachers in a blended learning environment, some studies have classified teachers' teaching behaviors in blended learning through cluster analysis into the following categories: excellent, qualified, good, and registered. The classification of teaching behaviors principally emphasizes the quantification of teachers' behaviors, that is, the frequency of posting and participating in various online interactions [8]. The frequency with which teachers engage in online activities can directly impact their teaching behaviors in blended learning environments. The research analyzes the behaviors of teachers in blended learning from the perspective of teachers, thereby proving the significant value of teachers' behaviors in blended learning. However, there is a need for further research on the entire process of blended learning, especially the integration of key aspects such as instructional design and organization, teacher guidance, and learning feedback. The present study endeavors to build upon the theoretical framework of pedagogical existence, thereby offering a novel expansion of the existing research paradigm. The present study systematically analyzes the teaching behavior characteristics of vocational Higher Vocational Teachers from four dimensions: blended teaching design and organization in the blended learning environment, promoting dialogue, teacher guidance strategies, and learning feedback and evaluation. Concurrently, the present study places particular emphasis on the influence mechanism of teachers' teaching behavior characteristics on students' satisfaction with blended learning courses. This objective is twofold: first, to establish a closer connection between teacher behavior research and students' learning experience; and second, to provide a comprehensive understanding of the relationship

between teacher behavior and student satisfaction. This multi-dimensional research design has two primary advantages. First, it can comprehensively reveal the characteristics of vocational Higher Vocational Teachers' blended teaching behaviors. Second, it can provide more targeted practical suggestions for optimizing teachers' teaching behavior.

2.3 The Relationship between Blended Learning Arrangements and Student Learning Satisfaction

In accordance with the regulations of the Ministry of Education concerning blended learning courses, a range of 20% to 50% of teaching time is allocated for the implementation of online and offline blended learning methods.[9] The semester plan of blended learning will have an impact on students' learning. Consequently, this study categorizes the semester organization of blended learning into four distinct types: The frequency of the educational program is weekly, with a combination of online and offline learning approaches. The scheduling of these sessions is conducted at predetermined intervals, with the timing determined by the characteristics of the instructional content or the specific arrangements for teaching. When employed in conjunction with the practice of blended learning, the proportion of blended course teaching is divided into "2:8," "3:7," "4:6," and "5:5" configurations. The temporal organization of blended learning by educators will exert an influence on students' satisfaction with the course. A preference for fixed time frames has been observed among students enrolled in vocational education programs who favor blended learning courses [10]. The implementation of blended pedagogical methods exhibits significant variability, with teachers employing a mixture of offline and online instructional approaches. The classification system encompasses three categories. The first category is characterized by an alternating approach, wherein the pedagogy is transitioned between online and offline modalities. The second category is defined by a complementary relationship, where the modality of teaching is tailored to the characteristics of the instructional objectives. The third category, termed the "flipped classroom," involves a preview of online content prior to in-person class, complemented by problem-based learning activities in the offline setting. The implementation of blended learning approaches has been demonstrated to exert a significant influence on the level of student satisfaction experienced within the course. The integration of alternating and complementary blended learning approaches has been demonstrated to enhance students' course experience [11]. In light of these findings, the present study puts forward the following hypotheses:

(1) The implementation of blended learning in higher vocational education demonstrates a significant positive influence on students' satisfaction with course content and delivery.

(2) The balance between online and offline instructional components in blended learning within higher vocational education demonstrates a significant positive influence on students' satisfaction with the course.

(3) The blended teaching practices of instructors in higher vocational education demonstrate a positive predictive relationship with students' course satisfaction.

3. Research Design

3.1 Research Tools

3.1.1 Blended teaching behavior

This study adopted the blended teaching behavior measurement scale compiled by Ma Jing [12, 13] for the blended teaching behavior. It consists of four dimensions: teaching behavior design and organization, promoting dialogue, direct guidance, and feedback evaluation, with a total of 29 questions. The α coefficient of the scale is 0.96, indicating good reliability.

