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Original Article

Cultural Adaptation and Psychometric Validation of the Achievement Motivation Measure Among Iranian Students Engaged in Blended Learning: A Cross-Sectional Study

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ABSTRACT

Background: Achievement motivation is a key psychological construct influencing adolescents' academic engagement, perseverance, and performance, particularly in blended learning environments that require greater self-regulation and goal-oriented behavior. This study aimed to culturally adapt and evaluate the psychometric properties of the Persian version of the Achievement Motivation Measure for Arab Postgraduate Students (AMMA) among upper-secondary students in Bojnord, Iran.

Methods: This cross-sectional study was conducted from September 2024 to July 2025 among 1,231 upper-secondary students selected via two-stage cluster random sampling from a population of 9,721. Twelve schools (six boys' and six girls') were randomly chosen, followed by the selection of 72 classes within these schools. All participants had prior blended learning experience. The AMMA was translated and culturally adapted using the World Health Organization (WHO) forward–backward procedure. Face and content validity were assessed by ten experts using the Content Validity Ratio (CVR) and Content Validity Index (CVI). Construct validity was examined using Exploratory Factor Analysis (EFA) (n=479) and Confirmatory Factor Analysis (CFA) (n=373). Concurrent validity was assessed against the Mathematics Motivation Questionnaire (n=190). Reliability was evaluated using Cronbach's alpha, split-half reliability, and test–retest reliability (n=189).

Results: The Persian version of AMMA demonstrated strong content validity (CVR=0.80–1.00; S-CVI/Ave=0.89). EFA identified four factors—Perseverance, Ambition, Goal Setting, and Resilience—explaining 61.58% of total variance (KMO=0.904); Bartlett's test of sphericity, (P<0.001). CFA confirmed excellent model fit (χ^2/df=1.48, RMSEA=0.034, SRMR=0.030, CFI=0.99, TLI=0.99, IFI=0.99). Concurrent validity was supported by a strong positive correlation with mathematics motivation (r=0.79, P<0.001). Reliability was high, with an overall Cronbach's alpha of 0.90, subscale alphas ranging from 0.72 to 0.92, a split-half coefficient of 0.716, and an Intraclass Correlation Coefficient of 0.92.

Conclusion: The Persian version of AMMA is a valid, reliable, and culturally appropriate instrument for assessing achievement motivation among Iranian secondary school students and can support educational research, counseling, and motivation-enhancement programs.

Keywords: Achievement, Motivation, Psychometrics, Education, Distance, Iran

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Introduction

In the Iranian education system, achievement motivation plays a crucial role in the academic success of upper-secondary students. This stage of development is characterized by important educational and career-related transitions, including choosing a field of study, developing an academic identity, making career decisions, and preparing for high-stakes assessments such as the national university entrance examination (1, 2). Successfully navigating these challenges requires students to demonstrate perseverance, establish clear goals, maintain strong academic aspirations, and effectively manage academic stress, all of which contribute to desirable educational outcomes (3).

In recent years, blended learning environments, which integrate both online and face-to-face instruction, have become increasingly prevalent. This shift has introduced new academic challenges that underscore the role of achievement motivation. Students are required to balance self-directed online learning with conventional classroom responsibilities (4).

Moreover, several contextual factors have intensified achievement motivation among adolescents, including heightened competition for university admission, rising family expectations, the education system's emphasis on standardized testing, and unequal access to high-quality learning resources (5). Additionally, blended learning experiences have introduced variability in students' learning conditions, digital engagement, and study habits, all of which may influence motivational patterns.

Students with high levels of achievement motivation are more likely to establish well-defined academic goals, follow structured study plans consistently, and demonstrate sustained perseverance and resilience when confronted with academic difficulties (6). Conversely, low achievement motivation is associated with decreased study engagement, increased risk of academic burnout, heightened test anxiety, poorer academic outcomes, and less effective educational decision-making (7).

Despite the importance of this construct, many existing tools for assessing achievement motivation in Iran present notable limitations. Some instruments are designed for different age groups, while others lack a clear theoretical foundation or robust factor structure. Many have not undergone adequate cultural or linguistic adaptation for Iranian students (8, 9). Moreover, many of these scales are grounded in earlier motivational frameworks and assess only a single aspect of achievement motivation, such as perseverance or ambition. However, achievement motivation is an inherently multidimensional construct that encompasses perseverance, goal-setting, tolerance of difficulties, and striving for excellence (10, 11).

Research has shown that achievement motivation emerges through the interplay of several factors, including the need for success, risk tolerance, striving for competence, and the desire to overcome obstacles (12-14). Building on this perspective, scholars argue that motivation assessment instruments must have a strong theoretical foundation. This ensures not only psychometric rigor but also predictive validity for related academic behaviors (15). Consistent with this approach, more recent measurement tools inspired by McClelland's theory conceptualize achievement motivation as a multidimensional construct, incorporating elements such as perseverance, ambition, goal orientation, and resilience (16).

Within this context, Grera (2022) developed the Achievement Motivation Measure for Arab Postgraduate Students (AMMA), which is explicitly based on McClelland's theory (17). This instrument represents a contemporary, theory-driven, and multidimensional approach to assessing achievement motivation.

The AMMA consists of 19 items rated on a five-point Likert scale that assess four primary dimensions: ambition, goal setting, perseverance, and resilience. Exploratory Factor Analysis (EFA) has confirmed the

conceptual coherence of its four-factor structure. The instrument also demonstrates strong psychometric properties, with a Cronbach's alpha of 0.85, test–retest reliability of 0.83, and split-half reliability of 0.77 (17).

Although the AMMA was validated using university students, it is based on McClelland's theory of achievement motivation. This framework encompasses fundamental psychological processes, including the need for achievement, goal-oriented behavior, and perseverance.

These constructs remain developmentally relevant and conceptually stable from late adolescence into early adulthood. Evidence suggests that the core aspects of achievement motivation become especially prominent during the upper-secondary stage, a period characterized by heightened academic demands and critical decisions regarding future pathways.

