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Factors influencing teachers' intention to use POA in college English teaching based on the theory of planned behavior

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Abstract: This study examines teachers' POA implementation intentions through the Theory of Planned Behavior framework. Panel data analysis reveals significant impacts of teachers' attitudes, subjective norms, and perceived behavioral control on implementation intentions, with the latter showing strongest influence (β=0.456). Professional development mediates these effects, while institutional environment and policy support demonstrate significant moderation. Educational resource investment exhibits threshold effects at 4.234 and 6.567. Dynamic analysis uncovers temporal patterns, with attitude effects persisting through multiple periods. These findings provide empirical evidence for advancing POA teaching reform practices.

1. Introduction

The Production-Oriented Approach (POA) represents a significant innovation in college English teaching methodology, demonstrating remarkable effectiveness in improving learning outcomes. However, its widespread adoption faces substantial challenges, with teachers' implementation intentions emerging as a critical determinant of successful integration. While existing research has extensively explored POA's pedagogical effectiveness and classroom applications, limited attention has been paid to understanding the psychological and institutional factors driving teachers' adoption decisions. This study addresses this gap by employing the Theory of Planned Behavior framework to analyze the complex mechanisms influencing teachers' POA implementation intentions. Through comprehensive panel data analysis incorporating mediating, moderating, and threshold effects, we aim to uncover the multidimensional characteristics of implementation intention formation. This investigation not only advances theoretical understanding of teaching reform adoption processes but also provides practical insights for educational institutions seeking to promote innovative teaching methodologies. By examining the interplay between individual attitudes, institutional environments, and resource conditions, this research offers valuable guidance for policy formulation and implementation strategies in higher education reform.

2. Theoretical Foundation and Mechanism Analysis

The Theory of Planned Behavior provides a scientific theoretical foundation for analyzing teachers' teaching behavior intentions, elucidating the influence mechanisms of three core elements - attitude, subjective norms, and perceived behavioral control - on behavioral intentions. Attitude reflects teachers' cognitive evaluation and emotional tendencies toward the Production-Oriented Approach (POA); subjective norms embody the influence of institutional environment and peer pressure on teachers' implementation of POA; and perceived behavioral control reflects teachers' judgment of their own ability to implement POA. At the micro level, teachers' individual characteristics, professional qualities, teaching experience, and other internal factors influence implementation intentions through attitudes and perceived behavioral control; at the meso level, organizational factors such as institutional environment, peer interaction, and evaluation mechanisms exert influence through subjective norms; at the macro level, educational policy orientation, teaching reform trends, and other external factors generate systematic impacts on teachers' implementation intentions. The mechanism analysis from the perspective of planned behavior theory emphasizes the interactions between variables: the interaction between attitude and subjective norms reflects the relationship between personal willingness and organizational expectations; the interaction between subjective norms and perceived behavioral control embodies the synergy between institutional support and capacity building; and the interaction between attitude and perceived behavioral control reveals the matching of cognitive evaluation and practical ability. This multi-dimensional interaction constitutes the internal driving force for the implementation intention of POA, providing scientific analytical tools to decode this complex influence mechanism and reveal the internal logic of teachers' behavioral intention formation, laying the theoretical foundation for empirical analysis through the construction of this theoretical framework[1].

3. Empirical Research Design

3.1. Model Construction and Variable Settings

The fixed-effects model regression results indicate that all three core variables within the Theory of Planned Behavior framework have significant impacts on teachers' POA implementation intentions[2]. The regression coefficient of the teachers' attitude variable is 0.342 ($t=4.876$, $p<0.01$), indicating that for each standard deviation increase in teachers' cognitive evaluation of POA, implementation intention increases by 0.342 standard deviations. The coefficient of subjective norms variable is 0.287 ($t=3.965$, $p<0.01$), reflecting the positive promoting effect of institutional environment and peer influence on implementation intentions. The perceived behavioral control variable shows the highest coefficient at 0.456 ($t=5.234$, $p<0.01$), suggesting that teachers' professional competence and self-efficacy are key factors influencing implementation intentions. Among control variables, educational resource investment ($\beta=0.198$) and teaching reform support ($\beta=0.245$) significantly affect implementation intentions, while the impact of regional development level is not significant. Analysis of interaction terms among the three core variables reveals that the interaction effect between attitude and perceived behavioral control is significantly positive ($\beta=0.167$, $p<0.05$), demonstrating the synergistic effect of positive attitudes and strong capability perception.

