RSC-YUSUF HAMIED INSPIRATIONAL CHEMISTRY PROGRAMME IN INDIA

EVALUATION REPORT FOR TEACHER DEVELOPMENT PROGRAMME

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HOMI BHABHA CENTRE FOR SCIENCE EDUCATION

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RSC-Yusuf Hamied Inspirational Chemistry Programme in India

Evaluation Report
for
Teacher Development Programme

February 2019

Homi Bhabha Centre for Science Education (HBCSE),

Tata Institute of Fundamental Research (TIFR)

Mumbai, India

This report is regarding the evaluation of the teacher development component of *RSC-Yusuf Hamied Inspirational Chemistry Programme*. The work was carried by Homi Bhabha Centre for Science Education (HBCSE), Tata Institute of Fundamental Research (TIFR), Mumbai, India. The HBCSE members involved with the evaluation project were

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The necessary permissions and consent were obtained from the schools and participants for data collection done as part of this evaluation project.

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1. BACKGROUND

With a generous donation by Dr. Yusuf Hamied, the Royal Society of Chemistry (RSC) in the United Kingdom (UK) initiated the *RSC-Yusuf Hamied Inspirational Chemistry Programme* in India. The programme has two major components; one has its focus on students[1] (*Salters' Chemistry Camps*) whereas the other was primarily meant for teachers. The programme for teachers, referred as *RSC-Yusuf Hamied Teacher Development Programme* was initiated in 2014 and was conceptualised for five years. The main aim of this programme was to equip "8000 teachers across India with the specialist knowledge and skills to deliver exciting and engaging chemistry lessons, and to pass this knowledge to their colleagues"[2].

The model adopted for the teacher training programme RSC was as follows:

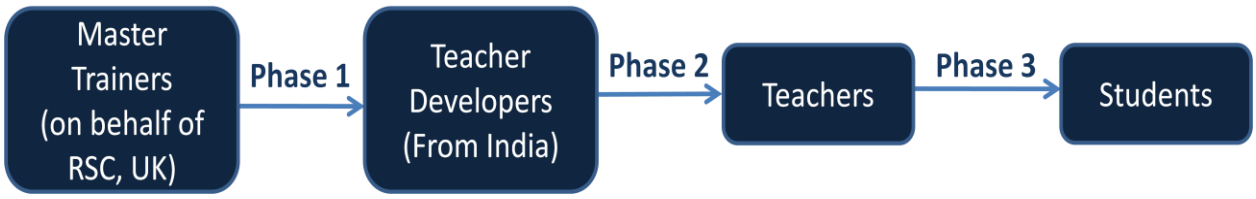


Figure 1: Teacher training model adopted in the RSC-Yusuf Hamied Inspirational Chemistry Programme

The above cascade model of teacher training was used to reach a target population of 8000 teachers and a larger group of students. Phase 1 of the programme involved training of 42 resource persons (referred to as Teacher Developers-TDs), from states of Karnataka, Kerala, Maharashtra and Tamil Nadu. These TDs had been selected through interviews. They were trained by experts i.e. Master trainers (MTs) from the UK on behalf of RSC. Three residential training workshops (of 5 days each) were conducted by MTs in the period June 2014 - August 2015 for the TDs in India. These programmes were conducted at the Homi Bhabha Centre for Science Education (HBCSE), Tata Institute of Fundamental Research (TIFR), Mumbai. Phase 2 of the programme involved teacher training workshops conducted by these 42 TDs, in different states of India including their own states. These workshops were conducted free of cost for the teachers. The TDs formally started the teacher training workshops in 2015. However, it was expected that some pilot teacher training programmes would have been conducted by them after their own level one training in 2014. The pilot programmes were meant to help the TDs to reflect on the implementation of the programme.

RSC-Yusuf Hamied Inspirational Chemistry Programme in India completes five years in 2018 and thus, it was planned to undertake an evaluation of the programme. HBCSE, TIFR, Mumbai, India, a leading research and development institution in the field of science and mathematics education began the evaluation of the teacher development component in January 2018. The evaluation is primarily focused on government and government-aided schools in the state of

[1] www.saltersinstitute.co.uk/

[2] www.rsc.org/careers/cpd/yusuf-hamied-inspirational-chemistry-programme/

Kerala, Karnataka and Maharashtra. From January 2015 to January 2018, a large numbers of training camps have been conducted by TDs in these states (614 camps for government/government-aided /private schools including more than 11,000 teachers).

For all the three states, the data for schools has been collected with a considerable time lag with respect to the training of teachers. It is important in any such study that the baseline information be collected about the schools and classroom practices, prior to the training, so as to understand the shift in the classroom teaching-learning scenario as part of the training. In the stipulated time frame available for data collection, efforts were made to collect baseline data for a few schools located in some parts of Maharashtra and Gujarat (Surat).

The data collected is primarily qualitative in nature as it is important to get impressions about the classroom teaching-learning practices of chemistry. Efforts were made to visit schools in different geographical regions of a given state so as to capture the diversity and complexity integral to such programme. For the states mentioned above, we could visit schools only once, and interact with teachers and students. In our opinion, more sustained visits would have been useful to develop an interaction with the teachers and to present even more enriched reflections.

We are thankful to RSC office in India, especially Mr. Ershad Abubacker and Ms. Bhakti Dhamdhere, for sharing the required data and also acting as liaison between HBCSE, TDs and schools. We acknowledge the key role of the TDs crucial for data collections in the schools. We received excellent cooperation from teachers, students (and their parents) and school managements, in the absence of which, the required data could not have been collected.

We hope the detailed report presents valuable glimpses about the progress of teacher development component of *RSC-Yusuf Hamied Inspirational Chemistry Programme* over the last five years along with some insights that will be useful for its shaping in the near future. HBCSE members involved with this work also have enriched their own understanding especially about chemistry education at school level.

2. OUTLINE OF THE STUDY

One of the main purposes of this study is to understand the progress of the teacher development workshops conducted as part of *RSC-Yusuf Hamied Inspirational Chemistry Programme* and whether it has impacted the chemistry teaching-learning scenario in the classrooms.

HBCSE interacted with the TDs, teacher participants and students (whenever possible) so as to capture the different aspects of the training programme. Before presenting the details about the data collection, it will be useful to discuss in brief the training received by the TDs themselves.

Training of TDs

This phase was carried out during 2014-2015 wherein the TDs were trained by master trainers from UK through three workshops, each of five days. The first two workshops were conducted in the months of September/October 2014 and in November 2014. The third workshop was conducted in August/September 2015.

The first workshop primarily covered active learning techniques (activities, games and puzzles that can be used to engage students in class), after which the TDs started conducting the teacher training workshops in their own states. During the second workshop, they were expected to share their reflections from the pilot teacher training programmes conducted by them. This workshop also covered some aspects of resource development for their future training workshops. The third workshop which was conducted with a gap of one year, that is, in August/September 2015 focused on content discussions for some of the core topics covered in chemistry syllabi at high school level in India, as well as misconceptions in chemistry and how to address the same. In addition, the TDs learned how to make active learning resources using ICT. One of the main aims of the third workshop was to help TDs to generate their own resources for teacher training programmes.

For training of TDs and teachers, the master trainers developed three modules that had bearing on the chemistry syllabi prescribed at the national level for secondary classes in India (NCERT, class 8-10). These designed modules were-

- Towards active learning: This module introduces the teachers to a wide range of Active Learning Strategies (ALS) (e.g. Concept map, card sorting, show-me board, bingo etc) that can be applied to teach various topics.
- Chemical reactions and equations: This module provides the teachers, techniques to simplify balancing of chemical reactions. It also includes games and activities to teach molecular formulas and types of chemical reactions.
- The particle nature of matter: This module tries to clarify an abstract concept like particle nature of matter and helps the teachers to identify and overcome students' common misconceptions.

The modules clearly state the objectives of the training programme. These modules were also analysed by us to gather information about the strategies and resources delivered to the TDs during their training. During the teacher training workshops, TDs distributed printed copies of the teacher booklet to the teacher participants.

Documents related to conduction of training programme, obtained from RSC (India) helped us to understand the facts and figures about the entire programme. We analyzed the documents to gather information about the programmes conducted for government/government-aided schools and to shortlist the schools for classroom observation.

Information about the teacher training programme

According to the data provided by RSC (India) office, the total number of workshops conducted by the TDs in the states of Karnataka, Kerala and Maharashtra, till January 2018 was 614. Of these, 39 workshops were conducted in the year 2015. The maximum numbers of teacher training workshops were conducted by TDs, during January 2016 to December 2016 (367 workshops). For the year 2017, there was a decline in the number of workshops conducted (208 workshops). For most of the teacher training workshops, the participants included teachers from private /government/ government-aided schools. The state in which maximum number of teacher training workshops were conducted was Karnataka and this was during the period of January 2015 to December 2017 (447 workshops).

Table 2.1 given below presents the number of teachers that were trained over a period of three years (2015 to 2017) and teacher workshops conducted till January 2018, as a part of RSC teacher training programme, in states of Karnataka, Kerala and Maharashtra (The maps of these states are given in **Appendices,** pages 64-66). The total number of teachers trained in these three states till 2017 itself has exceeded the target that was set at the initiation of RSC teacher training programme in India.

State ↓ Year →	2015	2016	2017	Total number of teachers	Total number of workshops conducted till January 2018
Karnataka	1571	4052	3901	9524	447
Kerala	362	623	21	1006	76
Maharashtra	598	578	203	1379	91
Total	2531	5253	4125	11909	614

Table 2.1: Number of teachers trained and teacher workshops conducted in states of Karnataka, Kerala and Maharashtra

3. DATA COLLECTION

A) From Teacher Developers (TDs)

❍ Survey Questionnaire

A questionnaire as a Google form was developed and used to collect preliminary data from TDs. This data consists of details about their demographic background, the teacher training workshops conducted by them, the language of the workshop, number of participants, kinds of schools, the forthcoming planned workshops etc. The form also had open and closed ended questions where TDs were asked to describe the challenges encountered during the training programme, resource development done by them as well as their impressions of their own training. The link to the form was mailed to 37 TDs **(Table 3.1)** whose email IDs were made available to us by RSC. Of these 37, we received responses from 21 TDs. Some of these TDs were interviewed by us at a later stage to get a better understanding of the concerned aspects. **Table 3.2** presents the professional background of these TDs.

States	**No. of TDs (link mailed)**	**No. of TDs (responded)**
Andhra Pradesh	1	1
Karnataka	17	12
Kerala	9	5
Maharashtra	9	3
Tamil Nadu	1	0
Total	**37**	**21**

Table 3.1: Regional distribution of TDs

Professional background	**Number**
In-service teacher/Principal at school	7
Lecturer/Assistant Professor at college	5
Involved as Resource person/Subject Expert (for private organisation)	4
Freelancer Educationist/Trainer	2
Retired (Teacher/Principal/ Scientist)	3
Total	21

Table3.2: Professional background of TDs

- Interviews

The TDs we interviewed (number-12) ranged across a spectrum of individuals (those who made significant contributions for the training as well as those who had not been able to conduct many workshops).The interviews were conducted in person except for one TD who was interviewed telephonically. All interviews were audio recorded. TDs were also requested to exhibit their own resources or the actual photographs of the resources developed by them.

- Observation of the teacher training workshops by TDs

We observed the training workshops (number-7) conducted by TDs in the states of Gujarat, Kerala, Karnataka, Madhya Pradesh, and Maharashtra. Observing these workshops helped us to comprehend the salient features of the workshop, the actual conduct of the activities and participation/interactions of the participants. We selected those workshops which had participation of science (chemistry) teachers from government/government-aided schools, teaching at secondary school level.

B) From teachers

Representative samples of government/government-aided schools were selected from the states of Kerala, Karnataka, Maharashtra and Gujarat for pre/post-training data collection. We once again used questionnaire and interviews as tools for data collections from teachers. The necessary details about selection of sample schools in each state are discussed in section 4, which is 'Analysis of the data', under sub-section 'About the school'.

- Questionnaire

A questionnaire was administered to the teachers post their training during our school visits. This questionnaire comprised of three parts and had both open and closed ended questions - a) The first section had questions related to personal information about the teachers and general information about the schools, b) The second section covered questions related to the syllabus followed, medium of instruction, facilities available, class strength, etc. and c) The third part consisted of questions regarding the teachers impressions of the RSC teacher training workshop and their implementation of the RSC activities in their own classrooms.

For the states of Maharashtra and Gujarat, baseline data was collected using another questionnaire which primarily contained questions related to the training programmes that were attended by the teachers in the past and the teaching methodologies used by them in their classrooms.

- Interviews

The interviews conducted with the teacher participants helped us to understand teachers' responses to the questionnaire in greater detail. For the teachers who had been implementing the activities from the RSC workshops, we tried to understand – a) how the activities were modified

and incorporated for their own classroom b) how frequently these were being implemented c) challenges faced for preparation of resources and implementation of such activities and d) the lesson plans made by the teachers. We managed to interview some of the teacher participants who could not implement these and the interview questions were focused more to understand the reasons for the same.

- Classroom observations

Direct classroom observations were conducted during school visits to the schools mentioned in **Table 3.3** to gain firsthand experience about the implementation of active learning strategies and RSC resources. We also tried to understand the existing mode of chemistry teaching in the classrooms, nature of practical activities conducted in the classroom, participation of students and their interactions in the classroom as well as the availability of infrastructure and the facilities at the schools.

C) Focus group discussions with students

After the lesson observation, 3-4 students who volunteered were selected from the class for a focus group discussion. In most of the schools, while selecting students for discussion, an attempt was made to maintain equal female-male ratio. We could conduct such discussions in most of the schools where lesson observations were done. The participant students were free to respond in the language they were comfortable in and they often chose their regional language (Hindi/Malayalam/Marathi). All these languages were known to the person conducting the focus group discussion. Each discussion lasted for 15-20 minutes. One of the primary purposes of such discussions was to get feedback about classroom teaching in general and also to understand whether RSC or equivalent activities were being used in the classes. Such discussions were audio recorded and transcribed for data analysis.

Overall, the post-training data was collected from 36 government/government-aided schools and 34 teachers filled the questionnaire administered by us. Students' focus group discussions were conducted in 24 schools whereas classroom observations were done in 25 schools. While preparing the preferred list of schools for data collection, efforts were made to include schools from different geographical locations across the state covering urban/semi-urban and rural regions **(Appendices,** page 64-67**)**. In the state of Kerala, the data collection could be done only in 5 schools as torrential rains had significantly affected the state.

As mentioned earlier, we did visit some schools prior to the teacher training to collect baseline data (Maharashtra and Gujarat). In Maharashtra, we visited four schools in Bhor (a region located near Pune, about 200 km away from Mumbai) and five schools in Ratnagiri (a district in Konkan region, about 340 km away from Mumbai). We also visited four schools in Surat (a city in the state of Gujarat, about 300 kms from Mumbai) prior to the scheduled teacher training programmes by RSC (India). The post-training data collection was done during December 2018 to January 2019, through school visits. **Table 3.3** presents the State-wise distribution of schools from where the data was collected.

Places	No. of schools visited	No. of Teachers who filled the questionnaire	Teacher interviews		No. of Focus group (Students)	No. of Classroom observations
			With audio recording	Without audio recording*		
PRE TEACHER TRAINING						
Maharashtra						
Ratnagiri	5	5	5	-	5	5
Bhor (Pune)	4	4	4	-	4	4
Total	**9**	**9**	**9**	**0**	**9**	**9**
Gujarat						
Surat	4	4	4	-	4	4
Grand Total	**13**	**13**	**13**	**0**	**13**	**13**
POST TEACHER TRAINING						
Karnataka						
Raichur	2	2	2	-	2	2
Davanagere	1	1	-	-	1	1
Udupi	4	4	4	-	4	4
Bangalore Rural	3	3	3	-	3	3
Total	**10**	**10**	**9**	**0**	**10**	**10**
Kerala						
Idukki	1	1	1	-	-	-
Calicut	1	1	1	-	1	1
Malappuram	3	3	3	-	2	2
Total	**5**	**5**	**5**	**0**	**3**	**3**
Maharashtra						
Jalgoan	5	5	4	1	4	4
Junnar(Pune)	3	3	3	-	3	3
Ambegaon (Pune)	2	2	2	-	2	1
Ratnagiri	4	4	2	-	1	1
Bhor(Pune)	3	3	3	-	-	-
Total	**17**	**17**	**14**	**1**	**10**	**9**
Gujarat						
Surat	4	2	1	-	1	3
Grand Total	**36**	**34**	**29**	**01**	**24**	**25**

Table 3.3: State-wise distribution of sample schools

*- detailed notes were taken by the interviewer (since the participant did not give permission to record)

4. ANALYSIS OF THE DATA

The current section presents observations, based on the data collected as part of the evaluation study. As discussed before, the data is collected by attending the training workshops conducted by TDs, by interacting with teachers, classrooms observations and focus group discussion with students wherever possible.

