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# Evaluating academic motivation among Chinese secondary EFL learners: validation and measurement invariance

Xia Kang<sup>1</sup>, Dongpin Hu<sup>2\*</sup>, Yajun Wu<sup>3</sup> and Jiutong Luo<sup>4</sup>

## Abstract

Inspired by self-determination theory (SDT), the Academic Motivation Scale (AMS) was developed to measure students' learning motivation. While the AMS has been widely validated and used in educational contexts, it has generally overlooked the domain-specific nature of academic motivation, particularly in learning English as a foreign language (EFL) in China, home to the world's largest population of EFL learners. This study sought to adapt the AMS and substantiate its validity using both within-network and between-network approaches with a sample of 1,390 Chinese secondary EFL learners. Results from item analysis, internal consistency, and confirmatory factor analysis (CFA) showed that the 28-item EFL-specific AMS exhibits robust psychometric properties, characterised by a seven-factor structure, and demonstrates invariance across gender and grade levels. Structural equation modelling (SEM) analyses further indicated that both extrinsic and intrinsic motivations are positively correlated with perceived teacher support, engagement, and achievement, whereas amotivation is inversely associated with these outcomes. Implications, limitations, and directions for future research are also discussed.

**Keywords** Academic motivation scale, Validation, Measurement invariance, Self-determination theory, Chinese secondary EFL learners

## Introduction

Motivation is one of the most critical factors influencing students' learning outcomes in English as a foreign language (EFL) [1, 2]. Self-determination theory (SDT) conceptualizes academic motivation as an individual's perception of the personal value, enjoyment, and satisfaction of academic pursuits [3]. Over the past four decades,

academic motivation has emerged as a prominent focus within educational psychology, with extensive exploration of its antecedents—such as teachers' interpersonal involvement, social support, and psychological needs—and its consequences, including academic achievement, learning engagement, and positive self-concept [4–9]. Given the pivotal role of academic motivation in facilitating educational advancement, educators and researchers have dedicated effective methods for enhancing students' academic motivation [10, 11]. However, there remains a lack of consensus regarding the definitions and constructs used to assess academic motivation. For example, Deci and Ryan used an intrinsic motivation construct to portray academic motivation [12], while Ryan and Deci expanded this framework by incorporating both intrinsic and extrinsic motivation [13]. In contrast, Vallerand et al.

\*Correspondence:

Dongpin Hu  
dhu@eduhk.hk

<sup>1</sup>School of Mathematics and Information Science, Guangzhou University, Guangzhou, China

<sup>2</sup>Department of Curriculum and Instruction, Faculty of Education and Human Development, The Education University of Hong Kong, Hong Kong, China

<sup>3</sup>School of Humanities and Education, Foshan University, Foshan, China

<sup>4</sup>Faculty of Education, Shenzhen University, Shenzhen, China



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proposed a self-determination continuum of academic motivation [14], encompassing amotivation, extrinsic motivation, and intrinsic motivation.

Based on the SDT, the academic motivation scale (AMS) offers a comprehensive framework for evaluating academic motivation by encompassing the dimensions of amotivation, intrinsic, and extrinsic motivation. This multidimensional approach enables a nuanced assessment of students' academic motivation from various perspectives [15]. Despite the widespread use of the AMS among scholars [14–19], there remains a lack of consensus concerning its dimensionality and structural composition. For example, based on factor analysis, researchers have proposed various structural models for the AMS, resulting in three-factor [16], four-factor [17], five-factor [18], and seven-factor configurations [14, 15]. What structural characteristics does the AMS exhibit among Chinese secondary EFL learners? Aside from Zhang et al. [20], who investigated the validity of the AMS among Chinese high school and vocational high school students, there is a notable absence of research that considers the domain specificity of the AMS and examines the structural characteristics and validity of the EFL-related AMS.

In addition to neglecting the domain specificity of the AMS [15, 19], existing studies have seldom addressed the measurement invariance of the AMS across different genders and grade levels. For instance, both [21] and [22] observed that female students exhibited higher levels of academic motivation than their male counterparts, highlighting significant gender differences in academic motivation. In a study focused on sixth and seventh-grade middle school students in the United States [23], it was found that the motivation levels of seventh-grade students were significantly lower than those of their sixth-grade counterparts. This finding suggests the presence of grade-specific variations in academic motivation. Therefore, while assessing the validity of the AMS, it is essential to analyse measurement invariance across genders and grade levels to broaden the applicability of this scale further.

To address the shortcomings identified in the current literature, the present study seeks to investigate the factorial structure and applicability of the AMS within the context of EFL in mainland China. Additionally, this study aims to assess the measurement invariance of the AMS across different genders and grade levels. Specifically, following Martin's construct validation framework [24], the within-network approach involved item-level analysis, factor correlation matrix inspection, confirmatory factor analysis (CFA), and invariance assessment across gender and grade levels were conducted. The between-network approach was also employed to investigate associations between the AMS and the theoretically relevant constructs, including academic engagement,

teacher support, and academic achievement. This research is poised to elucidate the concept, components, and structure of the AMS and develop a reliable tool for assessing the academic motivation profiles of Chinese EFL learners.

## Literature review

To evaluate the between-network validity of the AMS for Chinese secondary EFL learners, we examined the zero-order correlations between the EFL AMS and a range of related constructs, including academic engagement, teacher support, and academic achievement. Furthermore, we analysed the predictive effects of EFL AMS on these constructs. Academic engagement is considered an external manifestation of academic motivation [25] and demonstrates a significant correlation with it [26]. Additionally, the substantial correlation between academic motivation and academic achievement [27], as well as between academic motivation and teacher support [28], suggests that both academic achievement and teacher support may also serve as suitable metrics for evaluating the between-network validity of the AMS. In summary, academic engagement, teacher support, and academic achievement are the key metrics for assessing the between-network validity of the AMS.

