CONSTRUCTION AND PILOT TEST OF AN INSTRUMENT TO MEASURE THE GAPS IN TEACHING-LEARNING OF SCIENCE AT MIDDLE STAGE IN SELECT TRIBAL DOMINATED RURAL SCHOOLS OF CHHATTISGARH, INDIA

B. K. Tripathi[1*], Indrani Bhaduri[2], Rachna Garg[3], Ashish Kumar Srivastava[4], Dinesh Kumar5, R K Parashar[6], Ruchi Verma[7], and Sunita Farkya[8]**

1, 3-8. Department of Education in Science and Mathematics
National Council of Educational Research and Training, New Delhi
2-Education Survey Division
National Council of Educational Research and Training, New Delhi
*Present Address: Director Inter-University Centre for Teacher Education, BHU, Varanasi
**Corresponding Author: sfarkya@gmail.com

The present study intends to develop tools to find out the gaps in science teaching and learning in select schools of scheduled tribes-dominated districts of Chhattisgarh. The tools development was completed in four phases following a modified Plomp model. In the preliminary investigation phase, research team members visited the schools of Chhattisgarh to analyse and determine the need. In the design phase, with the help of experts' opinion, the design of tools was finalised. In the construction phase, the development of four tools and their review with the panel of experts was carried out. These tools were; Tools for assessing attainment to leaner in leaning science for Classes VI, VII and VIII (TALS); a tool for attitude of learners in learning science (TATLS), Classroom Observation Schedule (COS), School Observation Schedule (SOS). Draft tool for Performance Indicators for Teachers (TPIT) developed by NCERT was administered in the study with minor modifications. In the time final, test evaluation and revision phase four, after the pilot test of tools in four schools of Raipur, Chhattisgarh, and data analysis, four tools were finalised again by a panel of experts. However, for the tool for assessing learners' attainment in learning science (TALS) for Classes VI, VII and VIII after applying in SPSS version 16 and Kuder Richardson formula 20, (KR 20), individual item analysis was suggested in the study.

Keywords: Instrument, Teaching-learning of Science, Tribal schools.

1. Introduction

In India, science learning in school education has been envisioned as a significant paradigm shift in learning strategies as recommended in National Curriculum Framework 2005. NCF 2005 emphasises learner-centred pedagogy rather than a teacher-centric approach. This major paradigm shift has necessitated bringing changes in curriculum transaction strategies for achieving the associated goals at the grassroots level (NCERT, 2006). Students' engagement in the process of learning is the most crucial expression to implement this change so as to follow this educational reform (NCERT, 2006). Thus, the science curriculum envisages 'learning by doing', connecting concepts with day-to-day life outside the school beyond the textbook (NFG Position Paper on Teaching of Science, 2006).

After independence, the education sector in India has expanded to a great extent but without any assurance of equity in educational opportunity or quality of education. Despite the Right to Education Act, 2009 (RTE) for providing equal opportunity, achievement of learning outcomes continued to remain poor for several children, primarily from disadvantaged groups. This may be due to various reasons, such as diversified social strata, rural and urban divides, lack of information due to geographical locations, etc. (CBPS, 2017). Tribal populations continue to have one of the lowest enrolments and retention rates as well as learning outcomes in the country, despite efforts for more than half a century of interventions for bringing improvement in their educational status (CBPS, 2017).

Quality teaching and learning, specifically in science, is crucial for developing scientific literacy in the young generation and improving economic productivity for sustainable development. The Indian school curriculum and policies have forged a remarkable level of consensus that science education is vital for all children attending schools. Hence, science is prescribed as a compulsory subject from elementary school onwards. "We can regard good science education as one that is true to the child, true to life and true to science" (NFG Position Paper on Teaching of Science; p. 2). Our vision towards improving the learning of science encompasses three factors: the learner (child), the environment — physical, biological, and social (life) in which the learner is embedded, and the object of learning (i.e., science in the present context) (NFG Position Paper on Teaching of Science; p. 2)

Even after almost ten years post-NCF 2005, the percolation of spirit and recommendations of the National Curriculum Framework at grassroot level was very slow. It may be due to cascade model of teacher training education programmes. Following the cascade model, it might have been diluted when it reached the end-users through various steps in the chain of the school system from national to state and finally to schools through the district, block, and clusters by Key Resource Persons. Thus, to meet the goals and objectives of science education as per the recommendations of NCF 2005, it is a prerequisite to assess the impartation of curriculum, as translated in the syllabus and further into textbooks and other teaching-learning material, through learners, classroom practices, and the learning environment.