A) **Observation of teacher training workshops by TDs**

We were able to attend seven teacher training workshops conducted by the TDs. Of these most were of two days duration, however, occasionally this duration was reduced to one and a half day, due to time constraints. These workshops were generally as per the expected format where the RSC modules were primarily used for training. TDs included examples from subjects like biology, physics and mathematics while teaching the first module (Active Learning Strategies) so as to make the workshop more inclusive for a mixed group of teachers. The medium of instruction used for teacher training workshops was predominantly English; however, regional languages like Hindi, Kannada and Malayalam were also used along with English. Mostly, teacher participants had completed their higher education through English medium colleges and thus language comprehension was not an issue during training workshops. We also witnessed that efforts were made by the TDs to prepare activity cards in the regional languages so as to enhance participation of the teachers in the workshops.

TD's reported and we observed that teachers were quite engaged with the activities during the workshops and were in general very positive about the training in their verbal comments in the feedback session. However, teacher participants also commented about the lack of availability of resources in their own language, during the feedback sessions. Among the training programme observed by us, the number of participants varied from 30 to 50 and this was a challenge to the TDs at times. Often the session on misconceptions was compromised, due to time constraints. Thus, the research dimension, ideas about constructivism and students' conceptions were often missing in the workshop and these were not communicated to teachers.

B) **Data obtained from TDs**

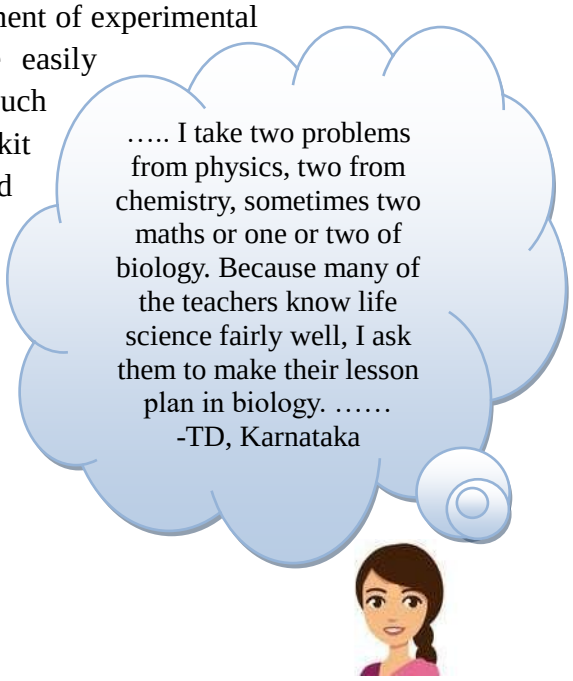
- TDs' Impressions of the training they received

Overall, the TDs were highly appreciative of the training they had received. There was a consensus amongst the TDs, who responded to the questionnaire that the RSC training equipped and empowered them for conducting the teacher training programme. Some of their responses were - i) the workshops had a good balance of discussion regarding content as well as about the active learning strategies, ii) the training enhanced their own understanding of teaching skills and forced them to think out of the box, iii) it motivated them to learn more about both chemistry

content and pedagogy and iv) the workshops helped them to reflect about the teaching-learning processes and helped them to mature as facilitators.

❍ Resources developed by the TDs

The discussion in this section is based on our observations of teacher training workshops. A significant contribution by TDs is the development of experimental activities. Efforts were made by TDs to use easily available low-cost materials to conduct such activities. One TD had developed a micro-scale kit for various chemistry experiments and had created a YouTube channel to upload the demo videos. These contributions are important as experimental activities are generally not done in schools. Some TDs made efforts to include experiments in addition to those discussed in the RSC modules. Some of these contributions are presented in this report.



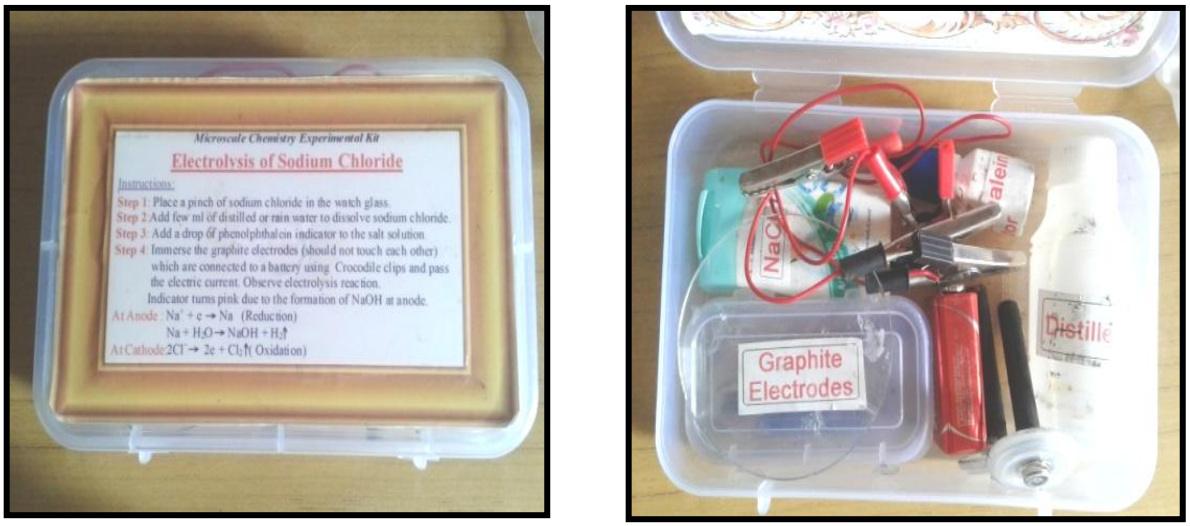


Image 1: Micro-scale kit developed by a TD (Karnataka)

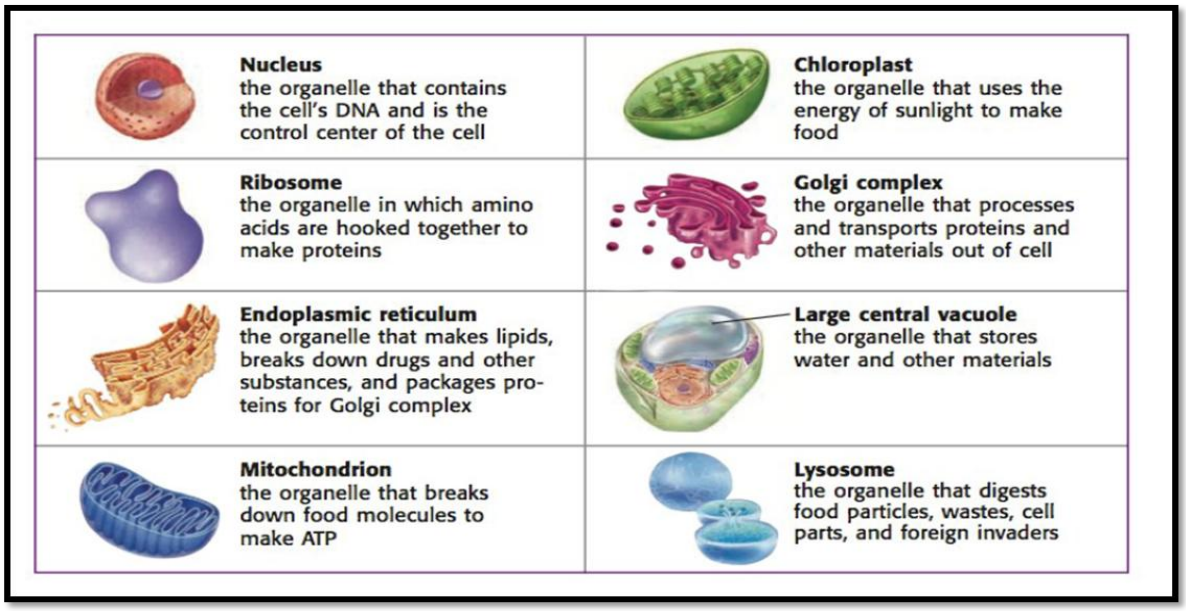


Image 2: Card sorting activity for cell organelles developed by a TD (Karnataka)

Moreover, some TDs included experiments in biology and physics too. In addition, some TDs translated the activity cards into regional languages (Kannada and Marathi). We also observed that the active learning strategies had been extended to subjects like biology, physics and mathematics.

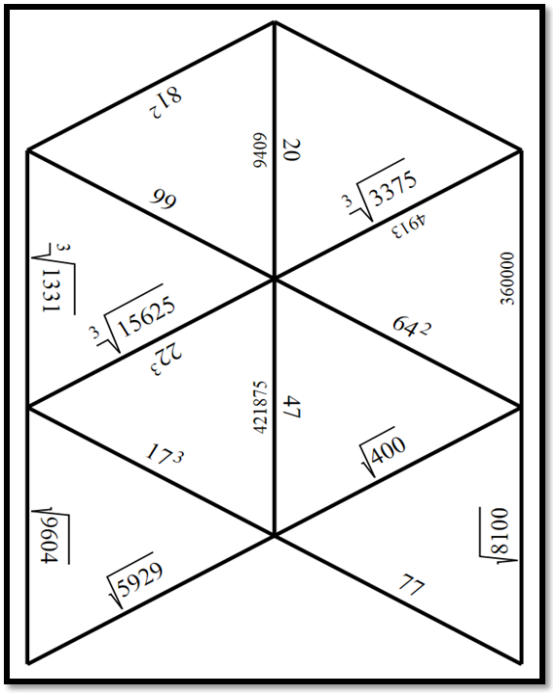


Image 3: Tarsia grid for square roots and cube roots developed by a TD (Karnataka)

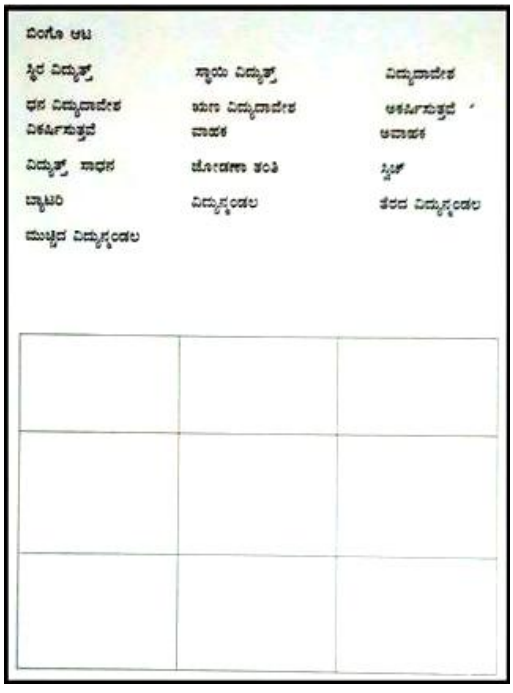


Image 4: Bingo activity translated by a TD (Karnataka) in regional language (Kannada)

❍ Challenges faced by the TDs

TDs (number-21) reported different challenges faced by them for conduct of the training workshops. We have collated these challenges in **Table 4.1**. Two of the major challenges were- the time allocated for the actual academic sessions and the number of teacher participants in the programme.

Challenges	**Number of TDs**
Medium of instruction	4
Content to be discussed	2
Time constraint	12
Number of teacher participants in the programme	11
Space crunch	4
Teachers' motivation	4
Lacunas in content knowledge (of participants)	6
Lack of enthusiasm to learn new teaching methodologies	5
Low interest in learning new content (of participants)	4

Challenges listed by TDs under category *other challenges*

- Providing resources in regional language
- Demands for more resources (especially related to the curriculum)
- Dealing with a diverse group of teachers with different subject background
- Teachers' resistance to change
- Organizing workshops being difficult and time consuming
- Inadequate labs and lack of proper infrastructure in schools

Table 4.1: Challenges faced by the TDs

These challenges differed from state to state. In Kerala, the state government conducts their own teacher training programmes during vacations. Thus, most school authorities are not keen to send teachers for additional training programmes like those organised by RSC trained TDs. In addition, as RSC trained TDs in Kerala are in-service teachers, attending government trainings is mandatory for them. Thus, time available for conducting workshop for these TDs is curtailed.

A similar situation existed in Maharashtra. Majority of the TDs in the state are in-service teachers associated with private schools. One TD pointed out during the interview that limited leave is granted to them per year, which is one of the major constraints for conducting workshops. Additionally, the time and persistent efforts needed to seek permissions from the principals are other hurdles. TDs from Karnataka stated that contacts with government officials are essential

while organizing workshops for government school teachers. Therefore, the TDs who did not have such contacts were not able to conduct more workshops.

Other challenges mentioned by the TDs were - i) getting an exclusive group of chemistry teachers for the workshop was a difficult task, ii) the training programme is restricted to chemistry and in reality often science teachers (involved with teaching of biology and physics) and/or teachers from other subject discipline are participants. In such cases, catering to the needs of such participants is difficult so is meeting the challenge of sustaining their interest, iii) lack of a team on behalf of RSC (India) who could help in organisational aspects and iv) challenges faced in dealing with authorities, especially those from non-chemistry backgrounds, who were not cognizant about RSC and its education outreach programmes. TDs also mentioned lack of proper labs and equipments in schools as a challenging situation for conducting teacher training workshops. TDs felt that the training programme did not demand any follow up after teacher training and in their opinion, this has been an important limitation of the programme. They suggested that follow up needs to be integrated into this programme. In their opinion, more workshops need to be conducted for the same participants along with visits to the schools. Such a step will lead to sustained interactions with teachers.

- Strategies used by TDs to overcome obstacles

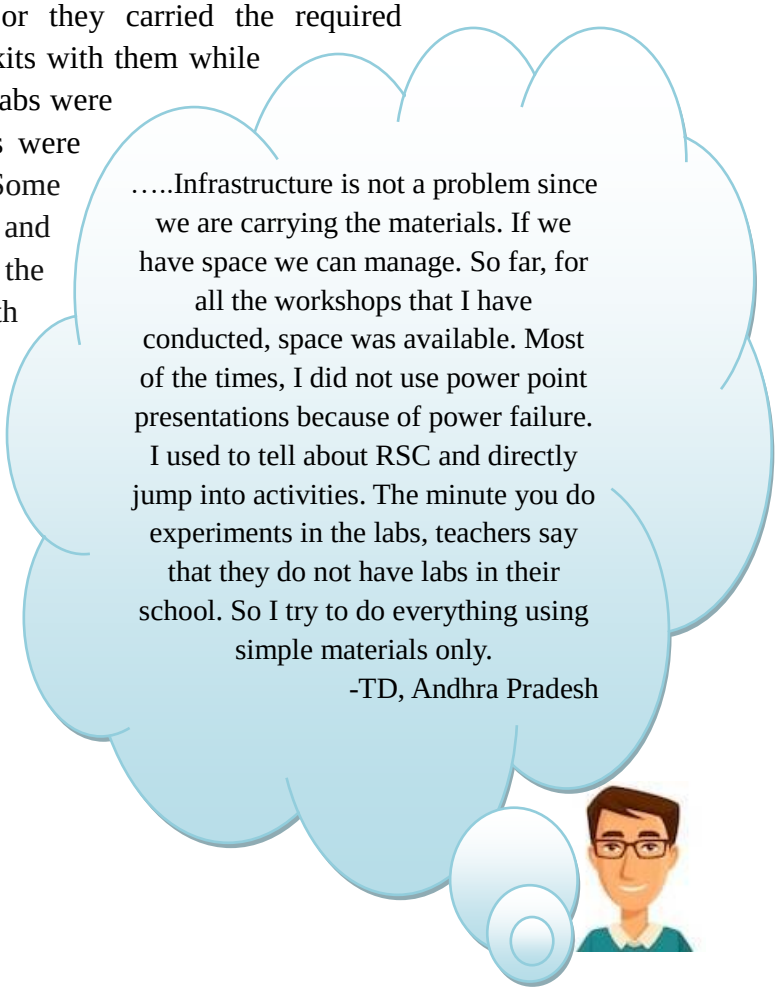
In Karnataka, personal contact with the officials from District Institute of Education and Training (DIET) helped the TDs in organizing the workshops. At times, the Deputy Directors of Public Instruction (DDPI) and District Educational Officer (DEO) supported their cause. Some TDs worked in collaboration with organizations like Agastya International Foundation (AIF) and Rotary Club that strive for similar causes. Such partnerships not only proved beneficial for both the partners in terms of achieving the targets and using funds efficiently, but also enhanced the feasibility of accessing the government school system.

