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ORIGINAL

Psychometric analysis of the Test Anxiety Questionnaire in schoolchildren

Análisis psicométrico del Cuestionario de Ansiedad ante los Exámenes en escolares

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ABSTRACT

Test anxiety is a disproportionate emotional response to an assessment in an academic context due to feelings of rejection, underachievement, fear, discomfort and worry about possible negative outcomes. The objective was to analyze the psychometric properties of the Test Anxiety Questionnaire (CAEX in Spanish) in Peruvian high school students aged between 11 and 17 years (M = 14,03, SD = 1,8). Confirmatory factor analysis (CFA) was performed, and the results confirmed the factorial structure of the CAEX distributed in 4 factors. The goodness-of-fit indices were acceptable (x^2 = 2791,87, p = 0,000, CFI = 0,928, TLI = 0,925, RMSEA = 0,051, SRMR = 0,062) and showed that the CAEX presents discriminant validity (p > 0,05). It is concluded that the CAEX has adequate psychometric properties and is suitable for future research related to the mental health of high school students.

Keywords: Anxiety; Tests; Confirmatory Factor Analysis; Schoolchildren.

RESUMEN

La ansiedad ante los exámenes es una respuesta emocional desproporcionada frente a una evaluación en un contexto académico, debido a sentimientos de rechazo, bajo rendimiento, miedo, incomodidad y preocupación por posibles resultados negativos. El objetivo fue analizar las propiedades psicométricas del Cuestionario de Ansiedad ante los Exámenes (CAEX) en estudiantes de secundaria peruanos con edades comprendidas entre los 11 y 17 años (M = 14,03, SD = 1,8). Se realizó un análisis factorial confirmatorio (AFC), y los resultados confirmaron la estructura factorial del CAEX distribuida en 4 factores. Los índices de bondad de ajuste fueron aceptables (x^2 = 2791,87, p = 0,000, CFI = 0,928, TLI = 0,925, RMSEA = 0,051, SRMR = 0,062) y mostraron que el CAEX presenta discriminante (p > 0,05). Se concluye que el CAEX posee propiedades psicométricas y es adecuado para futuras investigaciones relacionadas con la salud mental de los estudiantes.

Palabras clave: Ansiedad; Exámenes; Análisis Factorial Confirmatorio; Escolares.

INTRODUCTION

Regular basic education is one of the pillars of education, as it develops key competencies required in students, with educational systems focused on assessments to help students improve their academic results.

Thus, as the level of testing in schools increases, almost all students experience situations of anxiety.[1] In general, test anxiety is a disproportionate emotional response to an assessment, which is seen as a threatening situation, due to feelings of rejection, underachievement, fear, discomfort, and worry about the possible negative consequences of taking an exam in any form and at any level.[2,3,4] There is no consensus in the scientific and academic community on its conceptualization due to the dynamic nature of the construct.[5] However, a valid and reliable measure of test anxiety is needed to allow timely detection of this disorder in schoolchildren.

Since 1938, several models of test anxiety have been developed in different populations and in multiple languages: (a) unidimensional; the *Emotional Reactions Before Examination*,[6] the *Test Anxiety Questionnaire* (TAQ) of Mandler & Sarason[7] and the Sarason's *Test Anxiety Scale*,[8] (b) two-dimensional; Test Anxiety,[9] (c) multidimensional; the Sarason's *Reactions to tests* (RTT), the Sarason's Test Anxiety Inventory (TAQ),[10] the Spielberger's *Test Anxiety Inventory* (TAI),[11] a multidimensional test anxiety scale,[12] the *Perceived Test Anxiety in Adolescents*,[13] The *Test Emotions Questionnaire* (TEQ) by Pekrun et al.[14], the Test Anxiety Inventory-State[15] and *The Tripartite Model of Emotions* (Chin et al., 2017). Likewise, the various multidimensional instruments that have been used in adolescents were designed for an adult population.[17]