To continuously bring the quality standard and due recognition to the current curriculum in science at the grassroots level, it is essential to get feedback from time to time in view of ensuring optimum learning experiences for learners and continuous improvement in quality of learning in science (NCERT, 2017). For assessing students' learning experiences and achievement of learning outcomes, all factors including learning environment in which the learner is embedded with the learning process, teachers' role as facilitator in teaching-learning process, learners' attitude towards Science learning and attainment of learning outcomes by them need to be taken into account. Thus, the objective of the study was to develop assessment tools to find out the gaps to get the inputs for continuous improvement in the quality of curricular material, and teaching-learning process and teacher education programmes.

The present paper includes a systematic development of assessment tools for data collection to assess implementation of the National Curriculum Framework recommendations in learning of science in select rural schools of two scheduled tribe-dominated districts of Chhattisgarh state of India so that the baseline status of teaching and learning of science in the schools of scheduled tribes dominated districts of the state Chhattisgarh may be assessed, and the learning gaps may be identified, intervention may be planned and tried out, and a framework may be developed for in-service teacher education.

2. Methodology

2.1 Theoretical Framework

Many educational theories such as socio-cognitive learning, self-efficacy, experiential, reflective, and communities of practice theories have been considered in the present study. However, there is little mention of theoretical frameworks or orientations in the literature regarding science learning as recommended by the current curriculum, especially in tribal-dominated areas of India.

Since any instrument for such studies was not reported earlier for tribal-dominated rural schools of Chhattisgarh state, it is logical to construct tools for the same. For the appropriate measuring techniques for accurate data collection and arriving at correct and error-free conclusions for meeting out the objectives of the study, it is reasonable to construct an instrument using the commonalities with similar disciplines, or interacting disciplines such as Social Science and Mathematics. An underlying characteristic and assumption of the theories followed in this study is that learning involves social participation.

Due to the unavailability of suitable tools for accomplishing the study's objectives to assess science teaching-learning at the middle stage, the researchers' team ventured to construct the instrument afresh. An instrument was developed to establish a baseline of a student's conceptual learning in science and find gaps in the teaching-learning process and learning environment. Further, keeping in mind the definition of quality (NCERT-QMT, 2013), tools were also developed to assess other components of the teaching and learning process in the classroom and learning environment.

2.2 Research Procedure

Construction of tools for the measurement of teaching-learning of science at middle stage learners in tribal-dominated rural schools was carried out following modified Plomp model (Table 1):

Table 1

Research Procedure Phase-wise

Phase I	Phase II	Phase III	Phase IV
Preliminary Investigation • Material analysis	Design • Literature Survey • Setting-up a criteria for construction of instrument	Realisation and Construction • Development of an initial pool of items for tools	Test Evaluation and Revision • Pilot test and administration of assessment tools

• Student analysis • Competency analysis • Front end analysis	• Setting-up a criteria for development of items for construction of tools	• Review of the assessment tools by a panel of experts	• Analysis of the data • Finalisation of tools

In the first and second phases, besides a thorough literature review/survey, the research team performed extensive information retrieval by first, second, third, seventh, and eighth authors. This was followed by visits in schools of Chhattisgarh to observe the ground reality by second, fifth, and eighth authors regarding the implementation of recommendations of the present curriculum for assessment of which instrument was to be developed by all authors. In addition, all authors also consulted the literature on other assessment tools used in various survey researches for assessing the status of teaching and learning. In Phase III the second and eighth authors established the discussion forum to generate an initial pool of items by all the research team members for the development of tools to assess various aspects as per the preliminary investigations by analysis of material, student, competency and front end analysis followed by expert opinion.

2.3 Study Design

The present study focuses on design and construction of tools for exploring the status, needs, and attitude of science teachers and learners for improving the teaching and learning of science. Five assessment tools were finalised based on the different approaches adopted for data analysis, including triangulation of data, mixed-method approach to consider multiple viewpoints, perspectives, positions, and standpoints to improve teaching and learning of science in rural schools of scheduled tribes dominated districts of Chhattisgarh.

