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The perceived teacher support scale (PTSS) for students: Development and psychometric studies

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ABSTRACT

This study developed a brief student-reported Perceived Teacher Support Scale (PTSS) to assess how well students felt supported by their teachers. Using a theory-driven approach, the PTSS with instrumental, emotional, informational, and appraisal support subscales was developed based on the framework of social support. A total of 1,138 middle school students in grades seven to ten from middle schools in mainland China participated in this survey. The psychometric features of the PTSS were studied using factor and Rasch analyses. Exploratory factor analysis revealed a three-factor model while confirmatory factor analysis supported three- and four-factor solutions. The Rasch analysis further demonstrated the psychometric quality of the four subscales: scale dimensionality, rating scale functioning, and item fit. Measurement invariance across gender was confirmed. The final PTSS had 25 items in four subscales evaluating students' perceived teacher support: instrumental, emotional, informational, and appraisal support. The correlation between the PTSS and student engagement supported concurrent validity. Finally, the study's limitations and implications are discussed. In general, the PTSS scale is a more effective tool for measuring students' perceived teacher support. It can be used to understand the situation of teacher support in different dimensions, and can also be used to conduct relevant cross-sectional and longitudinal research experiments.

1. Introduction

For a long time, researchers have focused on teacher support. According to sociology, psychology, and educational studies, student outcomes such as academic performance, motivation, and engagement benefit from teacher support. (e.g., Ahmed et al., 2010; Liu et al., 2017; Niehaus, Rudasill & Rakes, 2012). Teachers need to give students cognitive, metacognitive, social, emotional, practical, and physical abilities to help them succeed, learn, and grow (OECD, 2021). Frequently, teacher support is necessary to ensure that students comprehend and master these skills. Evidently, students need support from multiple sources, and teacher support may be a key source for promoting student development (Lozano Botellero et al., 2023; Metheny et al., 2008). Teacher support is widely recognized, yet its definition varies by culture, nation, and region. Trickett and Moos (1973) define teacher support as students' belief that their teachers care about them and will help them. Ryan and Patrick (2001) argue that teacher support is the caring, understanding, commitment, dependability, and friendliness of teachers toward their students. In a broader sense, the support that teachers offer to their pupils can be seen as a complex entity with multiple dimensions, including informational, instrumental, emotional, and

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appraisal support (House, 1981; Tardy, 1985).

Adolescence is a period of rapid developmental change in multiple areas, including identity formation, peer relationships, and the pursuit of autonomy (Eccles & Roeser, 2009). Adolescence, especially early to middle adolescence (roughly corresponding to grades 7–10), is a crucial period of transition. During these years, teenagers experience profound physical, emotional, and cognitive changes. They face increasingly complex academic demands in school, greater social pressures, and the challenge of developing their own identity and autonomy. Therefore, teacher support is critical during this time. Teachers can provide a steadying influence and offer the necessary guidance and support to meet the challenges students face (Reddy et al., 2003). Given the developmental and contextual changes that occur during adolescence, considering how teacher support is constructed and perceived across different periods, is critical. For older students who face more complex academic and social challenges, the types of support that are most effective in primary school may not be sufficient or appropriate, compared to middle school. For example, while younger students may require more direct and overt forms of instrumental support, older students may benefit more from informational and assessment support that could help them develop independent learning strategies and a strong academic self-concept. By focusing on students in grades 7–10, this study addresses a critical period of adolescence, during which the nature and impact of teacher support may differ from what was provided in earlier stages of education. Understanding these differences can inform the development of interventions and support strategies designed to meet the needs of adolescents.

One significant challenge associated with teacher support research is the lack of solid instruments. Examples of measurement instruments in this domain include the Teacher Support Scale(TSS) developed by Farmer et al. (1981), the Child and Adolescent Social Support Scale (CASSS) by Malecki et al. (2003), and the Teacher Support Subscale of the Social Support Scale for Children and Adolescents (SSSCA) by Harter (1985). These scales have limitations; they have too few items to cover the full range of teacher support adequately. Metheny et al. 's (2008) Teacher Support Scale (TSS), used as an independent measurement tool, does not fully fit its underlying theory. Although some items correspond to the relevant dimensions as the theory specifies, many items still cannot correspond. Theoretically, this study sought to create an updated and complete student-reported instrument for perceived teacher support. The significance of developing such an instrument is twofold: (1) to rigorously assess students' perceived teacher support in learning and (2) to help explore related research on teacher support and other concepts.

2. Literature review

2.1. Theoretical framework

Teacher support is commonly interpreted from two theoretical perspectives, i.e., social support theory (House, 1981; Tardy, 1985;) and self-determination theory (Deci & Ryan, 2000; Ryan & Deci, 2000).

Teaching in a way that caters to students' individual needs is central to the self-determination paradigm of education. Classrooms that practice need-supportive education can better meet students' demands for relatedness, competence, and autonomy. According to Stroet et al. (2013, 2015), teachers who practice need-supportive teaching help students achieve their needs for competence, relatedness, and autonomy by offering structural support, engagement support, and autonomy support, respectively. Thus, these three unique forms of teacher support are given greater weight under self-determination theory to foster students' intrinsic drive. Autonomy support is the degree to which teachers allow students to make connections between their learning and personal interests. Structural support provides direction, encouragement, clarity, and constructive criticism (Stroet et al., 2013, 2015). Supporting students through involvement entails spending time with them, showing concern, enjoying their company, tolerating them, and even providing them with resources.

The social support model defines teacher support as the perception and reality that a person is cared for, can obtain help, and is part of a supportive social network (House, 1981). House (1981) classified support as instrumental, emotional, informational, and appraisal. Instrumental support provides tangible tools and situations to aid student learning. Trust, empathy, and love are emotional support types. Informational support provides students with advice, suggestions, and other information. Appraisal support refers to support provided through feedback. House's (1981) conceptualization of support is the most commonly used classification method (Langford et al., 1997; Sarason et al., 1987) and is also frequently used in research on perceived teacher support (e.g., Harter, 1985; Malecki & Demaray, 2003; Peeters et al., 1995; Santiago et al., 2023; Shakespeare-Finch & Obst, 2011; Tardy, 1985). House's framework is widely used, and its four categories cover most of the content of teacher support. Later, Tardy (1985) expanded on this strategy by clarifying the operational definitions of the four dimensions. Combining House and Tardy's descriptions supported the project and ensured content validity, which was then used in this study. The brief operational definition of teacher support in Table 1 is

Table 1
Operational definitions and example items.

