



# Teachers' Perspective on Quality Enabling Conditions and Teaching-Learning Process in Chemistry at Secondary Stage (Grades 11 and 12)

RAJENDRA K. SHARMA AND RAM BABU PAREEK  
Regional Institute of Education,  
NCERT, Ajmer-305004

## Abstract:

*The quality of education in chemistry at the secondary stage (Grades 11 and 12) is an important factor in developing students' scientific understanding and abilities. Various parameters are considered to improve the quality of chemistry education at the secondary stage but quality enabling conditions and teaching-learning process in the school have crucial roles in quality education. Therefore, it is desired that teacher has quality enabling conditions in school to run the quality teaching-learning process. In view of the above, a study has been conducted in the secondary (Grade 11 and 12) schools of the Bhilwara district of Rajasthan to know the teachers' perspectives on the quality enabling conditions and teaching-learning process in chemistry. The mixed method (qualitative and quantitative) of research has been used in the present study. It has been observed that schools under study lack desired quality enabling conditions and teaching-learning process and thus, interventions are needed to improve the quality of chemistry education.*

**Keywords:** Teachers' Perspective, Quality Enabling Conditions, Teaching-Learning Process, Chemistry education

## 1. Introduction

In the Indian school system, Chemistry is introduced as a discipline in the final two years of the Secondary Stage (Grades 11 and 12), where students thereby get the opportunity to understand the nature of this discipline more deeply and develop desired competencies. To develop desired competencies in the learners, the school should have quality enabling conditions and teaching-learning process (Bedriya and Gulcin, 2020, Ben-Zvi and Hofstein, 1996). A good education institution is one in which every student feels welcomed and which has a stimulating learning environment where a wide range of learning experiences are offered. It is also mentioned that the institute should have good physical infrastructure and appropriate resources conducive to learning for all students (NEP, 2020). Thus, to ensure a meaningful learning experience in chemistry to develop desired competencies in the students, it is essential to establish good physical infrastructure and appropriate resources like access to apparatus, equipment, laboratories, use of e-resources and 3D models/kits, etc. (Hofstein and Lunetta 1982, Ioanna, Nikiforos and Tassos, 2018). The teacher has an important role in the quality teaching-learning process and thus, the competence of the teacher in content as well as pedagogy is essential for nurturing students' interest, comprehension, and proficiency in chemistry (Fauth et.al, 2019, Park and Oliver, 2008, Lucenario et.al, 2016). In view of the above, to explore the perspectives of chemistry teachers regarding the quality enabling conditions and the teaching-learning process in chemistry in Grades 11 and 12, a study has been conducted in the sample schools of Bhilwara district of Rajasthan and the findings of the study are presented in the present paper.

## 2. Rationale of the Study

Chemistry is introduced as a discipline in Grades 11 and 12 where students thereby get the opportunity to understand the nature of this discipline more deeply and develop desired competencies. To develop

the desired competence in the students, there is a need to establish quality enabling conditions and teaching-learning processes in the schools. Quality enabling conditions need learning resources like laboratories, models, improvised teaching learning aids e-resources, etc. while the quality teaching-learning process requires desired competencies in the teachers in the area of content as well as pedagogy. In view of the above, it was planned to know the teachers' perspective about quality enabling conditions and teaching-learning process in the selected schools of Bhilwara district.

### 3. Objectives

The present study aimed to explore the teacher's perspective on quality enabling conditions and teaching-learning process considering the following objectives-

- 1.To study the quality enabling conditions for learning chemistry at Grade11 and 12
- 2.To study the quality of teaching-learning process in chemistry in Grades 11 and 12

### 4. Method

To explore the teacher's perspective on quality-enabling conditions and quality teaching-learning processes in chemistry in the sample schools, qualitative as well as quantitative methods of research were used. Twenty secondary schools (Grade 11 and 12) were screened as sample schools and their chemistry teachers participated in the study. Questionnaires were developed to get information/data from the teachers about quality enabling conditions and teaching-learning process in chemistry in the sample schools. Sample schools were also visited to observe and learn more about the learning conditions. Interaction with teachers using unstructured questions was also made to know more about their teaching styles, experiences, and pedagogical aspects in teaching concepts of chemistry.

