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Development and Factorial Structure of the Green Crescent Life Skills Scale for Turkish Adolescents

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ABSTRACT: Background: The effectiveness of life skills-based prevention programs to prevent substance addiction has been underexplored in Türkiye, likely in part due to the lack of validated measurement tools developed specifically for that purpose. Therefore, the aim of this study is to develop a tool to measure life skills for middle school students. The present study aims to test the factorial structure, reliability, convergent and discriminant validity, and measurement invariance across gender and age groups of the Green Crescent Life Skills (GCLS) Scale. **Methods:** The study was conducted in Istanbul with two different sample groups. The first sample consisted of 566 and the second sample consisted of 885 middle school students. In the study, exploratory factor analysis (EFA) was applied to the first sample, and confirmatory factor analysis (CFA) was applied to the second sample to test the factorial structure of the scale. Convergent and discriminant validity were examined to provide evidence for construct-based validity. The reliability of the scale was assessed with Cronbach's α , composite reliability, McDonald's ω , and test-retest. **Results:** The EFA results showed that the scale consisted of four factors (self-awareness, coping with negative emotions, thinking skills, and peer relations). CFA results also confirmed this structure. The results revealed a significant positive correlation ($r = 0.52, p < 0.01$) between life skills and avoidance self-efficacy scores, as well as a significant negative correlation ($r = -0.53, p < 0.01$) between life skills and attitude toward drug use scores. Additionally, it was found that measurement invariances based on gender and age groups were provided. It was determined that all sub-dimensions had sufficient reliability levels. **Conclusion:** The findings of this validation study show that the GCLS Scale, which assesses four skills in a self-reported format, is a valid and reliable scale with considerable potential utility in monitoring life skills in Turkish adolescent populations.

KEYWORDS: Green crescent life skills scale; life skills; drug prevention; scale development

1 Introduction

Life skills programs have been utilized since the 1960s to provide knowledge of skills that can be transferred to multiple areas of an individual's life [1]. There are many accepted definitions for the broad category of life skills. Life skills are defined as "abilities for adaptive and positive behavior that enable individuals to deal effectively with the demands and challenges of everyday life" [2].

Life skills are often enhanced by a psychoeducational program called "Life Skills Training". These programs employed in different venues might have focused on different life skills and were implemented in different aspects of an individual's life. For example, they have been implemented in the areas of antipoverty,



HIV/AIDS, violence against children, the status of women, educational settings, multiple sports settings, individuals with developmental disabilities, improving the mental health of hospitalized patients, and drug and alcohol prevention.

Previous studies on the life skills approach have demonstrated it to be effective in preventing cigarette smoking, alcohol, and marijuana use [3]. Life skill programs focus on multiple age groups, ranging from youth through adulthood. However, considering alcohol and drug use prevention, the most effective prevention approaches target individuals at the beginning of adolescence. Smoking, drinking, and illicit drug use often begin during adolescence in Western countries. Research regarding the age of onset of drug use in Türkiye is consistent with Western societies. While the age of 15 is considered a critical age for the onset of drug use [4], more recent studies have reported an earlier age of initiation [5]. Alcohol is the most widely used drug among adolescents in Türkiye [6]. Smoking and alcohol use are less prevalent among Turkish adolescents than in European countries, and illicit drug use remains below the global average. However, studies report an increase in the use of these substances compared with previous years [7]. Although the prevalence of drug, alcohol, and tobacco use is still far lower than that reported in most European Union countries and the United States, the rising rates of use highlight the need for adolescent prevention and intervention programs in Türkiye [6–8].

There are few life skills-based prevention programs to prevent drug use in Turkish adolescents [8,9]; only one effectiveness study was reported [10]. Effectiveness studies of prevention programs can be effectively implemented when appropriate measurement tools are available.

Measurement tools aiming to measure life skills are also limited in Türkiye. Life skills scales developed or adapted in Türkiye generally include skills such as coping with emotions and stress, empathy and self-awareness, decision-making and problem-solving, creative thinking and critical thinking, and communication, and their target groups are mostly high school and university students. However, there are relatively few valid and reliable life skills scales that can be used in early adolescence. It can be attributed to the fact that there is no self-report survey with adequate psychometric properties that assesses constructs targeted by a particular drug prevention program for Turkish adolescents. Limitations of current instruments include inadequate information on psychometric properties or assessment of generic constructs, but they are not specific to drug prevention. Another limitation is that they do not examine the measurement invariance in gender and age. Whereas, previous research with Turkish secondary school students has shown age and gender differences in life skills [11]. Thus, it is hard to directly compare the performance of these groups on the life skills scales without being able to estimate the impact of potential structural differences. A valid comparison of the life skills across age or gender groups requires that the instrument be comparable in these groups. If measurement invariance cannot be confirmed, mean scores cannot be compared meaningfully. This is because groups probably interpret the question items differently.

A limited number of instruments are available that exclusively measure a cluster of life skills among adolescents in Western cultures such as the Youth Leadership Life Skills Development Scale [12], Life Skills Development Scale-Adolescent Form [13], Life Skills Development Inventory-College Form [14], Life Skills Training Questionnaire [15], The Life Skills Evaluation Instrument [16], National Youth Life Skills Evaluation Scale [17], Youth Life Skills Inventory [18], Youth Life Skills Scale [19], PLANEA Independent Life Skills Scale [20], and in non-western cultures such as Life Skills Scale [21], The Life Skills Scale [22], Life Skills Assessment Scale [23], Life Skills Scale for Adolescents and Adults [24], and Life Skills Scale [25]. These scales varied in terms of their objectives (e.g., needs of the target population), targeted age groups (e.g., elementary, high school, or college students and adults), and sub-factors (e.g., life skill categories). None of them were developed to measure the outputs of a special drug prevention life skills program in Türkiye.