Dimension	Definition	Example items
Instrumental support	Provide tangible resources and conditions to promote students' learning.	My teachers will take the time to help me when I need help for my study.
Emotional support	Provide trust, empathy, and love	My teachers trust me.
Informational support	provide students with advice, suggestions, guidance, and other information.	My teachers provide information to assist me in solving problems myself.
Appraisal support	provide feedback	My teachers give me feedback about my learning tasks.

based on the literature on both.

Teacher support plays a critical role in educational settings. Since teachers and students spend plenty of time together in the classroom, teacher support significantly impacts both students' academic development and affective outcomes (Lei, Cui & Zhou, 2018). Students perform better and are more motivated to learn when they perceive their teachers as supportive (Ricard & Pelletier, 2016). Research has indicated that emotional support from educators is linked to improved student affective outcomes, including self-efficacy, academic enjoyment, and learning engagement (Lee, 2012; Ruzek et al., 2016; Sakiz et al., 2012). Increased intrinsic motivation and decreased anxiety are also associated with teacher support (Pitzer and Skinner, 2016; Ricard & Pelletier, 2016; Yu and Singh, 2016). There was a strong correlation between these outcomes and tangible, practical support from teachers, according to research by Federici and Skaalvik (2013).

This contrasts teacher support under self-determination theory, which focuses primarily on teacher support related to promoting intrinsic motivation. The types of teacher support under the social support model are more holistic, and the content covered is more extensive and universal. Considering the purpose of developing student-report scales to assess students' perceptions of various teacher support and evaluate the learning outcomes resulting from teacher support, it is recommended that House's (1981) widely used four-factor framework of social support be adopted.

In China, the teacher-student relationship is traditionally characterized by students' high level of respect for teachers, who are viewed as authority figures and sources of knowledge. This respect is deeply rooted in Confucian values, which emphasize the importance of hierarchical relationships and education (Chien et al., 2024). This has had a significant impact on educational practices in China. Compared to education settings in Western cultures, relationships between teachers and students in China tend to be more formal and focused on obedience, while those in Western countries tend to prioritize equality and emotionally supportive relationships (Fabris et al., 2023). In Chinese classrooms, teacher support is often associated with academic guidance, strict discipline, and moral education; for example, teachers should provide guidance and authority in students' academic and personal development. Therefore, a teacher support scale developed in China may place a greater emphasis on academic assistance and guidance. In contrast, a greater emphasis on emotional support and cultivating interpersonal relationships may be placed in Western contexts.

2.2. Extant instruments for teacher support

The importance of teacher support in educational contexts does not appear to coincide with the development of scales to measure it. Teacher-supported scale development has received insufficient attention. As mentioned earlier, the commonly used teacher support instruments under the social support concept are the TSS (Metheny et al., 2008), TSS (Farmer et al., 1981), and Teacher Support Subscale of SSSCA (Harter, 1985). However, these instruments are only used with limitations.

First, Metheny et al. (2008) created and verified TSS. This scale was designed to assess teacher support. Originally, the 27-item TSS assessed student views of teacher support. Nevertheless, the results of CFA show that the four-factor model (positive regard, invested, accessible, and expectations) does not effectively consider the statistical evidence. The invested, positive regard, and accessible factors represented instrumental, emotional, and informational support. None of the factors supported the appraisal. The authors also admitted that the four-factor structure of the TSS was different from the four-factor structure of House (1981) and Tardy (1985) and that it was impossible to find factors corresponding to appraisal support, and new items needed to be added. The author hoped that this scale would be supplemented with theoretical support. Considering the above shortcomings, developing a new instrument to make up for the shortcomings in theory and model fitting is necessary.

The Career Motivation and Achievement Planning (C-MAP) was created by Farmer et al. (1981) using data from 1863 US ninth and twelfth graders and includes the TSS, a short, student-reported scale. Although the psychometric properties are acceptable, they have significant limitations. It has only one dimension and few items and has a low coefficient α value. As one of many subscales, it is not easy to cover the content of teacher support comprehensively. Similar problems exist for subscales that are part of a larger measurement instrument, such as SSSCA (Harter, 1985), CASSS (Malecki et al., 2003).

Some teacher support scales are designed based on self-determination theory. The Teacher as Social Context Questionnaire assesses students' perceptions of teachers' behaviours in supporting autonomy, competence, and relatedness as well as how teachers provide an environment that fosters students' psychological needs through involvement, structure, and autonomy support. The scale includes items that reflect how teachers interact with students, provide guidance and feedback, and create a supportive classroom climate (Belmont et al., 1988). The Learning Climate Questionnaire by Williams and Deci (1996) was adapted from the Health-Care Climate Questionnaire (Williams et al., 1996) and is designed to measure the extent to which students perceive their learning environment to be supportive of autonomy. The Perceived Autonomy Support Scale for Exercise Settings measures autonomy support in physical education settings. It assesses students' perceptions of teachers' behaviours that promote autonomous exercise motivation. The scale includes items that assess whether teachers provide meaningful justifications, offer choices, and acknowledge students' opinions and feelings about physical activities (Hagger et al., 2007).

Measuring instruments are essential tools for acquiring reliable, scientifically-based knowledge and facilitating theoretical advancements in various social science disciplines (Rammstedt & Bluemke, 2019). Developing a focused, theory-driven scale would allow for accurate measurement of students' perceived teacher support, which is crucial for research in this area.

The current teacher support scales are limited by a restricted number of items and fail to encompass the four dimensions of teacher support comprehensively. Previous studies have serious limitations in terms of content coverage and fit of the model. To address these limitations, this study developed items based on a four-factor model, selecting from scales with established reliability and validity to ensure robust content validity.

3. Method

This study used social support to (1) design a self-report instrument to assess students' perceived teacher support and (2) test its reliability and validity with 1138 students. Factor and Rasch analyses were used. The multidimensional Rasch model was employed since the four aspects of teacher support are connected. Unlike the one-dimensional Rasch model, the multidimensional model calibrates all subscales concurrently, allowing for correlation evaluation and improved measurement accuracy. Response category functioning, item fit statistics, and gender-based differential item functioning were studied using multiple Rasch analysis indicators. Following Messick's (1995) methodology for validity, this study examines the instrument's content, substantive, structural, generalizability, while excluding the external and consequential aspects of validity. Content validity was ensured through a theoretically driven process of scale development and expert review. Scale development is guided by a four-dimensional theoretical framework (e.g., House, 1981; Tardy, 1985) that ensures substantive validity and is supported by evidence from item fit statistics, the empirical hierarchy of item measures in Rasch analysis, and response category functioning. The CFA and EFA evaluated the validity of the structure. Sex-specific DIF analysis demonstrated transferability. Teacher support and student engagement are related, so the Student Engagement Scale (SES) and PTSS were associated to evaluate concurrent validity. The SES is a self-report scale for student engagement (Lam et al., 2014).

