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MEASURING CHINESE RURAL SCIENCE TEACHERS' SELF-PERCEPTION TOWARDS TEACHING COMPETENCIES: INSTRUMENT DEVELOPMENT

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Abstract. *The teaching competency of rural teachers is fundamental to providing rural pupils with a high-quality education. Nonetheless, China has not yet established standardized competence criteria for rural science teachers, making it difficult to ascertain the actual competence of the rural teaching force on the front lines. Consequently, this study aimed at accessing Chinese rural science teachers' teaching competency and exploring rural-urban differences by developing a measurement instrument. Factor analyses confirmed the reliability and validity of this instrument, which consisted of 21 items and four dimensions. In addition, the questionnaire was employed to examine 393 science teachers in China, discovering the significant rural-urban differences in terms of teaching implementation and learning evaluation together with teacher distribution. This study was hoped to promote the building of the teaching competency system and provide references for rural science teachers' professional development.*

Keywords: *rural teacher, teaching competency, science teacher, factor analysis*

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Introduction

Rural education is well renowned for its commitment to improving the general quality of pupils in rural regions. The latest survey shows that nearly one third of China's population live in rural areas, despite this large proportion, the rural areas nevertheless suffer several obstacles and concerns. For instance, rural-urban resource disparity, combined with the low salaries and low social status of rural areas, makes it difficult to recruit and retain rural teachers (Adams & Woods, 2015; Zhou et al., 2004). As a result, rural students have even less access to highly qualified and competent teachers committed to rural education (Reagan et al., 2019; Yarrow et al., 1999). Many scholars, not only in China, have revealed that many countries are confronted with comparable dilemmas, indicating that rural education has become a global issue (Beach et al., 2019; Ciftci & Cin, 2018; Downes & Roberts, 2018). The competence of instructors is crucial to rural education and the development of students' core abilities. Therefore, the development of rural education cannot be attained without teachers of exceptional quality and with qualified teaching competency.

Competency-based education is encouraged within the context of China's new curriculum reform, as science courses are essential for developing the pupils' scientific literacy. It is obvious that the proficiency of science teachers determines the quality of science education. Consequently, emphasis should be placed on the competency of rural science teachers (Chin, 2005). The promotion of pupils' competence and the standard of rural science education would both benefit from the teaching competency of rural science teachers reaching a qualified level. Some researchers have defined the requirements that competent teachers need possess, providing references and suggestions for the professional development of beginner teachers (Darling-Hammond & Baratz-Snowden, 2007; Esau & Maarman, 2019). In response to the COVID-19 pandemic, Caena and Vuorikari (2021) established a system of teacher competence applicable to teachers of many subjects. It has been determined that the study of general teaching

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competency has matured to the point where it can be used to measure the core competencies of teachers in various subjects. However, it had the disadvantage of being unable to highlight the competency features of practice-oriented science teachers. Although there were relevant studies which stressed the competency required of science teachers, such as scientific inquiry, there was little research that completely constructed science teachers' comprehensive competencies, particularly rural science teachers (Alake-Tuenter et al., 2012; Avraamidou & Zembal-Saul, 2010; Ramnarain, 2014).

Rural education has received widespread attention, and the frontline rural teaching force is still primarily stabilized through macro policies. Attempts to prepare teachers specifically for rural areas remain limited, and rural science teachers' competencies fall short of standards (Azano & Stewart, 2016; Monk, 2007). The research aimed at establishing the Teaching Competency of Rural Science Teachers (TCRST) instrument and applying it to examine differences in the teaching competencies of urban and rural science teachers. This research can help educational researchers build expected teaching competency standards, as well as encouraging more rural science teachers in conducting self-assessments of teacher competence.

