

Development and psychometric validation of the cognitive flexibility scale for Indian adolescents

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Abstract

A large number of instruments have been developed to measure cognitive flexibility, reflecting its growing recognition as an emerging and significant construct in psychology. The study reports on the development of a cognitive flexibility scale for adolescents, and the assessment of its internal consistency, test- retest reliability and validity. An exploratory sequential research design comprising three phases was employed. Phase 1 focused on item generation and testing an initial pool of items, leading to the development of a set of potential items for the scale. Phase 2 involved conducting a pilot study to assess the preliminary items, leading to the selection of the final set of items. Phase 3 was a validation phase where the scale was administered to a larger sample. Item analysis was used to assess the internal consistency of the scales, and Exploratory Factor Analysis to explore the properties of the CFS. Exploratory Factor Analysis using the principal axis identified a three-factor structure for the 26-item CFS. Internal consistency for the CFS (Cronbach's alpha = 0.79) was found to be acceptable. The cognitive flexibility scale provides a validated tool that will allow educators and researchers to assess the cognition of secondary school students, enabling them to plan interventions for them.

Keywords: Adolescents, Cognitive flexibility, Exploratory factor analysis, Psychometric properties, Scale development, Self-report measure.

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Contribution of this paper to the literature

A psychometrically validated, 26-item Cognitive Flexibility Scale, specifically tailored for adolescents has been developed. By developing a reliable three-factor structure, a self-report tool has been provided to researchers and teachers to assess students' cognition and design interventions that foster adaptability and socio-emotional competencies.

1. Introduction

Every day we require switching between different task goals. An academic task of preparing a project needs student to switch between gathering information, discussing ideas with peers, resolving disagreements and revising the final presentation based on feedback. Such situations require the ability to adapt thinking and behavior according to changing task demands. This highlights the need for cognitive flexibility by efficiently changing the task focus for enhanced performance (Xu, Verguts, & Braem, 2026). Cognitive flexibility has been recognized as the ability to adjust internal representations and behavior when the environment, task, or rules change (Chouhadi, Lamghari, & Ennaji, 2025). It is defined as the capacity of an individual to adapt to new or unexpected situations, consciously switching between different tasks, and evaluating alternatives (Bonnici, 2020). In this way, it has emerged as an important skill to increase an individual's life satisfaction and contributes to overall well-being (Kucukkelepce, Marasli, & Mir, 2026). Martin and Rubin (1995) proposed that cognitive flexibility entails the awareness of multiple potential solutions to a problem and the capacity to adapt seamlessly to situational changes (Martin & Rubin, 1995). Concluding, cognitive flexibility relies on the flexible transfer and reorienting of attention, representing an adaptive and regulatory thought and behavioral ability (Kramer, Humphrey, Larish, & Logan, 1994).

The senior secondary school years represent a critical period for the development of the child as students encounter numerous challenges- academic demands, interpersonal relationships and personal exploration. Cognitive flexibility plays an important role in influencing mental well-being and social adaptation. Individuals with high cognitive flexibility tend to show more adaptive coping strategies, enhanced psychological resilience and superior academic performance, while those with low cognitive flexibility display rigid thinking, impaired decision-making, and heightened emotional reactivity (Almutawa et al., 2025; Uddin, 2021). Those with high cognitive flexibility can rapidly acclimate to new environments, recognize and use opportunities and demonstrate proactive behaviors (Cai, 2024).

The available self-report measures have been primarily developed and validated using college students and adults (Martin & Rubin, 1995). Senior secondary students in adolescence stage differ in their cognitive flexibility structure from adults, with some studies revealing that a two-factor model provides a superior fit for their cognitive flexibility (Ardra & Hendrawan, 2025). Also, the current scales focus more on interpersonal communication competence (Ardra & Hendrawan, 2025), measuring flexibility across awareness of communication alternatives, willingness to adapt and self-efficacy in interpersonal interactions (Oshiro, Nagaoka, & Shimizu, 2016). However, senior secondary school students require a measure that encompasses academic adaptability and problem-solving in high-stakes educational environments. Further alternative measures focus on dimensions specifically relevant to Cognitive Behavioral Therapy, such as situational control, which may lack the ecological validity required to assess a student's daily academic lived experience (Dennis & Vander Wal, 2010). A brief, validated, and contextually relevant tool would allow for efficient early screening, enabling educators to identify students who may struggle with collaborative learning or adapting to new pedagogical strategies.