The research design utilised in this study consists of three distinct approaches: expert opinion, focus group discussion, and quantitative survey. The approaches are described as follows for different tools:

Table 2

Study design approach used for construction of the tools phase-wise

S.No.	Research Procedure	Study design (approach used)
1.	Phase I Preliminary Investigation	Literature survey, field visit, and analysis by the research team followed by focussed group discussion
2.	Phase II Design	expert opinion
3.	Phase III Realisation and construction	expert opinion, focus group discussion
4.	Phase IV Test Evaluation and Revision	focus group discussion, survey for field try-out

2.3.1 Phase I Preliminary Investigation

All the textual material, including primary and upper primary classes were obtained from SCERT, Chhattisgarh.

The research team visited the schools of Chhattisgarh to observe ground realities in the teaching and learning process for student and competency analysis. As a result, a blueprint for the development of tools was designed.

2.3.2 Phase II Design

2.3.2.1 Expert Opinions

Initially, expert opinion was sought for generating information about the determinants of effective science learning. A preliminary instrument as draft tools was presented to all expert participants. They were invited to identify important aspects that may assess the teachers, learners, and learning environment as well as relevant domains that could form sections or subsections of a questionnaire. Notes were taken from all the experts and compiled by the second and eighth authors for further inputs. Suggestions and comments were discussed, and with the consensus of the research team members, the domains for the development of different tools were finalised. Textbooks procured from SCERT, Raipur, Chhattisgarh were also consulted.

Data analysis was carried out following the content analysis method as suggested by Flick, 2002, with an aim to identify variations in perspectives. The third and eighth authors reviewed outcomes, comments, and domains, and all authors modified the preliminary draft questionnaire. A focus group session was planned with an agenda of "Exploring Needs of Students and Teachers for Improving Teaching and Learning of Science." It was followed by the development of items and draft tools.

2.3.3 Phase III Realisation and Construction

2.3.3.1 Focus Groups for Expert Validation of Draft Questionnaire

Both the focus group meetings were held during the 2015/16 academic year; first meeting at DESM, NCERT, New Delhi, followed by the second meeting at the SCERT, Raipur, Chhattisgarh.

In the second phase, expert validation of tool items was done by focus group review discussion of those items by a panel of experts at the national level by providing their comments. A set of a few semistructured triggering questions on any ambiguity, completeness, and clarity in understanding of the items and its relevance to teaching and learning of science were identified by the first, second, third, and eighth authors for each item to facilitate the group discussion and to assist future questionnaire development. The experts group reviewed all the tools, and necessary corrections were made in view of the following criteria:

1. Options given in multiple-choice questions should be appropriate.
2. Difficulty level of the items in the said tools must be in 25:50:25 for easy average and difficult types.
3. Items should assess learning outcome for various competencies in learners.

4. Items must be application-based, problem-solving, critical thinking, creative skills, and understanding.
5. Items from the whole syllabus must be included.
6. Language should be appropriate and easily understandable.
7. There should not be any ambiguity in the question stem or any of the multiple options.

All the tools were reviewed by subject experts from Chhattisgarh state, keeping in view the following points:

1. Contextualisation: The items were modified as per the local context
2. Cultural inputs
3. Language efficiency
4. Difficulty level in the context
5. Content cognition in the context

It was followed by another focus group meeting with a panel of state-level experts at SCERT, Raipur Chhattisgarh, to address contextual issues. A set of a number of criteria guiding the focus group meeting with a panel of state experts was identified by first, second, third, fourth, and eighth authors that included learners' language, culture, and natural phenomena in their surroundings for developing and fine-tuning the items in the assessment tools.

Based on comments received during the FGD for each item, thematic analysis was independently analysed by the first, second, and eighth authors. Themes were identified, suggestions for questionnaire improvement were studied, and modifications were made accordingly. Independent analysis confirmed the emerging themes.

2.3.4 Phase IV Test Evaluation and Revision

2.3.4.1 Field Try-out of Survey Questionnaire

The draft tools were administered for field validation among students, teachers, school principals, and community people wherever required, and data was collected for qualitative and quantitative analysis. Five schools of Raipur Chhattisgarh were selected for validation of tools.

