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Measurement Invariance and Construct Validity of the Turkish Version of the Learner Autonomy Scale in a Sample of High and Secondary School Students

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Abstract

The aim of this research is to adapt the 24-item "Learner Autonomy Scale" developed by Sereti and Giossos (2018) in higher education samples into Turkish by examining the psychometric properties of high school and secondary school samples, and to determine whether these groups are equivalent in terms of measurement invariance. The scale was applied in high school (n = 475) and secondary school (n = 395) samples consisting of 870 students. Different from the original four-factor scale form, EFA applied to both groups revealed a two-factor (factor load range: .308-.775) and 21-item. Correlation values (r = .209-.392, p<.001) indicate that the factors are not strongly related. The factors produced adequate internal consistency coefficients (α = .706-.866; ω = .708-.871) and were validated by meeting the fit indices accepted in the literature for CFA. Measurement invariance tests revealed strong invariance for the structural and metric tests and partial invariance for the scalar test in high school and secondary school samples. More research is needed to determine why the intersections of items 19, 20, and 21 are not invariant. The main contribution to "learner autonomy" in this study is the adaptation and justification of a valid and reliable measurement tool for determining autonomy in the adolescent age group. The use of the adapted scale in different educational environments and in the examination of "autonomy" by adapting it specific to the field (science, mathematics, etc.) will provide important implications for further theoretical studies.

Keywords: Autonomy, Learner autonomy, Measurement invariance, Scale Adaptation.

1. Introduction

Learner autonomy, which is closely related to the concept of learning and defined as the individual's ability to recognize and know his or her own qualities, manage learning tasks based on internal approval, and reach the information sources he or she is curious about beyond the classroom boundaries, is an important component in the construction of 21st century skills. "Learner autonomy," which is an indispensable component of a successful learning process, is defined as an experiential process in which students take responsibility for their own learning by exercising control over all stages of the educational process (Little, 2004; Moore, 1993; Oxford, 2008). In the design of autonomous learning environments, educators have developed measurement tools to determine autonomy in samples overwhelmingly selected from higher education levels. Along with the development of technological tools and their use as auxiliary resources in reaching the target achievements, the widespread use of distance education platforms and the increasing emphasis on learning tasks outside the classroom bring up the necessity of supporting high school and secondary school students as "autonomous learners."

In this study, it was aimed to test the validity and reliability of the "Learner Autonomy Scale" (LAS) developed by Sereti and Giossos (2018) to be used in a context where distance and face-to-face education are used together in higher education in high school and secondary school student samples in Türkiye. The article begins with a review of the literature on learner autonomy. Then, the steps in adapting and validating the scale are explained in detail. The article then moves on to report the measurement invariance of the scale between high school and secondary school groups. The findings were discussed in light of the literature, and the article was concluded.

2. Literature Review

The concept of "autonomy" is defined as the "ability to take responsibility" in which learners study completely on their own and perform the tasks necessary for their own learning (Holec, 1981, p. 3). In other words, autonomy basically involves students taking personal initiative to engage in learning, find resources and opportunities for learning, and persist in learning (Ponton, Carr, & Confessore, 2000). According to Nunan (1997), autonomy is considered a step in which students actively participate in the preparation of curriculum content and teaching activities. Oxford's (2008) view of autonomy implies "the processes by which learners make decisions that involve both planning and execution in a fully autonomous learning environment." "Autonomous learning," which is used in different disciplines and defined as self-management in the early literature (Long, 1989), more specifically means that the student has the ability to decide what and how to learn. The autonomous student actively manages the learning processes, recognizes and evaluates learning needs, tries to shape their goals, plans the learning content, controls the learning task, and finally evaluates them (Little, 2004).

Willis (2011) argues that, when learning is perceived as a shared responsibility of teachers and students, autonomy is more likely to be achieved in that classroom setting. In addition to materials produced only by teachers, students' ability to break down barriers with the classroom and the world beyond by producing their own study resources not only improves their autonomy but also encourages their creativity. Thus, a learning environment limited to predetermined materials leaves its place for an authentic and selective environment. In addition, the use of new technologies, especially the internet, in learning has increased the importance of keeping these tools under the control of their users, or, in other words, "autonomy." Increasing distance education services, in parallel with developments in technology, have led the subject of learner autonomy to take place on the agenda of theoretical and empirical research (Guven & Sunbul, 2007; Maryorita & Maay, 2023; Vasiloudis et al., 2015). The fact that student-teacher association is not an absolute necessity in distance education creates a learning environment based on student autonomy (Giagli, Giaglis, & Koutsouba, 2010; Pratiwi & Waluyo, 2023).

Theoretical approaches to learner autonomy define "autonomy" as a self-management ability or a psychological state (Anderson & Dron, 2011; Chen, 1983; Garrison, 2000; Merriam & Caffarella, 1999; Zimmerman & Schunk, 1989). The student's ability to manage how and what to learn is related to the amount of responsibility the student is willing to take for his or her own learning, which clearly reflects the needs of autonomous learning. Psychological disposition is defined as the attitude towards and taking responsibility for how and what the student will learn.

In the literature, the most commonly used scales for learner autonomy developed in the field of education are as follows: Guglielmino's (1977) self-directed learning readiness scale; Fisher, King, and Tague's (2001) self-directed learning readiness scale for nursing education; Chen's (2001) student autonomy scale; Walker and Fraser's (2005) distance education learning environments scale (DELES); Bekker and Van Assen's (2006) autonomy-commitment scale (ACS-30); Macaskill and Taylor's (2010) autonomous learning scale; Bei, Mavroidis, and Giossos's (2019) distance education student autonomy scale; Bei (2016) and Zhang and Li's (2004) learner autonomy scale. Scales targeting learner autonomy were applied in different populations (university, adults, etc.) and social contexts (face-to-face or distance).