3.1.2 Satisfaction with Blended Learning

This study employed the Blended Learning Satisfaction Scale developed by Zhou Yulu [14]. The scale was designed based on the requirements of the "Two Characteristics and One Degree" for blended gold courses, namely innovation, higher-order thinking, and challenge, as well as the various stages of blended learning. The scale consists of three dimensions: satisfaction with course objectives, satisfaction with the implementation process of course teaching, and satisfaction with the course environment, with a total of 19 questions. The α coefficient of the scale is 0.95, indicating good reliability.

3.2 Research Subjects

This study employed a random sampling method, targeting students from higher vocational and technical schools within Shaanxi Province. All

students participated in blended learning courses that were national-level online courses for vocational education, with each student having taken 1–2 such courses. A questionnaire survey was conducted using the Wenjuanxing platform. A total of 906 questionnaires were collected, with invalid responses, duplicate responses, and clearly invalid questionnaires excluded, leaving 888 valid questionnaires. Among these, 431 were male students, 457 were female students, 353 were first-year students, 249 were second-year students, and 286 were third-year students.

3.3 Statistical Methods

In this study, descriptive statistical analysis, correlation analysis, analysis of variance (ANOVA), and regression analysis were performed on the data using SPSS 29. Additionally, latent profile analysis of the blended teaching behaviors of vocational Higher Vocational Teachers was carried out via MPLUS 8.3 to depict the characteristics of their teaching behaviors in the context of blended learning.

4. Research Results

4.1 Common Method Bias Testing

The data in this study were tested for common method bias using Harman's one-factor test [15]. The results showed that two factors with eigenvalues greater than 1 were obtained without rotation, and the first factor explained 28.72% of the variance (<40%). Thus, common method bias did not have a significant impact on the results of this study.

4.2 Descriptive Statistical Analysis and Correlation Analysis of Key Variables

As demonstrated in Table 1, the results of the descriptive statistical analysis indicate a negative correlation between blended learning semester plans and teacher teaching behavior and course satisfaction. Conversely, the proportion of online and offline learning and teacher teaching behavior and course satisfaction are positively correlated. The present study sought to ascertain whether there is a correlation between student grade and gender with teaching behavior and course satisfaction in a blended environment. The findings indicated that there is no such correlation.

Table 1. Correlation Analysis of Teaching Behavior Factors in a Blended Learning Environment for Higher Vocational Teachers

Relevance	1	2	3	4	5	6	7	8	9	10	11	12	13
Gender	1	0.02	0.02	0.06	0.04	0.02	0.02	0.03	0.02	0.04	0.04	0.03	0.04
Ratio of online to offline learning time	0.02	1	-0.04	-0.07*	0.15**	0.15**	0.15**	0.15**	0.16**	0.15**	0.15**	0.13**	0.14**
Blended learning semester Plan	0.02	-0.04	1	-0.01	-0.15**	-0.13**	-0.13**	-0.13**	-0.13**	-0.14**	-0.14**	-0.15**	-0.14**
Grade	0.06	-0.07*	-0.01	1	0.01	0.02	0.02	0.03	0.02	0.03	0.00	0.01	0.01
Teachers' teaching behavior	0.04	0.15**	-0.15**	0.01	1	0.88**	0.86**	0.87**	0.87**	0.97**	0.90**	0.98**	0.97**
Course satisfaction	0.02	0.15**	-0.13**	0.03	0.88**	1	0.98**	0.99**	0.96**	0.87**	0.87**	0.85**	0.86**
learning environment Satisfaction	0.02	0.15**	-0.13**	0.02	0.86**	0.98**	1	0.97**	0.94**	0.85**	0.85**	0.84**	0.84**
learning process satisfaction	0.03	0.15**	-0.13**	0.03	0.87**	0.99**	0.97**	1	0.97**	0.86**	0.86**	0.85**	0.85**
Learning objectives satisfaction	0.02	0.16**	-0.13**	0.02	0.87**	0.99**	0.95**	0.97**	1	0.86**	0.86**	0.85**	0.84**
Teaching activity design and organization	0.03	0.15**	-0.14**	0.03	0.97**	0.87**	0.85**	0.86**	0.86**	1	0.96**	0.93**	0.90**
Promoting dialogue	0.04	0.15**	-0.14**	0.01	0.99**	0.87**	0.85**	0.86**	0.86**	0.96**	1	0.97**	0.93**
Direct guidance	0.03	0.13**	-0.15**	0.01	0.98**	0.86**	0.84**	0.84**	0.84**	0.93**	0.97**	1	0.95**
Feedback evaluation	0.04	0.14**	-.138**	0.01	0.97**	0.86**	0.84**	0.85**	0.84**	0.90**	0.93**	.953**	1
* *Significantly correlated at the 0.01 level; * Significantly correlated at the 0.05 level.													

