The Impact of Instructional Leadership on Inquiry-Based Teaching Practices among Physics Teachers at High Schools of Yuhua Education Group, China

Yan Deng[1*] and Beibei Chen [2]
[1]Master of Educational Administration, Stamford International University, Thailand
[2] Ph.D. Lecturer, Stamford International University, Thailand
[*] Corresponding author: 2312190004@students.Stamford.edu

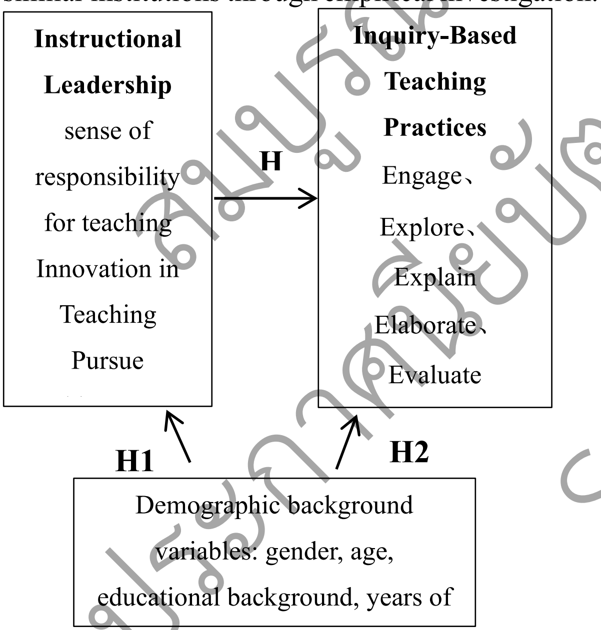
***Abstract*:** Inquiry-based teaching is central to physics core competencies, yet limited systematic research exists on its implementation in private education groups. This study investigates how high school physics teachers' instructional leadership affects inquiry-based teaching within the Yuhua Education Group. A full-sample survey of 197 teachers (100% response rate) was analyzed using quantitative methods, including descriptive statistics, t-tests, ANOVA, correlation, and regression analyses. Key findings: First, Teachers show high levels of instructional leadership and inquiry-based teaching. Second, Significant differences in leadership are found only by educational background, not by gender, experience, or title. Third, Leadership positively correlates with inquiry-based teaching. Fourth, Leadership significantly predicts inquiry-based teaching, explaining 65.4% of the variance, with teaching innovativeness being the strongest predictor. The study suggests enhancing instructional leadership, especially innovativeness, to deepen inquiry-based practices and improve physics instruction, offering empirical insights for private education groups and teacher professional development.

Keywords: Instructional Leadership, Inquiry-Based Teaching Practices, Physics Teachers at High Schools.

1. Introduction

Against the backdrop of a profound global shift in science education towards core competencies, the paradigm of teaching research has been transitioning from knowledge transmission to capacity building. International frameworks, represented by the OECD's PISA Global Competence Framework, the US Next Generation Science Standards (NGSS), and the EU's Science Education for Responsible Citizenship roadmap, explicitly state that the goals of science education have transcended traditional knowledge transmission to focus on cultivating students' scientific inquiry skills, innovative thinking, and complex problem-solving abilities (OECD, 2018). This transformation imposes revolutionary demands on the role of teachers, requiring them to evolve from passive executors of curricula into designers of learning environments, guides of scientific practice, and leaders of professional communities. Within this context, research on teacher instructional leadership demonstrates a significant trend toward subject-specific and practice-oriented approaches. Timperley (2011) proposed the theory of "teacher professional learning communities," arguing that the endogenous instructional leadership formed by subject-based teachers through collaborative inquiry serves as the fundamental driver for sustainable school teaching reform. Consequently, research on teacher instructional leadership has become increasingly integrated with subject-specific teaching practices. In physics education research, existing studies indicate that physics teachers' instructional behaviors, such as organizing inquiry activities and guiding students in scientific argumentation, significantly influence the depth of student scientific engagement. These findings provide a crucial contextual basis for understanding physics teachers' inquiry-based teaching practices from the perspective of instructional leadership.