Data Collection through the Unstructured Interview

The tools were administered in four government schools of Raipur, Chhattisgarh, for field validation. Resource persons also interacted with the learners, teachers, teacher educators, and education administrators separately through an informal, unstructured interview regarding tools, such as:

1. Learners, teachers, school heads were subjected to informal interviews about the tool items if they are understandable.
2. Whether the language of the items in the tools was easily understandable?
3. Is there any item in the tool which had not been taught in the class by the time the tools were administered?
4. How much portion of the syllabus was covered in the class?
5. Are the items in the tools locale-specific?
6. Is there any ambiguity/confusion in the stem of items or in the four options?

Tool Administration and Data Collection

The draft tools were administered for field validation among students, teachers, school principals, and community people wherever required, etc., and data was collected for qualitative and quantitative analysis. Five schools of Raipur Chhattisgarh were selected for validation of tools.

2.3.4.2 Data Analysis: Quantitative data from the pilot study were entered in SPSS version 16, and Kuder Richardson formula 20 (KR 20) was calculated to determine the internal consistency of the questionnaire.

2.4 Sample and Sampling Techniques

The sampling technique was purposive, and government schools at Raipur were chosen where the permission of piloting the instrument was granted by the interference of SCERT, Raipur, Chhattisgarh. The population of interest was students at the upper primary stage, teachers teaching science at the upper primary stage, school heads, and community for informal interaction. Total 504 students;164 from Class VI, 168 from Class VII, and 172 from Class VIII participated and filled up the tools number 1 and 2 as mentioned in Table 5 for assessing attainment of learners in learning science for Classes VI, VII, and VIII (TALS) and tool for assessing the attitude of learners in learning science (TATLS). A gender-wise sample of learners who took part is depicted in Table 3. However, science teachers of the same schools provided their feedback on Tool for Performance Indicators for Teachers (TPIT), and school heads of the same school provided feedback on the Classroom Observation Schedule (COS). In addition, faculty members from DIET Korba and Kanker provided their feedback on the school observation schedule (SOS).

Table 3

Sample Size: Class-wise Students' Participation

Class	Number of female students participated	Number of male students participated
VI	118	46
VII	129	39
VIII	105	67
Total	352	152
Total number of students' participation = 504		

The present study sample was drawn using multistage sampling techniques in identified schools at Raipur, Chhattisgarh.

Table 4

Identified Schools for Field Try out of Tools/Instrument

S.No.	Name of School
1.	Shaskiya Poorv Madhyamik Abhyas Shala, Shankar Nagar, Raipur
2.	J R Dani Govt Girl Hr Sec School, Raipur
3.	Govt Higher Sec School, Lalpur, Raipur
4.	Shaskiya Poorv Madhyamik Shala, Khamardeeh, Raipur

Sampling is done using the saturation sampling technique where the researcher reaches a point where no new information is obtained from further data. Saturation sampling determines the size of the sample in research, indicating that adequate data has been collected for a detailed analysis, basing it on the particular case that is being studied.

3. Results and Discussion

In this section, phase-wise findings from each of the three study approaches have been described by the authors while developing the instrument:

Phase I

3.1 Preliminary Investigation

Findings of material, students, competency, and front-end analysis are presented here.

3.1.1 Material Analysis

Textbooks are in the Hindi language. Development of word power in tribal language after every chapter in the textbook has also been observed (SCERT, 20).

3.1.2 Student and Teacher Analysis

In general, there is a lack of understanding of the concept and importance of the quality of the teaching-learning process. Lack of availability of qualified science teachers in schools of interior areas.

3.1.3 Competency Analysis

Since the state shares its boundaries with seven states of India, the culture and language of the state are considerably influenced by the culture of neighbouring states resulting in a mix of diversified cultures and dialects. This is the reason many languages and dialects are spoken in the state.

According to Census 2011, scheduled tribes population is 30.6 per cent of the total population, and this is why there is a lot of indigenous knowledge system along with well-developed deep-rooted life skills ingrained within every person in the community.

3.1.4 Front-end Analysis

Science textbooks of Chhattisgarh must be referred for developing items.