Although most of these instruments have adequate psychometric properties, only some of them confirmed gender measurement invariance [26,27].

Life skills education differs in its objectives and contents from country to country and from one locality to another. For this reason, it is more appropriate to test the effectiveness of life skills programs with measurement tools suitable for the culture in which they were developed. Life skills programs in non-Western countries require appropriate tools to measure their effectiveness, which help to develop their potential. An instrument to evaluate life skills developed for secondary school students in Türkiye will be a useful guide in developing a drug prevention program, implementing a program, and creating a measurable and valid evaluation of a specific life skills program and will also provide data to funders and decision-makers about life skills and the impacts of programs on youth.

The purpose of this research is to develop the Green Crescent Life Skills (GCLS) Scale for its use in the psychoeducational field, under a drug prevention framework. We sought to examine the factorial structure, measurement invariance, convergent and discriminant validity finally reliability of the GCLS Scale. In this way, the psychometric properties of the GCLS Scale in Turkish adolescents were estimated. We hypothesize that the resulting instrument will feature different dimensions based on the WHO [2]. Skills-based health education approach, the factor structure model will explain a latent second-order variable and measure invariance across gender and age, as well as adequate psychometric properties. Sufficient evidence of validity in relation to other variables is expected to be found from the study of the correlation between the instrument's scores with attitudes toward drug use and avoidance self-efficacy.

2 Method

2.1 Participants

Data were collected from two independent samples in Istanbul, a city highly representative of its socioeconomic structure. In both samplings, a probabilistic sampling strategy was used. In the first sample, six public middle schools in two central districts of Istanbul were initially selected. The first sample consisted of 566 middle school students aged between 10 and 16, including 286 females and 279 males (one missing information), with an average age of 12.80 years ($SD = 1.08$). Students as participants were distributed across three grade levels: 6th ($n = 189$, 33.4%), 7th ($n = 182$, 33.2%), and 8th ($n = 195$, 28.1%).

The second sample of the present study consisted of 885 (421 female, 464 male) middle school students aged between 10 and 16. The mean age of the participants was 12.81 years ($SD = 1.09$). Among the participants, 293 (33%) of them were 6th graders, 342 (38.6%) of them were 7th graders, and 249 (28.1%) of them were 8th graders (one missing information).

To test the factor structure and construct validity of the scale, an EFA was conducted on the first sample, while a CFA was performed on the second sample to validate the model. Cronbach's α and McDonald's ω , Composite Reliability Coefficient (CR), measurement invariance, and convergent and discriminant validity were also tested on the second sample.

The socioeconomic composition of the participants was quite similar to the first sample. In the second sample, six different schools were selected from two central districts of the same city, with a total of 885 participants involved. All 1451 students were Turkish citizens, and they were native Turkish speakers. The characteristics of the research groups are given in [Table 1](#).

Table 1: Characteristics of the research groups

	First working group (N = 566)	Second working group (N = 885)
Statistical procedures	EFA	CFA, convergent and discriminant validity, reliability coefficients, and measurement invariance
Gender		
Male	279 (49.3%)	464 (52.3%)
Female	286 (50.5%)	421 (47.5%)
Level of education/class		
6th grade	189 (33.4%)	293 (33%)
7th grade	182 (32.2%)	342 (38.6%)
8th grade	195 (34.5%)	249 (28.1%)
Age group		
10–12 age	236 (41.7%)	358 (40.4%)
13–16 age	328 (58.3%)	529 (59.6%)

Note: EFA, exploratory factor analysis; CFA, confirmatory factor analysis.

2.2 Procedure

The study was conducted according to the guidelines of the Declaration of Helsinki. To collect data, necessary permissions were obtained for 12 secondary schools by applying to the Ministry of National Education. The administrators of the selected schools were contacted, and the letter containing a parental consent form and information about the research was sent home with students to give to the parents. In addition, this letter included an email address and a phone number that parents can use if they want to ask questions before signing the consent form. Printed questionnaires were distributed to only students with parental written consent to participate in the research. In addition, the students were informed that they had the free will to fill in the questionnaire and could withdraw from it at any point they wished. All procedures were approved by the Istanbul Institutional Review Board (No. E.21319083).

2.3 Measurement Instruments for Assessing Convergent and Discriminant Validity

Favorable attitudes toward drug use and low avoidance self-efficacy are individual risk factors associated with adolescent substance use [28]; it has been found that training youth in life skills improves their self-efficacy to prevent substance use [29]. In the present study, correlations between the GCLS Scale, the Self-Efficacy for Adolescents Protecting Substance Abuse Scale [30], and the Drug Attitude Scale [31].

2.3.1 The Self-Efficacy for Adolescents Protecting Substance Abuse Scale (SEAPSAS)

SEAPSAS, developed by Eker et al. [30] to measure the self-efficacy of high school students in preventing substance addiction, consists of four subscales with a five-point Likert-type rating and 23 items. Each item was answered on a scale of 1 to 5, where 1 = strongly disagree and 5 = strongly agree. The psychometric properties of the SEAPSAS for middle school students were examined by İşmen Gazioğlu [32]. The SEAPSAS middle school version's four-factor model has the following goodness-of-fit indices: comparative fit index (CFI) = 0.99, root mean square error of approximation (RMSEA) = 0.04. Also, the SEAPSAS middle school version's subscales' Cronbach's α coefficients ranged from 0.93 to 0.62. The high total score on the scale indicates high self-efficacy in protection from substance addiction.