The current psychometric research stresses that the psychological instruments should be validated within the target population to address cultural, linguistic and contextual differences. These differences influence the interpretation of test items and expressions in psychological constructs (Gregoire, 2018; van de Vijver & Leung, 1997). Consequently, instruments developed in one sociocultural context cannot be assumed to possess equivalent validity when administered in another.

Indian school system is characterized by significant language, cultural and socio-economic diversity. Students have to navigate multilingual classrooms, heterogeneous learning environments, varying instructional approaches and unequal access to educational resources. These contextual characteristics shape students' opportunities to develop and demonstrate adaptive thinking and cognitive flexibility. The importance of context-sensitive conceptualization of higher-order cognitive abilities has also been highlighted in educational research. The paradigm shift advocated by the National Education Policy seeks to evaluate students' conceptual understanding and higher-order cognitive competencies and expects students to adapt their thinking across diverse academic and real-life situations. The development of a culturally relevant and contextually appropriate cognitive flexibility scale would strengthen educational research by providing a valid measure of cognitive flexibility, supporting schools in identifying learners who require cognitive interventions and contributing to evidence-based implementation of competency-oriented educational reforms.

2. Methods

The methodology for the development of the tool followed established procedures commonly used in psychometric scale construction. Exploratory sequential research comprising three phases was employed. Phase 1 involved generation and evaluation of an initial pool of statements developed through extensive reviews of literature and expert consultation, resulting in a preliminary version of the instrument. Phase 2 consisted of a pilot study involving fifty respondents, leading to the selection of the final statements for the instrument. Phase 3 focused on the validation phase, where the finalized Cognitive Flexibility Scale was administered to a representative sample of 200 respondents to assess its reliability and validity.

2.1. Phase 1: Generation and Development of Items for the Cognitive Flexibility Scale

2.1.1. Selection of the Items for Testing

An extensive review of the available theoretical and empirical literature was conducted. A systematic examination of the books, peer-reviewed journal articles and existing standardized instruments measuring cognitive flexibility and related constructs was done to identify the key dimensions and indicators of the construct. Based on the insights

developed a comprehensive pool of potential items reflecting the various aspects of cognitive flexibility among students and an initial pool of items was generated to represent the various facets of the construct. To maximize respondent comprehension and minimize ambiguity, the items were framed as interrogative statements rather than declarative statements, promoting clearer interpretation and more accurate responses (Kaiser et al., 2019).

The items were primarily developed to ensure adequate representation of the conceptual domains of cognitive flexibility, including adaptive problem-solving, perspective taking, self-regulation, social adaptability and reflective thinking.

A preliminary pool of sixty items was generated to capture the multidimensional nature of cognitive flexibility. Several items were formulated for each facet to facilitate a rigorous evaluation and ensure the selection of the most relevant, clear, and psychometrically robust items during the instrument refinement process.

2.1.2. Response Format

A five-point scale was used in an attempt to balance sensitivity. Instructions were given as the scale consists of a number of statements describing thoughts, feelings, and behaviors that people may experience in their daily lives. There are no right or wrong answers. Please read each statement carefully and indicate the extent to which it describes you by selecting the most appropriate response.

2.1.3. First Review of Items

During the review process by a team of five nominated experts, particular emphasis was placed on ensuring that each item accurately represented one or more dimensions of cognitive flexibility among students. The items were assessed to ascertain whether they encapsulated various aspects of adaptive thinking, problem-solving, self-regulation, social adaptability, and reflective decision-making. The language of the items underwent meticulous scrutiny to guarantee simplicity, clarity, and ease of comprehension for the target respondents. Efforts were directed towards framing the statements in a straightforward manner, enabling respondents to easily understand and relate them to real-life situations. Ambiguous, complex, or potentially confusing statements were either revised or removed. Additionally, measures were implemented to prevent the inclusion of items that might provoke disagreement, create misunderstanding, or bias respondents toward a particular response. Care was also taken to eliminate repetitive, vague, and biased statements. As a result of this review, several items were modified, refined, or discarded to improve the overall quality and content representation of the scale. The revised draft emerging from this stage was considered suitable for further evaluation through expert review and subsequent psychometric analysis.