Moreover, the instrument's items assess general motivational tendencies. They do not measure context-specific behaviors tied exclusively to university life. This characteristic supports its applicability in secondary education. Prior psychometric research has demonstrated that motivation scales originally developed for higher education can be effectively adapted for adolescent populations, provided that careful cultural and linguistic adjustments are made, item wording is tailored to be age-appropriate, and the factor structure is validated within the intended age group.

Achievement motivation is a construct that is deeply shaped by cultural and contextual factors. It is influenced by parental expectations, societal values, and the structure of the educational system in each country. In Iran's cultural setting, particularly in mid-sized cities such as Bojnord, several factors may shape achievement motivation. These include family pressure for academic success, intense competition for university admission, emphasis on securing prestigious careers, and societal attitudes toward academic excellence (18).

Additionally, the recent shift toward hybrid instructional models has influenced students' learning experiences, autonomy, and time-management skills. This assesses achievement motivation even more relevant in mixed educational settings. Cultural characteristics, including collectivism, strong parental involvement, and societal sensitivity to educational success, highlight the necessity of culturally adapting motivation measures for the Iranian setting.

Furthermore, the AMMA was initially designed for university students in Malaysia, and the items are designed to assess general motivational tendencies rather than context-specific behaviors. Due to linguistic and cultural differences between that population and Iranian upper-secondary students, the instrument cannot be applied directly without appropriate adaptation. Mere translation is insufficient to ensure conceptual, cultural, and psychometric equivalence. Therefore, procedures such as translation and back-translation, expert review, factor analyses, and comprehensive reliability and validity assessments are required to adapt the instrument to the Iranian educational context (19).

Given this research gap, it is essential to validate and culturally adapt the Persian version of the AMMA among upper-secondary students in Bojnord. This educational stage plays a pivotal role in shaping students' academic identity, career choices, exam preparation, and sensitivity to academic outcomes. Moreover, including students with experience in blended learning environments provides an opportunity to evaluate the scale within contemporary learning conditions. These conditions reflect current educational realities in Iran.

A valid and reliable instrument for assessing achievement motivation can help various stakeholders. Counselors, school psychologists, teachers, and educational policymakers can use it to identify motivational deficits. They can implement targeted interventions such as goal-setting workshops, motivational management training, and academic resilience programs. They can also design more precise strategies to enhance academic performance.

Accordingly, the present study aimed to culturally adapt and psychometrically validate the Persian version of the AMMA among upper-secondary students in Bojnord. By examining its content validity, construct validity, and reliability, the study seeks to establish a valid, reliable, and culturally appropriate tool for assessing achievement motivation. The resulting instrument is suitable for educational, research, and counseling contexts, where it can support academic guidance and enhance educational outcomes.

Methods

Study Design and Setting

This methodological cross-sectional study was conducted to translate, culturally adapt, and psychometrically evaluate the Persian version of the AMMA among upper-secondary school students in Bojnord, Iran. The research was carried out from September 2024 to July 2025. All study procedures adhered to ethical guidelines for research involving adolescent participants. The psychometric evaluation included assessments of content validity, construct validity, concurrent validity, and reliability. Construct validity was examined using both EFA and Confirmatory Factor Analysis (CFA).

The original AMMA instrument was developed for Arab postgraduate students; however, its items assess general achievement motivation constructs rather than context-specific postgraduate experiences.

Participants and Sampling

The target population included all students enrolled in grades 10–12 in public upper-secondary schools in Bojnord, Iran (N=9,721). A total of 1,300 students were invited to participate, and 1,231 completed the questionnaires, yielding a response rate of 94.7%, which provided an adequate sample for psychometric evaluation.

A multistage cluster random sampling method was employed to reduce selection bias. Initially, schools were stratified by gender, and six boys' schools and six girls' schools were randomly selected. Subsequently, six classes were randomly chosen from each school, and all students in the selected classes were invited to participate.

Subsample sizes were determined based on established psychometric guidelines and statistical power considerations. For EFA, a sample size of 500 exceeds the commonly recommended ratio of 10–20 participants per item and is well above the minimum threshold of 200–300 required for stable factor extraction. For CFA, a sample of 400 surpasses the widely accepted minimum of 200, ensuring adequate power for model fit evaluation.

For validity and reliability analyses, a sample size of 200 is considerably larger than the typical minimum range of 50–100, thereby improving the precision and generalizability of the estimates through reduced standard errors (20-23). Given that the instrument includes 19 items, the recommended subject-to-item ratio of 10–20 suggests a required sample size between 190 and 380 participants for factor analysis.

Larger sample sizes also enhance the accuracy of reliability estimates by reducing standard errors associated with Cronbach's alpha, Intraclass Correlation Coefficients (ICC), and factor loadings. Thus, the total sample of 1,300 students not only meets but exceeds these benchmarks, ensuring robust statistical power for all intended analyses.

To ensure independence across analyses, the total sample (N=1,231) was randomly divided into four mutually exclusive subsamples. This allocation was performed using a random number generator in Microsoft Excel. Each case was assigned to one of four groups: EFA (n=479), CFA (n=373), concurrent validity (n=190), and reliability (n=189). This procedure ensured that no participant was included in more than one psychometric analysis, preserving the statistical independence of each validation step.

Questionnaires with more than 20% missing data were excluded via listwise deletion, while partially incomplete responses were retained without imputation.

Tools/Instruments

This study aimed to validate the AMMA questionnaire, originally developed by Grera (2022), for use with university students. The instrument comprises 19 items distributed across four primary dimensions: Ambition, Goal Setting, Perseverance, and Resilience Responses are measured on a five-point Likert scale ranging from "never" to "always." Despite its original development for higher education contexts, the AMMA is theoretically grounded in general achievement motivation theory, making it conceptually transferable to upper-secondary students when appropriate linguistic and cultural adaptations are applied.

Validity and Reliability - In the original study, construct validity was supported by EFA using principal component analysis with varimax rotation, which yielded four independent factors with high factor loadings (above 0.50). Content validity was established through expert review in educational psychology. The scale demonstrated strong psychometric properties, with Cronbach's alpha of 0.85, test-retest reliability of 0.83, and split-half reliability of 0.77, indicating excellent internal consistency and temporal stability. Given its theoretical foundation, validated factor structure, and robust reliability coefficients, the AMMA is suitable for assessing achievement motivation in educational, psychological, and motivational research across diverse cultural contexts (17).

