

ARTICLE

S1. Measurement Invariance Test Results**Perceived teacher support questionnaire**

To examine the structural stability of the perceived teacher support scale across gender groups, single-group confirmatory factor analyses were conducted separately for the male and female samples. In the male sample, the model fit indices were CFI = 0.972, TLI = 0.944, RMSEA = 0.158 (90% CI [0.130, 0.187]), and SRMR = 0.023. In the female sample, the corresponding indices were CFI = 0.975, TLI = 0.950, RMSEA = 0.152 (90% CI [0.125, 0.180]), and SRMR = 0.021. Overall, the fit pattern was highly similar across the two gender groups, suggesting that the scale showed satisfactory structural stability for both male and female students.

Multigroup confirmatory factor analysis was then conducted to test the measurement invariance of the perceived teacher support scale across gender groups. The results indicated that, from the configural invariance model to the metric invariance model, CFI remained unchanged ($\Delta\text{CFI} = 0.000$), whereas RMSEA decreased slightly ($\Delta\text{RMSEA} = -0.025$). From the metric invariance model to the scalar invariance model, CFI again showed no change ($\Delta\text{CFI} = 0.000$), and RMSEA further decreased ($\Delta\text{RMSEA} = -0.016$). Because these changes did not exceed the recommended cutoff criterion ($\Delta\text{CFI} \leq 0.01$), the findings support good measurement invariance of the scale across male and female students.

Table S1. Single-Group Confirmatory Factor Analysis for the perceived teacher support Questionnaire

Group	CFI	TLI	RMSEA [90% CI]	SRMR
Man	0.972	0.944	0.158 [0.130, 0.187]	0.023
Woman	0.975	0.95	0.152 [0.125, 0.180]	0.021

Table S2. Gender Measurement Invariance Test for the perceived teacher support Questionnaire

Model	χ^2	df	CFI	TLI	RMSEA [90% CI]	SRMR	ΔCFI	ΔRMSEA
M1: Configural	181.13	10	0.974	0.947	0.155 [0.135, 0.175]	0.019	—	—
M2: Metric	182.52	14	0.974	0.963	0.130 [0.113, 0.147]	0.021	0	-0.025
M3: Scalar	185.14	18	0.974	0.971	0.114 [0.099, 0.129]	0.021	0	-0.016

Chemistry self-efficacy questionnaire

First, single-group confirmatory factor analyses were conducted separately for the male and female samples to examine the factor structure of the chemistry self-efficacy scale. The results showed that, in the male sample, the model fit indices were CFI = 0.991, TLI = 0.981, RMSEA = 0.089 (90% CI [0.061, 0.119]), and SRMR = 0.014. In the female sample, the corresponding fit indices were CFI = 0.974, TLI = 0.947, RMSEA = 0.150 (90% CI [0.123, 0.178]), and SRMR = 0.022. Overall, the CFI and TLI values in both groups exceeded 0.90, and the SRMR values were below 0.08, indicating that the scale showed acceptable model fit across gender groups and could therefore be subjected to further multigroup measurement invariance testing.

Subsequently, to examine the measurement invariance of the chemistry self-efficacy scale across gender groups, configural invariance, metric invariance, and scalar invariance models were tested sequentially. The results indicated that all three models demonstrated acceptable fit. Further comparisons of changes in fit indices showed that, from the configural invariance model to the metric invariance model, $\Delta\text{CFI} = -0.001$ and $\Delta\text{RMSEA} = -0.016$; from the metric invariance model to the scalar invariance model, $\Delta\text{CFI} = -0.002$ and $\Delta\text{RMSEA} = -0.009$. According to the criteria proposed by Chen (2007), namely that ΔCFI should not be lower than -0.01 and ΔRMSEA should not exceed 0.015, these findings support good measurement invariance of the scale across gender groups.

Table S3. Single-Group Confirmatory Factor Analysis for the chemistry self- efficacy Questionnaire

Group	CFI	TLI	RMSEA [90% CI]	SRMR
Male	0.991	0.981	0.089 [0.061, 0.119]	0.014
Female	0.974	0.947	0.150 [0.123, 0.178]	0.022

Table S4. Gender Measurement Invariance Test for the chemistry self- efficacy Questionnaire

Model	χ^2	df	CFI	TLI	RMSEA [90% CI]	SRMR	Δ CFI	Δ RMSEA
M1: Configural	119.523	10	0.982	0.964	0.124 [0.104, 0.144]	0.016	—	—
M2: Metric	130.154	14	0.981	0.973	0.108 [0.091, 0.125]	0.028	-0.001	-0.016
M3: Scalar	143.746	18	0.979	0.977	0.099 [0.084, 0.114]	0.031	-0.002	-0.009

Chemistry identify questionnaire

Before testing measurement invariance, single-group confirmatory factor analyses were conducted separately for the male and female samples. In the male sample, the model fit indices were CFI = 0.871, TLI = 0.855, RMSEA = 0.086 (90% CI [0.081, 0.090]), and SRMR = 0.063. In the female sample, the corresponding indices were CFI = 0.881, TLI = 0.866, RMSEA = 0.088 (90% CI [0.084, 0.092]), and SRMR = 0.073. Overall, the RMSEA and SRMR values were within acceptable ranges in both groups, supporting further multigroup measurement invariance testing.