> Most of the government school teachers demand for resources in regional language…
> We use both English and the native language to deliver the content and convey the subject. I have a very good collection of curriculum based resources in the regional language which I share with all the teachers during the training. I also share language software with the teachers so that they can generate their own resources in regional language.
>
> -TD, Karnataka

While organizing workshops, through government officials, the TDs did not have much control over the intake of teachers or the number of teachers. There were instances where the number of teachers attending the workshop had exceeded 100. Even though dealing with large group of teachers during workshops was mentioned as a challenge by most of the TDs, some of them successfully dealt with such situations through team work. Increasing the number of TDs per workshop and dividing the teachers into smaller groups were the most common strategies adopted by the TDs. Under circumstances where splitting the large group of teachers into smaller batches did not seem

feasible despite larger number of TDs, the TDs took turns to conduct the workshop. While one TD delivered a module, the others continued to guide the teachers.

Some TDs conducted the activities and practical sessions in the school auditorium; hence health and safety parameters were difficult to follow. For the practical sessions, TDs either used materials that were easily available or they carried the required chemicals and micro-scale experiment kits with them while conducting workshops in places where labs were not available. Glassware and apparatus were also replaced with low-cost materials. Some TDs used their own laptops, projectors and UPS devices during the training, while the others substituted the projectors with easily available materials like blackboards, flip boards and chart papers for rural schools.



The following table gives description of the strategies that were adopted by TDs to overcome various challenges faced by them for organisation and conduct of workshops. Such efforts indicate the commitment in conducting the workshops of TDs.

Challenges encountered by the TDs	Strategies adopted by the TDs
Organizing workshops	• Using personal contacts • Using Public-Private partnership
Non-availability of proper infrastructure and materials	• Carrying essential chemicals, laptop, projectors, UPS and other requirements with them. • Substituting glass wares and apparatus with easily available low-cost materials
Dealing with large group of teachers	• Increasing the number of TDs per workshop and dividing the teachers into smaller groups.
Teachers who speak regional languages	• Using combination of both English and the regional language whenever possible. • Requesting participant teachers to translate some of the technical terms. • Including games and activity cards in regional languages.
Dealing with mixed group of teachers (Science, Mathematics etc.)	• Including few games and activities related to non-chemistry subjects.

Table 4.2: Strategies adopted by TDs to overcome challenges

C) Data obtained from school visits and interactions with teachers

i) Karnataka

❍ Background

In the state of Karnataka, the data collection was done during July, 2018. The sample comprised of 10 schools from four districts of Karnataka, namely, Davangere, Raichur, Udupi and Bangalore rural **(Appendices,** page 64**)**. Teacher participants from these schools had attended the teacher training workshops during 2016-2017.

❍ About the schools

All the schools selected for data collection were government schools located in rural regions of the state. Most of these schools had one or two divisions for each grade. The predominant medium of instruction was Kannada however some of the schools offered English or Semi-English medium (science and mathematics are taught in English language) in addition to Kannada. The number of students per class varied from 30-60 for the Kannada medium classrooms whereas English / Semi-English medium divisions tend to have comparatively fewer students. With respect to infrastructure, most of the schools had a small library, laboratory space

and playground. Some of these schools were equipped with LCD projectors and screen. The students in these schools were primarily from lower socio economic background.

❍ Syllabus

Karnataka state syllabus, updated in 2017, is based on the national NCERT syllabus and the topics covered in the RSC modules were part of their chemistry syllabus. For grade 9 and 10 Karnataka state board schools use NCERT textbooks. **(Appendices,** pages 68-69**)**

❍ Impressions from classroom observation

Some of the observations from the classrooms are as follows -

- The active learning strategies were implemented in the classrooms, and were primarily used for evaluation after teaching the topics.
- During the classes observed by us, these activities were used primarily as tools for assessment/evaluation rather than for actual teaching-learning of the chemistry.
- In 2-3 schools, teachers were highly motivated and implemented the active learning strategies using other resources, for e.g. slates were used as show-me boards, Rangoli powder (easily available- low-cost material) was used for drawing diagrams.

> ...Definitely, we would like to have few more training sessions for activities related to building the concept rather than evaluation/assessment.
> -Teacher, Karnataka
> (This teacher felt that the activities are for assessment)

- We also observed that teachers were using the active learning strategies not only for chemistry but also for topics for subjects like physics, biology and mathematics as well.
- Chemistry experiments were demonstrated in the class by the teachers and not actually done by students.
- Micro-scale experiments even though appreciated the most by teachers, were not used in classrooms.
- In one of the schools in Bangalore rural, it was observed that groups of students took turns to teach the topics in the class where the teacher acted as the facilitator.

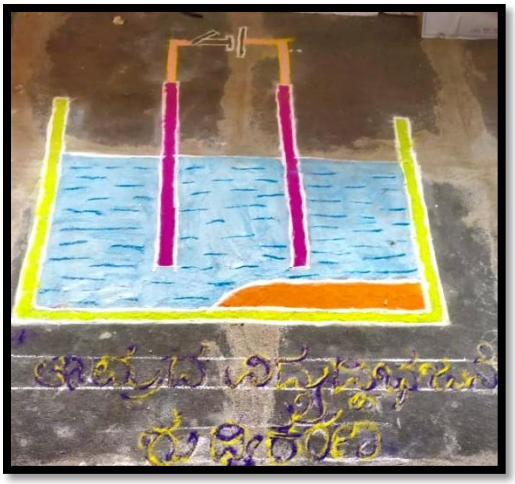


Image 5: Diagram using Rangoli powder

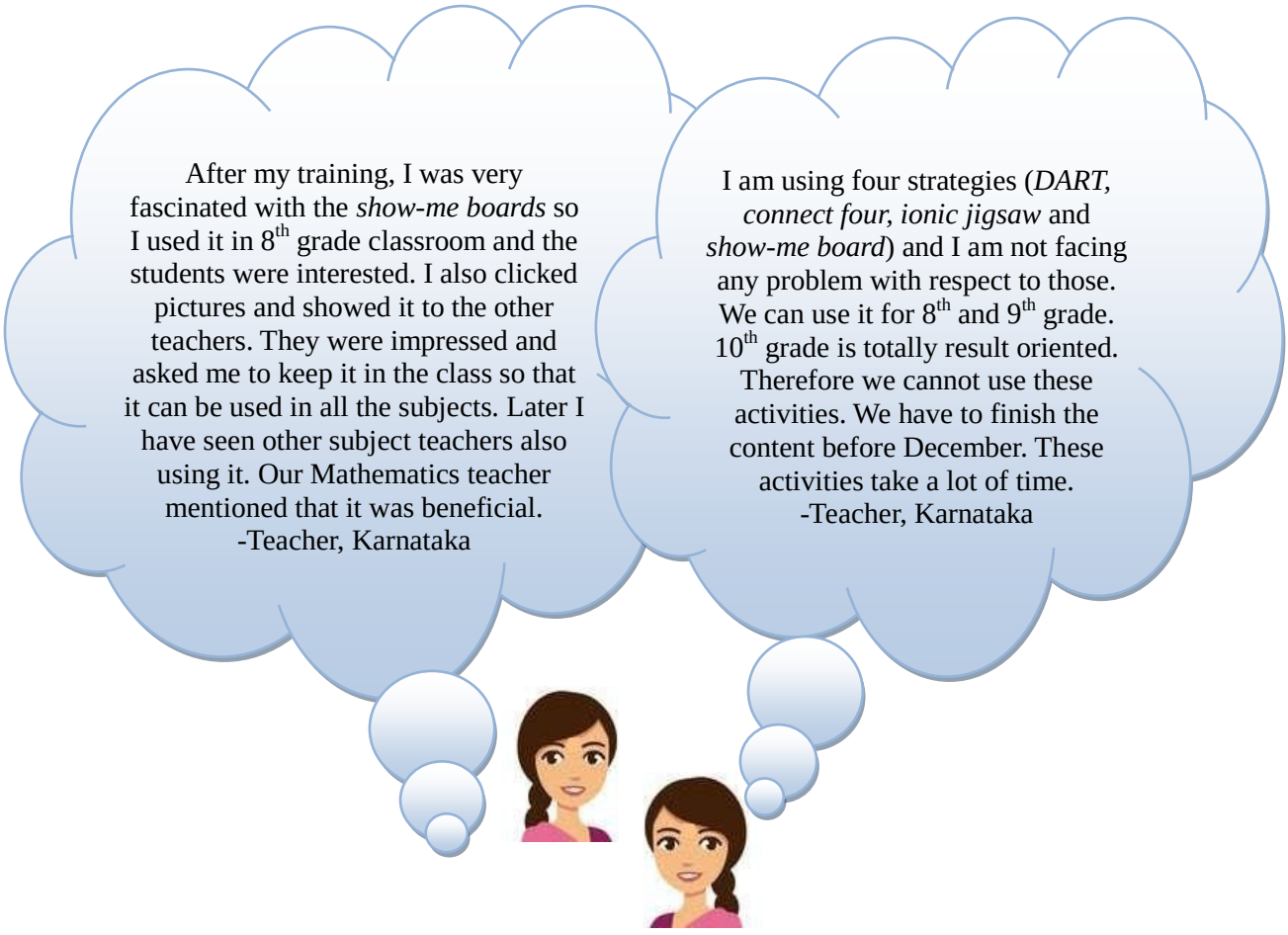
Image 6: Use of show-me boards in a Karnataka school

Image 7: Demonstration of chemistry experiments in class by a teacher.

Image 8: Availability of LCD projector facility in the classroom

❍ Impressions from teachers' responses to questionnaires and interviews

The teachers in Karnataka in general were positive about the training they received and perceived the same as one of the best training programmes attended by them. They also stated that the programme covered a variety of hands-on activities, content enrichment, development of resources and pedagogy and they were actively engaged during all the sessions. The micro-scale experiments were liked the most by these teachers. They also opined that the activities were interesting, innovative, user friendly and feasible in their own schools. Most of the activities were used by the teachers in the classes that we observed except the Directed Activities Related to Text (DART). Teachers did say that the DART cannot be used due to poor reading skills of the students. Teachers felt that that more training sessions need to be conducted by TDs, as such a step will help them to understand how to use the active learning strategies for introducing and teaching new concepts. In fact, they expressed a need for more frequent training workshops of such type of extended duration.



In the schools visited by us, there was only one science teacher who was expected to teach all three topics of the integrated science and technology. At times, mathematics was also taught by the same teacher. Some teachers opined that both preparation of teaching resources for active learning and classroom implementation of the same demands time, which is difficult to get. During the interviews, one teacher mentioned that to overcome this challenge, a group of

teachers from nearby schools have started exchanging the resources developed by them, thereby reducing the time and efforts required to prepare the resources. Teachers have also been using the chemical jigsaw puzzles to keep the students engaged in absence of science teacher.

❍ Impressions from focus group discussions with students

Most of the students from Udupi district were familiar with the active learning strategies which indicate that they are being used in the classrooms fairly regularly. Students from one of the schools in Karnataka (Kolbal region) mentioned that they themselves make tarsia and card-sort puzzles for various topics which were their favourite. In fact, they also included 'show-me' boards, and bingo in this list.

Interviewer: Do you play games in chemistry class?
Student: Yes.....We solve puzzles in groups. We join cards to make square shape, parallelogram and triangle. (Students are actually describing *Tarsia*)

- Focus group, Karnataka

Excerpts from focus group discussion with students

Interviewer: In your classroom, all of you had a white laminated sheet with you. What was that?
Student: When teacher asks questions, we write answers and show it to teachers. We do not tell.

- Focus group, Karnataka

ii) Kerala

❍ Background

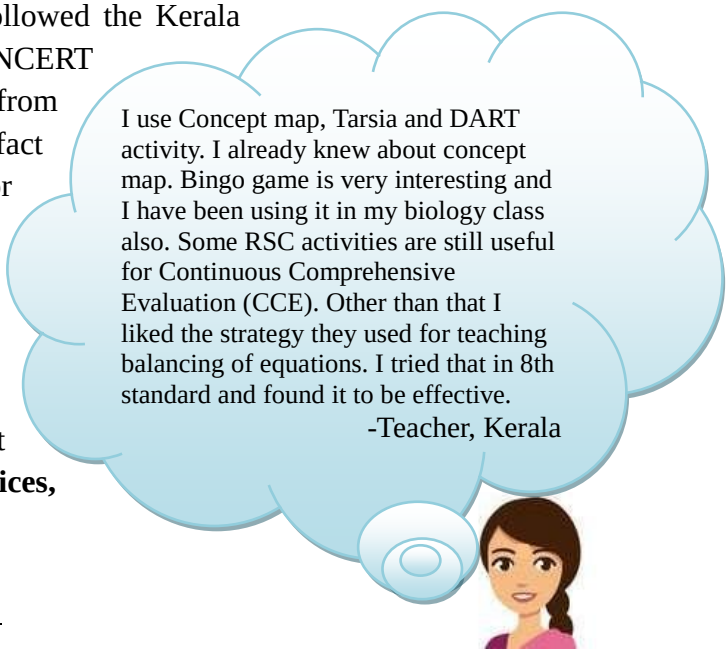
The data collection in the state of Kerala was done during the month of October, 2018. As a result of the unexpected torrential rainfall, sample schools available from Kerala was restricted to 5 schools spread across three districts of Kerala, i.e. Idukki, Calicut and Malappuram **(Appendices,** page 65**).** Classroom observations could be done for three schools which were shortlisted by one of the TDs. The teacher participants from these schools had attended the RSC teacher training workshop during 2015-2016.

❍ About the schools

The schools were located in rural, semi-urban and urban regions of the state. All the schools had both English and Malayalam medium divisions except for one school, which solely had Malayalam as the medium of instruction. Even though the number of divisions in the Malayalam medium school was lower, all the other schools had more than 15 divisions per grade at the secondary school level. The number of students ranged from 30 to 50 in each division. With respect to infrastructure, all four schools had a library, laboratory, playground, computer lab and an auditorium. The teacher participants from four of the schools were chemistry graduates and their teaching experience ranged from 10-25 years.

❍ Syllabus

The schools selected for data collection followed the Kerala State syllabus which is aligned to the NCERT syllabus. However, what makes it different from the other states that we have visited is the fact that they have three separate textbooks for physics, chemistry and biology for grade 9 and 10. Moreover, these subjects are further divided into two semesters whereby every year the students are expected to learn 7-8 chapters of chemistry. Science practical examinations are not conducted for grade 8, 9 and 10**. (Appendices,** page 68-69**)**



❍ Impressions from classroom observations

During school visits we could sense that educational system in Kerala was different from the other states visited by us. Only 3 school classrooms were observed by us, two for grade 9 and one for grade 8. The topic *Chemical reaction was* being taught in two of the classes and the third

one involved *Classification of elements*. In all three classes, teachers asked questions to revise the topics taught in the previous class. Students were then explained the core chemistry content.

While teaching *Chemical reactions*, teachers demonstrated experiments and asked probing questions based on students' observation. In one school, the teacher divided the students into groups, provided trays with all the materials required for the experiment, showed a demo video of the same experiment and then asked the students to perform the same experiment.

> Concept mapping because it can be applied to summarize any concept and students will get a holistic view of what we have taught in the class. Sometimes when students get bored, I use the *show-me boards*. I ask them to use their notebook as a board.
>
> -Teacher, Kerala

For teaching *Classification of elements*, the videos available on *Samagra* an e-resource portal were used. Concept maps and card sorting (from RSC-training) were the most common active learning strategies used in class and they were used mainly as assessment or revision tasks. Discussion with students also indicated the same. In one of the classes, students' notebooks were used as *show-me boards*. Most of the government school classrooms in Kerala are equipped with laptops and projectors.

Image 9: Students performing chemistry experiments (Displacement reactions)

❍ Impressions from teachers' responses to questionnaires and interviews

The five teachers interviewed by us seemed to be highly active and self motivated. They were of the opinion that the programme primarily covered demonstrations, activities and development of

resources, which were interesting and innovative. Concept map was the most frequently used activity in the classroom. Another interesting aspect is that most of the schools visited by us had inclusive education teachers to help the students with poor reading - writing skills and other learning disabilities. In absence of such teachers, the regular teachers would take turns to conduct remedial classes for these students after school hours. The students with learning disabilities were encouraged to complete activities like *tarsia*, *concept map* and *DART*. However, teachers stated that they were not using these activities frequently in their classroom.

We have S*amagra* where we get the images and videos of the experiments that are difficult to perform in class. Every classroom is hi-tech, we have laptops in class. We make lesson plans and upload it for H.M's approval. We also have internet facility, if not we are also allowed to carry the resources in pen-drive or mobile phones.

-Teacher, Kerala

It was mentioned during the interviews, that the teachers have only two periods per week for teaching chemistry in secondary schools and they have approximately 8 chapters each to teach in grades 9 and 10. Under such situation, the primary focus of teaching is syllabus completion. In their opinion, doing activities in classroom is time-consuming and also creates discipline related issues which affects classroom management. These were stated as main reasons for not implementing the activities in classroom on regular basis. Existing number of students in the class was considered as yet another constraint for implementation of these activities, even though they interesting.