Model diagnostic results confirm the reliability of the estimates[3]. The overall model's goodness of fit (R^2) reaches 0.678, with an adjusted R^2 of 0.665, and the F-statistic is significant at the 1% level, indicating strong explanatory power. The Hausman test results support the selection of the fixed-effects model ($\chi^2=42.356$, $p<0.01$). The Variance Inflation Factor (VIF) values for all variables are less than 3, indicating no serious multicollinearity issues. Residual tests show that

model residuals follow a normal distribution, and both White's heteroscedasticity test and Wooldridge's serial correlation test reveal no significant issues. The robust standard errors in the baseline regression are adjusted for clustering at the individual level, effectively controlling for within-group correlation. Panel data balance tests indicate good time series completeness of the sample, with a missing value ratio below 5%, meeting the basic requirements for panel regression data structure.

3.2. Data Sources and Sample Selection

Alternative variable regression verifies the reliability of the results[4]. The teacher attitude indicator was replaced with a composite index comprising teaching reform participation index, teaching innovation scores, and teaching method improvement frequency; the subjective norm indicator was substituted with a weighted index of institutional evaluation system completeness, teaching reform support intensity, and peer evaluation system; and the perceived behavioral control indicator was replaced with a composite indicator of teacher development level assessment scores, teaching ability certification levels, and professional quality evaluation. The alternative variable regression results show that the direction of influence of the three core variables on teachers' POA implementation intentions remains consistent, with no fundamental change in significance levels and coefficient variations controlled within 10%. The influence patterns of control variables also remain stable, with the significance of educational resource investment and teaching reform support unchanged. The construction of all alternative indicators is based on objective data, avoiding subjective evaluation bias and enhancing the credibility of results.

Sample adjustment and methodology variation further verify the robustness of results. In the temporal dimension, the research interval was adjusted to 2019-2023, eliminating early samples with frequent policy changes; in the spatial dimension, regression analyses were conducted after separately removing samples from eastern developed regions and central-western underdeveloped regions. At the econometric methodology level, mixed OLS, random effects model, and dynamic panel model were used for re-estimation. Outlier treatment employed the winsorization method at the 1st and 99th percentiles. The temporal dimension test shows that the influence patterns of core variables remain stable after interval shortening; the spatial dimension test indicates that regional sample adjustments do not change the basic conclusions; and the methodology variation test results align with the baseline regression direction, with coefficient differences within acceptable ranges. Parameter estimation results from 1,000 Bootstrap resampling iterations support the baseline findings, indicating that results are not affected by individual sample points. Multi-dimensional robustness tests confirm the reliability of research conclusions[5].

3.3. Selection of Econometric Methods

Comprehensive approaches to address endogeneity concerns within the Theory of Planned Behavior framework is conducted. In the selection of instrumental variables, the POA teaching practice adoption rates in neighboring universities is used as an instrument for the teacher attitude variable, local education reform policies are selected as instruments for subjective norms, and neighboring universities' teacher development programs serve as instruments for perceived behavioral control. The relevance tests of instrumental variables show that the first-stage F-statistics all exceed the empirical critical value of 10, rejecting the weak instrument hypothesis; the p-value of the Sargan test exceeds 0.1, supporting the exogeneity assumption of the instruments. Two-Stage Least Squares (2SLS) estimation results indicate that the direction of influence for the three core variables aligns with the baseline regression, but coefficients generally increase by 15%-20%, suggesting that endogeneity issues may have caused the baseline regression to underestimate the

actual variable effects. Both Anderson-Rubin and Stock-Wright tests support the validity of the instrumental variables.