3.1. Item development

Since the items were written in Chinese, the students from China were the ones who filled out the scale questions. Before conducting the interviews, we carried out a literature review to establish a theoretical framework and identify existing measures relevant to the research concepts. The scale items from the relevant literature were not used directly but served as a source of inspiration. Additionally, we conducted focus group interviews with 5 experienced middle school teachers and 40 students, using a semi-structured interview format to explore their perspectives on different dimensions of teacher support. Focus groups with teachers and students were conducted separately and each group had 5 participants. The semi-structured interviews enable respondents to provide a variety of potential responses (Dai et al., 2019). In analyzing the interview data, we began by transcribing the data during the pre-coding stage and meticulously reading through it several times. Subsequently, the data underwent multiple rounds of coding and re-coding. The emerging themes were grouped under the social model of teacher support, and then were phrased into items. The coding and extraction of themes were cross-checked to ensure accuracy. Following triangulation between the literature and the semi-structured interviews for item derivation, 40 items were identified. A total of 30 items remained in the pool following the elimination of superfluous and less relevant ones. Two items were adapted from Metheny et al. (2008) TSS. Seven experts—five faculty members with educational psychology expertise, in particular research experience relevant to teacher support and two are experienced teachers—reviewed all items for face and content validity. Seven experts answered each item: 'Items assessing student-perceived teacher support as "necessary," "helpful but not necessary," or "unnecessary"?' Expert replies determined content validity ratios (CVRs; Lawshe, 1975). Retained items had positive CVR indicators (four or more experts judged them important). The expert team also reviewed the readability of the items and made changes. After removing four items with poor CVR, the survey had 26 items: seven instrumental, six emotional, seven informational, and six appraisal support items. A common 6-point Likert-type response scale was used (1 = *Strongly Disagree*, 2 = *Disagree*, 3 = *Slightly Disagree*, 4 = *Slightly Agree*, 5 = *Agree*, and 6 = *Strongly Agree*). To make the scale more focused, this study uses mathematics as an example in the instruction and targets the support of mathematics teachers. We can change the descriptions in the introduction for applications in different subjects.

3.2. Sample

In this study, four southern Chinese middle schools were invited. One thousand two hundred-one students completed the survey. Ethics approval was obtained from the authors' affiliated University. The first author approached the participating school via his network. Upon the school principal's approval, written consent was obtained from the participating students and their guardians. If the grade was not between grade 7 and grade 10, or if all the answers were the same, these responses were removed. Including 583 males and 555 females, 1138 valid cases were obtained after eliminating ineligible instances. Multiple chained equation imputations of missing data were used (Azur et al., 2011). Members were randomly split into two groups. EFA and CFA were done using samples 1 and

Table 2
Details of samples.

	Sample 1		Sample 2	
	N	%	N	%
Grade 7	132	23.2 %	97	17.0 %
Grade 8	137	24.1 %	163	28.6 %
Grade 9	151	26.5 %	156	27.4 %
Grade 10	149	26.2 %	153	26.9 %
Male	284	49.9 %	299	52.5 %
Female	285	50.1 %	270	47.5 %
Overall	569	100.0 %	569	100.0 %

2 (Table 2). In Sample 1, 132 seventh-graders averaged 13.31 years old, 137 eighth-graders averaged 14.33 years old, 151 ninth-graders averaged 15.28 years old, and 149 tenth-graders averaged 16.14 years old. Overall, Sample 1 included 569 students: 284 female (49.9 %) and 285 male (50.1 %). Meanwhile, Sample 2 featured 97 seventh graders averaging 13.28 years, 163 eighth graders averaging 14.26 years, 156 ninth graders averaging 15.24 years, and 153 tenth graders averaging 16.13 years. Overall a total of 569 students were present in Sample 2, comprising 299 males (52.5 %)and 270 females (47.5 %).

3.3. Data analysis

The basic factors of the scale were calculated using an EFA with principal axis factoring and oblimin rotation. A set of exploratory factor analyses (EFAs) identified the underlying factor structure by eliminating items. According to Hair et al. (2006) and Hayton et al. (2004), the eigenvalue of a factor must be at least 1 to use in Cattell's (1966) screening test and parallel analysis. In addition to the requirements for factor extraction, three more exclusions are included for item deletion: (1) Factor loadings greater than 0.4 are considered substantial (Floyd & Widaman, 1995). (2) It is necessary for each latent component to have a minimum of three items (Comrey, 1988), if a factor contains fewer than three items, these items will be deleted. (3) And for an item to be deleted if its loading on different factors is higher than 0.4 (Hair et al., 2006).

A priori structural hypotheses driven by the social support framework and EFAs were tested using CFA (Netemeyer et al., 2003). Robust Maximum Likelihood (MLR) estimation was employed for the CFA because some components were not normally distributed (Li, 2016). All CFAs used R 3.5.0 in R Studio. Model fit metrics such as RMSEA and SRMR $\langle$ 0.08, CFI and TLI $\rangle$ 0.90 indicate a good fit (Hair et al., 2006; Hu & Bentler, 1998; McDonald & Ho, 2002).

Multi-group CFA analysis tested configural, metric, scalar, and residual measurement equivalence between gender groups (Raju et al., 2002) (Table 6). Model differences are assessed using two criteria: (1) The $\triangle$S-Bχ^2 test does not exhibit statistical significance (Satorra & Bentler, 2010), and (2) If the $\triangle$CFI between models is below 0.01, it indicates support for measurement invariance (Chen, 2007).

The benefits of Rasch in examining instrument quality have gained increasing recognition (Bond et al., 2020; Testa et al., 2019; Yan, 2018, 2020). Employing both factor analysis and Rasch analysis on the same dataset can provide supplementary indicators of the psychometric properties of the instrument, thereby offering more comprehensive validity evidence (Wang et al., 2022; Yan & Pastore, 2022). The PPTS data were analyzed using the multidimensional Rasch model because the four dimensions are connected (Adams et al., 1997). In contrast to the one-dimensional Rasch model, the multidimensional model calibrates all subscales simultaneously, considering their correlation and improving their measurement accuracy (Embretson & Reise, 2000). Rasch reliability, item fit statistics (Infit MNSQ and Outfit MNSQ), and differential item functioning (DIF) across genders will be used to assess instrument quality. Item fit statistics show how well subscale items measure unidimensional latent constructs. Linacre (2006) states that the Rasch model agreement is acceptable with Infit/Outfit MNSQ values between 0.5 and 1.5. It fits well between 0.75 and 1.33 (Wilson, 2005). After correcting for characteristic level, cross-gender DIF was calculated by comparing item difficulty. Differences over 0.5 logits imply significant DIF (Wang et al., 2006).