2.1.4. Pre-Try-Out/Pilot Testing

A pre-try-out was conducted on 50 students enrolled in senior secondary schools. Purposive sampling was used to select participants from diverse gender groups and educational levels, thereby ensuring adequate representation of the target population during the initial phase of instrument development. Inclusion criteria were that participants must be enrolled in senior secondary school and able to give informed consent. Participants who were unable to provide informed consent due to cognitive impairment were not included in the study.

Participants were told to read each item and were asked if the meaning of the items were clear. Also, they were asked whether they have any suggestions as to how the item could be improved, such as different words or ideas to communicate the idea being measured.

The research team subsequently reviewed the feedback on each item and made changes to improve comprehensibility and acceptability. Following the process, the wording of some items was changed, and 31 items were retained.

2.2. Phase 2: Testing

The final version was used to collect data in Ambala district of Haryana. The draft measures of the scale were administered to 200 participants with an equal representation of males (n=100) and females (n=100) enrolled in senior secondary schools, to examine the reliability and validity of the instrument.

The quantitative data were entered into an Excel spreadsheet, and subsequently into SPSS Statistics, version 22 for analysis.

The observation of the responses to the items were discussed amongst the research team after the completion of data collection. These observations guided the process of item selection, particularly decisions regarding item removal and interpreting results of the statistical analysis.

The performance of each item was assessed through the following analyses:

1. Endorsement frequency of items.
2. Discrimination function of items.
3. Item-Item correlations (Pearson's r) – The extent to which items on the scale are assessing the same content. It is unnecessary to have items measuring the same issue. A correlation between items higher than 0.5 was considered to be high.
4. Internal consistency (Cronbach's α)- how well each item correlates with other items and the total score.
5. Factor analysis- any items which did not load highly onto the factors extracted would be considered for removal.

Retention or removal of items was based on the comprehensive patterns of results, along with field researchers' feedback on respondents' reactions to each item

2.3. Phase 3: Validation

The 31-items Cognitive Flexibility scale was administered to 200 respondents. In addition, questions were also included on demographic variables.

2.3.1. Endorsement Frequency

The endorsement frequencies ranged from 8.4% to 72.3% across response categories (Table 1). No item exceeded the recommended 80% endorsement threshold, indicating the absence of significant floor or ceiling effects. Consequently, all items were retained for subsequent analyses.

Table 1. Endorsement frequency of the cognitive flexibility scale items (N = 200).

Item No.	Strongly Agree (%)	Agree (%)	Undecided (%)	Disagree (%)	Strongly Disagree (%)
1	22	27	7	34	10
2	1.0	4.0	7.0	58	30
3	7	39	13	36	5.0
4	0	9	28	45	18
5	3	10	14	34	39
6	0	13	11	56	20
7	1	4	7	59	29
8	0	13	15	48	24
9	3	11	10	37	39
10	1	18	22	32	27
11	4	9	14	46	27
12	1	18	14	44	23
13	8	19	11	36	26
14	10	29	18	28	15
15	1	10	26	54	9
16	1	11	14	37	37
17	10	36	14	29	11
18	1	10	9	61	19
19	15	33	14	32	6
20	1	3	9	45	42
21	15	36	20	21	8
22	11	36	22	24	7
23	6	11	9	30	44
24	4	11	10	47	28
25	30	43	11	14	2
26	14	22	15	42	7
27	50	36	6	6	2
28	22	39	9	27	3
29	16	43	21	15	5
30	21	33	12	23	11
31	11	27	15	37	10