4.3 Potential Profile Analysis of Teaching Behaviors of Higher Vocational Teachers in Blended Learning Environments

4.3.1 Characteristics of Teachers' Teaching Behaviors in Blended Learning

Pursuant to extant research, the following criteria must be met: The AIC, BIC, and ABIC values should be minimized, while entropy values should approach 1. Additionally, both blrt and lmr values should reach a significant level. The model fitting indices should ensure that each group contains at least 5% of the sample size after grouping [16]. A latent profile analysis was conducted on the dimensions of the mixed-mode teacher teaching behavior scale, with 1–4 category profile models extracted for comparison. The model fitting indices are presented in Table 2.

In this study, the indices of AIC, BIC, and ABIC underwent a progressive decrease from Profile 1 to Profile 4 in the mixed-environment setting, with the model indices for Profile 3 reaching a state of stability. When these results are integrated with entropy values, an entropy value greater than 0.9 signifies a satisfactory model fit. A subsequent analysis of the model fit data indicated that the entropy values for all three

profile models exceeded 0.9. When the values of BLRT and LMR in latent profile analysis reach a significant level, it is indicative of a robust model fit. In this study, Profiles 2, 3, and 4 all demonstrated a significant level of performance. However, the category probabilities for Profile 4 demonstrated a single group with a value of 0.01, indicating a low probability. Consequently, the four-category profile analysis was excluded. In the two-category and three-category analyses, the group probabilities in the two-category analysis demonstrated significant differences. In order to mitigate the tendency toward overly simplistic categorizations of teaching behaviors within a blended learning environment, this study elected to employ the three-category profile analysis as the ultimate model. The scores of teachers' teaching behaviors in a blended learning environment across the four dimensions are shown in Table 2. The initial category accounts for 34% of the total, the secondary category for 30%, and the tertiary category for 36%.

Table 2. Analysis of the Potential Profile Model of Teaching Behaviors of Higher Vocational Teachers in a Blended Learning Environment Fitting information

	AIC	BIC	ABIC	entropy	blrt	lmr	Grouping information
1	77817.229	78085.412	77907.567				
2	74073.359	74480.422	74210.479	0.951	0.00<0.01	0.00<0.01	0.41/0.59
3	38790.617	39336.56	38974.518	0.977	0.00<0.01	0.00<0.01	0.34/0.30/0.36
4	31848.972	37433.304	36979.164	0.981	0.00<0.01	0.00<0.01	0.36/0.01/0.34/0.29

Table 3. Analysis of Variance of the Classification of Teaching Behaviors of Higher Vocational Teachers in a Blended Learning Environment across Various Dimensions

Results of analysis of variance (ANOVA)						
	CLASS (mean ± standard deviation)			F(p)	Eta-biased (Partial η2)	Post - hoc testing
	Low interaction (n=305)	Positive interaction (n=264)	Normal interaction 3.0(n=319)			
Instructional design and organization	3.34±0.58	4.89±0.35	4.10±0.41	797.698**	0.64	2.0>3.0>1.0
Promoting dialogue	3.43±0.66	4.90±0.34	4.13±0.45	595.864**	0.57	2.0>3.0>1.0
Direct guidance	3.43±0.66	4.88±0.36	4.12±0.44	579.520**	0.57	2.0>3.0>1.0
Feedback evaluation	3.40±0.65	4.87±0.39	4.09±0.44	598.532**	0.58	2.0>3.0>1.0
* p<0.05 ** p<0.01						