China's basic education reform resonates with these international trends. The implementation of the General High School Physics Curriculum Standards (2017 Edition, Revised 2020) marks the entry of physics education into the "core competency era." The new standards position "scientific inquiry" as central, requiring educators to "focus on problem orientation, create authentic problem situations, and guide students through the complete process of scientific inquiry" (Ministry of Education, 2020). This conceptual innovation poses a revolutionary challenge to the professional capabilities of physics teachers. However, the implementation of the new standards commonly encounters the contradiction of "advanced concepts but lagging practices." A special investigation by the Ministry of Education (2023) identified three major dilemmas in current high school physics inquiry-based teaching: the formalization of inquiry activities, the superficiality of thinking skill development, and the singularity of evaluation methods. The key to resolving these dilemmas lies in shifting from policy-driven mandates to activating teachers' intrinsic professional agency. Systematically enhancing the instructional leadership of high school physics teachers to propel inquiry-based teaching from "form" to "substance" has become an urgent task for relevant education groups in realizing their strategic vision. This study aims to provide data-informed decision-making references for the professional development of teachers and teaching reform within the group and similar institutions through empirical investigation.



Research Objectives

Based on the research questions, the objectives of this study were determined as follows: 1) To understand the current status of instructional leadership among high school physics teachers at the Yuhua Education Group; 2) To understand the current status of inquiry-based teaching practices among high school physics teachers at the Yuhua Education Group; 3) To analyze the differences in instructional leadership among high school physics teachers across different demographic variables (gender, age, educational background, teaching experience, and professional title); 4) To analyze the differences in inquiry-based teaching practices among high school physics teachers across different demographic variables (gender, age, educational background, teaching experience, and professional title); 5) To determine the relationship between instructional leadership and inquiry-based teaching practices among high school physics teachers at the Yuhua Education Group.

2. Materials and Methods

This study took all in-service high school physics teachers at the Yuhua Education Group in Henan Province as the research object and adopted a full-sample sampling method to select participants from five high schools of the group. According to the sample size requirements of Krejcie and Morgan (1970), a total of 197 questionnaires were distributed, and 197 valid questionnaires were recovered, yielding a recovery rate of 100%. The specific questionnaire adopted in this research consisted of two established scales. The first was the Instructional Leadership Scale originally developed by Liu Qiuxia (2023). The scale comprised 17 items across five dimensions: teaching responsibility, teaching innovation, pursuit of achievement expectations, enhancement of student agency, and teaching execution. The original scale demonstrated good reliability, with an overall Cronbach's α of 0.968 and dimensional coefficients ranging from 0.924 to 0.973. In the present study (N=197), the overall Cronbach's α of the instructional leadership scale was 0.968, and the Cronbach's α coefficients of the five dimensions were 0.973 for teaching responsibility, 0.934 for teaching innovation, 0.924 for pursuit of achievement expectations, 0.954 for enhancement of student agency, and 0.950 for teaching execution. The second was the Inquiry-Based Teaching Practices Scale developed by Gejda and LaRocco (2006) based on the 5E instructional model. This scale consisted of 35 items across five dimensions: engage, explore, explain, elaborate, and evaluate. The original scale reported an overall Cronbach's α of 0.905, with dimensional coefficients of 0.891, 0.885, 0.907, 0.869, and 0.863, respectively. In the current sample, the overall Cronbach's α was 0.905, and the dimensional coefficients remained consistent with the original report. Confirmatory factor analysis provided further evidence for the construct validity of both scales. For the instructional leadership scale, the five-factor model demonstrated good fit indices ($\chi^2/df = 2.553$, RMSEA = 0.068, CFI = 0.977), with standardized factor loadings for each item on its corresponding dimension ranging from 0.84 to 0.97. The five-factor model of the inquiry-based teaching practices scale also fitted the data well, with all fit indices reaching common standards, proving that the scale had good structural validity. All these indicators demonstrated that the instruments employed in this study possessed sound psychometric properties and were appropriate for use in the context of Chinese private education groups.

3. Results and Discussion

3.1 Demographic Analysis of Respondents

The questionnaire used in this study is titled "Survey on the Teaching Leadership of High School Physics Teachers in Yuhua Education Group and Its Impact on Inquiry-Based Teaching Practice." A total of 197 valid samples were collected for data analysis. Descriptive statistical analysis was conducted on the collected data regarding teachers' gender, age, teaching experience, educational background, and professional title. Frequency and percentage were used for representation. Gender Distribution: Among the 197 valid samples, 84 were male (42.6%), and 113 were female (57.36%), indicating an imbalanced gender ratio. Age Distribution: 25 years and below: 4 (2.0%), 26-35 years: 119 (60.4%), 36-45 years: 41 (20.8%), 46-55 years: 17 (8.6%), 56 years and above: 16 (8.1%). Teaching Experience Distribution: ≤3 years: 46 (23.4%), 4-10 years: 114 (57.9%), 11-15 years: 16 (8.1%), 16-20 years: 12 (6.1%), ≥21 years: 9 (4.6%). Educational Background: Bachelor's degree: 110 (55.8%), Master's degree: 86 (43.7%), Doctoral degree: 1 (0.5%). Professional Title: Junior title: 131 (66.5%), Intermediate title: 53 (26.9%), Senior title: 13 (6.6%). The basic profile of the questionnaire participants is shown in the following table1:

Table 1. Basic personal information of teachers (N=197)

Background variable	classification	N	%
Gender	Male	84	42.64
	Female	113·	57.36
Age	25 and below	4	2.03
	26 to 35 years old	119	60.41
	36 to 45 years	41	20.81
	46 to 55 years	17	8.63
	Aged 56and above	16	8.12
Teaching age	3years and below	46	23.35
	4-10years	114	57.87
	11-15years	16	8.12
	16-20years	12	6.09
	21years and above	9	4.57
Educational background	Bachelor's degree	110	55.84
	Master's degree	86	43.65
	Doctoral degree	1	0.51
Professional Title	Junior title	131	66.50
	Intermediate title	53	26.90
	Senior title	13	6.60

3.2 Demographic Differences in Instructional Leadership

Independent samples t-tests and one-way ANOVA examined differences in perceived instructional leadership across demographic groups. No significant differences were found for gender, age, teaching experience, or professional title ($p > 0.05$). However, significant differences emerged across educational backgrounds ($F = 5.082$, $p < 0.01$). Post-hoc LSD tests indicated that teachers with a master's degree scored higher than those with a bachelor's degree, while the sole doctoral degree holder scored lowest. These results suggest that educational background was the only demographic variable producing significant differences in instructional leadership among high school physics teachers at Yuhua Education Group.

Table 2. Summary of ANOVA Results for instructional Leadership by Demographic Variables

Variable	F	p	LSD
Gender	t=0.191	.049*	n.s
Age	0.972	.424	n.s
Educational Background	5.082	.007**	2>1>3
Years of Teaching Experience	1.016	.400	n.s
Professional Title	0.351	.705	n.s

Note.:**p<0.01; n.s.=not significant.

Educational Background： 1=Bachelor's degree, 2=Master's degree, 3=Doctoral degree

3.3 Demographic Differences in Inquiry-Based Teaching Practices

A similar pattern was observed for inquiry-based teaching practices. No significant differences were found based on gender ($t = -0.061$, p = 0.294 > 0.05), age (F = 0.435, p = 0.783 > 0.05), years of teaching experience (F = 0.638, p = 0.636 > 0.05), educational background (F = 0.042, p = 0.959 > 0.05), or professional title (F = 0.593, p = 0.554 > 0.05). Post-hoc LSD tests revealed that while older and senior-title teachers scored slightly higher than their younger and junior counterparts, none of these differences reached statistical significance.

Table 3. Summary of ANOVA Results for Inquiry-Based Teaching Practices by Demographic Variables

Variable	F	p	LSD
Gender	t=-.061	.294	n.s
Age	.435	.783	n.s
Educational Background	.638	.636	n.s
Years of Teaching Experience	.042	.959	n.s
Professional Title	.593	.554	n.s

3.4 Correlation Analysis

Pearson correlation analysis revealed a strong, statistically significant positive correlation between teachers' overall perceived instructional leadership and their overall inquiry-based teaching practices ($r = 0.809$, $p < 0.01$). All five dimensions of instructional leadership—teaching responsibility ($r = 0.628$), teaching innovation ($r = 0.723$), pursuit of achievement expectations ($r = 0.779$), enhancement of student agency ($r = 0.733$), and teaching execution ($r = 0.769$)—were significantly and positively correlated with the overall inquiry-based teaching practices (all $p < 0.01$). Furthermore, each dimension of instructional leadership demonstrated significant positive correlations with all five sub-dimensions of inquiry-based teaching practices (engagement, exploration, explanation, elaboration, and evaluation), with correlation coefficients ranging from 0.607 to 0.879 ($p < 0.01$). These findings indicate that higher levels of instructional leadership are associated with better implementation of inquiry-based teaching practices.

3.5 Regression Analysis

A simple linear regression was conducted to test the predictive effect of instructional leadership on inquiry-based teaching practices. The model was statistically significant, $F(1, 195) = 368.449$, $p < 0.01$. Instructional leadership was a significant positive predictor of inquiry-based teaching practices ($\beta = 0.809$, $p < 0.01$), accounting for 65.4% of the variance ($R^2 = 0.654$, Adjusted $R^2 = 0.652$). These results demonstrate that teachers' instructional leadership strongly and positively predicts their implementation of inquiry-based teaching practices.