To date, no formal translation or validation of the AMMA has been conducted in the Iranian context, highlighting a significant gap in the availability of a culturally appropriate tool for assessing achievement motivation among Persian-speaking adolescents.

For assessing concurrent validity, the Mathematics Motivation Questionnaire (MMQ) by Fiorella and colleagues (2021) was used. This 19-item tool assesses five motivational dimensions: Intrinsic Value, Self-Regulation, Self-Efficacy, Utility Value, and Test Anxiety (24). Items are rated on a five-point Likert scale from "strongly disagree" to "strongly agree." The Persian version demonstrated strong psychometric support through CFA, confirming the five-factor structure with adequate fit indices (CFI=0.95, Goodness of Fit Index (GFI)=0.93, Adjusted Goodness of Fit Index (AGFI)=0.90, Root Mean Square Error of Approximation (RMSEA)=0.053). Cronbach's alpha values ranged from 0.79 to 0.87 across subscales, indicating good internal consistency (25). Criterion validity was supported through positive correlations with cognitive appraisals related to failure experiences in mathematics and adolescents' psychological capital.

Cultural Adaptation and Translation Procedure

The AMMA was translated and culturally adapted using the World Health Organization (WHO) forward–backward translation protocol (26) and Brislin's model (27). Initially, two independent forward translations were completed by a bilingual educational psychologist and a professional English language specialist. Following the reconciliation of these versions, an independent bilingual translator performed a backward translation. The resulting version was then systematically compared with the original instrument to ensure conceptual consistency.

An expert panel consisting of educational psychologists, school counselors, and sociologists—all native to Iran—subsequently evaluated the preliminary translated version. The review focused on cultural relevance, semantic clarity, and preservation of the intended constructs. Particular attention was given to items addressing constructs such as "competitiveness," "personal ambition," and "definitions of success," ensuring their alignment with the sociocultural values, norms, and lived experiences of Iranian upper-secondary students. For instance, items implicitly reflecting individualistic orientations were carefully assessed for compatibility with the more collectivist and family-centered perspectives prevalent in the Iranian context.

Based on the panel's feedback, minor revisions were applied to improve clarity and cultural appropriateness while maintaining the integrity of the underlying psychological constructs. Finally, a pilot test was conducted with a sample of 30 students from the target population to assess comprehensibility and contextual appropriateness. Feedback from participants resulted in further simplification of sentence structures and substitution of abstract academic terminology with more concrete, age-appropriate expressions familiar to Iranian adolescents. Special consideration was given to ensuring the relevance of all items within blended learning settings and the high-stakes academic environment characteristic of Iranian secondary education.

Content Validity

Content validity was assessed by a panel of 10 experts, including two specialists in educational measurement, three educational psychologists, two clinical psychologists, two school counselors, and one specialist in educational management. Each item was rated by the panels for on relevance, clarity, and simplicity, using a four-point scale. The Content Validity Ratio (CVR) was calculated based on Lawshe's method, with a minimum acceptable value of 0.62 for ten experts (28). The Content Validity Index (CVI) was determined at both the Item Level (I-CVI) and the Scale Level (S-CVI/Ave) in accordance with the approach proposed by Waltz and Bausell (29). The I-CVI was derived separately for relevance, clarity, and simplicity, and the overall I-CVI for each item was calculated as the mean of these three values. The S-CVI/Ave was subsequently computed as the mean of all overall I-CVI values across items.

Data Collection

The survey instrument was designed using Google Forms. Data were collected through a self-administered online questionnaire distributed via three distinct channels to ensure broad and reliable access. The questionnaire link was disseminated through: (1) personalized SMS messages sent to students' mobile phone numbers; (2) the official class groups on the *Soroush* messenger application; and (3) a QR code that was projected on classroom screens and also printed on posters placed in common areas within the schools.

Questionnaires were administered by trained research assistants who followed a standardized protocol to ensure uniform administration across all schools and classrooms. The training program for these assistants included: (1) delivering a neutral, scripted introduction to the study; (2) providing uniform instructions regarding the Likert scale and response procedures; (3) responding to participant inquiries using standardized, non-directive statements (e.g., "Please respond based on your personal experience"); and (4) maintaining consistent control over time and classroom conditions.

The questionnaire required approximately 15 minutes to complete. As an incentive for participation, students who completed the survey received a modest incentive consisting of 1 GB of mobile internet data regardless of their responses. To improve participation rates, a reminder message was distributed via the same communication channels (SMS and Soroush) three days following the initial invitation. Overall, 1,300 students were invited to take part in the study, and 1,231 successfully completed the questionnaires. All data collection procedures were conducted between November 2024 and June 2025.

Data Analysis

All statistical analyses were conducted using SPSS version 26 for descriptive statistics, EFA, and reliability analyses, and LISREL version 8.8 for CFA. Before EFA, the suitability of the data for factor analysis was assessed. Sampling adequacy was evaluated using the Kaiser–Meyer–Olkin (KMO) index, where values greater than 0.90 indicate excellent adequacy, values around 0.80 are considered good, and values exceeding 0.60 are deemed acceptable for factor analysis (30, 31). Bartlett's test of sphericity was applied to examine the suitability of the correlation matrix for factor analysis (32).

Additional assumptions for EFA were evaluated by examining the correlation matrix to ensure a sufficient number of coefficients exceeded 0.30 in absolute value, computing the matrix determinant to verify the absence of multicollinearity (greater than 0.00001), and evaluating initial communalities to confirm that each item shared adequate variance with others (33). The normality of the data was assessed through skewness and kurtosis indices, with absolute values below 2 indicating acceptable univariate normality (34).

EFA was conducted using principal axis factoring with Varimax rotation and Kaiser normalization. Item retention criteria included factor loadings ≥ 0.40, communalities ≥ 0.50, and theoretical interpretability of factors (35). Although moderate inter-factor correlations were observed (r ≈ 0.30), Varimax rotation was retained to preserve a simpler and more interpretable factor structure consistent with the theoretical conceptualization of related but distinct dimensions of achievement motivation. The level of inter-factor correlations was not sufficiently strong to justify the use of an oblique rotation, and the orthogonal solution demonstrated both stability and conceptual clarity (36).