## Academic motivation

Traditionally, academic motivation was described as the psychological factors that drive individuals to engage in academic activities [15, 29]. Self-determination theory (SDT) is one of the most impactful theoretical models for understanding motivation and has been widely applied in EFL studies as a valuable analytical framework [30, 31]. According to the SDT, academic motivation could be divided into three forms: amotivation, extrinsic motivation, and intrinsic motivation in terms of the levels of self-determination [13]. Amotivation, the lowest level of self-determination, refers to the lack of motivation or the absence of perceiving any reasons to engage in learning activities [13]. As expected, amotivation harms many academic outcomes, such as poor academic performance, low self-esteem, behavioural problems, absenteeism, and school dropout [32, 33].

Intrinsic motivation, the most autonomous type, denotes individuals' engagement in learning activities driven by inherent satisfaction and enjoyment [13]. Highly intrinsically motivated students are likely to achieve various favourable outcomes, including heightened engagement, elevated self-efficacy and flow experience, and enhanced academic performance [34]. Within the spectrum of self-determined motivation, intrinsic motivation can be further categorised into three dimensions: intrinsic motivation-to know (IM-TK), intrinsic

motivation-to accomplish (IM-TA), and intrinsic motivation-to experience stimulation (IM-ES) [14].

Extrinsic motivation exists on the continuum between amotivation and intrinsic motivation, which refers to the drive or incentive to engage in learning activities or pursue academic goals that are externally driven, such as obtaining rewards or avoiding punishments [13]. Research has identified several benefits associated with extrinsic motivation, including enhancing academic confidence, the development of internal attributions, and promoting intrinsic motivation [35]. Based on the degree of autonomy, extrinsic motivation can be further subdivided into three types: extrinsic motivation-external regulation (EM-ER), extrinsic motivation-introjected regulation (EM-IN), and extrinsic motivation-identified regulation (EM-ID) [14].

The domain specificity and group differences in academic motivation indicate that the validity of the AMS in specific academic domains and among specific groups requires further exploration. Green et al. documented distinctive patterns of academic motivation across subjects [36], such as English, mathematics, and science, in a study with Australian high school students. Similarly, Lepper et al. found that American students' intrinsic motivation declined significantly from primary to secondary education [37]. However, studies on the construct validity of AMS within specific non-Western populations remain limited [15]. Aside from [18], which established factorial invariance of the AMS across genders, few studies have investigated the effects of gender and grade level on this scale. Therefore, a validation study on the AMS focusing on Chinese secondary school students' EFL learning and validating the factorial invariance of the scale across gender and grade levels would significantly enhance the understanding of motivation within the field of EFL education.

### Academic engagement

Academic engagement refers to the extent to which students invest physical and mental energy in their learning activities [38]. As the manifestation of motivation, academic engagement reflects a student's level of academic motivation [26]. Also, academic motivation could reflect a student's subsequent learning behaviours and development [39]. Fredricks et al. explored the multifaceted nature of this construct and identified that academic engagement consists of three sub-facets: behavioural engagement (e.g., involvement in in-class and extracurricular activities), emotional engagement (e.g., emotional investment towards learning activities), and cognitive engagement (e.g., use of self-regulated learning strategies) [38]. In addition, Reeve and Tseng documented that apart from behavioural, emotional, and cognitive engagement, agentic engagement, which refers to a student's

dynamic construction of learning messages, is the fourth aspect of academic engagement [40].

This study focused on the most crucial aspect of academic engagement, namely, behavioural engagement [41]. On the one hand, the impact of emotional and cognitive engagement on educational outcomes works indirectly via behavioural engagement [42]. On the other hand, behavioural engagement has a more substantial impact on school outcomes than the other aspects of academic engagement [43]. As the core aspect of academic engagement, behavioural engagement significantly predicts academic motivation [44], academic achievement [45], self-regulation [46], and subjective well-being [47]. Also, empirical studies identified the precursors of behavioural engagement, including social support, teacher-student relationship quality, achievement emotions, academic motivation, and school psychological capital [48, 49]. To add to the body of knowledge on the antecedents of behavioural engagement in an EFL environment, one goal of the present study was to examine the predictive effect of academic motivation on behavioural engagement.

### Teacher support

Teacher support is generally defined as students' perceived care, concern, understanding of their needs, and assistance in achieving educational goals [50]. Teachers serve as an essential source of support for adolescents during their learning and school-related activities, with their influence often surpassing that of parents [51]. For example, Zhao and Yang found that teacher support could directly impact learning engagement or exert its influence indirectly through mediators such as academic enjoyment and boredom in the context of Chinese EFL education [52]. In a distinct study involving Chinese college students majoring in English, the results demonstrated that teacher support—an integral component of social support—significantly alleviates students' emotional experiences of anxiety within the classroom environment [53]. Furthermore, studies such as [54] and [55] demonstrate that teacher support significantly fosters stronger motivational beliefs. Additionally, research by Pekrun et al. indicates that teacher support mediates the relationship between achievement goals (especially academic motivation) and academic achievement, indicating that academic motivation plays a predictive role in teacher support [56]. Consequently, it is crucial to explore further the dynamic interaction between academic motivation and teacher support, especially in EFL education, where teacher support may uniquely shape students' language learning motivation and outcomes. Therefore, more empirical studies are warranted to examine these connections in greater depth, providing valuable insights for both research and educational practice.

### Academic achievement

As a core indicator of educational outcomes, academic achievement represents the level of knowledge attained by students and is of paramount importance to both teachers and students at all educational stages [57]. For students, achieving excellent academic achievement is a marker of academic honour and a gateway to higher education, broader academic success, and the development of valuable human capital [58]. In the Chinese context, academic achievement carries additional cultural weight, deeply rooted in traditional values that prioritise education as a crucial pathway to personal and societal advancement [59]. The pressure to excel, particularly in key examination subjects such as Chinese, mathematics, and English, is intensified by these scores' critical role in university admissions and broader socio-economic prospects [60].