Studies centered on "learner autonomy," focused on correlational relationships between configurations related to autonomy (Someya & Obermeier, 2023) and teachers' perceptions of learners (Doğan &Mirici, 2017; Lamb, 2011; Mirici, Galleano & Torres, 2013; Shahsavari, 2014), supporting autonomy in EFL students (Meri-Yılan, 2023) components that are effective in the development of autonomy (Chwo, 2011; Kristmanson, Lafargue, & Culligan, 2013; Özer & Yükselir, 2021; Udosen, 2014), autonomous learning environments (Aminah, Maulida, & Supriadi, 2023; Benson, 2001; Khonen, 2012), integration of autonomy into the classroom environment (Ahmadianzadeh et al., 2020; Shih, 2020; Tran, 2020), teacher roles (Borg & Al-Busaidi, 2012; Susanti, Rachmajanti, & Mustofa, 2023; Yıldırım, 2012), teaching practices that support autonomy (Course, 2017; Doğan & Mirici, 2017; Lenkaitis, 2020; Şener & Mede, 2023; Vázquez, 2018), factors that hinder learner autonomy (Basri, 2023).

Although scales for learner autonomy have been developed, it is not convenient to use these scales specific to a single context or age group because they target different contexts and samples. Most research has been done on the processes involved in facilitating autonomous learning rather than on the properties of autonomous learners. Rather than measuring autonomous learning directly, research has tended to measure configurations associated with autonomous learning, such as learning motivation and perceived efficacy. This may explain the lack of measurements.

Most of the studies on learner autonomy have been carried out in the context of language learning and with age groups at higher education levels. The situation where the development of autonomous learners is one of the main aims of university education (Bryde & Milburn 1990; Chemers et al. 2001; Ciekanski, 2007; Stephenson & Laycock 1993), and the support in these educational institutions (Baharom & Shaari, 2022; Gocić & Janković, 2021; Griffiths & Dikilitaş, 2022; Lien, 2022; Nhung & Yen, 2022; Phuong, Huy, & Lich, 2023), has become widespread with the development of distance learning tools. It is possible to observe similar developments in the education of the adolescent age group. Indeed, the studies conducted (Dubois, Guay, & St-Pierre, 2023; Faizah et al., 2023; Großmann et al., 2023; Kleinkorres, Stand-Rabrig, & McElany, 2023; Stevani & Ginting, 2022) reflect the increasing emphasis on the autonomy of high school and secondary school age groups.

Students should be encouraged to be independent learners outside the classroom. The rapid developments with the emergence of COVID-19 and the natural disasters that followed (for example, the earthquakes in Türkiye on February 6, 2023) have dragged individuals into unexpected situations with effects at all levels. In this process, while the MoNE is trying to compete with the urgent need for distance education, it has made available various platforms and digital tools for students and teachers. This process, which aims at distance learning, has increased the importance of student autonomy. Therefore, it is reasonable to argue that distance education applications, which have become widespread in higher education, will be a permanent part of the education of adolescent students. Otherwise, not providing students with sufficient autonomy may lead to consequences that hinder learning and undermine their motivation to learn (Le & Jia, 2022). It is therefore important to develop or adapt tools to help assess the characteristics of autonomous learners.

The use of a scale targeting high school and secondary school age groups is not common. In this respect, the learner autonomy scale adapted to high school and secondary school age groups can limit the problems related to the use of other scales targeting autonomy. In this age group, a "generic scale" specially designed or adapted to measure what is understood as autonomous learning is thought to be useful for research in the field. Therefore, adaptation of the scale seems appropriate for a specific context. Testing the LAS in high school and secondary school age groups provides additional opportunities to examine the possibility of generalizability across different age segments as it identifies the response patterns of students in distant age groups.

2.1. Purpose of the Study

The current research is designed to test the psychometric properties of a "self-report tool" developed to assess higher education students' autonomy levels in groups of high school and secondary school students. In this direction, the goal of the research is to adapt the LAS developed by Sereti & Giossos (2018) into Turkish by conducting a validity and reliability study. For this purpose, the following hypotheses were tested:

H1: The factorial construct of LAS represents a two-factor construct in line with the literature.

H1a: The factorial construct of the LAS obtained from the high school group represents a two-factor construct.

H1b: The factorial construct related to the LAS obtained from the secondary school group represents a two-factor construct.

H2: The LAS, adapted to determine students' autonomy levels, is reliable.

H2a: The reliability coefficients obtained from the high school group are within acceptable limits.

H2b: The reliability coefficients obtained from the secondary school group are within acceptable limits. H3: The factorial construct of the LAS is equivalent in high school and secondary school groups in terms of measurement invariance.

3. Method

3.1. Research Design

This research was conducted based on the relational screening model. Differences between groups are examined according to the variable states determined in relational screening models (Karasar, 2005).

3.1.1. Population and Sample

By using a random method, the sample of this study was selected from volunteer students studying at public secondary and high schools in Artuklu district of province Mardin. The schools where the research will be conducted were selected with the guidance of maximum diversity sampling, which is among the purposeful sampling methods. According to Patton (2002), purposeful sampling provides the opportunity to examine in detail situations that contain comprehensive information. Maximum diversity sampling is the creation of a sample from different situations that are similar within themselves regarding the problem (Büyüköztürk et al., 2017). For this purpose, a total of 600 students studying at 4 secondary schools and 3 high schools were included in the EFA group; 270 students were included in the CFA group. Information reflecting the participants is summarized in Table 1 below.