Image 10: A classroom in Kerala (Use of e-resources)

- ✓ The future trainings should be based on the hi-tech classrooms and it should include experiments and resources based on the syllabus.
- ✓ In Kerala, the classrooms have totally changed. We have smart rooms now so RSC too should find some new techniques.
- ✓ If resources are in a CD, we can use it in the classroom and I think it will be more helpful rather than using the cards and other things. -Teacher, Kerala

Teachers further mentioned that certain chapters in chemistry like *organic chemistry*, *metallurgy*, *mole concept* etc. are difficult for students even with the use of the activities. In their opinion; the current activities were not useful with respect to numerical problems in chemistry, which was yet another difficult area for those students who had difficulties with mathematics.

According to the data provided to us by RSC (India), no workshops were conducted in Kerala during year 2017 for government school teachers. We were keen on understanding the factors that hampered the conduct of RSC teacher training workshops. When probed, one of the teachers mentioned that in Kerala, technology is an integral part of classroom teaching-learning practices at school level. In addition, we were told that the government spends a lot of money from their budget on strengthening the public education system and they have introduced *Samagra*, an e-resource portal. Along with the textbooks, this portal provides various resources like activities, videos, descriptions about experiments, downloadable resources, lesson plans etc. Teachers in Kerala are using resources available on *Samagra* on continuous basis, as they are syllabus oriented and are available in the regional language. Thus, in our opinion the school education scenario in Kerala is different and needs to be considered for implementation of RSC training in this state.

❍ Impressions from focus group discussions with students

Students from both the schools in Malappuram mentioned that they play card-sorting games in their chemistry classes. At times, their chemistry classes were conducted in the labs, where the teachers not only demonstrated the experiments but also allowed students to perform them in groups. Students from Calicut region were familiar with concept maps since their teachers used the same for assessment or revision, after completion of each chapter.

Excerpts from focus group discussions with students

Interviewer: Do you use concept map frequently?

Students: Yes…. After every chapter, we are given concept maps which cover the important concepts in the chapter. We fill it and return to our teacher. It is just to check whether we have understood the chapter. We do not get it back. Concept maps are usually easy so most students can fill it but Unit tests have tough questions.

- Focus group, Kerala

Interviewer: Why do you like chemistry?
Students: Sir always takes lectures in the lab. He arranges the tables and chairs, and keeps materials ready. He makes us do experiments and teaches us topics in the lab itself. He does not teach the chapter first. He shows us the experiments first. Initially sir used to make us sit in a big circle and demonstrate the experiments. Later he divided us into groups. Since then every group gets to do experiments. We also see videos of experiments on smart board. Even our classrooms have projectors. -Focus group, Kerala

iii) Maharashtra

❍ Background

For the State of Maharashtra, post-training data collection was done from Jalgaon, Junnar and Ambegaon (latter two are part of Pune) In addition; we visited Ratnagiri and Bhor (Pune). At these places, data collection involved two phases. In phase I, the sample schools were visited to obtain baseline data before the scheduled teacher training workshops whereas, phase II involved school visits for post-training data collection. It was possible to do so as these places are comparatively in close proximity to HBCSE. In addition, the teacher training workshops in these places were scheduled during the evaluation period. In the following sections, we will first present the impressions from post visits to Jalgaon, Junnar and Ambegaon followed by those for Ratnagiri and Bhor (Pune). **(Appendices,** page 66).

❍ Syllabus

All schools visited by us follow the syllabus prescribed by Maharashtra State Board which offers integrated science textbooks up to grade 10. The state board science syllabus for grade 9 was revised in year 2017 whereas for grade 8 and 10, the new syllabus was implemented during the academic year 2018 - 19. Both old and revised syllabi have a bearing on the present NCERT syllabus. In each grade the syllabi include 4 - 6 chemistry chapters**. (Appendices,** pages 68-69**).**

Jalgaon, Junnar and Ambegaon (post-training visits)

❍ Background

We visited 5 schools in Jalgaon district, 2 schools in Ambegaon, and 3 schools in Junnar in July-August 2018. The teacher training workshops in Junnar and Jalgaon were conducted in January 2018 and that in Ambegaon was conducted in May 2016. Thus, we visited these regions after 7 and 26 months post teacher training workshops respectively.

❍ About the schools

The schools selected were government-aided schools located in rural, semi-urban and urban regions. The medium of instruction was predominantly Marathi. These schools varied substantially in terms of infrastructure and the facilities. Both schools in Ambegaon were using technology for teaching science. They had good labs and also a tinkering lab. On the other hand, the sample school in Pal region, Jalgoan, was tribal residential school with a projector facility in the classroom but no actual laboratory. In this school, the communication in the classroom was in *Pavri-Bhili*, a language significantly different from conventional Marathi language. In addition, the schools in Jalgoan had shifted to semi-English medium for teaching of mathematics and science few years back. Such a shift presented language as one of the major challenges for students in general and also for some teachers.

❍ Impressions from classroom observations

We could observe that the teacher participants in Jalgaon district (except for the school in Pal) were using the active learning strategies. However, we did not get a clear idea about how frequently ALS and other RSC activities were used in the classrooms. Activities like *tarsia* and *bingo* were being used even at the primary school, for environmental studies classes. It was observed that the students needed substantial time to complete the activities and there was practically no discussion among students and teacher. So it is rather difficult to comment on learning on behalf of students in these classrooms. In Junnar, we could observe the ALS (modified version of *DART*) being used in one of the three schools.

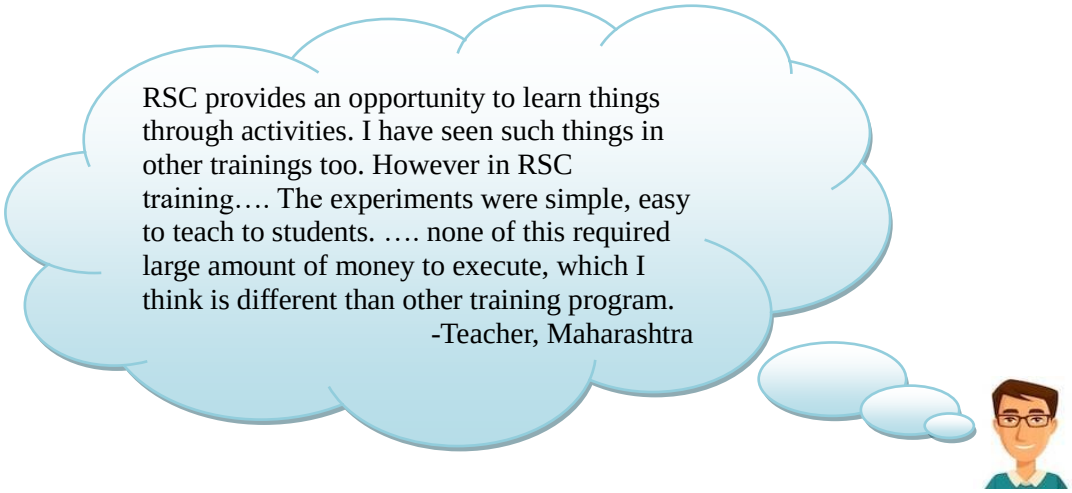
Image 11: Biology class in Junnar (Maharashtra)

Image 12: Card sorting activity by a teacher (Disease and disorder)

For Ambegaon, we did not see use of RSC activities in the classrooms. Since both these schools were using ICT integral to science teaching, perhaps they were not using the RSC activities. Moreover, we noticed that some of the teachers had made efforts to extend ALS to topics in biology and physics as well.

- Impressions from teachers' responses to questionnaires and interviews

Teachers in general opined that the ALS were- i) interesting and resources for ALS were easy to develop, ii) useful to the students with respect to learning formulas and definitions and
iii) effective in reinforcing the concepts taught.
Some of the teachers, especially from rural and tribal schools in Jalgaon stated that they were not able to internalize the contents of the workshop due to language issues, even though they found it interesting. They did comment about the need for more frequent workshops. We felt that continual workshops, especially in Marathi, will help to internalise ALS and related activities.



- Impressions from focus group discussions with students

We had focus group discussions in almost all these schools with students who spoke to us about the kind of activities they perform and also about use of technology (for some schools). We understood that in one of the schools in Ambegaon, located in a rural region, students had considerable freedom to do hands-on activities. We could see they were using virtual laboratory for physics and were familiar with chemistry virtual laboratory. However, in all these areas, students did not give any evidence about their familiarity with ALS and other RSC activities. These facts clearly indicate that all these schools did not implement the ideas from RSC training, for the reasons discussed above, which include language issues.

As explained before, both Ratnagiri and Bhor involved two phases of data collections. We have described them separately as there is difference in the schools selected for data collection.

Ratnagiri

❍ Background

For baseline data collection, we visited six schools in Ratnagiri district during the first week of August, 2018, just prior to the teacher training workshop. These schools were about 2 to 50 kms away from the central town of Ratnagiri. The post-training data, that is, phase two, was collected in January, 2019, that is, three months after the training. For one of the schools visited by us during phase I, the teachers did not attend the training and thus this school was dropped for post-training data collection. For another school the teacher was not available for post data collection phase and thus we have four schools that are part of both phases.

❍ About the schools

All the schools visited by us were government-aided and the students predominantly belonged to low socio-economic backgrounds. With respect to infrastructure, most of the schools had a library, laboratory, playground and computer lab. The number of students in a class was in the range of 50 to 60 for most of the schools.

School 1 was in the town and hence an urban school with good infrastructure and the medium of instruction was English or Marathi since the school had reserved few divisions for semi-English medium. The teacher participant from this school was a chemistry graduate with 20 years of teaching experience and taught science to grades 8 to 10.

School 2 was a semi-urban, Marathi medium, secondary school and had one division each for grade 8, 9 and 10 where the number of students ranged from 30 to 40 in each division. The teacher participant from this school was a chemistry graduate and had 13 years of teaching experience and taught mathematics and science in grade 8, 9 and 10.

School 3 was a semi-urban school which had both Marathi and semi-English medium divisions. The teacher participant was a mathematics graduate with 14 years of teaching experience and taught mathematics and science in class 9 and 10.

School 4 was a rural school which offered both Marathi and semi-English media of instruction. The teacher participant from this school was a chemistry graduate with 24 years of teaching experience and taught science in grade 8, 9 and 10.

Phase I: Baseline data collection

❍ Impressions from classroom observations

During baseline data collection, the teachers appeared knowledgeable, enthusiastic and self-motivated. Even while dealing with large class sizes, they exhibited good class control. These teachers primarily used traditional teaching methods to explain the topics. In addition, we observed demonstration of experiments related to chemical reactions, water of crystallization and properties of substances. Often the teachers used questions that would require critical thinking. However, students were not given time and opportunities to discuss with peers and answer the

questions. In addition, experiments were demonstrated and not performed by students in the classroom.

- Impressions from focus group discussions with students

We were keen on understanding whether students were engaged with any kind of activities especially related to science at their schools. Interaction with students in all the four schools clearly indicated that they were not engaged with any group activities in the classroom. The only activity that was mentioned by students as a group activity was use of the computer lab to gather ideas for making models for science projects to display in exhibitions. All these schools had lab facilities and students were performing experimental activities mentioned in the syllabus At times, students were encouraged to perform the activities especially in the laboratory.

Thus overall the traditional mode of teaching was the dominant mode used for teaching of sciences in the classrooms.

Phase II: Post-training data collection

- Impressions from classroom observation

During phase two, classroom observation and students interviews could be done only in one school (that is, school 2) as other schools clearly stated that they did not implement the ALS. In school 2, we observed the lesson on *Acids and Bases*. At the beginning of the class, an animated video was shown on a mobile phone, to revise the concepts that the students were expected to know before learning new topics. However, the effectiveness of the video was reduced due to small size of the mobile screen which was hardly visible to different students in the class. The teacher adopted predominantly the lecture mode during the class, even though she demonstrated a few experimental activities. These demonstrated experimental activities were from textbooks but did not provide much engaging opportunities to students.

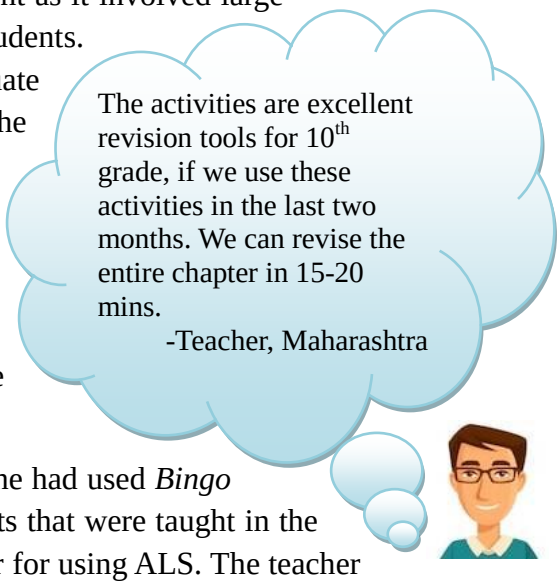
Image 13: Use of video and demonstration of experiments (Acids and bases)

❍ Impressions from focus group discussions with students

We did probe students about the games and activities mentioned in the RSC modules. However, interactions with students confirmed that the ALS and RSC activities were not implemented in the classroom, which confirmed the non-implementation of ALS and other RSC activities.

❍ Impressions from teachers' responses to questionnaire and interviews

In phase two of data collection, teachers presented their impressions about RSC training. Even after three months, teachers stated that the activities learnt by them at the RSC teacher training workshop were interesting and innovative. The responses obtained in the questionnaire filled during the post-training school visits also clearly indicated the same. In the interviews, most of these teachers opined that the RSC training was different as it involved large number of hands-on activities for both teachers and students. They accepted that the training presented adequate orientation about how to use these activities in the classroom. However, teachers perceived use of these activities in the classroom as time consuming. Thus, they opined that these were not feasible in classrooms with large number of students. Teachers further felt that the activities would be useful as revision tools and one of the teachers stated that they could be implemented only occasionally.



The teacher participant from school 4 mentioned that she had used *Bingo* activity in her class and it helped in revision of concepts that were taught in the class. In her opinion, small class size was the key factor for using ALS. The teacher from school 2 also had similar opinion.

The post-training school visits in Ratnagiri, indicated that the ALS, group work and resources from RSC modules were primarily not implemented in all the schools visited by us. We did make efforts to understand the reasons for the non-implementation. One of the important dilemmas stated by teachers was that their classes consisted of students with diverse learning levels. Due to this fact, they feared that when ALS would be given to a group of students, some students would complete them swiftly whereas the others in the same group would be left behind. Thus, teachers were confused about how to deal with such situations in the classrooms which may lead to issues of discipline.

For teachers, the shift from conventional role to that of facilitator, needed for implementation of ALS and group work in the classroom, is not easy and needs time. For such a transition, they require continual support and discussions, especially to surmount likely challenges that may arise in the process. In absence of such support system, teachers are likely to be diffident in using ALS, especially in classrooms with large number of students. Teachers from school 1 did not

prefer giving interviews but stated the following constraints for not implementing the activities in classroom: vastness of the syllabus, time constraint, preparing the student for board examination, large number of students in the classroom and issues related to discipline class.

The teacher participant from school 3 stated that large numbers of students in the class having poor reading-writing skills and language comprehension even when they are admitted to secondary schools is a major issue that needs to be addressed. As a result, teachers spend considerable time and efforts to explain concepts to such students. He therefore was not sure whether the ALS and other activities could be used due to such issues. Moreover, there exists a notion among the teachers that their students will not be able to complete the ALS and other activities as they often do not have sufficient pre-requisite knowledge about the topics covered in the science chapters. Thus, with such perceptions, teachers fear that students may remain disengaged in the classroom when such activities are undertaken.

In school 4, where the teacher was a motivated chemistry teacher, we were surprised to see that he too did not implement the ALS and other RSC activities. When probed, we realised that he had to teach in both Marathi and semi-English medium classes. Moreover, with recent retirement of 3 mathematics and science teachers from the school, the existing teacher(s) have to teach for 7 out of total 8 periods, which is a significant workload. This school is located in a rural area and there is only one bus that connects the school to nearby village from where the students commute. Therefore, at present, the primary focus of the school/ teachers is to improve infrastructure and transport facilities, so as to retain the number of students in the school. Due to such circumstances, the teacher experienced genuine time constraints. All these facts explain why he did not implement ALS and the activities even though he was appreciative of the same. In addition, the teacher pointed out that the students are primarily assessed through written examinations and it is important to have alternative methods of assessment so as to facilitate the implementation of ALS in the classrooms.

