

**A report of NIUS-TD workshop
on
Designing meaningful problems for assessment in Chemistry**

**CESME
(Under PMMMNMTT scheme of MHRD)**

Date: January 1-7, 2021



**Homi Bhabha Centre for Science Education
Tata Institute of Fundamental Research
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As part of the Centre of Excellence in Science and Mathematics Education (CESME, HBCSE), the National Initiative on Undergraduate Science (NIUS) teacher development (TD) workshop was conducted through online mode during January 1-7, 2021 for chemistry teachers teaching at the undergraduate level. This workshop was a part of the NIUS chemistry programme at the centre and is conducted under the CESME (HBCSE) programme set up under the Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching (PMMMNTT) scheme of the Ministry of Education (MoE).

The NIUS-TD workshop titled *Designing meaningful problems for assessment in Chemistry* was aimed at providing opportunities to in-service chemistry teachers teaching at the undergraduate level to reflect on the important role of problem designing and solving in learning concepts in chemistry. The workshop exposed chemistry teachers to some of the unconventional ways of designing problems and understanding their pedagogical significance.

Brief description of the workshop

Day 1 (Jan 1): The workshop started with a brief introduction by the teachers about themselves followed by an overview of the centre and its activities. The central idea for the workshop was discussed with the participants. This was followed by group sessions where the participants discussed a few theoretical questions from the past Indian Chemistry Olympiad theoretical examinations. These questions were shared prior to the workshop with the participants (on themes related to synthetic milk, lawsonine and water of crystallization, <https://olympiads.hbcse.tifr.res.in/how-to-prepare/past-papers/>).

The teachers were encouraged to share their reflections about the problems with respect to the following points- a) content and concepts covered, b) competencies/skills being tested and c) the strengths and weaknesses of the problem. The questions were discussed in considerable details by the resource persons with all the participants.

Day 2 (Jan 2): The discussions on the second day focused on an experimental problem that involved designing an appropriate experiment to study the catalytic effect of two substances (FeCl_3 and KI) on the decomposition of H_2O_2 . This problem did provide details of the materials and their total quantities available to the students. The focus of the discussion was - a) the pre-requisites needed for designing the task, b) consideration of safety aspects involved and c) decision making w.r.t. kind of measurements to be done and the errors associated with the same. Teachers also reflected on the likely learning at learners' end if they are engaged with such an activity. It was suggested that such a task can be presented to learners as a group activity as collaborative learning plays a crucial role in learning.

Day 3 (Jan 4): On this day, the participants shared their own questions with the other members. The discussion about the question focused on the concept(s)/skill(s), the likely misinterpretations at students' end and the difficulty level of the questions. Whether the questions presented sufficient relevant information for arriving at answers and the language clarity of the questions were also discussed during the presentations.

The participants were expected to revise their questions based on the feedback received from other members of the groups and resource persons. They further interacted with various resource persons for the same on a one-to-one basis.

Day 4 (Jan 6): On day 4, participants presented the revised questions to the entire group and received further feedback on their problems from other participants and resource persons.

During the afternoon session, we looked at some more examples of types of questions including open-ended questions and multiple-choice questions that can incorporate and

assess higher-order thinking skills. We reflected on the diversity and nature of questions that can be framed to test different aspects of students' learning and understanding, and also what kind of aspects/practices we teachers need to cultivate to frame such problems.

Day 5 (Jan 7): The presentations of problems by participants continued on this day. Additionally, free online resources useful for teaching-learning of chemistry that are compiled and organized on the chemistry education website of HBCSE were presented and discussed with the participants. Several online freely available resources on visualization, simulations, and laboratory techniques were shown to them with a brief description of the contents. Experiments and their related videos developed as a part of chemistry Olympiad and NIUS activities were also shared with them

(<https://chem.hbcse.tifr.res.in/resources/teaching-learning-of-chemistry/>).

We ended the workshop with a summary of the same and comments and feedback by teacher participants and resource persons.

The teacher participants submitted their final designed questions along with pedagogical reflections post to the workshop.

Some representative feedback from teacher participants

I knew setting a problem for students is a very challenging task. However, I was not aware of the complexity involved. This workshop gave me several pointers in this area.