### 5. Sample

The present study was conducted in the 20 Government secondary schools (Grade 11 and 12) of Bhilwara district in Rajasthan. The sample schools were screened by following certain criteria like rural and urban schools, representation of blocks, availability of PGT (Post Graduate Teacher), and performance of the schools in the state board examinations.

### 6. Tools

To meet the objectives of the study desired questionnaires were developed and validated. Tools were administered in the sample schools to get the teachers' perspective about quality enabling conditions and quality teaching-learning process in chemistry. The principal's questionnaire was mainly aimed at getting school information like contact details, enrolment, etc. The questionnaire developed for teachers was focused on knowing about quality enabling conditions and quality teaching-learning process in chemistry from the perspective of teachers. This questionnaire was divided into two parts. The first part of the questionnaire included questions about quality enabling conditions like availability of resources, time to complete the syllabus, professional development programs, etc. In the second part of the questionnaire focus was quality teaching learning process and thus questions on content analysis, student participation, teaching methods, teaching aids, assessments, sources of information beyond textbooks, remedial teaching, etc. were included.

### 7. Procedure of Data Collection

After getting administrative approval from the state authorities, the desired questionnaires were administered in the sample schools. Researchers personally visited the sample schools to get authentic information through questionnaires. Each chemistry teacher was also interviewed/ interacted with for further insights into their experiences related to the quality enabling conditions and teaching-learning process in chemistry.

### 8. Analysis of the Data

As per the objectives of the study information/ data were collected by administering the desired questionnaire in the sample schools. The data obtained were analyzed to find out teachers' perspectives

on quality enabling conditions and quality teaching-learning process. A detailed analysis of the data is given below under the headings (i) Quality: Enabling Conditions and (ii) Quality: Teaching-Learning Process

### 9. Quality: Enabling Conditions

As mentioned above the questionnaire developed for teachers included questions on quality enabling conditions and the quality teaching-learning process. Various parameters like the availability of resources, the amount of time available for teaching, opportunities for professional development, etc. were considered for the purpose. An analysis based on the parameters included is given below.

### 10. Availability of Resources

Availability of resources is an important component of quality enabling conditions. It is expected that for a quality teaching-learning process, adequate learning resources are available. These resources include access to textbooks, availability of laboratory facilities, e-resources, and 3D models. An analysis of the data indicates a small percentage (15.38%) of teachers have access to adequate resources in the school to teach chemistry. Textbooks are available in schools but there is a need for supplementary materials like teachers' handbooks, lab manuals, exemplar books, etc. to strengthen the teaching-learning process. An observation of the laboratory facilities during the visit of sample schools indicated that these facilities are available but there is a need for proper infrastructure and availability of chemicals and equipment etc. Digital resources are available online but teachers are not competent enough to use them and there is a need for capacity building of teachers in using e-resources. 3D models are very important in teaching the concepts like stereochemistry, reaction mechanism, crystal structures, etc. However, models are not available in the schools and therefore, teachers face a lot of difficulties in giving a visualization and conceptual clarity of the concepts to students.

### 11. Time Duration

A particular topic requires sufficient time to teach the concepts with conceptual clarity and accordingly, the Rajasthan Board of Secondary Education has also suggested the time duration required for completion of each topic. When it was asked to teachers whether the time set for completion of the topics was sufficient, 85.00% of the teachers responded that it was sufficient. However, when they were asked about time duration concerning particular topics, responses were not in good agreement with the earlier response and it was as given in Table.

**Table- 1: Time Duration Required for the Topics**

S.N.	Duration	The percentage of teachers who responded
1.	1 Week	10.0
2.	2 Week	15.00
3.	3 Week	15.00
4.	More than 3 Weeks	60.00

Moreover, personal interaction with teachers revealed that completion of the syllabus in the assigned time duration is a priority of teachers and thus, there is not much emphasis on an effective teaching-learning process.

