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Learners Cognitive Skills Test: A Culturally Relevant Assessment Development and Validation for Early Childhood Education

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Abstract

Background: Recognition of cognitive abilities among young learners should be done early in life so that school preparation and specific intervention can be enhanced. Nevertheless, most of the available evaluation instruments are imported and might not be culturally fit in the environment of Pakistani students and societies.

Purpose: This research was selected to create and test the Learners Cognitive Skills Test; LCST, which is a culturally competent tool to measure attention, perception, memory, learning language, and problem solving in young learners.

Procedure: LCST was used in 70 children aged between 9 and 10 years; they were in a government school. The contents of the test were based on the SNC to meet the objectives of this study. Validity was achieved by reviewing of SLOs by experts and giving weight to the SLOs and the content. The content validity index and ratio were used to assess construct validity basing on expert ratings. Further evaluation of content validity was done by conducting item analysis, such as item difficulty, discrimination index and point-biseral Pearson correlation. The reliability was established by test-retest stability and internal consistency and Cronbach alpha was taken to be reliability coefficient.

Findings: The LCST showed good content validity (CVI = 0.848) and five factor frameworks in accordance with the desired cognitive abilities. Out of the 50 items, item-37 expressed the highest point-biserial correlation and significantly predicted overall performance in simple regression (p value = .001) hence represented best as an item. The test-retest reliability was also a high internal consistency (Cronbach alpha = 0.86).

Conclusion: LCST is a psycho-metrically sound and culturally suitable instrument that can measure the cognitive abilities of young learners in the governmental sector. Its application can be utilized in teaching planning, early interventions and developmental tracking over time.

Keywords: Early childhood assessment, cognitive skills, test validation, content validity, construct validity, reliability, cultural relevance

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Introduction

Cognitive skills are basic mental capabilities which enable individuals to manipulate information, learn, memorize, resolve problems and concentrate attention (Anderson, 2010). These cognitive abilities form the basis of children learning preparedness and their future

academic success in the form of attention, perception, memory, language acquisition, and problem-solving (Diamond, A. 2013).These skills develop very fast in early childhood and are interconnected with sensory experiences (sight, hearing, tactile sense, smell, taste) which are all components of cognitive skills that predetermine the channels of learning and development in children (Blair and Raver, 2015). They are acquired at a fast rate during their early years and timely evaluation enables educators to find strengths, identify possible learning delays and offer specific intervention (Snow, C. E., & Van Hemel, S. B. (Eds.). 2008).

The culturally adapted tools are important in early childhood because in this stage of development, the tools have the capability of capturing variations of how young learners interact with language, memory, attention and problem solving in their own environment (McBride-Chang and Kail, 2002). It is based on the existing theories of cognitive development, uses culturally specific materials and language to increase accuracy and involvement in the assessment (Piaget, J. 1972; Vygotsky, L. S. 1978). Such cultural misfit may lead to false results and treatment choices that fail to meet the actual requirements of children (Van de Vijver and Tanzer, 2004; Peña, 2007).

The recent studies have highlighted the value of culturally relevant testing, where the language, experiences, as well as the socio-cultural background of the children to be assessed are taken into account to provide valid and useful assessment (Liu et al., 2019; Peña, 2007).

These tests assist the teachers and psychologists not to be culturally prejudiced and more accurately define the real strengths of children and their weaknesses to support (van de Vijver, 2017).

This paper presents the Learners Cognitive Skills Test (LCST) which is a culturally relevant test that is created to measure the early learners, and it is created so as to fill this gap and accuracy of measurement. Based on the theories of Piaget and Vygotsky on development, the LCST takes into consideration the necessity to identify the cognitive skills in early childhood to facilitate school readiness and interventions. The content validity, construct validity and reliability of LCST are outlined in this paper in the context of how the LCST was developed and validated.

Both male and female early learners in government schools in Punjab, Pakistan were considered the target population of this study. The selected area of research is District Rahim Yar Khan, which was selected after obtaining official authorization of the Chief Executive Officer (CEO) of education to conduct the experiment. There were 200 learners in the chosen institution who were officially enrolled in the pre- primary level first. Out of this population, seventy students were selected as a sample of the study population.

2 Method

2.1 Participants

To validate the Learners Cognitive Skills Test (LCST), 70 children including thirty boys and forty girls aged between nine and ten years old were taken as a sample. The respondents were sampled in schools of early childhood education in District Rahim Yar Khan, Punjab. Efforts were conducted to maintain diversity in the sample with children having different socioeconomic statuses and language. This heterogeneity was able to give a greater avenue on which the validity and applicability of the instrument in various groups of learners can be assessed.

2.2 Sample participants

For the validation of the Learners' Cognitive Skills Test (LCST), a sample of 70 children was selected, comprising thirty males and forty females between the ages of nine and ten years. The participants were recruited from early childhood education schools in District Rahim Yar Khan, Punjab. Efforts were made to ensure diversity within the sample, with children representing varied socioeconomic statuses and linguistic backgrounds. This heterogeneity provided a more comprehensive basis for evaluating the applicability and validity of the instrument across different learner groups.