Multivariate normality was assessed via Mardia's coefficient of multivariate kurtosis. The obtained value was 32.18, with a critical ratio of 4.8. This value is substantially below the recommended threshold of p(p+2)=399 (where p=19 represents the number of observed variables), suggesting that the assumption of multivariate normality was satisfied for the analysis (37). The absence of influential multivariate outliers was confirmed through Mahalanobis distance, using a significance threshold of P<0.001.

The CFA was conducted using Maximum Likelihood Estimation (MLE). The data's suitability for CFA was confirmed by examining the assumptions of MLE. This value is substantially below the recommended threshold of p(p+2)=399 (with p=19 observed variables), indicating that the assumption of multivariate normality was satisfied (37). The absence of influential multivariate outliers was confirmed using Mahalanobis distance (P<0.001) (37). Model fit was evaluated using the Chi-Square to Degrees of Freedom Ratio (χ^2/df; acceptable≤3.00), Comparative Fit Index (CFI; acceptable≥0.90), Non-Normed Fit Index, also known as the Tucker–Lewis Index (NNFI/TLI; acceptable≥0.90), Incremental Fit Index (IFI; acceptable≥0.90), Normed Fit Index (NFI; acceptable≥0.90), Root Mean Square Error of Approximation (RMSEA; acceptable≤0.08), and Standardized Root Mean Square Residual (SRMR; acceptable≤0.08) (38). Modification indices were examined only when theoretically justified; however, no substantial post hoc modifications were implemented beyond those consistent with the original factor structure.

Reliability was assessed through internal consistency, test–retest reliability, and split-half reliability. Cronbach's alpha coefficients were calculated for the total scale and subscales, with values ≥0.70 considered acceptable, ≥0.80 good, and ≥0.90 excellent. The 95% confidence intervals for Cronbach's alpha were also reported. ICC was calculated for test–retest reliability, with values ≥0.75 indicating good reliability (39). Split-half reliability was estimated using Spearman–Brown and Guttman coefficients. The test–retest procedure was conducted with a two-week interval between measurements.

Ethics - The study was approved by the Ethics Committee of Islamic Azad University, Semnan Branch, Iran. As the participants were under 18 years of age, written informed consent was obtained from their parents or legal guardians, while verbal assent was secured from the students themselves before data collection. Participation was entirely voluntary, and students were informed that they could discontinue their involvement at any time without penalty. Additionally, they were assured of anonymity and confidentiality to reduce social desirability bias.

Results

Participant Characteristics, Sampling, and Allocation

A total of 1,300 students were invited

to participate, and 1,231 returned complete questionnaires (overall response rate=94.7%). The target population comprised all upper-secondary students (grades 10–12) in Bojnord, with an official population size of 9,721 students. A multistage cluster random sampling approach was employed, stratified by gender. Six boys' schools and six girls' schools were randomly selected, and six classes were then randomly chosen from each school. To clarify the distinction between the total and analytic samples, as requested by reviewers, all 1,231 participants were included in the descriptive analyses and reporting of overall scale distributions. For psychometric evaluation, participants were assigned a priori to separate subsamples for EFA, CFA, concurrent validity assessment, and reliability testing. Following data screening and listwise deletion of cases with incomplete responses in analysis-specific datasets, the final sample sizes were 479 for EFA, 373 for CFA, 190 for concurrent validity analyses, and 189 for reliability analyses. The discrepancy between the planned allocations (500, 400, 200, and 200, respectively) and the final analytic samples resulted from missing data and the application of listwise deletion procedures. This information is reported to clearly distinguish the full study sample (N=1,231) from the subsamples used in each psychometric analysis (Table 1).

Content Validity

Content validity was evaluated by a panel of 10 specialists in educational measurement, educational psychology, clinical psychology, school counseling, and educational management. According to Lawshe's criterion, the minimum acceptable CVR for a panel of 10 experts is 0.62. All items exceeded this threshold with CVR values ranging from 0.80 to 1.00, indicating item necessity. The Item-level Content Validity Index (I-CVI) was calculated independently for relevance, clarity, and simplicity based on expert ratings. I-CVI values ranged from 0.80 to 1.00 for relevance, 0.80 to 1.00 for clarity, and 0.80 to 1.00 for simplicity. The average Scale-Level Content Validity Index (S-CVI/Ave) across all items was 0.89, indicating satisfactory content validity. Table 2 reports the item-level CVR and CVI breakdown (relevance, clarity, simplicity) and the overall I-CVI for each item.

Table 1: Demographic characteristics of participants and distribution across analytic subsamples

	Variable	Total (N=1231)	Exploratory (n=479)	Confirmatory (n=373)	Concurrent (n=190)	Reliability (n=189)
Gender	Male	690 (56.1%)	260 (54.3%)	211 (56.6%)	103 (54.2%)	116 (61.4%)
	Female	541 (43.9%)	219 (45.7%)	162 (43.4%)	87 (45.8%)	73 (38.6%)
Residence Status	Owned	783 (63.6%)	304 (63.5%)	228 (61.1%)	130 (68.4%)	121 (64.0%)
	Rented	448 (36.4%)	175 (36.5%)	145 (38.9%)	60 (31.6%)	68 (36.0%)
Father's Employment	Employed	1098 (89.2%)	428 (89.4%)	332 (89.0%)	174 (91.6%)	164 (86.8%)
	Unemployed	133 (10.8%)	51 (10.6%)	41 (11.0%)	16 (8.4%)	25 (13.2%)
Mother's Employment	Housewife	967 (78.6%)	376 (78.5%)	298 (79.9%)	143 (75.3%)	150 (79.4%)
	Employed	264 (21.4%)	103 (21.5%)	75 (20.1%)	47 (24.7%)	39 (20.6%)
Family Income	<15 million Toman	932 (75.7%)	370 (77.2%)	273 (73.2%)	145 (76.3%)	144 (76.2%)
	> 15 million Toman	299 (24.3%)	109 (22.8%)	100 (26.8%)	45 (23.7%)	45 (23.8%)
Mother's Education	<Diploma	360 (29.2%)	148 (30.9%)	102 (27.3%)	54 (28.4%)	56 (29.6%)
	Diploma	469 (38.1%)	180 (37.6%)	145 (38.9%)	74 (38.9%)	70 (37.0%)
	> Diploma	402 (32.7%)	151 (31.5%)	126 (33.8%)	62 (32.6%)	63 (33.3%)
Father's Education	<Diploma	341 (27.7%)	128 (26.7%)	104 (27.9%)	53 (27.9%)	56 (29.6%)
	Diploma	431 (35.0%)	179 (37.4%)	134 (35.9%)	67 (35.3%)	51 (27.0%)
	> Diploma	459 (37.3%)	172 (35.9%)	135 (36.2%)	70 (36.8%)	82 (43.4%)

* Overall descriptive statistics are based on the full sample (N=1,231). Sample sizes for individual psychometric analyses may vary due to listwise deletion of cases with missing data.