Literature Review

"Teaching competency" is closely tied to teaching skills and learning environments, all of which teachers need to acquire in order to deal with a variety of teaching scenarios (Caena, 2014). Blomeke et al. (2015) pointed out that "competence" was a broad term from a holistic perspective, and from an analytical standpoint, noted that "competency" refers to the components of competence. With an emphasis on categorizing and describing particular cognitive capacities, "competencies" were defined as cognitive capacities and skills. In this study, teaching competencies reflected the abilities required of secondary school teachers to manage daily situations. As for the dimensions of science teaching competencies, Alake-Tuenter et al. (2012) listed four factors: lesson preparation, adaptation of curriculum, scaffolded inquiry teaching, and evaluation. De Putter-Smits et al. (2012) asserted the importance of managing instructional contexts, regulation, emphasis, design, and innovation. In addition, the ability of teacher research was also considered as one of teacher's core competencies (Zhu & Wang, 2014), which was being described as a significant dimension of professional development increasingly (Campbell et al., 2004; Cochran-Smith, 2003).

Pedagogical Design

Pedagogical design (PD) is the cornerstone of teacher competencies and a prerequisite for implementing, assessing, and conducting educational research. Brown (2009) characterized it as the teacher's ability to design instructional episodes by recognizing and employing available resources, including teacher resources (subject knowledge and attitudes) and curriculum resources (teaching goals, domain representations, and tasks). As a vital component of pedagogical design, course materials have attracted a great deal of academic attention (Beyer & Davis, 2012). In addition, the analysis of previous knowledge and lesson goals, understanding students, and choosing strategies should also be considered within the framework of pedagogical design abilities. For instance, Davis et al. (2011) outlined the characteristics of pedagogical design abilities with a deep understanding of students and the achievement of pedagogical goals. John (2006) illustrated the seven basic components of pedagogical design: student engagement, disciplinary materials, curriculum, resources, classroom management, professional values, and activities. Besides, Zhang et al. (2017) divided science teachers' pedagogical design abilities into six areas: analyzing teaching materials, understanding learners, making goals, analyzing teaching contents, designing the teaching processes and teaching strategies, and choosing resources as well as media.

Teaching Implementation

Teaching implementation (TI) is a vital step in putting pedagogical design and planning into practice. Many scholars, such as Beyer and Davis (2012), and Wu et al. (2018) mentioned that the effectiveness of teaching may be improved by fostering a positive learning atmosphere to encourage interaction and cooperation among pupils, as well as motivating pupils to actively engage in the learning process. Additionally, practical work also attracted the attention of many researchers. Simpson and Brown (1977) noted the introduction of

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techniques, preparation for laboratory procedures, and hands-on experience. Beasley (1982) attached great importance to focusing on laboratory work, scientific inquiry, and information technology. What' more, international organizations such as UNESCO exerted considerable importance on the enhancement of teachers' information technology competence, who published a Competency Framework for Teachers in Information Technology (2008). As a consequence, quite a few scholars have begun to discover the significant contribution of information technology. For example, Forbes and Davis (2010) employed computer software to assist science teachers in the development of effective instructional practices. Karagozlu (2021) discovered that AR practices facilitated classroom participation and students' comprehension about science themes.

Learning Evaluation

Regarding learning evaluation (LE), the content evaluates students' science learning with a focus on their scientific achievements and performance in activities. Scholars discovered that the majority of instructors concentrated more on the correctness of students' responses than on their thoughts (Larkin, 2012; Levin et al., 2009; Talanquer et al., 2015). Therefore, science teachers should improve the ability of learning evaluation that promotes meaningful learning and sustained inquiry. Nevertheless, there existed international evaluation research that only paid attention to one evaluation component, as Aydeniz and Dogan (2016) evaluated and gave feedback on the process of science learning. Hensiek et al. (2016) measured students' hands-on laboratory skills through digital experiments. Likewise, there were studies that covered several aspects of evaluation. Bell and Cowie (2001), and Tulloch (1986) attached great importance to teachers' assessment of learning processes as well as assessment of academic quality. Despite certain distinctions in subject and content, the authors of the aforementioned study on science teachers' assessment placed a particular focus on the evaluation capacity to acknowledge and correct instructional flaws.