Firstly, I learnt various aspects of problem setting - the theme of the problem, the hints, the level of complexity, the extent of information recall, the grasp on basic chemistry. Secondly, I learnt that problems are an interface between students and teachers. To be a good problem setter one must be aware of the psychology of students and not just the subject content

The workshop was very enriching and I have gained a lot. I thank you all the organizers for giving me the opportunity and conducting this workshop. All the resource person were very helpful.

I thank the organizing team for keeping the patience and help the teachers learn the appropriate ways of setting concept-based problems.

Changed my perception of looking at the question and answers and problems in a different way. Problems are something that a student must not have seen before and have solved it based on the concepts the students have. The problem should be more logical and having a proper flow of questions with no extra/ additional information being provided.

A glimpse of the online workshop



Annexure A: List of Teacher Participants

Sr. No.	Name	Gender	Designation	Affiliation
1	Anubendu Adhikary	M	Assistant Professor	VITAP University
2	Anupa Kumbhar	F	Associate Professor	SPPU
3	Gulshanara Shaikh	F	Retired faculty	Formerly, St Xavier's College, Mumbai
4	Malti Sharma	F	Assistant Professor	University of Delhi
5	Sharda Mahilkar-Sonkar	F	Assistant Professor	University of Delhi
6	Amrit Krishna Mitra	M	Assistant Professor	Government General Degree College, Singur
7	Ashma Aggarwal	F	Associate Professor	Mumbai University
8	Rashmy Nair	F	Associate Professor	University of Rajasthan
9	Gazala Praveen	F	Assistant Professor	CCS University Meerut
10	Iyer Veena Hariharan	F		
11	Kirtikumar Patel	M	Assistant Professor	University of Mumbai
12	Pallavi Roy	F	Assistant Professor	SIES College of Arts, Science and Commerce
13	Rahul Singhal	M	Assistant Professor	University of Delhi
14	Santosh Lala Gawali	M		
15	Seema Gupta	F	Associate Professor	Acharya Narendra Dev College (University of Delhi)

Annexure B: List of Resource persons

Resource Persons outside HBCSE	Resource Persons from HBCSE
Lakshmy Ravishankar, formerly, KET's V.G.Vaze College of Arts, Science and Commerce, Mumbai	Ankush Gupta
Radha. V. Jayaram, Institute of Chemical Technology, Mumbai	Indrani Das (Sen)
	Savita Ladage
	Hanza George
	Mursaleen Shaikh

Annexure C: Timetable

NIUS TD Workshop on Designing meaningful problems for assessment in Chemistry
(January 1-7, 2021)

Day 1, Jan 1		
Time	Sessions	Resource Person
10-10:30 am	Welcome and Introduction of participants	Indrani Das Sen
10:30- 11:00 am	Central idea of the workshop	Indrani Das Sen and Savita Ladage
11:00 - 11:45 am	Group discussion on the problems	Resource Persons
12:00 - 1:00 pm	Discussion of Q1 (analytical/physical)	Ankush Gupta
2:30 - 3.30 pm	Discussion of Q2 (organic)	Lakshmy Ravishankar
3:30 - 3.45 pm	Summing up	Ankush Gupta
Day 2, Jan 2		
10:30 - 12:30 pm	Discussion of experimental problem	Indrani Das Sen
2:00 - 3:30 pm	Discussion on design of problems (problem solving process)	Ankush Gupta/Savita Ladage
3.30 pm - 4.00 pm	Discussion of question framing and presentations	Indrani Das Sen
Day break		
Day 3, Jan 4		
11:00 am- 1:30 pm	Small group discussions	Resource Persons
1.30 pm - 2.00 pm	Summing up session	Resource Persons
Day break		
Day 4, Jan 6		
10:00 am- 1:00 pm	Presentations by participants	All Resource Persons
3:00 pm - 5:00 pm	Types of problems in Chemistry for assessment	Ankush Gupta

Day 5, Jan 7		
10:00 am- 1:00 pm	Presentations by participants- continuation	All Resource Persons
2:30 pm - 3:30 pm	Resources in Chemistry	Mursaleen Shaikh and Hanza George
3:30 pm - 4:30 pm	Summing up and feedback	Indrani Das Sen and other HBCSE members
Submission of final questions by 12 pm, Jan 9		