### 12. Professional Development

In general, professional development programs are organized to help teachers improve their teaching methods and the students' learning outcomes (Guskey, 2002). In the present study, we collected information about the training programs that teachers attended to enhance their content knowledge and pedagogical skills in chemistry as well as its impact on student learning. It has been found that only 20% of teachers of the sample schools had the opportunity to participate in these programs offered by institutes like the Regional Institute of Education, NCERT, and the State government training institutes, etc. Teachers who joined the professional development programs reported that these programs have been useful in gaining new insights into students' difficulties, better understanding of

teaching methods, subject knowledge, and in-depth understanding of the concepts of chemistry.

### 13. Quality: Teaching Learning Process

A quality teaching-learning process in chemistry is required to foster a deep understanding of the concepts to the learners. It requires teachers who have desired content knowledge and pedagogical skills so that complex/difficult concepts may become easy and understandable to the learners. Hands-on laboratory experiences and appropriate use of learning resources have a crucial role in creating an environment where students actively participate, ask questions, and work together to develop a comprehensive grasp of chemistry concepts.

During the present study, teachers' perspective on the quality teaching-learning process in the sample schools was also taken by administering the desired questionnaire. The questionnaire had questions about quality processes like content analysis, student involvement in the teaching and learning process, instructional techniques, educational resources, and assessments, alternative sources of information, remedial teaching, and innovative methods to enhance teaching quality. A detailed analysis of the perspective of teachers obtained is given below.

### 14. Content Analysis

The chemistry curriculum is expected to be presented in a simplified manner to facilitate easy comprehension for students and thus, content analysis is important in planning the teaching because it facilitates organizing and planning the effective transaction in the process. As per the responses received, 95.00% of teachers have a practice content analysis before teaching concepts of chemistry, especially in topics like stereochemistry and reaction mechanisms, etc. However, personal interaction revealed that the practice of analysis does not meet the criterion needed for an effective teaching-learning process.

### 15. Students' Participation

Student's active participation in the teaching-learning process is very important because it makes them more motivated to learn and promotes higher-order thinking skills. It is also an indicator of the effectiveness of the process. It has been reported that students are more likely to ask questions if they perceive higher levels of support (Karabenick et.al, 1994) and lower levels of threat from their teachers (Peters, 1978).

As per the data received, teachers of the sample schools reported that 76.92% of students actively participated in the process. However, 23.08% of students have poor or no participation in the process. The frequent mode of participation of students was asking questions. Moreover, 55.00% of students ask general questions related to blackboard work and only a few students raise questions on understanding part of the concepts. It is a serious issue because an effective teaching-learning process requires questions from the students on conceptual clarity or higher-order thinking. This indicates that teachers need to promote the active participation of students by promoting higher-order thinking.

### 16. Teaching Method and Use of Teaching Aids

It is expected that teachers will adopt a good method for effective chemistry teaching to take place. There are various methods to teach but in deciding a teaching method a teacher needs to consider student background, knowledge, environment, and learning goals. At the grade 11 and 12 levels, chemistry teachers should use student-centered and interactive learning methods. It is also expected that the teacher will use appropriate chemistry teaching aids to further reinforce the lesson and to make it more interesting. In teaching chemistry, teachers should incorporate three-dimensional conceptual integration, particularly when teaching topics such as stereochemistry and reaction mechanisms, by incorporating visual activities to enhance the learning experience (Bodner, 2003, Brand, 1987). An analysis of the data received reveals that 85.00% of teachers use traditional lecture methods for teaching chemistry and no teaching aids are used in the learning process. During personal interaction

with the teachers, it was revealed that there is no availability of appropriate learning resources and teaching aids for teaching some specific concepts like stereochemistry and reaction mechanisms. In this era of education, it is expected that teachers will be well-equipped with learning resources including ICT resources for effective teaching. However, in the present case, the dependence of teachers only on traditional teaching ways cannot be appreciated and there is an urgent need to equip the teachers with required learning resources.