Teacher Research

Since the late 1980s, there has been a movement that teachers are viewed as "thinkers" and "knowers" who should actively engage in research and possess specific understanding of their teaching and learning process, which has sparked great research interest in teacher research (TR) (Cochran-Smith & Lytle, 1999). Given that teacher research benefits teachers' continuous learning and student accomplishment, it should be a core competency for science instructors (Mitchell et al., 2009; Sperling & DiPardo, 2008). As for the items of teacher research, Castle (2006) proposed seven items: being conscious of problems, posing questions, consulting others for knowledge, responding, and sharing conclusions with others, etc. Additionally, Dobber et al. (2012) presented a set of relevant aspects in the research procedures, including the collection of data, the presentation of research proposal, the data processing, and the reporting of the results. Alake-Tuenter et al. (2012) subsequently enumerated the teacher's comprehension of research abilities, which included raising questions, looking for specific information, formulating plans, conducting research, analyzing and interpreting data, communicating and presenting conclusions.

Research Focus

According to the literature review of the framework of teaching competency, 21 items were arranged, adapted, and derived from previous research for the four dimensions of teaching competency: PD, TI, LE, and TR. These dimensions were used as the foundation for designing the TCRST to assess the teachers' self-perception towards teaching competencies of rural science teachers. The specific research questions were set:

RQ 1: What empirical evidence supports the validity and reliability of the TCRST instrument?
RQ 2: What differences in self-perception of teaching competencies exist between rural and urban science teachers?

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Research Methodology

Instrument Development

The survey instrument was a paper-and-pencil questionnaire that was designed in three stages. The first step came with the development of the TCRST. Based on the literature review, this study constructed a theoretical framework of rural teachers' competency and summarized four dimensions: PD, TI, LE, and TR. As shown in Table 1, a total of 21 items were condensed and their connotations were defined. "I can arrange or design..." was used to restate each item in the questionnaire, and scores were formatted using a 5-point Likert scale. Subsequently, the research group's feedback was submitted to evaluate the item attributes, the adequacy of item expressions, and any potential linguistic ambiguities. These four dimensions and the 21 TCRST items eventually achieved adequate agreement, symbolizing the formation of the initial questionnaire.

The second step was the validation of the TCRST. Before applying the questionnaire, the study gathered data from Chinese science teachers to validate the initial instrument. The recovered questionnaires were then utilized to examine the reliability and validity of the initial instrument using EFA and CFA. The EFA would be used to discover what factors emerged from the data, and the CFA would be used to check whether these factors could hold up under close examination.

Through questionnaire development and validation, a final instrument was generated with 6 items in the PD, 6 items in the TI, 4 items in the LE, and 5 items in the TR. The TCRST would be employed to measure the self-perception towards teaching competencies of rural science teachers and compare them to those of urban science instructors. Figure 1 depicts the specifics of the three-step procedure.

Participants

In this research, the data collections from participants were divided into three periods. The first two phases took place in 2019 and involved science teachers from different cities in Shandong province, China. In order to clarify the structure of instrument, 286 science teachers participated in the pilot study (Group 1), containing 107 males and 179 females respectively. To collect additional empirical evidence for the instrument's validation, 617 science teachers were randomly selected from different schools in Shandong province. Considering the invalid questionnaires, 457 science teachers were included as the final sample (Group 2; recovery rate: 74.1%), consisting of 172 males and 285 females. Given the instrument's success in passing validity testing, the research conducted the third round of distribution and collection in 2020, in which 519 science teachers in Zhejiang province were randomly invited to participate in the evaluation of self-perception towards teaching competencies. Among them, 393 valid questionnaires were finally analyzed (Group 3; recovery rate: 75.7%), with 188 urban teachers and 205 rural teachers.

All science teachers who participated in this study were informed of their rights and volunteered to undertake the research. They were assured that all personal information would be treated confidentially and anonymously and that the survey would contribute to the improvement of rural science teachers' teaching competency.

Statistical Analysis

The statistical analysis of this research comprised EFA, CFA, the chi-square test, and independent sample *t*-tests. The questionnaires were finalized with the support of EFA and CFA. Using SPSS 22.0, the EFA was carried out to clarify the factor structure. The AMOS 26 software was then utilized to execute the CFA test in order to determine whether the actual data matched the teaching competency model. On the basis of the final instrument, the research deployed the chi-square test to examine the variations in demographic characteristics between urban and rural teachers and independent sample *t*-tests to explore the rural-urban differences in teaching competency.