Considering the significance of academic achievement, empirical research has identified a number of precursors of academic achievement, such as academic motivation, learning engagement, achievement emotions, and teacher support [6, 8, 52, 56]. Given the paucity of research on the domain specificity of academic motivation in an EFL context, this study examines the relationship between EFL-related academic motivation and EFL achievement among Chinese secondary EFL learners.

### Linking academic motivation to engagement, teacher support, and achievement

Previous research has demonstrated the predictive effects of academic motivation on learning engagement [26, 61], teacher support [56], and academic achievement [8, 32], providing empirical evidence of the correlations between these variables. While other potential antecedents of academic outcomes, such as psychological needs [62] and self-concept [63], are also well-established in the literature, this study specifically focuses on academic motivation due to its central role in driving students' active engagement with learning, fostering teacher-student relationships, and enhancing performance. The strong connection between motivation and these educational outcomes makes it a key target for interventions to improve student success, particularly in the EFL context.

Moreover, despite the robust evidence supporting the relationship between academic motivation and these variables, much of the existing research has not accounted for the domain specificity of academic motivation, which suggests that further exploration of these relationships is necessary. Therefore, this study explored the link between EFL-related academic motivation and behavioural engagement, perceived teacher support, and EFL achievement to better understand the predictive effects of EFL-related academic motivation and establish the EFL-related AMS's between-network validity.

### Rationale and research hypotheses

The present study seeks to address existing research deficiencies through three distinct yet interrelated approaches. First, we employed a within-network methodology to adapt the AMS for the EFL context, assessing its factorial structure and construct validity among Chinese secondary EFL learners. Second, we conducted multi-group SEM to evaluate the measurement invariance of the EFL-related AMS across different genders and grade levels. Third, utilising a between-network approach, we investigated the associations between EFL-related academic motivation and perceived teacher support, academic motivation, and academic achievement, thereby assessing the external validity of the adapted EFL-related AMS. In summary, the present study aims to address the following three research questions.

**RQ1:** What are the factorial structure and psychometric properties of EFL-related AMS among Chinese secondary EFL learners?

**RQ2:** Does the EFL-related AMS exhibit measurement invariance across gender identity and grade levels?

**RQ3:** Does the EFL-related AMS demonstrate strong external validity as assessed through a between-network approach?

### Methodology

#### Participants and procedures

The questionnaire survey included 1,390 secondary EFL learners from Kunming City, Yunnan Province, China. Among these participants, 639 were males (46.0%) and 751 were females (51.0%). The mean age of the participants was 13.46 years old ( $SD=0.74$ ), with ages ranging from 12 to 17 years. The participants were in seventh and eighth grades, with nearly equivalent group sizes: 697 seventh and 693 eighth graders.

The sampling procedure comprised three key aspects. First, a stratified three-stage sampling method was employed to select participants. Secondary schools in Kunming City were classified into three levels based on official accreditation. Convenient sampling was then applied to select one school from each level, designated as schools A, B, and C in descending order of accreditation. Subsequently, half of the seventh and eighth grades from these three schools were randomly selected, resulting in a total of 30 classes participating in the questionnaire survey (School A: 14 classes,  $N=662$ , 47.9%; School B: 7 classes,  $N=335$ , 24.0%; School C: 9 classes,  $N=393$ , 28.1%). Second, the survey was administered in Chinese. The original AMS, written in English, was first translated into Chinese and then back-translated into English by two bilingual researchers to ensure the face validity of the measurement scale (see Appendix). Third, ethical approval for the present study was obtained from the first author's university (Human Research Ethics Committee's



Reference Number: EA2003020) in Hong Kong. Prior to the commencement of the questionnaire survey, all participants signed consent forms, verbal informed consent was also obtained from participants' parents or legal guardians, and anonymous pen-and-paper questionnaires were then distributed.

### Instruments

#### *EFL-related academic motivation scale (EFL-related AMS)*

The 28-item AMS initially developed by Vallerand et al. [64] measured the EFL-related academic motivation. Considering the specific nature of academic motivation [19], all items of the original AMS were reformulated to fit the EFL learning context better. The EFL-related AMS includes three aspects of amotivation, intrinsic, and extrinsic motivation, encompassing seven specific subscales. For example, one item of the amotivation subscale was rephrased from "Honestly, I don't know; I really feel that I am wasting my time in school" to "I feel that learning English is a waste of time". Example items of the other six subscales were "The more English knowledge I master, the happier I become" (4-item IM-TK), "I learn English for the pleasure I experience while surpassing myself" (4-item IM-TA), "For me, learning English is fun" (4-item IM-ES), "Learning English is to find a good job" (4-item EM-ER), "Learning English is to have an additional option when looking for a job in the future" (4-item EM-ID), and "Learning English is to prove to others that I am an intelligent person" (4-item EM-IN). Participants responded to the 28 items in the seven sub-scales of the EFL-related AMS by applying a 5-point Likert scale ranging from "1 (Strongly disagree)" to "5 (Strongly agree)". Higher scores indicate greater agreement with the corresponding item.

#### *Foreign language learning engagement scale*

The 4-item behavioural engagement scale adapted from the Engagement vs. Dissatisfaction with Learning Questionnaire [65] was utilised to measure participants' foreign language learning engagement. Participants responded to the items on a five-point Likert scale, with higher scores indicating a higher commitment to English learning. The reliability of this scale has been validated in previous studies [43, 48]. The CFA results indicated that the model fit the data well:  $\chi^2(2)=9.650$ ,  $p<.001$ , CFI=0.997, TLI=0.992, RMSEA=0.052, 90% CI [0.023, 0.088], SRMR=0.007, indicating that foreign language learning engagement scale possesses strong construct validity. Additionally, this scale demonstrated high internal consistency, with Cronbach's  $\alpha$  of 0.89. Furthermore, foreign language learning engagement was modelled as a latent variable in the SEM analysis.