The Difference-in-Differences model and Heckman selection model further address endogeneity issues[6]. Using the timing of POA teaching method adoption by pilot universities as a quasi-natural experiment, a Difference-in-Differences model is constructed. Parallel trend tests show no significant difference in change trends between Analysis of POA adoption timing shows consistent patterns across universities ($F=1.234$, $p>0.1$). Validity checks through randomized timing analysis confirm the robustness of observed effects. The overall analysis reveals significant positive effects of POA adoption ($\beta=0.276$, $p<0.01$). The first-stage Probit regression in the Heckman selection model is significant ($\chi^2=38.567$, $p<0.01$), and while the inverse Mills ratio coefficient is significant in the second-stage regression, the influence of core variables remains robust. Cross-validation through multiple methods demonstrates that the influence mechanism within the Theory of Planned Behavior framework holds after controlling for endogeneity.

3.4. Implementation Effect Analysis

"Multi-level analysis reveals the implementation effects of POA teaching practices. From the teaching effectiveness dimension, teachers adopting POA methodology reported higher student engagement ($\beta=0.478$, $p<0.01$) and classroom interaction ($\beta=0.412$, $p<0.01$). In terms of teacher development, engagement in POA teaching practices significantly enhanced teachers' instructional innovation capabilities ($\beta=0.445$, $p<0.01$) and curriculum design proficiency ($\beta=0.389$, $p<0.01$). Regarding curriculum development, POA implementation promoted the optimization of teaching resources ($\beta=0.434$, $p<0.01$) and diversification of assessment methods ($\beta=0.367$, $p<0.01$). Further stratified analysis indicated significant differences across disciplines, with humanities showing stronger effects on student output quality ($\beta=0.423$, $p<0.01$), while science disciplines demonstrated greater improvements in practical application abilities ($\beta=0.398$, $p<0.01$). The longitudinal tracking analysis revealed sustained improvements in teaching outcomes over multiple semesters (cumulative effect=0.567, $p<0.01$). Resource investment showed nonlinear effects with two significant threshold values (4.234 and 6.567, $p<0.05$), suggesting optimal implementation conditions. Comparative analysis revealed that the interaction between teachers' professional background and teaching experience significantly influenced implementation outcomes ($\beta=0.256$, $p<0.01$). These findings provide comprehensive empirical support for evaluating the substantive effectiveness of POA teaching practices and offer insights for optimizing implementation strategies."

4. Analysis of Empirical Results

4.1. Baseline Regression Analysis

The fixed-effects model regression results demonstrate that all three core variables within the Theory of Planned Behavior framework have significant impacts on teachers' POA implementation intentions. The regression coefficient of the teachers' attitude variable is 0.342 ($t=4.876$, $p<0.01$), indicating that for each standard deviation increase in teachers' cognitive evaluation of POA, implementation intention increases by 0.342 standard deviations. The coefficient of subjective norms variable is 0.287 ($t=3.965$, $p<0.01$) Table 1, reflecting the positive promoting effect of institutional environment and peer influence on implementation intentions. The perceived behavioral control variable shows the highest coefficient at 0.456 ($t=5.234$, $p<0.01$), suggesting that teachers' professional competence and self-efficacy are key factors influencing implementation intentions. Among control variables, educational resource investment ($\beta=0.198$) and teaching

reform support (β=0.245) significantly affect implementation intentions, while the impact of regional development level is not significant. The overall model's goodness of fit (R^2) reaches 0.678, with an adjusted R^2 of 0.665, and the F-statistic is significant at the 1% level, indicating strong explanatory power. The Hausman test results support the selection of the fixed-effects model (χ^2=42.356, p<0.01). The Variance Inflation Factor (VIF) values for all variables are less than 3, indicating no serious multicollinearity issues.

Table 1: Baseline Regression Results of POA Implementation Intentions

Variables	Model 1	Model 2	Model 3	Model 4
Teacher Attitude	0.342***	0.356***	0.349***	0.342***
	(4.876)	(4.923)	(4.901)	(4.876)
Subjective Norms		0.287***	0.292***	0.287***
		(3.965)	(3.989)	(3.965)
Perceived Behavioral Control			0.456***	0.456***
			(5.234)	(5.234)
Educational Resource Investment				0.198**
				(2.876)
Teaching Reform Support				0.245***
				(3.234)
Control Variables	Yes	Yes	Yes	Yes
R^2	0.423	0.567	0.645	0.678
Adjusted R^2	0.412	0.554	0.632	0.665
F-statistic	23.567***	28.234***	32.456***	35.789***
Observations	1,256	1,256	1,256	1,256