> The teachers have mentioned that the RSC training should be made available to all the rural schools at the grass root level and it should be done chapter wise. Most of the teachers recommended that if they get resource materials as per the chapters in their syllabus, it might be easier to implement the ALS in classrooms and would be more beneficial for students.
>
> -Teacher, Maharashtra

> When particularly probed for possible solutions for preparing materials, one of the teachers suggested that if a group of teachers come together to prepare the resources for the topics related to their subject of specialization and share it with each other, it will reduce the load of resource generation. Thus, teaching aids for all chapters for grade 8, 9 and 10 can be prepared.
>
> -Teacher, Maharashtra

Bhor

❍ Background

Like Ratnagiri, Bhor (Pune) was yet another region where we did the baseline data collection in September 2018. Even though we visited four schools for baseline data collection phase, only three of these were covered for the post-training phase (December 2018) as teacher from the fourth school did not attend the training.

❍ About the schools

School 1 and 2 were primarily semi-urban schools with good infrastructure and laboratory facilities. These schools also had junior college and offered both Marathi and semi-English as media of instruction. Both these schools are well established and reputed schools in Bhor.

School 1 had five to six divisions each for grade 8, 9 and 10. Number of students in the classroom ranged from 60 to 80 per division. The teacher participant from this school was a physics graduate and had 10 years of teaching experience and teaches science and mathematics in grade 9 and 10. School 2 had 3 divisions each for grade 8, 9 and 10. Compared to school 1, the number of students per division in this school was less and ranged from 40 to 50. The teacher participant from this school was a chemistry graduate with 12 years of teaching experience.

School 3 was a rural Marathi medium school which had one division each for grade 8, 9 and 10. As compared to school 1 and 2, the number of students per division was less and ranged from 20 to 25. The teacher participant from this school was also a chemistry graduate with 20 years of teaching experience. The school did not have facilities like computer labs and library. There was no separate science laboratory. It contained a single cupboard with some charts and materials required to perform experiments.

Phase I: Baseline data collection

❍ Impressions from classroom observations

During baseline data collection, the classroom observations indicated that in all four sample schools, teachers generally used traditional modes of teaching, which involved explanation of topics by the teachers. Teachers did ask questions, primarily after teaching which were answered by only a few students in the class. For school 1 and 2, every division had two science periods that were allotted for experiments. We did not observe any experimental demonstrations during the lesson observations.

Image 14: Demonstration of experiments (Types of chemical reactions)

Due to unavailability of laboratory space in school 3, the chemistry experiments (*Types of chemical reactions*) were demonstrated in the classroom. However, students' involvement in the classroom teaching-learning process was limited and overall very few students were answering questions asked in the classroom. This was partly due to the fact that the teacher was not encouraging communication in the class because of the traditional style of teaching.

In school 2, even though computer lab was available, the teacher preferred to use mobile phone to show videos, as setting up the projector and transferring the students to computer lab was perceived as time consuming. The visibility of the videos was thus a problem.

- Impressions from teachers' responses to questionnaires and interviews

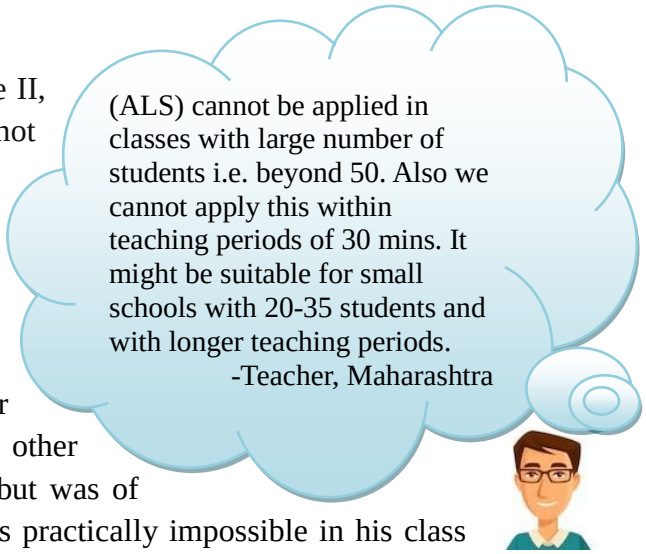
For school 1 and 2, teachers did explain that double science practical period in the timetable was used primarily for demonstration purpose as the number in the classroom was large. However, students were given freedom to go to the lab and perform experiments in physics but not in chemistry due to safety concerns. Conventional mode of teaching was used for science classroom and all teachers were open to admit the same. They also stated that charts, models and videos using LCD projectors were used occasionally for science teaching. With respect to the practical activities, teacher from school 3 (with no lab space) stated use of demonstrations which were also observed by us. Overall, teachers with whom we interacted appeared open towards new ideas. Thus, we anticipated that they may implement the ALS and other RSC activities post-training.

- Impressions from focus group discussions with students

We interacted with students of class 8 and 10 in four schools. Students reconfirmed use of demonstration mode for experimental activities. We were surprised when students also indicated that they would like to learn chemistry through games, videos and to perform experiments. This comment further enhanced our curiosity regarding the post-training school visits.

Phase II: Post-training data collection

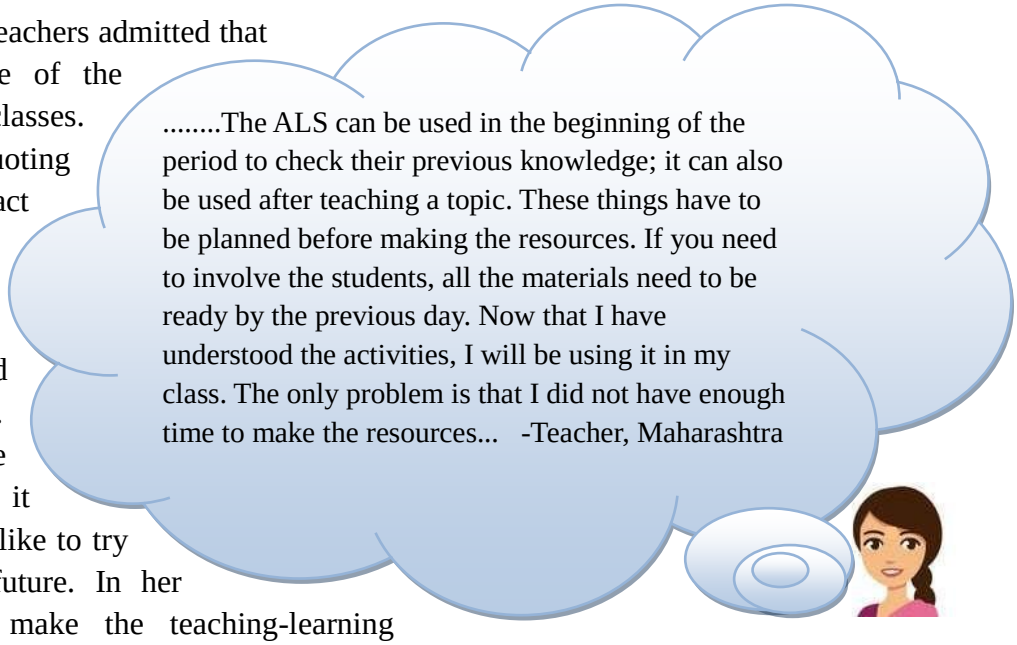
To our surprise when we visited schools in phase II, we observed that the teachers were not implementing ALS and other activities. Thus, we did not get permission for classroom observations and/or students' interviews.



In the questionnaire, most of the teachers appreciated the RSC training and opined that it was innovative. During interview, teacher participant from school 1 perceived ALS and other activities useful from education point of view, but was of the opinion that implementation of the same was practically impossible in his class

due to large number of students and the existing duration of school periods (i.e.30 minutes/per period). Based on our interactions with teachers in phase I, we were not convinced with the fact that these teachers have not implemented any of the activities from RSC training.

After probing, two of the teachers admitted that they did try using some of the activities in their own classes. The hesitation for not quoting the same was due to the fact that the implementation was not done on continuous basis. Teacher from school 2 had used *tarsia* activity in her class. She also stated that the students did find it interesting and she would like to try more activities in near future. In her opinion, such activities make the teaching-learning process joyful and would help students to learn the concepts. When probed about why she discontinued the use of ALS, she stated time constraint as the primary reason. She further mentioned that these techniques are comparatively new to teachers in her region. Thus, with practice and experiences about better time management, teachers might be able to implement the same in the classrooms. All three teachers mentioned that preparation of ALS resources require time and planning. They plan to allocate the summer vacation for this task so that the prepared resources can be used in the next academic year.



The teacher from school 1 reported that he tried using *concept map* and *ionic jigsaw* provided in the RSC modules. However, he did observe that in his class, around 30 students were engaged with the task seriously whereas remaining 40 students remained disengaged. He was confused about how to handle such situations and was unsure about classroom management when students are divided into groups. He further explained that he was unclear about the optimal size of each group. In his opinion, he would prefer not to make too many groups as effective interactions with a large number of groups would be an issue. Such difficulties were genuine and need to be addressed. In absence of such discussions, motivated teachers who are willing to experiment are likely to give up use of ALS after few trials. Thus, sessions involving discussions about likely challenges in the classroom for implementation of ALS, needs to be incorporated in the training workshops. Once again, in our opinion, sustained interactions through follow-up workshops will help promising teachers to shift towards ALS.

GUJARAT-SURAT

❍ Background

Due to uncertainty about the data collection in the state of Kerala, we explored the possibility for data collection in another state, especially the state close to Mumbai where HBCSE is located. As one of the teacher training workshops was being scheduled in Surat (Gujarat) in September 2018, we managed to collect both baseline and post-training data from four schools in Surat and also attended the RSC teacher training workshop. The post-training visits were done in December 2018, that is, 3 months after the training.

In year 2012, as a part of their Corporate Social Responsibility (CSR), L&T (Hazira) had initiated the 'Science on wheels' project, managed by Agastya International Foundation (AIF), for rural government schools in the state of Gujarat. For Surat, this project is extended and thus currently is still going on. As part of this programme, three instructors from AIF have been visiting 21 schools, twice in a month, along with a van equipped with the school laboratory materials. These instructors not only teach science topics and demonstrate experiments in classrooms but also engage students with hands on science activities. Thus, in Surat, apart from classroom teaching, students were engaged with science activities due to presence of AIF.

The RSC training programme in September, 2018 was a part of AIF training programme and was conducted for teachers from schools where the 'Science on wheel' project was functional. The RSC trained TD who conducted the training is associated with AIF as Project officer in Andhra Pradesh. The training workshop was attended by all the three instructors from AIF at Surat.

❍ Syllabus

All four schools visited by us follow the integrated science syllabus prescribed by Gujarat State Education Board (GSEB). Grades 8 and 9 have separate science textbooks for semester 1 and semester 2, each comprising of 9 chapters. However for grade 10, all 18 chapters are included in a single textbook. Each grade includes five chemistry chapters and the topics are based on the NCERT syllabus. **(Appendices,** pages 68-69**)**

❍ About the schools

Two schools selected for baseline data collection were Surat Municipal Corporation (SMC) schools whereas the other two schools were catering primarily to tribal students. The SMC schools (school 1 and 2) were from pre-primary to grade 8 and catered to students from low socio-economic backgrounds. The schools are run in two shifts, one for boys and another for girls. School 3 and 4 have only grade 9 and 10 classes, with one class per grade, and were co-educational schools. In addition, one of the schools was residential. The medium of instruction was Gujarati for all the four schools. Along with these schools, we were interested in attending

the sessions taken by AIF instructors, who conduct science activities in Surat. However, the same became possible only during post-training visits.

Phase I- Baseline data collection

- Impressions from classroom observations

During school visits, in school 1 and 2, we observed science classes for class VIII (girls' batch). Teachers in these classes read paragraphs from the textbook and presented explanation for the same in colloquial language along with demonstration of 1 or 2 activities mentioned in the textbook (e.g. observation of slides under the microscope).

In school 3, the teacher's focus was on completing the syllabus. Thus, the classroom discourse was dominated by teacher with practically no interactive participation from students. We were also not sure whether the diagrams drawn to illustrate the science concepts were internalised by the students. In school 4, the teacher adopted a constructivist approach and used a variety of probing questions in teaching. There was active participation from the students and they were able to use their previous experiences while gaining new knowledge.

- Impressions from teachers' responses to questionnaires and interviews

All four teachers frequently attended training programmes conducted by government bodies and AIF. They mentioned that the AIF training workshops are based on their syllabus and involved learning concepts through activities. The models prepared during such workshops were also used in classes while teaching certain chapters. During interviews, these science teachers stated that the practical part of science is usually dealt with by the staff of AIF. This fact explained why no experimental activities were conducted in the classrooms. Thus, the teachers had offloaded the responsibility of conducting activities and experiments to AIF instructors, who seemed to be aware of this issue. What we understood through interactions with AIF members is that they are catering to this issue through their own teacher training programs.

- Impressions from focus group discussions with students

Our interactions with the students confirmed our impressions from classroom observations. However, these students were excited about the activities and experiments conducted by the AIF instructors.

Phase II- Post-training data collection

By the time we revisited schools for phase II, the teacher from school 4, who attended the training, had retired whereas teacher from school 1 did not attend the training. However, for both these schools, we did observe the sessions by AIF members who had attended the RSC training.

We were interested in understanding whether the AIF instructors integrated the RSC activities and ALS in their own sessions. In addition, this opportunity helped us to understand how AIF volunteers go about their training workshops. The remaining two schools were non-implementing schools. Thus, no focus groups discussions could be conducted for phase II.

❍ Impression from AIF sessions:

AIF members conducted sessions at least for 1.5 hours using group activities mode. Materials needed were distributed to each group, and this was preceded with clear instructions. The entire approach was close to ALS and was engaging for students. These instructors were good facilitators. Every activity was followed by a discussion facilitated by instructor's probing questions that helped students to enlist their observations and arrive at the appropriate explanation based on the same. During the session observed by us, we did not directly see the RSC activities being used. Thus we did not conduct focus group discussions with the students.
However, these members communicated that they are including *tarsia*, *bingo, card sorts* and *show-me boards* post the RSC training (see image 15, photograph shared by AIF members after our visit to Surat). These photographs clearly show engagement of students with ALS. The volunteers also spoke about use of micro-scale experiments for their own sessions.

Image 15: Use of dominoes and card sorting in sessions conducted by Agastya International Foundation

Because of this training we got to know about new activities that we are able to take to the schools. We use these activities (*Dominoes, Bingo, Connect four, Show-me board* and *card sorting*) in the beginning and end of our session.

-AIF Instructors, Gujarat

Image 16: Practical sessions conducted by Agastya International Foundation

❍ Impressions from teachers' responses to questionnaires and interviews

School 1 and 2 had only one science teacher for grade 6, 7 and 8. In school 2, the upper primary section comprised of 3 classrooms (one division each for grade 6, 7 and 8) which was managed by 3 teachers (one teacher taught science and mathematics, one taught social sciences and one, languages). They did not have formal time tables, instead, every day; each teacher would spend 1-1.5 hrs in all the classes. The classrooms included substantial number of migrant students from Uttar Pradesh, Bihar and Nepal. Therefore, teachers often had to deal with poor language comprehension and reading-writing levels of the students. Thus, the teachers were expected to teach basic linguistic/mathematical skills to such students along with teaching chapters from syllabus. These facts present glimpses of the complex issues that are faced by teachers in classrooms. With respect to the experimental part, the teacher from school 2 mentioned that she allowed students to perform biology and physics experiments. However, for chemistry, she is not comfortable in doing so due to safety reasons. Her own experience was that often desired results were not obtained by her at the end of the experiments. What we could infer was perhaps over time the stock of chemicals becomes old and thus the desired results are not obtained. Due to the limited budget, the chemicals are not replenished from time to time.

The RSC training covers both content and activities that can be used to teach science topics. I also like the chemistry experiments even though I won't be able to implement these in my class.

-Teacher, Gujarat

In school 3 and 4, it was observed that all the subjects for grade 9 and 10 were taught by three teachers including the Principal of the school. The science and mathematics teacher in school 3 retired, after which the other two teachers were forced to teach subjects earlier taught by him. The appointment of a new teacher in these rural government schools is not done promptly and usually takes prolonged time. Teachers mentioned that they are also entrusted with administrative work thereby reducing the time available for teaching. With all such complex factors, it was not surprising that teachers could not adopt ALS and other RSC activities.

5. SUGGESTIONS AND POINTS TO PONDER

Teacher Developers (TDs), engaged with RSC teacher training since last 3 to 4 years, have gained valuable field experiences that have shaped their own training directly or indirectly. This pool of talented TDs has several suggestions for the RSC teacher training programme in the near future. It is important to reflect upon these points and in our suggestions; we have made efforts to categorize them.