The PPTS and SES (Lam et al., 2014) were correlated to demonstrate concurrent validity. With 26 items, SES measures student

Table 3
Results of EFA.

Item	Instrumental support	Emotional support	**Information support (Including Appraisal support)**
1	0.664	0.095	–0.051
2	0.760	–0.034	–0.032
3	0.658	–0.153	0.187
4	0.788	0.029	–0.082
5	0.806	0.065	–0.115
6	0.669	0.167	–0.084
7	0.580	–0.026	0.231
8	0.120	0.594	–0.008
9	–0.088	0.885	–0.137
10	0.091	0.611	0.021
11	0.127	0.599	0.005
12	–0.087	0.620	0.112
13	0.020	0.439	0.299
14	0.067	0.178	0.586
15	–0.013	0.158	0.646
16	–0.081	0.029	0.841
17	0.071	–0.111	0.818
18	0.016	–0.094	0.870
19	–0.097	0.207	0.628
20	0.047	–0.030	0.790
21	–0.078	0.270	0.498
22	0.013	0.118	0.661
23	0.041	–0.188	0.914
24	0.030	–0.154	0.907
25	–0.025	–0.041	0.842

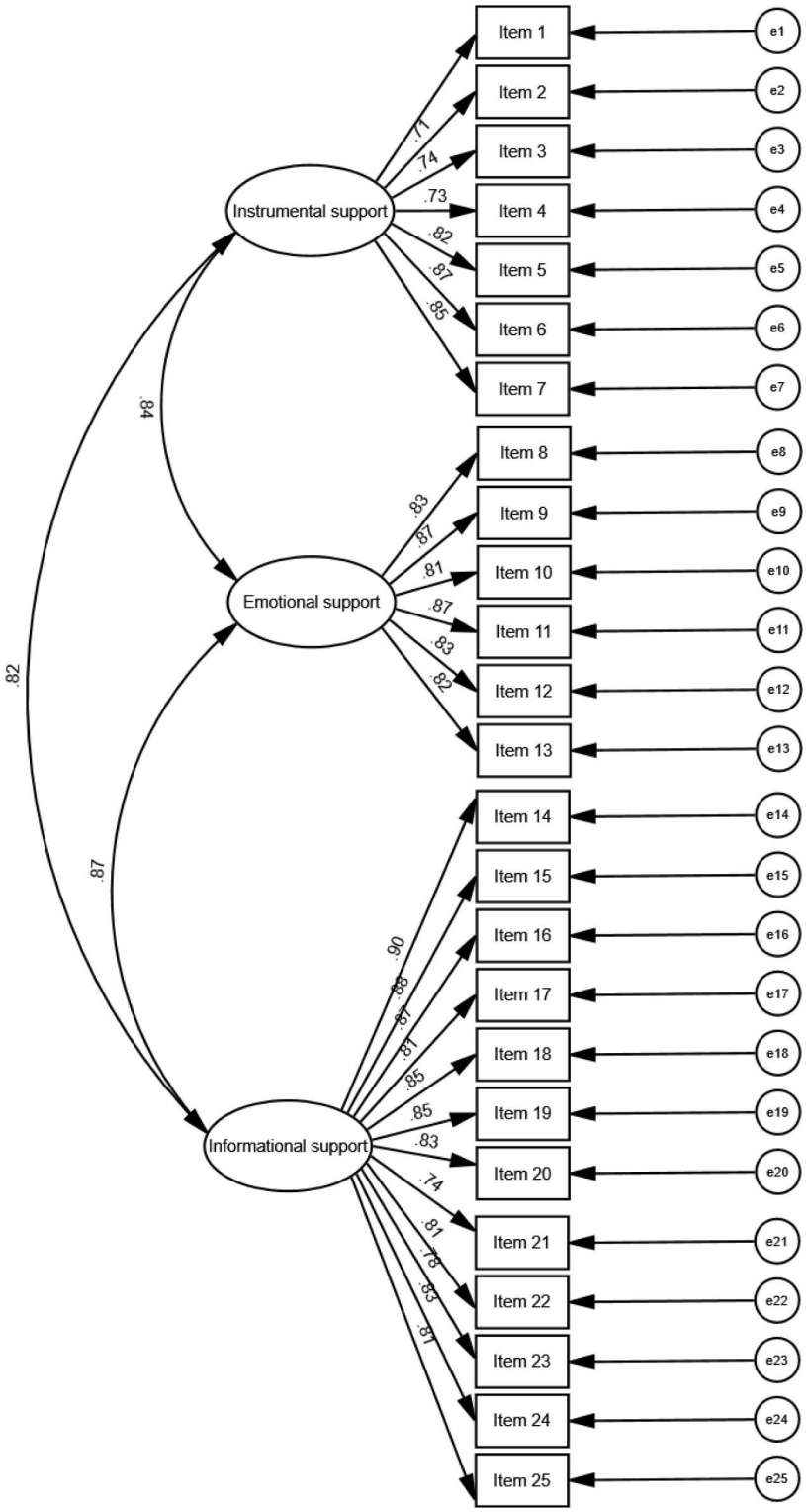

Fig. 1. Model 1 with standardized factor loadings instrumental, emotional, and informational supports (Including appraisal information) and their correlations.

participation in three dimensions: affective, behavioral, and cognitive (Lam et al., 2014). The affective, behavioral, and cognitive engagement subscales measure students' preferences for learning and school, their efforts to learn and participate in school activities, and their use of meaningful information-processing strategies in learning. This study used the Chinese version of the self-reported SES. Student involvement and academic achievement improve with instructor assistance. Empirical evidence shows that care and encouragement, scaffolded feedback and guidance cues, and personalized learning support improve students' learning engagement and academic performance (Sadoughi & Hejazi, 2022). Other research has revealed that student views of teacher support strongly correlate with academic engagement, including enthusiasm for learning and motivation to excel (Wentzel & Asher, 1995; Wentzel, 1997). Therefore, there is enough evidence to hypothesize that teacher support increases student engagement.

4. Results

4.1. EFA results

The values for Kaiser-Meyer-Olkin measure of sampling adequacy was 0.97 and Bartlett's test of sphericity was $\chi^2(300) = 13{,}146.44$, $p < 0.001$, indicating that the data were suitable for factor analysis. Item #24 was deleted because it did not meet the loading factor criterion. A three-factor model with 25 items was finalized (Table 3). The total extracted variance is 53.3 %. Each dimension has seven instrumental support items, six emotional support items, and twelve informational support items (including five appraisal support items) for each dimension. The factor loadings of all items are above 0.4.