2.3 Feasibility Test

A group of twenty professionals in the field of Early Childhood Education (ECE) was consulted to help in the instrument development and validation process. These professionals were involved in test item review because the items had to comply with the stipulated curriculum, their developmental suitability among young learners, and the use of easy language.

They were asked to provide feedback on the instrument in order to measure different issues such as content coverage, relevancy of student learning outcomes (SLOs), and precision of gauging the desired cognitive skills. Moreover, the professionals helped in developing various types of validity like face validity, content validity, and construct validity, which provided a better degree of reliability and credibility of the Learners Cognitive Skills Test (LCST).

2.4 Instrument Development

The Learners Cognitive Skills Test (LCST) was created in terms of the cognitive domains and cognitive development principles discussed by Bloom in his theory, Plowden Report and the Vygotsky theory of early learning. The LCST includes fifty questions, which are distributed into five sub-scales, i.e. attention, memory, language learning, and problem-solving. The development of the items was guided by the literature review, curriculum analysis, and consultation with the early childhood educators. To enhance the contextual relevance, culturally familiar objects, pictures, and situations were used.

The content of the test was based on English and Mathematics Student Learning Outcomes (SLOs) of the revised Grade One course under Single National Curriculum (SNC) in Punjab to be used in 20232024. There are fifty multiple-choice items that make up the LCST, each of which correlates with a particular cognitive skill of attention, perception, memory, language acquisition, and problem-solving. To guarantee a broad coverage of the content, a table of specifications was developed that provides the test with a sense of validity.

Table-1 Table of Specification

Basic. LCST SLOs of Subjects	Units	Attention	Perception	Memory	Languge Learning	Problem Solving	Total SLOs	Units Wise %	Program Wise %
English	Cobbler, Cobbler	3	3	3	3	3	15	20%	
	Sharing & Caring	3	3	3	3	3	15	20%	
	Classroom Manners	3	3	3	3	3	15	20%	60%
Math	Number Operation	3	3	3	3	3	15	20%	
	M &Time	3	3	3	3	3	15	20%	40%
Total SLOs		15	15	15	15	15	75	100%	100%
W. of SLOs		20 %	20%	20%	20%	20%	100%		

2.4.1 Subject-Wise Marks Distribution

The Learners Cognitive Skills Test (LCST) had the marks distributed between English and Mathematics to make the assessment of the abilities of the Grade One learners balanced. The tests had a total of fifty marks with English scoring thirty (60%) and Mathematics scoring twenty (40%). All cognitive skills were given 20 percent of the overall marks and helped to assess the cognitive development in a full picture. An accompanying table shows the organized arrangement of the marks in the subjects, units and cognitive skill areas.

English was given sixty percent of the marks and related to the competencies of reading, critical thinking, language focus and writing skills.

The rest forty percent was given to Mathematics with emphasis laid on the operations with numbers, problem solving and foundation mathematical concepts suitable to learners in early ages.

Table-2 LCST Subject-Wise Marks Distribution

Subjects	Units	Attention	Perception	Memory	Language Learning	Problem Solving	Total Marks	Units Wise %	Program Wise %
English	Cobbler, Cobbler	2	2	2	2	2	10	20%	
	Sharing & caring	2	2	2	2	2	10	20%	
	Classroom Manners	2	2	2	2	2	10	20%	60%
Math	Numbers	2	2	2	2	2	10	20%	
	M & Time	2	2	2	2	2	10	20%	40%
Total Marks		10	10	10	10	10	50	100%	100%
% of Each Cognitive Skill		20%	20%	20%	20%	20%	100%		

The distribution of marks of the Learners Cognitive Skills Test (LCST) figure marked the focus of the curriculum on two major subject areas.

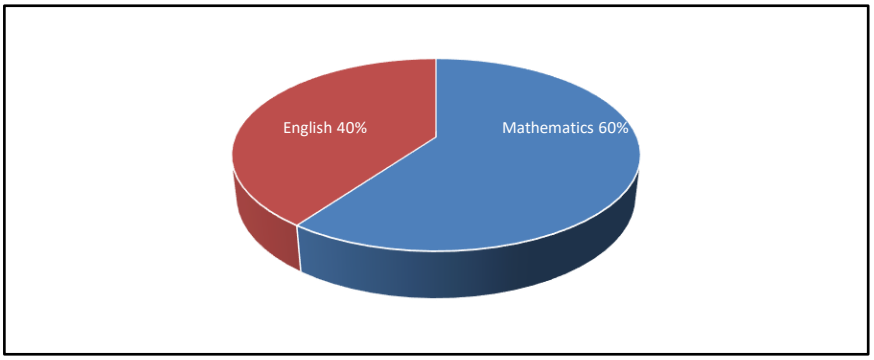

Figure: Marks Distribution for English and Mathematics Programs in LCST

2.4.2 Unit-Wise Marks Distribution

The figure below shows the distribution of marks each of the units included in the final Learners Cognitive Skills Test (LCST).