A one-way analysis of variance (ANOVA) was conducted with the four dimensions of teachers' instructional behaviors in blended learning environments as the dependent variables and the latent categories of teachers' instructional behaviors as the independent variables. The ensuing results are as follows: the primary effects of the latent categories were found to be significantly present across all four dimensions of teachers' instructional behaviors. Post hoc tests revealed (e.g., Table 3) that in the first category of samples, teachers' instructional behaviors were significantly below the sample mean. These teachers exhibited a propensity to employ offline-oriented blended designs in their instructional planning, exhibited a reduced frequency of instructional dialogues in the classroom, provided less direct guidance to students, and offered inadequate feedback, thus being designated as "low-interaction blended." In the second sample, teachers' instructional behaviors exhibited a significant increase compared to the other two samples. The promotion of dialogue, direct teacher guidance, and feedback occurred with high frequency in blended classrooms, thus classifying it as the "highly interactive blended" type. In the third sample, teachers' instructional behaviors demonstrated an intermediate level of proficiency across all dimensions, thus classifying it as the "moderately interactive blended" type.

4.3.2 Analysis of Variance of Student Course Satisfaction with Teacher Teaching Behavior in a Blended Environment

A variance analysis was conducted, with teachers' potential categories of teaching behavior serving as the independent variable and the various dimensions of blended learning course satisfaction—namely, satisfaction with course objectives, satisfaction with course processes, and satisfaction with course conditions—as the dependent variables. The ensuing discourse will elucidate the findings of the aforementioned analysis. In the comprehensive measurement analysis of course satisfaction, it was ascertained that active interactive blended learning attained the highest score, followed by general interactive blended learning. Conversely, low interactive blended learning design exhibited a comparatively lower overall score. A

comprehensive analysis of the multifaceted dimensions of course satisfaction revealed significant disparities in teacher teaching behaviors across three distinct domains: course objectives, course processes, and course conditions satisfaction. Among the three dimensions, course process satisfaction achieved the highest mean score, with active interactive blended learning achieving the highest score in course process satisfaction (e.g., Table 4).

Table 4. Classification of Teaching Behaviors of Higher Vocational Teachers in a Blended Learning Environment Analysis of Variance of Course Satisfaction

	CLASS (mean ± standard deviation)			F(P)	Eta-biased (Partial η2)	Post - hoc testing
	Low interaction (n=305)	Positive interaction (n=264)	Normal interaction (n=319)			
Course objectives satisfaction	20.79±3.81	29.14±2.35	24.56±2.99	502.42**	0.53	2.0>1.0;3.0>1.0;2.0>3.0
Course satisfaction	34.57±6.18	48.57±3.94	40.90±4.98	520.55**	0.54	2.0>1.0;3.0>1.0;2.0>3.0
Course environment satisfaction	10.32±1.90	14.56±1.20	12.39±1.50	514.46**	0.54	2.0>1.0;3.0>1.0;2.0>3.0
Course satisfaction	21.90±3.88	30.76±2.46	25.95±3.07	537.09**	0.55	2.0>1.0;3.0>1.0;2.0>3.0
* p<0.05 ** p<0.01						

4.4 Multiple Logistic Regression Analysis of Teaching Behavior Based on the Characteristics of Teaching Arrangements in Blended Environments