4.2. CFA results

According to the EFA model, the CFA findings indicate a good model fit with $\chi^2 = 1461.558$, df = 272, RMSEA = 0.078, 90 % C.I. = [.071.084], CFI = 0.930, TLI = 0.923, and SRMR = 0.036. Instrumental, emotional, and informational support (including appraisal) were found based on theory-driven item content. Informational and appraisal support were loaded onto one factor, which differed from House (1981) and the original theoretical model mentioned in the scale development section above. Indeed, there were theoretical similarities and indistinguishabilities between informational support and appraisal support because appraisal is a kind of information that focuses on the evaluation of the self (House, 1981).

Model 2, which corresponds to the projected model offered by House (1981), was considered alongside the three-factor model that EFA showed (Model 1, see Fig. 1) to identify the most appropriate model. Model 2 is a four-factor competition model that represents the four support types. As the theoretically predicted, all items were allocated to latent factors.

The findings of the CFA for Model 2 are as follows: $\chi^2 = 1286.159$, df = 269, RMSEA = 0.071, 90 % C.I. = [.064,.078], CFI = 0.942, TLI = 0.936, SRMR = 0.035, which demonstrate that the model fits well. We used the Akaike information criterion (AIC) and Bayesian information criterion (BIC) for model comparison instead of chi-square because the chi-square is susceptible to sample size effects, particularly when it is quite large (Newsom, 2012).

Both models provided good fits to the data, as demonstrated in Table 4. However, Model 2 exhibited marginally superior fit statistics and reduced AIC and BIC. Model 2's four-factor answer provides a more satisfactory explanation of the data than Model 1. Based on data from Sample 2, the two models' standardized factor loadings and correlations are displayed in Figs. 1 and 2. All of the factors had satisfactory factor loadings. Instrumental support factor loadings in Model 1 were 0.710 to 0.870, emotional support factor loadings were 0.806 to 0.873, and information support factor loadings were 0.743 to 0.895 (including appraisal information). The factor loadings for instrumental, emotional, informational, and appraisal support in Model 2 ranged from 0.710 to 0.870, 0.806 to 0.909, 0.765 to 0.875, and 0.765 to 0.875, respectively.

In Model 2, convergent validity was indicated for factor loadings, AVE, and omega total computed composite reliability (CR). Every one of the 25 items has a loading greater than 0.7, which is higher than Hair et al. (2006)'s suggested value of 0.5. A high CR value (>0.7) indicates reliability and convergent validity (Hair et al.,2006). As shown in Table 5, the correlation coefficient between informational and appraisal support is greater than the square root of AVE, which suggests that discriminant validity is weak, according to Fornell and Larcker (1981). Relationships between two concepts may explain significant inter-construct correlations. The reason may be that these two concepts are close in the social support framework. Student-reported data collecting may be another factor. The reliability of the scale is high, with the values of the four dimensions ranging from 0.913 to 0.950. (Table 5).

To detect whether there is a multicollinearity problem, the variance inflation factor (VIF) values of the four factors were calculated, which were 2.939, 3.661, 5.831, and 4.305, as shown in Table 5. The conservative threshold VIF should be <5 to indicate that there is no collinearity problem (Hair Jr et al. 2016). Since only the VIF value of Informational support is at the edge of the conservative threshold, if the widely accepted standard VIF < 10 (Kutner et al., 2005) is considered, the VIF values of the four factors are acceptable.

Table 4
CFA results on Sample 2.

	χ2	df	CFI	TLI	RMSEA	SRMR	AIC	BIC
Model 1	1461.558, $p < 0.001$	272	0.930	0.923	0.078	0.036	29,676.437	29,906.662
Model 2	1286.159, $p < 0.001$	269	0.942	0.936	0.071	0.035	29,507.037	29,750.295

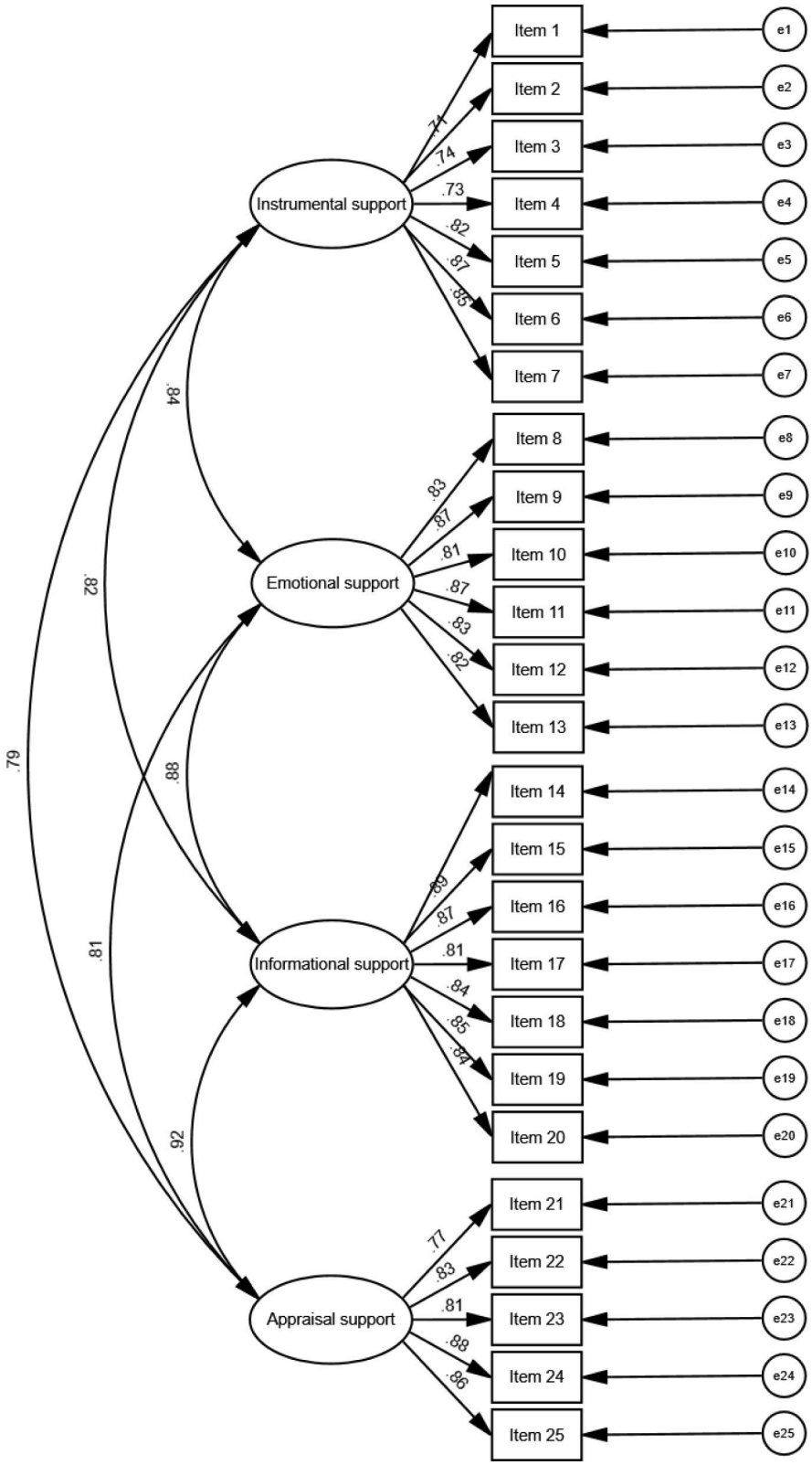

Fig. 2. Standardized factor loadings and their correlations of Model 2.

