INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN PROGRESSIVE EDUCATION & DEVELOPMENT

OPEN ACCESS JOURNAL

Vol 13, Issue 1, (2024) E-ISSN: 2226-6348

Reliability and Validity of the Chinese Version of the Scale for Assessing the Teachers' Innovative Behavior

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To Link this Article: http://dx.doi.org/10.6007/IJARPED/v13-i1/18845 DOI:10.6007/IJARPED/v13-i1/18845

Published Online: 28 January 2024

Abstract

Comprehending teachers' innovative behaviors is essential to foster them, yet China lacks a specialized tool for this assessment. This study aimed to evaluate the applicability, reliability, and validity of an international teacher innovation scale within the Chinese educational milieu. The research involved 642 junior high teachers in Guangxi, China, with a subset of 125 participating in a retest after three weeks. Techniques like item, factor, correlation, and reliability analyses were employed. Results indicated that the scale's various validity forms (structural, convergent, discriminant, correlational, calibration) and reliability measures (internal consistency, split-half, retest) met or surpassed threshold criteria. Consequently, the adapted Chinese Teachers' Innovative Behavior Scale demonstrates robust validity and reliability, offering a credible tool for assessing Chinese teachers' innovative behavior. In subsequent research, this scale can be employed to assess teachers' innovative behaviors in China.

Keywords: Teacher Innovative Behavior, Teacher Innovative Behavior Scale, Reliability, Validity, Chinese Sample

Introduction

With the development of the information society, the global economy and all areas of society are constantly and rapidly changing. In a rapidly changing and open environment, ensuring that the education system keeps pace with the times is one of the major challenges facing China. Therefore, the education system cannot remain static but should evolve to meet expectations and needs that are synchronized with current developments. In the field of education, the innovative behaviors that should be prioritized and focused on are those of teachers, as teachers are not only the largest unit in this field, but also the main driver of the education system, and the creation of innovations in the field of education depends on the innovative behaviors of teachers (Hasanefendic et al., 2017; Koeslag-Kreunen et al., 2018; Lambriex-Schmitz et al., 2020). Therefore, it is important to equip teachers with this behavior.

China also attaches great importance to teacher innovation. "Reform" and "innovation" are high-frequency words in China's education policy documents. 2019 China Education Modernization 2035, issued by the CPC Central Committee and the State Council, proposes to "build a high-quality, specialized and innovative teaching force(Central People's Government of the People's Republic of China, 2019). In 2022, the Ministry of Education and other eight departments issued the "New Era Basic Education Strong Teachers Plan", which proposes that "efforts should be made to create a high-quality, specialized and innovative primary and secondary school teacher team in the new era"(Ministry of Education of the People's Republic of China, 2022).

Then, "How to stimulate teachers' innovative behavior?" will be an important question for schools to crack. Obtaining the teachers' innovative behavior measurement tool to understand the current level of teacher innovation behavior in China is the first step to crack this problem.

Due to the great attraction of innovative behavior, the development of theories and measurement tools for teachers' innovative behavior has also gained the attention of scholars. International research in this area started much earlier and is much richer than Chinese research in this area. A total of 8 papers were published in "Peking University Core" and "Chinese Social Sciences Citation Index" journals and 12 master's theses were found in China National Knowledge Infrastructure (CNKI). The study focused on higher education teachers, with only one journal paper and four dissertations sampling primary and secondary school teachers (Chenyang, 2021; Mingjun et al., 2016b; Yan, 2022; Yuna, 2019). This is insufficient compared to the importance of teacher innovative behavior and the large population of primary and secondary school teachers in China.

Teachers' Innovative Behaviour

The conceptualization of teacher innovative behavior is largely rooted in the broader theories of innovative behavior from psychology and organizational management disciplines. Notably, the innovative behavior theory by Scott and Bruce (1994) and the innovative work behavior theory by Janssen (2000) have profoundly shaped the understanding of teacher innovative behavior, with subsequent models and assessment scales reflecting the foundations established by these theories.

Drawing upon the foundational works of West and Farr (1989)and Messmann and Mulder (2012),Zainal and Mohd Matore (2021) articulate innovative behaviors as individual actions geared towards the inception, enhancement, or application of novel products, technologies, services, or procedures. This objective is to augment the efficiency and effectiveness within an organization. This behavioral set encapsulates a spectrum of activities: exploring opportunities, generating ideas, promoting those ideas, and actualizing them to foster innovation.