Variable	Dimension	N	(M)	(SD)
Instructional Leadership	Teaching Responsibility	197	4.48	0.497
	Teaching Innovation	197	3.77	0.688
	Pursuit of Achievement Expectations	197	4.23	0.631
	Enhancement of Student Agency	197	4.36	0.604
	Teaching Execution	197	4.28	0.612
	Instructional Leadership (Overall)	197	4.22	0.490
Inquiry-Based Teaching Practices	Engage	197	4.06	0.776
	Explore	197	4.19	0.729
	Explain	197	4.40	0.597
	Elaborate	197	4.34	0.653
	Evaluate	197	4.35	0.591
	Inquiry-Based Teaching Practices (Overall)	197	4.27	0.597

4. Conclusion

Based on the provided document (the study on high school physics teachers at Yuhua Education Group) and following the structure, style, and length of your reference example, here is the extracted English content: The results revealed no significant gender differences in instructional leadership among high school physics teachers at Yuhua Education Group, except for an isolated overall difference with no supporting dimensional significance. This suggests that within the group's current teaching environment, instructional leadership behaviors are perceived and practiced relatively consistently across genders. A possible explanation is that the group's standardized teaching management system, professional development programs, and evaluation mechanisms are applied uniformly regardless of gender, resulting in minimal variation in how male and female teachers demonstrate or experience instructional leadership. This finding implies that the group does not need to design gender-specific intervention strategies for enhancing instructional leadership at its current stage. Both perceived instructional leadership and inquiry-based teaching practices varied significantly only across educational background levels, with no statistically significant differences found based on age, teaching experience, or professional title. Teachers with master's and bachelor's degrees reported higher levels of instructional leadership, particularly in the dimensions of achievement expectation pursuit and student agency enhancement. However, educational background did not yield significant differences in inquiry-based teaching practices. This pattern can be reasonably explained through the lens of initial professional preparation: teachers with higher academic qualifications may receive more systematic training in educational theory, curriculum design, and pedagogical innovation during their pre-service education, which subsequently shapes their leadership perceptions and practices. The lack of significant differences across age, experience, and professional title suggests that within this private education group context, instructional leadership and inquiry-based practice are influenced more by institutional factors—such as the group's unified teaching research mechanism (e.g., "Group Master Teacher Workshops"), resource allocation, and professional development opportunities—than by individual career stage or seniority. This finding carries a clear practical implication: the Yuhua Education Group should focus on strengthening initial teacher preparation and providing targeted professional support for teachers with lower educational backgrounds, while recognizing that career stage alone does not confer leadership advantage. The strong positive correlation ($r = 0.809$, $p < 0.01$) and robust predictive effect ($\beta = 0.809$, $p < 0.01$, explaining 65.4% of the variance) of instructional leadership on inquiry-based teaching practices represent the most important finding of this study. This relationship can be understood through the dual lenses of Constructivist Learning Theory, Transformational Leadership Theory, and Self-Determination Theory. Instructional leadership behaviors—such as taking teaching responsibility, demonstrating teaching innovation, pursuing achievement expectations, enhancing student agency, and executing teaching effectively—satisfy teachers' professional needs for autonomy, competence, and professional identity. This satisfaction acts as a powerful professional resource that drives a positive motivational process, directly enhancing teachers' engagement in inquiry-based teaching practices across all five dimensions: engagement, exploration, explanation, elaboration, and evaluation. The fact that instructional leadership explained nearly two-thirds of the variance in inquiry-based teaching practices underscores its central importance as an organizational and professional determinant of teaching quality in this private education context. For administrators at Yuhua Education Group, the implication is clear: cultivating instructional leadership among physics teachers—particularly fostering teaching innovativeness, which emerged as the strongest predictor—is not merely a matter of professional development preference but a strategic priority for deepening inquiry-based teaching reform and improving physics classroom instruction. This can be achieved through leadership development programs, the institutionalization of cross-campus teaching research communities, and the consistent practice of providing instructional autonomy, resource support, and professional recognition. Support.

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Authors' Biography:

Yan Deng is a Master of Education candidate in the Educational Administration program at the Graduate School of Stamford International University, Thailand. Her research interests primarily focus on high school teachers' instructional leadership and inquiry-based teaching practices.