Table 1. Participant characteristics

	Characteristic	N				%			
		School Grade							
		High School		Secondary School		High School		Secondary School	
	Gender	EFA	CFA	EFA	CFA	EFA	CFA	EFA	CFA
	Female	180	62	124	73	59,2	47,7	55,8	52,2
	Male	165	68	131	67	40,8	52,3	44,2	47,8
	Total	345	130	255	140				
Secondary School	**Grade Levels**								
	5th grade			79	38			26,7	27,0
	6th grade			66	32			22,3	23,0
	7th grade			72	34			24,3	24,0
	8th grade			79	36			26,7	26,0
High School	9th grade	76	34			25,0	26,0		
	10th grade	68	30			22,4	23,0		
	11th grade	77	39			25,3	30,0		
	12th grade	83	27			27,3	21,0		

According to the participant information in Table 1, it is seen that the total of high school students is 345 (female 180; male = 165) for EFA and 130 (female = 62; male = 68) for CFA, and that the total of secondary school students is 255 (female = 124; male = 131) for EFA and 140 (female = 73; male = 67) for CFA. In the EFA group in the high school sample, it is understood that there is a distribution of 25% in the 9th grade, 22.4% in the 10th grade, 25.3% in the 11th grade, and 27.3% in the 12th grade; and for the CFA group, there is a distribution of 26% in the 9th grade, 23% in the 10th grade, 30% in the 11th grade, and 21% in the 12th grade. In the EFA group in the secondary school sample, there is a distribution of 26.7% in 5th grade, 22.3% in 6th grade, 24.3% in 7th grade, and 26.7% in 8th grade; and in the CFA group, there is a distribution of 27% in 5th grade, 23% in 6th grade, 24% in 7th grade, and 26% in 8th grade.

3.1.2. Data Collection Tools

The original scale was tested on a sample of 258 undergraduate and graduate students. In the EFA process conducted within the scope of construct validity, a 24-item and 4-factor construct was decided. Scale dimensions are listed as “Special Self-Management Ability” (8 items), “Special Psychological Tendency” (6 items), “General Self-Management Ability” (7 items), and “General Psychological Tendency” (3 items). The first factor explained 22.84% of the variance, the second factor explained 9.13% of the variance, the third factor explained 7.06% of the variance, and the fourth factor explained 6.36% of the variance. The Cronbach's alpha value for the whole scale was calculated as .85, and for the subscales as .82, .65, .76 and .48, respectively. Robinson et al. (1991)

suggest that in EFA applied for exploratory purposes, values below .70, which is the accepted lower limit for Cronbach's alpha, can also be accepted.

3.1.3. Data Collection

The scale was distributed to the students after the necessary permission was obtained from the Mardin National Education Provincial Directorate. During the data collection process, the researchers gave the students information about the purpose, duration, and confidentiality of the research. The students were reminded that their participation in the research is voluntary, and written consent was obtained from the students. This study was approved by the Ethics Committee of the Fırat University Institute of Educational Sciences.

3.2. Procedure/Process

Depending on the purpose of the study, the scale's adaptation to Turkish, validity, and reliability procedures were carried out, respectively.

3.2.1. Adapting to Turkish

In the first stage, within the scope of the research, the scale was translated into Turkish by 2 English teachers and 1 psychological counselor, taking into account the criteria of the International Testing Commission (Hernández et al., 2020). The examination of the form created from the obtained translations in terms of suitability for high school and secondary school students and the language was carried out by a Turkish teacher. In line with the suggestions reached in terms of context and linguistics, the final form was created.

In the second stage, the back translation of the scale was done by an English teacher and an educational sciences expert. In order to examine the consistency between the new English form created and the original form, the opinion of one lecturer in the School of Foreign Languages was taken. The experts consulted are scientists who work both on the subject being measured and in the field of scale development. Although the necessity of obtaining opinions from at least three experts is discussed in the literature (Yusoff, 2019), the number of experts on the subject on which the problem of this research focuses is two. In line with the opinions obtained from the experts, relevant corrections were made, and the scale was made ready to use.

3.2.2. Validity

Regarding construct validity, EFA and CFA were conducted for both high school and secondary school "scale" forms. Using CFA after EFA is a widely accepted method in construct validity studies (Worthington & Whittaker, 2006).

Exploratory Factor Analysis (EFA): EFA provides a number of tools to analyze the construct of relationships among many variables by identifying sets of highly correlated variables known as factors (Hair et al., 2014, p. 92). It is common to use EFA in scale development studies and CFA in scale validation studies. The use of CFA alone is based on systematic results and theoretical assumptions. Exploratory EFA can be used in scale validation studies when new predictions about the number and relationships of factors are available (Izquierdo, Olea, & Abad, 2014). In this adaptation study, the original scale with four sub-dimensions was hypothesized to have two sub-dimensions, in line with previous empirical findings.

Regarding the high school and secondary school scale forms, before EFA was performed, the "power to represent the whole" and "discrimination" of the items in the scale were calculated as item-total correlation. Items showing item-total correlation with a cut-off value of .30 and above were included in the analysis. Then, the Bartlett Sphericity test and the Kaiser-Meyer-Olkin (KMO) test were performed to determine the suitability of the data for factor analysis (Tavşancıl, 2010). The suitability of the data for factor analysis is determined by the fact that the KMO coefficient is at least 0.60 and the Bartlett test is significant (Çokluk, Şekercioğlu, & Büyüköztürk, 2018).

Principal component analysis was chosen as the factorization technique. Principal component analysis is used when it is aimed at summarizing most of the original information (variance) with a minimum number of factors (Hair et al., 2014). According to Brown (2006), the researcher can apply axis rotation to the factors obtained as a result of factor analysis. Thus, highly correlated items can be easily interpreted by grouping them under certain factors.