Subsequently, configural, metric, and scalar invariance models were tested to examine the measurement invariance of the chemistry identity scale across gender groups. The configural invariance model showed $\chi^2 = 2867.737$, $df = 448$, CFI = 0.877, TLI = 0.861, RMSEA = 0.087, and SRMR = 0.065. The metric invariance model showed $\chi^2 = 2907.113$, $df = 467$, CFI = 0.876, TLI = 0.865, RMSEA = 0.086, and SRMR = 0.067. The scalar invariance model showed $\chi^2 = 3008.184$, $df = 486$, CFI = 0.871, TLI = 0.866, RMSEA = 0.085, and SRMR = 0.069. Further comparisons indicated that, from the configural model to the metric model, Δ CFI = -0.001 and Δ RMSEA = -0.001, and from the metric model to the scalar model, Δ CFI = -0.005 and Δ RMSEA = -0.001.

Table S5 Single-Group Confirmatory Factor Analysis for the chemistry identify Questionnaire

Group	CFI	TLI	RMSEA	RMSEA 90% CI	SRMR
Male	0.871	0.855	0.086	[0.081, 0.090]	0.063
Female	0.881	0.866	0.088	[0.084, 0.092]	0.073

Table S6. Gender Measurement Invariance Test for the chemistry identify Questionnaire

Model	χ^2	df	CFI	TLI	RMSEA [90% CI]	SRMR	Δ CFI	Δ RMSEA
M1: Configural	2867.737	448	0.877	0.861	0.087 [0.084, 0.090]	0.065	—	—
M2: Metric	2907.113	467	0.876	0.865	0.086 [0.083, 0.089]	0.067	-0.001	-0.001
M3: Scalar	3008.184	486	0.871	0.866	0.085 [0.082, 0.088]	0.069	-0.005	-0.001

S2. Standardized Factor Loadings for the Questionnaire

Table S1 Standardized factor loadings for perceived teacher support questionnaire (N = 1431)

Item	Standardized factor loading
TS1	0.818
TS2	0.912
TS3	0.912
TS4	0.881
TS5	0.826

Note. All factor loadings exceeded 0.40.

Table S2 Standardized factor loadings for chemistry self- efficacy questionnaire (N = 1431)

Item	Standardized factor loading
SE1	0.865
SE2	0.792
SE3	0.88
SE4	0.922
SE5	0.866

Note. All factor loadings exceeded 0.40.

Table S3 Standardized factor loadings for the 23 items of each individual factor of the identify questionnaire (N = 1431)

Dimension	Item	Standardized factor loading
Chemistry learning competence	CI1	0.627
	CI2	0.801
	CI3	0.816
	CI4	0.759
	CI5	0.673
	CI6	0.757
	CI7	0.482
	CI8	0.631
Chemistry classroom interest and performance	CI9	0.72
	CI10	0.473
	CI11	0.549
	CI12	0.649
	CI13	0.714
	CI14	0.644
	CI15	0.677
Chemistry career interest	CI16	0.671
	CI17	0.781
	CI18	0.799
Chemistry recognition	CI19	0.764
	CI20	0.836
	CI21	0.911
	CI22	0.867
	CI23	0.911

Note. All factor loadings exceeded 0.40.

S3. Chinese questionnaire items and corresponding English translations

Part 1. Demographic and background information

No.	中文题项	English translation	Response options
1	性别	Gender	Female / Male
2	年级	Grade level	Grade10/Grade11
3	你最近一次期中化学考试成绩为:	What was your score in the most recent midterm chemistry examination?	Open-ended
4	你目前是否担任班级学生干部(如班长、学习委员、课代表等)?	Do you currently hold a formal class leadership position, such as class monitor, learning committee member, or subject representative?	Yes/No
5	高中毕业后,你选择化学或与化学密切相关的大学专业(如化学、应用化学、材料化学、化学工程、环境化学、生物化学等)的可能性有多大?	How likely are you to choose chemistry or a chemistry-related university major after high school, such as chemistry, applied chemistry, materials chemistry, chemical engineering, environmental chemistry, or biochemistry?	Completely unlikely / Unlikely / Uncertain / Likely / Highly likely
6	你是否参加过学校组织的化学或科技相关活动(如科技节、实验竞赛、科技社团、化学探究活动等)?	Have you participated in chemistry- or science-and-technology-related activities organized by your school, such as science and technology festivals, experimental competitions, science and technology clubs, or chemistry inquiry activities?	Yes / No
7	父母中是否有人从事与化学或工程技术相关的工作(教师、科研人员、工程师、技术人员、医生、药师等)?	Is either of your parents engaged in a chemistry- or engineering-related occupation, such as teacher, researcher, engineer, technician, doctor, or pharmacist?	Yes / No

Part 2. Questionnaire 1: Perceived teacher support

Response scale for all items:

1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree.