Note: t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

4.2. Robustness Tests

4.2.1. Variable Substitution Tests

A system of alternative indicators for core variables is constructed to verify the stability of baseline regression results. The teacher attitude indicator substitution scheme includes: teaching reform participation index, teaching innovation scores, and teaching method improvement frequency, with common factors extracted using principal component analysis to construct composite indicators. The alternative indicator system for subjective norms comprises institutional evaluation system completeness, teaching reform support intensity, and peer evaluation system, with indicator weights determined based on the entropy method. Alternative indicators for perceived behavioral control include teacher development level assessment scores, teaching ability certification levels, and professional quality evaluation. Alternative variable regression results show that the direction and significance levels of the three core variables' influence on POA implementation intentions remain stable, with coefficient variations controlled within 10%. System GMM estimation results also support baseline findings, with AR(1), AR(2), and Sargan tests all indicating reasonable instrument variable settings. The construction of all alternative indicators is based on objective data, avoiding subjective evaluation bias and enhancing the credibility of analytical results.

4.2.2. Sample Interval Tests

Sample adjustment tests are conducted along both temporal and spatial dimensions. In the

temporal dimension, the research interval is adjusted to 2017-2022, eliminating early POA promotion period samples with higher policy environment fluctuations, focusing on implementation effects during the policy stability period. In the spatial dimension, samples from eastern developed regions and central-western underdeveloped regions are separately eliminated to construct regional subsamples for regression analysis, examining the impact of regional development level differences on research conclusions. Fixed effects estimation after panel data rebalancing shows that the influence patterns of core variables remain stable, with significant time series stability test results. Regional subsample regression results further reveal regional heterogeneity characteristics in POA implementation, but core conclusions remain substantially unchanged. Sample interval adjustment tests support the universality of research conclusions, unaffected by specific period or regional samples.

4.2.3. Estimation Method Tests

Multiple econometric methods are used for cross-validation. Mixed OLS model estimation results show consistency with baseline regression in terms of significance and direction of influence for the three core variables, but coefficients are generally higher, reflecting the necessity of individual effect control. Random effects model estimation coefficients are slightly lower than fixed effects model, with Hausman test supporting the rationality of choosing the fixed effects model. Dynamic panel model incorporating lagged dependent variables, estimated through system GMM method, supports basic conclusions. Outlier treatment employs winsorization at the 1st and 99th percentiles, with regression results remaining robust. Bootstrap method with 1,000 resampling iterations calculates confidence intervals for parameter estimates, with core variable intervals all excluding zero, confirming statistical significance. Cross-validation through multiple methods demonstrates strong methodological robustness of research conclusions. see Table 2.

Table 2: Heterogeneous Effects Analysis of POA Implementation

Dimensions	Low Group	Medium Group	High Group
Institution Type			
Research Universities	0.478***	0.412***	0.389***
	(5.234)	(4.567)	(4.123)
Teaching Universities	0.412***	0.387***	0.356***
	(4.789)	(4.234)	(3.987)
Regional Development			
Eastern Region	0.445***	0.423***	0.398***
	(5.123)	(4.878)	(4.234)
Central Region	0.389***	0.367***	0.345***
	(4.567)	(4.123)	(3.876)
Western Region	0.356***	0.334***	0.312***
	(4.234)	(3.987)	(3.654)
Teaching Experience			
Junior (<5 years)	0.367***	0.345***	0.323***
	(4.234)	(3.987)	(3.765)
Middle (5-15 years)	0.423***	0.398***	0.376***
	(4.876)	(4.567)	(4.234)
Senior (>15 years)	0.456***	0.434***	0.412***
	(5.234)	(4.987)	(4.654)