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Figure 1
The Specific Steps for Instrument Development, Validation and Application

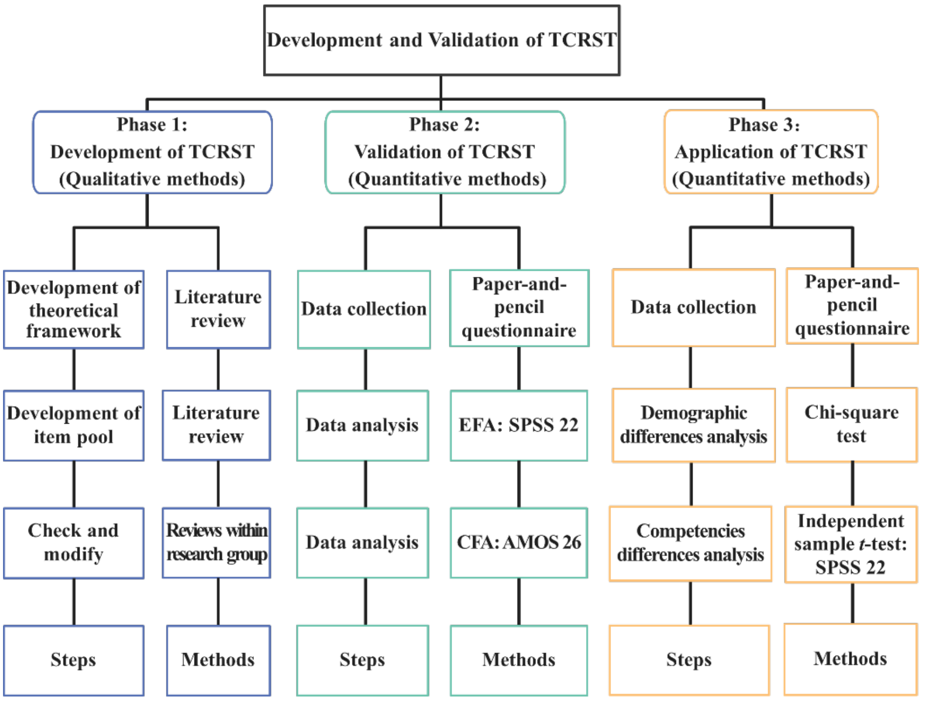

Table 1
Dimensions and Measuring Items of the Initial Version of TCRST (21 Items)

Dimensions	Items	Measuring Items	Literature Resources
Pedagogical Design	PD 1	I can analyze the teaching materials' content composition, connectivity, and educative value.	Beyer and Davis (2012)
	PD 2	I can analyze pupils' knowledge, experience, cognitive and emotional development.	
	PD 3	I can design instructional objectives based on curriculum standards, textbook materials, and learner traits.	
	PD 4	I can design, arrange, and orchestrate teaching processes and sessions based on essential themes and challenges.	
	PD 5	I can design science learning activities depending on tasks and challenges.	John (2006)
	PD 6	I can choose teaching tactics, materials, and media technologies for a given content and lesson style.	Zhang et al. (2017)
Teaching Implementation	TI 1	I can motivate students' motivation to learn through vivid, concrete lessons.	Wu et al. (2018)
	TI 2	I can create authentic learning settings by choosing resources and background information based on content and students' experiences.	Alake-Tuenter et al. (2012)
	TI 3	I can correctly operate, demonstrate, and guide experiments and I can improve or innovate teaching experiments.	Forbes and Davis (2010)
	TI 4	I can organize science-based inquiry-learning activities and encourage students' participation.	Simpson and Brown (1977)
	TI 5	I can use information technology and multimedia.	
	TI 6	I can create an open learning environment, let students communicate, and stimulate cooperation and discussion.	