Table 5
Cronbach's α, CR, inter-construct correlations, square roots of AVE and collinearity statistics.

	Cronbach's α	CR	VIF	F1	F2	F3	F4
Instrumental support (F1)	0.915	0.916	2.939	**0.781**			
Emotional support (F2)	0.933	0.934	3.661	0.770***	**0.839**		
Informational support (F3)	0.950	0.950	5.831	0.771***	0.833***	**0.855**	
Appraisal support (F4)	0.913	0.917	4.305	0.720***	0.744***	0.852***	**0.838**

Square roots of AVE is on the diagonal line.
*** $p < 0.001$.

4.3. Multi-group CFA

Past studies imply that boys and girls may have different socialization experiences, which may affect their expectations and interpretations of teacher behavior (Eccles & Roeser, 2011). Evidence also suggests that teachers might interact differently with boys and girls, potentially offering more encouragement and emotional support to girls and more directive or disciplinary support to boys (Beaman et al., 2006). Additionally, research suggests that girls generally report higher levels of perceived teacher support than boys, which is related to their greater focus on and sensitivity to relationships in educational settings (Rueger et al., 2008). By testing measurement invariance, researchers can determine whether perceived teacher support structures operate equally across genders, thereby ensuring that observed differences are not due to measurement bias but reflect real differences in perception. If invariance is not supported, it may indicate that the items used to measure teacher support are not equally correlated or understood across genders, suggesting that a more nuanced or differentiated instrument is needed.

The baseline model was employed because males and females had the same factor pattern and a better configuration model fit index. Supporting the hypothesis of metric, scalar, and residual invariance across gender, the Satorra-Bentler scaled chi-square test and CFI adjustments were used. The Satorra-Bentler scaled chi-square comparing scalar, metric, and residual invariance models was not significant ($Pp > 0.05$). △CFI fell below 0.01. Details are shown in Table 6.

Furthermore, mean differences between genders were tested using an independent *t*-test. The total teacher support scale and subscale scores were derived using the mean item scores. There was no gender difference in total score of teacher support ($t = 0.954$, $p = 0.341$). Men and women were found to be almost similar (Table 7).

4.4. Rasch analysis results

Sample 2 data was analysed using ConQuest version 2.0's multidimensional Rasch rating scale model (Adams et al., 1997; Wu et al., 2007). Compared to Model 1, which was derived using EFA, the more theoretically consistent model (Model 2) fits better. As a result, the four groups of teachers who had their support adjusted using multidimensional Rasch analysis. Step calibration of the six-point response scale (a measure of transition between neighboring categories) rose monotonically from −2.110, −1.831, −1.045, 0.961 to 4.025 logits. A grading scale with four or more categories should use steps between 1.4 and 5.0 logits, but shorter steps are acceptable (Linacre, 2002). Overall, the step distance is acceptable. The model data fit using item fit statistics (i.e., Infit and Outfit MNSQ) in Table 8 shows that all items fit the Rasch model well. For most items, the Infit and Outfit MNSQ were within the ideal range (0.75–1.33) (Wilson, 2005), with five exceptions (Items #1, 2, 3, 4, and 14) but within the acceptable range (0.5–1.5) (Linacre, 2006). All of the PTSS item measures were found to be invariant (within the margin of error) between genders since no items exhibited large DIF across the sexes, according to the DIF analysis. Table 8 presents the item difficulty, associated standard errors, item-fit statistics, and DIF results.

The four continuous lines on the left show student distribution across the four PTSS subscales. The students who provided the highest level of perceived teacher support were assigned the highest ranking, whereas those who reported the lowest level of perceived teacher support were assigned the lowest ranking. From the four subscales, derive every item located on the right side of the scale. Items with more difficult levels were at the top, and items with easier levels were at the bottom. Table 8 and Fig. 3 show that the item difficulty is between −0.65~ 0.65 logits. Students had the hardest time recognizing appraisal support item #23 (My teachers tell me how I perform in class.). Item #21 (My teachers will inform me when I make mistakes.) was the easiest. The Wright map demonstrates that, compared to the range of student ability, the item difficulty range on the four subscales is narrow.

Furthermore, Rasch's reliability was satisfactory. The results showed that the EAP/PV reliability of the four subscales was 0.92, 0.94, 0.93, and 0.91.

All 25 items in the final PTSS version fit the Rasch model, meaning they were measured in a way that aligns with the underlying

Table 6
Results of multi-group CFA.

Gender	df	χ2	TLI	RMSEA	SRMR	CFI	△CFI	Change in χ2	Change in df	p
Configural	538.000	1910.700	0.919	0.080	0.040	0.928	–	–	–	–
Metric	559.000	1936.200	0.923	0.078	0.046	0.928	<0.01	15.569	21.000	>0.05
Scalar	580.000	1960.200	0.925	0.077	0.047	0.928	<0.01	24.101	21.000	>0.05
Strict	605.000	2039.300	0.928	0.075	0.047	0.928	<0.01	26.866	25.000	>0.05

Table 7
Descriptive statistics and *t*-test of gender.

By gender	Male (n = 299)		Female (n = 270)				
	Mean	SD	Mean	SD	t	p	ES (Cohen's d) [95 % CI]
Instrumental support	4.760	0.969	4.709	0.842	0.663	0.508	0.056 [–0.109, 0.221]
Emotional support	5.035	0.941	4.940	0.862	1.251	0.211	0.105 [–0.060, 0.270]
Informational support	4.881	0.959	4.808	0.902	0.921	0.358	0.077 [–0.088, 0.242]
Appraisal support	4.908	0.936	4.859	0.835	0.648	0.517	0.054 [–0.110, 0.219]
Total perceived teacher support	4.889	0.881	4.822	0.780	0.954	0.341	0.080 [–0.085, 0.245]

Table 8
Item statistics in the Rasch analysis.