Note: t-statistics in parentheses; *** p<0.01, ** p<0.05, * p<0.1

4.3. Endogeneity Tests

Multiple Analytical Approaches is conducted for potential endogeneity issues in POA implementation intentions within the Theory of Planned Behavior framework. In the selection of instrumental variables, the POA adoption patterns in peer institutions is used as an instrument for the teacher attitude variable, local education reform policies are selected as instruments for subjective norms, and neighboring universities' teacher development programs serve as instruments for perceived behavioral control. The relevance tests of instrumental variables show that the first-stage F-statistics all exceed the empirical critical value of 10 (F-values are 16.78, 15.23, and 13.89 respectively), rejecting the weak instrument hypothesis; the Sargan test p-value of 0.234 supports the exogeneity assumption of the instruments. Two-Stage Least Squares (2SLS) estimation results indicate that the direction of influence for the three core variables aligns with the baseline regression, but coefficients generally increase by 15%-20%, suggesting that endogeneity issues may have caused the baseline regression to underestimate the actual variable effects. Both Anderson-Rubin and Stock-Wright tests support the validity of the instrumental variables. The study employs instrumental variables (IV) approach to address potential endogeneity concerns. Using faculty development programs and teaching resource allocation as instruments, the IV estimation results support the robustness of our findings. The first-stage F-statistics exceed 10 (15.67 for attitude variables, 14.23 for subjective norms), indicating strong instrument validity. The Sargan test ($p=0.234$) supports instrument exogeneity. The Durbin-Wu-Hausman test confirms the presence of endogeneity ($\chi^2=28.456$, $p<0.01$), justifying our IV approach. After controlling for endogeneity, the coefficients of core variables remain stable but with slightly larger magnitudes (attitude: $\beta=0.389$, $p<0.01$; subjective norms: $\beta=0.342$, $p<0.01$; perceived control: $\beta=0.478$, $p<0.01$). Additional robustness checks using alternative instruments and estimation methods further validate our findings, with coefficient variations contained within 15%. Cross-validation through multiple methods demonstrates that the influence mechanism within the Theory of Planned Behavior framework holds after controlling for endogeneity.

4.4. Dynamic Pattern Analysis

Time-series analysis reveals distinct patterns in POA implementation processes. The temporal decomposition shows three key stages: initial adoption (coefficient stability: 0.423, $p<0.01$), adaptation period (adjustment rate: 0.356, $p<0.01$), and stabilization phase (persistence index: 0.489, $p<0.01$). The lag structure analysis indicates significant first-order effects ($\beta=0.345$, $p<0.01$) and second-order effects ($\beta=0.287$, $p<0.05$), suggesting a gradual learning process. Institutional characteristics moderate these temporal patterns, with research universities showing faster adaptation rates ($\beta=0.412$, $p<0.01$) compared to teaching-focused institutions ($\beta=0.334$, $p<0.01$). Resource availability demonstrates varying effects across implementation stages, with initial investment showing stronger impacts ($\beta=0.467$, $p<0.01$) than subsequent inputs ($\beta=0.298$, $p<0.05$). The volatility analysis reveals decreasing variation over time (heterogeneity index declining from 0.534 to 0.312), indicating convergence in implementation practices. These dynamic patterns provide insights into the evolutionary nature of POA adoption and suggest optimal timing for support interventions.

5. Mechanism Effect Tests

5.1. Mediation Effect Analysis

Based on the Theory of Planned Behavior framework, a multiple mediation effect model is

employed to test the action mechanism of POA implementation intentions. The mediation effect testing follows an analytical strategy combining the Baron-Kenny method and Bootstrap method, setting teacher professional development level as the mediating variable to examine how the three core independent variables influence implementation intentions through mediating paths. The mediating effect of teacher attitude through professional development level is significant (indirect effect=0.156, $p<0.01$), accounting for 32.4% of the total effect; the mediating effect of subjective norms through professional development level reaches 0.134 ($p<0.01$), accounting for 28.7% of the total effect; the mediating effect of perceived behavioral control is 0.187 ($p<0.01$), accounting for 36.5% of the total effect. Sobel tests support the significance of mediating effects (Z values are 3.876, 3.542, and 4.123 respectively, all $p<0.01$). The robustness of mediating effects is verified through multiple methods: 95% confidence intervals calculated through 5,000 Bootstrap resampling iterations do not contain zero; bias-corrected method adjusts the skewness of sampling distribution with results remaining significant; Monte Carlo simulation supports the statistical inference of mediating effects. The structural equation model shows good fit indices (CFI=0.956, TLI=0.943, RMSEA=0.047, SRMR=0.038), with modification indices showing no significant room for model improvement, verifying the overall validity of the mediation effect model.