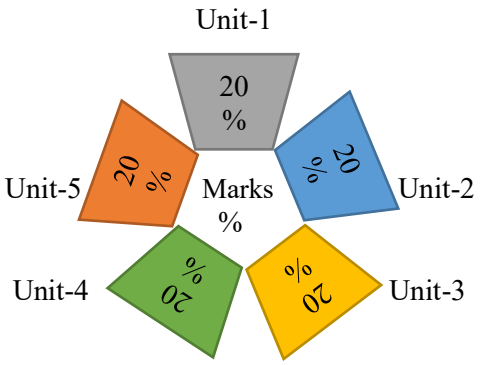

Figure: Allocation of Marks for Each Unit of LCST

2.4.3 Cognitive Skills Marks Distribution

Mark was distributed more or less in all cognitive skills. In particular, each of the domains, attention, perception, memory, language learning, and problem-solving was assigned 20 per cent of the total marks. This even mixing provided a proportional assessment of cognitive learning abilities of the learners at the early childhood education level (Woolfolk-Hoy, 2012; Gallahue et al., 2012; McDevitt and Ormrod, 2004; Dovve et al., 2021; Sahin, 2009; Zhong et al., 2010).

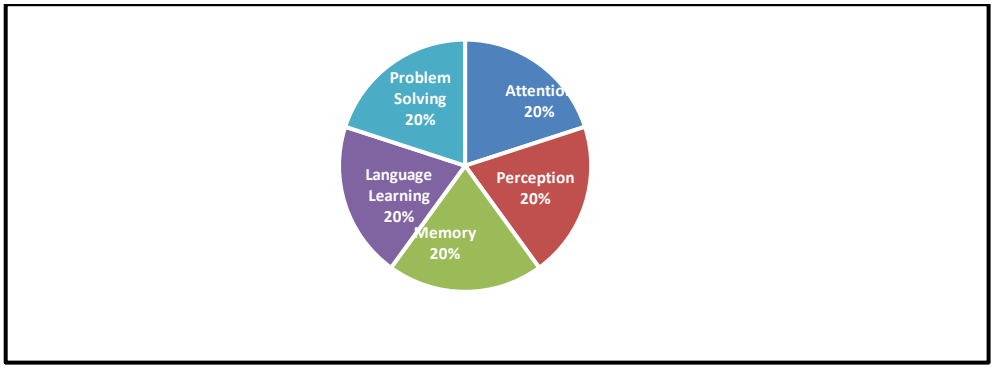

Figure: Marks Allocated for Each Basic Learners' Cognitive Skills

2.5 Content Valediction of LCST

Establishing test validity is essential, as a test holds little value without it. Overall validity improves when test items are carefully evaluated (Odukoya et al., 2018).

Table-3 Comparison of Validity

Components	Researchers	Techniques
Construct Validity	Engellant et al. (2016); Taherdoost (2016), Choudhary & Tyagi (2017)	CVR, CVI based on expert review, Allocating appropriate weightage/percentage to SLOs and content
Face Validity	Engellant et al. (2016); Taherdoost (2016), Choudhary & Tyagi (2017)	Expert review, Allocating appropriate weightage/percentage to SLOs and content
Content Validity	Engellant et al. (2016); Taherdoost (2016)	Item analysis
Criterion Validity	Engellant et al. (2016); Taherdoost (2016)	Discrimination analysis

(Adapted from Aulia et al., 2014)

2.4.1 Construct Validity

A Construct is an abstract concept, such as cognitive or leadership ability, that reflects complex traits that cannot be directly observed but can be measured through well-designed tests. An expert panel of twenty early childhood educators, subject specialists, and item developers reviewed the items for clarity, relevance, and cultural appropriateness. Construct validity was established through evaluation by a panel of 20 early childhood education experts (Taherdoost, 2016). Using the construct validity method, each item of the test was rated as essential on to calculate the Content Validity Index and Content Validity Ratio (Allahyari et al. & Lawshe's, 1975). All items meet the acceptable range of recommended CVI, CVR threshold of 0.90 good construct validity index by (Polit & Beck and Waltz et al. 2010).

I-CVI= Essentials\T. Experts, S-CVI= Sum of I-CVI\T. Items

CVR= (ne−2N) \ (N/2),
Ne = “essential”
N = total number of experts

2.4.3 Content Validity

Content validity is the extent to which a test fully represents the construct or behavior it is intended to measure. (Mohamad et al., 2015). Content validity was examined through item analysis of the 50 test items administered to 70 students. Item difficulty was calculated as the proportion of correct responses per item, with acceptable values ranging from 0.30 to 0.80. Item discrimination was determined via upper-lover method and using the point-biserial correlation coefficient, comparing the performance of high- and low-achieving groups. Items with discrimination indices below 0.20 or extreme difficulty values were revised or removed. Such analysis was done to make sure that the items retained had the ability to distinguish between different levels of ability and thus content validity of the instrument was supported (Kelley, 1939).