It was decided to distribute the factor loads using the Promax rotation method. In this oblique rotation method, the correlation of factors is allowed (Tabachnick & Fidell, 2015). In factor subtraction, values with an eigenvalue of 1 and higher were considered important components. In this study, the cut-off value determined for the factor load value was determined as .30, taking into account the coefficient ranges adjusted for the sample number of Hair et al. (2014). Among the overlapping (cross) items loaded on more than one factor in the draft scale, those that were above the tolerance value (.10; Tavşancıl, 2010) were excluded from the analysis, respectively, and the factor analysis was repeated (Çokluk et al., 2018).

Tabachnick and Fidell (2015) suggest a holistic evaluation of the eigenvalue, the contribution amount to the total variance, and the scree plot to decide the total factor number of the scale. In addition, in light of previous empirical findings, it is suggested that the researcher can use the previously determined number of factor constraints (Hair et al., 2014). Parallel analysis findings proposed by Pallant (2020) were added as a reference point to the set of criteria followed in determining the number of factors. When deciding on the final number of factors, the risk of too many factors creating interpretation difficulties was taken into account.

Confirmative Factor Analysis (CFA): CFA is applied to test the extent to which the a priori factor loading model on predetermined configurations represents the real data (Hair et al., 2014, p. 603). In a sense, CFA is a tool that provides verification of theory-based assumptions.

In order to evaluate the fit of the measurement model designed within the scope of CFA, the fit indices recommended by Kline (2019, p. 270) and accepted as a guide in this study were examined and interpreted (values were considered good fit 3 and below). For $\chi 2/df$; .10 and below for RMSEA; .90 and above for CFI; .85 and above for GFI; .10 and below for SRMR.

3.2.3. Reliability

In this study, Cronbach's alpha and McDonald's omega were used to evaluate the internal consistency of the scales. Additional reliability coefficients were also considered in this study. In this context, the reliability measure derived from CFA was used. This is referred to as composite reliability (CR). For CR calculated by the Fornell and Larcker (1981) technique, values of .7 and above mean good reliability.

3.3. Measurement Invariance

Measurement invariance, or equivalence, tests whether measurements provide results with the same characteristics (Horn & McArdle, 1992, p. 117). This is considered a crucial step for group comparison studies, as measurement invariance indicates whether different group members interpret scale items based on similar response patterns (Cheung & Rensvold, 2002; Vandenberg & Lance, 2000). In addition, measurement invariance provides additional evidence for construct validity (Van de Schoot, Lugtig, & Hox, 2012).

Measurement invariance is tested at least at three incremental levels from a psychometric perspective (Chen, 2007; Asparouhov & Muthén, 2014): configural invariance, metric invariance, and scalar invariance. Configurational invariance refers to whether the same number of latent configurations characterized by the same items fit equally well with the data across groups. Metric invariance is tested when configural invariance is met. Metric invariance adds the restriction that the relationship between hidden constructs and items must be equal across groups. If metric invariance is not achieved, it turns out that different student groups interpret the items in different ways. Another level of measurement invariance is scalar invariance, which indicates that students with the same implicit construct choose the same response options for the same items. Once the scalar invariance is met, the researcher has the opportunity to compare the implicit factor means, variances, and covariance between groups.

The results were interpreted according to the $\chi 2$, CFI, and RMSEA indexes. $\chi 2$ values are sensitive to sample sizes and the number of groups (Hair et al., 2014). Therefore, CFI and RMSEA are considered stronger indicators. Cheung and Rensvold (2002) and Rutkowski and Svetina (2014) determined cut-off values of $-0.01 \leq CFI \leq 0.01$ and $RMSEA \leq 0.10$ as criterion criteria. In this study, the cut-off values suggested by the aforementioned researchers were followed.

4. Data Analysis

IBM SPSS 22 and AMOS 24 programs were used in the analysis of the data. In the measurement invariance analysis, "multi-group confirmatory factor analysis" (MG-CFA), which is the most frequently used test technique, was used (Bryne, 2010; Millsap, 2011). The ultimate goal of MG-CFA is to compare implicit factor means, variances, and covariances between groups after controlling for measurement errors. Analyses were performed after examining whether the data set and data structure met the assumptions required by univariate and multivariate statistical methods. In the analyses carried out within the scope of EFA, it was observed that 8 observations in the high school group and 11 observations in the secondary school group consisted of missing data, and in the CFA group, 3 observations in the high school group and 5 observations in the secondary school group were found to be missing data. After it was determined that these data were randomly distributed, the mean of the series was assigned to replace the missing data. Among the Z scores calculated to detect univariate outliers, those exceeding ± 3 criterion values were excluded from the analysis (Johnson & Wichern, 2007).

5. Findings

5.1. Preliminary Analyzes

A preliminary analysis of the metric quality of the items was conducted to apply EFA to the most appropriate items representing the scale. In order to determine the representativeness and distinctiveness of the scale items as a whole, the item-total correlation was examined using the Pearson correlation coefficient. If the total test correlation of the items is low (<.3), it is stated that the item measures a different quality than other items (Büyüköztürk, 2014; Hair et al., 2014). It is desired that the correlation value between items be higher than .3 (Pallant, 2020). According to the analysis results performed on both high school and middle school samples, item-total correlation coefficients ranging between .34-.56 for the high school group and .31-.59 for the middle school group were obtained. Inter-item correlation values range between .32-.59 for the high school group and .31-.55 for the secondary school group.

The t-test analysis results performed according to the average of the lower and upper groups revealed that each item was significant at the p<.001 level between the groups in the high school and middle school samples. The regression analysis performed to predict the total score of each item produced significant F values at the p = .00 level for all items in both samples.

5.2. Findings Concerning the Validity Study

Under this heading, findings related to EFA and CFA are included.

