

Construction and Validation of Tests for Assessing Early Literacy and Early Numeracy Skills in Kannada-Speaking Preschool Children

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Abstract: Early literacy and early numeracy skills are critical building blocks for successful engagement with formal schooling. However, there are very few assessment tools that are culturally and linguistically suitable to assess these skills among Kannada speaking preschool children. The present study focused on the construction, content validation, standardization, item analysis, and reliability estimation of two researcher-developed assessment tools: the Test for Examining Early Literacy Skills in Kannada (TEL-K) and the Test for Examining Early Numeracy Skills in Kannada (TEN-K). The tests were developed to assess developmentally relevant early literacy and numeracy abilities among Kannada-speaking preschool children, including children with hearing loss. TEL-K comprised 22 main questions carrying a total of 100 marks across 12 domains: auditory identification, visual identification, visual discrimination, visual analysis, visual tracking, letter identification and sight-word reading, auditory memory, visual memory, coloring, copying, independent writing, and writing from memory. TEN-K comprised 21 main questions carrying 65 marks across seven domains: non-numerical comparative measurement, identification and sequencing of numbers, counting and comparison, operations with numbers, shapes, money, and time concepts. The test items were developed with reference to Bloom's Taxonomy and underwent content validation by special educators, regular preschool educators, speech-language pathologists, audiologists, and caregivers of children with special needs. Following content validation, the tests were administered to 60 typically developing native Kannada-speaking preschool children aged 3–6 years for developmental standardization. Item analysis showed that most TEL-K items were easy or very easy, with 14 items demonstrating excellent discrimination after revision, six showing good discrimination, and two showing marginal discrimination. For TEN-K, seven items demonstrated excellent discrimination, 11 good discrimination, and three marginal discrimination following revision. Internal consistency was good for both TEL-K (Cronbach's $\alpha = 0.826$) and TEN-K (Cronbach's $\alpha = 0.816$). Mean scores demonstrated age-related developmental trends across the literacy domains and, broadly, across numeracy domains. The findings provide preliminary evidence for the developmental appropriateness, item quality, and internal consistency of TEL-K and TEN-K for assessing early literacy and early numeracy skills among Kannada-speaking preschool children.

Index Terms - Early literacy, early numeracy, preschool children, Kannada, test construction, test validation, TEL-K, TEN-K

I. INTRODUCTION

The preschool years are a crucial time for the development of basic literacy and numeracy skills. Early literacy encompasses a set of emerging skills that are critical for later reading and writing skills. These include language skills, auditory and visual discrimination skills, letter recognition, phonological awareness, memory skills, visual tracking skills, copying skills and emergent writing skills. Early numeracy includes the development of core mathematical concepts such as comparison skills, counting skills, number identification skills, quantity skills, simple math operations skills, shape skills, money skills and time skills. The assessment of these basic skills is important because it allows teachers and other professionals to identify children's current skills, emerging skills and skills that may need additional support. Assessment tools used in preschool education should be age-appropriate, culturally relevant, linguistically appropriate, and sensitive to developmental changes. This need for assessment is especially important for children learning in regional languages. For preschool children speaking Kannada, assessment materials developed in other languages or cultural contexts may not accurately reflect their linguistic environment. A locally developed assessment tool can incorporate Kannada vocabulary, Kannada alphabet knowledge, culturally familiar objects and situations, and developmentally relevant literacy and numeracy experiences.

The need becomes still more significant when assessing preschool children with hearing loss. Their performance in early literacy may be influenced by auditory access, language exposure, listening experience, amplification, and communication development. Therefore, assessment materials need to provide opportunities to examine both auditory and visual components of early literacy. The methodology underlying the present study specifically identified a lack of suitable test material for detailed assessment of early literacy and early numeracy among Kannada-speaking preschool children. Consequently, two tools—TEL-K and TEN-K—were constructed to assess these foundational abilities. This study describes the development and presents a preliminary validation of these two measures.

II. NEED FOR THE STUDY

One of the biggest challenges in assessment of preschool children is the availability of tools that are not only developmentally appropriate but also linguistically relevant. Assessment of early literacy cannot be limited to letter recognition only. It must include multiple components such as auditory and visual recognition, visual analysis, memory, letter and word recognition, and emergent writing. Likewise, assessment of early numeracy must involve examination of children's understanding of quantity, comparison, number symbols, counting, operations, shapes, money, and time.

