



Questions Raised by Learners in Online Science Classrooms: The Technological Oversight

Author: Vertika Chowdhary

Designation: PhD Scholar

Name of the Department: Department of Education

Name of the Organization: University of Delhi

City: Delhi

Country: India

Abstract: Human beings harbour a natural curiosity about the world around them. They want to know about phenomena that are taking place in and around them. When people want to know something, they seek that information by asking questions. Asking questions therefore, is a very important component of the learning process. It is an essential aspect of “meaningful learning and scientific inquiry” (Chin & Osborne, 2008). Questioning process requires both, the one who is asking question and the one to whom the question is posed, to engage with the subject in a meaningful manner. Questioning therefore requires active listening, analysis of the available information, reflection and careful construction of clear and comprehensive sentences.

During the COVID-19 pandemic, as part of the research investigation, a plan was etched out to observe the online science classrooms to capture the process of students’ asking questions during classroom discussions. Present paper is based on the empirical data of 10 online ICTs enabled classes that were observed at the upper-primary level of government schools of Delhi, using videotelephony software platforms like Zoom and Google meet. How effective have ICTs based strategies been in teaching-learning of science? How has learner-teacher interactions been in online classes? Did they improve learners’ questioning in online science classrooms? This paper makes an attempt at exploring these questions.

Index Terms: Questions, Questioning, pedagogy of science, learners’ questions, online classrooms, Information and Communication Technologies (ICTs).

*I keep six honest serving-men,
(They taught me all I knew):
Their names are What and Why and When,
And How and Where and Who.*

--Rudyard Kiplingⁱ

1. Context: Inferring from Kipling's poem, questions are the building blocks of knowledge, a way of understanding the world around us. Human beings seek information by asking questions, and they learn through this process of information seeking, and processing that information, that leads to knowledge creation. When people want to know something, they seek that information by asking questions. Asking questions therefore, is a very important component of the learning process. It is an essential aspect of "meaningful learning and scientific inquiry" (Chin & Osborne, 2008). Questioning process demands a deeper engagement with the subject being discussed. It requires both, the one who is asking question and the one to whom the question is posed, to engage with the subject in a meaningful manner. Questioning therefore requires active listening, analysis of the available information, reflection and careful construction of clear and comprehensive sentences.

Anybody who spends some time with young children know that they ask many questions. Even before the development of speech, infants use non-verbal cues like hand and eye gestures and other expressions to ask questions (Meij, 1994). The formation of a question is an integral part of a universal grammar. It is a blueprint for language that is hard-wired into the human brain (Chomsky, 1995). Questions are psychological tools for thinking, and "when embedded in the discourse of collaborative peer groups, help learner[']s co-construct knowledge inter-psychologically. This knowledge is then appropriated or constructed intra-psychologically by the individual members" (Vygotsky, 1978; cited in Chin, 2001). Understanding the significance of questions, they should be an integral part of any form of learning and thus, of any effective classroom. The very nature of the inquiry driven discipline of science requires learners to think critically and question everything, so, questioning becomes all the more important in a science classroom. Though the available literature has substantial research on teachers' questions in a classroom there is not much research work on students' questions.

This understanding guided the conceptualisation of this pilot study done during late 2020 when the schools and other educational institutions were shut down due to the social-distancing protocols of the Indian government. In order to continue learning most schools and colleges resorted to ICTs for teaching-learning. There are two main categories of ICTs used by teachers: supportive ICT use and classroom ICT use (Tondeur, van Braak, & Valcke, 2007). The classroom ICT use, aims to support and enhance the actual teaching and learning process. This paper, focused only on the classroom ICT use in science education. Their strategies included use of interactive platforms like Zoom, Google Meet, and MS Teams, use of messaging services like WhatsApp and Telegram, use of data collection tools like Google docs, creation of online courses, and other collaborative teaching-learning mechanisms. Understanding that the role of ICTs, as envisaged for teaching-learning of science, is not only to facilitate learning but also enhance the teaching-learning experience of the learners. For the study, the online science classes of grades 5 to 9 in government school of Delhi had been observed. The selection of classes was guided by access to the online classes as these observations were primarily aimed at testing of the observation schedule that was prepared to carry out classroom observations for the larger research. The idea was to see the

nature of questions being asked by the learners. The observations were planned to be non-participative as this would help observing the classroom processes without disturbing the natural course. A total of 10 classes were observed over a period of 4 weeks.

The expectation was that the observations would provide a glimpse into the classroom environment, students' interactions, and pedagogies that encourage questioning in a science classroom. However, out of the total 10 classes observed, in 6 classes learners listened to the teacher. They viewed videos and replied to the questions asked by the teacher related to what they viewed, heard and observed. Except for affirmations regarding their visibility on the technology platform, students did not ask any questions. Few questions related to instructions on home-task, learners waited for teacher to ask questions to which they enthusiastically replied.