5.2.1. Findings Related to EFA

EFA findings for high school and secondary school groups were reported together. Bartlett's test of sphericity for high school and secondary school groups (High School: $\chi 2 = 1813{,}948$, df = 210, p = .000; Secondary School: $\chi 2 = 2216{,}896$, df = 276, p = .000) and Kaiser-Meyer-Olkin's measure of sampling adequacy (High School: KMO = .863; Secondary School: KMO = .896), reveal the factorability of the correlation matrices of the scale in both groups. The eigenvalue and the contribution amount to the total variance of both samples are presented together in the table below.

Table 2. EFA and reliability test results for high school and secondary school samples

High School

Items		Unrotated Factor Matrix – Components 1	2	3	4	Items	Rotated Factor Matrix (Promax) – Components: Self-Management	Psychological Tendency	Communality
5		**,693**				5	,727		,523
18		**,669**				7	,679		,458
17		**,657**			,385	8	,670		,437
16		**,656**				18	,649		,444
6		**,640**				17	,648		,434
7		**,639**				2	,646		,411
1		**,630**				6	,644		,426
8		**,627**			-,336	1	,640		,420
2		**,618**				16	,637		,421
4		**,574**			-,405	4	,611		,366
20		**,506**				3	,571		,311
3		**,500**				24	,529		,318
24		**,479**			,392	20	,457		,306
21		,395		,373	,392	19	,374		,342
23		,393				12		,775	,614
19		,363				11		,761	,591
12		,357	**,695**			9		,704	,483
11		,344	**,680**			13		,611	,429
9			**,638**			10		,561	,311
13		,390	**,537**	-,415		22		,495	,307
22			,449	,447		14		,403	,314
14			,357	**-,584**					
10			**,539**	**,543**					
15		,306		,470					
Factor Eigenvalue	PCA	5,594	2,581	1,402	1,080		5,594	2,581	
	PA	1,558	1,467	1,435	1,340				
Total Variance	%						26,639	12,289	
	% (Cumulative)						38,928		
Reliability	Alpha (α)						,866	,728	
	Omega (ω)						,871	,739	

Secondary School

Items		Unrotated Factor Matrix – Components 1	2	3	4	Items	Rotated Factor Matrix (Promax) – Components: Self-Management	Psychological Tendency	Communality
16		**,681**				4	,713		,462
7		**,677**				5	,700		,443
1		**,659**				2	,689		,465
2		**,650**				7	,677		,486
6		**,649**				3	,668		,397
4		**,620**			,315	8	,666		,406
17		**,620**			-,324	16	,654		,471
18		**,612**				1	,599		,446
5		**,610**				6	,597		,434
8		**,578**				17	,587		,392
3		**,569**				18	,550		,374
12		**,506**	,379			24	,443		,314
22		**,487**		,392		19	,384		,324
24		**,425**				20	,377		,323
23		,397	,345			22	,308		,329
11		,370	**,591**			11		,724	,485
13		,350	**,562**			13		,709	,461
14			**,482**			14		,642	,368
10			**,404**		,365	12		,608	,463
9			,395		,369	9		,504	,349
19				**,543**		10		,498	,331
20		,317		**,480**	**,402**				
21				**,476**					
15				,389	-,379				
Factor Eigenvalue	PCA	6,008	2,037	1,436	1,189		5,766	1,937	
	PA	1,614	1,513	1,508	1,373				
Total Variance	%						27,459	9,222	
	% (Cumulative)						36,681		
Reliability	Alpha (α)						,851	,706	
	Omega (ω)						,862	,708	

Note: "PCA": Principal Component Analyis
"PA": Parallel Analysis

According to Table 2, when the unrotated factor matrices in the high school and secondary school groups are analyzed for four components as in the original scale, it is seen that high factor loads are listed under two components while some factor loads are loaded crosswise. Scree Plots for high school and secondary school samples are presented in Figure 1 below.