The researcher-developed TEL-K and TEN-K were therefore designed as multidimensional assessments. TEL-K incorporated 12 areas of early literacy, while TEN-K incorporated seven areas of early numeracy. The items were also organized according to cognitive processes represented in Bloom's Taxonomy, allowing the assessment to move beyond simple recall toward understanding, application, analysis, and creation-related responses.

The study was therefore undertaken to develop assessment tests that could provide systematic information regarding early literacy and numeracy development among Kannada-speaking preschool children.

III. OBJECTIVES

The study was aimed:

1. To develop a test for assessing early literacy skills of preschool children speaking Kannada.
2. To develop a test to assess the early numeracy skills among the Kannada speaking preschool children.
3. To establish the content validity of the developed tests through expert evaluation.
4. To standardize TEL-K and TEN-K on typically developing Kannada-speaking preschool children aged 3–6 years.
5. To examine the difficulty and discrimination characteristics of individual test items.
6. To estimate the internal consistency reliability of TEL-K and TEN-K.
7. To examine age-related developmental patterns in early literacy and early numeracy performance.

IV. METHOD

The test-construction component followed a developmental assessment and standardization approach. The initial test items were constructed based on identified early literacy and numeracy domains. The materials were subsequently subjected to expert content validation, administered to typically developing Kannada-speaking preschool children, and examined through item analysis and internal consistency estimation.

Participants for Standardization

Following expert content validation, the finalized TEL-K and TEN-K were administered to **60 typically developing native Kannada-speaking preschool children aged 3–6 years** for standardization. The sample consisted of:

Table 1

Age-Wise Distribution of Children Included in the Study

Age group	Number of children
3–4 years	13
4–5 years	25
5–6 years	22
Total	60

Children were selected from Chethana Smart Kids School, Vidyanarayapuram, Mysuru; children from Anganwadi near Manasa Gangotri; children visiting Sri Ganapathy Sachchidananda Ashram; and siblings of children visiting the All India Institute of Speech and Hearing, Mysuru.

CONSTRUCTION OF TEL-K

Test for Examining Early Literacy Skills in Kannada

The **Test for Examining Early Literacy Skills in Kannada (TEL-K)** was developed to assess early literacy abilities in Kannada-speaking preschool children. The test comprised **22 main questions carrying a total of 100 marks**. The questions were distributed across 12 domains.

Table 2
Structure and Marking Scheme of TEL-K (Early Literacy)

No.	Domain	Questions	Marks	Percentage
1	Auditory identification	2	10	10%
2	Visual identification tasks	4	20	20%
3	Visual discrimination	1	5	5%
4	Visual analysis	3	7	7%
5	Visual tracking	2	6	6%
6	Identification of letters and sight-word reading	3	15	15%
7	Auditory memory	1	5	5%
8	Visual memory	1	5	5%
9	Colouring	1	2	2%
10	Copying	1	10	10%
11	Independent writing	2	10	10%
12	Writing from memory	1	5	5%
Total		22	100	100%

The literacy assessment included visual and auditory identification of Kannada alphabets, phoneme-grapheme correspondence, recognition of lexical-category words, memory, visual processing, and early writing. The lexical categories represented familiar preschool vocabulary, including body parts, fruits, common objects, animals, vehicles, vegetables, food items, action verbs, birds, clothing, professions, public places, rooms of the house, seasons, safety, colours, opposites, and parts of the day.

Bloom's Taxonomy Framework

The items were developed with reference to Bloom's Taxonomy. Auditory and visual identification items primarily addressed remembering; visual discrimination and visual analysis addressed analysis; visual tracking addressed application; letter identification and sight-word reading involved remembering and understanding; memory tasks assessed remembering and understanding; colouring and copying involved application; and independent writing and writing from memory involved higher-level production.

This framework helped ensure that TEL-K examined multiple cognitive processes rather than relying exclusively on recognition or recall.

CONSTRUCTION OF TEN-K

Test for Examining Early Numeracy Skills in Kannada

The **Test for Examining Early Numeracy Skills in Kannada (TEN-K)** was designed to assess foundational mathematical and numerical concepts relevant to preschool development. TEN-K comprised **21 main questions carrying 65 marks**, organized into seven major domains.