The literature review of recent years shows several studies of construction, adaptation and validation of instruments in school-aged adolescents; the *Test Anxiety Scale for Children* (TASC) by Wren and Benson,[18] the *Test Anxiety Inventory for Children and Adolescents* (TAICA) by Lowe and Lee, the *Test Anxiety Inventory for Children and Adolescents (*TAICA) by Lowe and Lee,[19] the *Test Anxiety Inventory* (TAI) by Ali and Mohsin,[20] the *Examination Stress Scale* (ExamSS) by Sung & Chao,[21] the *Test Anxiety* Scale[22] and the *Persian Translation of the Children's Test Anxiety Scale*.[23] As for Spanish-speaking instruments, the School Anxiety Inventory or "Inventario de Ansiedad Escolar" (IAE) of Martínez et al.[24] and the Test Anxiety Questionnaire or "Cuestionario de Ansiedad ante Exámenes" (CAEX) by Valero et al.[25] The latter is a measure developed in Spain and applied to a sample of university students, which is frequently used in Spanish-speaking schoolchildren, mainly in case studies and with treatment and control groups.[26]

Likewise, CAEX presents a tetra-factorial structure based on evaluation situations and Lang's three-dimensional theory[24] which distinguishes between cognitive, physiological and motor or behavioral responses, keeping the composition similar to the structure of CAEX.[4] The composition is comparable to the general structure of anxiety and in this sense, the separate evaluation is important, in order to choose the most appropriate treatment later, because each of the systems are regulated by different rules, these responses may maintain discordance or lack of uniformity among.[17] CAEX was corroborated in countries such as Spain in a school context with three dimensions.[28] However, it is evident that in a university context study it was not possible to replicate the four dimensions.[29] In Peru, no studies have been conducted to analyze the psychometric properties of CAEX in schoolchildren; therefore, it is necessary to conduct a study that examines the factorial structure of CAEX in a sample of Peruvian schoolchildren.

In the Peruvian context the CAEX has been used to compare anxiety levels in secondary education settings.[30] This raises questions when administering an adult test anxiety scale to schoolchildren, which in the Peruvian context did not replicate all of the dimensions.[29] In the Peruvian context, all assumptions regarding reliability and validity become speculative.[18] In addition, analyzing discriminant validity would allow measuring the degree to which the instrument demonstrates weak correlations with constructs that are theoretically different, being important to establish the psychological properties of the instrument.[31] The discriminant validity is important for establishing the psychometric properties of an instrument.[32]

Another reason for assessing psychometric properties in adolescents is because the effects of test anxiety are detrimental on learning and academic performance.[3,16] In Latin American countries it is the first cause of dropout, due to disinterest and discouragement due to feelings of low personal control that contribute to poor academic performance and the development of depression.[33] The low level of personal well-being has caused school backwardness in the region, with a dropout rate of 40 % during the year 2014 in weighted average according to Rodriguez;[34] followed to that, in 2017, of the total number of high school students in the world who failed the school year, 30 % were in Latin America.[35] Higher test anxiety has been identified in female high school students, in students with the lowest grades and in those who have failed grades.[26] In addition, the detrimental effects and social service costs associated with anxiety justify the detection of test anxiety[36] symptoms using psychometrically sound measures.[37] Thus, the importance of assessing the associated influencing factors and linking them to the four dimensions to evaluate psychological and educational outcomes that predict future performance.[16] The accumulation of findings helps to clarify the scientific understanding of the reliability and validity of key measures of the core constructs within CAEX. Thus, such an accumulation of evidence could be an important factor in the validation of required instruments. Therefore, the aim of the present study is to analyze the psychometric properties of the CAEX in Peruvian high school students, taking into account the structure proposed by the original author.

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METHOD

Design and participants

A validation study was carried out.[38] The psychometric properties of the Test Anxiety Questionnaire were analyzed (CAEX).[25] For the sample size,[39] the anticipated effect size was considered (δ = 0,3), the desired statistical significance level (α = 0,05), the test power (1 - β = 0,95), the number of observed (50) and latent variables (4) of the model, indicating a minimum sample size of 207 students. All in all, there were 628 students studying between the first and fifth year of secondary school from 7 private educational institutions in the city of Lima, selected by non-probabilistic convenience sampling, with voluntary participation, ages ranged between 11 and 17 years, with mean age was 14,03 years (standard deviation 1,8), being 319 males (50,8 %) and 309 females (49,2 %). Prior to the evaluation, all parents provided informed consent through a Google form.