2.3.2 Drug Attitude Scale (DAS)

DAS, developed by Aksoy [31] to measure high school students' attitudes towards addictive substances, consists of 45 items with a Likert-type rating with responses varying from 1 (absolutely inappropriate) to 5 (absolutely appropriate). The scale has two dimensions: "positive attitude-21 items" and "negative attitude-24 items". Psychometric properties of the DAS for middle school students were examined by İşmen Gazioğlu [32]. DAS middle school version's two-factor model has the following goodness-of-fit indices: CFI = 0.96, RMSEA 0.05. The internal consistency coefficients (Cronbach's α) of the DAS middle school version are 0.92 for a positive attitude and 0.932 for a negative attitude.

2.4 Item Pool Preparation and Pre-Pilot Testing

The item pool preparation process followed DeVellis' [33] guidelines for scale development, which consisted of identification of the construct to be measured, generating an item pool, determining the format for measurement, expert review of the initial item pool, including validation items, and administration of the scale to a developmental sample. These stages are described in detail below.

To clarify the range of life skills to be assessed, an intensive literature review was carried out. Regarding instruments for evaluating the outcomes of drug prevention life skills programs, several researchers have developed a variety of instruments to measure life skills in each component. In 1990, Botvin et al. [3] developed life skills training (LST) to prevent drug abuse through a multimodal cognitive-behavioral approach. The LST program includes three main modules for drug resistance, personal self-management, and social skills. According to WHO, life skills programs to prevent the use of alcohol, cigarettes, and illicit drugs should include three skill domains: interpersonal relations and communication, critical thinking and decision-making, and coping and self-management skills [2].

According to a recent meta-analysis [34], interpersonal skills, assertiveness, and problem-solving skills are three of the active components that are consistently associated with the overall effectiveness of preventive interventions to reduce risk behaviors in adolescents. These domains were taken into consideration while creating the item pool. Additionally, since one of the developmental characteristics specific to early adolescence is "worrying about physical appearance", the domain of self-awareness skills (awareness of the changing body and healthy life choices) has been added to the three domains defined by WHO. Consequently, the item pool was formed based on these skill domains:

- (1) Self-awareness (awareness of the changing body, healthy life choices)
Example item: "I am aware of the consequences of not taking proper care of my body." (Item 8)
- (2) Coping with negative emotions (coping with negative emotions, coping with challenging life events, positive thinking, self-control)
Example item: "I can overcome challenges by using my strengths." (Item 18)
- (3) Thinking skills (problem-solving, critical thinking, decision-making)
Example item: "I think carefully before attempting to solve a problem." (Item 30)
- (4) Peer relations (relationship initiation and maintenance skills, resistance to peer pressure, distinguishing between safe and unsafe areas).
Example item: "I can share my thoughts with others, even if they don't agree with me." (Item 50)

Similar to other scale development studies, the authors of the present study sought to develop an item pool that would be considerably larger than the final scale. In total, 89 items were developed, which represented the four life skills domains. Then, developed items were evaluated for face validity. Five experts, three of whom were from the field of assessment and evaluation and two of whom were from the field of education programs and training, reviewed the initial item pool.

All items were comprehensively reviewed to ensure their relevance in measuring life skills in adolescence. This process involved assessing each item's conceptual alignment with the target construct, ensuring clarity and readability, and avoiding ambiguous, overlapping, or irrelevant meanings. Special attention was given to ensure that the language used was both developmentally suitable for adolescents and free from potential misinterpretations. Then all items in the item pool were phrased as declarative statements and measured on a "1 = strongly disagree" to "5 = strongly agree" response set.

However, to further assess the clarity and comprehensibility, a pre-pilot test was conducted with a sample of 60 students who closely resembled the target population. The objective of this phase was to evaluate the clarity of the items and statements, assess the average response time, and identify any items that might be unclear to respondents. The average completion time for the scale was determined to be approximately 40–45 min. Following this process, the scale was finalized for administration to the study groups after necessary adjustments had been made. To ensure ethical compliance, informed consent was obtained from parents before administering the self-reported questionnaires, and assent was also provided by the children for their participation.

2.5 Data Analysis

The factorial structure of the GCLS was examined using EFA and CFA. In EFA, a principal component analysis (PCA) was conducted via SPSS 25.0 (IBM Corp., New York, NY, USA), whereas in CFA, the covariance and asymptotic covariance matrix were used with the robust maximum likelihood method as the parameter estimation method via LISREL 8.8 (Scientific Software International, Chicago, IL, USA). To test the equivalence (invariance) of the model across gender and age groups, multi-group confirmatory factor analysis (MG CFA) was employed. This analysis was conducted in R Studio 4.2.2 (Posit, PBC, Boston, MA, USA, ABD) with R 4.2.2 (R Development Core Team, Vienna, Austria) with the 'Lavaan' and 'semTools' packages. Additionally, Cronbach's α , McDonald's ω , and composite reliability coefficients were estimated for sub-dimensions and the overall scale to examine reliability.

Prior to conducting EFA, the following fundamental assumptions were evaluated: First, the adequacy of the sample size was ensured. In general, a minimum of five to ten participants per item is recommended, with a total target of at least 100 to 200 participants [34]. To determine the suitability of the data for factor analysis, a Kaiser-Meyer-Olkin (KMO) test and Bartlett's test were conducted. The KMO value must exceed 0.60, and the results of Bartlett's test must be statistically significant. Ensuring these assumptions is essential for producing valid and reliable results from the EFA.