#### *Perceived teacher support scale*

The participants' perceived support from their English teachers was measured by a five-item scale adapted from the Child and Adolescent Social Support Scale [66]. One example item is "My English teacher takes care of my feelings". Participants rated their agreement with the five statements on a five-point Likert scale. This scale has demonstrated good validity and internal consistency in prior research [52, 54, 67]. The perceived teacher support scale exhibited good internal consistency, with a Cronbach's  $\alpha$  of 0.86. The CFA results showed that the model fit the data well:  $\chi^2(5)=31.007$ ,  $p<.001$ , CFI=0.991, TLI=0.982, RMSEA=0.061, 90% CI [0.042, 0.083], SRMR=0.017. These findings suggest that the perceived teacher support scale possesses good construct validity. The SEM analysis treated perceived teacher support as a latent variable.

#### *EFL achievement*

Participants' English scores from their final examination were collected to characterise their EFL achievement. The face validity of the examination paper is ensured, as it was uniformly formulated by the local education bureau. The examination is scored out of 100 points, with higher scores indicative of more outstanding EFL achievement. In the SEM analysis, EFL achievement was treated as an observed variable.

#### *Data analysis*

We utilised SPSS 23.0 and Mplus 8.3 to analyse the data in several stages [68]. Initially, relevant assumptions associated with multivariate statistical analyses were assessed to detect any outliers before conducting pertinent statistical analyses. Following this, we focused on the validity of the within-network construct, starting with a detailed item and reliability analysis. Then, different CFA models were tested to determine the best fit for the data. We compared the seven-factor model (Model 1) with four alternative models to explore the most suitable fit. More specifically, one of the alternatives (Model 2) is a five-factor model, which lumps all intrinsic motivation items into one dimension and keeps amotivation and the three ordered extrinsic motivation factors distinct from each other [18]. Another alternative (Model 3), proposed by [16], is a three-factor model similar to Model 2, but with the extrinsic motivation items combined into one dimension. Meanwhile, Model 4 is a one-factor model that combines all items into an omnibus motivation factor, and Model 5 is a hierarchical model with two second-order factors and one first factor (i.e., amotion). The two second-order factors in Model 5 are general extrinsic motivation, underpinned by the first-order factors of EM-ID, EM-IN, and EM-ER, and intrinsic motivation,

which is underpinned by the first-order factors of IM-TK, IM-TA, and IM-ES.

To assess the model fit, we considered multiple indices and compared the goodness-of-fit of the five factorial models. Indexes of chi-square to the degree of freedom ratio ( $\chi^2/df$ ), comparative fit index (CFI), Tucker-Lewis index (TLI), root mean square error of approximation (RMSEA), and standardised root mean square residual (SRMR) were adopted to evaluate models' goodness-of-fit. More specifically, a model fits well with the data if the values of  $RMSEA \leq 0.06$ ,  $SRMR \leq 0.08$ ,  $CFI \geq 0.90$  and  $TLI \geq 0.90$  [69]. Furthermore, multi-group CFA was conducted to examine the measurement invariance of the identified measurement model across gender and grade levels. In this phase, we followed the approach proposed by [70] to sequentially test the measurement model's configural, metric, and scalar invariance across gender and grade levels. When two nested models vary in the comparative fit index ( $\Delta CFI$ ) of less than 0.01 [71], and the overall model fit is deemed adequate [72], measurement invariance is established.

Besides, the between-network validity of the EFL-related academic motivation was assessed in two steps. First, zero-order correlations were tested between EFL-related motivation and perceived teacher support, learning engagement, and EFL achievement. Second, SEM analyses were conducted to validate the predictive effects of EFL-related motivation on perceived teacher support, learning engagement, and EFL achievement while controlling for gender, age, and grade level.

## Results

### Preliminary analysis

Following the recommendations of [73], relevant assumptions associated with multivariate statistical analyses were evaluated before conducting the pertinent statistical analyses. Based on the Q-Q plots of each EFL-related motivation indicator variable, which showed a generally linear pattern, indicating that data approximately follow a normal distribution. To eliminate the influence of outliers on the correlation between studied variables, the criteria that the largest-magnitude z-score beyond  $\pm 3$  would be considered as univariate outliers were adopted [74], and it was found that there were no outliers. Besides, using a

threshold of 4 for Mahalanobis values, 5 cases were identified as outliers and excluded from the data.

### Within-network construct validity of EFL-related motivation

#### Item level analysis

Item analysis was first conducted to detect the discrimination and effectiveness of all items in the EFL-related AMS. Specifically, 27% of the highest and lowest scores were selected and analysed in this phase [75]. Our analysis revealed that for each item, the mean values of high and low groups were significantly different at a 0.001 level, indicating that all items of EFL-related AMS were discriminative and effective. Therefore, all items could be used in the formal investigation. Then, item-total correlation analyses were conducted to detect the correlation between each item for each global subscale. According to the benchmark ( $r = .30$ ) proposed by Pallant [76], all items in the EFL-related AMS had good homogeneity (ranging from 0.45 to 0.80), indicating that no items need to be eliminated.