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Learning Evaluation	LE 1	I can track students' learning and assess students' performance using varies methods.	Bell and Cowie (2001)
	LE 2	I can scientifically analyze students' learning after a unit.	Tulloch (1986)
	LE 3	I can systematically evaluate the students' practical inquiry process and results.	Hensiek et al. (2016)
	LE 4	I can provide timely feedback, guidance, and correction to students, based on academic quality and performance in classroom.	
Teacher Research	TR 1	I can recognize my teaching deficiencies and raise research issues.	Zhu et al. (2013)
	TR 2	I can search, collect, and analyze the relevant literature for the problem.	Dobber et al. (2012)
	TR 3	I can select proper methods based on study objectives and issues, construct research plans, and analyze the feasibility.	
	TR 4	I can conduct research using a protocol and a scientific method.	Castle (2006)
	TR 5	I can articulate my research findings and opinions by writing research reports.	

Research Results

Exploratory Factor Analysis

The research employed EFA to identify and interpret the latent factors of the instrument. The sample of 286 science instructors was suitable to perform EFA analysis with the high KMO value (.93), and the value of Bartlett's test was significant (χ^2 = 2657.55, *df* = 210, and $p < .001$). Subsequently, the rotated component matrix could be used to discover the prominent factors, which showed that 21 items were classified into four factors with factor loadings ranging from .40 to .79, indicating the 21 items could all be retained. As can be seen in Table 2, the total variance explained is 58.80%, the Cronbach's alpha for the four factors is .87, .77, .79, and .78, respectively, and the overall alpha is .92, suggesting the four factors have highly acceptable reliability. According to the EFA results, the four factors were extracted as PD, TI, TR, and LE.

Table 2
Indices of EFA on the TCRST Instrument

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1: Pedagogical Design (PD), α = .87, *M* = 4.48, *SD* = 0.33				
PD 1	.71			
PD 2	.64			
PD 3	.77			
PD 4	.79			
PD 5	.70			
PD 6	.58			
Factor 2: Teaching Implementation (TI), α = .77, *M* = 4.31, *SD* = 0.42				
TI 1		.69		
TI 2		.57		
TI 3		.57		
TI 4		.61		
TI 5		.40		
TI 6		.55		

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	Factor 1	Factor 2	Factor 3	Factor 4
Factor 3: Teacher Research (TR), α = .79, *M* = 3.92, *SD* = 0.55				
TR 1			.57	
TR 2			.74	
TR 3			.78	
TR 4			.74	
TR 5			.54	
Factor 4: Learning Evaluation (LE), α = .78, *M* = 4.33, *SD* = 0.37				
LE 1				.57
LE 2				.63
LE 3				.58
LE 4				.71
Eigenvalues	8.20	1.75	1.35	1.05
% of variance	18.44	14.21	14.09	12.06
% of cumulative	18.44	32.65	46.74	58.80

Confirmatory Factor Analysis

Different from EFA, CFA seeks to clarify the structure of the four-factor model (Figure 2). The fitness of the items (χ^2 = 462.582, *df* =179, RMSEA = .06, GFI = .91, NFI = .94, RMR = .02) showed that the four-factor model was a satisfying structure, as seen in Table 3. In addition, the factor loadings and *t*-values range from .65 to .89, showing significance at the .05 level, indicating that the construction has good convergent validity. The values of AVE are all accessed to be larger than .50. Besides, the values of CR range from .89 to .91, higher than .70 (Hair et al., 2010). Table 4 provides specific details. There was no denying that adequate evidence was presented to support the convergent validity and reliability of TCRST to evaluate science teachers' perceptions of teaching competency.

Figure 2
The TCRST Model with 21 Items

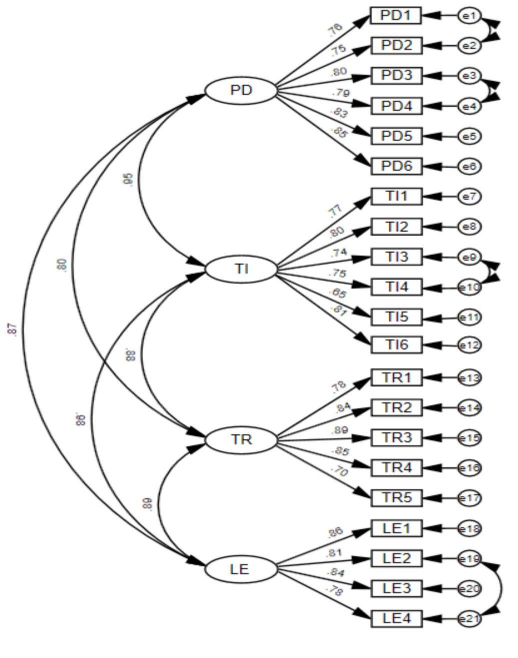

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Table 3
Model Fitting Index of the TCRST Instrument