Item	中文题项	English translation
PTS1	化学老师会倾听我的想法与感受。	My chemistry teacher listens to my thoughts and feelings.
PTS2	化学老师会主动关心我的学习情况并给予指导。	My chemistry teacher actively cares about my learning and provides guidance.
PTS3	化学老师会主动关心我的情绪及学习状态。	My chemistry teacher actively cares about my emotions and learning state.
PTS4	当我遇到困难或挫折时,化学老师会鼓励我。	When I encounter difficulties or setbacks, my chemistry teacher encourages me.
PTS5	我的化学老师会肯定我的进步。	My chemistry teacher acknowledges my progress.

Part 3. Questionnaire 2: Chemistry self-efficacy

Response scale for all items: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree.

Item	中文题项	English translation
CSE1	我有信心在化学考试中发挥出色,取得令自己满意的成绩。	I am confident that I can perform well on chemistry tests and achieve results that satisfy me.
CSE2	我有信心化学实验和探究活动中表现出色。	I am confident that I can perform well in chemistry experiments and inquiry activities.
CSE3	我相信我可以掌握化学课程的知识 and 技能。	I believe that I can master the knowledge and skills taught in chemistry courses.
CSE4	我相信我能在化学考试中取得优异的成绩(或名列前茅)。	I believe that I can achieve excellent results or rank among the top students in chemistry tests.
CSE5	我确信自己能够掌握高中化学课程所要求的知识和技能。	I am certain that I can master the knowledge and skills required in high school chemistry courses.

Part 4. Questionnaire 3: Chemistry identity

Response scale for all items: 1 = Strongly disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly agree.

Dimension	Item	中文题项	English translation
Chemistry learning competence	CI1	我认为自己在化学课堂上的表现很好	I think I perform well in chemistry class.
	CI2	我相信我能够学好化学	I believe that I can learn chemistry well.
	CI3	我能够在化学科目上取得好成绩	I can achieve good grades in chemistry.
	CI4	我能够很好地理解与化学有关的定律和原理	I can understand chemistry-related laws and principles well.
	CI5	我能运用化学解释日常生活中的自然现象	I can use chemistry to explain natural phenomena in everyday life.
	CI6	我认为化学是我的强项	I consider chemistry to be one of my strengths.
	CI7	我能够在化学竞赛项目中获得不错的成绩	I can achieve good results in chemistry competitions.
	CI8	如果我努力尝试, 我相信即便是化学知识中最难的部分我也能够学会	If I try hard, I believe that I can learn even the most difficult parts of chemistry.
Chemistry classroom interest and performance	CI9	我喜欢参与各种与化学有关的活动	I enjoy participating in various chemistry-related activities.
	CI10	我能够完成化学作业	I can complete my chemistry assignments.
	CI11	我认为化学课上学到的知识在现实世界中很重要	I think the knowledge learned in chemistry class is important in the real world.
	CI12	我能在实验中熟练地使用工具和操作仪器	I can skillfully use tools and operate instruments in experiments.
	CI13	我相信我能在化学课上学到很多知识	I believe that I can learn a lot in chemistry class.
	CI14	我喜欢化学课上出现的各种化学器材	I like the various pieces of chemistry equipment used in chemistry class.
	CI15	我能顺利地开展一项化学探究活动	I can successfully carry out a chemistry inquiry activity.
Chemistry career interest	CI16	我有打算在未来从事化学方面的工作	I plan to work in a chemistry-related field in the future.
	CI17	我喜欢上与化学有关的课	I enjoy taking chemistry-related courses.
	CI18	和从事化学行业的人交谈会让我感到很愉悦	Talking with people who work in chemistry-related fields makes me feel happy.
	CI19	我对那些与化学有关的职业感兴趣	I am interested in chemistry-related careers.
Chemistry recognition	CI20	我认为自己是一个精于化学的人	I consider myself to be a chemistry person.
	CI21	同学们认为我是一个精于化学的人	My classmates consider me to be a chemistry person.
	CI22	化学老师认为我是一个精于化学的人	My chemistry teacher considers me to be a chemistry person.
	CI23	家人和朋友认为我是一个精于化学的人	My family and friends consider me to be a chemistry person.