Exploring Opportunities: This necessitates individuals to be attuned to their work milieu, staying abreast of the latest shifts, understanding organizational structural changes, and assimilating novel insights into their roles(Messmann & Mulder, 2012).

Generating Ideas: Defined as a creative behavior facet, it involves enhancing existing processes or products, or innovatively addressing problems by devising fresh solutions. This genesis of new ideas is contingent on exploring and harnessing identified opportunities(De Spiegelaere et al., 2014).

Promoting Ideas: Post ideation, it is imperative to champion these nascent ideas. This involves mobilizing support, enlightening peers about the ongoing processes, negotiating resources, and disseminating the innovative concepts both within and beyond the organization's confines(Messmann & Mulder, 2012).

Realizing Ideas: This phase is characterized by the tangible manifestation of an idea. It involves the rigorous testing and refinement of the innovation, coupled with strategic incorporation into organizational practices (Messmann & Mulder, 2014).

However, it's pivotal to note that these dimensions of innovative behavior aren't strictly sequential. Their manifestations are often nonlinear and episodic(Gkontelos et al., 2022; Messmann & Mulder, 2014). Innovation is perceived as a multifaceted process, punctuated by distinct activities and innovative actions at each juncture. Consequently, individuals might concurrently engage in diverse innovative acts at any moment(Gkontelos et al., 2022).

Teachers' Innovative Behavior Scale

In the pursuit of measuring teachers' innovative behaviors, Chinese scholars predominantly adapt or reference instruments initially designed by international researchers for gauging innovative behaviors within corporate and public sector employees. Among the most frequently employed scales are those crafted by (Kleysen and Street, 2001; Janssen 2000; Scott and Bruce, 1994; De Jong and Den Hartog (2008). However, the original context of these scales, which is detached from educational settings, leads to inherent limitations in their applicability.

To address this, specific scales tailored for the educational sector have emerged. For instance, Messmann and Mulder (2012) devised a 19-item scale for vocational education staff, encompassing five dimensions: exploring opportunities, generating ideas, promoting ideas, realizing ideas, and reflecting. Yet, the "Realizing Ideas" dimension faced challenges in cross-validation. Similarly, Lambriex-Schmitz et al (2020) introduced a 44-item scale across five dimensions for staff in Dutch vocational institutions. However, the extensive item count could hinder respondent engagement, potentially compromising the data quality. As Messmann & Mulder (2020) emphasized, the usability of a scale is critical as it directly influences respondents' attentiveness and the authenticity of the responses.

For this research, the selected instrument is the Teachers' Innovative Behavior Scale (TIBS) introduced by. Specifically designed for primary and secondary school educators, this scale draws inspiration from the innovative behavior scales of (De Jong and Den Hartog, 2008; Messmann and Mulder, 2012). With a 20-item configuration spread over four dimensions, the scale demonstrated both reliability and validity in a sample of 1,415 teachers in Malaysia.

Informed by Plake and Wise (2014) classical test theory, which advocates for the objectivity, reliability, validity, and usability of measurement tools, this study endeavors to assess the reliability and validity of the TIBS, as crafted by Zainal and Matore (2021), within the context of junior high school educators in China.

Materials and Methods

Participants

Using a proportionate stratified sampling technique, this study targeted the Guangxi Zhuang Autonomous Region (Guangxi) in China, which comprises 12 municipalities. As of 2021, Guangxi was home to 2,024 public junior high schools (grades 7-10) staffed by 172,131 teachers. Employing the Cochran (1977) formula to determine the sample size, and given a

confidence level of 99% and an expected level of precision of 0.05 for a population of 172,131, the minimum effective sample size was ascertained to be 664. The number of teachers sampled from each city was proportional to the number of junior high school teachers in that city relative to Guangxi's total. Consequently, 179 junior high schools were incorporated in the survey. From each of these schools, 4-5 teachers were arbitrarily chosen to participate, culminating in a sample of 864 teachers. Of these, 858 completed,return rate is 99.31%. Following the elimination of invalid and aberrant submissions, 642 questionnaires were deemed valid, representing a 74.83% validity rate. A subset of these participants, 125 in total, underwent a second test after a three-week interval.