3. Results

3.1. Phase 2: Testing

3.1.1. Discriminating Power

In accordance with Kelley (1939) criterion, respondents were ranked based on their total scale scores, with the top 27% and bottom 27% of the distribution selected to constitute the high and low cognitive flexibility groups, respectively. Independent samples t-tests were employed to compare the mean scores of these two groups for each item. The premise was that items indicative of cognitive flexibility should elicit different responses from individuals with high versus low levels of this trait. Consequently, items that exhibited statistically significant differences between the groups were deemed to have sufficient discriminative capacity. Items with higher t-values were interpreted as more effective in distinguishing between respondents with varying levels of cognitive flexibility. In contrast, items showing weak discrimination or non-significant differences between groups were considered for revision or elimination. This procedure ensured the retention of only those items that significantly contributed to measuring the construct within the scale. The item analysis results demonstrated that the retained items effectively distinguished between respondents with high and low cognitive flexibility. The significant differences observed between the criterion groups offered preliminary evidence of the instrument's construct validity and justified the inclusion of the selected items in the final version of the Cognitive Flexibility Scale.

The item analysis of the 31 items included in the pilot version of the cognitive flexibility scale that six items had poor discriminant validity. Retention or removal of items was based on the comprehensive pattern of results, plus feedback from field researchers following the pilot data collection. This process resulted in a reduction from 31 items to 26.

The scale was able to distinguish between those with low and high cognitive flexibility (discriminant validity), as shown in Table 2.

Table 2. Comparison of scores on cognitive flexibility scale with low and high cognitive flexibility.

Item No.	T-test value	Item No.	T-test value
1	2.25*	17	2.39*
2	2.99*	18	1.29
3	2.13*	19	4.64*
4	2.68*	20	8.32*
5	5.38*	21	6.14*
6	7.93*	22	3.33*
7	1.46	23	4.92*
8	8.19*	24	5.75*
9	6.25*	25	7.14*

Item No.	T-test value	Item No.	T-test value
10	2.16*	26	1.82
11	2.53*	27	4.62*
12	6.73*	28	1.06
13	3.50*	29	5.27*
14	2.45*	30	6.18*
15	1.39	31	2.01*
16	8.22*		

Note: *Significant at 0.01 level of significance.

3.2. Phase 3: Validation

3.2.1. Respondents’ Demographic Characteristics and Total Score Distributions

A total of 200 respondents were randomly selected from senior secondary schools has been included in the study. The distribution of the sample across demographic variables is depicted in Table 3. Table 3 reveals the sample features an equal distribution across gender, grade level, and parental literacy status.

Table 3. Demographic Characteristics of the respondents.

Educational Grade	Male (N=100)		Female (N=100)	
	XI -50	XII- 50	XI -50	XII- 50
Parental literacy level	Literate Parents -25 Illiterate Parents -25	Literate Parents -25 Illiterate Parents -25	Literate Parents -25 Illiterate Parents -25	Literate Parents -25 Illiterate Parents -25

After scoring the data, descriptive statistics were calculated. The results revealed that the mean CFS score was 86.46, with a standard deviation of 6.27, a minimum score of 68, a maximum score of 106, a kurtosis of 0.45, and a skewness of 0.32.

3.2.2. Internal Consistency

Cronbach’s alpha coefficient for the CFS was 0.79, indicating the acceptable range of internal consistency (Kline, 2000). When the alpha coefficient for each subscale was calculated, the results ranged from 0.60–0.83. The internal reliability of the 26-item scale was found to be good (Cronbach’s alpha = 0.79), and inter-item correlations ranged from 0.711 to 0.98, falling within the advised range of 0.20 to 0.40.

3.2.3. Test-Retest Reliability

The test-retest reliability assessment was conducted with 200 eligible respondents (100 male and 100 female). Mean (SD) scores on the CFS were 103.6 (6.6) for the total sample. The variability reflects the scale's ability to distinguish between individuals with differing levels of cognitive flexibility and supports its usefulness for research and assessment purposes. The test-retest correlation coefficient was found to be 0.7, indicating that the scale has acceptable temporal reliability and produces reasonably consistent results across repeated administrations.

3.3. Factorial Validity

3.3.1. CFS: Exploratory Factor Analysis (EFA) and Scale Reduction

Our analysis confirmed this sampling size to be adequate for factor analysis. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.70 and Bartlett’s test of sphericity was significant (p < 0.001).