High School Secondary School

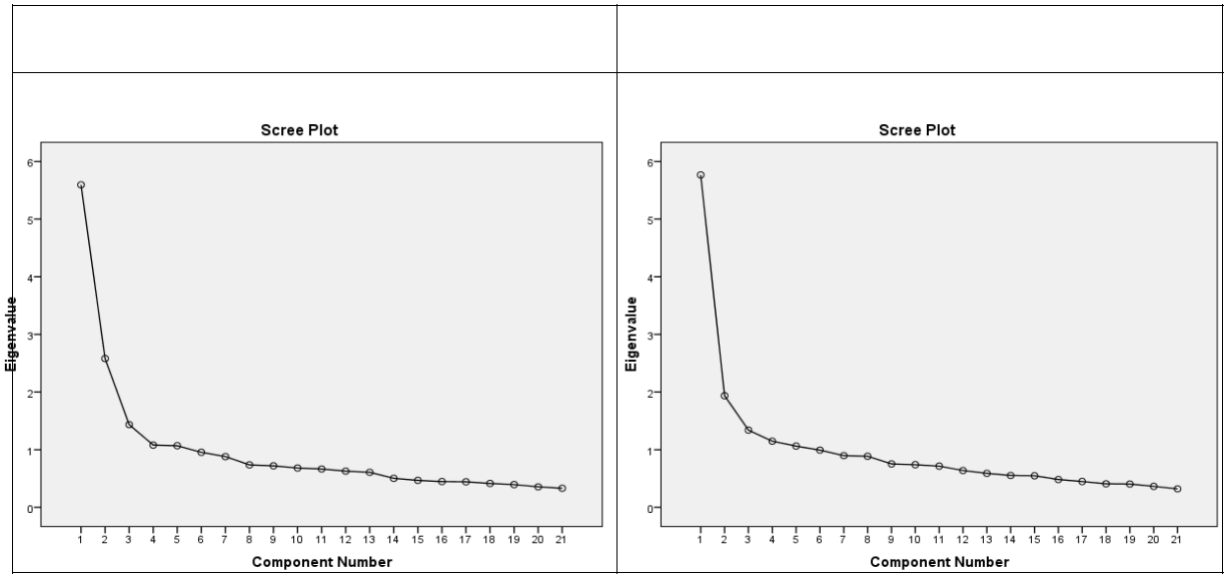


Figure 1. Scree plot for high school and secondary school samples

In order to determine the optimum number of factors, when the Scree Plot of both samples (Figure 1) is examined, it can be said that there is a fairly clear break between the 1st and 2nd components and that there is a clear break between the 2nd and 3rd components. Items 15, 21, and 23, which were cross-loaded during Promax rotation and contributed weakly to the common variance, were excluded from the analysis. As a result of this process, the number of items in the original scale form decreased from 24 to 21. Factor loads were gathered under two components for both groups. Thus, it can be said that the H1-coded hypothesis is supported.

The factor loads of the high school group ranged from .374 to .775 and explained 38.928% of the total variance; the factor loads of the secondary school group varied between .308-.724 and explained 36.681% of the total variance. The Parallel analysis proposed by Pallant (2020) was used as an additional way to support the two-factor analysis. While deciding on the number of factors to keep, if the initial eigenvalues obtained with SPSS are greater than the criterion values obtained from the Parallel analysis, the relevant factors are preserved, but if they are lower, they are rejected. Parallel analysis results in Table 2 support the idea that only two factors should be preserved. The absolute threshold of explained variance has not been adopted by some researchers (Hair et al., 2014, p. 107). Cliff (1987) suggests that increasing the explained variance causes extraneous variables to overlap. A large number of factors not only provide opportunities to increase the level of variance explained but also make the evaluation of the structure difficult. However, it causes the unique variance and error variance to inflate. In the literature, deciding the final number of factors is left to the researcher (Hair et al., 2014; Tbachnick and Fidell, 2015) In this research, the number of factors was decided by combining conceptual foundations and empirical evidence with the set of criteria envisaged for EFA. The two factors were labeled as "Self-Management" and "Psychological Tendency" which are frequently used in the literature, adhering to the concepts of "Special Self-Management" and "Special Psychological Tendency" in the original scale form. Correlations between factors are presented in the table below.

Table 3. Correlation coefficients between factors

Subscale	1	2
1 Self-Management	1	
2 Psychological Tendency	.209** (.392**)	1

**p<.001

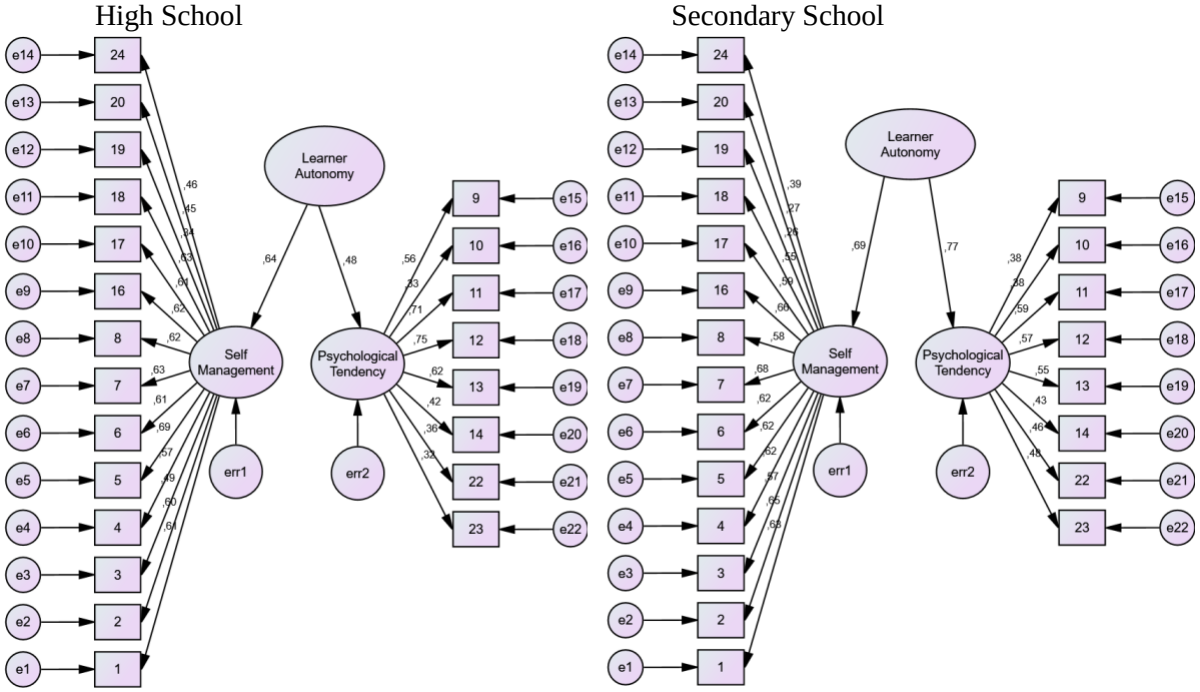
Note: The value before the parenthesis reflects the high school sample, and the value in the parenthesis reflects the secondary school sample. The purpose of presenting the correlation matrix in the table is to show the strength of the relationship between two factors. While no relationship may be

found, a very high level of relationship may also be obtained (Pallant, 2020, p. 219). Inferences can be made by evaluating the predictions regarding theoretical concepts and the exploratory function of EFA together. As suggested in the literature (Anderson and Dron, 2011; Chen, 1983; Garrison, 2000; Merriam and Caffarella, 1999; Zimmerman and Schunk, 1989), self-management and psychological tendencies can be considered under the umbrella of autonomy. However, they can also be examined as different factors.