Table 3
Structure and Marking Scheme of TEN-K (Early Numeracy)

No.	Domain	Questions	Marks	Percentage
1	Non-numerical comparative measurements	8	8	12.3%
2	Identifying and sequencing numbers	5	25	38.4%
3	Counting and comparing numbers	4	16	24.5%
4	Operations with numbers	1	4	6.2%
5	Shapes concept	1	4	6.2%
6	Money concept	1	4	6.2%
7	Time concept	1	4	6.2%
Total		21	65	100%

The test assessed verbal counting, recognition of number symbols from 0 to 10, quantity recognition, shapes and patterns, manipulation of quantities, simple addition, money concepts, and time concepts.

Bloom's Taxonomy was also used to organize TEN-K items. Comparison and measurement items addressed understanding; number identification and sequencing involved remembering and understanding; counting and comparison and numerical operations involved application; and shape, money, and time concepts primarily addressed remembering and understanding.

Content Validation

The preliminary versions of TEL-K and TEN-K were submitted for content validation. The validation panel included:

- one special educator,
- four regular preschool teachers,
- one speech-language pathologist,
- one audiologist, and
- one caregiver.

The content-validation process was intended to establish the correctness, developmental appropriateness, linguistic suitability, completeness, and practical usability of the test materials. Feedback from the validators was incorporated into the development process before the tests were administered to the standardization sample. The present study reports **expert-based content validation** rather than a numerical content-validity coefficient.

Standardization Procedure

After content validation, TEL-K and TEN-K were administered to 60 typically developing Kannada-speaking preschool children aged 3–6 years. The sample was divided into three chronological age groups: 3–4 years, 4–5 years, and 5–6 years. Domain-wise scores were examined across the three age groups to determine whether the tests demonstrated developmental sensitivity.

V. RESULTS

Developmental Performance on TEL-K

The results demonstrated generally progressive performance across the three age groups in the 12 literacy domains.

Table 4.

Mean Domain Scores on TEL-K Across Age Groups

TEL-K domain	3–4 years	4–5 years	5–6 years
Auditory identification	10.00	9.96	10.45
Visual identification tasks	18.15	19.20	19.32
Visual discrimination	4.54	4.68	5.09
Visual analysis	5.08	6.56	6.95
Visual tracking	4.77	4.92	5.00
Letter identification & sight-word reading	14.08	14.40	14.68
Auditory memory	4.46	4.80	4.91
Visual memory	4.54	4.92	5.00
Colouring	2.00	2.00	2.09
Copying	10.00	10.00	10.14
Independent writing	7.46	8.92	9.86
Writing from memory	4.85	4.92	5.00

The reported results showed a general increase in performance with age. Particularly notable age-related gains were observed in visual analysis, independent writing, auditory memory, visual memory, and letter/sight-word-related abilities. It can be interpreted that TEL-K was developmentally sensitive and capable of distinguishing performance across the 3–4, 4–5, and 5–6-year age groups.

Children aged 3–4 years demonstrated emerging literacy abilities, whereas children aged 4–5 years showed stronger letter recognition, visual processing, and emerging writing abilities. Children aged 5–6 years generally demonstrated more developed letter recognition, sight-word reading, copying, independent writing, and writing from memory.

Developmental Performance on TEN-K

The TEN-K findings also demonstrated generally increasing performance across age groups.

Table 5

Mean Domain Scores on TEN-K Across Age Groups

TEN-K domain	3–4 years	4–5 years	5–6 years
Non-numerical comparative measurements	8.00	8.00	8.00
Identifying and sequencing numbers	23.46	24.00	22.27
Counting and comparing numbers	10.08	9.96	10.91
Operations with numbers	4.00	4.00	4.00
Shapes concept	4.00	4.00	4.00
Money concept	4.00	4.00	4.00
Time concept	2.69	3.28	3.32
Total score	56.23	57.24	57.50

The total mean score increased from 56.23 among children aged 3–4 years to 57.24 among those aged 4–5 years and 57.50 among those aged 5–6 years. Time concepts and counting/comparison showed particularly noticeable developmental differences. Children aged 3–4 years demonstrated emerging understanding of number concepts and basic counting. By 4–5 years, children showed improved number identification and sequencing, while children aged 5–6 years demonstrated more developed number-order knowledge, counting, comparison, basic operations, shape concepts, money concepts, and time-related understanding. The findings are described as **age-related developmental trends** rather than statistically significant differences.