2.5 Item Analysis of Learners’ Cognitive Skills Test (LCST)

The quality and effectiveness of the test items in the Learners Cognitive Skills Test (LCST) was done through item analysis. The SPSS Version 24 was used to compute various statistical values such as the difficulty index as a proportion of correct items, Discrimination Index, point- biserial correlation coefficient, Regression, Cronbach’s Alpha, Standard Deviation, Skewness, and Kurtosis, Standard error of the measured (SEM), Mean Proportion (p), and Mean Biserial. These statistics offered information on the validity, reliability and the general quality of test items.

2.5.1 Item Difficulty Index

The difficulty level classifies test items to five levels namely; very difficult, difficult, moderate, easy and very easy. In the case of the Learners Cognitive Skills Test (LCST) the proportion (p) or percentage of correct responses was determined in respect to each item. This index is used to show the percentage of learners who were able to respond to an item correctly hence giving the level of difficulty of the item. Those that were on extreme ends of the scale (very difficult or very easy) were counted as to be revised or discarded in order to enhance overall quality and reliability of the test (Kelley, 1939).

The level of difficulty of an item is calculated in the following formula:

Difficulty Level= No Correct Responses\T. N of Responses

Table-4 Difficulty Level (p)

Quality Level	Proportion Correct (p)	Status of Items	Remarks
Very Difficult	0.00 – 0.20	Need complete revision / Drop out	Items too difficult for learners
Difficult	0.21 – 0.40	Revision	Require modification for clarity/content
Moderate	0.41 – 0.60	Good	Acceptable items with balanced difficulty
Easy	0.61 – 0.80	Revision	May need adjustment to increase rigor
Very Easy	0.81 – 1.00	Need complete revision / Drop out	Items too simple for learners

(Adapted from Aulia et al., 2014)

2.5.2 Item Discrimination (Upper–Lower Method)

The upper lower 27 percent Kelley test was the measure of item discrimination. In this approach, participants were first ranked according to their total test scores (excluding the target item to avoid part–whole bias). The highest-scoring 27% of participants were classified as the upper group, while the lowest-scoring 27% formed the lower group. For each item, the proportion of correct responses was calculated separately for the upper group (pH) and the lower group (pL). The item discrimination index (D) was then computed as:

$$D = pH - pL$$

A higher value of D indicates that the item effectively distinguishes between high- and low-performing participants. Items with $D \geq 0.40$ were considered excellent, values between 0.30 and 0.39 were regarded as good, values between 0.20 and 0.29 were marginal, and items with $D < 0.20$ or negative values were considered weak or problematic and thus candidates for revision or removal. This method provided evidence on the discriminating power of each of the 50 test items among the 70 participants (Kelley, 1939).

Table-5 Item Discrimination Index Criteria

Quality Level	Range	Discrimination Status	Remarks
Zero	0.00	No Discrimination	Drop out
Poor	0.00 – 0.19	Weak Item	Drop out
Marginal	0.20 – 0.29	Marginally Good	Retain with caution/ minor revision
Good	0.30 – 0.39	Good Item	Retain
Excellent	≥ 0.40	Excellent Item	Retain

(Adapted from Kolte, 2015)

2.5.3 Point-Biserial Correlation Coefficient

The point-biserial coefficient indicates the degree to which an item discriminates between high- and low-performing participants and popularized its use in psychometric and test analysis (Gulliksen, 1950). The point-biserial correlation coefficient was employed in the present study to assess the relationship between participants' performance on each test item and their overall performance on the test. The statistic is a special form of Pearson product moment correlation, made to be used in the case where one of the variables is dichotomous and the other is continuous. In this study, each of the 50, test items were scored dichotomously (0 = incorrect response, 1 = correct response), while the total test score, obtained by summing all items, was treated as a continuous variable introduced the mathematical foundation by Karl Pearson (1909).

Table-6 Point-Biserial Criteria

Quality Level	Point-Biserial Value	Status of Item	Remarks
Weak	≤ 0.199	Poor Item	Needs complete revision / Drop out
Acceptable	0.200 – 0.299	Acceptable	Retain with caution
Strong	0.300 – 0.399	Strong Item	Retain
Very Strong	≥ 0.400	Very Strong	Retain

(Adapted from Aulia et al., 2014)

2.6 Reliability Testing

The alpha coefficient shows the consistency of a test and it aids in distinguishing low, moderate, and high levels of consistency. A test that is very reliable will give consistent and stable measurements of how much the scores of students show some relative meaning in different conditions and situations. The Cronbach alpha was used to measure the internal consistency of the sub-scale and the entire instrument (Aulia et al., 2014).