#### Confirmatory factor analysis

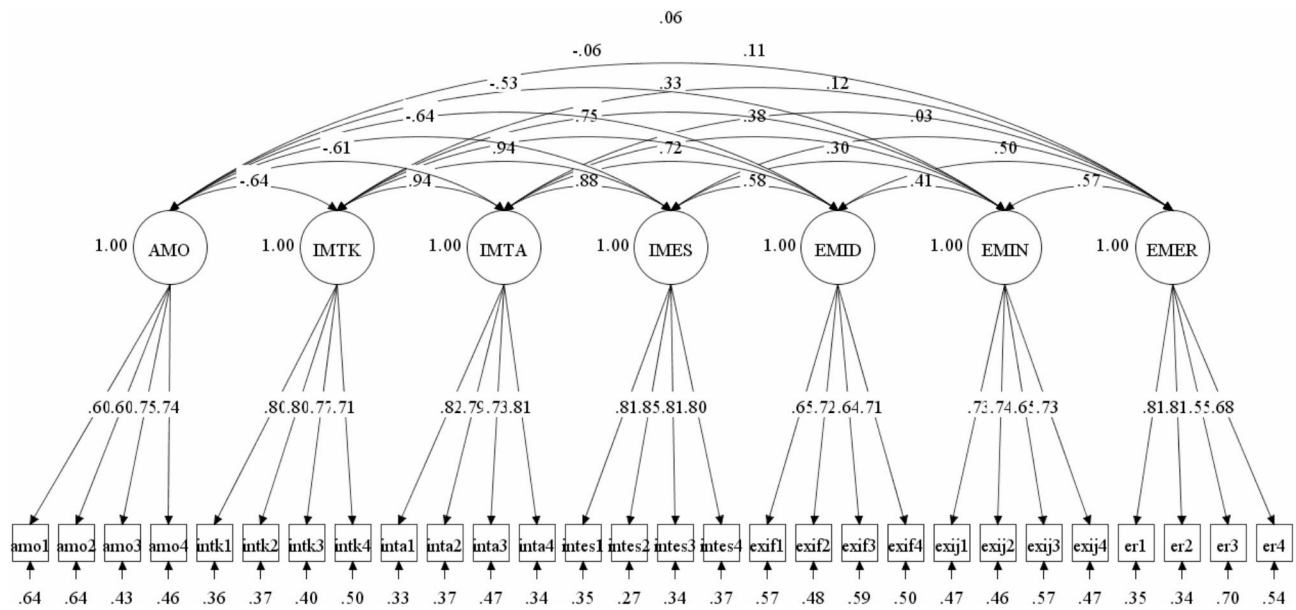
The CFA results for five proposed EFL-related AMS models are presented in Table 1. Both Model 3 and Model 4 showed CFI and TLI values below 0.90, indicating inadequate fit to the data. Regarding the RMSEA and SRMR values, Model 2 demonstrated an RMSEA value exceeding 0.60, and both Model 2 and Model 5 had SRMR values greater than 0.08, further indicating that these two models did not fit the data well. In contrast, Model 1 in the CFA demonstrated a satisfactory fit to the data, indicating that the 28-item seven-factor model appropriately represents the observed data.

In addition, this study utilised a chi-square difference test to determine if the alternative models (Models 2–5) significantly improved data fit over the seven-factor model (Model 1). The test results revealed that Model 1 had a superior fit to the data compared to all four alternative models. Second only to Model 1, Model 2 appears to be plausible for CFI/TLI values exceeded 0.90, RMSEA value slightly exceeded 0.06, and SRMR value was less than 0.08. Model 2 aligns with the model proposed by [3, 13], in which the three subscales of intrinsic motivation were merged into a single scale. Despite not being

**Table 1** Goodness-of-fit indices for the seven-factor model and alternative models

Model	$\chi^2$	df	$\chi^2/df$	CFI	TLI	RMSEA	90% C.I.	SRMR	$\Delta\chi^2$	$\Delta\chi^2/df$
M1 Seven-factor	1790.199***	329	5.441	0.931	0.920	0.057	0.054, 0.059	0.069	-	-
M2 Five-factor	2204.210***	340	6.483	0.911	0.902	0.063	0.060, 0.065	0.072	414.011***	11
M3 Three-factor	4321.917***	347	12.455	0.811	0.794	0.091	0.088, 0.093	0.114	2531.718***	18
M4 One-factor	7128.246***	350	20.366	0.678	0.652	0.118	0.116, 0.121	0.119	5338.047***	21
M5 Hierarchical	2326.299***	341	6.822	0.906	0.896	0.065	0.062, 0.067	0.092	536.100***	12

Note: \*\*\*  $p < .001$



**Fig. 1** Graphical representation of the seven-factor model and factor loadings

**Table 2** Goodness-of-fit indices for the seven-factor model

Model	$\chi^2$	df	CFI	TLI	RMSEA	90% C.I.	SRMR
Amotivation	343.857	105	0.973	0.966	0.040	0.036, 0.045	0.037
IM-To Know	305.099	105	0.981	0.975	0.037	0.032, 0.042	0.037
IM-To accomplish	252.684	105	0.986	0.982	0.032	0.027, 0.037	0.034
IM-Stimulation	337.816	105	0.979	0.974	0.040	0.035, 0.045	0.041
EM-Identified	338.962	105	0.974	0.967	0.040	0.035, 0.045	0.037
EM-Introjected	275.174	105	0.980	0.975	0.034	0.029, 0.039	0.031
EM-External	528.845	105	0.954	0.941	0.054	0.049, 0.058	0.066

optimal, Model 2 suggests that the distinctions among the three dimensions of intrinsic motivation are weaker than those among the three dimensions of extrinsic motivation [15].

Apart from having satisfactory fit indices, all the standardised factor loadings for each item in the seven-factor model (Model 1) were significant at  $p < .001$ . These loadings ranged from 0.55 to 0.86 (see Fig. 1) and surpassed the recommended threshold value of 0.40 [77]. As a result, the seven-factor model of the EFL-related AMS fit the data best and thus was adopted.

After determining the seven-factor model of the EFL-related AMS, we examined the model fit of each of the seven subscales. Table 2 presents the goodness-of-fit indices for the seven subscales of the EFL-related AMS. The CFI and TLI values were higher than the cutoff of 0.90, and the values of RMSEA and SRMR were less than the threshold values of 0.06 and 0.08, respectively. That is, all the seven subscales fitted the data well.

**Reliability**

The internal consistency reliability of the seven subscales of the EFL-related AMS was evaluated using Cronbach’s

alpha. According to the cutoff for an acceptable alpha value (Cronbach’s  $\alpha \geq 0.70$ ) proposed by [78], all the seven subscales had good internal consistency: Cronbach’s  $\alpha = 0.77$  for amotivation, Cronbach’s  $\alpha = 0.80$  for EM-ER, Cronbach’s  $\alpha = 0.77$  for EM-ID, Cronbach’s  $\alpha = 0.81$  for EM-IN, Cronbach’s  $\alpha = 0.85$  for IM-TK, Cronbach’s  $\alpha = 0.87$  for IM-TA, and Cronbach’s  $\alpha = 0.89$  for IM-ES (see Table 3).