Instruments

The CAEX[25] consists of 50 items with 6 response options on a Likert scale (*0 = Never happens to me to 7 = Always happens to me*. It was developed to assess the cognitive and behavioral aspects of test anxiety through four factors: (1) worry, (2) physiological responses (3) situations and (4) avoidance.[25] The questionnaire has reported a Cronbach's Alpha of 0,95 as an overall score.[40]

The *Échelle de Motivation en Éducation* (EME) scale designed and validated by Vallerand[41] is made up of 28 items with 7 response options on a Likert scale (*1=Not at all to 7=Totally*) distributed in seven factors that assess from internal motivation to amotivation. The original scale has reported adequate internal consistency (α =0,80). It was translated into English by Vallerand et al.[42], in university students as Academic Motivation Scale (AMS). Subsequently, a Spanish version (EME-E) was validated in a university context and adapted to an educational context,[43] and adapted to a secondary school context by Núñez et al.[44] Becerra-González and Morales-Ballesteros[45] with an acceptable reliability of α = 0,930.

Procedure

Contacts were made with administrators of private educational institutions in the city of Lima. A request was submitted, outlining the objective of the research, and the administrators granted their approval. Moreover, consent was obtained from the parents, and subsequently, assent was obtained from students whose parents had agreed voluntarily to participate in the research. The confidentiality of the information gathered was assured, and it was communicated that they could discontinue their participation in the study at any point in time. The study was reviewed and approved by the ethics committee of a private university (N° 38-2021). All ethical procedures pertaining to the 1975 Declaration of Helsinki and its subsequent revision in 2008 were considered.

Data analysis

The information was recorded in a database and cleaned in order to detect missing data and atypical cases. In addition, the skewness and kurtosis of the items were analyzed, identifying the saturation of some of them, for which a matrix of inter-item polychoric correlations was used.[46]

Because there are precedents of the factor structure and its psychometric properties in different populations, we proceeded to analyze the factor structure in a confirmatory manner through structural equation modeling (SEM). In this process, the lavaan package and the R program (Version 4.0.2) were used and the weighted least squares factorial estimation method with mean and variance adjusted (WLSMV) was employed since the data were ordinal in nature. For the evaluation of the models, the goodness-of-fit indices were considered,[47] such as the comparative fit index (CFI) and the Tucker-Lewis index (TLI), the standardized root mean square residual (SRMR) and the parameters for the root mean square error of approximation (RMSEA) were considered. For a good model fit, the CFI and TLI values should be greater than 0,95 and the RMSEA index should be close to or less than 0,05, although RMSEA values less than or equal to 0,08 may indicate an acceptable fit.[48] In addition, the internal consistency of the scale was analyzed by means of the ordinal alpha coefficient with their respective confidence intervals (90 % CI), where values of 0,70 to 0,80 are considered acceptable and values greater than 0,80 indicate high reliability.

RESULTS

Descriptive analysis

The descriptive analyses show that the skewness and kurtosis coefficients of several items are greater than 1 in absolute value, which indicates that the variability in the responses is not adequate. The correlation coefficients of the corrected items are greater than 0,3, except for items 3 and 7, and according to the ordinal alpha coefficients, if any item were eliminated, this does not affect the internal consistency of the scale (table 1).