Professional development of the TDs

- The current TDs are keen on their own training in the next phase of the programme. In their opinion, such training should cover the following aspects - discussions about Pedagogical Content Knowledge (PCK) and chemistry concepts that are difficult to teach, sessions highlighting use of technology and apps in addition to creating online resource bank and conducting webinars.
- TDs want further opportunities to interact with master trainers from UK (that is, chemistry education experts) so that they can present their own ideas for teacher training workshops. In their opinion, the constructive feedback from master trainers will be useful for refining these ideas.
- There is a perception in some of the active TDs that currently the training has become a routine activity for them. In other words, their growth has reached a stagnation stage. Thus, they are looking for different challenging roles in the upcoming phase of RSC teacher training programme. Such a shift in the role will help them to utilise their potential once again.
- Some of the TDs aspire to write reports and case studies so as to highlight and publish their own experiences. Thus, they suggested training and discussion about the same as it will help in gaining recognition for the work done, in addition to the academic growth.

Follow-up programmes

- Most of the TDs suggested that follow-up workshops must be a mandatory feature of the training programme. In their opinion, these will enable constant communication between the TDs and the teachers. TDs would like to interact with small groups of motivated promising teachers, formed on the basis of geographical location for such workshops. TDs felt that as such workshops are primarily conceptualised by them, evaluation by RSC at the initial phase will not only ensure the quality but also act as feedback mechanism.

Recruitment of new groups of TDs

- If RSC is planning to recruit new TDs, the existing TDs suggested that competency with multiple Indian languages needs to be considered as one of the important factors while selecting the individuals.

Organizational support

- TDs felt that substantial time is needed for organization of the teacher training workshops. Thus, some kind of organisational support needs to be provided on behalf of RSC (India) for the same. They suggested formation of Public Relation (PR) team by RSC (India) to take

care of the organisational load. The PR team can organize meetings/conferences for government officials and school Principals to bring awareness about the programme and also about RSC.

Organising regional events/exhibitions

- If possible, RSC (India) should conduct regional events/exhibitions that give opportunities to TDs as well as teachers to share their resources and experiences with the peers. In due course, an app/repository of the Active Learning Resources by TDs and teachers can be prepared for wider dissemination in different parts of the country.

Sessions to be incorporated for teacher training workshops

- TDs felt that more experimental sessions and ICT based resources (including how to prepare them) need to be incorporated in the future teacher training workshops.

In addition, teachers with whom we interacted also presented some suggestions that are as follows-

- Workshops need to be conducted more frequently (at least 2 per year) so as to have more sustained interactions with TDs
- Sessions relate to the time management for implementation of ALS should be included in the training workshops
- Resources in regional languages will be useful
- Resources, including experimental activities, mapped to the school curricula, will be helpful

Other possible channels for expansion of the programme

We did seek information about teacher training programmes (apart from those organised by RSC) that were undertaken by teachers. Teachers from all the three states shared information about a variety of such programmes. We received information about organizations/NGOs that are functional with such teacher training programmes. In the following section, we are sharing this information. Such awareness, in our opinion, is important for any institution (including HBCSE) or organizations interested in teacher training in India.

Karnataka

The Karnataka government organizes several workshops for in-service teachers on regular basis. Such training includes sessions about the syllabus and policy changes in the field of science education. Government authorities in this state invited Agastya International Foundation, a well established NGO that has interest in reaching out to schools in rural parts of India. Some of the TDs trained by RSC are also associated with AIF. We observed that the same NGO is functional in Surat and has adapted the ALS and some of the RSC activities. Thus, we feel collaboration with NGOs like AIF can be a step in the right direction for dissemination of materials. Such NGOs have an established network with government schools including those located in rural areas of the country. Thus, reaching a large number of schools becomes feasible. Further, training promising volunteers of such NGOs can also be thought of.

In Karnataka, some of the TDs could effectively tap the government education system through collaborating with bodies like Rotary Clubs. Such partnership helped to conduct large number of workshops in and out of Karnataka. Again, bodies like Rotary Clubs have network across different states in India, and can spread awareness about RSC and its teacher training programme.

Our interactions with sample schools in this state indicates that teachers are looking forward for more sustained training so that they gain confidence in implementing the ALS in their classrooms. We feel that groups of TDs located in Karnataka, can consolidate their initiative regarding the follow-up workshops. With such a step, sizable numbers of teachers from government system will be able to adapt ALS to their own classrooms.

Kerala

Teachers in Kerala have a deeper continual engagement with training programmes conducted by the state government as it has systematic follow up schedules. What we could gather from teachers is that the resource persons (who are in-service experienced senior teachers) at such training programmes do partly adopt constructivist approach and act as facilitators. In addition, teachers are trained to use ICT for teaching as part of such training programmes. Most of the government and government-aided schools in Kerala are being upgraded with hi-tech classrooms and thus ICT seems to be used regularly in classrooms. The teachers in this state are often involved with group discussions that focus on difficulties faced while teaching chemistry (science) topics from the syllabus. Peer group interactions play an important role in developing an understanding about dealing with such difficulties.

In Kerala, as compared to Karnataka, the number of RSC teacher training workshops conducted for government/government-aided schools was comparatively limited. One of the possible ways to propagate ideas from RSC training is to link the existing (or new) resources to *Samagra*, the e-resource portal that is regularly used by government school teachers. If possible, efforts can be made to conduct training of those resource persons who are involved with the state government teacher training programmes. Efforts on behalf of RSC (India) are likely to play a significant role for such integration. These efforts will help trained TDs to have better access to the existing teacher training programmes.

For schools in Kerala, chemistry is generally taught by teachers who are chemistry graduates and thus, there exists a large pool of untapped chemistry teachers available for training. Thus, integration with state level teacher training, especially through ICT mode will be a useful step for propagation of ALS and RSC resources. We also understood that the cluster meetings for chemistry teachers from government schools are held regularly, twice a year. This is yet another platform that can be harnessed effectively for training.

Maharashtra

One of the programmes mentioned by teachers is Rashtriya Madhyamik Shiksha Abhiyan (RMSA)[3,4]. This programme was appreciated by the teacher participants for its constructivist approach and subject specific training. In our opinion, such national initiatives, needs to be tapped for wider dissemination of the RSC teacher training and material, especially for government systems. One of the teacher participant shared information about *Avirata*, an online training programme (in Marathi) for continuous professional development of in-service teachers involving multiple levels. She completed first two levels of *Avirata* by 2018 and was happy that she could get trained at her doorstep. She further mentioned that assignments were an integral part of this programme to gain credits. We feel this is an important example through which teachers can not only be exposed to RSC materials but also may be motivated to generate resources and share their experiences regarding classroom implementation of the same. In addition, Accelerated Learning Programme (ALP) is yet another initiative on behalf of government of Maharashtra that focuses on teaching mathematics, science and first language so as to reduce the dropout rates of students, especially at grade 9.

Reflections for the future

We hope the above information presents glimpses about the efforts devoted to science education, especially by government bodies in India. It indicates that online channels are being used by the government educational bodies in a significant way for professional development of in-service teachers. Such channels can be tapped effectively so as to reach to the wider population of teachers especially from government school systems that cater to large number of students. If possible, video resources that demonstrate the actual use of these resources in classroom settings can be developed and shared. For teacher training, national initiatives like RMSA, aimed at training high school teachers can be co-ordinated with.

We feel that the trained TDs have a significant role for the next phase of RSC teacher training programme in India. They have extended the resources to other science subjects and have developed pedagogical insights which need to be showcased. TDs can help in preparation of resources in Indian languages, and such a step will help in making these resources more useful to teachers and students from government schools located in rural and semi-urban areas.

In addition, currently various teacher training programmes are being conducted as part of Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNMTT)[5] by several institutions across the country. Collaborations with such institutions can be another phase of RSC teacher training programme in India.

[3] www.samagra.mhrd.gov.in/

[4] Cousins, B. *et al.* (2016). Formative Evaluation: RMSA Teacher In-Service Training Evaluation,(Report No. RMSATCA 2.19), RMSA technical cooperation agency

[5] www.mhrd.gov.in/guidelines-scheme-pandit-madan-mohan-malaviya-national-mission-teachers-and-teaching-pmmmnmtt

6. CONCLUSION

In this report, we have described the steps involved in the evaluation project undertaken by us, along with analyses of the data obtained from the TDs, teachers and the students. The impressions presented within the report are primarily based on the data collected from various schools in the states of Karnataka, Kerala and Maharashtra, after the teacher participants attended the training programmes. For Maharashtra and Surat, the baseline data was also obtained prior to the training in addition to the post visits.

Overall the TDs reported that they were positive about the training they received from the master trainers. Regarding the workshops they conducted, they were of the opinion that these would be useful to the schools and the teachers. Two of the major challenges reported by them were time constraints and the number of participants attending the workshop. An important point was that, often biology/physics/mathematics teachers or the science teachers who taught these subjects participated in the workshops. This challenge has been met by most of the active TDs and they have made considerable efforts to extend the resources to physics and biology. TDs also have used their own competency with Indian languages to conduct the training programme. According to TDs, there were several requests for resources in regional languages. Our interactions with the teachers and the schools we visited also corroborate the remarks of the TDs.

We could see the ALS and other activities being implemented in various schools in Karnataka, Kerala and Maharashtra. In Surat, the sessions by AIF have incorporated the RSC activities. What struck us as significant is the fact that some of the teachers were using these active learning strategies to teach other subjects besides chemistry and were also displaying innovations in terms of development of new resources and translation of available ones. This according to us is remarkable and needs to be highlighted. Interestingly students also mentioned that quite a few activities had been done in their classes.

Even in schools where the activities were not being used, the teachers had good opinions about the training, trainers and the activities. Large number of students in the classrooms, vastness of the syllabus, time constraints and time management issues were mentioned by most teachers as factors that limit the use of ALS and other activities in classrooms. They opined that more sustained exposure to ALS will help them to implement the same in their classrooms. Discussion about the classroom difficulties that are likely to arise during implementation with probable solutions is yet another aspect that needs to be covered in the training camp. Perhaps, presenting videos that indicate such issues will help teachers to develop confidence with respect to implementation of ALS.

Schools in Surat have a substantial number of newly admitted students at middle school level (class VI to VIII) who have migrated from other states and had language comprehension issues. Thus, implementation of ALS is challenging in such classes. In Karnataka and Maharashtra, the government/government-aided school students from vernacular medium are given an option to switch to semi-English medium during the upper primary and secondary grades. These kinds of shifts also lead to language comprehension issues among the students, during the initial phases. This was one of the major difficulties for implementation of ALS in these classes.

With respect to the implementation of experimental activities, many teachers faced a dilemma related to whether students should be allowed to handle chemicals. Thus, the experimental

activities were often performed as demonstrations. Perhaps even further use of easily available materials in experimental activities and development of micro-scale activities will help to overcome such fears. We do not feel that virtual laboratory is a substitute to such situations, even though it can be harnessed for learning.

We feel that efforts on behalf of TDs and also by teachers need to be showcased, preferably through the internet as it is a significant recognition of their efforts. Such a step will make resources available to larger pool of teachers and it will inspire other like-minded teachers to get involved with the process of resource generation. The sense of ownership towards the entire process and resources, in true sense, will motivate them to use ALS for classroom engagement. In our opinion, TDs now should be encouraged to conduct camps with promising teachers in a given geographical region primarily aimed at resource generation by teachers. Such a step gives a different challenging role to TDs and will help the promising teachers to develop confidence about implementing ALS and related activities for teaching-learning of chemistry (science).

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8. Appendices

A. Data collection tools

Questionnaire for Teacher Developer

Evaluation of *RSC-Yusuf Hamied Inspirational Chemistry Programme* in India
Homi Bhabha Centre for Science Education,
TIFR Mumbai

Personal Information
Name of the Teacher Developer: _____
Email Id: _____
Qualification: _____
Occupation: _____

1) Till date, I have conducted teacher training workshops in the state/s of

☐ Maharashtra ☐ Kerala ☐ Karnataka

☐ Other state/s (give few examples)_____

2) The total number of teacher training workshops conducted by me till date is_____

3) I have conducted teacher training workshops primarily for

☐ Government school/s ☐ Government-aided school/s ☐ Private school/s

4) I have conducted workshops

☐ Once in 6 months ☐ Once in 3 months ☐ Twice in 3 months

☐ Twice in 1 month ☐ Every week

The following questions to be filled only if you have conducted teacher training workshops for Government/Government-aided schools

5) For, teacher training programme conducted by you in past

Maximum number of participants in a workshop _____
Minimum number of participants in a workshop _____

6) Medium of Instruction used for teacher training workshops

☐ Only English ☐ Only Vernacular ☐ Both

(If vernacular specify the language/s)_____

7) For most of the workshops, the teacher participants were primarily from

☐ State board ☐ CBSE board ☐ ICSE

8) The workshops included teachers who teach

☐ Only General Science ☐ Only Non-science subjects
☐ General Science+ Non-science subjects

9) I have been using resources primarily

☐ Developed by me
☐ Given by RSC (for example power point presentations, videos, etc)
☐ Non RSC but not developed by me
☐ Activities developed by other TDs

10) The workshops are generally finalized through

☐ Meeting the Principals personally
☐ Writing emails/letters to Heads of Educational institution
☐ Contacts with state officials/organization responsible for organizing teacher training programmes
☐ Invitation by schools
☐ Invitation by bodies such as SCERT or equivalent
☐ Invitation by private bodies who conduct teachers training programmes for government/government-aided schools

11) For the workshops, I did face challenges related to

☐ Medium of instruction
☐ Content to be discussed
☐ Time constraint
☐ Number of teacher participants in the programme
☐ Crunch of space
☐ Teachers' motivation
☐ Lacunas in content knowledge (of participants)
☐ Participants unenthusiastic to learn new teaching methodologies
☐ Low interest to learn something new knowledge

Describe a few challenges in detail:

_____

_____

12) Apart from the Units provided by RSC, for Teacher Training workshop, I have developed and used activities related to (Give few examples and their brief description)

a) Chemistry

_____
_____
_____

b) Physics and Biology

_____
_____
_____

c) Other subjects

---

13) Have you visited any school/s for observing the teachers after the workshops?

☐ Yes ☐ No

If Yes how often

☐ Once in a month ☐ Once in three month
☐ Once in six month ☐ Once in a year

14) Are you in contact with teacher participants of any workshops?

☐ Yes ☐ No

If Yes, in contact with teacher participants of

☐ At least 1 or 2 workshop
☐ 4-5 workshops
☐ 8 -10 workshops
☐ More than 10 workshops

The contact is mainly through

☐ Whatsapp ☐ E mail ☐ Telephone ☐ Other

15) Details of upcoming workshop/s for Government/Government-aided schools (scheduled during March to June 2018)

_____
_____
_____

Interview schedule for Teacher Developer

Evaluation of *RSC-Yusuf Hamied Inspirational Chemistry Programme* in India
Homi Bhabha Centre for Science Education,
TIFR Mumbai

Name of the Teacher Developer: _____

1. Whether you were involved with teacher training programmes prior to RSC training? If yes- were you trained for the same?
2. In your opinion, what was different about RSC training? (Aspects you liked/you did not like).
3. In what way RSC training has equipped you as a teacher developer?

CHALLENGES (Government schools)

4. How do you deal with large group of teachers during workshop? (if given a freedom to choose, what should be the ideal group size)
5. How do you cater to the needs of teachers from vernacular medium in the group?
6. How did you handle problems related to content?
7. What do you do when the schools allotted for teacher training lack of proper infrastructure?

SUGGESTIONS

8. What would be your suggestions, if RSC has to conduct further training for you (phase II)?
9. If RSC has to select new group of TDs and conduct training (like yours), what would be your suggestions?
10. If there would be no further training by RSC, what kind of support from RSC will help you to continue the teacher training programmes in future?
11. Any other suggestions?

