

The Impact of Teaching Informatization on Students' Cognitive Level

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ABSTRACT

This study, based on data from the China Education Tracking Survey, systematically examines the impact of information technology in rural teacher education on students' cognitive abilities and explores how enhancing teachers' intelligent educational literacy can influence their identity and professional development. The empirical results indicate that frequent use of information technology tools by teachers significantly enhances students' cognitive abilities, particularly in rural areas and among younger students. Furthermore, the advancement of information technology in education not only optimizes the teaching process but also promotes the professional identity and growth of rural teachers. Based on the data analysis, the paper proposes policy recommendations to improve the infrastructure for information technology, strengthen teacher training, and provide professional support. This research enriches the theoretical framework related to the professional development of rural teachers and intelligent education, and has practical implications for promoting balanced rural education development.

KEYWORDS

Rural teachers; Teaching informatization; Intelligent education literacy; Identity; Students' cognitive level

1 Introduction

Rural teachers commonly face challenges of low identity and constrained professional development. This situation stems not only from divergences between educational philosophies and rural teaching practices but also from multiple influences including geographical, cultural, and social status factors, making it difficult for them to establish a stable sense of professional belonging. Concurrently, shortages in resources, limited promotion opportunities, and insufficient social support exacerbate occupational stress, thereby undermining job satisfaction. Modern concepts and technologies of intelligent education offer new growth opportunities for rural teachers. Enhancing intelligent educational literacy—encompassing knowledge, skills, thinking, application, and attitudes—not only contributes to improving teaching effectiveness and professional confidence but also alleviates identity crises, broadens career development paths, and fosters the sustainable development of rural education.

2 Literature review

2.1 Current research status in China

The issues of rural teachers' identity and survival conditions have become focal points in current educational research. On one hand, rural teachers experience a certain mismatch between educational concepts and rural educational practice, which impedes their effective integration into the local educational ecology. On the other hand, there is a notable disconnection between their professional development and actual needs. Scholars such as Wu Kaixin et al. have pointed out that the identity crisis of rural teachers mainly manifests in ambiguous roles in educational practice; they often find themselves as "outsiders" or "wanderers," unable to establish deep emotional ties within rural communities ^[1]. Zhang Hongwei and colleagues argue that this lack of identification stems not only from limited professional development but also from traditional rural social expectations that do not align with the teacher's role ^[2]. These studies collectively suggest that enhancing intelligent educational literacy can not only strengthen professional competence but also expand career development pathways, thereby mitigating identity crises among rural teachers.

2.2 International research status

Internationally, research on rural teachers' identity and survival conditions primarily focuses on the difficulties teachers face, identity characteristics, and influencing factors. Lassig and others contend that under the global trend of educational marketization, rural teachers endure survival pressures, with many leaving due to low salaries and poor working conditions ^[10]. Acheson et al. analyze the work difficulties of rural secondary school teachers in the United States from the perspective of emotional labor, highlighting how isolation and lack of resources undermine teachers' motivation. They recommend enhancing emotional support and professional training to strengthen teachers' professional identity ^[11]. In summary, the identity and survival of rural teachers are influenced by multiple factors; improving professional development, occupational identity, and intelligent literacy can not only help overcome identity

crises but also enhance educational quality, promoting the sustainable development of rural education.

3 Theoretical foundations

3.1 Self-determination theory

Self-Determination Theory (SDT), proposed by Deci and Ryan in 1975, posits that individual behavior is influenced not only by external environmental factors but can also be motivated and altered through the psychological needs of individuals. The theory categorizes motivation into intrinsic motivation, extrinsic motivation, and amotivation, describing how individual actions can be driven by both external and internal motivations ^[3]. Extrinsic motivation is generally not driven by interest in the activity itself but rather by factors such as pleasing others or obtaining rewards, whereas intrinsic motivation arises from an individual's interest or satisfaction in the activity itself, often linked with stronger willpower. Amotivation represents a lack of self-determination; under certain external conditions, it may convert into extrinsic motivation. Within this theoretical framework, intrinsic motivation provides enduring energy that fosters sustained behavioral change, though its maintenance depends on supportive external environments; when these are compromised, intrinsic motivation diminishes accordingly ^[4]. For rural teachers, the combined effect of internal and external incentives generates motivation to enhance intelligent educational literacy, driven by the demand for high intelligent literacy, prompting continuous awareness and improvement of intelligent literacy capabilities.