The items in the student's questionnaire must be in Hindi language (Maneesriwongul and Dixon, 2004).

The items must include contextual or local-specific items and also must include local language inputs.

The items must assess local and cultural competency in science.

Phase II

3.2 Design

Findings of design of instrument are presented in this section using expert opinion.

3.2.1 Expert Opinions

For the development of an instrument, research team members, along with the experts' opinion, identified the following areas for the construction of tools:

1. Learning of science concepts by learners.
2. Learners' attitude of learning science.
3. Role of science teacher as facilitator in teaching and learning of science.
4. Classroom interactions between learners and teachers.
5. Conduciveness of the learning environment for optimum learning attainment.

As a result, five types of tools were finalized, as mentioned in Table 5.

Table 5

Tools for Measurement of Teaching Learning of Science in Two ST Dominated Districts of Chhattisgarh

S. No.	Tools Developed
1.	Tool for assessing attainment of learners in learning science for Classes VI, VII, and VIII (TALS)
2.	Tool for attitude of learners in learning science (TATLS): To understand the degree of the attitude of learners in learning science
3.	Tool for Performance Indicators for Teachers (TPIT): To understand the role of the teacher as a facilitator
4.	Classroom Observation Schedule (COS): To understand how much classroom process facilitates learning science
5.	School Observation Schedule (SOS): To understand how much conducive is the school environment in the learning of science

Phase III
3.3 Realisation and Construction

Findings of expert opinion for construction of all five types of tools mentioned in Section 3.2 are presented in this section.

3.3.1 Tool for assessing attainment of learners in learning science for Classes VI, VII, and VIII (TALS): For the construction of this tool following two major domains were identified for item development:

(i) *Class-wise:* As emerged with the expert opinion, assessment items were developed from the science curriculum for upper primary Classes VI, VII and VIII separately and with due consultation of the curricular material in-force in Chhattisgarh state.

(ii) *Theme-wise* (Table: 6): Items may be developed theme-wise. The science is taught at the upper primary stage around the seven potentially cross-disciplinary themes (NCERT, 2006). For better insights and analysis, themes were separated under the three thematic groups I, II, and III based on the nature of the individual theme.

Table 6

Distribution of themes under the science syllabus at the upper primary stage

Thematic Group 1	Thematic Group 2	Thematic Group 3
How Things Work; Moving Things, People, and Ideas; Natural Phenomena	Materials; Natural Resources	Food; The World of the Living

Writing of items: A large number of items for each dimension were developed by the research team members in this study with the help of science textbooks developed by NCERT and SCERT, Chhattisgarh for Classes VI, VII, and VIII. The number of items developed in each domain as per the theme-wise and class-wise distribution of concepts in the syllabus is presented in Table 7. The tool was developed in the Hindi language as Hindi is a speaking language with many changing dialects in Chhattisgarh State.

The items in the tool were incorporated to assess learners' science learning, keeping in view the learning outcomes addressing various scientific competencies such as, to identify, to differentiate, to classify, to conduct simple investigations, to relate processes and phenomena with causes, to explain processes and phenomena, to write word equations, to measure and calculate, to draw labelled diagrams, to plot and interpret graphs, to construct models, to discuss and appreciate the story of scientific discovery, to apply learning in scientific concepts, to make efforts to protect the environment, to exhibit creativity and values of honesty and various skills in science such as to observe, recall, provide logical reasons, think critically, be creative, analyze and interpret, apply learning in solving problems, etc.

There were three sets of questionnaires, Set I, Set II, and Set III. Fifteen items in each set were common; five items each from thematic group I, thematic group II and thematic group III. Rest of the items in Set I, Set II, and Set III were from thematic group I, thematic group II and thematic group III, respectively.

There was no definite number of items in each of the sets because the syllabus and textbooks of Chhattisgarh state for Classes VI, VII, and VIII revealed that there is not an equal distribution of the concepts from thematic group I, thematic group II and thematic group III in each class; such as, in Class VII, more concepts of thematic group III are being included, however, in Class VIII, more concepts in thematic group I are being covered.