Scale/item	Item measure	SE	Infit MNSQ	Outfit MNSQ	DIF by gender
1	−0.51	0.05	1.38	1.41	0.05
2	0.01	0.05	1.40	1.38	0.32
3	0.36	0.05	1.46	1.42	0.07
4	−0.15	0.05	1.39	1.29	0.23
5	−0.05	0.05	1.20	1.16	0.06
6	−0.09	0.05	0.91	0.85	0.03
7	0.43	0.11	1.10	1.10	0.16
8	0.53	0.05	1.09	1.19	0.19
9	−0.11	0.05	0.88	0.69	0.01
10	−0.49	0.05	1.17	1.03	0.10
11	0.17	0.05	0.95	0.79	0.26
12	−0.18	0.05	1.08	0.84	0.04
13	0.09	0.12	1.13	0.94	0.22
14	−0.16	0.05	0.66	0.58	0.09
15	−0.19	0.05	0.80	0.69	0.04
16	−0.33	0.05	0.88	0.71	0.03
17	0.58	0.05	1.25	1.30	0.13
18	0.25	0.05	1.04	0.91	0.02
19	−0.46	0.05	0.97	0.80	0.10
20	0.32	0.12	1.06	1.09	0.02
21	−0.65	0.05	1.05	0.84	0.12
22	−0.36	0.05	0.95	0.75	0.16
23	0.65	0.05	1.15	1.19	0.01
24	0.41	0.05	0.96	0.89	0.15
25	−0.06	0.10	0.95	0.83	0.12

theory. Due to the sequential nature of the step calibration, the present six-point rating scale is satisfactory. In addition, the results demonstrated that the PTSS item measurements were consistent (within the margin of error) across gender levels, and none of the items had a significant DIF.

4.5. Correlations with SES

Table 9 shows that the Spearman correlation matrix confirmed PTSS external validity. The correlation coefficients between perceived teacher support, behavioral engagement, and cognitive engagement were greater than 0.4 (Schober et al., 2018), indicating a moderate link. Subscale correlations were substantial. Info-support correlated most with cognitive engagement, while instrumental support correlated least with affective engagement. This study confirms the concurrent validity of the PTSS due to its significant correlation with the SES scores.

5. Discussion

This study describes the development and validation process of the PTSS for middle school students in grades seven–ten. House's (1981) definition and four-dimension framework of teacher support provide a strong foundation and premise for instrument development. Although EFA indicated a 3-factor structure, the CFA results showed that a theory-driven 4-factor structure had a better data-model fit. The correlation coefficient between informational and appraisal support is greater than the square root of AVE, indicating poor discriminant validity (DV). The CFA findings worsened after combining strongly linked factors; therefore, we used a four-factor model. Based on House's (1981) hypothesis, these two factors are interrelated and difficult to distinguish. This partly explains the strong correlations between these two factors. The three-factor model occurs perhaps because appraisal support is, by definition, giving evaluative feedback to others. Feedback is essentially about performance and understanding (Hattie & Timperley, 2007). This explains, to a certain extent, the results of EFA. As a special type of information, many research studies have affirmed the role of evaluation information and status (Ahmad et al., 2013; Al-Bashir et al., 2016; Fyfe & Rittle-Johnson, 2016). Therefore, we do

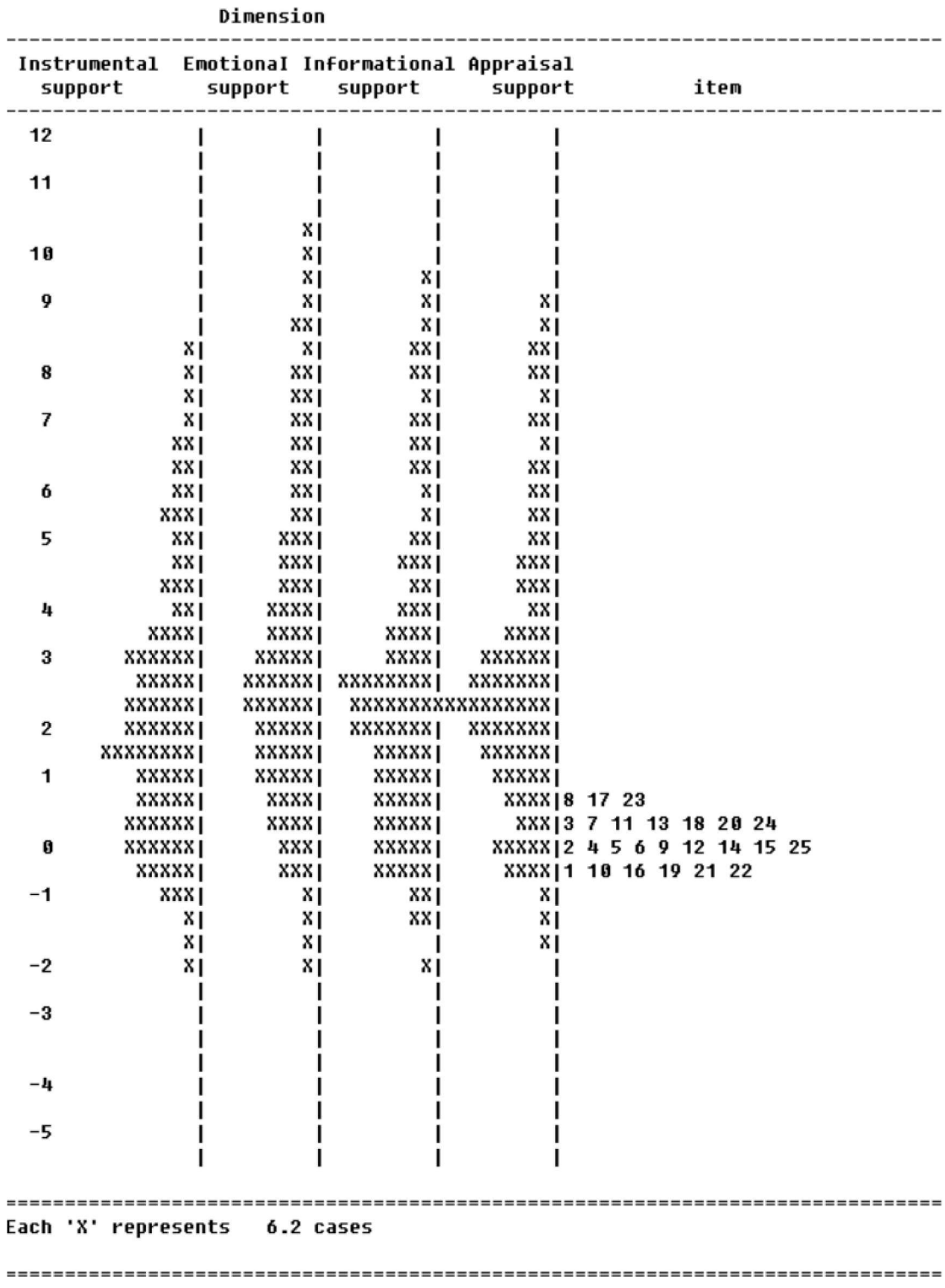

Fig. 3. Wright map for the 25-item PTSS on the four subscales: instrumental, emotional, informational, and appraisal support. Each ''X'' represents 6.2 cases.