3.2 Teacher professional development theory

The concept of "teacher professionalization" was first proposed in the 1980s. Currently, three principal perspectives prevail concerning the definition of teacher professional development: The first views it as a static process emphasizing self-development and professional growth; the second regards it as a dynamic process, conceptualizing it as an ongoing "teacher education" progression; the third synthesizes the previous two, combining static professional growth and dynamic development. It posits that professional development encompasses multiple dimensions including teaching skills, ideals and beliefs, and knowledge competencies, relying not only on individual effort but also on support from educational institutions and external environments. This integrated perspective is widely accepted among scholars ^[5].

For primary and secondary school teachers in rural areas, professional development directly impacts the modernization of rural education. In the era of artificial intelligence, intelligent educational literacy has become a crucial competence in professional development, raising higher expectations for teachers. Nonetheless, rural teachers still confront challenges such as survival difficulties and identity crises in their careers, which may negatively affect their professional growth. Entering the intelligent era calls for greater attention to the interaction between technological advancement and teacher professional development. Only by keeping pace with the times and continuously enhancing their intelligent knowledge, skills, and ethical literacy can rural teachers become highly intelligent educators who effectively contribute to the advancement and development of rural education.

4 Empirical analysis

4.1 Variable selection

The data for this study are drawn from the China Education Tracking Survey (CETS). The survey, based on the 2013–2014 school year as a baseline, chose two cohort groups—the first and third grades of junior high school (grades 7 and 9)—as the starting points. Using average population education level and population mobility rate as stratification variables, 28 county-level units (counties, districts, cities) were randomly selected nationwide as survey sites. The survey covers educational information from students, teachers, and schools comprehensively. Therefore, this study selected the panel data from 2013 to 2014 as the sample, excluding data with missing or abnormal values. After data cleaning and collation, the final research sample size is 12,633.

4.2 Model construction

The specific variable definitions are shown in Table 1-1:

Table 1-1 Variable Definitions

Variable Type	Variable Name	Definition and Coding
Explanatory Variable	Teaching Informatization	Binary variable: frequent use of multimedia projection equipment / internet / personal teaching websites or blogs, Weibo = 1; occasional or never use = 0
	Students' Cognitive Level	Students' cognitive ability test scores, continuous variable
Control Variable	Teacher Gender	Male = 0, Female = 1
	Teacher Education Level	Junior college = 1, Bachelor = 2, Graduate and above = 3
	Teacher Teaching Experience	Continuous variable
	Teacher Professional Title Level	No title = 1, Level 3 = 2, Level 2 = 3, Level 1 = 4, Senior and Senior First Level = 5
	Student Gender	Male = 1, Female = 0
Control Variable	Proportion of Local Students in School	Proportion of students with local hukou in the corresponding grade
	Urban-Rural Household Registration	Urban hukou = 1, Rural hukou = 0
	Left-behind Children Status	Left-behind children = 1, otherwise = 0
	Boarding Status	Boarding = 1, Non-boarding = 0
	Student Family Economic Status	Poor = 1, Medium = 2, Wealthy = 3
	Only Child Status	Only child = 1, otherwise = 0
	School Local Ranking	Best = 3, Upper middle = 2, Middle and below = 1
	School Type	Public = 1, Private = 0

4.3 Descriptive analysis

Table 1-2 Variable Definitions

Variable Name	Category	N	%
Teacher Gender	Female	11,602	91.84
	Male	1,031	8.16
Student Gender	Female	6,213	49.18
	Male	6,420	50.82
Teacher Education Level	Junior College	1,624	12.86
	Bachelor	10,820	85.65
	Graduate and above	189	1.5
Teacher Professional Title Level	No Title	1,040	8.23
	Level 3	187	1.48
	Level 2	3,781	30
	Level 1	5,445	43
	Senior and Above	2,180	17
Urban-Rural Household Registration	Rural Hukou	6,999	55.4
	Urban Hukou	5,634	44.6
Left-behind Children Status	No	2,925	23.15
	Yes	9,708	76.85
Boarding Status	Non-boarding	8,403	66.52
	Boarding	4,230	33.48
Student Family Economic Status	Poor	2,679	21.21
	Medium	9,200	72.83
	Wealthy	754	5.97
Only Child Status	No	7,093	56.15
	Yes	5,540	43.85
School Local Ranking	Middle and below	2,086	16.51
	Upper middle	7,629	60.39
	Best	2,918	23.1
School Type	Private	876	6.93
	Public	11,757	93.07

The overall education level of teachers is relatively high, with 85.65% holding a bachelor's degree, 1.5% having a graduate degree or above, and only 12.86% holding an associate degree. The vast majority are female, accounting for 91.84%.

Teacher professional titles are mainly concentrated in Level 1 and Level 2. Specifically, 8.23% have no professional title, 1.48% are Level 3, 30% are Level 2, 43% are Level 1, and 17% hold senior and senior first-level titles.