3.3.2 Tool for Attitude of Learners in Learning Science (TATLS)

The tool was conceptualised to collect the information for students' approaches towards learning science. The questionnaire was developed with the intention to acquire information about students' interest in learning science and identify the behavioural gaps in the process of learning science. In the questionnaire, items were included which assess learners' interest in learning science and learning gaps while learning science. In addition, items were also included which assess students' awareness about the importance of learning science.

This questionnaire contained two parts, Part I and Part II. Part I was meant for information about the identity of the learner, their school name, science teacher, district name, gender, etc. Part II includes three sub-sections. Each subsection has a few items. Each item has five options. Out of these five options, one has to select one. The options against each item are agree, completely agree, can't say, disagree, and completely disagree.

Each item in this questionnaire was written under one of the following three dimensions:

- Learning and Interest in Science
- Perceptions about Teaching-learning Strategies
- Importance of Science

3.3.3 Tool for Performance Indicators for Teachers (TPIT)

The draft tool (PINDICS) developed by NCERT (2015) was used, and science teachers of selected schools provided their feedback for a few modifications. The tool was administered by teachers to assess themselves as a facilitator in the teaching and learning of science at the upper primary level. Thus, it provided the data of teachers' self-assessment in teaching science. The test has two parts. Part I is for personal information, and Part II is for gathering information related to the practice of teaching. Part II comprises the following six dimensions.

- Designing Learning Experience
- Learning Strategies and Activities
- Classroom Management and Learning Environment
- Assessment and Feedback
- Professional Development
- Mechanics

Each item may be answered by respondents on a 5-point rating scale. These five points are never, seldom, periodically, consistently, and not applicable. Therefore, each teacher has to rate themself against each item under any one of these five categories which they feel best suitable with their teaching-learning process (NCERT, 2015).

3.3.4 Classroom Observation Schedule (COS)

The tool was conceptualised to gather information about the process and methods of teaching and learning of science in the classroom. The objective of this questionnaire was to understand the teaching and learning process in the classroom. While developing this tool, following aspects were considered:

(i) Whether the teaching and learning are learner-centric?

(ii) Whether the teacher is facilitating learning keeping in view to enhance learner's competency?

(iii) Is the pedagogy appropriate for learning various concepts?

(iv) Whether the learning is active or passive?

(v) Is there any experiential learning/ performing activities?

(vi) What available resources were used in the teaching and learning process?

(vii) How the aspects of values were integrated during the teaching and learning process?

(viii) How is the assessment integrated into the teaching-learning process?

(ix) Does the classroom process follow any lesson plan for learning?

(x) Do they follow some activities beyond textbooks for learning science?

(xi) Do they follow some activities beyond the classroom for learning science?

(xii) Are there any teachers' misconceptions about any concept in science?

(xiii) What is the degree of learners' reading, writing, and comprehension skills?

The tool was administered in a classroom situation by DIET faculty members and feedback was provided.

Item writing: Finally, for the development of the tool, five dimensions were identified:

1. 'Preparation made by the Teacher before the Classroom Teaching', comprising 5 items.

2. 'Interaction in the Classroom' comprising 15 items.
3. 'Handling Student Responses' comprising 6 items.
4. 'Engagement with Teaching-learning Resources' comprising 7 items.
5. 'Class Organization' comprising 4 items.

Thus, the tool comprises a total of 37 items to be administered at the time of the classroom process.

3.3.5 School Observation Schedule (SOS)

The tool was conceptualised to collect information about the school climate, including infrastructure, learning resources, school environment, etc. Therefore, the test was developed in the following eight dimensions.

1. Teacher availability
2. Teacher development
3. Time table
4. Resource availability
5. Science laboratory facility
6. Library facility
7. ICT integration in teaching-learning
8. Health, hygiene, and sanitation

The tool was developed for administration among school heads/principals for feedback.

The tool was developed under eight dimensions to gather information about the school environment. The first dimension is entitled 'Teacher availability.' There are five questions in this dimension. The second dimension is entitled 'Teacher development,' and it has four questions. The third dimension is 'Timetable,' and it has two questions. The fourth dimension, 'Resource availability,' has 12 questions. The fifth dimension, 'Science laboratory facility,' has six questions. The sixth dimension, 'Library facility,' has six questions. The seventh dimension is 'ICT integration in teaching-learning and, it has only one question. The eighth and last dimension is 'Health, hygiene, and sanitation, there are 16 questions in this dimension. Thus, there are 52 questions in this test. The test comprises both close-ended and open-ended type of questions.