The demographic characteristics of the sample are as follows. Regarding gender, 23.7% are male, and 76.3% are female. Regarding ethnicity, 56.2% are of Han ethnicity, and 43.8% are ethnic minorities. 61.9% are under 40 years old, 27.3% are 40 to 49 years old, and 10.9% are 50 years old or older 96% have a bachelor's or higher degree., 51.1% have 10 years of teaching experience or less, 48.9% have more than 10 years of teaching experience.56% for Chinese, math and English teachers, 44% for history, politics, geography, physics, chemistry, biology, art, information technology and psychology teachers. Regarding region, 54.7% of teachers in urban schools, 30.1% in county schools, and 15.3% in township schools.

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Measures

Teacher Innovative Behavior Scale

Teacher innovative behavior was assessed using the Teacher Innovative Behavior Scale, as devised by (Zainal and Matore, 2021). This scale encompasses a total of 20 items, organized into four distinct dimensions: exploring opportunities (5 items), generating ideas (5 items), promoting ideas (5 items), and realizing ideas (5 items). Cronbach’s alpha coefficient by construct is 0.788 to 0.856,indicative of satisfactory reliability. Participants rated their responses on a 5-point Likert scale,where 1 denoted "never" and 5 signified "very often".

Criterion-Related Validity Instrument: Teacher Efficacy Scale

Criterion-related validity was assessed utilizing the Teacher Efficacy Scale, originally formulated by Tschannen-Moran and Hoy (2001). This instrument comprises a total of 24 items, which are further categorized into three distinct dimensions: perceived efficacy of teaching strategies, perceived efficacy of classroom management, and efficacy of student engagement. The Cronbach's alpha values were 0.91, 0.90, and 0.87,indicative of robust internal consistency. Notably, the Teacher Efficacy Scale has garnered extensive utilization in empirical research, demonstrating consistent validity and reliability across various studies (Oakes et al., 2013; Temiz & Topcu, 2013; Yun et al., 2019). The Chinese version of this scale was employed in the current study, and participants provided responses on a 5-point Likert scale, ranging from 1 (indicating "never") to 5 (representing "very often"). Higher scores on the scale denote elevated levels of teacher efficacy, with the Cronbach values for the three

dimensions in this specific study measuring 0.906, 0.916, and 0.914, affirming their strong internal consistency.

Demographic Information

Demographic data, encompassing gender, ethnicity, and age, were collected, alongside job-related information, including academic qualifications, teaching experience, and school location.

Translation and Adaptation

The adaptation of the Teacher Innovative Behavior scale from its original English version to a Chinese counterpart followed a systematic process, aligning with the Brislin translation model(Brislin, 1970),which involves translation, back-translation, expert consultation, pre-survey, and the finalization of the Chinese scale. The stepwise procedure unfolded as follows:

Stage 1: Two native Chinese speakers, both possessing English degrees and English proficiency, independently translated the scale into Chinese. Subsequently, a doctoral-level expert in educational administration convened with the initial translators to consolidate a unified Chinese translation.

Stage 2: An academic proficient in English, with experience in teaching at a university and studying abroad, translated the Chinese version back into English.

Stage 3: The translated versions were meticulously compared and discussed with the initial translators to forge the initial draft of the Chinese scale.

Stage 4: The first draft was submitted to an expert committee comprising two Ph.D. holders in educational administration and three junior high school teachers. This committee deliberated on the draft, offering insights and revisions.

Stage 5: A pre-survey was conducted, involving the distribution of the questionnaire to ten junior high school teachers for completion. Subsequent interviews were conducted to gauge participants' feedback, including their perception of the questionnaire's completion time, textual clarity, and overall questionnaire readability. Following this feedback, the Chinese version of the scale was refined and finalized.

Procedure

The survey was administered during the months of April to May 2023 using a Chinese online survey platform. To facilitate participant access, the researcher disseminated the questionnaire link (https://www.wjx.cn/vm/QgnBkjd.aspx#) through a WeChat group, providing clear instructions on the survey completion process. It was emphasized that respondents were required to answer all questions for a successful submission, and each device (be it a phone or computer) could only submit one response to maintain data integrity. Notably, all respondents managed to complete their questionnaires within a concise two-day timeframe. Furthermore, prior to the survey's commencement, participants were duly informed of its voluntary nature and the assurance of their anonymity in contributing to the study.