Pre-training questionnaire for teachers

Homi Bhabha Centre for Science Education (TIFR), Mumbai
RSC Teacher training Evaluation project

Part A: General Information

Information about School:

1. Name of School: _____

2. Syllabus: ☐ State ☐ CBSE ☐ ICSE

3. Medium of Instruction: ☐ English ☐ Vernacular

If vernacular specify medium of instruction _____

4. Specify the medium of instruction for science subject for classes V-VII_____

VIII-X_____

5. Facilities available:

☐ Library ☐ Laboratory ☐ Playground ☐ Computer lab ☐ Auditorium

8.Representative number of students per classroom:

For V-VII class ☐ 30-40 ☐ 41-50 ☐ 51-60 ☐ 61-70

For VIII-X class ☐ 30-40 ☐ 41-50 ☐ 51-60 ☐ 61-70

Others:_____

9.Percentage of Female students per classroom:

For V-VII class ☐ ≥ 5% ☐ ≥ 25% ☐ ≥ 50% ☐ ≥ 75%

For VIII-X class ☐ ≥ 5% ☐ ≥ 25% ☐ ≥ 50% ☐ ≥ 75%

Personal Information:

8. Gender ☐ M ☐ F

9. Age: _____ Email Id: _____

10. Qualification: ☐ B.Sc. ☐ M.Sc. ☐ B.Ed. ☐ M.Ed. ☐ Ph.D.

Subject of Specialization in graduation: _____

11. Total experience of teaching (Science): _____Years

12. Class/ Classes taught: ☐ 6-7 ☐ 8-9 ☐ 9-10 ☐11-12

13. The type of science text books used

☐ Integrated ☐ Separate textbook for physics, chemistry & biology

14. I teach science topics primarily in/related to

☐ Biology ☐ Chemistry ☐ Physics

15. I generally upgrade my subject knowledge by (You can tick more than one option)

☐ Reading reference books ☐ Using Internet resources

☐ Attending teachers' workshops ☐ Interactions with subject experts

Others (explain in brief)

_____

_____

16. In school, I have been actively participating in (You can tick more than one option)

☐ Mentoring students for any science project

☐ Development of science/chemistry activities

☐ Development of science/chemistry computer based instructional material

☐ Writing science/chemistry articles

☐ Developing remedial instructional material

☐ None of the above

Others (explain in brief)

_____

17. Have you attended any teacher training workshops in the last 3 three years?

☐ Yes ☐ No

18. If yes, the total number of teacher training workshops attended in last 3 years are

☐ 1 ☐ 2 ☐ 3 ☐ More: _____

19. These teacher training workshops were primarily conducted by (You can tick more than one option)

☐ Your school management

☐ SCERT/NCERT/NCST or equivalent organization_____

☐ Private organization (give example)_____

20. In what way were these teachers training workshops useful to you? (You can tick more than one option)

☐ I came to know more about different methods of teaching science topics

☐ I got access to new teaching resources (for example books, websites, videos etc.)

☐ Interaction with resource persons helped upgrade my content knowledge

☐ Interaction with resource persons helped upgrade my pedagogical knowledge

☐ I learnt more about laboratory activities suitable for in my classes

Part B: To be filled by teachers teaching chemistry

21. List two chemistry topics from your textbooks that you find easy/difficult to teach.

Class	**Easy topics**	**Difficult topics**
V-VII	1. 2.	1. 2.
VIII-X	1. 2.	1. 2.

22. List two topics from your textbooks that you find interesting/uninteresting.

Class	**Interesting**	**Uninteresting**
V-VII	1. 2.	1. 2.
VIII-X	1. 2.	1. 2.

23. While teaching chemistry topics for class VIII-X, I often use (you can tick more than one option)

☐ Activities given in the textbook

☐ Quizzes/puzzles/games

☐ ICT based instructional material (for example videos, simulation, films, CDs, power point presentation etc.)

☐ Smart Boards

☐ Teaching aids

☐ None of the above

☐ Other material (give one or two examples)

_____

24. While teaching chemistry topics, at Class VIII-X, I face difficulties due to (You can tick more than one option)

☐ Vastness of syllabus

☐ Class strength

☐ Unavailability of resources (for example books, teaching aids, equipped labs, etc)

☐ Technical language of textbook

☐ Abstractness of concepts that needs to taught

Others (specify) _____

25. In your opinion, for effective teaching of chemistry in your own classroom, you need access to (You can tick more than one option)

☐ Good chemistry reference books

☐ Teaching aids (for example, working models, molecular models, charts, etc.)

☐ Computer instructional resources

☐ Information about good teaching resources

☐ More illustrations and easy language in the existing chemistry textbooks

☐ Information about low-cost science experiments/activities

Others (specify)_____

Thank you for your help!

Post-training questionnaire for teachers

Homi Bhabha Centre for Science & Education (TIFR), Mumbai
RSC Teacher Training Evaluation Project

Information about School:

1. Name of School: _____

2. Syllabus ☐ State ☐ CBSE ☐ ICSE

3. Medium of Instruction: ☐ English ☐ Vernacular

If vernacular specify medium of instruction _____

4. Specify the medium of instruction for science subject for classes V-VII___& VIII-X_____

5. Facilities available: ☐ Library ☐ Laboratory ☐ Playground

☐ Computer lab ☐ Auditorium

6. Representative Number of students per classroom:

For V-VII class ☐ 30-40 ☐ 41-50 ☐ 51-60 ☐ 61-70

For VIII-X class ☐ 30-40 ☐ 41-50 ☐ 51-60 ☐ 61-70

Others: _____

7. Percentage of Female students per classroom:

For V-VII class ☐ ≥ 5% ☐ ≥25% ☐ ≥50% ☐ ≥75%

For VIII-X class ☐ ≥ 5% ☐ ≥ 25% ☐ ≥ 50% ☐ ≥ 75%

Personal Information:

8. Gender: ☐ M ☐ F

9. Age: _____

Email Id_____.

10. Qualification: ☐ B.Sc. ☐ M.Sc. ☐ B.Ed. ☐ M.Ed. ☐ Ph.D.

Subject of Specialization in graduation: _____

11. Total experience of teaching (Science): _____Years

12. I have experience of teaching Class/ Classes: ☐ 6-7 ☐ 8-9 ☐ 9-10 ☐11-12

13. How did you come to know about RSC teacher training workshop?

☐ School Authorities ☐ Colleagues ☐ RSC Teacher Developer ☐ Internet

Other source: _____

14. When did you attend RSC teacher training workshop?

☐ 1 month ago ☐ 3 months ago ☐ 6 months ago ☐ 1 year ago

☐ more than 1 year

15. RSC teacher training workshop covered

☐ Content enrichment

☐ Development of demonstrations/activities

☐ Development of resources using computers

☐ Pedagogy (how to teach)

☐ Misconceptions

☐ Others specify _____

16. What is your opinion about activities learnt at RSC teacher training workshop?

☐ Feasible at my school

☐ Innovative

☐ Similar to given in our textbooks

☐ Interesting

☐ Not feasible in large classroom

☐ Time consuming

☐ Interesting but time consuming

☐ Others specify: _____

17. In your opinion, which were the unique features of RSC teacher training workshop? (List any 2-3 features)

18. Do you use the activities learnt at RSC teacher training workshop?

☐ Yes ☐ No

If yes, how frequently

☐ In each class ☐ Once in a week ☐ Once in 15 days ☐ Once in a month

☐ Other specify: _____

19. Which activities learnt at RSC teacher training workshop, you could implement/use in your science class? Why?

Activities implemented (2 examples)	**Reasons - why you could implement?**

20. Why did you implement these activities?

21. How successful was the implementation of these activities in your class?

22. Would you implement these activities again in another class? (Give reason for your answer)

23. If you need to make some modifications in these activities as per the requirement of the class what it would be?

24. Would you recommend these activities to other teachers for this topic? (Give reason for your answer)

25. Which activities learnt at RSC teacher training workshop, you could not implement/use in your science class? Why?

Activities not implemented (2 examples)	**Reasons- why you could not implement?**
i. ii.	

26. The RSC training helped you to understand

☐ How to present demonstrations/activities in classroom

☐ How to handle students' questions

☐ How to design activities useful for content understanding

☐ About students' difficulties in understanding chemistry concepts

☐ About using computer based resources

27. What suggestions do you have for RSC teacher training programmes scheduled in near future?

Thank you for your help!

Interview schedule for teachers

Evaluation of *RSC-Yusuf Hamied Inspirational Chemistry Programme* in India

Homi Bhabha Centre for Science Education, TIFR Mumbai

1. How was RSC training different from the other training that you have attended?
2. Which are the activities from RSC training that you most frequently used/are using?
3. Are these activities doable in your school?
4. In your opinion, do these activities benefit the children? (Elaborate)
5. Are the activities always performed in groups? If yes, are these planned groups?
6. Are these activities being used by your colleagues for subjects other than chemistry?
7. Which is the activity that you have least used?
8. In your opinion, what could be the reasons for the non implementation of ALS in schools?
9. Have you prepared new resources? Or used these activities for subjects other than chemistry?
10. Do you have a functional science lab in your school?
11. Do students individually do the experiments or do you demonstrate it?
12. For grade 9 and 10, do you have practical periods?
13. Do you have any suggestions for RSC?

Schedule for focus group discussions with students

Evaluation of *RSC-Yusuf Hamied Inspirational Chemistry Programme* in India

Homi Bhabha Centre for Science Education, TIFR Mumbai

1. Which is your favourite branch of science? Why?
2. Do you like chemistry? If yes, what do you like about chemistry? If no, what do you not like about chemistry?
3. Are any activities like quiz, demonstrations, games, etc. used while learning chemistry in classrooms regularly? Describe and give examples.
4. Can you describe activities in which you participated during chemistry classes?
5. Of the activities you remember, which activity/ies you enjoyed /liked the most? Why?
6. What activities you would like to have while studying chemistry?
7. Are such activities also used in other science subjects/any other subjects as well? If yes, which subjects and what topics? (Examples with descriptions).
8. Have you seen chemistry related videos/experiments or listen to lectures using computers in school or at home? (Give examples).

B. Consent forms

TDs

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TATA INSTITUTE OF FUNDAMENTAL RESEARCH
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National Centre of the Government of India for Nuclear Science and Mathematics and a Deemed University
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वेबसाइट / Website : www.hbcse.tifr.res.in
फैक्स / Fax : 022-2556 6803

The research Institute and researcher

Homi Bhabha Centre for Science Education (HBCSE, TIFR) is responsible for evaluating the *Yusuf Hamied Teacher Development Programme* in India conducted on behalf of Royal Society of Chemistry (RSC-India). Prof. Savita Ladage is a faculty member at HBCSE and is one of the main researchers involved with this work on behalf of HBCSE.

The Purpose of study

The primary aim of the study is to assess the impact of *Yusuf Hamied Teacher Development Programme* conducted by the RSC-India and the study is restricted to government schools from the states of Karnataka, Kerala and Maharashtra.

Procedure

The data collection will be mainly through questionnaire, interviews and observation of the forthcoming training programmes. The questionnaire provided to you will not take more than 30-40 minutes to complete. To develop deeper insights, some of you are likely to be interviewed at the later stage. With your permission, the interviews will be audio recorded and will be transcribed for analysis. Your honest responses are important and a valued part of the study. Your participation in this study is voluntary.

Risks and Benefits

There are no risks for participation in this study. The study will provide useful insights about *Yusuf Hamied Teacher Development Programme* conducted by RSC-India.

Confidentiality

Your identity will be kept confidential and your responses will be used only for educational/evaluation research, report and publication purposes.

Compensation

You will not be paid for taking part in this evaluation study by HBCSE, TIFR.

Consent form for Teacher Developer

I have read the above information and am willing to participate in the evaluation study to be conducted by HBCSE for *Yusuf Hamied Teacher Development Programme* by RSC-India. I understand that my participation in this study is voluntary and my identity will be kept confidential. I am also aware that my responses in the questionnaire/interview will be used for the educational/evaluation research and report purpose.

I hereby give my consent
a) to fill the questionnaire ☐
b) to be interviewed - with audio recording ☐ without audio recording ☐

Name of the participant Signature of participant Date

Teachers

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National Centre of the Government of India for Nuclear Science and Mathematics and a Deemed University
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The purpose of study

The primary aim of the study is to assess the impact of *Yusuf Hamied Teacher Development Programme* conducted by the RSC-India and the study is restricted to government schools from states of Karnataka, Kerala and Maharashtra.

Procedure

The data collection will be mainly through questionnaires, interviews and classroom observations. The questionnaire provided to you will not take more than 30-40 minutes to complete. To develop deeper insights, some of you are likely to be interviewed at the later stage. With your permission, the interviews will be audio recorded and will be transcribed for analysis. Your honest responses are important and a valued part of the study. Your participation in this study is voluntary.

Risks and Benefits

There are no risks for participation in this study. The study will provide useful insights about teaching and learning chemistry in secondary school.

Confidentiality

Your identity will be kept confidential and your responses will be used only for educational/evaluation research, report and academic publication purposes.

Compensation

You will not be paid for taking part in this evaluation study by HBCSE, TIFR.

Consent form for Teachers

I have read the above information and am willing to participate in the evaluation study to be conducted by HBCSE for *Yusuf Hamied Teacher Development Programme* by RSC-India. I understand that my participation in this study is voluntary and my identity will be kept confidential. I am also aware that my responses in the questionnaire/interview will be used for the educational/evaluation research and report purpose.

I hereby give my consent

a) to fill the questionnaire ☐

b) to be interviewed - with audio recording ☐ without audio recording ☐

Name of the participant Signature of participant Date

Students

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The purpose of study
The primary aim of the study is to assess the impact of *Yusuf Hamied Teacher Development Programme* conducted by the RSC-India and the study is restricted to government schools from states of Karnataka, Kerala and Maharashtra. For the same, we need to collect data from schools by interacting with teachers and students.

Procedure
If you decide to allow your ward to participate in this study, you need to sign the consent form granting us permission to interview your ward. The interview will be conducted with groups of students to gather information about their experiences regarding the classroom teaching of chemistry. The list of questions asked as a part of the interview will be given to students for your information. With your permission, the interview will be audio recorded.

Risks and Benefits
There are no risks of participation in this study that we are aware of. Taking part in this study is completely voluntary. The interview has no bearing on classroom performance/ academic achievements of the students. The responses in these interviews will provide valuable insights about classroom implementation of *Yusuf Hamied Teacher Development Programme* conducted by RSC-India.

Confidentiality
Your ward's identity will be kept confidential and the interview responses will be used only for educational/evaluation research, report and academic publication purposes.

Consent form for Minor Subjects

I have read the above information and am willing to let my ward be interviewed as part of the evaluation study to be conducted by HBCSE (TIFR) for *Yusuf Hamied Teacher Development Programme* by RSC-India. I understand that my ward's participation in this study is voluntary and his/her identity will be kept confidential. I am also aware that his/her responses in the interview will be used for educational/evaluation research and report purpose.
To be filled by parents

☐ I give my consent that my ward can be interviewed for the above mentioned programme

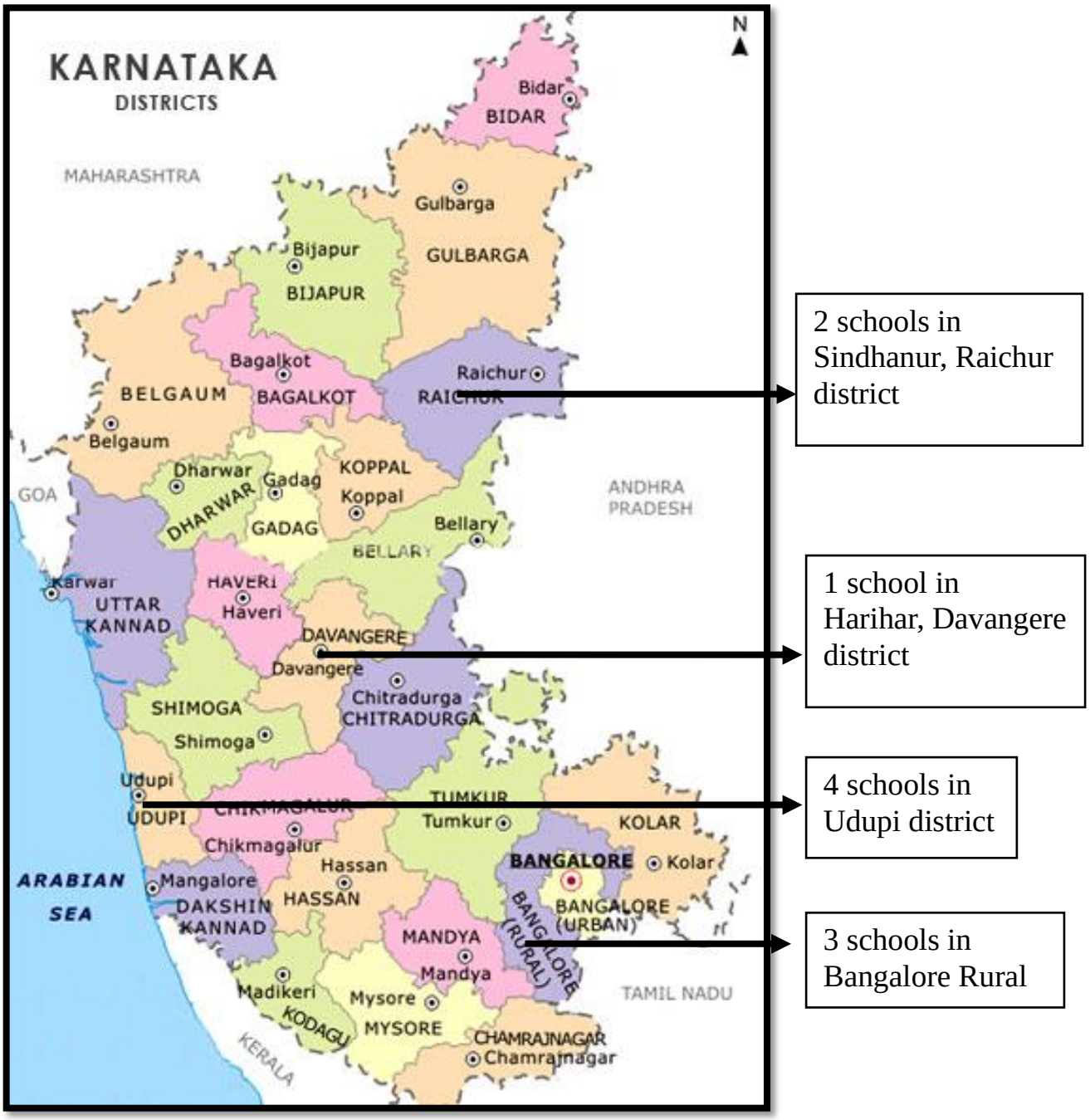
☐ I give consent to audio record the responses of the interview.