Goodness-of-Fit Indexes	χ^2/df	Absolute Fit Indices			Relative Fit Indices				
		RMSEA	GFI	RMR	NFI	RFI	CFI	IFI	TLI
Calculated Values	2.58	.06	.91	.02	.94	.93	.96	.96	.96
Fit Criteria	≤ 3	≤ .08	≥ .90	≤ .08	≥ .90	≥ .90	≥ .90	≥ .90	≥ .90

Table 4
Indices of CFA on the TCRST Instrument

Factors	Items	Standardized Factor Loading	AVE	CR
PD	PD 1	.76	.64	.91
	PD 2	.76		
	PD 3	.80		
	PD 4	.79		
	PD 5	.83		
	PD 6	.85		
TI	TI 1	.78	.57	.89
	TI 2	.80		
	TI 3	.74		
	TI 4	.75		
	TI 5	.65		
	TI 6	.81		
TR	TR 1	.78	.66	.91
	TR 2	.84		
	TR 3	.89		
	TR 4	.85		
	TR 5	.70		
LE	LE 1	.86	.68	.89
	LE 2	.81		
	LE 3	.85		
	LE 4	.78		

Differences in Demographic Variables

In order to verify the distribution of urban and rural science teachers, the research examined the variations in demographic factors using the chi-square test. Regarding gender, educational background, as well as title, there were significant differences between urban and rural science instructors ($p < .05$, $p < .01$, $p < .01$). Moreover, there was no significant difference in teacher training ($p > .05$). The specific results are shown in Table 5.

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The results showed that there were considerably more male teachers than female teachers in rural areas. The distribution of science instructors with master's degrees and junior college degrees (experts with extensive teaching experience) was much higher in urban schools. Additionally, in rural schools, second-level and third-level teachers were more common than advanced and first-level teachers, who were more prevalent in urban schools. Although the indicator of teacher training didn't approach statistical significance, it was clear that scientific teachers who completed education courses were more concentrated in urban areas.

Table 5
Demographics of Science Teachers in the Phase 3

Variable	Category	Urban (%)	Rural (%)	χ^2	*p*
Gender	Male	41.9	58.1	333.87	.049*
	Female	59.5	40.5		
Teacher Training	More	53.5	46.5	1.641	.117
	Rarely	45.0	55.0		
Educational Background	Junior college	77.0	23.0	595.481	.007**
	Bachelor	40.6	59.4		
	Master	80.9	19.1		
Title	Advanced	66.1	33.9	715.326	.004**
	First-level	60.3	39.7		
	Second-level	32.8	67.2		
	Third- level	32.9	67.1		

Notes: * < .05, ** < .01; The title is reduced from top to bottom.

Differences in School Region

In addition to examine the validity of the TCRST, the study further conducted a comparative analysis to explore the differences in teaching competencies between urban and rural teachers. The research revealed that urban teachers scored higher than rural teachers on all dimensions of teaching competencies, demonstrating a significant disparity between urban and rural teaching standards. Teaching implementation receives the greatest scores from both urban and rural teachers, the scores are 8.30 and 8.02, respectively. Likewise, the lowest scores for both urban and rural science teachers are in the same dimension, teacher research, where they score 7.43 and 7.13, correspondingly. Regarding pedagogical design and learning evaluation, urban science teachers obtain scores of 8.13 and 8.19, whereas rural science teachers receive scores of 7.92 and 7.82, respectively. Further conducting independent sample *t*-tests, the results showed that there were significant differences between urban and rural science teachers on certain dimensions, which were teaching implementation (p = .017< .05) and learning evaluation (p = .004< .01), as shown in the Figure 3.