3.4. Focus Group for Expert Validation of Draft Questionnaire

The experts' group reviewed all the tools, and necessary corrections were made with the panel of experts.

3.4.1 Tool for Assessing Attainment of Learners in Learning Science for Class VI, VII, and VIII (TALS)

The TALS was reviewed based on the following criteria, and a total of 647 items was finalised for field try out (Table 7):

1. Option given in multiple-choice questions were reviewed and finalised for ambiguity, editing for appropriate and easily understandable language, difficulty level, attainment of competencies, etc.
2. Items were modified for assessment of understanding the concept, problem-solving skills, critical thinking, and creative skills.

3. Appropriate splitting or clubbing of items were carried out.
4. Items from the whole syllabus were included.

All the tools were reviewed by subject experts from Chhattisgarh state, keeping in view the following points:

1. Contextualisation: The items were modified as per the local context
2. Cultural inputs
3. Language efficiency
4. Difficulty level in the context
5. Content cognition in the context

Table 7

Number of Items finalised (TALS)

Dimension		Number of items	Total number of items
Class VI	(Set I) Thematic Group I	46	196
	(Set II) Thematic Group II	53	
	(Set III) Thematic Group III	97	
Class VII	(Set I) Thematic Group I	44	166
	(Set II) Thematic Group II	27	
	(Set III) Thematic Group III	95	
Class VIII	(Set I) Thematic Group I	67	285
	(Set II) Thematic Group II	98	
	(Set III) Thematic Group III	120	
Total number of items	Science	647	647

Table 8

Local Specific Inputs in TALS

Criteria	Examples	Concepts on which Items are based
Contextualisation: The items were modified as per the local context	The tribes of Chhattisgarh depend on agriculture and forest produce for their livelihood.	Hybridisation techniques, blue-green algae in agriculture, hybrid varieties of animals, cattle, apiculture, legume crops, crops, nitrogen fixation, humus, fibers, and fabrics common diseases in plants and animals, weeds, agriculture, and forest products, etc.

Cultural inputs	Each house in Chhattisgarh, there is a Mahua drink-making unit	Separation process.
Language efficiency	After every five kilometres, the dialect in Chhattisgarh changes, and, therefore, textbook gives a list of the meaning of popular words.	Naphthalene balls have been written as damarkigoli, the enzyme is written as rukshansh; all items are in Hindi.
Difficulty level in the context / Content cognition in the context	Tribes of Kanker do rear cows for cow-dung to be provided for high agricultural produce, not for milk.	Milk to curd process, pasteurisation of milk.
Environment and surroundings	The rich biodiversity of Chhattisgarh state.	It includes items to assess learners understanding about their surroundings; such as Saprophytes, e.g., mushrooms; parasites, e.g., Amarbel; amphibians; annual, biennial, perennial plants, types of soil, rusting, LPG as fuel, materials, and minerals, galaxy, adaptation in plants and animals, the food chain.
Textbook	National context	Respiration in seeds, acid rain, uses of petrol in a motor vehicle, not as fuel, lens and mirror, chemical reactions, insulator and non-insulator, diseases of importance, a test of carbohydrate, natural phenomena and processes, measurements, cell structure.

3.4.2 TATLS, TPIT, COS and SOS

The TATLS, TPIT, COS, and SOS were reviewed based on the following criteria, and items were finalised for field try out (Table 8):

1. Options given in multiple-choice questions were reviewed and finalised for ambiguity, editing for appropriate and easily understandable language, etc.
2. Items were modified for appropriate assessment and data collection for learning gaps and learning environment.
3. Appropriate splitting or clubbing of items were carried out.

Phase IV

3.5.1 Field Try-out of Survey Questionnaire

Results presented in Table 9 reveal KR 20 values (Kuder Richardson formula 20) to determine the internal consistency of the questionnaire.

Analysis by item response theory may suggest a modification or dropping or retaining of each item with a goal of improving measurement accuracy.