Initially, principal component analysis was conducted on the 26 items of the Cognitive Flexibility scale to identify the optimal number of factors to parsimoniously explain the order and structure of items in the scale. Three factors with an eigenvalue greater than 1.0 (Kaiser, 1960) were retained. Solutions for one, two or three factors were examined using principal axis factoring of the factor loading matrix. A total of 55.15% of the variance was explained by a 3-factor solution. To further identify potential meaningful factors the scree plot was examined. Inspection of Cattell’s scree test (i.e., levelling off of eigenvalues after an “elbow”) supported the appropriateness of a-3 factor solution. For each factor extracted, only individual items with primary loadings at 0.4 or more and no cross-loadings at 0.3 and above were retained. Items with factor loadings of .30 and above were considered for retention, provided they were theoretically meaningful and demonstrated satisfactory psychometric properties. The internal consistency of the scale was estimated using Cronbach’s alpha coefficient. Cronbach’s alpha equal to or greater than 0.70 was considered satisfactory.

Table 4 presents the factor loadings for the 26-item Cognitive Flexibility Scale after Exploratory Factor Analysis using the principal axis factoring extraction method. The analysis identified a clear three- factor structure, with all 26 items loading significantly onto their respective factors.

Review of factor loadings of items on Factor 1 indicates that it refers to an individual's ability to think rationally, explore alternative approaches, manage responsibilities, make adaptive decisions, and regulate behavior while responding to changing personal and academic demands. Factor 2 includes an individual's capacity to adjust thoughts and behaviors in social situations, understand diverse perspectives, maintain interpersonal relationships, communicate effectively, and adapt to social expectations and group dynamics. Factor 3 refers to an individual's ability to reflect on experiences, regulate emotions, cope with stress, learn from feedback, and generate multiple solutions when faced with personal, social, or academic challenges.

The factors have hence been named as:

- Adaptive Problem-Solving and Self-Regulation (Factor 1): 9 items.
- Social Adaptability and Interpersonal Flexibility (Factor 2): 9 items.
- Reflective Problem-Solving and Emotional Adaptability (Factor 3): 8 items.

Table 4. The final results for EFA.

Items No.	Statements	Factor loadings		
		Factor 1	Factor 2	Factor 3
1	I often feel shy or hesitant about doing what I truly want to do. (Reverse scored)			0.46
2	I actively seek new opportunities to enhance my learning and skills.	0.402		
3	When I am assigned an important responsibility, I create a to-do list to manage the task and reduce stress.	0.489		
4	I am capable of resolving behavioural issues while managing a class.			0.516
5	When working on an important project, I can decline social invitations because my priorities are clear to me.		0.576	
6	When I feel stressed, I can analyse the situation to identify the causes of my stress.			0.302
8	In situations of conflict, I can think of multiple ways to resolve the issue.			0.369
9	After reacting to my parents in anger, I reflect on my behaviour and evaluate my response.			0.382
10	I can refresh and motivate myself when I need a break from routine activities.			0.434
11	I often explore creative ways to make my work more interesting and innovative.	0.515		
12	I usually think logically before making a decision.	0.654		
13	I find it difficult to express my views when I am among strangers. (Reverse scored)		0.474	
14	I find it difficult to remain comfortable when someone makes a joke about me.	0.568		
16	I make an effort to spend quality time with my parents to strengthen our relationship.		0.416	
17	I prefer adjusting my plans rather than strictly following a pre-scheduled plan.	0.408		
19	I find it difficult to work according to my parents' expectations. (Reverse scored)		0.428	
20	If a friend has difficulty communicating or understanding something, I try different ways of explaining it to help them understand.		0.488	
21	If I realize that my hands need washing while waiting for my turn in a declamation contest, I would request permission to wash them before speaking, even if my name has already been called.	0.514		
22	When a classmate bothers or distracts me during class, I find it difficult to think of different ways to handle the situation. (Reverse scored)	0.393		
23	Material possessions alone are not the true source of happiness.		0.488	
24	I become nervous while crossing the road and tend to rush. (Reverse scored)			0.436
25	Tasks should generally be started and completed according to the assigned schedule.		0.541	
27	Teachers should pay attention to the individual needs of every student.		0.58	
29	I feel upset when decisions about group activities are made without consulting me.		0.466	
30	I find it difficult to overcome negative feelings toward relatives who remind me of unpleasant childhood experiences. (Reverse scored)			0.526
31	I may avoid revealing the real reason for an incomplete assignment to protect my reputation. (Reverse scored)	0.5		

Note: Extraction method: Principal axis factoring; rotation method: Varimax.