Table 2: Content validity indices based on expert evaluation

Item	CVR	Relevance CVI	Clarity CVI	Simplicity CVI	I-CVI (Mean)
i1	1.00	1.00	0.90	0.80	0.900
i2	0.80	1.00	0.90	1.00	0.967
i3	1.00	0.80	0.90	0.80	0.833
i4	1.00	0.80	0.80	0.90	0.833
i5	0.80	0.80	0.80	0.80	0.800
i6	1.00	0.90	1.00	1.00	0.967
i7	0.80	0.80	1.00	0.80	0.867
i8	0.80	0.80	0.90	1.00	0.900
i9	1.00	1.00	1.00	0.90	0.967
i10	1.00	1.00	0.80	1.00	0.933
i11	0.80	1.00	1.00	0.90	0.967
i12	0.80	1.00	1.00	0.90	0.967
i13	0.80	1.00	0.90	0.80	0.900
i14	0.80	0.80	0.90	0.80	0.833
i15	0.80	0.80	0.90	0.80	0.833
i16	0.80	0.80	0.90	0.80	0.833
i17	1.00	0.80	0.80	0.90	0.833
i18	0.80	0.80	0.90	0.80	0.833
i19	1.00	1.00	0.80	0.90	0.900

* CVI: Content Validity Index; CVR: Content Validity Ratio; I-CVI: Item Level Content Validity Index; Average Scale Level-CVI=0.89.

Exploratory Factor Analysis

EFA was performed on the designated exploratory subsample (n=479) using Principal Axis Factoring (PAF) with Varimax rotation and Kaiser normalization. This approach resolves a prior inconsistency in which Principal Component Analysis had been referenced in the text while PAF was applied in the tables. Before factor extraction, sampling adequacy and suitability for factor analysis were assessed. The KMO value was 0.904, indicating meritorious adequacy, and Bartlett's test of sphericity was significant ($\chi^2(171)=4955.577$, $P<0.001$), confirming the appropriateness of factor analysis. The scree plot (Figure 1) and eigenvalues >1 indicated the extraction of four factors, which together explained 61.58% of the total variance after rotation. Item inclusion was based on primary factor loadings of at least 0.40, communalities of 0.50 or higher, and conceptual interpretability. The factor extraction process converged after five iterations.

The scree plot (Figure 1) was reviewed first, followed by evaluation of the rotated factor matrix and communalities (Tables 3 and 4), in accordance with the intended presentation sequence. Extracted communalities ranged from 0.565 to 0.674 (Table 3), suggesting that each item had an adequate proportion of variance explained by the retained factors. In the rotated factor matrix (Table 4), primary loadings are highlighted in bold to facilitate interpretation, with the highest loading for each item emphasized. Factor labels were assigned based on the predominant content of the items loading on each factor, ensuring consistent terminology across the manuscript. The four factors were labeled as follows: Factor 1—Perseverance (items i1–i7), Factor 2—Ambition (items i15–i19), Factor 3—Goal-Setting (items i8–i11), and Factor 4—Resilience (items i12–i14). The term "Resilience" is used consistently throughout to address earlier inconsistencies involving alternative labels such as Endurance or Stability.

Inter-Factor Correlations

Inter-factor Pearson correlations computed on factor scores (EFA sample, n=479) are presented in Table 5. All inter-factor

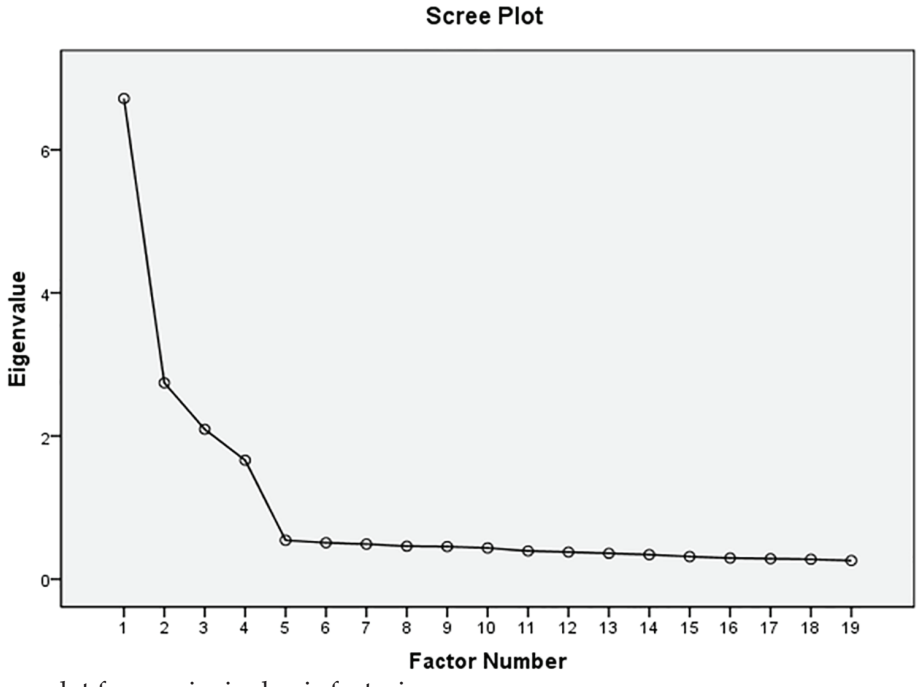

Figure 1: Scree plot from principal axis factoring
* Extraction: Principal Axis Factoring; Rotation: Varimax with Kaiser normalization; Sample: N=479.