A multiple logistic regression analysis was conducted to explore the factors influencing the latent categories of teachers' instructional behaviors in a blended learning environment. The three latent categories of teachers' instructional behaviors in blended learning were utilized as the dependent variables. The independent variables employed in this study included gender (female students as the reference group), grade level (third-grade students as the reference group), blended learning semester plans, and the ratio of online to offline teaching time. A multiple logistic regression analysis was performed with "low-interaction blended learning" as the reference group. The results of the study indicated that gender was not a predictor of the categories of teachers' instructional behaviors in blended learning. The grade level, the ratio of online to offline teaching time in blended learning, and the blended learning semester plan have been shown to predict the potential categories of teachers' instructional behaviors in blended learning. Utilizing a 5:5 blended learning arrangement as the reference category for the independent variable, the coefficients for the 2:8 ratio were -1.18 and -1.01 for "active interactive blended" and "general interactive blended," respectively, with p-values both less than 0.001. This finding indicates that this ratio significantly reduced the probability of blended learning interactions becoming active interactive or general interactive. The coefficient for the 3:7 ratio on "active interactive blended" was -0.76, with a significant p-value (<0.001). However, the effect on "general interactive blended" was not significant (p=0.154). The coefficient for the 4:6 ratio on "positive interactive blended learning" is -0.82, with a significant p-value (<0.001). However, the effect on "general interactive blended learning" is not significant (p=0.820). The coefficients for alternating online and offline sessions were determined to be 0.59 and 0.65, respectively, with p-values of 0.05 and 0.019, respectively. These findings suggest that each alternating online and offline session significantly increased the probability of the blended learning classroom becoming either an active interactive or general interactive type. Second-year students indicated a higher probability of encountering the active interactive form of blended learning. (e.g., Table 5).

Table 5. Multiple Logistic Regression Analysis of the Relationship between Teaching Arrangements in Hybrid Environments and Teaching Behaviors among Higher Vocational Higher Vocational Teachers

		A cross-sectional model of teacher teaching behavior in blended learning					
		Positive interaction			Normal interaction		
		B	Standard Error(SE)	Significance	B	Standard Error(SE)	Significance
Gender	Female	0.169	0.465	0.716	0.142	0.451	0.753
Ratio of online to offline learning	1=2:8	-1.184	0.254	0.001***	-1.015	0.255	0.001**
	2=3:7	-0.821	0.235	0.001***	-0.327	0.229	0.154
	3=4:6	-0.764	0.263	0.004**	0.056	0.245	0.820
	4 = 5:5 (control)	.					

		.					
Blended Learning Semester Plan	1.Following each online learning session (i.e., when online learning and offline teaching activities alternate)	0.591	0.304	0.05*	0.645	0.276	0.019**
	2.Subsequent to or prior to the conclusion of all online courses	-0.19	0.517	0.714	-0.466	0.507	0.358
	3.Conducted at intervals of a fixed number of weeks	-0.003	0.459	0.994	-0.423	0.458	0.356
	4.Determined (control) in accordance with the characteristics of the teaching content or the teaching arrangements.	.					
Grade	A.First grade	0.456	0.507	0.369	-0.35	0.381	0.353
	B.Second grade	1.099	0.502	0.029*	0.15	0.377	0.688
	C.Third grade(control)						
Reference category: Low-interaction hybrid Dependent variable: Blended learning behavior type							

4.5 Hierarchical Regression Analysis of Students' Course Satisfaction in Blended Learning Environments

The present study sought to elucidate the impact of teachers' instructional behaviors in a blended learning environment on students' course satisfaction. To this end, hierarchical regression analysis was employed, with teachers' instructional behaviors and related control variables sequentially incorporated as independent variables to analyze changes in students' course satisfaction. The hierarchical regression analysis comprised three models. In Model 1, the independent variable was the classification of teachers' instructional behaviors, and a linear regression analysis was conducted with course satisfaction as the dependent variable. The R-squared value of the model was 0.125, indicating that it could explain 12.5% of the variation in KCMY. When conducting an F-test on the model, it was found that the model passed the F-test ($F = 126.065$, $p < 0.05$), indicating that teaching behavior characteristics have a significant impact on course satisfaction. The regression coefficient value for CLASS is 0.953, which is significant ($t=11.228$, $p=0.000<0.01$). This finding indicates that the potential classification of teachers' teaching behavior profiles has a significant positive impact on course satisfaction.

Incorporating the ratio of online to offline learning time for this course into Model 1 is the purpose of incorporating Model 2. The change in the F-value is statistically significant ($p < 0.05$), indicating that the ratio of online to offline learning time in blended learning adds explanatory power to the model. Furthermore, the R-squared value increased from 0.125 to 0.136, indicating that the ratio of online to offline learning time contributes to explaining course satisfaction. The regression coefficient for the ratio of online to offline learning time is 0.224, and it is statistically significant ($t=3.419$, $p=0.001<0.01$), indicating that the ratio of online to offline learning time has a significant positive impact on KCMY.