This paper is organized under three main sections. First section provides the context of the research study and role of ICTs during the pandemic. Second section will briefly discuss the efficacy of these platforms during online teaching learning especially highlighting the issues related to equity and the nature of science. The third section of the paper will be the findings that emerged from the observations followed by concluding remarks.

2. Observations of online science classrooms during COVID-19 led school closures

In a world dealing with a fatal virus, school closure meant a complete shutdown of the teaching-learning experience. For learners staying home, experiencing deaths around, and a complete social isolation, education was envisaged as a way to normalize the situation. Technology seemed like a sensible way forward to continue teaching-learning. As a result, schools provided opportunities for teachers to create online classes, dissemination of assignment, and interaction with learners and parents using digital resources. It is during this time that 10 science classrooms were observed to capture the student-teacher interactions. A detailed observation schedule was prepared to guide the process of observations and tested to see if it captured the key components of teaching-learning. Some of the main observations from the classrooms are shared below.

A conducive teaching learning environment and a good rapport between teacher and students encourages learners to ask questions. In the observed classes there were few instances where students asked a question to the teacher and that led to a meaningful conversation between the students and the teacher. For example, in one class the teacher asked learners to draw animals with a big stomach (*mota pet*) so that they can draw different types of food in it and observe food patterns.

Learner 1: Ma'am, do we draw the picture of their stomach?

Teacher: Yes

Learner 2: Ma'am, is it necessary to make a big stomach?

Teacher: Yes! Then I will ask you to add different type of food items. How would you do that?

This type of dialogue could take place because the learners were not afraid to ask questions to the teacher who in turn patiently listened to their questions and gave them opportunity to think and respond.

To take everyday teaching-learning online, requires meticulous planning and its careful execution. This is especially true for teaching-learning of science which requires a variety of teaching-learning resources, well-

thought teaching approaches, and innovative pedagogies. It also requires teachers that are capacitated on the effective use of online platforms, devices and tool, and can create digital instructions using them. But teachers in the government schools of Delhi were not equipped with all these skills and they did not have access to basic digital infrastructure required to create effective online instructions.

Online classes were more of one-sided information transactions where teachers provided learners information and they noted them down. Assignments were sent to them using WhatsApp groups that had been created for the purpose. There were few questions that emerged during the discussions. It was seen that learners ask questions when they are comfortable in classroom, share a good rapport with the teacher, and they are able to link the classroom discussion with the things that they have observed or experienced in real life. For example, during a discussion on the structure of tooth, a student asked, “Ma’am, when a tooth breaks-off we don’t see gums, nor do we see pulp. Why does the tooth not look like the diagram?”. This clearly highlights that the learner has tried to match a real-life tooth to the structure that is given in the textbook or shown and discussed in the class. Online interactions provided very few opportunities to do that. As there were no teaching-learning materials, students relied on teachers’ instructions and reading of the textbook.

The timing of one period was a mere 40 minutes which does not support meaningful engagement with the topic. In a hurried manner the teacher rushed through topics to complete the prescribed syllabus.

Online classes have limited scope as far as the pedagogies go. There were no opportunities to organize learners into pairs or groups to perform collaborative tasks and so there was no possibility to learn from their peers. Without any activities, experiments, field visits there were no way of making the learning interesting for the students. Teachers too had no access to libraries or laboratories to devise creative teaching-learning strategies.

Like most ed-tech solutions, students become targeted numbers to be reached with very little focus on meaningful learning. As there was no consistency in assessment, no one asked if learners really learned something or not. That is also reflected by the limited focus on learners’ questions in the classroom. When questions are such important part of science learning why do no one asked the question of sparse students’ questions?

Most of the learners in the observed classrooms belonged to lower socio-economic contexts of Delhi. They had limited access to digital devices like laptops, smartphones, and unlimited data packages. What was observed that learners, especially in upper primary classes had a single smartphone with limited data packages in the house which they utilized for online classes. This means that there were frequent issues of connectivity due to incoming calls, poor connection, or data pack exhaustion. Often learners would ask, Ma’am, aapko main dikhayi de raha hoon? (Ma’am, do you see me?). Ma’am, meri awaaz aa rahi hai? (Ma’am, do you hear me?). A lot of time goes waste in ascertaining that the internet is functional and the learners can be seen or heard.

Sometime the one-way information transaction and disruptions caused learners to lose interest in the class. In such moments they were seen to wonder, “Ma’am, class kab khatam hogi?” (Ma’am, when will the class end). This broke natural flow of the classroom interaction. In a 40-minute classroom there was only 15-20 minutes of learning time that the teacher and the learner had. This time was not enough to build a concept, discuss it at length, and then invite learners to ask question, if any.