Statistical Analysis

The data analysis for this study involved the utilization of SPSS 27.0.1.0 and AMOS 23.0.0. The analytical process was structured as follows: item analysis → exploratory factor analysis (EFA) → confirmatory factor analysis (CFA) encompassing assessments of structural validity,

discriminant validity, and convergent validity → correlation analysis → criterion-related validity → reliability analysis, which included evaluations of internal consistency, split-half reliability, and retest reliability.

Initially, item analysis was performed on the entire sample (n=642). Subsequently, the sample was randomly divided into two approximately equal-sized datasets. Sample 1 (n=321) was employed for conducting an exploratory factor analysis (EFA) to assess the questionnaire's construct validity. Principal component analysis (PCA) with Varimax rotation was chosen as the extraction method, and factor loadings exceeding 0.50 were considered significant.

Sample 2 (n=321) was then utilized to execute a confirmatory factor analysis (CFA) employing a maximum likelihood procedure to validate the model derived from the EFA. During parameter estimation, the variances of latent constructs were constrained to one. Model fit was evaluated using various indices recommended by Hu and Bentler (1998), including standardized root mean square residuals (SRMR), root mean square error of approximation (RMSEA), Tucker-Lewis index (NFI), and comparative fit index (CFI). Acceptable model fit criteria included CFI > 0.90, SRMR < 0.11, NFI > 0.90, and RMSEA < 0.08(Browne, 1993; Hu & Bentler, 1998).Chi-square, while also considered, was primarily used as a reference indicator due to its tendency for model rejection in large sample sizes (Hu & Bentler, 1998).

The validity of the measurement model was evaluated based on the average variance extracted (AVE) > 0.5(Kline, 2005), and construct reliability (CR) > 0.7 was deemed acceptable(Hatcher, 1994).

Pearson correlation coefficients were computed to assess the relationships between the overall Teacher Innovative Behavior scale and its four subscales, as well as among the subscales themselves. Correlation coefficients within the range of 0.1 to 0.3 were classified as low, 0.31 to 0.5 as moderate, and values exceeding 0.5 were considered high(Bortz et al., 1995; Giannakopoulos et al., 2013). Criterion-related validity was established by examining the association between teacher innovative behavior and teacher efficacy. Lastly, the internal consistency of the questionnaire was evaluated using Cronbach's α, with a reliability coefficient equal to or exceeding 0.70 considered acceptable.

Descriptive Statistics

The outcomes of the normality test applied to the measurement model revealed that the gathered data exhibited a normal distribution, thereby satisfying the normality assumption. Table 1 presents the skewness values, which ranged from +0.23 to -0.28, and kurtosis values, which ranged from +0.43 to -0.13. Notably, all data points displayed statistically significant normal distribution characteristics, with both skewness (within ±2) and kurtosis (within ±7) falling well within the acceptable range as defined by Lomax and Schumacker (2012) and Kim (2013).

Table 1
Normality(n = 642 teachers)

Variable	Dimension	Min.	Max	Mean	Skewness	Kurtosis
Teachers' Innovative Behavior	Exploring opportunities	1.60	5.00	3.71	0.00	0.27
	Generating ideas	1.20	5.00	3.60	0.23	0.17
	Promoting ideas	1.00	5.00	3.21	0.02	0.21
	Realising ideas	1.00	5.00	3.34	-0.08	0.43
Teacher Efficacy	Teaching strategy efficacy	2.00	5.00	3.94	-0.28	0.13
	Classroom management efficacy	1.90	5.00	3.98	-0.28	-0.13
	Student engagement efficacy	2.00	5.00	3.83	-0.16	-0.04

Results

Item Analysis

The discriminative power of the scale's question items was evaluated using both the critical ratio value method and the correlation method. For this analysis, participants were divided based on their total scores for each sub-dimension of teachers' innovative behaviors: the top 27% were categorized as the high group, while the bottom 27% constituted the low group. An independent samples t-test was conducted to compare these high and low subgroups. Results indicated significant differences across all items (t-values ranging from 17.52 to 30.50, all $p < 0.001$). Further, an examination of the correlation between individual items and their respective dimension's total score revealed correlation coefficients ranging from 0.50 to 0.81 (all $p < 0.01$). Moreover, the Cronbach's alpha values for all items decreased upon their deletion. Based on these findings, all question items within the Chinese version of the Teacher Innovative Behavior Scale demonstrated robust discriminative ability.