Among the sample, 50.82% are male students, and 49.18% are female. The distribution of urban and rural household registration is relatively balanced, with rural hukou accounting for 55.4% and urban hukou accounting for 44.6%. A large proportion of students are left-behind children, making up 76.85%. Non-boarding students comprise 66.52%, while boarding students account for 33.48%. Regarding family economic status, the majority fall in the medium category at 72.83%, with 21.21% classified as poor and 5.97% as wealthy. Only children constitute 43.85% of the sample. The majority of schools are ranked upper middle locally, accounting for 60.39%. Most schools are public, representing 93.07%.

4.4 Baseline regression

According to the regression results in Table 1-3 below, Column (1) includes only individual fixed effects and year fixed effects without other control variables. Column (2) adds control variables while controlling for individual and year fixed effects. The following conclusion can be drawn: Teachers' use of internet media for teaching is positively and significantly related to students' cognitive levels, with a regression coefficient of 0.0623, significant at the 1% level, indicating that frequent use of internet media by teachers significantly improves students' cognitive levels.

Table 1-3 Baseline Regression Results

	(1)	(2)
VARIABLES	m1	m2
	Student Cognitive Level	Student Cognitive Level
Teaching Informatization	0.1368*** (0.0186)	0.0623*** (0.0180)
Teacher Gender		-0.0983*** (0.0276)
Teacher Bachelor Degree		0.0447* (0.0237)
Teacher Graduate Degree and Above		-0.0503 (0.0706)
Teacher Teaching Experience		-0.0038*** (0.0013)
Teacher Professional Title Level		0.1156*** (0.0104)
Student Gender		-0.0175 (0.0145)
Proportion of Local Students in School		0.2201*** (0.0518)
Urban-Rural Household Registration		0.0749*** (0.0170)
Left-behind Children Status		0.0692*** (0.0174)
Boarding Status		-0.0662*** (0.0038***)
Medium Student Family Economic Status		0.1564*** (0.0183)
Wealthy Student Family Economic Status		0.2804*** (0.0349)
Only Child Status		0.2020*** (0.0167)
School Local Ranking		0.2156*** (0.0127)
School Type		-0.0174 (0.0355)
Year	Controlled	Controlled
Individual	Controlled	Controlled
Constant	-0.0367*** (0.0099)	-1.3201*** (0.0662)
Observations	12,633	12,633
R-squared	0.0044	0.1122

4.5 Robustness check

Considering that public schools are the main body of education in China, data provided by public schools are more reliable and representative. Therefore, this study removes samples from private schools for regression to better control the interference of other factors and to make the research results more explanatory. In the robustness check, the effect of teaching informatization on students' cognitive level remains statistically significant, indicating that the results are robust.

Table 1-4 Robustness Check Results

	(1)
	m1
VARIABLES	Student Cognitive Level
Teaching Informatization	0.0358* (0.0184)
Teacher Gender	-0.1070*** (0.0306)
Teacher Bachelor Degree	0.0824*** (0.0248)
Teacher Graduate Degree and Above	0.0059 (0.0717)
Teacher Teaching Experience	-0.0025* (0.0015)
Teacher Professional Title Level	0.1122*** (0.0118)
Student Gender	-0.0191 (0.0149)
Proportion of Local Students in School	0.2540*** (0.0570)
Urban-Rural Household Registration	0.0726*** (0.0175)
Left-behind Children Status	0.0581*** (0.0181)
Boarding Status	-0.0739*** (0.0188)
Medium Student Family Economic Status	0.1555*** (0.0190)
Wealthy Student Family Economic Status	0.2680*** (0.0357)
Only Child Status	0.2056*** (0.0172)
School Local Ranking	0.2127*** (0.0136)
Year	Controlled
Individual	Controlled
Constant	-1.3799*** (0.0708)
Observations	11,757
R-squared	0.1106

4.6 Heterogeneity analysis

This study conducted separate regressions for students with urban hukou and rural hukou and found significant differences, confirmed by inter-group coefficient difference tests. It shows that teaching informatization has no significant effect on urban students, whereas frequent use of internet media by teachers significantly improves the cognitive levels of rural students. This may be because urban schools usually have better infrastructure and resources, including teaching technology equipment, network connections, and teacher training. Thus, urban students have likely been exposed to more informatized teaching means, resulting in a smaller incremental impact of further teaching informatization on their cognitive levels. In contrast, rural students typically face greater educational disparities, such as inadequate infrastructure and insufficient teacher resources. In such cases, frequent use of internet media by teachers may become an effective way to bridge the gap, thereby significantly improving rural students' cognitive levels.