Table 3: Item communalities obtained from exploratory factor analysis

Item	Initial	Extraction
i1	0.533	0.565
i2	0.595	0.621
i3	0.524	0.567
i4	0.587	0.630
i5	0.548	0.585
i6	0.563	0.594
i7	0.568	0.605
i8	0.503	0.572
i9	0.576	0.663
i10	0.533	0.611
i11	0.557	0.648
i12	0.522	0.620
i13	0.523	0.642
i14	0.540	0.674
i15	0.574	0.632
i16	0.571	0.626
i17	0.571	0.626
i18	0.583	0.648
i19	0.527	0.573

correlations were positive and moderate in magnitude (r range=0.302–0.348; all P<0.001), supporting related but distinct latent constructs.

Confirmatory Factor Analysis

CFA was performed on the confirmatory subsample (n=373) using Maximum Likelihood Estimation in LISREL 8.8. The proposed four-factor model, comprising 19 items associated with the four latent constructs identified through EFA, was evaluated. All standardized factor loadings were statistically significant (t>7.00) and fell within an acceptable range (0.62–0.92); and none exceeded 1.00, indicating no issues with scaling or reporting.

Table 4: Item-level factor loadings derived from exploratory factor analysis using varimax rotation

Item	Factor 1 (Perseverance)	Factor 2 (Ambition)	Factor 3 (Goal-Setting)	Factor 4 (Resilience)
i1	**0.725**	0.081	0.122	0.132
i2	**0.755**	0.166	0.123	0.097
i3	**0.737**	0.126	0.075	0.049
i4	**0.770**	0.105	0.141	0.081
i5	**0.726**	0.166	0.070	0.159
i6	**0.745**	0.101	0.160	0.067
i7	**0.761**	0.110	0.082	0.090
i15	0.156	**0.762**	0.133	0.092
i16	0.138	**0.765**	0.097	0.110
i17	0.125	**0.753**	0.180	0.101
i18	0.143	**0.774**	0.121	0.114
i19	0.128	**0.728**	0.135	0.087
i8	0.110	0.130	**0.717**	0.167
i9	0.181	0.160	**0.767**	0.125
i10	0.132	0.161	**0.747**	0.101
i11	0.140	0.150	**0.771**	0.107
i12	0.181	0.121	0.213	**0.726**
i13	0.127	0.130	0.099	**0.774**
i14	0.129	0.154	0.150	**0.782**

* Bold entries indicate the highest loading for each item.

Table 5: Inter-factor correlations

Factor	1 (Perseverance)	2 (Ambition)	3 (Goal-Setting)	4 (Resilience)
1 — Perseverance	1.00	0.326*	0.320*	0.306*
2 — Ambition	0.326*	1.00	0.348*	0.30
3 — Goal-Setting	0.320*	0.348*	1.00	0.341*
4 — Resilience	0.306*	0.302*	0.341*	1.00

* P<0.001.

Although modification indices were reviewed and only theoretically meaningful adjustments were considered, no post hoc changes were applied, as the model demonstrated adequate fit and alignment with the original factor configuration.

Error-based fit indices also indicated good fit, including an RMSEA of 0.034 (90% CI: 0.023–0.044) and an SRMR of 0.030. Furthermore, the incremental and comparative fit indices showed excellent values (CFI=0.99, NNFI/TLI=0.99, IFI=0.99, and NFI=0.98). The absolute fit indices were also acceptable, with GFI and AGFI values of 0.94 and 0.93, respectively. Although modification indices were examined to identify potential areas of local misfit, no post hoc modifications to the hypothesized four-factor model were required or implemented, as the initial model demonstrated superior fit to the data. The Expected Cross-Validation Index (ECVI) for the proposed model (0.80) was lower than that of the saturated model (1.02), indicating good generalizability. The standardized factor loadings and corresponding t-values are illustrated in Figures 2 and 3, respectively. These results were obtained from a CFA conducted with LISREL 8.8 employing the Maximum Likelihood estimation approach based on a sample of 373 participants.

Concurrent Validity

Concurrent validity was examined by correlating AMMA total and subscale scores with the MMQ in the concurrent validity subsample (n=190). Descriptive statistics indicated a Mean (SD) of 56.75 (16.60) for the AMMA and 56.76 (5.88) for mathematics motivation.

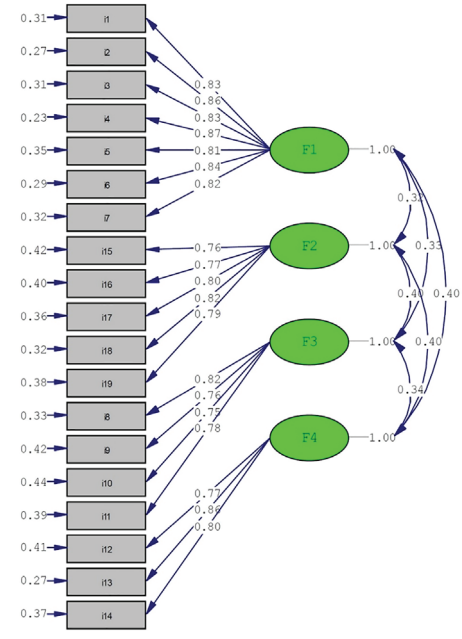

Figure 2: Standardized factor loadings for the four-factor model
* RMSEA: Root Mean Square Error of Approximation; df: degrees of freedom.