The correlation values presented in Table 3 show that the extracted factors are not strongly related and can be identified independently.

5.2.2. Findings Related to CFA

The CFA findings conducted for high school and secondary school groups are presented together in Figure 2.



First-order CFA results	
CFA: λ = .32-.75; χ2 = 480,862; df = 208; χ2/df = 2,312; CFI = .842; GFI = .866; RMSEA = .67; SRMR = .714.	CFA: λ = .27-.68; χ2 = 386,796; df = 208; χ2/df = 1,860; CFI = .862; GFI = .876; RMSEA = .59; SRMR = .643.
σ2 (%): Self-Management = .42; Psychological Tendency =.73	σ2 (%): Self-Management = .40; Psychological Tendency =.32
CR: Self-Management = .871; Psychological Tendency = .742	CR: Self-Management = .861; Psychological Tendency = .717
Second-order CFA results	
χ2 = 480,658; df = 207; χ2/df = 2,332; CFI = .844; GFI = .867; RMSEA = .67; SRMR = .715.	χ2 = 386,331; df = 207; χ2/df = 1,866; CFI = .863; GFI = .878; RMSEA = .59; SRMR = .646.

Figure 2. Standardized path diagrams reflecting high school and secondary school groups and CFA results.

Figure 2 shows the path diagrams of the CFA and the refined fit indices for both samples. Except for that, four items in the high school group and five items in the secondary school group produced results below the criterion value (λ < .50) suggested by Fornell and Larcker (1981); it can be said that the fit indices reflecting the data of both samples are at an acceptable level. Regarding the factor-load value ranges, the fact that λ < .50 adversely affects the average variance extracted (AVE) ratio is related to convergent validity. Regarding this, Fornell and Larcker (1981) state that the

convergent validity of a construct with a load value of less than 0.50 but a composite reliability coefficient (CR) higher than .7 is still sufficient. The CR performed to calculate the construct reliability of the factors validated in the refined models shows that sufficient coefficients (>.7) are obtained. In both samples, the items loaded on the relevant factors significantly (p<.05). Therefore, unlike the original scale form, which was defined as having four sub-dimensions, the scale was confirmed to have two sub-dimensions supporting hypotheses H1a and H1b.

It was tested whether there was a significant decrease in the second-order CFA model fit compared to the first-order model (Brown, 2006). The obtained chi-square difference values (.18, p>.05 for the high school sample; .30, p>.05 for the secondary school sample) did not cause a significant decrease in the fit values of the second-order model application compared to the first-order model. Therefore, this finding supports the defensibility of the second-order model.

While the explained variances (σ2) reflected a similar coefficient between the groups in terms of the Self-Management dimension, they revealed a difference of .41 in terms of the Psychological Tendency dimension. To investigate whether this finding was due to differences between groups, estimation of measurement invariance was used.

5.3. Findings on Reliability

Cronbach alpha (α = .706-.866) and McDonald omega coefficients (ω = .708-.871), are supporting the H2 coded hypothesis and reflect that the scale produces a desired level of internal consistency coefficient in high school (H2a) and secondary school (H2b) groups. CR, which was applied additionally at the CFA stage, revealed coefficients above the cut-off value of .7 in the high school and secondary school groups.

5.3.1. Results of Measurement Invariance between High School and Secondary School Samples

In order to test whether the recently created original measurement tool has the same psychometric properties between high school and secondary school groups in Türkiye, measurement invariance was performed, and the relevant analysis results are presented in the table below.

Table 4. Measurement invariance results for high school and secondary school groups

Model	General Fit Indices			Model Comparison	Comparative Fit Indices				
	χ2 (df)	CFI	RMSEA	SRMR		Δ χ2	Δdf	ΔCFI	ΔRMSEA	p
Configural										
1.	867,651 (416)	.851	.045	.071	-	-	-	-	-	-
2. Metric	890,310 (436)	.850	.044	.071	2 vs. 1	22,659	20	.001	0,001	.305
3. Scalar	994,163 (456)	.822	.047	.074	3 vs. 2	103,853	20	.028	0,003	.000

At each step of measurement invariance, the aforementioned constraints remained in effect. First, configural invariance was tested. According to Table 4 information reflecting invariance models (configural, metric, and scalar), it can be said that the model fit required by configural invariance is within acceptable limits. At this stage, factor loadings, inter-factor correlations, and error variances were allowed to be freely estimated between both groups. Secondly, the metric invariance test was performed by limiting the factor loads to be equal between levels. Since the comparative fit indices (CFI and RMSEA) between the configural and metric models meet the specified criteria values ($-0.01 \leq CFI \leq 0.01$ and $RMSEA \leq 0.10$), it can be stated that metric invariance is achieved. Therefore, it can be said that high school and secondary school students answered the scale items in a similar way. Finally, scalar invariance was tested by setting the residual variance across levels to 0.

When the differences between the fit indices obtained from scalar invariance and the fit indices obtained from metric invariance are examined (CFI = .028), it is understood that the model does not provide the cut-off values determined for scalar invariance. In other words, the results showed poor fit with the data. The source of the invariance was searched using the change indices of the scalar invariance model. Then, the parameter of the largest change index is stretched one by one (a free estimate). After the relevant parameters were stretched, the model was re-run, and this process

was repeated until none of the modification index values were statistically significant (Yoon & Kim, 2014). After analyzing the differences between the intersection points of the metric and scalar models, a significant difference was observed regarding items 19, 20, and 21. This means that the three items have non-invariant intersections. Therefore, partial scalar invariance is provided by releasing the restriction on items 19, 20, and 21. Thus, it was possible to compare the latent factor averages. The final stage, which reflects factor invariance between groups, supports the hypothesis coded H3.