Item Analysis

Item analysis was conducted to determine the difficulty and discrimination characteristics of the individual test items. The difficulty index represented the proportion of children responding correctly to an item. A higher value indicated an easier item. The discrimination index was used to determine how effectively an item differentiated between higher- and lower-performing children.

Item Analysis of TEL-K

The item analysis of TEL-K showed that:

- 13 items were classified as **very easy**.
- 9 items were classified as **easy**.
- Initially, 14 items demonstrated excellent discrimination.
- 4 items demonstrated good discrimination.
- 1 item demonstrated marginal discrimination.
- 3 items demonstrated poor discrimination.

Items VIII, XIV, and XVI initially demonstrated poor discrimination and were revised. Following revision, 14 items demonstrated excellent discrimination, six showed good discrimination, and two showed marginal discrimination. The item difficulty values ranged approximately from 74.67% to 97.33%, indicating that the test was relatively easy for the typically developing standardization group. The source describes this distribution as appropriate for the developmental level of the population.

Item Analysis of TEN-K

For TEN-K:

- 19 items were classified as **easy**.
- 2 items were classified as **very easy**.
- Initially, 7 items demonstrated excellent discrimination.
- 7 items demonstrated good discrimination.
- 3 items demonstrated marginal discrimination.
- 4 items demonstrated poor discrimination.

Items X, XI, XVI, and XVII were revised to improve discrimination. Following revision, seven items demonstrated excellent discrimination, 11 demonstrated good discrimination, and three demonstrated marginal discrimination. Item II, which was answered correctly by all children, was retained. The reported item difficulty indices ranged from approximately 70.00% to 100%, indicating that the items were generally within an easy-to-very-easy range for the standardization group.

Reliability

Internal Consistency of TEL-K

The overall internal consistency of TEL-K was **Cronbach's $\alpha = 0.826$** . This indicated good internal consistency among the items and suggested that the items consistently assessed the intended early literacy construct.

Internal Consistency of TEN-K

The overall internal consistency of TEN-K was **Cronbach's $\alpha = 0.816$** , also indicating good internal consistency. The result suggested that the items consistently represented the underlying early numeracy construct.

Table 6

Reliability Coefficients

Test	Number of main questions	Maximum score	Cronbach's α	Interpretation
TEL-K	22	100	0.826	Good internal consistency
TEN-K	21	65	0.816	Good internal consistency

Evidence for Validity

The study provided several forms of preliminary validity evidence.

Content Validity

The tests were evaluated by professionals representing special education, preschool teaching, speech-language pathology, audiology, and caregiving. Their feedback was used during finalization of the tests.

Developmental Validity

TEL-K demonstrated a generally progressive pattern of scores across the three age groups. The methodology interpreted the increasing performance of older children as evidence that the test items were developmentally appropriate and sensitive to age-related changes.

TEN-K also demonstrated developmental trends across comparison, number knowledge, counting, operations, shapes, money, and time concepts. The source therefore identified developmental evidence supporting TEN-K.

Item-Level Evidence

The item difficulty and discrimination analyses provided additional empirical evidence concerning the functioning of individual items. Items with poor discrimination were revised, resulting in improved discrimination classifications for both tests.

VI. DISCUSSION

In this study, two early literacy and early numeracy assessments were devised for preschool children in Kannada language and preliminary evidence of validation for the tests is shown. Results showed that TEL-K and TEN-K provide a multimodal measure of basic academic skills. The general design of TEL-K, such as auditory identification, visual recognition, discrimination, analysis, tracking, memory, coloring, copying and writing, was in line with the notion that emergent literacy comprises many interrelated linguistic, perceptual, cognitive, memory and motor skills (National Early Literacy Panel [NELP], 2008; Whitehurst & Lonigan, 1998). Alphabet knowledge and writing-related activities were also included, because research has demonstrated that alphabet knowledge, print knowledge, and early writing are excellent predictors of subsequent literacy development (Piasta, et al., 2010; Puranik & Lonigan, 2011).

The auditory and visual components of TELL-K were extremely relevant to preschool children with hearing loss. Children with hearing loss have been observed to have difficulty with oral language, phonological memory, notions of print and other emergent literacy skills (Werfel et al., 2017), which require stringent testing methodologies. TEL-K was designed to be age appropriate in the identification of early literacy, i.e. auditory and visual tasks.