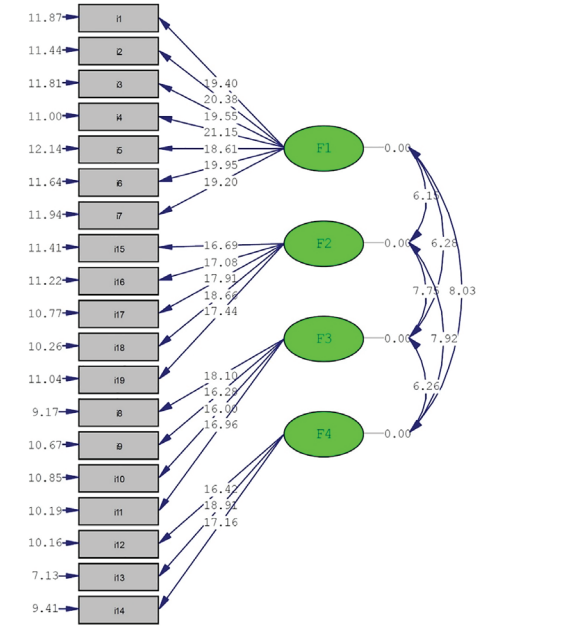

Figure 3: Significant t-values for factor loadings
* RMSEA: Root Mean Square Error of Approximation; df: degrees of freedom.

Pearson two-tailed correlations showed a strong and statistically significant association between the AMMA total score and mathematics motivation (r=0.785, P<0.001), providing robust evidence of concurrent validity. All AMMA dimensions were also positively and significantly correlated with the criterion: Perseverance r=0.612, Ambition r=0.546, Goal-Setting r=0.514, and Resilience (r=0.428 (all P<0.001). Intercorrelations among the AMMA dimensions were moderate (r=0.21–0.34), supporting related yet distinct constructs, and each dimension showed a strong association with the AMMA total score (r=0.60–0.78). Although all dimensions demonstrated adequate criterion-related validity, the comparatively smaller correlation for Resilience suggests that this dimension captures broader perseverance under adversity that may not be fully aligned with mathematics-specific motivational content measured by the criterion instrument.

Reliability Evidence

Reliability analyses were performed using the reliability subsample (n=189). The Persian version of AMMA demonstrated excellent internal consistency for the total 19-item scale (Cronbach's α=0.901, 95% CI [0.884, 0.916]). Internal consistency coefficients for the four subscales ranged from acceptable to excellent, including: Perseverance (7 items; α=0.915, 95% CI [0.897, 0.931]), Ambition (5 items; α=0.878, 95% CI [0.850, 0.904]), Goal-Setting (4 items; α=0.717, 95% CI [0.660, 0.769]), and Resilience (3 items; α=0.813, 95% CI [0.772, 0.849]).

Corrected item–total correlations ranged from 0.390 to 0.639, indicating adequate item discrimination. Two items (i12 and i14) showed comparatively lower corrected item–total correlations (approximately 0.39–0.40); however, deleting these items did not meaningfully improve internal consistency (Cronbach's α if item deleted ranged from 0.893 to 0.900). Considering their theoretical relevance and content coverage, all items were retained.

Split-half reliability analysis yielded a raw correlation between halves of 0.557 (95% CI [0.45, 0.65]); after correction for test length, the Spearman–Brown coefficient was 0.716 (95% CI [0.63, 0.79]) and the Guttman split-half coefficient was 0.707 (95% CI [0.62, 0.78]), supporting acceptable reliability of the scale.

Test–retest reliability over a two-week interval demonstrated excellent temporal stability, with an intraclass correlation coefficient (two-way mixed effects, absolute agreement) of ICC=0.92 (95% CI [0.89, 0.95], P<0.001).

Overall, following cultural adaptation and expert evaluation, the Persian version of AMMA exhibited strong content validity, a robust four-factor structure (KMO=0.904; Bartlett's test P<0.001; explained variance=61.58%), excellent CFA fit indices (RMSEA=0.034; CFI=0.99; TLI=0.99, and IFI ≈ 0.99), strong internal consistency across the total scale and subscales (α=0.717–0.915), acceptable split-half reliability (Spearman–Brown=0.716; Guttman=0.707), and excellent test–retest stability (ICC=0.92).

Discussion

The present study aimed to culturally adapt and psychometrically evaluate the AMMA among upper-secondary school students in Bojnord, Iran, who had experience with blended learning environments combining online and face-to-face instruction. The findings indicated that the Persian version of the AMMA possessed satisfactory content validity, construct validity, concurrent validity, and reliability. These results support its applicability as a valid and reliable instrument for assessing achievement motivation within this educational setting.

Content validity was examined through CVI and CVR analyses. The overall CVI exceeded 0.85, indicating a high degree of item clarity, simplicity, and relevance of the items. Based on the guidelines proposed by Waltz and Bausell, a CVI value of 0.79 or higher is considered acceptable, indicating that the present findings exceeded the recommended benchmark (29). Furthermore, CVR values ranged from 0.80 to 1.00, exceeding the minimum acceptable threshold, surpassing the minimum acceptable value of 0.62 suggested by Lawshe for a panel of 10 experts (28). These findings indicate that, from the experts' perspective, the items were judged to be essential and appropriately representative of the achievement motivation construct.

These results are consistent with previous studies on the cultural adaptation of motivational instruments in Iran. For instance, Derakhshanrad and Piven, in their adaptation of the Persian version of Herman's Achievement Motivation Questionnaire, reported high content validity indices, underscoring the importance of cultural sensitivity in the development and adaptation of motivational measures (8). Furthermore, research on academic motivation in Iran has emphasized that assessment tools should be designed or adapted in accordance with the specific social and educational context in which they are applied (1, 11).

The reliability of the AMMA was assessed through Cronbach's alpha coefficients. The scale demonstrated excellent internal consistency, with an overall alpha of 0.90. According to established psychometric benchmarks, this value reflects a high level of reliability (40). The reliability coefficients of all subscales ranged from 0.717 to 0.915, with the highest value observed for perseverance and the lowest for Goal-Setting.

These reliability estimates are comparable to those reported in similar studies. For instance, Grera, in the validation of the AMMA among Arab postgraduate students, reported acceptable to high Cronbach's alpha coefficients (17). Likewise, studies on academic and mathematics motivation have typically reported reliability coefficients ranging from 0.70 to 0.90 (24, 25). The relatively higher coefficients obtained in the current study may reflect the homogeneity of the sample and the strong cultural relevance of the items for the studied population. Furthermore, the "alpha if item deleted" results showed that excluding any item did not improve the overall alpha coefficient, indicating that each item makes a meaningful contribution to the scale's internal consistency.