To assess the fit of the CFA model derived from the EFA results, the following fit indices were used: The chi-square statistic to the degrees of freedom ratio (χ^2/df) should be less than three, indicating an acceptable fit of the model. It is recommended that both the CFI and the non-normed fit index (NNFI) exceed 0.90 [35,36]. RMSEA should be less than 0.05, and the standardized root mean square residual (SRMR) should not exceed 0.05 [35,37]. It is critically important to confirm the model's validity and reliability by verifying that it meets these criteria.

3 Results

3.1 Exploratory Factor Analysis

To assess the structural validity of the GCLS, EFA was performed using PCA with varimax rotation. This approach was selected to maximize factor variances. The KMO measure was 0.89, and Bartlett's test of sphericity yielded a χ^2 value of 6410.938 ($p < 0.01$), indicating adequacy for factor analysis. The primary criterion for determining the number of factors to retain was based on extracting factors with eigenvalues greater than 1.00 [38]. Consequently, four factors with eigenvalues exceeding 1.00 were retained for further analysis.

Following the EFA, a total of 89 items were included in the analysis, and the items were systematically eliminated based on their factor loadings and the 0.30 threshold in the rotated component matrix. Following the performance of PCA on the remaining 54 items, four components were identified as making a significant contribution to the overall variance. The PCA results revealed four factors, namely self-awareness, coping with negative emotions, thinking skills, and peer relationships. The factor loadings for these factors ranged from 0.33 to 0.72, with the total variance explained by these factors amounting to 34.60%. The detailed factor loadings, eigenvalues, and the explained variance for each scale are presented in Table A1 in Appendix A.

3.2 Confirmatory Factor Analysis

CFA was conducted to assess whether the data collected from the second sample ($N = 885$) confirmed the structure consisting of 54 items and four factors obtained as a result of EFA. The fit indices for the GCLS Scale indicated a satisfactory model fit: $\chi^2/df = 2.54$, CFI = 0.98, NFI = 0.97, NNFI = 0.98, RMSEA = 0.04, SRMR = 0.05. The significance of the factors in the four-factor model was evaluated using t -values. Due to the 39th item ("It is almost impossible for me to reject others") showing a non-significant t -value and high error variance, it was removed from the model.

Following this adjustment, a revised model consisting of 53 items (excluding the 39th item) was evaluated, resulting in a path diagram displaying the standardized factor loadings (see Table 2). The fit indices for the revised four-factor model confirmed that the GCLS Scale provided a satisfactory fit to the data, further supporting the validity of the model [37].

Table 2: Path diagram for the GCLS scale (53-item revised model)

Factor	Items	Standardized factor loadings	Error variance
Factor 1: Self-Awareness	Item 1	0.65	0.57
	Item 2	0.65	0.58
	Item 3	0.70	0.52
	Item 4	0.71	0.49
	Item 5	0.56	0.69
	Item 6	0.61	0.63
	Item 7	0.50	0.75
	Item 8	0.70	0.51
	Item 9	0.70	0.51
	Item 10	0.69	0.52

(Continued)

Table 2 (continued)

Factor	Items	Standardized factor loadings	Error variance
Factor 2: Coping with Negative Emotions	Item 11	0.63	0.60
	Item 12	0.64	0.60
	Item 13	0.58	0.67
	Item 14	0.64	0.59
	Item 15	0.63	0.60
	Item 16	0.70	0.51
	Item 17	0.65	0.57
	Item 18	0.71	0.50
	Item 19	0.69	0.53
	Item 20	0.62	0.61
	Item 21	0.59	0.65
Factor 3: Thinking Skills	Item 22	0.67	0.55
	Item 23	0.69	0.52
	Item 24	0.65	0.57
	Item 25	0.72	0.48
	Item 26	0.70	0.51
	Item 27	0.73	0.46
	Item 28	0.76	0.42
	Item 29	0.71	0.49
	Item 30	0.75	0.43
	Item 31	0.74	0.45
	Item 32	0.73	0.47
	Item 33	0.64	0.59
	Item 34	0.70	0.51
	Item 35	0.63	0.60
Factor 4: Peer Relationships	Item 36	0.62	0.62
	Item 37	0.58	0.67
	Item 38	0.57	0.68
	Item 40	0.68	0.54
	Item 41	0.66	0.57
	Item 42	0.74	0.45
	Item 43	0.61	0.63
	Item 44	0.53	0.71
	Item 45	0.60	0.63
	Item 46	0.70	0.50
	Item 47	0.67	0.55
	Item 48	0.55	0.69
	Item 49	0.50	0.75
	Item 50	0.63	0.60
	Item 51	0.63	0.60

(Continued)

Table 2 (continued)

Factor	Items	Standardized factor loadings	Error variance
	Item 52	0.63	0.61
	Item 53	0.68	0.53
	Item 54	0.48	0.77

Pearson correlation analysis was conducted to test the relationships between the subfactors of the GCLS Scale. The correlation coefficients between the subscales ranged from 0.60 to 0.75. It was concluded that the existence of a second-order factor could explain the common source among these factors, as indicated by the high correlations between the subfactors in the first-order CFA model. Consequently, a second-order CFA was conducted to test the hypothesis that the four factors of the GCLS Scale-self-awareness, coping with negative emotions, thinking skills, and peer relationships-load onto a single, broader latent life skills factor [39].