It is recommended that since there are no items in the TALS that can assess the

Table 9

Class-wise and theme-wise KR20 value for TALS

Dimensions		KR20 value
Class VI	(Set I) Thematic Group I	0.38
	(Set II) Thematic Group II	0.36
	(Set III) Thematic Group III	0.32
Class VII	(Set I) Thematic Group I	0.33
	(Set II) Thematic Group II	0.39
	(Set III) Thematic Group III	0.45
Class VIII	(Set I) Thematic Group I	0.37
	(Set II) Thematic Group II	0.39
	(Set III) Thematic Group III	0.41

It was analysed that the internal consistency of the questionnaire tool, TALS is less than 6. Thus, analyses of individual items need to be carried out based on which individual items may be retained, modified, split, or clubbed.

3.5.2 Analysis for TATLS, TPIT, COS and SOS

Analysis of items of these tools was based on the feedback received by learners, teachers, school heads, and faculty members from DIET while administration of tools was done in selected schools at Raipur. Finally, the tools were finalised based on the analysis of feedback with the panel of experts with language editing and minor changes.

4. Recommendations

Statistical Analysis of TALS indicates very little internal consistency, and thus it is important to analyse each item individually using other methods.

reading, writing, and comprehension of middle-stage learners, some open-ended items may be given, so that reading, writing, or comprehension of learners may also be assessed. These open-ended questions may be on the same concept as given in multiple-choice items to assess the genuine understanding and attainment of learning outcomes.

5. Limitations

1. Field validation of questionnaires was carried out only in four government schools of Raipur. Therefore, it is a very small sample to finalise an error-free assessment tool.
2. Though the dialect in the Chhattisgarh state of India changes even within the periphery of five kilometres, it is difficult even after local specific language editing exercises for finalisation of tools, the tools may not be accurate and very suitable for all.
3. Though the assessment tools are to be developed to find out the gaps in learning, teaching-learning process, and learning environment for science learning, it is limited largely to assessing the academic aspects of quality.

6. Conclusion

In the present study, four tools have been finalised for administration in the given sample in selected schools in tribal-dominated rural schools and to study the baseline status of teaching and learning of science to find the gaps. However, tools for assessing learners' attainment in learning science for Classes VI, VII, and VIII (TALS) may be improved by using other methods of analysing individual items. Further research is needed to finalise these items. Further, through administering these assessment tools in experimental groups, researchers may point out the gaps in some aspects of quality that may provide insights or may be of interest to policymakers, education administrators, curriculum developers, and researchers who want to work for different studies related to interventions for the achievement of quality.

Acknowledgements

Research team members acknowledge the financial support and encouragement provided by the Director, NCERT for carrying out this work through PAC-approved programme Code 6.01 and 6.02 during 2015–16 and 2016–17.

References

CBPS. 2017. Reviewing the Status of Education in Tribal Areas in Maharashtra: A Comprehensive Report, Centre for Budget and Policy Studies (CBPS), Bengaluru. p. 139.

Census. 2011. Total Population, Population of Scheduled Castes and Scheduled Tribes and their Proportions to the Total Population. Office of the Registrar General and Census Commissioner, India, Ministry of Home Affairs, Government of India. http://censusindia.gov.in/Table_Published/A-Series/A-Series_link/t_00_005.aspx

FLICK, U. 2002. Qualitative Research-State of the Art. *Social Science Information*. Vol. 21, No. 1. pp. 5–24.

MANEESRIWONGUL, WANTANA AND JANE K. DIXON. 2004. Instrument Translation Process: A Methods Review. *Journal of Advanced Nursing.* Vol. 48, No. 2. pp. 175–186.

MLJ. 2009. The Right of Children to Free and Compulsory Education Act, *Gazette of India.*

NCERT. 2005. National Curriculum Framework.

———. 2006. National Focus Group Position Paper on Teaching of Science.

———. 2013. Implementation of Quality Monitoring Tools — Quality Management in Elementary Education under SSA, p. 68. NCERT, New Delhi.

———. 2017. Promoting Quality Learning in Science at Upper Primary Level in Scheduled Tribes (ST) Dominated Districts of Chhattisgarh: A Framework-Report, 243.

SCERT. 2014–15, 2016–17. *Vigyanewam Prodyogiki*, Chhattisgarh state.