Incorporation of a blended learning semester plan is evident in Model 3, which aligns with the framework of Model 2. Following the incorporation of this variable, the F-value change demonstrates statistical significance ($p < 0.05$), thereby signifying that the blended learning semester plan contributes explanatory power to the model. Furthermore, the R-squared value increased from 0.136 to 0.143. The regression coefficient for the time allocation of in-person instruction is -0.135, and this coefficient is statistically significant ($t = -2.690$, $p = 0.007 < 0.01$). This finding indicates that the blended learning semester plan has a significant negative impact on course satisfaction. Consequently, as the interval between offline and online teaching increases, students' satisfaction with blended learning experiences a corresponding decrease. (e.g., Table 6.)

Table 6. Hierarchical Regression Analysis of Teaching Arrangements of Vocational Higher Vocational Teachers in Blended Environments on Teaching Behaviors

Results of Hierarchical Regression Analysis – Simplified Format			
	Layer 1	Layer 2	Layer 3
Constant	10.393** (56.096)	9.902** (42.401)	10.241** (38.692)
Class	0.953** (11.228)	0.913** (10.718)	0.883** (10.318)
The ratio of online to offline learning time		0.224** (3.419)	0.220** (3.364)
Blended Learning Semester Plan			-0.135** (-2.690)

R^2	0.125	0.136	0.143
$\triangle R^2$	0.125	0.011	0.007
△F-value	F (1,886)=126.065, p=0.000	F (1,885)=11.687, p=0.001	F (1,884)=7.234, p=0.007
Note: Dependent variable = Course satisfaction			
* p<0.05 ** p<0.01 The figures within the parentheses represent the t - values.			

5. Research Conclusions and Implications

5.1 Research Conclusions

5.1.1 Three Types of Teaching Behavior Characteristics of Teachers in Higher Vocational Colleges in Blended Learning Environments

This study employs latent profile analysis, grounded in the theory of pedagogical presence, to examine teachers' instructional behaviors in blended learning environments. The design and organization of instructional activities in blended learning show no significant differences in the profile model of instructional behaviors. However, the promotion of dialogue, direct guidance, and instructional feedback evaluation exhibited significant variations in the profile model of instructional behaviors. A profile analysis of teacher behavior in blended learning in higher vocational education reveals that blended learning classrooms in higher vocational education can be categorized into three distinct types: low-interaction blended, general-interaction blended, and active-interaction blended. The design and organization of blended learning are concrete manifestations of teaching existence, and their practical process naturally elicits teaching interaction. Such interaction includes the promotion of dialogue, direct guidance, and feedback evaluation, which essentially constitute a collection of bidirectional interactions and influences between teachers and students. Active interaction is a critical component of effective learning in the classroom setting. The value characteristics of blended learning are promoted through bidirectional interaction between teachers and students in blended discussions (online + offline). The alterations in teacher-student interaction in blended learning classrooms at higher vocational colleges are predominantly manifested in the promotion of dialogue, direct guidance, and teaching feedback evaluation. Among these, teaching feedback exhibits substantial disparities in the blended learning behavior profile model. Online teaching has the capacity to collect students' process-based learning data in a manner reminiscent of a companion, thereby enabling educators to provide targeted teaching feedback based on individual students' learning characteristics. This, in turn, has the potential to enhance students' learning experience. The optimization and improvement of teacher feedback in blended learning has been demonstrated to effectively enhance teachers' teaching behavior.

5.1.2 The Impact of Blended Learning Arrangements in Higher Vocational Education Classrooms on Student Learning Outcomes

The divergent approaches to online and offline teaching in the context of blended learning have the potential to profoundly impact teachers' behavioral patterns. The efficacy of dual-track teaching content is directly correlated with students' pedagogical presence in blended learning. A well-defined and logical teaching plan assists students in organizing their learning tasks, effectively minimizing learning time, and cultivating positive learning habits. Disconnected online and offline classroom teaching can lead to conflict between the two methods, hindering deep integration, with classroom interaction forms being relatively mechanical and difficult to integrate deeply. The study's findings indicated a preference among vocational education students for a blended learning model, characterized by alternating online and offline sessions throughout the semester. A balanced integration of online and offline sessions, with judicious scheduling of blended course teaching time, has been shown to enhance students' comprehensive understanding of teachers' instructional behaviors and foster positive learning experiences in the classroom.