### 17. Use of Sources of Information Other Than Textbooks

Various sources of information other than textbooks like reference books, exemplar materials, handbooks, journals, and digital resources are available in chemistry and teachers need to use them to further strengthen the teaching-learning process. An analysis of the responses received from the teachers of sample schools indicates that only 50.00% of teachers use sources of information other than textbooks. When it was asked the teachers were asked which source of information was used it was responded that they only used YouTube videos and model papers. As mentioned above various sources of information are available other than textbooks and nowadays these sources are digitally available. NCERT material is also readily available to download and use. Thus, there is a need to encourage and motivate teachers to use them for the benefit of learners.

### 18. Assessment of Students During Classroom Process

Assessment of students during the classroom process provides information about learners' progress and achievements and it allows the teachers to modify the process for the effective learning of the learners. During the present study, teachers were asked about the mode of assessment used by them. In response to the question, it was responded that general mode of assessment like asking verbal questions or assigning activities/exercises, etc. The responses obtained are given in Table- 2.

**Table 2: Mode of Assessment of Students During Classroom Process**

S.N.	Method of Assessment	Percentage of teachers Used
1.	By asking verbal questions	100
2.	By an activity	55
3.	By giving exercise during class	90
4.	By giving assignment	75

An analysis of the responses received indicates that asking verbal questions is the preferred mode of assessment. Exercises /assignments are also frequently given to the students but only 55% of teachers assess the learning through activities. When it was asked whether they were satisfied with the mode of assessment being used, 65% of teachers showed their satisfaction. Personal interaction with teachers also revealed that they are not competent enough to use the modern methods of assessment and therefore, there is a need to train the teachers with methods of assessment used in the learning of chemistry.

### 19. Remedial Teaching/Corrective Measures

Remedial teaching is important in enhancing the academic performance of the low achieving students to the expected level. As per guidelines of the Rajasthan Board of Secondary Education remedial classes are to be conducted for the low achieving students. As per the data received 95.00% of teachers of the sample schools conduct remedial chemistry classes for the low achieving students. However, when it was asked whether remedial classes have been successful in improving the performance of students, teachers responded that they were not aware of it.

### 20. Teachers Satisfaction

If the teaching-learning process is effective and has been successful in achieving the expected learning outcomes, the teacher feels satisfied. In the present case, only 30.76% of teachers feel satisfied with their teaching in the chemistry class. Further interaction revealed that these teachers' satisfaction is based on the performance of their students in Board examinations not on the classroom process. It was



also revealed that they are not satisfied with the process they run as they are not comfortable in handling various concepts of chemistry like reaction mechanisms and stereochemistry. This indicates that there is a need to strengthen the capacity building of teachers in content as well as pedagogy to run the process effectively.

Personal interaction with teachers also revealed that they are not satisfied by the non-academic work assigned to them by education authorities as due to these activities they are not able to spare time for effective teaching.

### **21. Problem Faced by the Teachers**

Teachers need to be well-trained in content as well as pedagogy and learning resources should also be available for an effective teaching-learning process. If it is not so, a lot of problems are faced by the teachers in class. When teachers of the sample schools were asked whether they face any problems in the class, almost all the teachers responded that sometimes they face problems in the class. When it was asked what type of problems are faced, it was shared that most of the time they felt difficulty in clearing the concepts as appropriate learning resources are not available to them. Moreover, in certain areas of chemistry like reaction mechanism and stereochemistry they do not have conceptual clarity.

### **22. Major Findings, Conclusion, and Recommendations**

The present study has revealed various aspects of quality enabling conditions and teaching-learning process in chemistry in the sample schools. The major findings of the study are given below-  
The sample schools do not have proper quality enabling conditions for teaching chemistry. It has been observed that-