As part of the ANOVA model, Fisher (1925) has defined the Intraclass Correlation Coefficient (ICC) as the percentage of between-group variance to the overall variance to determine how well individuals in the same group are similar to those in different groups. Reliability was checked by giving the LCST to a subset of participants' n = 50 again after four weeks and then the intraclass correlation coefficient (ICC) is computed. To test the reliability of the scores between raters/measurements, SPSS was used to calculate the intraclass correlation coefficient (ICC).

3. Data Analysis

Data analysis in this research was performed in Statistical Package of the Social Sciences (SPSS) and the main aim of the research was to establish the validity and reliability of the Learners Cognitive Skills Test (LCST). In order to make sure that there was validity, several strategies were used. The content validity is studied by way of item analysis. Regression analysis was done to ascertain the best predictors of the test items.

3.1 Experts Review Statistics

The expert review and the content validity index (I-CVI) and content validity ratio (CVR) were used to estimate the construct validity and content validity.

Table-7 Construct Validity Statistics

No of Panelists	No. of Items	I-CVI Range	CVR Range	Cut-off Value	Decision
20	1	0.95	0.90	0.50	Accepted
20	14	0.90	0.80	0.50	Accepted
20	17	0.85	0.70	0.50	Accepted
20	18	0.80	0.60	0.50	Accepted
Total	50		Sum of I-CVI = 42.4/50 S-CVI = 0.848		All Accepted

Detailed CVI-CVR values for each item are presented in Appendix 1

3.2 Item Analysis

Content validity was examined through item analysis. The difficulty index through proportion of correct and discrimination index via upper-lower Method, and point biserial correlation coefficient.

Table-8 Item-wise Test Statistics

Item No.	Prop. Correct	Disc. Index	Point-Biserial	Based on Difficulty	Based on Disc. Index	Based on Point-Biserial	Status/ Remarks
1	0.80	0.27	0.261	Very Easy	Marginal Good	Acceptable	Need Revision
2	0.75	0.50	0.507	Easy	Excellent	Very Strong	Retained
3	0.66	0.44	0.283	Easy	Excellent	Acceptable	Retained

Item No.	Prop. Correct	Disc. Index	Point-Biserial	Based on Difficulty	Based on Disc. Index	Based on Point-Biserial	Status/ Remarks
4	0.66	0.55	0.468	Easy	Excellent	Very Strong	Retained
5	0.58	0.50	0.467	Moderate	Excellent	Very Strong	Retained
6	0.47	0.50	0.371	Moderate	Excellent	Strong	Retained
7	0.58	0.61	0.455	Moderate	Excellent	Very Strong	Retained
8	0.52	0.61	0.539	Moderate	Excellent	Very Strong	Retained
9	0.50	0.66	0.585	Moderate	Excellent	Very Strong	Retained
10	0.58	0.61	0.490	Moderate	Excellent	Very Strong	Retained

Note:Detailed item-wise statistics are presented in Appendix B.

3.3 Regression Analysis

Regression analysis was processed for question 37, which emerged as the most significant predictor and showed the highest statistical contribution in explaining variance in learners' scores.

Table-9 Regression Statistics Coefficients

Variable	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%
Intercept	25.581	1.457	17.553	5.91E-27	22.673	28.489
Q31	11.958	1.952	6.124	0.000	8.062	15.854

3.4 Reliability Analysis

Reliability was determined through the reliability tool test–retest. In the context of this study, Interclass correlation coefficient was applied to compare groups and assess whether the LCST produced consistent results across different sets of learners. A Cronbach's alpha of 0.86, well above the 0.7 to 0.9 benchmark suggested for quantitative measures, indicates early identification of cognitive skills in young learners is essential for supporting school readiness and targeted interventions. Nevertheless, most of the available assessment instruments are imported and might not be conforming to the cultural aspects of the learners in the Pakistani schools and societies.

4. Results

1- Face validity of the Cognitive Skills Test of Learners was maintained by giving the test items to be reviewed by the experts. The professionals revised the items in terms of clarity, relevance, appropriateness, and lack of ambiguity to the content of the test. Their feedback was taken into consideration to adjust the wording, structure and level of difficulty of the items to suit them to be culturally suitable and relevant to Grade One learner.

This procedure established that the LCST emerged to be an appropriate measure of the targeted cognitive skills and was appropriate to administer in the early childhood education setting.

Content Validity Index (CVI) and Content Validity Ratio (CVR) had been used to determine construct validity of the Learners Cognitive Skills Test (LCST) on the basis of the review of the test items by experts. The items with a high I-CVI value of 0.95 to 0.80 and scale constituting the critical value of 0.50 and above and the I-CVI values of 0.80 exceeded the desirable limit of 0.80, which indicates that there was a strong consensus among the experts about the sufficiency of the items. The LCST was found significantly valid in content (S-CVI Ave = 0.848) and a five-factor framework that reflected the desired cognitive skills. Everything was accepted and held on.