Second-Order Confirmatory Factor Analysis

A second-order CFA was conducted to test the hypothesis that the four factors of the GCLS Scale load onto a single, broader latent factor. The purpose of this analysis was to evaluate the structural integrity of the model by examining the relationships between factors and aggregating them under a second-order construct.

The results demonstrated that the model showed a good fit according to the criteria specified in references [36,37]. In particular, the ratio of the chi-square to the degrees of freedom (χ^2/df) was 2.51, with a statistically significant p -value. The SRMR was 0.05, and the RMR was 0.06. Furthermore, the CFI was 0.99, the NFI was 0.98, and the NNFI was 0.99, which indicates an excellent fit for the model. The RMSEA value of 0.04 provides further evidence that the model provides a close approximation to the data.

These results support the validity of the GCLS Scale, indicating that the four factors can be aggregated into a single, higher-order construct with a robust alignment to the data (see Fig. 1).

3.3 Convergent and Discriminant Validity

To assess the convergent and discriminant validity of the GCLS Scale, Pearson's correlation coefficients (r) were computed between the GCLS Scale, SEAPSAS, and DAS. The analysis revealed a significant negative correlation between the GCLS Scale and DAS ($r = -0.53, p < 0.01$), indicating that students with higher life skills exhibit more negative attitudes towards drugs. Also, as expected, a positive correlation was identified between the GCLS Scale and SEAPSAS ($r = 0.52, p < 0.01$), indicating that individuals with higher life skills also demonstrate higher self-efficacy in protecting themselves from drug addiction. The results provide substantial evidence to support the convergent and discriminant validity of the GCLS Scale.

3.4 Measurement Invariance

Measurement invariance is the process of evaluating whether a measurement tool maintains a consistent construct and meaning across different groups, such as gender and age. This is crucial for ensuring that the measurement is fair and reliable across diverse populations and is typically evaluated using MG CFA [40]. In this study, measurement invariance was tested across gender and age groups using Sample 2.

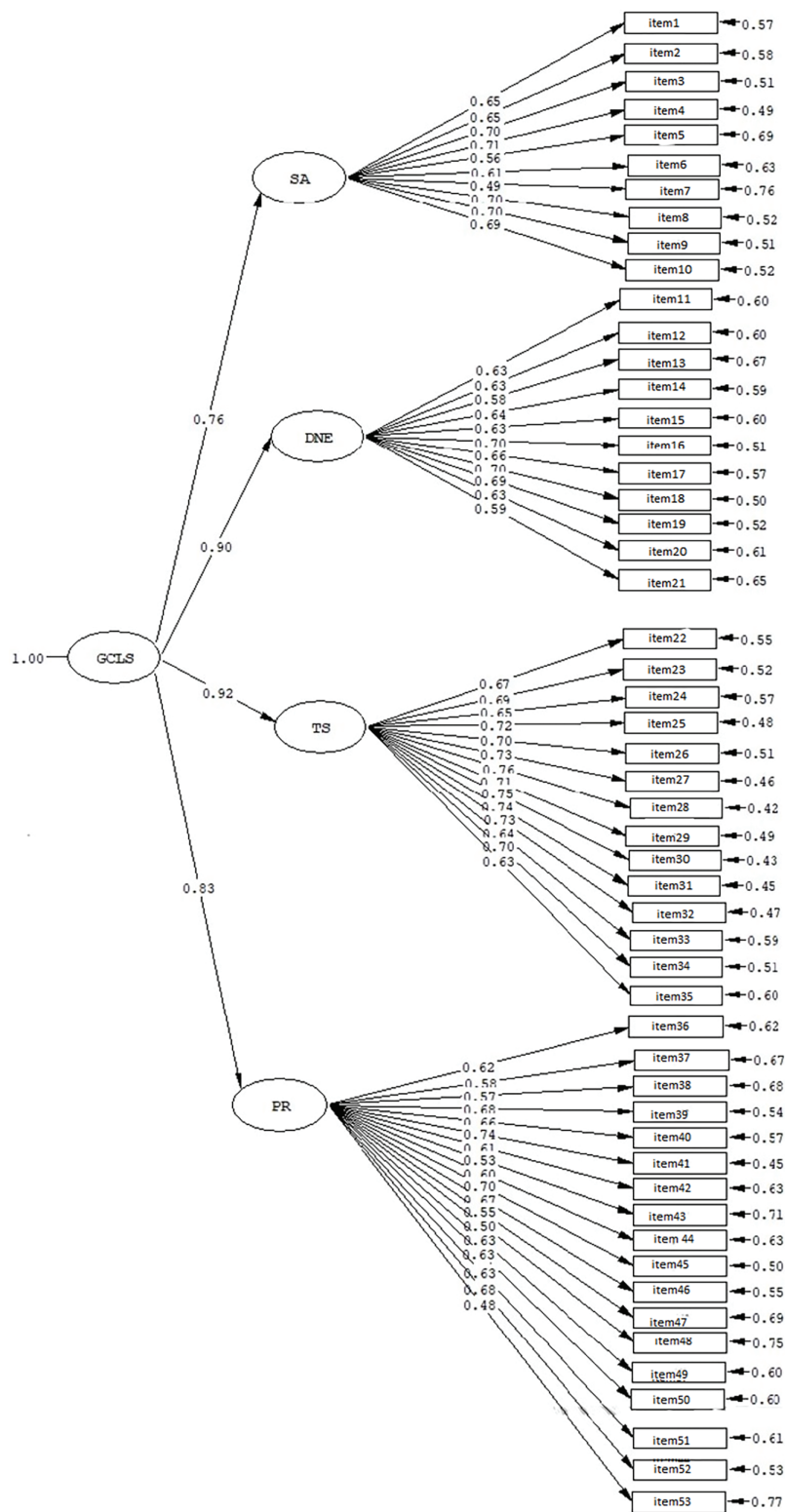


Figure 1: Second-order CFA path diagram of the GCLS Scale. Note. SA: Self-Awareness, CNE: Coping with Negative Emotions, TS: Thinking Skills, PR: Peer Relationships