Table 9
Correlations between PTSS and SES.

	Perceived teacher support	Instrumental support	Emotional support	Informational support	Appraisal support
Affective engagement	0.397***	0.338***	0.356***	0.382***	0.356***
Behavioral engagement	0.488***	0.424***	0.455***	0.456***	0.440***
Cognitive engagement	0.466***	0.401***	0.410***	0.458***	0.450***
Student engagement	0.537***	0.459***	0.482***	0.519***	0.494***

Note.
*** $p < 0.001$.

not recommend merging them into one factor, but in future scale development, the wording of the statements can be further improved to make the two more clearly distinguishable. A single data-collection method may also have contributed to this problem. Based on these reasons and experts' discussions of the content of the scale, we believe that discriminant validity is acceptable. Rasch's analysis also supported the 4-factor model. The entire scale and subscales have a Cronbach''s α score of 0.913–0.973, suggesting high reliability. Using a multigroup CFA, configural, metric, scalar, and residual invariance were confirmed for gender measurement equivalency. PTSS correlated significantly with SES, confirming concurrent validity. Nearly 1100 Chinese middle school pupils supported the 25-item PTSS's reliability and validity.

This study has several contributions. First, the latest scale is an independent scale that focuses only on teacher support and offers a more comprehensive classification of social support; in previous studies, the teacher support scale was more like a subscale or a four-factor scale that could not completely cover the factors. Second, the analysed data show that the model has a better model fit, and the final version of each item loads on each factor with a value of >0.5, and there is no loading on different factors at a medium level at the same time. Third, the number of items on each factor has been increased, which makes up for the shortcomings of previous studies. Given that research related to teacher support continues to receive attention, instruments suitable for evaluating experimental effects are increasingly attractive and promising. The present scale was validated for Chinese middle schoolers and adapted to China. Despite a few things borrowed from English scales, the current scale is reliable and valid in Chinese culture. This tool proves House's model in Chinese culture. This instrument could be revalidated in non-Chinese cultures in future studies. The present scale is suitable for educational use since it is simple and can be completed by typical students in around ten minutes.

The practical implication of developing a new scale of student-perceived teacher support is that it can provide nuanced insights into teacher-student dynamics that are critical to educational outcomes. First, it allows for precise assessment of different dimensions of teacher support, and by accurately capturing these dimensions, educators and policymakers can identify specific areas where support is lacking and develop interventions accordingly. For example, Hughes and Kwok (2007) showed that teacher-student relationships have a significant impact on students' academic and behavioral outcomes. Robust scales can help identify specific support deficits that require policy intervention.

Second, standardized scales enable data collection across time and across different educational contexts. This facilitates longitudinal research that tracks changes in perceived teacher support and its long-term effects on student achievement. In addition, it allows for cross-cultural comparisons, thereby enhancing the generalizability of the findings. The study by Roorda, Koomen, Spilt and Oort (2011) provided meta-analytic evidence demonstrating the importance of emotional teacher-student relationships in different educational settings, highlighting the need for reliable measurement tools.

Finally, such scales can foster better communication between students and teachers. When student perceptions are systematically collected and analyzed, they can lead to more informed discussions about teaching practices and student needs. This feedback loop can help foster a more supportive and responsive educational environment.

This study had some limitations. Because the schools and students originated from urban areas in the southern provinces of mainland China, the samples in each round exhibited a considerable degree of homogeneity. The uneven educational development in China may result in participants in this study differing from those in other regions, potentially affecting the external validity. Therefore, the application of this scale in other regions of China and in international contexts should be studied with caution. Perceived teacher support is inherently subjective and influenced by personal perceptions and biases. Students' responses to scale items may be influenced by factors such as mood, recent experiences, or personal relationships with teachers. This subjectivity may introduce response bias that affects the reliability of scale scores. Scales developed in one cultural context may need to be adapted and validated when applied to different cultural or linguistic groups to ensure their validity and reliability. Given the cultural differences, the implications of the findings of this study should be carefully considered in the context of cross-cultural research. The teacher support scale developed and validated in the Chinese context may capture aspects of support that are particularly relevant in Chinese classrooms, such as academic rigor and structured instruction, while it may underestimate aspects of emotional support that are more prominent in Western settings. When using this scale in other countries, it is important to consider the influence of cultural norms and educational expectations, and examine whether the scale is applicable to different cultural contexts or needs to be adjusted. This will provide a more nuanced understanding of teacher support in different educational settings. Furthermore, both PTSS and SES are in the form of self-reports and are from the same source. Future studies may consider integrating data from other sources, such as the teachers' perspective, to enhance the robustness of the findings.

Finally, this study provides preliminary evidence of PPTS content, structural, and generalizability validity but cannot evaluate external and consequential validity. Additional research may lend further credibility to the PPTS's assessment of student-perceived teacher support.

6. Conclusion and future research

This study developed and verified a reliable and valid student-reported teacher-support measure using 1138 mainland Chinese middle-school students. This preliminary 25-item, 4-factor scale is the self-reporting tool for students based on House's (1981) paradigm. Future research could use the scale to develop and test intervention strategies designed to enhance specific types of teacher support, measure its effectiveness in improving student motivation, and identify best practices for teachers. To design such intervention programs, researchers could rely on a classification system of motivational behaviors. For example, when we want to promote student autonomy, competence, and relatedness to promote students' intrinsic motivation, we can use a classification system of need-supportive motivational behaviors (Ahmadi et al., 2023). Corresponding items can also be found in the scale for need-supportive teacher behaviors. For example, items corresponding to "Relatedness Supportive Behaviors" can be found in the emotional support dimension. Future research can these findings in different cultural contexts and student groups to improve its reliability and validity.

CRediT authorship contribution statement

Junsheng Wu: . **Zi Yan:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Formal analysis, Conceptualization. **Yongle Yang:** Writing – review & editing. **Jinyu Zhu:** Writing – review & editing, Validation. **Yuhan Xiong:** Writing – review & editing. **Jiaying Chen:** Writing – original draft.

Declaration of competing interest

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Supplementary materials

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