Equally, values of the CVR at, 0.90 t0 0.60 indicated that most items were considered to be important by the panel of experts hence validity of the test in measuring the focus constructs. These results offer an indication that the LCST is a culturally relevant and

psycho-metrically valid instrument of measuring the cognitive abilities of learners during the early childhood education level.

2- LCST item analysis was done to establish its content validity so that every item used in the test was able to measure the intended. The given statistics help in the evidence about the validity, reliability, and the general quality of the test items. Following the analysis of fifty items and the calculation of the item difficulty, discrimination and point biserial correlation, the best twenty- five MCQs were selected, giving the excellent results of 0.86 Cronachs alpha which is far much better than the 0.7 to 0.9 standard that should be applied to quantitative measures and thus the high level of reliability was achieved (Tavakol and Dennick, 2011).

3- Of the 50 items, item-37 had the most point-biserial correlation with the total score ($r = .596$) and was significant to overall performance in simple regression ($p < .001$), hence it is the best representative item. The p-value was associated with it was.001, which proved its high level of statistical significance. It was found that the standardized results showed a very significant effect as compared to the other items. The item-37 was a good discriminant and predictive item and therefore it was the most valid indicator of the cognitive skills test of the learners.

4- Discrimination analysis was used to determine the Criterion predictive validity of the Learners Cognitive Skills Test. This exercise affirmed that the LCST is not only associated with the cognitive abilities of the targeted learners but also a strong indicator of the future performance of learners. Therefore, analysis of discrimination offered strong information of the criterion predictive validity of the test. The item-37 was not only a good measure of the intended construct but it also was a criterion-predictive valid item which displayed a high ability to predict overall performance more accurately compared to other items on the test. The finalized LCST was then updated to be used in the pretest and post-test study.

5- Alpha of the Cronbach was determined as ICC= 0.86, which shows a high degree of excellent reliability to test the cognitive skills of learners. In the case of the LCST, the data that had been generated by the means of the ICC reliability analysis indicated that the test scores outcomes were highly consistent between the groups of early learners, which is, in other words, the fact that the test tool was stable, dependable, and could produce similar results in a different classroom or cultural setting. This helps in the generalizability of the test in the sense that it is not biased to a particular group of learners and the test is able to measure the cognitive skills fairly across the different participants.

6- The outcome of the validity and reliability test gives a solid argument in the fact that the LCST is a culturally sensitive, psychometrically competent, and effective instrument to measure the cognitive ability of early learners.

5 Discussion

This article created and confirmed the Learners Cognitive skills Test (LCST) as a culturally competent test to measure utmost abilities of cognitive skills in young learners. The high content validity highlights the significance of having an expert-review of the assessment tools in preparation of context-specific content.

The theoretical framework that the LCST is based on is supported by the five-factor structure which is consistent with literature on the multidimensional nature of cognitive development in early childhood (Jean Piaget, 18961980).

The measures of reliability suggest that LCST offers consistent and stable results, which are appropriate in the research and practice. There were no gender differences as it has been observed in the existing literature indicating that environmental and educational experiences have a stronger influence on early cognitive development than biological sex (Maria Montessori, 18701952). The developmental theories are supported by the age-related differences which emphasize that cognitive development is rapid in preschool and early primary years.

The current research sought to prove a new Learning Cognitive Skills Test that had 50 dichotomously rated questions that were done on 70 early learners. To conduct a multi- step validation process, content validation, item analysis, point-biserial correlations and regression analysis to verify that the instrument is theoretically sound and psychometrically sound was used.

The initial validation of content was done by the level of review of the experts. A set of subject-matter experts rated every item based on its essentiality, clarity, and relevance to the construct of cognitive skills in a letter-school learner using the Content Validity Ratio (CVR) and Content Validity Index (CVI). The total CVR and CVI scores were beyond the acceptable levels showing that the items were in line with the theoretical definition of cognitive skills and represented the content area sufficiently.

Item analysis also helped to support construct validity. The difficulty index indicated that the majority of items were in the recommended moderate range which implies that they were not very easy or difficult to the target group of learners. The results showed that most items were discriminatory because the discrimination indices were calculated using the upper-lower 27% technique and backed by the point-biserial correlations. The results were sorted this way indicating that the items are performing in the right direction and assessing different levels of the intended construct. The point-biserial correlation was run on each item connecting dichotomous responses (0 = incorrect, 1 = correct) to the overall test score. Items that contained greater point-biserial values were stronger in discrimination, that is, the better it was in identifying learners with higher cognitive levels of skills.

The findings showed that some of the items attained high levels of correlation thus supporting the construct validity of the test. To have more insight into the predictive ability of individual items, regression analysis was performed. Item 37 was the most correlated with the overall test score and statistically significant predictor of total performance ($p < .001$). This implies that the Item 37 represents a very vital aspect of performance of cognitive skills among learners and is very significant in the scale structure. The combination of the findings gives the Learners Cognitive Skills Test validity evidence.