The assessment was conducted through MG CFA (see Table 3), with various models being tested at different stages of the analysis. There is no universal consensus on the best-fit indices or cutoff values for measurement invariance. In this study, the cutoff values suggested by Chen [41] and Rutkowski and Svetina [42] were used.

Table 3: The goodness of fit indices and comparison of models

Models	χ^2 (df)	χ^2 /df	CFI	TLI	RMSEA	SRMR	Model comparison	Δ CFI	Δ RMSEA	Δ SRMR
Across gender										
M1: Configural Invariance	2896.69 (2638)	1.09	0.939	0.937	0.019	0.057	–	–	–	–
M2: Metric (weak) Invariance	2900.53 (2687)	1.08	0.950	0.949	0.017	0.063	M1-M2	0.011	–0.002	0.006
M3: Scalar (strong) Invariance	2957.75 (2736)	1.08	0.948	0.948	0.017	0.063	M2-M3	–0.002	0.000	0.000
M4: Strict Invariance	3014.51 (2789)	1.08	0.947	0.948	0.017	0.064	M3-M4	–0.001	0.000	0.001
Across age groups										
M1: Configural Invariance	2912.03 (2638)	1.10	0.926	0.923	0.019	0.056	–	–	–	–
M2: Metric (weak) Invariance	2910.68 (2687)	1.08	0.939	0.938	0.017	0.061	M1-M2	0.014	–0.002	0.005
M3: Scalar (strong) Invariance	2963.27 (2736)	1.08	0.938	0.938	0.017	0.061	M2-M3	–0.001	0.000	0.000
M4: Strict Invariance	3021.85 (2789)	1.08	0.937	0.938	0.017	0.062	M3-M4	–0.002	0.000	0.001

Note: df, degrees of freedom; CFI, comparative fit index; TLI, Tucker-Lewis index; RMSEA, root mean square error of approximation; SRMR, standardized root mean square residual. The chi-square difference values have been scaled because each model was estimated with robust standard errors. M1: Factor loadings, item intercepts, and error variances are free; M2: Factor loadings are fixed; M3: Factor loadings and item intercepts are fixed; M4: Factor loadings, item intercepts, and error variances are fixed.

The configural invariance model was initially tested (using Sample 2) across gender and age groups. The fit indices obtained from this model met the criteria for configural invariance, with $CFI \geq 0.90$, $TLI \geq 0.95$, $RMSEA \leq 0.08$, and $SRMR \leq 0.06$, thereby confirming that configural invariance was achieved [35]. The subsequent stage involved the assessment of metric invariance. The fit indices for the metric invariance model (M1–M2: $\Delta CFI = 0.011$, $\Delta RMSEA = 0.002$ for gender; $\Delta CFI = 0.014$, $\Delta RMSEA = 0.002$, $\Delta SRMR = 0.005$ for age groups) demonstrated that the model fit was satisfactory. This result indicates that factor loadings were similar across gender and age groups [43]. The subsequent stage of the analysis involved testing scalar invariance. The next stage involved testing scalar invariance. The differences between the fit indices for scalar invariance and metric invariance (M2–M3: $\Delta CFI = 0.002$, $\Delta RMSEA = 0.000$, $\Delta SRMR = 0.000$ for gender; $\Delta CFI = 0.001$, $\Delta RMSEA = 0.000$, $\Delta SRMR = 0.000$ for age groups) showed that the cutoff points were met. This indicates that scalar invariance was achieved and that regression constants were similar across groups [41]. Finally, strict invariance was tested. The fit indices for strict invariance (M3–M4: $\Delta CFI = 0.001$, $\Delta RMSEA = 0.000$, $\Delta SRMR = 0.001$ for gender; $\Delta CFI = 0.002$, $\Delta RMSEA = 0.000$, $\Delta SRMR = 0.001$ for age groups) confirmed that the error terms were similar across gender and age groups, and strict invariance was achieved [39].

In summary, the GCLS Scale demonstrated full measurement invariance across gender and age groups. These findings suggest that the GCLS Scale provides consistent meaning and measurement across these groups.

3.5 Reliability

The reliability of the GCLS Scale was assessed using Cronbach's α , McDonald's ω , composite reliability, and test-retest reliability methods. The Cronbach's α reliability coefficients for Self-Awareness (SA), Coping with Negative Emotions (CNE), Thinking Skills (TS), Peer Relationships (PR), and the total GCLS Scale were 0.87, 0.88, 0.93, 0.91, and 0.96, respectively. The scores are considered to be reliable in terms of high

internal consistency. Another coefficient that is frequently recommended for the evaluation of reliability in measurement constructs is omega (ω), as proposed by McDonald [44]. McDonald's ω coefficients for SA, CNE, TS, and PR dimensions and total score were 0.868, 0.884, 0.931, 0.931, and 0.963, respectively. The GCLS Scale's stability over time was examined through a test-retest reliability assessment with a three-week interval. The results indicated that the subscales' reliability coefficients ranged from 0.72 to 0.77, indicating an adequate level of reliability. Also, the analysis showed that the GCLS Scale's test-retest reliability was at a good level.