Construct validity was evaluated using EFA. The KMO value was 0.904, indicating excellent sampling adequacy, and Bartlett's test of sphericity was statistically significant, confirming the suitability of the correlation

matrix for factor analysis. According to Kaiser's criteria, KMO values greater than 0.90 are classified as "excellent," suggesting that the data in this study met highly favorable statistical conditions (30).

The EFA yielded a four-factor structure that collectively explained approximately 60% of the total variance. This level of explained variance is considered acceptable in psychometric research and is consistent with recommendations that values exceeding 50% are adequate (41). The extracted factors represented perseverance, ambition, goal-setting, and resilience, which conceptually align with theoretical frameworks of achievement motivation, particularly McClelland's need for achievement theory and contemporary models of academic motivation (16).

Concurrent validity was assessed by examining the correlations between AMMA scores and the MMQ. The overall AMMA score demonstrated a strong, statistically significant positive correlation with mathematics motivation, supporting the expected conceptual convergence between the two measures while indicating that they assess related but distinct constructs. All subscales were also positively and significantly correlated with the criterion measure, with the strongest association observed for perseverance and the weakest for resilience. This pattern is theoretically expected, as resilience represents a broader construct that extends beyond motivation in a specific academic domain such as mathematics.

These findings are consistent with studies highlighting the roles of motivation, self-efficacy, and resilience in academic achievement (42, 43). Additionally, studies conducted in Iran have reported significant associations between achievement motivation and academic performance, learning engagement, and educational success (1, 9).

From a theoretical perspective, the prominence of perseverance and goal-setting dimensions may reflect the specific demands of blended learning environments, where students must rely heavily on self-regulation, sustained effort, and clearly defined goals to succeed. Research on online and blended learning contexts indicates that intrinsic motivation, academic resilience, and perceived competence play critical roles in students' adaptation and perseverance in these settings (10, 44, 45). Therefore, the factor structure identified in this study is not only statistically robust but also theoretically meaningful and consistent with existing empirical evidence.

Limitations and Suggestions

This study has several limitations. First, data collection was limited to public upper-secondary schools in Bojnord city. This may restrict generalizability to students from other cities, rural regions, private schools, or different socio-cultural backgrounds. Additionally, while all participants had experience with blended learning, the extent and quality of this exposure may vary across schools and regions, potentially influencing motivational patterns. Future research should include larger, more diverse samples across Iran to explore regional variations in achievement motivation.

Second, reliance on self-report questionnaires may introduce subjective bias. Adolescents might respond in socially desirable ways, especially when evaluating traits like ambition or perseverance. Achievement motivation is shaped by complex emotional, cognitive, and socio-cultural factors, including students' experiences in hybrid learning settings. Future studies should employ mixed-method approaches, such as qualitative interviews, teacher evaluations, and behavioral observations, to capture deeper dimensions of motivational processes.

Third, motivational constructs may vary across developmental stages. Therefore, future research could adapt the AMMA for middle-school or university populations to examine developmental differences. Cross-cultural comparisons with countries sharing similar competitive educational systems would also be valuable. Comparative studies examining motivation in fully in-person, fully online, and blended environments could

provide insight into how instructional formats shape motivational trajectories.

Fourth, parental marital status and other family structure variables were not collected, even though such factors can influence adolescents' motivational orientations and academic resilience. Including these variables in future studies may offer a more comprehensive understanding of family dynamics and their relationship to achievement motivation.

Conclusion

This study culturally adapted and psychometrically validated the Persian version of the AMMA among upper-secondary students in Bojnord, Iran, who had prior experience with blended learning. The findings provided strong evidence of content, concurrent, and construct validity, supporting a multidimensional framework encompassing perseverance, ambition, goal setting, and resilience. The scale also demonstrated strong psychometric properties and consistently high levels of reliability across the overall measure and its subscales, with stability over time and satisfactory internal consistency.

Given its strong psychometric performance, the Persian version of AMMA is a valid and reliable instrument for assessing achievement motivation among Iranian adolescents. Its application is particularly relevant in contemporary educational contexts where students navigate blended learning environments that demand heightened self-regulation, perseverance, and adaptive motivational skills. The scale can be effectively used in educational research, school counseling, and intervention planning to examine links between motivation and academic engagement, performance, resilience, psychological well-being, and long-term educational outcomes.

Abbreviations

AGFI: Adjusted Goodness of Fit Index
AMMA: Achievement Motivation Measure for Arab Postgraduate Students
CFA: Confirmatory Factor Analysis
CFI: Comparative Fit Index
CVI: Content Validity Index
CVR: Content Validity Ratio
EFA: Exploratory Factor Analysis
GFI: Goodness of Fit Index
ICC: Intraclass Correlation Coefficient
IFI: Incremental Fit Index
I-CVI: Item Level Content Validity Index
KMO: Kaiser–Meyer–Olkin Measure of Sampling Adequacy
MLE: Maximum Likelihood Estimation
MMQ: Mathematics Motivation Questionnaire
NFI: Normed Fit Index
NNFI (TLI): Non-Normed Fit Index (Tucker–Lewis Index)
RMSEA: Root Mean Square Error of Approximation
S-CVI/Ave: Average Scale Level Content Validity Index
SRMR: Standardized Root Mean Square Residual

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Authors' Contribution

SM, MRMS, and AT designed and drafted the manuscript. MRMS performed the statistical analysis and validation. AT and HV contributed to data interpretation. All authors reviewed and approved the final manuscript.

Conflict of Interest

The authors declare that they have no competing interests.

Ethical Considerations

This research was conducted in accordance with ethical principles and approved by the Research Ethics Committee of Islamic Azad University, Semnan Branch, Iran (IR.IAU.SEMNAN.REC.1404.078). Participants were enrolled only after providing informed written consent, ensuring that they were fully aware of the study's purpose and procedures. The research posed no physical, psychological, or

social risk to the participants. Furthermore, all stages of the study, including design, data collection, and implementation, were carried out in accordance with the institutional guidelines and regulatory frameworks of the university.

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Availability of Data and Materials

The datasets and supplementary materials, including analysis scripts or codes utilized in this study, are available from the corresponding author upon a reasonable request.

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