5.1.3 The Blended Teaching Behaviors and Instructional Arrangements of Higher Vocational Teachers Exert an Influence on Students' Course Satisfaction.

In the context of interactive blended learning, educators are able to effectively monitor and guide students' learning processes by constructing a diverse interactive task system. Teachers collect real-time process data to provide personalized feedback to students, optimize teaching strategies based on learning data analysis results, and then conduct new teaching activities. This two-way information interaction mechanism between

"teaching" and "learning" forms an interactive blended learning model with ubiquitous characteristics. Interactive blended learning has been shown to enhance students' participation in the classroom and improve their satisfaction with the educational environment. Student satisfaction with course learning serves as the driving force for course improvement and development. A cross-sectional analysis of teachers' blended teaching behaviors and an analysis of students' satisfaction with blended course learning revealed that active, interactive blended classrooms exhibit significant differences in student course satisfaction. Furthermore, in active interactive blended classrooms, scores for all dimensions—including satisfaction with teaching objectives, teaching processes, and teaching conditions—exceed those in general blended and low-interactive blended classrooms.

A subsequent investigation into the relationship between teaching behavior characteristics in blended learning, the hierarchical allocation of blended learning arrangements, and student course satisfaction was conducted. The results of this investigation indicated that teaching behavior in blended teaching accounts for 12.4% of student course satisfaction, blended teaching behavior and course teaching duration account for 13.4% of course satisfaction, and blended teaching behavior, course teaching duration, and teaching arrangements (semester) account for 14% of course satisfaction. A comparative analysis of the three influencing factors revealed that the characteristics of teaching behaviors in blended learning exhibited the highest degree of explanatory power with respect to students' course satisfaction.

5.2 Research Implications

5.2.1 Reasonably Plan Blended Learning Arrangements to Strengthen Students' Perception of Teaching Presence.

The systematic structuring of blended learning in the context of vocational education exerts a direct influence on the efficacy of instruction. A review of extant empirical evidence reveals an urgent necessity to address the disconnection between online and offline components, as it exacerbates students' academic burden in the context of digital learning. The implementation of blended learning necessitates a comprehensive system for the design and organization of teaching content, with a reasonable allocation of online and offline teaching arrangements to ensure its effective execution. An effective blended learning model has the potential to enhance students' perception of teaching content and foster a positive experience with intelligentization learning.

5.2.2 Optimizing Blended Learning Interactions to Enhance Student Satisfaction

Higher vocational teachers must engage in scientific analysis of the interactive forms of blended learning, utilizing diverse interactive types as a point of departure to gain profound insight into the characteristics of students' blended learning experiences and to explore the interactive mechanisms of vocational education students through teaching methods and processes. In blended learning approaches, online student interactions are characterized by a certain degree of concealment, as some interactions occur on online platforms, such as forum discussions, online assignment submissions, and feedback. Interactions are not always immediately observable by all classroom members, and students may participate in interactions out of a herd mentality. Nonetheless, offline interactions are characterized by a greater degree of directness and are typically facilitated through verbal communication. Teachers must develop new interaction models through blended learning approaches to facilitate students' transition from passive learning in the classroom to active, constructive engagement. It is incumbent upon teachers to meticulously monitor the efficacy of blended interactions across multiple channels, introduce multi-modal indicators, and systematically analyze classroom interactions from a physiological perspective. This comprehensive approach enables the identification of learning issues and the implementation of personalized learning interventions, thereby ensuring the optimal learning environment. It is imperative that educators establish diverse and rich interaction models to empower students with agency in blended classroom interactions. In doing so, educators can ensure depth in classroom interactions and promote the comprehensive development of students' knowledge and skills.

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