Exploratory Factor Analysis

To assess the structural validity of the scale, an exploratory factor analysis was performed on Sample 1. The analysis yielded a Kaiser-Meyer-Olkin (KMO) measure of 0.95 and a significant Bartlett's test of sphericity ($X^2=8669.76$, $df=190$, $p<0.001$), suggesting that the dataset was appropriate for factor analysis. Guided by the eigenvalue criterion of greater than 0.9, the scree plot, and the original scale's constructs, a four-factor solution was extracted. Notably, item 5, originally under the "explore opportunities" factor, emerged within the "generate ideas" factor, leading to its removal. Both item 10 and item 19 exhibited cross-loadings, with item 10 loading 0.51 on the "generate ideas" factor and 0.62 on the "promote ideas" factor, and item 19 loading 0.58 on the "realizing ideas" factor and 0.54 on the "facilitating ideas" factor. Consequently, both items were deleted.The remaining items aligned with the original scale's theoretical conceptualization, boasting factor loadings ranging from 0.55 to 0.83. Post-rotation eigenvalues for the four factors stood at 10.29, 1.66, 1.15, and 0.92, accounting for a cumulative variance of 72.21%. The resultant model encapsulated a 4-factor representation of teachers' innovative behavior. The rotated component matrix details can be found in Table 2.

Table 2
Factor loadings of the Teachers' Innovative Behavior Scale (n=321)

Item		Explore opportunities	Generate ideas	Promote ideas	Realize ideas
1	Identify the needs of my clients (students, parents, community)	0.767			
2	Identify opportunities that can be taken	0.831			
3	Looking for opportunities to advance the organization.	0.649			
4	Think about producing innovations that can be used to achieve organizational goals.	0.55			
6	Generate new ideas		0.766		
7	Submit innovative ideas.		0.806		
8	Give suggestions for improvement on the ideas given.		0.732		
9	Find a solution to a problem using new techniques/methods.		0.667		
11	Actively engage in promoting new ideas to colleagues.			0.688	
12	Actively engage in promoting new ideas to superiors.			0.786	
13	Actively engage in informing others about the progress of a new idea			0.797	
14	Convince others of the importance of a new idea.			0.817	
15	Actively engage in highlighting new ideas so that they have the opportunity to be implemented.			0.748	
16	Strive to develop something new.				0.599
17	Analyses the undesirable effects when new ideas are put into practice.				0.752
18	Realize a new idea into something useful.				0.764
20	Contribute energy to realize new ideas.				0.699

Note: Factor loadings below 0.5 are not presented.

Confirmatory Factor Analysis

Following the factor analysis, which revealed the scale's factor structure, a confirmatory factor analysis was conducted using Sample 2. The results, detailed in Table 3, demonstrate that the 4-factor model, as proposed by the original scale, exhibited an acceptable fit with indices: X^2/df=3.65, NFI=0.94, CFI=0.96, and RMSEA=0.06. The standardized path coefficients for this 4-factor model, representing teachers' innovative behavior, are depicted in Figure 1.

Discriminant Validity

The 4-factor model underwent validation against six alternative factor models, with fit indices compared across all seven models. As evidenced in Table 3, the fit indices for the 4-factor model surpassed those of the other models, thereby establishing its discriminant validity. Consequently, the 4-factor model is deemed appropriate as the definitive factor structure for the scale.

Table3
Confirmatory Factor Analysis Model Fit Indices

No.	Models		X^2	df	X^2/df	NFI	CFI	RMSEA	model comparison	ΔX^2	Δdf
1	4 Factor Model	EO;GI;PI;RI	412.63	113	3.65	0.94	0.96	0.06			
2	3 Factor Model I	EO+GI;PI;RI	643.82	116	5.55	0.91	0.93	0.08	2vs1	231.19***	3
3	3 Factor Model II	EO;GI;PI+RI	737.17	116	6.36	0.9	0.91	0.09	3vs1	324.54***	3
4	3 Factor Model III	EO;GI+PI;RI	991.27	116	8.55	0.86	0.88	0.11	4vs1	578.64***	3
5	2 Factor Model I	EO+GI;PI+RI	968.77	118	8.21	0.87	0.88	0.11	5vs1	556.14***	5
6	2 Factor Model II	EO+RI;GI+PI	1295.58	118	10.98	0.82	0.83	0.13	6vs1	882.955***	5
7	1Factor model	EO+GI+PI+RI	1475.88	119	12.4	0.79	0.81	0.13	7vs1	1063.25***	6