Table 1. Item descriptions of the test anxiety questionnaire (CAEX) items

	M	DE	Sk	K	r-itc	α
Item 1	0,35	0,88	3,34	12,57	0,39	0,96
Item 2	1,35	1,47	1,08	0,25	0,48	0,96
Item 3	0,14	0,73	5,72	32,82	0,17	0,96
Item 4	0,26	0,71	3,67	15,82	0,51	0,96
Item 5	2,13	1,76	0,43	-1,19	0,43	0,96
Item 6	0,54	1,03	2,31	5,31	0,65	0,96
Item 7	0,40	0,84	2,43	6,19	0,26	0,96
Item 8	1,00	1,23	1,49	1,91	0,49	0,96
Item 9	0,59	1,03	2,14	4,65	0,63	0,96
Item 10	0,78	1,22	1,71	2,36	0,55	0,96
Item 11	0,27	0,69	3,35	13,36	0,42	0,96
Item 12	0,81	1,15	1,61	2,18	0,54	0,96
Item 13	0,73	1,24	1,92	3,09	0,58	0,96
Item 14	1,14	1,44	1,27	0,74	0,59	0,96
Item 15	0,42	0,93	2,64	6,88	0,66	0,96
Item 16	0,54	1,04	2,36	5,57	0,70	0,96
Item 17	0,75	1,06	1,71	2,98	0,61	0,96
Item 18	0,93	1,25	1,49	1,56	0,71	0,96
Item 19	0,69	1,16	1,98	3,59	0,68	0,96
Item 20	0,85	1,23	1,68	2,48	0,55	0,96
Item 21	0,35	0,85	3,01	9,50	0,69	0,96
Item 22	1,52	1,53	0,92	-0,17	0,65	0,96
Item 23	0,38	0,91	3,02	9,70	0,50	0,96
Item 24	1,36	1,30	1,06	0,63	0,69	0,96
Item 25	1,48	1,47	0,89	-0,13	0,64	0,96
Item 26	1,33	1,49	1,11	0,27	0,64	0,96
Item 27	1,55	1,66	0,91	-0,42	0,45	0,96
Item 28	2,43	1,71	0,23	-1,26	0,57	0,96
Item 29	1,54	1,54	0,92	-0,12	0,72	0,96
Item 30	0,98	1,38	1,58	1,74	0,62	0,96
Item 31	1,10	1,51	1,35	0,69	0,68	0,96
Item 32	1,39	1,45	1,05	0,25	0,69	0,96
Item 33	1,49	1,51	0,97	-0,03	0,75	0,96
Item 34	1,61	1,59	0,83	-0,41	0,77	0,96
Item 35	1,79	1,51	0,61	-0,62	0,71	0,96
Item 36	1,54	1,49	0,87	-0,20	0,62	0,96
Item 37	1,06	1,45	1,38	0,96	0,62	0,96
Item 38	0,94	1,26	1,51	1,76	0,72	0,96
Item 39	2,00	1,57	0,34	-0,97	0,53	0,96
Item 40	2,81	1,64	-0,19	-1,17	0,53	0,96
Item 41	2,05	1,50	0,38	-0,81	0,48	0,96
Item 42	1,27	1,37	1,11	0,55	0,60	0,96
Item 43	1,55	1,48	0,73	-0,44	0,58	0,96
Item 44	1,91	1,56	0,47	-0,81	0,64	0,96
Item 45	2,46	1,69	0,03	-1,26	0,54	0,96
Item 46	1,93	1,52	0,40	-0,85	0,52	0,96
Item 47	2,42	1,76	0,11	-1,32	0,56	0,96
Item 48	1,70	1,69	0,59	-0,96	0,44	0,96
Item 49	1,41	1,38	0,99	0,37	0,57	0,96
Item 50	1,17	1,43	1,17	0,48	0,45	0,96

Note: M = Mean, SD = Standard deviation, Sk = Skewness coefficient, K = Kurtosis coefficient, r-itc = Item-total-corrected item correlation, α = ordinal alpha reliability coefficient (matrix of polychoric correlations).

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Evidence of validity

Confirmatory factor analysis was performed to evaluate 3 models of the test anxiety scale. Model 1 was unifactorial (all 50 items saturated on a single factor) and in model 2 a structure of 4 correlated factors was analyzed (table 2). The results show that model 2 has acceptable goodness-of-fit indices (x^2 = 2915,13, p = 0,000, CFI = 0,928, TLI = 0,924, RMSEA = 0,049 [90 % CI = 0,047 - 0,051], SRMR = 0,065). A third model composed of 48 items and 4 factors was analyzed (items 4 and 18 were eliminated through the index modification method), and the goodness-of-fit indices TLI and RMSEA were increased and SRMR decreased (table 3).

Table 2. Estimates of factor loadings through confirmatory factor analysis

Variables	Factor 1	Factor 2	Factor 3	Factor 4
Item 12	0,403			
Item 14	0,517			
Item 18	0,150			
Item 22	0,513			
Item 23	0,481			
Item 35	0,701			
Item 4	0,262			
Item 1		0,507		
Item 10		0,657		
Item 11		0,573		
Item 2		0,422		
Item 20		0,546		
Item 26		0,617		
Item 27		0,627		
Item 28		0,701		
Item 29		0,736		
Item 3		0,643		
Item 33		0,760		
Item 34		0,716		
Item 6		0,577		
Item 7		0,722		
Item 9		0,704		
Item 13			0,511	
Item 15			0,725	
Item 16			0,675	
Item 17			0,666	
Item 19			0,464	
Item 21			0,601	
Item 24			0,783	
Item 25			0,644	
Item 30			0,709	
Item 31			0,730	
Item 37			0,830	
Item 38			0,843	
Item 39			0,754	
Item 8			0,653	
Item 32				0,682
Item 36				0,803
Item 40				0,601
Item 41				0,659
Item 42				0,580
Item 43				0,693
Item 44				0,679
Item 45				0,746
Item 46				0,650
Item 47				0,622