Additionally, composite reliability, which is crucial for accurately estimating the internal consistency of a construct by accounting for both factor loadings and error variances [45], was computed based on the factor loadings and error variances obtained from CFA. The composite reliability coefficients for SA, CNE, TS, PR, and the total GCLS Scale were 0.88, 0.88, 0.93, 0.91, and 0.96, respectively (see Table 4).

Table 4: Reliability coefficients for GCLS Scale and sub-scales

	Cronbach's α	Composite reliability	McDonald's ω	Test-Retest (n = 36)
Self-Awareness (10 items)	0.877**	0.882**	0.868**	0.724**
Coping with negative emotions (11 items)	0.882**	0.884**	0.884**	0.772**
Thinking Skills (14 items)	0.931**	0.931**	0.931**	0.750**
Peer Relationships (18 items)	0.915**	0.917**	0.931**	0.740**
GCLS Scale total (53 items)	0.964**	0.965**	0.963**	0.843**

Note: ** $p < 0.01$ (two-tailed tests). For test-retest, Pearson correlation was used when the normality assumption was met; otherwise, Spearman's rho was used.

Finally, the mean scores for the GCLS Scale (Mean = 207.65, SD = 44.74), as well as for the sub-scales of Self-Awareness (Mean = 40.22, SD = 8.51), Coping with Negative Emotions (Mean = 41.95, SD = 9.58), Thinking Skills (Mean = 54.65, SD = 12.30), and Peer Relationships (Mean = 73.64, SD = 15.00) were relatively high (see Table 5).

Table 5: GCLS Scale's subscales bivariate correlations and descriptive statistics (N = 885)

	Self-awareness	Coping with negative emotions	Thinking skills	Peer relationships	M	SD
Self-awareness	1				40.22	8.51
Coping with negative emotions	0.64**	1			41.95	9.58
Thinking skills	0.64**	0.75**	1		54.65	12.30
Peer relationships	0.60**	0.66**	0.70**	1	73.64	15.00
GCLS	0.78**	0.86**	0.89**	0.89**	207.6	44.74

Note: M, Means; SD, Standard Deviation. ** $p < 0.01$ (two-tailed tests).

The bivariate relationships between the GCLS Scale and its subscales indicate that life skills consist of interrelated dimensions. Positive high correlations were found between GCLS and self-awareness, coping with negative emotions, thinking skills, and peer relationships ($r = 0.78, 0.86, 0.89, 0.89$; $p < 0.01$). Furthermore, the intercorrelations among the subscales ranged from 0.60 to 0.75, with all relationships positive and statistically significant. Significant correlations were observed between all sub-scale scores and the total scale score, providing further support for the reliability of the GCLS Scale (see Table 5).

4 Discussion

This study sought to expand the literature on life skills for adolescents in non-Western countries by developing a self-reported instrument to evaluate constructs targeted by a particular drug prevention program for Turkish adolescents. The construct validity of the GCLS Scale via EFA and CFA and the measurement invariance of the related models were tested across age and gender groups. The findings supported the conceptual framework underlying the GCLS Scale with four sub-scales (self-awareness, coping with negative emotions, thinking skills, and peer relationships) that are subsumed under a single broader latent factor of the GCLS Scale. Measurement invariance results indicate that the scores obtained from this scale can be used to compare gender and age groups.

As a result of EFA, a 4-factor structure consisting of 54 items that explain 34.60% of the total variance was obtained. The theoretically constructed measurement model verified by the data was tested with CFA. It was determined that the GLCS Scale with 53 items under a 4-factor structure was confirmed as a model. However, due to the high correlation values between factors, it was thought that a second-order structure could be defined and a second-level CFA was performed. Considering the fit indices estimated and the standardized factor loadings as a result of the second-order CFA analysis, it was found that the fit indices were sufficient and the factor loadings were between 0.76 and 0.92. Accordingly, it was determined that the 4-factor structure of the GCLS Scale, consisting of 53 items, was verified as a model under the Life Skills second order and adapted to the data at a good level. As a result, it can be stated that the measurements obtained from the GCLS Scale provided construct validity. In addition, the study aims to assess the measurement invariance of the GCLS Scale across gender and age groups. Results revealed that full invariance (model equivalency) was achieved in the gender and age subsamples. Information on measurement invariance provides evidence of the degree to which an instrument measures the same latent dimension(s) in all age and gender groups.

Results of the present study revealed that the life skills scores of adolescents were relatively high. Some authors have indicated higher levels of life skills in the adolescent population [25], whereas others have reported average levels [21]. These contradictory results may be because the life skills scales were developed for different constructs and also have different subscales or not to ensure measurement invariance between age groups. In the present study, the high life skills scores may be due to the fact that the mean age of the participants is below the age of 15 considered a critical age for the onset of drug use.

Some studies have found significant differences in adolescents' social [25] and life skill levels [21,46] regarding gender, whereas others have found no difference [47]. The subscales of the GCLS Scale are self-awareness, coping with negative emotions, thinking skills, and peer relationship skills, which are gender-sensitive skills. In previous studies, boys exhibited more positive attitudes toward their bodies than did girls [48]. Girls coped more maladaptively with common stressors than boys [49]. Gender-related difference in problem-solving ability is an issue of great controversy, but Zach et al. [50] reported that boys performed better than girls on the problem-solving task. Girls reported higher levels of interpersonal functioning and are more concerned about the quality of their interpersonal relationships [29] in addition, boys and girls differ in nature. To what extent these different findings in the literature about gender differences in life skills are realistic, they are correct in proportion to the comparability of the relevant structure in the gender groups. Strict measurement invariance across gender was obtained in the present study that indicated the GCLS was assessing the same latent structure in girls and boys. In other words, observed scores from the GCLS Scale can be compared more realistically across gender groups.