6. Discussion

This research has been put on the agenda to test the validity and reliability of the LAS (Sereti & Giossos, 2018), which was developed by targeting the higher education age group in high school and secondary school age groups. A total of 600 students studying at four secondary schools and three high schools were included in the EFA group, and 270 students were included in the CFA group in this study, which was carried out on a sample of students attending high school and secondary school in Türkiye. The scale, which took its final form after the opinion of experienced researchers during the adaptation stage to Turkish, has a sufficient level of face validity. The factor construct and reliability of the scale were carried out using both groups of students. EFA results revealed that the scale had a two-factor construct and a total of 21 items, after three scale items with insufficient performance were eliminated. Item factor loads for the high school group ranged from .374 to .775, explaining 38.928% of the variance. Factor loads for the secondary school group ranged from .308 to .724 and this explains 36,681% of the total variance. The CFA results conducted for both groups proved that the two-factor construct was confirmed and the model fit indices met the guideline values frequently used in the literature.

Within the scope of reliability analysis, internal consistency reliability was examined, and Cronbach's alpha and McDonald's omega coefficients were used as a guide. The coefficients related to the LAS obtained in both high school and secondary school samples revealed that the scale reflected the internal consistency coefficient at the desired level. CR, which was applied additionally in the CFA stage, produced coefficients above .7, which is the cut-off value in the high school and secondary school groups. Two-factor analysis, which emerged in the scale forms applied in both high school and secondary school samples, revealed a low level of correlation as a result of correlation analysis. This indicates that each subscale can be used independently. In this study, unlike the original four-dimensional scale form, a two-dimensional scale form was obtained. The concepts of "Self-Management" and "Psychological Tendency," which are frequently emphasized in the literature, were preferred in labeling the sub-dimensions obtained in this study. In this case, it can be said that the LAS has sufficient psychometric properties in terms of validity and reliability.

The scale provided factorial equivalence by measuring "learner autonomy" in the same way in high school and secondary school samples. In this sense, the present study provides evidence of measurement invariance between two different groups, shedding light on future studies to determine autonomy in relevant groups. This is important because it shows that the "learner autonomy scale," which is mostly used in higher education samples, can be used to determine the level and probability of perceived autonomy in high school and secondary school populations. Beyond general information on measurement invariance, this study provided specific non-invariant item information (items 19, 20, and 21). In this regard, a partial invariance test was performed, and the factor averages were compared. However, more research is needed to determine why the intersections of items 19, 20, and 21 are not invariant. In addition, researchers and practitioners can enrich their understanding of differences between groups by further identifying sources of invariance by focusing on invariant items. This type of research will be especially valuable when cultural differences are apparently expected and when distinctive cultural factors are expected to influence item responses.

Although this study included many schools, the data are not representative of all students in Türkiye. Therefore, the results may not be generalizable to all students. Future research should repeat this study, including samples from different cultures, to achieve higher generalizability. It may be suggested to make comparisons of the level of autonomy measured by the "learner autonomy scale" between high school and secondary school students. This would provide additional evidence as to whether the "learner autonomy scale" is invariant between two different populations.

In this study, no attempt was made to measure test-retest reliability. If interventions are designed to promote 'learner autonomy' in groups of high school and secondary school students, changes in scores should be expected because the adapted scale aimed to identify current autonomous learning status. Testing the predictive power of the scale is considered important in terms of clarifying the relevant constructs and proposing new hypotheses.

Although the original scale focused on higher education students and distance learning, most of the insights emerging in the literature (Ahangar, 2023; Agustín-Llach & Alonso, 2017; Benson, 2007; Keuk & Lim, 2019; Mitchell, 2023) and the conceptual frameworks of the scale sub-dimensions also support the transferability of the scale by adapting it to other self-directed learning schemes, distance and face-to-face learning contexts, and to domain-specific. Therefore, this means that the concept of autonomy should be freed from the limitations created by the context of distance learning.

Candy (1991) and Guglielmino (1989) argue that the self-management skill required for autonomous behavior and performed in one context or situation should be generalizable to other contexts or environments. This assumption should be met with caution because it is not advisable to assume that someone with autonomy in a particular content area would have the same amount of preparation in an unconventional context (Fisher, King, & Tague, 2001). For a person to manage himself or herself in a certain content area, that person needs to have a certain level of knowledge in that area. Therefore, it may be advisable that the measurement of autonomy be done in a specific context.

In conclusion, this adapted assessment tool is a useful tool for researchers who want to develop autonomy in learning and for teachers who want to support autonomous learning with their students. The scale will allow students to diagnose their attitudes towards autonomous learning and their self-management skills.

7. Conclusion

In this study, in which the LAS developed by Sereti and Giossos (2018) was adapted into Turkish, high school and secondary school samples were used, unlike the higher education context in which the original scale was configured. The psychometric properties of the "learner autonomy scale" produced acceptable results and revealed a two-dimensional construct unlike the original four-dimensional scale. The resulting factor analysis was validated in both groups, revealing invariant measures. In addition, the correlation analysis between the factors performed in these two groups shows that the sub-dimensions (self-management and psychological tendency) can be used independently. Thus, simply learning about self-management can give us an incomplete picture of individuals' psychological tendencies and lead to misleading inferences about the perception of "autonomy" as a whole. However, teachers can determine students' autonomous behaviors based on students' responses to the scale. This measurement tool, which will be useful in supporting autonomous learning, will allow teachers to diagnose their students' attitudes towards autonomous learning and their self-management skill levels.

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