4. Discussion

The study described in this paper aimed to develop a culturally appropriate measure of cognitive flexibility for adolescents, resulting in 26-item scale comprising three subscales, which would enable educational institutes to reliably and validly assess the cognitive flexibility of the students.

Traditionally, performance-based and laboratory tasks have been used primarily to measure cognitive flexibility. These measures have been assessing individuals’ ability to shift between mental sets, rules or perspectives. These approaches that focus primarily on cognitive processes, have treated it as an isolated executive function and ignored the social and emotional context in which the flexibility is practiced in daily life. The present scale incorporates behavioural, social and emotional aspects of cognitive flexibility, thereby providing a more comprehensive assessment of the construct. This multidimensional approach holds relevance in contemporary educational contexts, where students are expected to demonstrate adaptability, resilience, problem-solving, and effective interpersonal functioning. This has been recognized as a functional skill manifested in the way adolescents adapt their behaviours across situation, negotiate social relationships and regulate emotional responses to change and ambiguity. It also provides an ecologically valid representation to cognitive flexibility rather than reducing it to a performance on decontextualized tasks.

In present times, adolescents are expected to demonstrate adaptability, resilience, problem-solving ability and effective interpersonal functioning besides academic competence. The modern education ecosystem is based on evolving curricula, collaborative and project-based learning models and heightened social complexity. All of these require more than static cognitive skills. They expect students to adjust their thinking, behaviour and emotional responses to changing circumstances. This tool offers educationists and psychologists a practically useful approach to understanding the struggles of adolescents to meet the demands of adaptive learning environments.

The emergence of three subscales suggests that adolescents may exhibit varying degrees of flexibility across these domains. The students may demonstrate stronger cognitive adaptability in academic problem solving while showing lower flexibility in social or emotional domains or vice versa. This allows practitioners to move beyond a

single global flexibility score towards a more comprehensive profile of a student's strengths and areas requiring support. By grounding item development in the lived context of the target adolescent population, the resulting scale is positioned to offer stronger content and construct validity for use within this population than adapted versions.

5. Limitations

The administration of the cognitive flexibility scale was challenging initially, as respondents often struggled to distinguish their actual behaviour and their perceived ability to respond in hypothetical situations. To address these concerns, the wording of several items was refined and administration guidelines were developed to promote consistency in data collection and improve respondents' understanding of the statements.

Further, although the scale demonstrated satisfactory psychometric properties, a few items exhibited moderate factor loadings. These items were retained because of their theoretical relevance and contribution to the content coverage of the construct. Further studies may examine the performance of these items across diverse samples and educational contexts to determine whether additional refinement is needed.

Another limitation relates to the use of self-report responses, which may be influenced by social desirability, self-perception biases and respondents' willingness to provide accurate information. Cognitive flexibility being a complex and multi-dimensional construct, future research may benefit from incorporating multiple assessment approaches.

The present study relied primarily on Exploratory Factor Analysis to establish the underlying structure of the scale. Though the three-factor solution is theoretically and statistically supported, Confirmatory Factor Analysis was not conducted. Further research is required to validate the proposed factor structure and establish the stability of the dimensions across different populations. Future investigations should also examine convergent, discriminant and predictive validity to strengthen the psychometric evidence for the cognitive flexibility scale and enhance its applicability in educational and psychological settings.

6. Conclusions

This study describes the development and properties of a culturally appropriate measure of cognitive flexibility amongst the students. The 26-item cognitive flexibility scale consists of three subscales, all of which showed good internal consistency. The availability and use of this measure will support the design and evaluation of interventions aimed at enhancing problem-solving, adaptability and socio-emotional competencies among the students.

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