*Note: EO is exploring opportunities; GI is generating ideas; PI is promoting ideas; RI is realizing ideas. "+" is two factors combined into one. *p<0.05, **p<0.01, ***p<0.001.*

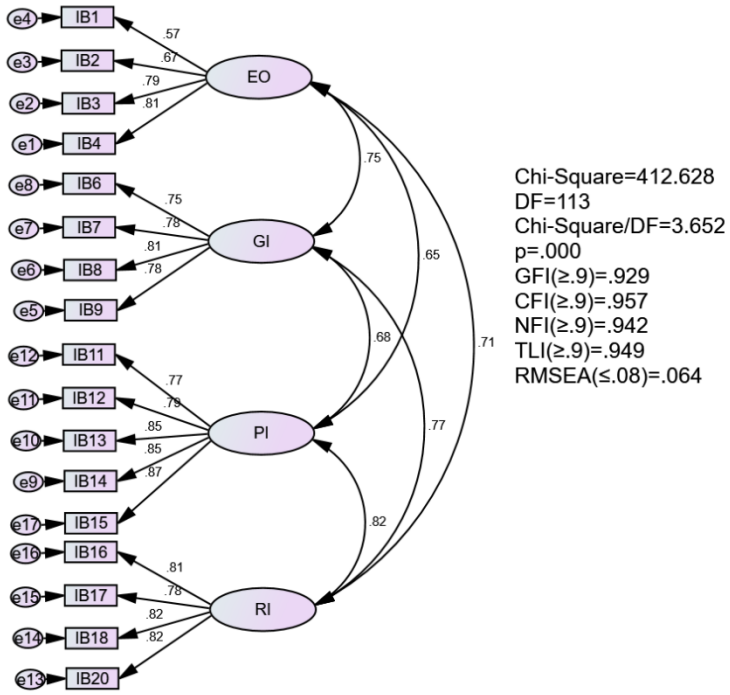

Figure 1: Standardized path diagram for confirmatory factor analysis of the 4-factor model of teachers' innovative behaviors

Convergent Validity

The Chinese version of the Teachers' Innovative Behavior Scale consists of four factors: explore opportunities, generate ideas, promote ideas, and realize ideas. Their Average Variance Extracted (AVE) values are 0.51, 0.60, 0.68, and 0.65, respectively, all exceeding the threshold of 0.5. Additionally, the composite reliability (CR) values for these factors are 0.80,

0.86, 0.92, and 0.88, each surpassing the benchmark of 0.7. Consequently, the scale demonstrates acceptable convergent validity.

Correlation Analysis

The teachers' innovative behavior exhibited robust positive correlations with the four factors: exploring opportunities (r=0.788), generating ideas (r=0.833), promoting ideas (r=0.885), and realizing ideas (r=0.886). Moreover, these factors were intercorrelated. Specifically, exploring opportunities correlated positively with generating ideas (r=0.614), promoting ideas (r=0.553), and realizing ideas (r=0.592). Similarly, generating ideas was positively correlated with promoting ideas (r=0.612) and realizing ideas (r=0.669), while promoting ideas had a positive correlation with realizing ideas (r=0.737). These patterns suggest that the factors within the Chinese version of the Teachers' Innovative Behavior Scale are in alignment with the constructs they aim to measure. Notably, the correlation coefficients between the total score and each of the four factors exceeded the inter-factor correlations, which indicates both the distinctiveness and coherence of the factors. This further underscores the scale's robust structural validity.

Criterion-Related Validity

Grounded in Bandura's Social Cognitive Theory, an interplay exists between an individual's self-efficacy and behavior. Consistent with this, prior studies have consistently shown a positive correlation between teacher efficacy and innovative teacher behaviors(Hsiao et al., 2011; Klaeijsen et al., 2018; Runhaar et al., 2016; Zainal & Mohd Matore, 2021). In the present study, correlation coefficients between teacher efficacy and teacher innovative behavior can be found in Table 4. Notably, both the overall score and individual factor scores of teachers' innovative behavior exhibit significant positive correlations with the comprehensive score and respective factor scores of teacher efficacy. This underscores that the Chinese version of the Teachers' Innovative Behavior Scale possesses commendable criterion-related validity.