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Item 48	0,642
Item 49	0,514
Item 5	0,610
Item 50	0,522

Note: Factor 1 = Avoidance, Factor 2 = Physiological response, Factor 3 = Worry, Factor 4 = Situations. Goodness-of-fit indices: x^2 = 2915,130 p = 0,000, CFI = 0,928, TLI = 0,924, RMSEA = 0,049 (90 % CI = 0,047 - 0,051), SRMR = 0,065.

Table 3. Goodness-of-fit indices for the CAEX models

Model	x^2	p	IFC	TLI	RMSEA	SRMR
M1. 1 factor (50 items)	3859,23	< 0,01	0,889	0,884	0,060 (0,058 - 0,062)	0,064
M2. 4 factors (50 items)	2915,13	< 0,01	0,928	0,924	0,049 (0,047 - 0,051)	0,065
M3. 4 factors (48 items)	2791,87	< 0,01	0,928	0,925	0,051 (0,048 - 0,053)	0,062

Note: x^2 = Goodness-of-fit test, p = probability, CFI = Comparative Fit Index, TLI = Tucker-Lewis Index, RMSEA = Root Mean Square Error, SRMR = Standardized Root Mean Square Residual.

As evidence of discriminant validity (table 4), an analysis of correlations between the scores obtained with the test anxiety questionnaire (CAEX) and its respective dimensions with the scores of the educational motivation scale (EME-E) was performed. The correlation coefficients are low and null (0,00 - 0,07); that is, no significant correlations were found (p > 0,05).

Table 4. Means, standard deviations and correlations with confidence intervals

Variable	M	SD	1	2	3	4	5	6
1	11,36	10,27	1,00					
2	5,17	3,96	0,63**	1,00				
3	19,96	13,96	0,79**	0,64**	1,00			
4	24,69	13,35	0,63**	0,45**	0,68**	1,00		
5	61,18	36,26	0,89**	0,70**	0,93**	0,86**	1,00	
6	126,61	28,03	0,07	0,03	0,07	0,00	0,05	1,00

Note: 1 = Physiological response, 2 = Avoidance, 3 = Worry, 4 = Situations, 5 = Global score of test anxiety (CAEX), 6 = Global score of academic motivation (EME-E), M = mean, SD = standard deviation, *p < 0,05. **p < 0,01.

DISCUSSION

Test anxiety is a variable frequently used in educational settings, being assessed with different instruments and in different populations, which implies relative claims in reliability.[18]

The purpose of this study was to validate in a population of Peruvian high school students, the Spanish version of test anxiety (CAEX), a widely used measure to assess students' test anxiety through four dimensions that include: (1) cognitive thoughts and worry, (2) physiological anxiety responses, (3) situations and types of proposed exams, and (4) avoidance behaviors. The study shows a valid and reliable instrument for high school students. In sum, a 48-item version was validated, which provides the application in this specific environment favoring comprehension and everyday situations even though it is a large instrument.[49]

Exploratory Factor Analysis (EFA) is useful in test construction, however, it does not provide a convincing assessment of the factor structure of the scale, since it does not allow confirming the series of latent variable models that best fit the data. Therefore, Confirmatory Factor Analysis (CFA) was performed to compare the factor structure. The CFA results revealed the tetrafactorial structure with adequate internal consistency along the four dimensions. The empirical data fit the Spanish CAEX model with 4 components.[25] The CAEX allows measuring each behavioral characteristic of the problem separately.