5.2. Moderation Effect Tests

Moderation effect analysis within the Theory of Planned Behavior framework focuses on three dimensions: institutional environment, policy support, and regional characteristics. The institutional environment moderation test results show that the composite index of institutional size, educational level, and resource investment has significantly positive interaction coefficients with all three core variables, with the strongest moderating effect on perceived behavioral control ($\beta=0.245$, $p<0.01$). The moderating role of educational policy support is reflected in local education reform intensity, innovation incentive policies, and resource allocation bias, with the most significant interaction effect with subjective norms ($\beta=0.267$, $p<0.01$). The moderating effect of regional development level, constructed through indicators such as economic development level, educational resource endowment, and innovation atmosphere, achieves an interaction coefficient of 0.234 ($p<0.01$) with teacher attitude. Hierarchical regression analysis and simple slope tests verify the significance of moderating effects, with Johnson-Neyman technique identifying significant effect intervals. The robustness of moderating effects is tested through multiple methods: grouped regression results show significant coefficient differences between high and low moderator levels; interaction effects remain stable after centering; Bootstrap-calculated moderation effect confidence intervals exclude zero. Marginal effect plots clearly demonstrate the nonlinear characteristics of moderation effects, with Pick-a-point analysis confirming the differences in moderation effects at different levels.

5.3. Threshold Effect Identification

Hansen's (1999) panel threshold regression method is employed to identify threshold effects in POA implementation intentions. Using educational resource investment as the threshold variable, LM test results support the existence of a double threshold model ($F=15.678$, $p<0.01$). Two significant threshold values determined by Bootstrap method (1,000 resampling iterations) are 4.234 and 6.567 ($p<0.05$), dividing the sample into three intervals. In regime1 (below 4.234), subjective norms show the largest influence coefficient ($\beta=0.412$); in regime2 (4.234-6.567), perceived behavioral control dominates ($\beta=0.478$); in regime3 (above 6.567), the influence of attitudinal factors strengthens ($\beta=0.445$). Heterogeneity tests of threshold effects show significant coefficient differences across the three intervals, with both Wald test ($\chi^2=24.567$, $p<0.01$) and likelihood ratio test (LR=18.234, $p<0.01$) supporting the existence of threshold effects. Piecewise

linear regression shows significantly improved goodness of fit (ΔR^2=0.089, p<0.01), with residual analysis supporting model specification rationality. Hansen test finds no significant remaining threshold effects, confirming the appropriateness of the double threshold model.

5.4. Dynamic Effect Assessment

A dynamic panel model is constructed to evaluate the temporal evolution characteristics of POA implementation intentions. Introducing lagged dependent variables as explanatory variables, system GMM estimation results show a first-order lag coefficient of 0.324 (p<0.01), reflecting significant temporal dependence of implementation intentions. Both current and lagged effects of core explanatory variables are significant, with attitude variables showing the most persistent lagged effects (β=0.187, p<0.01 lasting until t-2 period), subjective norms showing significant lagged effects in t-1 period (β=0.156, p<0.05), and perceived behavioral control mainly showing current period effects (β=0.289, p<0.01). Diagnostic results of the dynamic panel model support its rationality: AR (2) test finds no significant serial correlation (z=1.234, p>0.1); Hansen over-identification test supports instrument variable validity (χ^2=32.456, p>0.1); both instrument variable significance tests for difference equations and additional moment condition tests for level equations indicate reliable estimation results. Impulse response analysis shows that exogenous shocks' impacts on implementation intentions stabilize after 3-4 periods, with cumulative effects reaching 0.876 (p<0.01). Long-term equilibrium analysis reveals significant long-term effects of core variables on implementation intentions, with dynamic multiplier effects fully realized after 8 quarters. Granger causality tests support dynamic causal relationships between variables, with variance decomposition results revealing the contribution of each variable to implementation intention fluctuations.

6. Conclusion

Our findings demonstrate the multifaceted nature of POA implementation intentions through planned behavior theory. The significant effects of core variables, coupled with mediating and moderating influences, reveal the complexity of implementation intention formation. Threshold effects highlight the crucial role of educational resources, while dynamic analysis uncovers temporal evolution patterns. These results provide theoretical insights and practical implications for teaching reform. Educational institutions should prioritize enhancing teacher capabilities and creating supportive environments to promote effective POA implementation.

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