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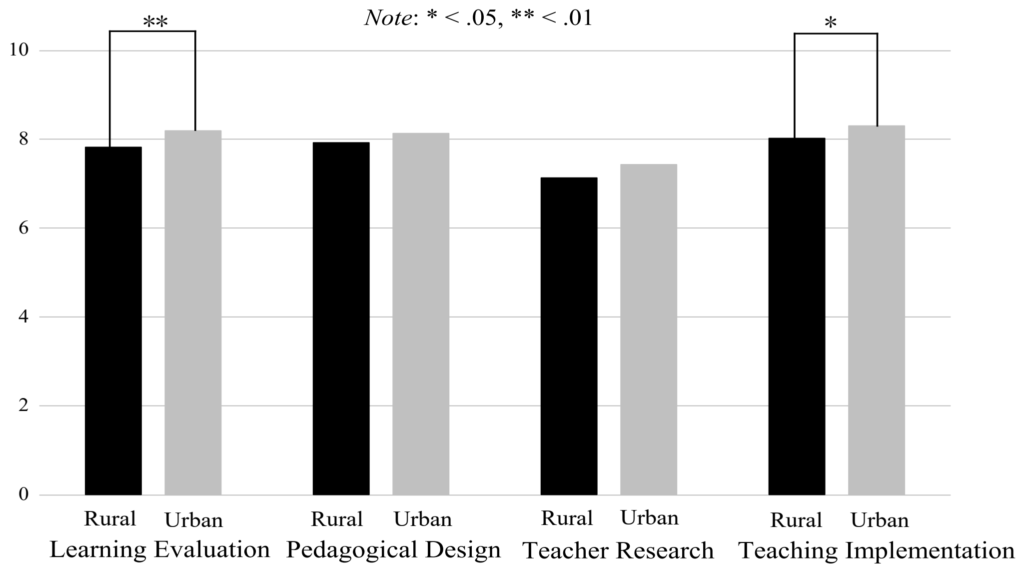
Figure 3
Differences between Urban and Rural Science Teachers on Each Dimension



Discussion

The study aimed at measuring the self-perception towards teaching competency of Chinese rural science teachers and exploring the rural-urban differences using the instrument developed in this research. For RQ1, the survey constructed an initial theoretical framework based on the literature review. The EFA was then employed to discover what factors emerged from the data, with the construct validity and reliability of the initial instrument being reported. Subsequently, the convergent validity of the TCRST model was evaluated using CFA. On the whole, TCRST was demonstrated to be a valid and reliable instrument.

For RQ2, the research was divided into two parts to examine the differences between urban and rural teachers. Part 1: The study examined the rural-urban differences across demographic characteristics, results indicated significant differences in gender, educational background, and title. Firstly, the study addressed the disparate gender distribution among urban and rural teachers. The immense pressure of teaching in rural schools mandates that male teachers shoulder the responsibility. The second finding was that teachers with master's degrees and extensive teaching experience were primarily situated in urban schools. This may be due to the fact that teachers with great educational background prefer urban schools with superior teaching environments. Lastly, urban schools were found to have a greater proportion of teachers with the higher title. In China, urban schools continue to lure outstanding rural teachers for more promotion quotas than rural areas. Additionally, significant opportunities for professional development contribute to the advancement of urban teachers (Peng et al., 2014). Part 2: The rural-urban differences of teaching competency of Chinese science teachers were explored using TCRST. There is a critical role for teachers in providing meaningful and equal science learning for both rural and urban students, which requires a focus on science teachers' competency. Yet the survey still perceived significant differences between urban and rural teachers, which was in line with existing research (He et al., 2021; Liu & Onwuegbuzie, 2012). The research revealed that teachers in urban and rural areas showed strikingly different teacher competencies on these two dimensions: teaching implementation and learning evaluation, which was consistent with the existing studies (He et al., 2021).