- Teachers are not equipped with the learning resources required to teach chemistry.
- Laboratory facilities are available but there is a need for proper infrastructure and availability of chemicals and equipment etc.
- Teachers have not undergone Professional development in the area of content as well as pedagogy.
- As per the teacher's time duration specified by the Board is not sufficient to complete the topic.
- Teaching learning process is also not to the desired level. It has been observed that-
- Content is not properly analyzed by the teachers for lesson planning
- It has been reported that student's participation in the process is good but it was not reflected in their interaction with teachers.
- Teachers mainly use conventional teaching methods and no teaching aids are used in the process.
- Except for some digital resources, no other source of information is used along with textbooks
- Assessment of learning in the process is also carried out using traditional methods. No modern techniques of assessment are used.
- Remedial classes are conducted as per Board guidelines but their impact on the academic performance of students is not assessed
- Teachers reported satisfaction with teaching teaching-learning process. However, personal interaction reflected that teachers are not fully satisfied with the process they run.
- Teachers need capacity building in content as well as pedagogy to run the classroom process effectively.
- Teachers have a lot of responsibilities/non-academic work other than teaching and that affects the participation of teachers in teaching.

### **23. In view of the above, it is recommended that-**

- Teachers should be equipped with learning resources to run the teaching-learning process effectively.
- NCERT has developed low-cost models to teach the various concepts of chemistry and therefore, a set of models should be made available to teachers for use.

- Professional development programmes should be conducted regularly Professional development programmes should also be linked with career advancement/promotion schemes for teachers to enhance participation of teachers in these programmes.
- Programs should also be conducted to orient the teachers about new developments in the teaching-learning process in chemistry.
- Proper training should also be given to teachers about the use of digital resources in the classroom process.
- The administration needs to take initiatives to reduce the involvement of teachers in non-academic activities.
- Need based interventions should be given at school level

### Acknowledgment

The authors are thankful to NCERT, New Delhi, and RIE, Ajmer for academic and financial support. The academic and administrative support of the Department of Education, the Government of Rajasthan, and the sample schools is also acknowledged.

### References

1. Bedriya T. & Gulcin M. (2020). Teachers' Conceptual Perceptions and Thoughts about Learning Environment. *Turkish Online Journal of Qualitative Inquiry (TOJQI)*, 11, (3), 368-392.
2. Ben-Zvi, R. & Hofstein, A. (1996). *Improving Teaching and Learning in Science and Mathematics*; Teachers College Press: New York, 109-119.
3. Ministry of Education, Government of India (2020). *National Education Policy of India (NEP-2020)*
4. Hofstein, A. & Lunetta, V. (1982) The role of the laboratory in science teaching: Neglected aspects of research, *Review of Educational Research*, 52(2), 201-217
5. Ioanna B., Nikiforos P. & Tassos M. (2018). *Digital Learning Technologies in Chemistry Education: A Review*. 10.1007/978-3-319-73417-0\_4.
6. Fauth B., Decristan J., Decker A.T., Hardy G.B.I. & Kunter E.K.M. (2019). The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality, *Teaching and Teacher Education*, 86, 102882, <https://doi.org/10.1016/j.tate.2019.102882>.
7. Park S. & Oliver J. S. (2008). Revisiting the conceptualization of Pedagogical Content Knowledge (PCK): PCK as a conceptual tool to understand teachers as professionals, *Research in Science Education*, 38(3), 261-284.
8. Lucenario J.L.S., Rosanelia T. Yangco, Punzalan A.E. , Espinosa A.A. (2016). *Pedagogical Content Knowledge-Guided Lesson Study: Effects on Teacher Competence and Students' Achievement in Chemistry*", *Education Research International*, 2016, Article ID 6068930, 9 pages, <https://doi.org/10.1155/2016/6068930>
9. Guskey, T.R. (2002). Professional Development and Teacher Change. *Teachers and Teaching: Theory and Practices*, 8(3), 381-391
10. Karabenick, S. A., and Sharma, R. (1994). Perceived teacher support of student questioning in the college classroom: Its relation to student characteristics and role in the classroom questioning process. *Journal of Educational Psychology*, 86, 90 -103.
11. Peters, R. A. (1978), Effect of anxiety, curiosity and perceived instructor threat on students verbal behavior, *Journal of Educational Psychology*, 70, 388-395.
12. Bodner G.M., (2003). Problem-solving: the difference between what we do and what we tell students to do. *University Chemistry Education*, 7, 37-45.
13. Brand D.J., (1987). Molecular structure and chirality. *Journal of Chemical Education*, 64, 1035-1038