☐ I do not give consent for participation in this interview.

Name of the ward Signature of parent/guardian Date

C. Maps of states indicating sites of data collections

Karnataka[6]



2 schools in Sindhanur, Raichur district

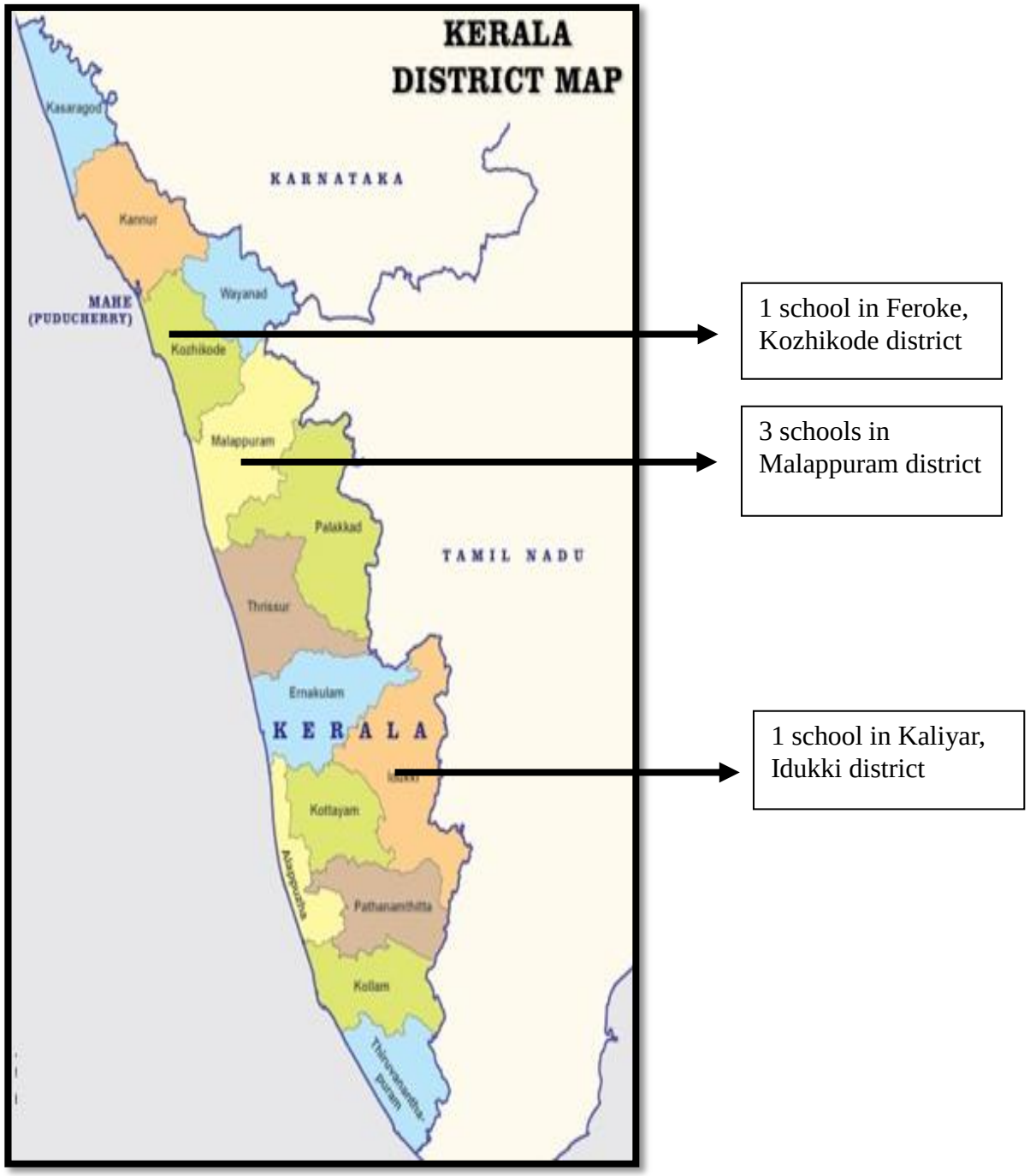
1 school in Harihar, Davangere district

4 schools in Udupi district

3 schools in Bangalore Rural

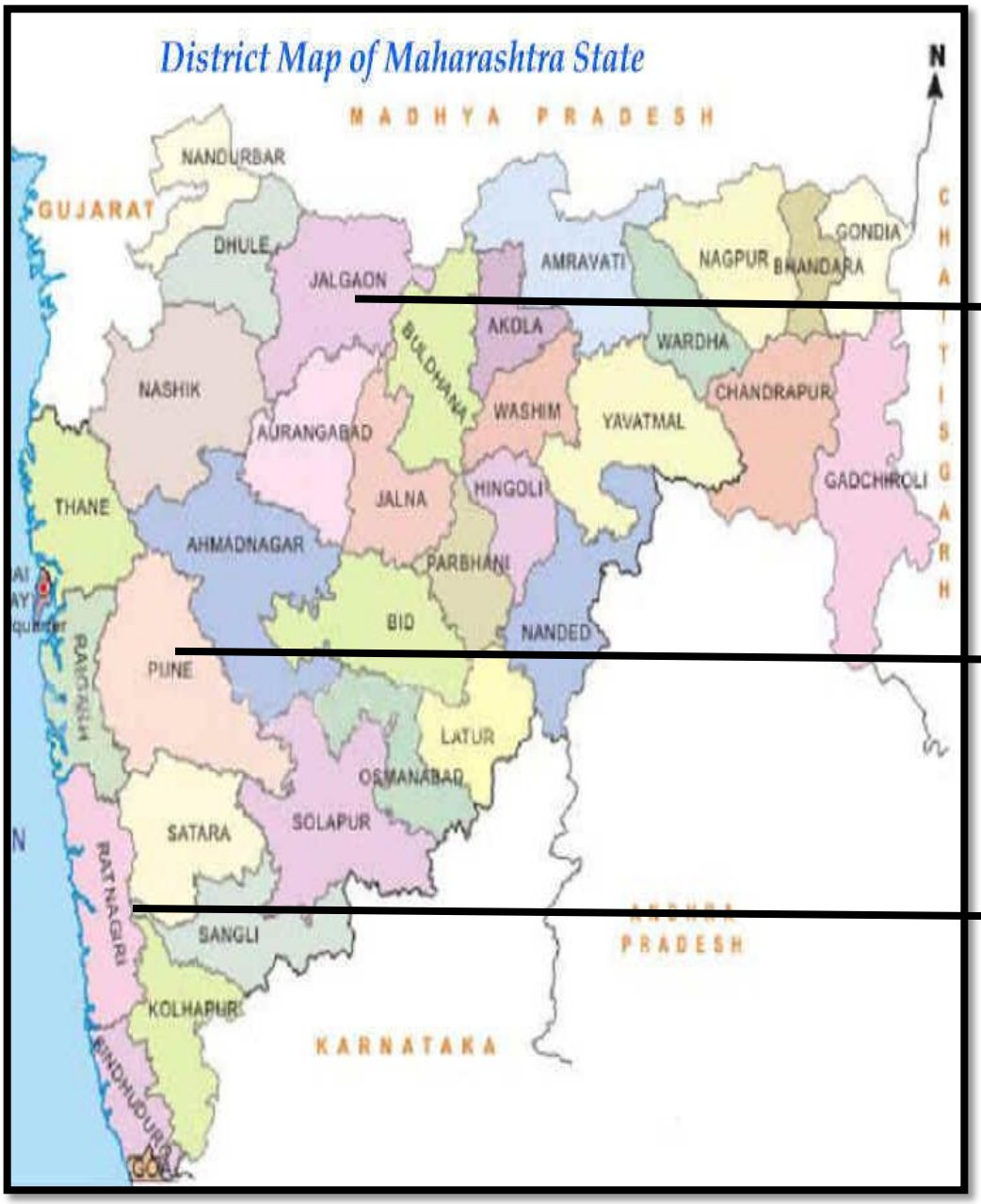
[6] http://travel2karnataka.com/districts_of_karnataka.htm

Kerala[7]



[7] http://www.aicofindia.com/AICEng/Pages/BusinessProfile.aspx?ItemID=14

Maharashtra[8]



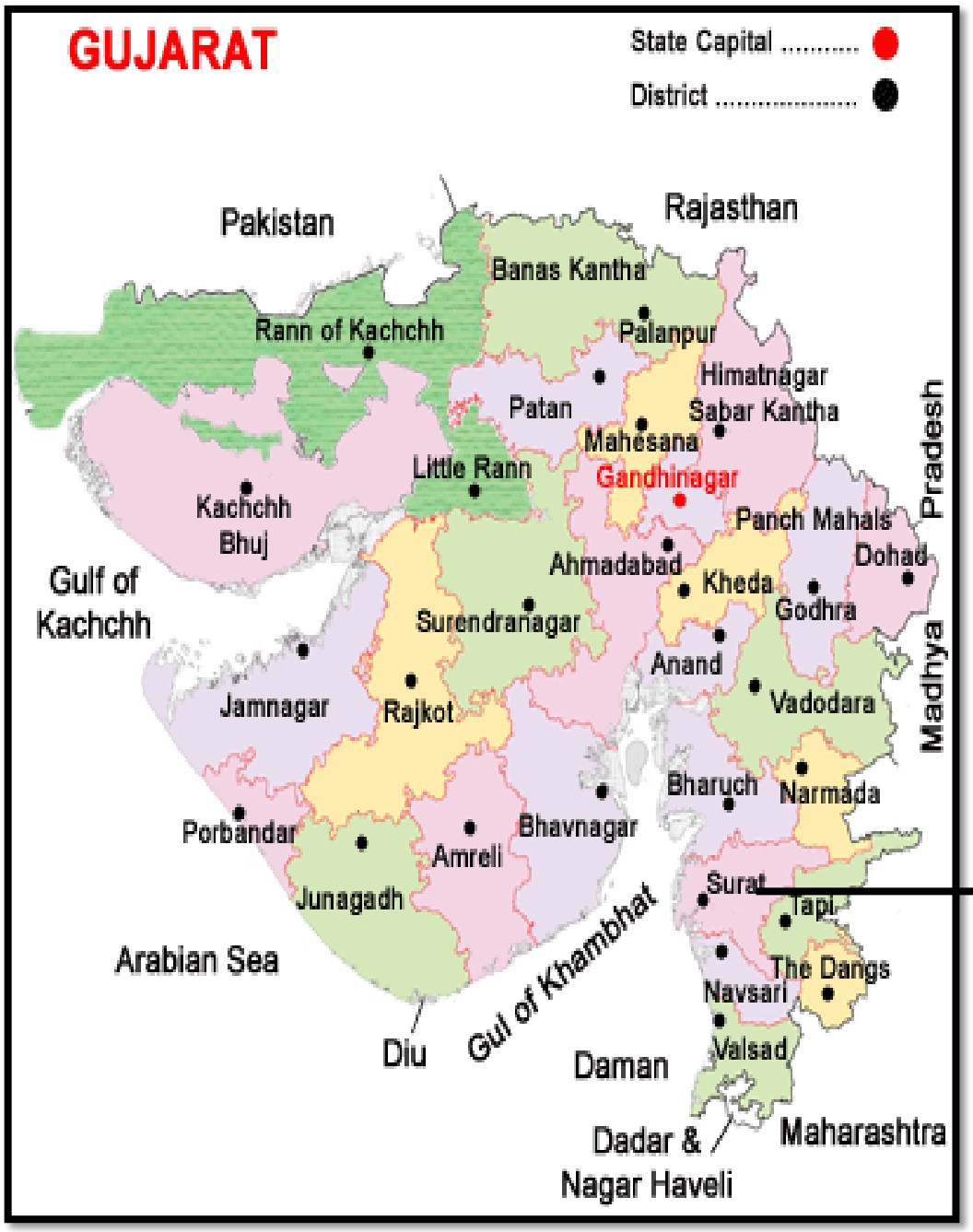
2 schools in Pal, 1 school in Mohamandali, 1 school in Chinaval and 1 school in Khiroda, Jalgaon district

3 schools in Junnar and 2 Schools in Ambegaon (post-visits)
3 schools in Bhor, Pune district (baseline and post-visits)

5 schools in Ratnagiri district (baseline and post-visits)

[8] http://www.mahahp.gov.in/stmap.aspx

Gujarat (Baseline and post-visits)[9]



4 schools in Surat district

[9] https://www.districtsofindia.com/gujarat/statedistrict.aspx

D. Number of chemistry chapters in science textbooks

States	No. of science text books			Total No. of chapters in science			Total No. of chapters in chemistry		
Grades	**8**	**9**	**10**	**8**	**9**	**10**	**8**	**9**	**10**
Gujarat	2	2	1	18	18	18	5	5	5
Karnataka	2	1	2	23	10	16	7	4	5
Kerala	2	5	5	20	22	24	7	7	8
Maharashtra	1	1	2	19	18	20	6	4	5
NCERT	1	1	1	18	15	16	5	4	5

E. List of chemistry chapters

Class VIII

NCERT	Gujarat SCERT	Karnataka SCERT	Kerala SCERT	Maharashtra SCERT
• Synthetic fibres and plastics • Metals and non-metals • Coal and petroleum • Combustion and flame • Chemical effects of electric current	• Preparation of gases • Molecular structure • Metal-non metal • Combustion • fossil fuels	• Structure of atom • Atoms & molecules • Chemical reactions and their types • Chemicals in our daily life • Water • Heat • States of matter	• Properties of matter • Basic Constituents of matter • Chemical changes • Metals • Solutions • Water • Fibres and plastics	• Inside the atom • Composition of matter • Metals and Non-metals • Introduction to acid and base • Chemical change and chemical bond • Man made materials

List of chemistry chapters (cont.)

Class IX

NCERT	Gujarat SCERT	Karnataka SCERT	Kerala SCERT	Maharashtra SCERT
• Matter in our surroundings • Is matter around us pure • Atoms and molecules • Structure of the atom	• Properties of matter • Structure of atom • Periodic classification of elements • Chemical bonding • Chemical reactions	• Matter in our surroundings • Is matter around us pure • Atoms and molecules • Structure of the atom	• Structure of atom • chemical bonding • Classification of elements and the periodic table • Non-metals • Acids, alkalis and salts • Compounds of non-metals • Carbon and its compounds	• Carbon : An important element • Substances in common use • Measurement of matter • Acids, bases and salts

Class X

NCERT	Gujarat SCERT	Karnataka SCERT	Kerala SCERT	Maharashtra SCERT
• Chemical reactions and equations • Acids, bases and salts • Metals and non metals • Carbon and carbon compounds • Periodic classification of elements	• Acids, bases and salts • Metals • Non-metals • Mineral coal and mineral oil • Organic compounds	• Chemical reactions and equations • Acids, bases and salts • Metals and non-metals • Carbon and its compounds • Periodic classification of elements	• Periodic table and electronic configuration • Mole concept • Rate of chemical reactions and chemical equilibrium • Reactivity series and electrochemistry • Production of metals • Nomenclature of organic compounds • Chemical reactions of organic compounds • Chemistry for human progress	• Periodic Classification of Element • Chemical reactions and equations • Metallurgy • Carbon compounds

Royal Society of Chemistry (UK), initiated the RSC-Yusuf Hamied Inspirational Chemistry Programme in India in 2014. One of the components of this programme focused on professional development of chemistry teachers at high school level.

In 2018, Homi Bhabha Centre for Science Education (HBCSE), Tata Institute of Fundamental Research (TIFR), conducted an evaluation of the teacher development component in a few states of India. This report presents the achievements and impact of the teacher development programme.

FEBRUARY, 2019

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION

TATA INSTITUTE OF FUNDAMENTAL RESEARCH

MUMBAI, INDIA