Research shows that there is a merit in taking the learners out of their context to a dedicated learning environment. This takes the learner away from their disrupters at home to a more appealing environment which is conducive to learning. However, that was not possible during the pandemic. Many learners lived in small accommodations with multiple individuals living together in one room. The space definitely lacked teaching-learning material, appropriate seating arrangements, and a possibility of meaningful teacher-pupil, and pupil-pupil interaction.

Converting a home into an online classroom strains the everyday routine of the family. Students may have created a learning corner for themselves but various disrupters impacted the teaching-learning process. Crying babies, television noises, ringing doorbells, and cooker whistles were part of the classes during many observations. So, use of digital technologies did help in continuity of learning, but there is no way of ascertaining the effectiveness of the teaching-learning experience.

3. Findings:

The 10 science classrooms observed during the COVID-19 pandemic to test and refine the research tools for the research study. But the observations were insightful of the whole process of online learning of science. As discussed above there was very little dialogue between the teachers and learners during the classroom discussions. There were even fewer questions during almost 10 hours of observations. However, it was identified that for a teacher to encourage learners to ask questions the teachers need to prepare and plan the online classes differently. Some key insights are summarized below:

- A Situation Analysis needed to be done, to assess the learners' access to digital devices and necessary internet broadband services before planning online instructions. Now that the schools have re-opened an assessment needs to be done of functionality of the available digital resource to help teachers and learners utilize them.
- It emerged that though ICTs can be effective complement to the regular classroom teaching-learning, it cannot be utilized on its own, as of now. There is a need to explore the possibility to strengthen the existing technology architecture of the Government school run in the capital city of the country.
- In a science classroom teacher should not only be able to use ICTs to create online learning space, but they need to be able to develop a plan for effective online instruction, identifying effective content, appropriate activities, worksheets, and ways of meaningful assessment. ICTs offer a range of tools for use in school science activity including spreadsheets, graphing tools, presenting tools, multimedia simulation software, among others. Teachers need to be capacitated on these tools to strengthen the teaching-learning process.
- Online platforms like Zoom, Google Meet, and MS Team can be used to create useful teaching-learning strategies only when the instructions are carefully planned and executed. Rigorous capacity building of teachers is required to equip them with the necessary skills to use digital devices and plan innovative instructions.
- At home, parents need to be oriented on ways to support the learning of their children using ICTs. Along with giving them access to smartphones they need to be acquainted with ways of creating an enabling learning environment at home.

- After the reopening of schools both teachers and students should be given opportunities of having interactive online classes at least few times a month. This would provide teachers the opportunity to experiment with different platform, and digital resources.

4. Conclusion:

The school closures due to the global pandemic acted both as a challenge as well an opportunity for teachers and learner to find alternative ways to continue learning. It also brought a realization that the schools in India especially those for the most marginalized are not equipped to provide a viable alternative to regular classroom pedagogy. After the reopening of schools in 2022, there has not been any efforts for equipping the schools with the necessary digital infrastructure and capacitate teachers on digital pedagogies. Teachers are not internally motivated to use ICTs in the classroom due to a number of constraints like lack of confidence and experience with technologies and limited access to reliable resources (Osborne & Hennessy, NA), therefore serious thought and dedicated resources need to be put into their capacitation. In the 21st century, opportunities are rising for ICTs to play a central role in developing scientific reasoning and critical skills among learners, an opportunity that must not be missed. However, we still need to appreciate that during the pandemic, learning continued amid blaring cooker whistles, discharging batteries, vanishing data packages, and reduced attention spans.

References

- Chin, C. (2001). Learning in science: What do students' questions tell us about their thinking? *Education Journal*, 29(2), 85-103.
- Chin, C., & Osborne, J. (2008). Students' questions: A potential resource for teaching and learning science. *Studies in Science Education*, 44(1), 1–39.
- Chomsky, N. (1995). *The minimalist program: Current studies in linguistics*. Cambridge: MIT.
- Meij, H. V. D. (1994). Student questioning: A componential analysis. *Learning and individual differences*, 6(2), 137-161. [https://doi.org/10.1016/1041-6080\(94\)90007-8](https://doi.org/10.1016/1041-6080(94)90007-8)
- Osborne, J., & Hennessy, S. (NA). Literature Review in Science Education and the Role of ICT: Promise, Problems and Future Directions. Report 6: Futurelab Series.
- Tondeur, J., van Braak, J., & Valcke, M. (2007). Towards a typology of computer use in primary education. *Journal of Computer Assisted Learning* (23), 197-206.
- Vygotsky, L. (1966). Play and its role in the mental development of the child. *Voprosy Psikhologii*, 12(6), 62–76.

ⁱ Excerpt from Rudyard Kipling's poem *I keep six honest serving-men*. Retrieved from <http://www.kiplingsociety.co.uk>