Furthermore, the internal consistency reliability of the seven subscales of the EFL-related AMS was re-estimated by conducting item deletion. Specifically, we calculated the Cronbach’s alpha of one subscale (e.g., amotivation subscale) when one item of this scale was deleted (e.g., “I feel that learning English is a waste of time.”). Systematically and sequentially, one item was removed each time, and it was found that the Cronbach’s alpha coefficient for the seven subscales of the EFL-related AMS would slightly decrease. Thus, it could be concluded that each item within these seven subscales satisfies the benchmark and should not be deleted.

**Table 3** Results of descriptive statistics, internal reliabilities, and bivariate correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. AMO	-												
2. IM-TK	-0.521**	-											
3. IM-TA	-0.492**	0.807**	-										
4. IM-ES	-0.522**	0.810**	0.770**	-									
5. EM-ID	-0.396**	0.617**	0.584**	0.479**	-								
6. EM-IN	-0.034	0.270**	0.310**	0.250**	0.325**	-							
7. EM-ER	0.023	0.135**	0.143**	0.066*	0.445**	0.477**	-						
8. EG	-0.491**	0.661**	0.647**	0.683**	0.471**	0.221**	0.103**	-					
9. PTS	-0.454**	0.576**	0.546**	0.574**	0.496**	0.170**	0.124**	0.593**	-				
10. EFLA	-0.373**	0.351**	0.350**	0.373**	0.267**	0.096**	0.028	0.405**	0.339**	-			
11. Gender	-0.204**	0.166**	0.131**	0.155**	0.127**	0.026	-0.009	0.130**	0.084**	0.165**	-		
12. Age	0.124**	-0.028	-0.053*	-0.066*	-0.026	-0.033	-0.033	-0.029	-0.040	-0.036	-0.086**	-	
13. Grade level	0.122**	-0.020	-0.019	-0.064*	-0.022	-0.010	-0.027	-0.032	-0.049	0.010	-0.025	0.665**	-
Mean	2.133	3.533	3.477	3.369	3.920	2.819	3.121	3.493	3.788	67.810	-	-	-
SD	0.835	0.817	0.825	0.844	0.731	0.855	0.863	0.792	0.730	21.071	-	-	-
Cronbach's alpha	0.77	0.85	0.87	0.89	0.77	0.81	0.80	0.89	0.86	-	-	-	-

Notes: AMO = Amotivation; EG = Foreign Language Learning Engagement; PTS = Perceived Teacher Support; EFLA = EFL Achievement

\*\*\*  $p < .01$ ; \*  $p < .05$

**Measurement invariance across gender and grade levels**

Following identifying the better-fit model, multi-group CFA was conducted to ascertain the measurement invariance of the seven-factor model of EFL-related AMS across gender and grade levels. Following the sequential framework established by [70], configural, metric, and scalar invariance of the EFL-related AMS were systematically tested stepwise to ensure a comprehensive understanding of its measurement properties across diverse groups.

**Measurement invariance across gender.** To evaluate the measurement invariance of the seven-factor model of EFL-related AMS between male and female groups, initially, we began by examining separate baseline models. The data fit the model well for the male group: RMSEA = 0.061, 90% C.I. = (0.057, 0.065), CFI = 0.921, TLI = 0.910, and SRMR = 0.066. Likewise, the female group's data also demonstrated a good model fit, showing RMSEA = 0.058, 90% C.I. = (0.055, 0.062), CFI = 0.924, TLI = 0.912, and SRMR = 0.075. These results suggest that the seven-factor model of EFL-related AMS seemed cross-validated across both male and female groups. Subsequently, tests of overall configural, metric, and scalar invariance of the seven-factor model of EFL-related AMS across genders were conducted. As presented in Table 4, the overall model fits were good, with the value of  $\Delta$ CFIs between two nested models being 0.004 or more minor. This finding meets the cutoff criteria proposed by [71], thereby confirming the establishment of configural, metric and scalar invariance across genders.

**Measurement invariance across grade levels.** Baseline model measurement invariance of the seven-factor model of EFL-related AMS was also evaluated across seventh-graders and eighth-graders. For seventh-graders, the data fitted the model well: RMSEA = 0.056, 90% CI = (0.052, 0.060), CFI = 0.931, TLI = 0.920, and SRMR = 0.070. The baseline model also fitted the data of eighth-graders: RMSEA = 0.064, 90% CI = (0.060, 0.067), CFI = 0.917, TLI = 0.904, and SRMR = 0.074. Then, configural, metric, and scalar invariance were tested stepwise. As shown in Table 2, the overall model fits were good, and the value of  $\Delta$ CFIs between two nested models was equal to 0.002 or smaller, suggesting that configural, metric and scalar invariance were established across the populations of seventh graders and eighth graders.

**Between-network validation**

The seven-factor model of EFL-related AMS possessed robust psychometric properties and maintained measurement invariance across genders and grade levels when measuring the academic motivation of Chinese EFL learners. Additionally, to evaluate the between-network validity of the seven-factor model, correlations were examined between EFL-related academic motivation and



**Table 4** Fit indices for measurement invariance tests of the model across gender and grade levels

Model	$\chi^2$	df	CFI	$\Delta$ CFI	TLI	RMSEA	90% C.I.	SRMR
M1 <sup>a</sup> : Configural invariance	2275.89	658	0.922	-	0.911	0.059	0.057, 0.062	0.071
M2 <sup>a</sup> : Metric invariance	2319.201	679	0.921	0.001	0.912	0.059	0.056, 0.062	0.073
M3 <sup>a</sup> : Scalar invariance	2445.959	707	0.917	0.004	0.911	0.059	0.057, 0.062	0.080
M4 <sup>b</sup> : Configural invariance	2289.258	658	0.923	-	0.912	0.060	0.057, 0.062	0.072
M5 <sup>b</sup> : Metric invariance	2322.667	679	0.923	0.000	0.914	0.059	0.056, 0.062	0.074
M6 <sup>b</sup> : Scalar invariance	2384.968	707	0.921	0.002	0.916	0.058	0.056, 0.061	0.074

Notes: <sup>a</sup>Fit index for measurement invariance tests of the model across genders

<sup>b</sup> Fit indices for measurement invariance tests of the model across grades

academic and well-being outcomes, including learning engagement, perceived teacher support, and EFL achievement.