The TEN-K also provided a complete picture of early numeracy including number recognition, counting, sequencing, comparing quantities, basic operations, shapes, money, and time. The pattern was consistent with results indicating preschool numeracy is a collection of interrelated skills, such as counting, cardinality, numerical identification, number comparison, ordering and early arithmetic (Purpura et al., 2015). The application of practical mathematical concepts allowed to go beyond simple numerical knowledge, and was indicative of the range of mathematical skills present in preschool development. Overall, findings demonstrated that TEL-K and TEN-K comprehensively assessed core components of reading and numeracy, and were conceptually compatible with previous research on the development of early academic skills.

The age-related pattern observed in TEL-K supports its developmental sensitivity. Older children generally performed better in visual analysis, memory, letter identification, writing, and other literacy-related domains. The strongest increase was observed in independent writing, with mean scores increasing from 7.46 in the 3–4-year group to 8.92 in the 4–5-year group and 9.86 in the 5–6-year group.

TEN-K also showed an increase in total mean scores across age groups, from 56.23 to 57.24 and 57.50. However, several domains showed ceiling effects, with children obtaining maximum mean scores in non-numerical comparison, operations, shapes, and money. This finding suggests that these items may have been relatively easy for the typically developing standardization sample. The source's item analysis similarly classified most TEN-K items as easy.

The relatively high difficulty indices observed in both tests should therefore be interpreted carefully. For a preschool screening or developmental assessment, easy items may be useful for establishing foundational competence. Nevertheless, future versions could benefit from additional items distributed across a wider difficulty range so that the tests can better distinguish children with stronger and weaker emerging skills.

The internal consistency coefficients of 0.826 for TEL-K and .816 for TEN-K represent an important strength. These findings suggest that the items within each instrument showed adequate consistency in measuring their respective constructs. The item-analysis procedure further strengthened the instruments by identifying poorly discriminating items and revising them.

VII. STRENGTHS OF THE DEVELOPED TESTS

Several features of TEL-K and TEN-K strengthen their potential clinical and educational utility.

Kannada-language relevance: The instruments were specifically designed for native Kannada-speaking preschool children.

Developmental appropriateness: Items were organized around skills expected during the preschool period.

Multidimensional assessment: Both literacy and numeracy were assessed across several domains.

Cultural relevance: Familiar objects, vocabulary, daily routines, and contextual concepts were incorporated.

Expert validation: Professionals from multiple disciplines participated in content validation.

Bloom's Taxonomy alignment: Items were mapped onto different cognitive processes.

Empirical item analysis: Difficulty and discrimination indices were used to identify problematic items.

Good internal consistency: Both tests demonstrated Cronbach's alpha values above .80.

Developmental sensitivity: Performance generally increased across age groups.

Potential relevance to hearing-loss assessment: TEL-K incorporated auditory as well as visual components and was subsequently used in the broader study involving preschool children with hearing loss.

VIII. CONCLUSION

The present study described the construction and preliminary validation of two Kannada-language assessments—the Test for Examining Early Literacy Skills in Kannada (TEL-K) and the Test for Examining Early Numeracy Skills in Kannada (TEN-K)—for preschool children aged 3–6 years. TEL-K comprised 22 questions across 12 early literacy domains and carried 100 marks, whereas TEN-K comprised 21 questions across seven early numeracy domains and carried 65 marks. Both tests were developed using developmentally relevant content and were aligned with Bloom’s Taxonomy.

Expert review provided preliminary evidence of content appropriateness, while administration to 60 typically developing Kannada-speaking preschool children provided developmental standardization data. The results showed generally age-related developmental trends across the literacy domains and overall numeracy performance. Item analysis resulted in the revision of poorly discriminating items. Internal consistency was good for both TEL-K ($\alpha = 0.826$) and TEN-K ($\alpha = 0.816$).

Overall, the findings suggest that TEL-K and TEN-K have promising preliminary psychometric characteristics and may serve as useful assessment instruments for examining foundational literacy and numeracy skills among Kannada-speaking preschool children. However, broader standardization and additional psychometric validation are necessary before the instruments can be considered fully norm-referenced measures or used for high-stakes diagnostic decisions.

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