The overall CAEX scale in Peruvian high school level students was consistent with the Spanish version of the CAEX. In this study, as in previous studies (Rodríguez et al., 2014) the internal consistency was good in the CAEX total score ($\alpha_{ordinal}$ = 0,96) and its subscales: worry ($\alpha_{ordinal}$ = 0,92), situations ($\alpha_{ordinal}$ = 0,90) and physiological response ($\alpha_{ordinal}$ = 0,91). One of the weaknesses was the subscale "avoidance" ($\alpha_{ordinal}$ = 0,67) which presents values of Ordinal α below the acceptable threshold of 0,7.[51] Similar studies show similar results,[29] which merits further examination in future studies. However, α values slightly below 0,7 (α ≤ 0,60) are acceptable at

the early stages of research.[52]

The "worry" subscale showed adequate reliability and a higher factor loading than the other subscales, which makes it a promising subscale for future prospective studies. Likewise, it is identified as, cognitive anxiety and contributes significantly to a wide range of negative evaluation concerns, and manifestations of test anxiety involving cognitive learning and planning operations that the child and adolescent may experience.[1,17,53] That is, students focus on irrelevant cognitions during testing situations, affecting their optimal performance.[54] This aligns with a cross-sectional study on self-perceived anxiety, indicating that gender in schoolchildren has a significant effect on anxiety when faced with an exam, and that it is girls who experience a greater increase in worry than boys before an exam, given that they are likely to feel anxiety about their performance, which hinders the ability to develop their full potential.[55]

Regarding the physiological response items, they describe responses like dizziness, increased cortisol, nervousness, elevated heart rate, etc. commonly experienced by test-anxious students.[19,56] CAEX as an instrument introduces the dimensions worry and physiological response as distinct constructs, yet present in test anxiety as worry and emotionality.[9,19] Previous findings confirm that the original model and the proposed models assume a positive correlation between the dimensions worry and emotionality.[57,58]

The items in the "situations" subscale introduce assessment items, which provide additional information on the situational mechanisms that contribute to the difficulties experienced by children with anxiety.[59] Cognition and worry related to evaluative situations disrupt optimal performance in test situations by disrupting optimal working memory performance.[60] However, this instrument focused on some common assessment situations in schoolchildren. Regarding transferability, translation of an instrument and cultural adaptation in other contexts is possible by following the procedures for translation and cultural adaptation.[61] Previous studies show the adaptation of a multidimensional measure of test anxiety, which was translated from German into English, with school-specific content items that were modified to a university context to test situations (quizzes, written tests, oral exams). The instrument proved to be valid and reliable in context and used in new contexts.[12,62]

Included in the remaining subscale of "avoidance" are items pertaining to generalized forms of test risk-avoidance decision making. Findings indicate that people with elevated levels of anxiety report less willingness to take risks.[63] Likewise, cognitive and emotional responses become cues that drive behavioral avoidance efforts.[64] In addition, the avoidance construct is related to a fear of test failure.[65]

Finally, the CAEX is shown to diverge from the EME-E measure, indicating that the construct is sufficiently independent and actually measures a construct distinct from academic motivation.[66] This validity test helps to ensure that the instrument measures what it is intended to measure without being overly redundant with similar constructs or too closely related to constructs from which it would be expected to diverge.[67]

The above demonstrates that CAEX[25] in its four components is valid and reliable for application to high school students. Likewise, the elimination of two items 4 "if I am five minutes late for an exam I do not enter" and 18 "I feel great desire to smoke during the exam" maintained the four-factor structure and a similar fit, therefore, this proposal is an option until additional data are collected to allow more refined comparisons.

The CAEX instrument is designed to assess students' level of test anxiety. The teacher could use it to get a picture of the group, strengthen education in the future by using it as a progressive assessment, and teachers are recommended to help students who report high anxiety by understanding physiological symptoms, worries, situations, and test avoidance.

The limitations of this study are related to the type of sample, since there could be a partial bias; therefore, random samples should be considered in future research for greater generalization. In addition, studies focused on concurrent validity and factorial invariance are recommended to guarantee the absence of bias in different populations.

CONCLUSIONS

The results of the study show that the CAEX instrument is valid and reliable, and its items measure the general concept of test anxiety along with its 4 dimensions. The study demonstrates the assessment of the dimensions in schoolchildren with a 50-item and 48-item CAEX instrument. The instrument is defined theoretically and operationally, thus orienting the identification of the degree of anxiety, worry, emotionality, situations and test avoidance behaviors. The application in other countries should be done as long as the translation and adaptation are sensitive to cultural contexts.

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