Expert judgment provided good content validity whereas the item analysis, point-biserial correlations and regression provided evidence on construct validity. This is in line with the current psychometric practice where validity is discussed as a composite construct that is provided by a wide range of evidence. All in all, the findings demonstrate that the test is theoretically based and empirically valid, which enables using it as a valid tool of measuring the cognitive abilities of early learners.

6 Conclusion

The current research paper presented and tested the Learners Cognitive Skills Test (LCST) which is a 50-item test that evaluates cognitive skills in early learners. The instrument showed high psychometric qualities using a systematic validation procedure. Expert ratings by use of CVR and CVI revealed that the items were a sufficient measure of the construct of cognitive skills and hence there was content validity. The analysis of items also helped to prove that the construct validity was acceptable as most of the items were characterized by adequate difficulty and high discrimination index. The use of point-biserial correlations revealed that items served well to differentiate higher and lower performing learners, whereas the use of regression analysis provided important items that go a long way in determining the overall performance of a test.

Put collectively, these results can give significant evidence that the LCST is theoretically sound and empirically strong.

The instrument may be viewed as a valid instrument in measuring cognitive abilities among young learners, and may be used in the educational assessment, instructional planning and study into development in early childhood. In general, the LCST could be regarded as a valid instrument to evaluate the cognitive skills of early learners and is prospective to be applied to

the educational research and practice.

The LCST is a structured and validated instrument of cognitive skills measurement in early learners, which offers numerous opportunities of future research. Its use can be longitudinal research to study the cognitive development over time, intervention research to study the effects of teaching methods, and cross-cultural research to study variations in the patterns of learning among different populations. The tool can also inform curriculum planning and instructional design as it can identify certain areas where the learners require support. The LCST has a potential as a normative measure in research, assessment, and policy making in early childhood education with additional confirmation in larger and more diverse samples.

It is suggested that future research employing more extensive and more varied samples will serve to further improve the scale and enhance its applicability to any other setting. It might determine how the test is applicable to the special need's population and how predictive the test is on future academic success.

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Appendix-A

Learners' Cognitive Skills Test (LCST) – Item-wise Content Validity Ratio (CVR)(Based on Lawshe, 1975; Allahyari et al., 2011)

Table-7

Item	No. Panelists	No. Essential Ratings	I-CVI	CVR	Cut-off Value	Decision
1	20	19	0.95	0.90	0.50	Accepted
2	20	18	0.90	0.80	0.50	Accepted
3	20	18	0.90	0.80	0.50	Accepted
4	20	18	0.90	0.80	0.50	Accepted
5	20	18	0.90	0.80	0.50	Accepted
6	20	18	0.90	0.80	0.50	Accepted
7	20	18	0.90	0.80	0.50	Accepted
8	20	18	0.90	0.80	0.50	Accepted
9	20	18	0.90	0.80	0.50	Accepted
10	20	18	0.90	0.80	0.50	Accepted
11	20	18	0.90	0.80	0.50	Accepted
12	20	18	0.90	0.80	0.50	Accepted
13	20	18	0.90	0.80	0.50	Accepted
14	20	18	0.90	0.80	0.50	Accepted
15	20	18	0.90	0.80	0.50	Accepted
16	20	17	0.85	0.70	0.50	Accepted
17	20	17	0.85	0.70	0.50	Accepted
18	20	17	0.85	0.70	0.50	Accepted
19	20	17	0.85	0.70	0.50	Accepted
20	20	17	0.85	0.70	0.50	Accepted
21	20	17	0.85	0.70	0.50	Accepted
22	20	17	0.85	0.70	0.50	Accepted
23	20	17	0.85	0.70	0.50	Accepted
24	20	17	0.85	0.70	0.50	Accepted
25	20	17	0.85	0.70	0.50	Accepted
26	20	17	0.85	0.70	0.50	Accepted
27	20	17	0.85	0.70	0.50	Accepted
28	20	17	0.85	0.70	0.50	Accepted
29	20	17	0.85	0.70	0.50	Accepted
30	20	17	0.85	0.70	0.50	Accepted
31	20	17	0.85	0.70	0.50	Accepted
32	20	17	0.85	0.70	0.50	Accepted
33	20	16	0.80	0.60	0.50	Accepted
34	20	16	0.80	0.60	0.50	Accepted
35	20	16	0.80	0.60	0.50	Accepted
36	20	16	0.80	0.60	0.50	Accepted
37	20	16	0.80	0.60	0.50	Accepted
38	20	16	0.80	0.60	0.50	Accepted

39	20	16	0.80	0.60	0.50	Accepted
40	20	16	0.80	0.60	0.50	Accepted
41	20	16	0.80	0.60	0.50	Accepted
42	20	16	0.80	0.60	0.50	Accepted
43	20	16	0.80	0.60	0.50	Accepted
44	20	16	0.80	0.60	0.50	Accepted
45	20	16	0.80	0.60	0.50	Accepted
46	20	16	0.80	0.60	0.50	Accepted
47	20	16	0.80	0.60	0.50	Accepted
48	20	16	0.80	0.60	0.50	Accepted
49	20	16	0.80	0.60	0.50	Accepted
50	20	16	0.80	0.60	0.50	Accepted