For the convergent and discriminant validity study, the correlation among the GCLS Scale, SEAPSAS, and DAS was calculated. Correlation analysis results were in line with the previous studies examining the relationship between life skills self-efficacy and attitudes [51,52]. Individuals with high self-efficacy make more effort to avoid harmful behaviors such as addiction and cope more effectively with the challenges

they encounter. Individuals with high self-efficacy are more resilient to drug use and use life skills more effectively [53,54]. Furthermore, it is stated in the literature that individuals with high life skills can evaluate the possible harms of substance use more accurately and develop more negative attitudes towards substance use and that there is a strong negative correlation between life skills and attitudes towards drug use [55]. Therefore, it can be said that provided GCLS Scale's convergent and discriminant validity.

The reliability of the GCLS Sale was examined by Cronbach's α . McDonald's ω and composite reliability methods. The Cronbach α reliability of the scale was calculated as 0.96. Measurements with a reliability coefficient of 0.70 and above are considered to be reliable.

5 Limitation and Future Research

The current study is not without limitations. First, because the GCLS Scale is a self-report measure. The responses may have been influenced by social desirability attitudes, which often endanger self-report scales. Second, it is necessary to expand the sample to allow a broader generalization of the findings. There is a need to assess the generalizability of the findings in different samples in different cities in Türkiye. Future research might provide a more in-depth exploration of the GCLS Scale's psychometric properties, such as test-retest reliability, divergent validity, and response styles. We would encourage future research to assess the temporal stability of the GCLS Scale over time and with different adolescent populations (e.g., homeless, and immigrants). Despite those limitations described above, the present study makes further contributions to the literature focused on creating a measurable and valid evaluation of a life skills-based drug prevention program and also will provide data to funders and decision-makers about life skills and the impacts of programs on youth. Ultimately, the GCLS Scale proves a useful instrument for researchers and practitioners interested in prevention and intervention programs based on skills training in adolescence.

6 Conclusions

In summary, the findings arising from this validation study were generally encouraging and robust. The GCLS Scale, which assesses four skills in a self-reported format, is a valid and reliable scale and a cost-effective tool with considerable potential utility in monitoring life skills in adolescent populations. It is also a potentially useful tool for evaluating interventions aimed at improving and developing these skills in different groups of adolescents in school. The use of the GCLS Scale before and after interventions would also help to measure their impact on strengthening life skills.

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Availability of Data and Materials: Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

Ethics Approval: All procedures were approved by the Istanbul Institutional Review Board (No. E.21319083). Informed consent was obtained from all participants' parents included in the study.

Conflicts of Interest: The authors declare no conflicts of interest to report regarding the present study.

Appendix A

Table A1: Factors of the GCLS Scale, item loadings, and varimax rotation

Factor	Component 1	Component 2	Component 3	Component 4	Eigen value	Variance explained
Factor 1: Self Awareness					2.09	6.67%
Item 1	0.59					
Item 2	0.513					
Item 3	0.47					
Item 4	0.57					
Item 5	0.44		0.21			
Item 6	0.37					
Item 7	0.34					
Item 8	0.53					
Item 9	0.63		0.23			
Item 10	0.49		0.25	0.25		
Factor 2: Coping with Negative Emotions					2.51	7.74%
Item 11	0.32	0.44		0.25		
Item 12	0.26	0.39		0.28		
Item 13		0.64		0.21		
Item 14	0.31	0.47				
Item 15		0.47	0.25			
Item 16		0.72				
Item 17		0.61				
Item 18		0.53		0.29		
Item 19		0.69		0.25		
Item 20		0.62	0.25			
Item 21		0.47				
Factor 3: Thinking Skills					11.37	10.68%
Item 22			0.51			
Item 23		0.25	0.50	0.26		
Item 24		0.24	0.46			
Item 25	0.21	0.21	0.56			
Item 26			0.57			
Item 27			0.61			
Item 28			0.66			
Item 29			0.54			
Item 30			0.68			
Item 31			0.58			
Item 32			0.50	0.21		
Item 33			0.51			
Item 34	0.26		0.53	0.24		
Item 35			0.49			
Factor 4: Peer Relationships					2.72	9.52%
Item 36		0.23		0.50		
Item 37				0.46		
Item 38	0.26			0.43		
Item 39*				0.34		
Item 40			0.33	0.60		
Item 41			0.27	0.53		
Item 42			0.38	0.59		
Item 43	0.24			0.45		
Item 44				0.40		
Item 45			0.32	0.45		
Item 46	0.28		0.26	0.33		
Item 47			0.29	0.56		
Item 48				0.49		
Item 49				0.51		
Item 50				0.47		
Item 51	0.22		0.29	0.48		

(Continued)

Table A1 (continued)

Factor	Component 1	Component 2	Component 3	Component 4	Eigen value	Variance explained
Item 52				0.58		
Item 53		0.23		0.42		
Item 54				0.45		

Note: Item 39* to be removed from the scale with CFA and Factors (factor 1, factor 2, etc.) are numbered according to the place of the items in the scale.

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