Considering the sample includes students in Grade 7 and Grade 9, students at different grade levels are at different stages of learning and development and vary in their acceptance and adaptability to teaching informatization. According

to the regression results in Table 1-5, the impact of teaching informatization on students' cognitive level is significant at the 1% level in Grade 7, with a coefficient of 0.1024, indicating a larger effect. In Grade 9, the effect is significant at the 5% level with a coefficient of 0.0520, possibly because Grade 7 students (typically in their first year of junior middle school) are generally more open and adaptive to new teaching methods and technologies. Therefore, teaching informatization has a more significant impact on their cognitive level. Grade 9 students, nearing entrance into high school, may have already been exposed to a certain degree of informatized teaching, leading to a smaller effect on their cognitive improvement.

Table 1-5 Urban-Rural Difference Regression Results

	(1)	(2)	(1)	(2)
	Urban	Rural	Grade 7	Grade 9
VARIABLES	Student Cognitive	Student Cognitive	Student Cognitive	Student Cognitive
	Level	Level	Level	Level
Teaching Informatization	0.0367 (0.0264)	0.0994*** (0.0246)	0.1024*** (0.0277)	0.0520** (0.0240)
Teacher Gender	-0.0515 (0.0402)	-0.1809*** (0.0377)	0.0148 (0.0351)	0.1342*** (0.0326)
Teacher Bachelor Degree	0.0457 (0.0426)	0.0329 (0.0289)	-0.1357 (0.0827)	0.0747 (0.1397)
Teacher Graduate Degree and Above	-0.1322 (0.1042)	0.0330 (0.0916)	-0.0073*** (0.0017)	0.0015 (0.0022)
Teacher Teaching Experience	-0.0038* (0.0020)	-0.0019 (0.0018)	0.1526*** (0.0132)	0.0664*** (0.0182)
Teacher Professional Title Level	0.1108*** (0.0163)	0.1019*** (0.0136)	-0.0319 (0.0206)	-0.0086 (0.0204)
Student Gender	-0.0333 (0.0220)	0.0049 (0.0193)	-0.0348 (0.0712)	0.3477*** (0.0711)
Proportion of Local Students in School	0.3505*** (0.0779)	0.0053 (0.0648)	0.0880*** (0.0245)	0.0540** (0.0248)
Urban-Rural Household Registration	0.0853*** (0.0291)	0.0612*** (0.0216)	-0.0448* (0.0258)	-0.1453*** (0.0258)
Left-behind Children Status	-0.2073*** (0.0351)	-0.0157 (0.0216)	0.1893*** (0.0261)	0.1376*** (0.0254)
Boarding Status	0.1931*** (0.0341)	0.1428*** (0.0215)	0.3139*** (0.0497)	0.2799*** (0.0493)
Medium Student Family Economic Status	0.3068*** (0.0508)	0.3020*** (0.0520)	0.1682*** (0.0227)	0.2518*** (0.0231)
Wealthy Student Family Economic Status	0.2764*** (0.0250)	0.1036*** (0.0226)	0.1866*** (0.0187)	0.2329*** (0.0170)
Only Child Status	0.2107*** (0.0192)	0.1948*** (0.0171)	-0.0471 (0.0540)	-0.0356 (0.0455)
School Local Ranking	-0.1699** (0.0737)	-0.0178 (0.0411)	0.1024*** (0.0277)	0.0520** (0.0240)
School Type	0.0367 (0.0264)	0.0994*** (0.0246)	0.0148 (0.0351)	0.1342*** (0.0326)
Year	Controlled	Controlled	Controlled	Controlled
Individual	Controlled	Controlled	Controlled	Controlled
Constant	-1.2045*** (0.1035)	-1.0330*** (0.0807)	-1.0267*** (0.0877)	-1.3570*** (0.0926)
Observations	5,634	6,999	6,474	6,159
R-squared	0.1224	0.0589	0.0964	0.1293

5 Conclusion

This study, based on data from the China Education Panel Survey (CEPS), empirically analyzed the impact of teaching informatization by rural teachers on students' cognitive levels. The results show that teachers' frequent use of internet media and other informatization tools can significantly enhance students' cognitive abilities, with this effect being more pronounced among rural students and lower-grade student groups. Teaching informatization not only improves teaching

effectiveness but also effectively alleviates the identity crisis faced by rural teachers, promoting their professional confidence and career development. The study recommends further strengthening the informatization infrastructure in rural schools, enhancing teachers' digital education literacy, and increasing professional support and training for teachers. These measures will help promote balanced development of rural education and provide a solid foundation for the modernization of rural education and the sustainable development of the rural teacher workforce.

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