Appendix-B

Item-wise statistics of Learners' Cognitive Skills Test (LCST) at ECE
Table- 8

Item	Prop. Correct	Disc. Index	Point Biserial	Based on Difficulty	Based on Disc. Index	Based on Point Biserial	Status/ Remarks
1	0.80	0.27	0.261	Very Easy	Marginal Good	Acceptable	Need Revision
2	0.75	0.50	0.507	Easy	Excellent	Very Strong	Retained
3	0.66	0.44	0.283	Easy	Excellent	Acceptable	Retained
4	0.66	0.55	0.468	Easy	Excellent	Very Strong	Ratained
5	0.58	0.50	0.467	Modrate	Excellent	Very Strong	Retained
6	0.47	0.50	0.371	Moderate	Excellent	Strong	Retained
7	0.58	0.61	0.455	Moderate	Excellent	Very Strong	Retained
8	0.52	0.61	0.539	Moderate	Excellent	Very Strong	Retained
9	0.50	0.66	0.585	Moderate	Excellent	Very Strong	Retained
10	0.58	0.61	0.490	Moderate	Excellent	Very Strong	Retained
11	0.58	0.72	0.564	Moderate	Excellent	Very Strong	Retained
12	0.61	0.77	0.591	Easy	Excellent	Very Strong	Dropout
13	0.66	0.55	0.466	Easy	Excellent	Very Strong	Dropout
14	0.69	0.50	0.495	Easy	Excellent	Very Strong	Dropout
15	0.41	0.50	0.407	Moderate	Excellent	Very Strong	Retained
16	0.66	0.33	0.240	Easy	Good	Acceptable	Retained
17	0.66	0.22	0.204	Easy	Marginal Good	Acceptable	Retained
18	0.58	0.27	0.371	Moderate	Marginal Good	Strong	Retained
19	0.72	0.32	0.316	Easy	Good	Strong	Retained
20	0.75	0.38	0.363	Easy	Good	Strong	Retained
21	0.80	0.27	0.285	Very Easy	Marginal Good	Acceptable	Need Revision
22	0.75	0.50	0.451	Easy	Excellent	Very Strong	Retained
23	0.66	0.44	0.310	Easy	Excellent	Strong	Retained
24	0.66	0.55	0.473	Easy	Excellent	Very Strong	Retained
25	0.58	0.50	0.474	Moderate	Excellent	Very Strong	Retained
26	0.47	0.50	0.505	Moderate	Excellent	Very Strong	Retained
27	0.58	0.61	0.484	Moderate	Excellent	Very Strong	Retained
28	0.50	0.66	0.580	Moderate	Excellent	Very Strong	Retained
29	0.50	0.66	0.414	Moderate	Excellent	Very Strong	Retained
30	0.55	0.66	0.515	Moderate	Excellent	Very Strong	Retained
31	0.58	0.72	0.596	Moderate	Excellent	Very Strong	Retained
32	0.58	0.83	0.585	Moderate	Excellent	Very Strong	Retained

33	0.66	0.55	0.405	Easy	Excellent	Very Strong	Retained
34	0.69	0.50	0.356	Easy	Excellent	Strong	Retained
35	0.38	0.55	0.526	Difficult	Excellent	Very Strong	Retained
36	0.66	0.33	0.366	Easy	Good	Strong	Need Revision
37	0.66	0.22	0.169	Easy	Marginal Good	Acceptable	Need Revision
38	0.58	0.27	0.310	Moderate	Marginal Good	Strong	Need Revision
39	0.72	0.33	0.247	Easy	Good	Acceptable	Need Revision
40	0.75	0.38	0.262	Easy	Good	Acceptale	Need Revision
41	0.58	0.61	0.545	Moderate	Excellent	Very Strong	Retained
42	0.38	0.55	0.463	Difficult	Excellent	Very Strong	Retained
43	0.55	0.55	0.455	Moderate	Good	Very Strong	Need Revision
44	0.44	0.44	0.419	Moderate	Excellent	Very Strong	Retained
45	0.58	0.27	0.299	Moderate	Marginal Good	Acceptable	Need Revision
46	0.72	0.33	0.220	Very Easy	Good	Strong	Retained
47	0.75	0.38	0.329	Very Easy	Good	Strong	Retained
48	0.58	0.61	0.479	Moderate	Excellent	Very Strong	Retained
49	0.38	0.55	0.466	Difficult	Excellent	Very Strong	Retained
50	0.55	0.55	0.488	Moderate	Excellent	Very Strong	Retained

Appendix-C List of Search Engine

Google Scholar	JSTOR	Science Direct	Scopus	Web of Science
Research Gate	Science.gov	Springer	ERIC	SSRN