#### Bivariate correlations

Table 3 showcases the descriptive statistics, internal reliabilities of the studied variables, and bivariate correlations among the variables. Consistent with expectations, amotivation exhibited negative correlations with learning engagement, perceived teacher support, and EFL achievement. Conversely, the three components of intrinsic motivation (i.e., IM-TK, IM-TA, and IM-ES) and the three elements of extrinsic motivation (i.e., EM-ER, EM-ID, and EM-IN) displayed a positive correlation with learning engagement, perceived teacher support, and EFL achievement. In addition, gender, age, and grade levels were observed to have significant correlations with the three components of EFL learning motivation and the outcome variables of learning engagement, perceived teacher support, and EFL achievement. This highlights the importance of controlling for these three variables when examining the correlations among the variables under study.

#### Contributions of the seven motivational components to academic engagement, perceived teacher support, and EFL achievement

SEM was conducted to explore the predictive effects of the seven motivational components on learning engagement, perceived teacher support, and EFL achievement while controlling for gender, age, and grade levels. As shown in Table 5, amotivation in learning English negatively and strongly predicted learning engagement ( $\beta = -0.601, p < .001$ ), perceived teacher support ( $\beta = -0.556, p < .001$ ), and EFL achievement ( $\beta = -0.417, p < .001$ ). Except for the insignificant prediction effects of extrinsic motivation-external regulation on EFL achievement, the two other components of extrinsic motivation (i.e., EM-ID and EM-IN) and all three components of intrinsic motivation (i.e., IM-TK, IM-TA, and IM-ES), are significantly and positively correlated with learning engagement, perceived teacher support, and EFL achievement.

#### Discussion

In the current study, the quality of each item was first evaluated through item analysis, assessing the accuracy and reliability of the items within their respective subscales. By comparing the fit of five models of EFL-related AMS, it was determined that the seven-factor measurement model provided the best fit to the data. Subsequently, measurement invariance of the seven-factor measurement model was examined across gender and grade levels. Additionally, the between-network validity of the EFL-related AMS was investigated by exploring the predictive effects of EFL-related motivation on learning engagement, perceived teacher support, and EFL achievement within the context of Chinese secondary EFL learning. These findings contribute to the existing literature on the validity of the AMS, emphasising its applicability to Chinese secondary EFL learners.

The item level analysis and confirmatory factor analysis results revealed that the seven-factor model of EFL-related AMS exhibited robust psychometric properties, addressing the first research question. Furthermore, we measured the goodness-of-fit indices for the seven subscales of the EFL-related AMS, and each subscale demonstrated a good fit to the data, further validating the appropriateness of the seven-factor measurement model. This finding dovetails with previous studies on the measurement model and related psychometric properties of AMS [15, 79]. However, much of the existing research has mainly focused on general school contexts within Western settings (e.g., Hungary), neglecting the domain specificity of academic motivation. The present study addresses this gap by expanding the applicability of the AMS and by adapting and validating the most suitable model of the EFL-related AMS among Chinese secondary EFL learners. This contribution enriches the literature and provides a more nuanced understanding of academic motivation in the specific context of EFL learning for Chinese students.

Results of multi-group CFA demonstrated robust measurement invariance of the EFL-related AMS across gender and grade levels; thereby, the second research question was answered. These findings contribute to and extend existing literature. For example, Caleon et al.

**Table 5** Regression results of the seven factors of EFL-related motivation with learning engagement, perceived teacher support, and EFL achievement

Motivation Subscales	Learning engagement					Perceived teacher support					EFL achievement							
	Unstd. B	SE	Std. $\beta$	t	p	R <sup>2</sup>	Unstd. B	SE	Std. $\beta$	t	p	R <sup>2</sup>	Unstd. B	SE	Std. $\beta$	t	p	R <sup>2</sup>
AMO	-0.778	0.050	-0.601	-15.444	***	0.364	-0.707	0.049	-0.556	-14.398	***	0.310	-15.187	1.219	-0.417	-12.458	***	0.187
IM-TK	0.720	0.030	0.749	24.007	***	0.562	0.612	0.030	0.649	20.158	***	0.423	9.796	0.767	0.362	12.768	***	0.146
IM-TA	0.697	0.029	0.736	24.021	***	0.545	0.582	0.029	0.625	19.831	***	0.393	9.795	0.750	0.366	13.056	***	0.150
IM-ES	0.684	0.027	0.767	25.238	***	0.590	0.569	0.027	0.653	20.760	***	0.427	9.538	0.690	0.382	13.826	***	0.160
EM-ID	0.730	0.045	0.573	16.204	***	0.335	0.763	0.046	0.609	16.749	***	0.373	10.773	1.105	0.298	9.749	***	0.109
EM-IN	0.240	0.030	0.259	7.983	***	0.086	0.189	0.030	0.208	6.361	***	0.052	2.950	0.784	0.112	3.762	***	0.041
EM-ER	0.061	0.025	0.078	2.470	*	0.027	0.075	0.025	0.097	3.027	**	0.019	0.069	0.647	0.003	0.107	ns	0.030

Notes: Unstd. = Unstandardized coefficients; Std. = Standardized coefficients; SE = Standard error. \*\*\*  $p < .001$ ; \*\*  $p < .01$ ; \*  $p < .05$ ; ns = nonsignificant

validated the measurement invariance of the AMS across gender and ability groups among Singaporean secondary students [15]. Similarly, Tóth-Király et al. confirmed the measurement invariance of the AMS across gender and age groups in Hungarian high school students [79]. In contrast to these previous studies, the present study focused on a domain-specific adaptation of the AMS tailored to the EFL context. Notably, in addition to establishing measurement invariance across gender, age, and ability groups, the present study documented the AMS's invariance across grade levels, thereby offering a more comprehensive validation of the scale.