Table 4
Correlation of Teachers' Innovative Behaviors with Teacher Efficacy(r，n = 321)

	Teachers' innovative behavior	Explore opportunities	Generate ideas	Promote ideas	Realize ideas
Teacher efficacy	.619**	.547**	.520**	.494**	.564**
Teaching strategy efficacy	.595**	.543**	.519**	.452**	.539**
Classroom management efficacy	.553**	.504**	.461**	.437**	.497**
Student engagement efficacy	.629**	.526**	.514**	.527**	.580**

Reliability Analysis

An assessment of internal consistency was executed for the Teachers' Innovative Behavior Scale. The obtained Cronbach's alpha for the overall scale was 0.941, with the respective coefficients for the factors—exploring opportunities, generating ideas, promoting

ideas, and realizing ideas—being 0.809, 0.861, 0.914, and 0.881. The split-half reliability for the overall scale was determined to be 0.859, with the factors yielding split-half reliabilities of 0.744, 0.819, 0.913, and 0.886. Furthermore, a Pearson correlation analysis between initial scores and retest scores revealed retest reliabilities for the four dimensions as 0.80, 0.79, 0.74, and 0.85. Collectively, these findings affirm that the Chinese version of the Teachers' Innovative Behavior Scale possesses satisfactory reliability metrics.

Discussion and Conclusion

The revised Chinese version of the Teachers' Innovative Behavior Scale comprises 17 items across four dimensions. It exhibits a coherent structural model with satisfactory validity. Item analysis suggests that all items of this Chinese version demonstrate strong discriminative power. Exploratory factor analysis revealed four distinct factors, leading to the elimination of three items. Consequently, the final scale consists of 17 items, distributed as follows: four for exploring opportunities, four for generating ideas, five for facilitating ideas, and four for realizing ideas. Confirmatory factor analysis affirmed that the four-factor model's fit indices were superior to alternative models, with notable discriminant validity. The four-factor model was thereby established as the definitive structure. The scale's convergent validity was established, with AVE values ranging from 0.51 to 0.68 and CR values between 0.80 and 0.92 for the four factors.

The factors align well with the constructs the scale intends to measure. The four subscales correlate significantly with the overall scale, exhibiting coefficients from 0.788 to 0.886 ($P < 0.001$). Inter-factor correlations were also positive, ranging from 0.553 to 0.737 ($P < 0.001$). There's evident criterion-related validity, as demonstrated by the significant positive correlations between the total scores of the Teachers' Innovative Behavior Scale and teacher efficacy scores, with coefficients between 0.437 and 0.629.

The revised scale's reliability metrics are robust: internal consistency for the scale is 0.941, with individual factors ranging from 0.81 to 0.91. Split-half reliability for the overall scale stands at 0.86, and between 0.74 to 0.91 for the factors. Retest reliability spans from 0.74 to 0.85 for the factors.

This scale underwent modifications based on Plake and Wise (2014) classical test theory, with its validity further validated through a sample of junior high school teachers in China. The data for this research, gathered from a varied cohort of teachers across 179 junior high schools in 12 cities within Guangxi, bolsters the study's representativeness and, in turn, its reliability. The revised Chinese version of the Teachers' Innovative Behavior Scale, even after omitting three items, demonstrates robust reliability and validity. The excised items—"Think about improvements in my work," "Find new approaches to accomplish a task," and "Introduce new ideas in the organization systematically"—may not align with the Chinese educational milieu or resonate with the lived experiences of junior high school teachers in China.This process not only elevated the scale's objectivity, reliability, and validity but also adapted the Teachers' Innovative Behavior Scale to the specificities of the Chinese educational landscape.This meticulous process not only elevated the scale's objectivity, reliability, and validity but also adapted the Teachers' Innovative Behavior Scale to the specificities of the Chinese educational landscape.

The Chinese version of the Teachers' Innovative Behavior Scale also provides an effective instrument for evaluating the innovative behavior of teachers in China and enriches the evaluation tools of teachers' professionalism in China. The Chinese version of the scale has

strong practical significance in today's world, which emphasizes social innovation and improves teachers' innovative ability. It can be applied to the study of teachers' innovative behavior ability and related fields in China, which can help researchers and educational administrators to understand the level of teachers' innovative behavior more accurately and provide the basis for taking effective measures to stimulate teachers' innovative behavior.

Limitations

The sample for this study exclusively comprised junior high school teachers from Guangxi, China. It did not encompass samples from other provinces or regions, nor did it incorporate data from teachers at different educational stages. Future studies should consider expanding the sampling scope to enhance the sample's representativeness and encompass a more diverse cross-section of the teaching population.

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