When referring to teaching implementation, the uneven distribution of resources is the main reason undoubtedly (Zhou et al., 2004). To cope with this problem, substantial educational resources are allocated to rural areas, including the incorporation of digital educational resources into teaching practices and the construction of information and communications technology (ICT) policy. Nonetheless, due to a lack of experience in technological

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learning, the majority of rural teachers fail to use these tools skillfully (Wang et al., 2019). Moreover, the Science Curriculum Reform of Compulsory Education of China (Ministry of Education, 2022) aims at reorienting the idea from emphasizing test scores to encouraging sustainable development and lifelong learning. When faced with increased class sizes and limited time, it can be challenging for rural science teachers to implement innovative teaching strategies (Wang, 2011).

The establishment of the National Assessment of Educational Quality (NAEQ) also illustrated the importance of evaluating students' learning. The differences between urban and rural teachers' teaching evaluations may be closely related to the following factors: teacher shortages in rural areas force science teachers to teach many subjects, and the pressure of large class sizes also makes it extremely difficult to assess (Li et al., 2020). In contrast, urban teachers are not only free of these concerns but are also offered more opportunities for professional development (Sargent & Hannum, 2009). Consequently, they are generally equipped with advanced concepts, such as theoretical knowledge and implementation methods of learning evaluation. When rural teachers remain stagnant in evaluating students' final grades, urban teachers have been able to replace the traditional ideas with multiple methods and perspectives to systematically assess students' learning processes, scientific inquiry processes, etc.

The pedagogical design is an essential prerequisite for the successful implementation. How can teachers assess their success if teaching goals are not clearly established from the start? It is impossible to implement teaching without first going through the logical cycle of setting goals, deciding on methods, choosing resources, arranging activities (Tyler, 1949). However, the results revealed that the pedagogical designs of both urban and rural teachers were inferior to their teaching implementation. Even if rural teachers are in short supply, each science teacher should nevertheless devote considerable time and effort to lesson plan preparation. Although the planned procedures may not always correspond with instructional activities, teachers need occasionally be flexible and adaptable in the classroom (Hatch & Clark, 2021).

The results showed that urban and rural teachers needed to make the most progress in the fourth dimension, teacher research. It was obviously evident that science teachers failed to reflect the lengthy history of the teacher research movement. Even though science teachers are aware of the value of teacher research, it is still challenging to make a difference (Lunenberg et al., 2007). Ermeling (2010) discovered that significant improvements were more likely to occur when instructors worked in teams in stable contexts, employed inquiry-based procedures, and were directed by qualified leaders. Furthermore, several studies have discovered that a professional community in which teachers communicate their findings or collaborate to undertake research is an essential prerequisite for teacher research (Cochran-Smith & Lytle, 2009; Lunenberg et al., 2007).

Conclusions and Limitations

Rural education has always been a hot topic and a challenging one in all countries. In comparison to previous studies of science teachers, less attention has been paid to the comprehensive teacher competencies required of rural science teachers. This study constructed a competency structure for rural science teachers that included 21 items and four dimensions: pedagogical design, teaching implementation, teacher research, and learning evaluation. Using TCRST with good reliability and validity, the research analyzed differences in teaching competencies between rural and urban teachers. Science teachers in rural areas as well as educational researchers can greatly benefit from this study. On the one hand, rural science teachers can undertake a self-assessment of their competence based on the four dimensions. On the other hand, the TCRST model is expected to inspire educational researchers to propose competency criteria for rural science teachers. Additionally, this research is dedicated to drawing the attention of educational researchers and education authorities to the need to establish effective policies and provide competence-based training for rural teachers to eliminate the disparities between rural and urban teachers (especially the aspects of teaching implementation and learning evaluation).

The limitations of this research should be acknowledged. Further qualitative strategies or mixed methods, such as observing rural science teachers in the classes or conducting in-depth interviews, should be employed to acquire a real picture of their competencies. Moreover, since there is lack of particular documents and criteria specifically for rural science teachers, the construction of TCRST model relies more on competence documents issued by other nations. Given this, the research is considered to promote the establishment of professional standards for Chinese rural science instructors.

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Declaration of Interest

The authors declare no competing interest.

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