In addressing the third research question, our findings revealed a negative predictive effect of AMO on learning engagement, perceived teacher support, and EFL achievement. Conversely, intrinsic and extrinsic motivation (except EM-ER) demonstrated a positive predictive impact on these outcomes. This evidence supports the between-network validity of the EFL-related AMS. Our results suggest both intrinsic and extrinsic motivation (excluding EM-ER) are advantageous for secondary EFL learners in terms of academic and well-being outcomes. As EFL learners' intrinsic and extrinsic motivation towards English learning strengthens, they are more likely to receive incredible support from their English teachers, engage more actively in learning activities, and achieve higher proficiency levels in English. Although the positive influence of intrinsic motivation on academic and well-being outcomes has been widely documented in previous research [29, 34], the role of extrinsic motivation remains relatively unexplored [80, 81]. Within the framework of self-determination theory, extrinsic motivation-external regulation was perceived as the most controlled form of extrinsic motivation [82], with self-determination ranking only above amotivation [14]. The validated EFL-related AMS offers a valuable tool for assessing the academic motivation profiles of EFL learners, both within and beyond the studied region. Furthermore, our confirmation of the seven-factor configuration of the AMS underscores the importance of analysing each dimension of academic motivation separately to gain a more nuanced understanding of learners' motivational profiles.

**Limitations and future directions**

This study was the first to validate the EFL-related AMS and confirm the seven-factor measurement model of EFL motivation in a sample of Chinese secondary EFL learners. While the current study was conducted within a Chinese EFL context, its findings hold implications for other EFL contexts. Specifically, it underscores the significance of validating a translated instrument in a context distinct from its original development. However, three limitations need to be addressed. First, this study was

conducted in China's dominant Confucian Heritage Culture (CHC) region, confirming the applicability of EFL-related AMS in the CHC context. In addition to CHC, Chinese culture has other vital components, such as Taoism, Buddhism, and the cultures of 55 ethnic minorities [83]. Thus, recruiting participants from broad cultural settings is recommended to expand the applicability of EFL-related AMS. Second, potential same-source bias could not be wholly excluded, for the data in the present study were self-reported due to an inherent social desirability bias [84]. The utilisation of a large sample with relatively random selection and the corroboration of research findings by other studies indicate the reliability and applicability of our research results in exploring Chinese secondary EFL learners' motivational profiles. Even so, collecting data from multiple sources in future research may increase the validity of the conclusions [85]. Third, in the between-network validity study, the present study focused solely on academic engagement, teacher support, and EFL achievement. Future endeavours could expand the scope of theoretically pertinent constructs by exploring the linkages between the seven subtypes of academic motivation and other outcomes, such as psychological well-being [78], goal orientation and academic well-being [86], achievement emotions [87], and educational aspirations [88].

## Conclusion

Academic motivation shapes students' learning experiences and fosters their overall development. By deepening our understanding of academic motivation and actively cultivating it, educators and researchers can design more effective teaching strategies, ultimately improving educational outcomes and promoting holistic student growth. However, existing literature lacks consensus regarding the structure of the AMS. Moreover, most studies validating the AMS have predominantly focused on Western contexts, often overlooking domain-specific nature and cultural nuances. In response to this gap, the present study utilised data from Chinese secondary EFL learners and employed within-network and between-network approaches to evaluate the structure and validity of the AMS within the CHC context. Our findings support the seven-factor model of the AMS, affirming its applicability for assessing the motivation profiles of Chinese secondary EFL learners. In addition, the established measurement invariance of the EFL-related AMS across genders and grade levels underscores its efficacy for comparative analyses across these dimensions. This finding further attests to the scale's stability, reliability, and extensive applicability in the EFL education context. Implementing this validated EFL-related AMS can provide English educators with a comprehensive understanding of students' motivation in learning English, thereby informing and

enhancing instructional strategies to better support student engagement and motivation.

## Abbreviations

AMS	Academic motivation scale.
SDT	Self-determination theory.
IM-TK	Intrinsic motivation-to know.
IM-TA	Intrinsic motivation-to accomplish.
IM-ES	Intrinsic motivation-to experience stimulation.
EM-ER	Extrinsic motivation-external regulation.
EM-IN	Extrinsic motivation-introjected regulation.
EM-ID	Extrinsic motivation-identified regulation.

## Supplementary Information

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Supplementary Material 1

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## Author contributions

X.K. - Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing - original draft, Writing - review & editing D. H. - Formal analysis, Funding acquisition, Methodology, Project administration, Resources, Software, Writing - original draft, Writing - review & editing, Communication between the journal and the authors Y. W. - Formal analysis, Methodology, Software, Writing - original draft, Writing - review & editing J. L. - Methodology, Writing - review & Editing.

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## Data availability

The corresponding author will provide related information about the data and materials presented in the article when requested.

## Declarations

### Ethics approval and consent to participate

Ethical approval for the present study was obtained from the University of Hong Kong (Human Research Ethics Committee's Reference Number: EA2003020). Prior to the commencement of the questionnaire survey, all participants signed consent forms, verbal informed consent was also obtained from participants' parents or legal guardians, and anonymous pen-and-paper questionnaires were then distributed. The procedure of obtaining consent is approved by the ethics committee. This study reporting experiments on humans has confirmed that all experiments were performed in accordance with relevant guidelines and regulations. For more details about the ethical principles and guidelines for educational research involving human participants, please refer to <https://www.rss.hku.hk/integrity/ethics-compliance/hrec>.

### Consent for publication

Not applicable.

### Competing interests

The authors declare no competing interests.

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